Colophon

This is a publication of the Foundation Grote Buitenlandse Excursie(s) Fysisch Mathematische Faculteitsvereniging (Foundation GBE-FMF), best to be translated as Foundation for International Student Excursions. The foundation is founded by the Fysisch-Mathematische Faculteitsvereniging (FMF), the organization for students in (applied) physics, mathematics, computer science, biomedical engineering and astronomy of the University of Groningen.

Its goal is to organize intercontinental study tours for students of the FMF every two years. The foundation consists of a board and a committee. The board acts as a supervisor while the committee is involved in the actual organization.

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Middle and North Eastern America Excursion

2003

Final Report

Dutch study tour to Boston, New York and Mexico City

Foundation GBE-FMF
University of Groningen, The Netherlands

PREFACE

Currently, you're reading the final report of ManeaX '03, Middle and North Eastern America Excursion 2003. The committee ManeaX '03 organized a three-week study tour to Boston, New York and Mexico City from March 28 till April 20, 2003. This committee is part of the Foundation Grote Buitenlandse Excursie(s) Fysisch Mathematische Faculteitsvereniging (GBE-FMF).

The Foundation GBE-FMF is tightly linked to the Fysisch-Mathematische Faculteitsvereniging (FMF), a student association for students in Mathematics, Computer Science, (Applied) Physics, Astronomy and Biomedical Engineering at the University of Groningen. The FMF has about 700 members and organizes different activities: from selling textbooks, organizing scientific excursions and lectures to organizing parties, movie nights and sports tournaments. Besides that, the FMF organizes a one-week study tour every two years, the 'Kleine Buitenlandse Excursie'.

The main purpose of the Foundation GBE-FMF is to organize three-week intercontinental study tours for members of the FMF every two years. Thanks to this foundation the FMF was able to arrange study tours to Thailand and Singapore (EAST '96) and Japan (Nippon '01).

This report contains first of all a travel report of the study tour. A group of 25 students and 2 members of the scientific staff fulfilled a heavy, but interesting program in the three mentioned cities. The aim of this study tour was to give the participants an overview of the American and Mexican (scientific) society. To achieve this a number of scientific institutes and cultural phenomena were visited. The main source of funding of this tour were the case studies, research or training assignments for a company or institute performed by the participating students. You'll find a description of all the performed case studies in this report. The two members of the scientific staff who accompanied us, Professor Dr. Bert Niesen and Dr. Frank van Steenwijk, wrote a short report about their experiences. The five committee members also spout their personal experiences and frustrations and give an overview of the complete organization process. After this a financial report can be found. Finally, some words of gratitute are addressed to all who made this tour possible.

I hope you enjoy reading this final report.

Evert-Jan Borkent
Chairman ManeaX '03

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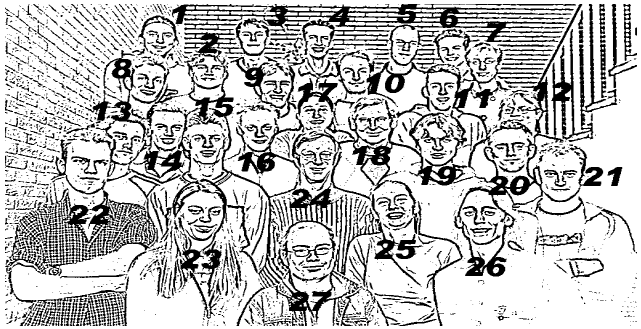


TRAVEL REPORT

Daily reports - Boston

Day 1: Friday, March 28th
Journey to Boston
by Ronald Hoogma

It was early in the morning when several alarm clocks of the ManeaX participants rang. Most of them didn't need an alarm clock though, many had been awake for several hours already in anticipation of what was about to happen. They were about to go on a tour, not just a tour, but a study tour, and not just a study tour, but a tour that would bring them to the busy streets of Boston, the busier streets of New York and the even busier streets of Mexico City.

At 7:15 AM most of them met at Groningen Central Station, only one managed to set his alarm clock at the wrong time and did not wake up till he was called out of his bed. He would take the next train. The group that was on time put the first FMF-stickers in place to mark the start of the journey. While waving friends and family goodbye, the train set into motion.

Several hours later the train stopped at Schiphol Airport and the participants proceeded to the check-in desk. The luggage of some people was checked, but all luggage was found to be okay and proceeded to the customs. Again some people were searched, but everything turned out to be okay again. One final test awaited us at the gate. People from the customs took people in groups of four and in a rapid pace asked them questions like if their luggage was their own, if they had accepted packages from other people and what the purpose of their trip was. Everything was okay and we were allowed to enter the airplane to start the 7.5-hour flight.

The flight was a beautiful one. In the beginning it was a bit cloudy, but the clouds soon disappeared and we had a good view over the North Sea, a small part of England and the Atlantic Ocean!

After flying some hours, spotting several ships, we flew across parts of frozen ocean close to Newfoundland. Ice floes could be seen clearly. Even the smallest ice floes we could see were probably the size of large houses, a magnificent sight. Soon we flew over the United States of America. We saw small cities and villages, all of them built in a very regular way. Take a building block of like 200 by 200 meters, put some streets around it, put more buildings blocks around it, add streets and repeat this as often as you want and you have an American city. Americans must like swimming; a lot of swimming pools next to the houses could be seen from above.

Some more hours had passed when we flew over New York and caught our first glimpse of the Empire State Building, the Chrysler Building and the Statue of Liberty. At 4:15 PM local time we set foot on American ground.

We got a nice stamp in our passports at the customs and checked out. We would go to Boston by train, so we went by AirTrain (a kind of monorail connecting several parts of the airport) to the train station. There we could leave our luggage under the watchful eye of a train officer. Since we still had about 45 minutes before the train left and because people were hungry, we took the AirTrain again to find some food. At another part of the airport we made our first acquaintance with the food court concept which you can find a lot in the USA. A food court is a group of small fast food shops like McDonalds, Subways, pizza shops and Asian food shops. All these shops share their tables. So if you're in a group, and one person wants to eat pizza, someone else a burger and others Japanese food, they can still sit together.

After our fast food dinner we went back to get on our train to start the 6-hour travel to Boston. Some people were tired already and spent most of the journey asleep, some read their favourite books (I spotted people reading Dune, D&D, Giphart and mathematics books), and others went to the train cafetaria to get a drink. The bartender, who called himself Batman, was happy to provide a Budweiser after having seen our ID.

The train continued and we ended up at Boston South Station. We grabbed the subway and headed for the Boston International Hostel. Since it was about 1 AM local time we checked in quietly, picked a room, picked a bed (each room had 3 bunk beds) and went to sleep.

Day 2: Saturday, March 29th
Exploring Boston
by Martijn Bodewes

The first real day in the States. Now we could finally see something else than trains, planes en subways.
After a good night rest at the hostel we headed out for our first real American breakfast: donuts! For the next week we would have our breakfast at the Dunkin' Donuts. They had enough choice to try a different donut every day! After our first donut we went to downtown Boston using the 'T'. The T is the subway system in Boston. That morning we walked around in Beacon Hill.

Beacon Hill consists of stately 19th-century brick townhouses, gas lanterns, rooftop gardens and picturesque narrow alleys. The first thing to see at Beacon Hill is the Massachusetts State House, which was completed in 1798. After a short walk through Mt. Vernon Street, where you have to watch your step carefully because the brick sidewalks are torn apart by tree roots, we ended up in Acorn Street. This is the most photographed street of Boston, and yes we did take pictures too. It is also the narrowest street in Boston. A few blocks further there is Pickney Street with the House of Odd Windows, built in 1884. It has no less than seven windows, none of which are

identical. On 9 ½ Pickney Street there is a gated tunnel, which leads to three hidden houses. In 1830 an ordinance was passed that decreed the passageway to be built in order to accommodate a boy with a basket on his head and one cow. After this we walked steeply down hill to Cambridge Street, on which the Old West Church is located. A little further, back up the hill, are the Abiel Smith School and the William Nell House. The William Nell House (1800) was a black rooming house and hiding place for escaping slaves. The next nice thing we saw was the Lithuanian Vilna Shul. It is said that Leonard Nimoy (Captain Spock from Star Trek) has conceived the Vulcan hand symbol (live long and prosper) from a religious symbol in the synagogue. Some way further down we stumbled upon a woman, who called Nanne a longhaired leftover hippie from the sixties. She told us about the black slaves fleeing and using back gardens and small alleys to escape. We stopped to listen for a while to her fascinating stories. After this it was a small walk to the Public Garden where we planned to have lunch!

In the Public Garden we stumbled upon thousands of people in a demonstration against the war in Iraq. After a few moments of awe we wandered off to get our lunch. Walking makes you hungry!

After lunch it was time to see more of the historic parts of Boston by walking the Freedom Trail. This is a trail consisting of numerous famous places that are important in the history of the United States. The trail starts at the Old State House, like our first walk in Beacon Hill. From there it was a short trip to the 217-feet steeple of the Park Street Church. Built in 1809, the church was the scene of the first anti-slavery speech delivered by William Lloyd Garrison. During the war of 1812, the church stored gunpowder in its basement, giving the location the name 'Brimstone Corner'. Next to the church is the Granary Burying ground. With its massive front gate, the Granary Burying Ground serves as the final resting place for many notable revolutionary-era patriots, including three signers of the Declaration of Independence: John Hancock, Robert Treat Paine and Samuel Adams. Also buried here are Peter Faneuil, Paul Revere, Benjamin Franklin's parents and the victims of the Boston Massacre.

Next stop was the First Public School site. The first of the country's public schools was built in 1635. Samuel Adams and Benjamin Franklin attended this school. Later it became the Boston Latin School, which is still in operation. Right across the street is the statue of Benjamin Franklin. It was designed by Richard S. Greenough and was the first portrait statue erected in the United States. The four bronze tablets surrounding the base of the statue highlight Franklin's career as a printer, scientist, and signer of the Declaration of Independence and the peace treaty with France.

A few blocks further is the Old State House, which was built in 1713 and is Boston's oldest public building. It served as the headquarters for the British government in Boston. The public could watch government in action when a gallery opened here in 1766. In 1776 the Declaration of Independence was read from the balcony. Right across the street is the site of the Boston Massacre, nine British soldiers killed five colonists here.

We went on to Faneuil Hall. Merchant Peter Faneuil built this building in 1742 and donated it to the town. It was enlarged in 1806. For over 250 years the first floor has served as a marketplace and the second floor as an open forum meeting hall. Because of the protests against the British taxation policies voiced here during the 1760's, the meeting hall is dubbed the 'Cradle of Liberty'.

Not far away from Faneuil Hall is Paul Revere's House. This building was built around 1680. It is the oldest wooden building still standing in Boston. Paul Revere lived here from 1770 to 1800. While living here he performed the patriotic acts he was famous for, such as the Boston Tea Party and his night ride to warn the Lexington and Concord residents of the approaching British Redcoats.

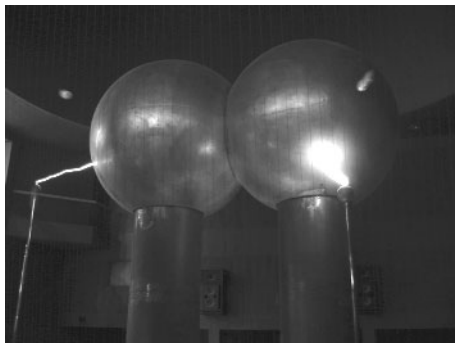
Old North Church was built in 1723 and is the oldest church building in Boston. On April 18, 1775, Robert Newman, the church's sexton, hung two lanterns in its steeple to warn that the British troops were arriving 'by sea', thereby sending Paul Revere on his famous 'midnight ride' to Lexington and Concord to warn Samuel Adams and John Hancock that the British were coming. From the church we crossed Charles River over the Charlestown Bridge to take a look at the U.S.S. Constitution and the Bunker Hill monument. Our first stop was Bunker Hill. 'Don't fire until you see the whites of their eyes!' Colonel Prescott uttered this phrase to his troops on June 17, 1775, at the start of the famous battle of Bunker Hill, the first major battle of the American Revolution. The monument, a 221-feet granite obelisk, was dedicated in 1843. Next stop and end of the Freedom Trail was the U.S.S. Constitution, also known as 'Old Ironsides'. It was launched in Boston on October 21, 1797. Old Ironsides is the oldest commissioned warship afloat in the world. She was used to fight against the Barbary Pirates and also to fight the British in the War of 1812. It was during this war that she received her nickname 'Old Ironsides' because of the way the British cannonballs were bouncing off her hull.

From this we went back to the city center to have dinner. Some of us took the ferry back to the center through the harbor of Boston. From the boat you had an excellent view of downtown Boston.

After this long day of walking we enjoyed our meal at a bar in Quincy Market. Here we had our first encounter with the strict drinking laws in America. Not everybody brought his passport, so not everybody could get a nice cold refreshing beer. A wise lesson for all the good days that would come in the United States.

Day 3: Sunday, March 30th
Exploring Boston
by Nanne Huiges

The initial plan for today was to go for a walk in Boston's financial district, have some lunch and then visit Faneuil Hall. After that we would go to the Museum of Science. The alarm woke us at 8:30 AM and a quick look out the window told us...RAIN. A lot of rain. Just around the corner, right in between the hostel and the Dunkin' Donuts, was a little shop that sold umbrellas. And that is where some of us went to get some protection against the elements. The (very cheap) portable tents where not very good, and several of them would die in the next few (windy) days. After saying a cheerful good morning to the nice young man behind the counter (read: after yet another encounter with the 'Dunkin Donuts Dude from Hell'), eating a nice salsa bagel with cream cheese and drinking a cup of coffee, El Jefe told us that there was a change of plans; first the Museum of Science and then hoping for sun.



So we first took the T to the museum. With the rain still pouring happily we arrived. The Museum of Science is quite big. Actually, it's too big to cover in one day, or in this case, part of a day. One of the big attractions is the Miramax theatre. As the Museum of Science states itself: 'When the world's largest film format is projected onto a five-story-tall domed screen, it wraps audiences in larger-than-life images'. The movie we saw was 'Lewis & Clark'. This is the story of two army commanders who where the first to make the east to west journey through America. In an American style full of heroic actions the movie tries, but somewhat fails, to learn us about earlier times.

After the film, which gave some of us a nice place to nap, we went into the museum. The group split up in several small ones and we tried to cover a part of the building. One of the things I saw was the mathematics room, for instance. Here you could see several shapes and mathematical formulas explained by image and movement. Bigger, and more American, was the Theatre of Electricity, built around the biggest Van de Graaff generator (2.5 MV and 4 meter sparks!) and some Tesla coils. A nice American girl told us all about electricity, lightning and the Faraday cage. The show was aimed at children and laymen, but still the Van de Graaff generator was quite impressive. Especially Mr. Van Steenwijk was deeply impressed. During his lessons 'Electricity and Magnetism', he has to deal with equipment that pales into insignificance in comparison to the Theatre of Electricity.

Moving on we found a small corner in which the hard job of a surgeon was shown. One setup involved two pairs of 'scissors' which you had to use to get some thread through a ring. You could only look through a camera. The other was a computer that simulated resistance. This was quite impressive. You could virtually lift up a crate and actually feel the weight (and the lack off weight, when you dropped it).

Of course there was a lot more to see, of which I will briefly mention free internet for posting on the diary and an animal show which was extremely lame.

When everybody was ready, we found the rain still falling down. One group decided to go to the Museum of Fine Arts. This large museum had sections with African, Chinese, Egyptian, Greek and Roman art, from ceramics and metalwork to statues and paintings. Most people decided to go to the section 17th, 18th and 19th century paintings. There were beautiful paintings by, among others, Rembrandt, Van Gogh and Monet.

I went to the movies with a small group. We picked a theatre from the Lonely Planet (thank you 1) and found a movie theatre in Harvard. We went to the first movie that played (Chicago) and bought ourselves the biggest portion of popcorn they had (it IS America after all). After this, we looked in the Lonely Planet again to find a place to eat. It recommended a place called 'The Garage', which we could see from the spot were we where standing (thank you 2). It was a real American 'food court' style place, with a couple of different places to eat, from which we picked a Vietnamese restaurant.

After a good meal, we went back to the hostel. After getting off the T, we made a small detour to the Prudential Center. This is a big skyscraper, which has an observatory at the 50th floor. After looking over Boston by night, we went back to the hostel.

Day 4: Monday, March 31st
Visit to Sun Microsystems
by Niels Maneschijn

The first company to be visited by us was Sun Microsystems. Therefore we slipped into our suits and took the bus to Burlington Mall, leaving quite an impression singing in the bus ("Are you a religious group?"). After stopping at the mall for lunch and checking out the Aqua Massage, we continued by foot. After about half an hour walking through the local commercial district we arrived at Sun Labs, which happens to be located at One Network Drive and houses 2400 people.

Sherry Clay, who introduced us to Steve Heller, a.k.a. Gandalf, welcomed us. With his enormous trekking boots Mr. Heller didn't look very director-like, but rather like a guy from some popular hacker movie. He gave us a quick overview of the different research activities at Sun Labs. These activities include developing a meaning based search system (instead of the usual word matching methods), working on awareness systems (meaning a system which is aware of the location of people and which is e.g. capable of deciding on the best way to contact a person and adapting the environment to a person's liking), and Java-based speech technology. He also told us a bit about combining Public Key Infrastructure and Federated Trust security systems.

The next speaker was Tony Printezis, who managed to show and talk about

seventeen slides in about twenty minutes. He is a member of the Java Technology Group, which goal is to do research on Java to be used in the industry for the longer term. He also introduced us to the nicknames used in the department, taken from the Tolkien universe. His current research subject is automatic memory management, also known as 'garbage collection'. This under the motto: 'Eat lunch, have fun, kick butt, pick up the garbage'. Pitfalls in memory management are memory leaks (memory space that is allocated but never freed after its use) and dangling references (pointers to data that don't exist anymore). Java has an automated garbage collector that automatically takes care of de-allocating unused memory.

The simplest way to implement garbage collection is running the application and the garbage collector turn by turn. This has a major disadvantage: because the time needed for garbage collection is proportional to the memory size, this can take several seconds, during which the application is unresponsive. This is a bad thing for interactive and server applications. A solution to this is running the garbage collector concurrently with the application. This way, the application is stopped just momentarily to perform the actual garbage collection. The same thing can be done with many applications running in parallel in a multi-processor environment, and even with multiple garbage collectors running concurrently. You can already find this technology in modern Java Virtual Machines, two years after the lab research.

The last Sun speaker was Willie Walker, from the Speech Integration Group, consisting of three people. They are working on the 'Duke speaks, Duke listens' project. The goal of this project is to develop a Java platform for speech applications as well as a research platform, and showing the world how fast Java can be. The resulting speech synthesizer, FreeTTS, is based on the existing Festival and Flite programs, which are programmed in C. It is supposed to be fast, useful, open source, have its own voices and provide a Java Speech API. Challenges in making FreeTTS were handling the large data sets (210 MB) and large amounts of floating point operations (250,000 for 'Hello World'), and working with Java's quirks, which turned out to be very few. The software was running within four weeks, and was optimized thereafter. The results on a dual CPU machine were quite impressive: two to four times the performance of Flite. Java's floating point performance seems to be better than C's.

FreeTTS is currently released on freetts.sourceforge.net, has been downloaded about 70,000 times and is being used by researchers worldwide. The result: Java is well suited for speech applications, and Open Source development works, but takes some time.

The other speech application is, of course, speech recognition. The Java version is called Sphinx 4 and aimed to be a state of the art decoder and trainer, with high accuracy and speed. A community approach was used building Sphinx 4, using Sun's engineering and external speech recognition knowledge. Goals were to create a system, which is fast, has a large vocabulary (64,000 words), is usable as a research platform and preferably created under Open Source.

A Hidden Markov Model was used to construct a token tree. Among the challenges met were the complex theory and handling the large search spaces efficiently (a thousand word dictionary uses half a million nodes). But eventually 98.9% accuracy was achieved, with faster than real-time processing, which is as fast and as good as Sphinx 3. Challenges that are still to be met are using a 64,000-word dictionary and using parallel processing.

Some lessons learned were: speech recognition is a lot harder than speech synthesis, large data structures are expensive, garbage collection can take 5% of the total processing time, the speed of floating-point operations is not a major concern, and again, Open Source can succeed.

After testing the speech recognition with our own female non-native speaker (Astrid, score: 66%) and a short break, Ewoud and Casper gave a short overview of the research done at the University of Groningen. At the end all Sun employees attending were given thirty seconds by Steve Heller to tell something about the research field which interested them the most. This left us just enough time to take some pictures of our group before the bus arrived.

Back in Boston, the shutterbugs in our group scurried to the Prudential Building to take some pictures of Boston at sunset. After dinner in a place called Whiskey's, the majority of the group went to bed.

Day 5: Tuesday, April Fools' day
Visit to Microsoft and HP

by Casper Bodewitz

I came to the conclusion that a) Boston is a nice place to live in and b) this environment is great to do all kinds of business.

The Microsoft Technology Center is situated in the beautiful setting of the Cambridge countryside. The center has a very stylish architecture and interior design, which is suited perfectly for its purpose. The purpose of the Technology Center is to let customers get experience with the capabilities of Microsoft's implementation of the .NET framework. In this presale process they offer the customer three stages:

- .NET strategy briefings
- Architecture Design Sessions
- Proof of concept projects

Their main focus is on showing how legacy and new software systems can be integrated through the .NET framework, using the open standards supported by a large consortium of business on standard bodies, XML and Web Services.

The main characteristics of the .NET framework are managed code (thread safety), garbage collection and strict typing; concepts that all have been established for a number of years now and are incorporated in for example the Java implementation of SUN Microsystems. Because the framework has a Common Runtime Language, platform independence can be achieved.

In the envisioning room we were shown a business scenario with the aid of the entire multimedia infrastructure, which itself was managed and interfaced to with a .NET solution.

This demonstrated the power and potential of the .NET framework and how Microsoft has built a family of products around this concept.

All throughout the presentation we heard about the pros and cons of the Microsoft and Linux platforms as well as how .NET is meant to be a framework that is platform independent so integration of systems can be realized further. To demonstrate this, the company has developed a .NET framework based on a FreeBSD system.

According to Chris Hallberg, who demonstrated the business scenario, Microsoft is in the business of selling software, but has realized that to achieve their goal of connecting people, services and information, it needs an open framework. This must be widely supported by all the main players in the industry as well, so the open source community can participate in the process.

After this morning demonstration we once again walked through the sunny countryside to our bus.

Visit to Hewlett Packard

The Cambridge Research Laboratory in the heart of Boston across the street from MIT, looking out over central Boston, was the setting for a great afternoon with the wonderful people of HP.

We were received in a state of the art multimedia conferencing room. There were cameras all around us, to zoom in on people in the room. A speaker on possibly the other side of the globe could have the feeling as if he was speaking to one large audience.

From the overview of the research fields in which the Cambridge Lab conducted its work we learned the focus points of their operation.

The goal of the research on large scale multimedia indexing is to build the technologies that will allow easy access, navigation and organization of vast repositories of multimedia (audio, images, video). We saw a demonstration of this in the SpeechBot project and the BoogeeWoogee engine. The SpeechBot project is a search engine where users can search digital audio and video media by inputting typed keywords. These keywords are matched with the indexed source of audio/video data. This multimedia data is transcoded to a standard audio format and then processed through a speech recognition component. This component produces transcriptions of conversations, which are then indexed according to fairly standard indexing algorithms.

The Metro project aims on creating a world of plug-and-play, mix-and-match, wireless, shared resources that don't require you to be an expert to configure, use, and extend. At HP they call this dissociated computing. They are studying this in the research demo setup, where iPAQs have been programmed to run the Linux platform. iPAQs rule! At HP they know how to do research. Research is taking chances exploring things without guarantee of business success. At the Cambridge Technology Center they explore the field of pervasive computing. They have ported Linux to the iPAQ and have used all the multimedia techniques to transform their workplace into a lab where they have created lightships (infra-red power UTP beacons) so each handheld can locate itself and give the user the closest available printer in a building, for example. Another application is tracing/tracking so a handheld can create a network map of its pervasive environment.

All throughout the afternoon there was a lively interaction between the people at HP and us. They clearly saw their job as being their hobby. The computer science students were happy to spot the large number of computing books in the offices including the standard work for every IT person: 'Introduction to algorithms' by Cormen, Leiserson, and Rivest.

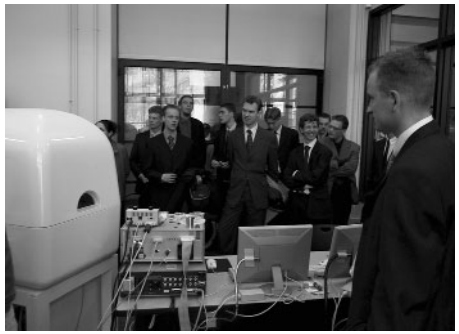
Day 6: Wednesday, April 2nd
Visit to MIT
by Joost Massolt and Niels Heinis

After our daily breakfast at the Dunkin' Donuts, we spent the day visiting the Massachusetts Institute of Technology (MIT) in Cambridge and in the evening we visited an NBA basketball game with the Boston Celtics vs. Miami Heat.

Since it was only a few hundred meters away, mostly consisting of a bridge across Charles River, we went to MIT by foot. We were welcomed at MIT's Nanolab at 9:00 AM.

The Nanolab is a one year old shared facility. Shared means that several research groups can use the lab. It is used for mechanical, tensile, hydraulic and fatigue tests on different materials. Among its microscopes is an atomic force microscope (AFM). It uses extreme low forces, pico Newtons, to perform measurements. The measurements are performed in a liquid for biological applications. The liquid doesn't affect the measurements. The Nanolab also has got an AFM for nanostructuring, i.e. nanowriting. It can write lines with a width of 15 nm. One of its applications lies in mechanical storage systems. The problem is that it is very slow. Besides the AFM's, the lab also has got a nanoindenter. This indenter is capable of cyclic and high temperature (<1000 °C) indentations, with a maximum applied load of 20 N or a maximum displacement of 30 microns. It uses an optical microscope for the

placement of the indenter. It takes a few hours before the indenter is stable enough to perform measurements due to mechanical and temperature vibrations. The problem is that surface effects are measured, not the mechanical properties. Another indenter, the triboindenter by Hysitron, uses an indenter on a piezotube. This nanoindenter features in situ imaging and AFM imaging of indentations, for a maximum applied load of 30 mN or a maximum displacement of 5 microns. The indenter tells you something about the Young's modulus, not about the hardness. Research at the Nanolab concentrates on dislocation phenomena and mechanical properties of nanocrystals.



After the Nanolab we went to a classroom where Nicola Mazari, professor in computational materials science, told us something about modelling at nanoscale. He was making a model of melting surfaces. 'Ad-atoms' on top of the surface make the surface melt. The question was what would happen with the surface atoms and the ad-atoms. He found out that they don't 'hop' across the surface, but that other atoms under the surface come to the surface. The ad-atoms 'sink' into the surface. After the surface has cooled down the atoms form a crystalline structure again. Simulating one picosecond takes about four weeks of computer time. Using computational science is the third way, after theory and experiment. Quantum mechanical simulations combine accurate predictive power with atomic resolution. And it gives you some fancy movies to watch ;-).

After lunch at MIT's food court, we went to a 2nd grade materials science class. Once every two weeks all students have to give a short presentation about a subject of the book. After a presentation there were some minutes for a discussion. In this class, we attended two presentations. The first one, about bone structures, was a clear presentation. The student was quite relaxed and explained everything very clear. The teacher commented that she presented particularly well, although she made some interpretation mistakes. Next time she has to improve her slides. The second presentation, about iron-carbon steel processing parameters, was not so good. The student seemed to be quite nervous, he talked fast and switched a lot between sheets. Hylke asked him a question which he was able to answer very well. During these two presentations the other students were quiet. Some played games on their laptops.

After these presentations it was time to see some more of the MIT campus. A 2nd grade student guided us and told all sorts of facts about the university. MIT has about 10,000 students: 4,000 undergraduates and 6,000 graduates. One year of studying and living at MIT costs about $40,000, an undergraduate study takes 4 years and a graduate study 2 years. Luckily there is a lot of financial aid for the students. Most students live in dormitories on the campus, where they have all sorts of facilities like a hair dresser, a travel agency, restaurants and an enormous sports center. The sports center was build in 2002 and it is the biggest in North America. There are about 1000 teams playing in all kinds of national competitions. The sports facilities are free for all students. Like many universities, MIT has its own chapel, designed by Saarinen, which has no windows. All light comes from the roof window. Saarinen also designed the auditorium. It has a domed ceiling and because there are no columns, every seat has an unobstructed view. The auditorium was designed to have sublime acoustics.

Very famous are the MIT hacks. For example the 'Campus police car on the Great Dome', where some students put a complete car on top of the Great Dome. The lights of the car were flashing and a dummy policeman and a bag of donuts were inside. More hacks can be found on http://hacks.mit.edu. At the end we asked our guide why the bridge in front of MIT was named the Harvard Bridge and not the MIT Bridge? He told us a story which represents the relationship between MIT and Harvard quite well. Once the bridge was built, they wanted to call it the MIT Bridge. But engineers of MIT inspected the bridge and said that it would collapse within five years and therefore said it could better be called Harvard Bridge. So it happened and indeed the bridge collapsed within a few years! The next day at Harvard we asked if they knew this story, but they had never heard of it.

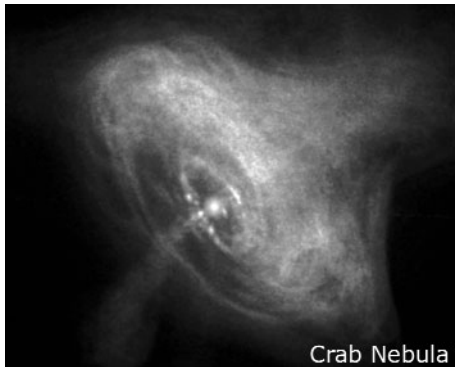
In the evening we went to the NBA basketball game of the Boston Celtics vs. Miami Heat. While the FleetCenter was not completely filled, the game started with a short moment of silence and the singing of the national anthem by a police officer. All of a sudden we heard music from 2 Unlimited. Yes, from The Netherlands and yes, 10 years old! The game started and within a few seconds the Celtics scored: 2-0. During the first quarter more and more people entered the stadium while the Celtics did not loose the lead; it ended in 27-18. During the second and third quarter the stadium was completely full. The speaker made us make a lot of noise and shout DE-FENSE, BOOM-BOOM! On every time-out cameras were pointed at the audience and everyone tried to behave as crazy as possible to get on the big screen high in the top of the stadium. The second and third quarter went very well for the Celtics; they ended in 46-28 and 73-44 respectively. Since the Celtics led with about 30 points, many people did not find it exciting enough anymore and left the stadium. Of course we stayed till the end. The match, in which the Celtics were leading from start to finish, ended in 90-62. Although it was not a very exciting match, it was a very cool experience and of course we celebrated the victory with some beers and a sing-a-long in the subway.

Day 7: Thursday, April 3rd
Visit to Harvard University

by Guido van der Wolk and Astrid Tuin

The Center for Astrophysics combines the resources and research facilities of the Harvard College Observatory and the Smithsonian Astrophysical Observatory under a sin-

gle director to pursue studies of those basic physical processes that determine the nature and evolution of the universe. The Smithsonian Astrophysical Observatory (SAO) is a bureau of the Smithsonian Institution, founded in 1890. The Harvard College Observatory (HCO), founded in 1839, is a research institution of the Faculty of Arts and Sciences, Harvard University, and provides facilities and substantial other support for teaching activities of the Department of Astronomy. The establishment of a joint center in 1973 formalized the long relationship between the two organizations, which began when the SAO moved its headquarters to Cambridge in 1955.


Crab Nebula

Some three hundred Smithsonian and Harvard scientists cooperate in broad programs of astrophysical research supported by Federal appropriations and University funds as well as contracts and grants from government agencies. These scientific investigations, touching on almost all major topics in astronomy, are organized into seven divisions: Atomic and Molecular Physics, High Energy Astrophysics, Optical and Infrared Astronomy, Radio- and Geoastronomy, Solar, Stellar and Planetary Sciences, Theoretical Astrophysics and Science Education.

Six astronomers from the various divisions informed us about the research done at the Harvard-Smithsonian Center for Astrophysics.

Radio astronomer Mark Reid whose research interests are in black holes, active galactic nuclei, galactic structure, star formation, evolved stars, astrophysical masers and radio interferometry gave a talk about the credibility of a super-massive black hole at the center of the Milky Way.

With the Very Long Baseline Array (VLBA) Harvard astronomers mapped the motions of six giant stars with masers revolving round the center of the Milky Way. They noticed that one of the stars gets an enormous sweep when it's close to the black hole position. From this the mass of the center - one astronomical unit large - of our Milky Way can be estimated to 3×10^6 solar masses. This gives an incredibly dense environment for the cluster of 2×10^{20} solar masses per cubic parsec. So dense that the center of our Milky Way is rather expected to be a black hole.

In three talks - 'The Sun and the Solar Wind' (Steven Cranmer), 'Formation of Planets' (Scoot Kenyon) and 'Planets Outside the Solar System' (Dimitar Sasselov) - an impression was given of what kind of research is done in the Solar, Stellar and Planetary Sciences (SSP) division. Its research is directed towards determining the physical properties of the Sun, other stars, planets and small bodies in the solar system, and towards the detection of extra-solar planets.

The aim of the solar research is to understand the basic structure and behavior of the Sun and to learn how the Sun affects the Earth. Stars like the Sun and other types of stars are investigated to advance our knowledge of solar and stellar evolution and to understand the formation of stars, stellar systems and planets.

Planetary research is based on making simulations of the dust rings around stars from which planets are formed. Most generally a Jupiter-like planet is formed around stars which removes all dust.

SSP research is based on theoretical investigations, computations, laboratory work, and observations from ground-based observatories and from satellites, including SOHO, TRACE, the Far Ultraviolet Spectroscopic Explorer, the CHANDRA X-ray Observatory, and the Hubble Space Telescope.

Margaret Geller gave a talk about interacting galaxies. Dr. Geller was a pioneer in mapping the nearby universe. Her maps provided a new view on the enormous patterns in the distribution of galaxies like the Milky Way - the largest patterns we know. Dr. Geller's long-range scientific goals are to discover what the universe looks like and to understand how it came to have the rich patterns we observe today. To put the pieces of this grand puzzle together she studies systems of galaxies ranging from pairs of galaxies to clusters containing thousands of objects. She has developed innovative techniques for using the data to understand the properties of these systems and their evolution throughout the history of the universe.

The sixth and final talk was from Christine Jones. Her talk dealt with cluster evolution observed with the CHANDRA X-ray Observatory. She gave an overview of the rich amount of clusters. Beautiful pictures of the bullet cluster were shown. This is a cluster which merges at a supersonic speed of 2 Mach.

Major achievements of the Center for Astrophysics:

- Pioneer in development of instrumentation for orbiting observatories in space.
- World leader in ground-based gamma-ray astronomy.
- Pioneer and international leader in the application of computers to problems of theoretical astrophysics, particularly stellar atmospheres.
- Leader in the field of x-ray astronomy: experiments aboard ANS, ROSAT, HEAO-1 and HEAO-2 satellites; imaging instruments on HEAO-2 (Einstein) produced first focused images of x-ray sources in space; instruments built for the Chandra Observatory and center for its operations, observations, and data analysis.
- Recognized leader in the development of Very Long Baseline Interferometry (VLBI) technique for radio astronomy as well as instruments for observations at millimeter and sub-millimeter wavelengths.
- Major efforts in infrared astronomy, including mapping the Milky Way by balloon-borne telescopes, development of the Infrared Telescope (IRT) experiment for Space lab, and

principal investigator for the proposed SIRTF satellite observatory.
- Participant in the landmark "CfA Redshift Survey," a precise determination of distances to some 20,000 galaxies and basis for the "Slice of the Universe" study showing galaxies distributed in thin sheets surrounding huge, bubble-like cosmic voids.
- Pioneer in the development and design of electronic detectors for optical telescopes, and the related image processing by computer.

After a buddy check at "Au bon pain" we got a tour around the Harvard Campus by Alette Miller, a second year History of Art student. First she told a bit about the history of Harvard University. In the year of foundation, 1636, Harvard only had one professor and 10 students; today there are about 6,500 undergraduate and 12,000 graduate students. The price of the ground Harvard Campus is built on has risen from $50 back in 1636 to $18,000 per square meter nowadays. When Harvard opened to women, male and female students got lectures separated from each other. Because the professors had to walk for about ten minutes to the place where the female students were taught, these female students always said they learned in fifty minutes what the male students learned in one hour...

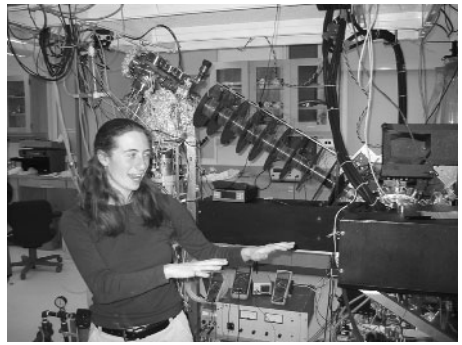
The tuition fee for Harvard is $37,000 a year. But in case a student, of whom the board thinks is good enough for Harvard, can't bring in the tuition fee there will be enough financial support from the board to let this student study at Harvard.

Around the Old Yard there are a couple of freshmen dorms, Massachusetts Hall and Harvard Hall. This last building is the successor of two earlier Harvard Halls. The first was pulled down because of malconstruction, the second burned down. The only thing left of the second is a book that a student had 'loaned' from the library in the Hall. Though the president was glad when the student returned it, he still expelled the student because of his 'stealing'. The present Harvard Hall houses different classrooms.

The president lives in Massachusetts Hall; the remarkable thing is that there are also freshmen living in this building. Among others the departments of chemistry, physics and astrophysics are located in the Science Center. There are several classrooms and computer facilities in this center. On the roof there is a telescope. According to our tourguide, this is a very good place to have a date...

A library which is open twenty-four hours a day during the two weeks before periods of exams is housed in another building. Besides this library there are also a food court and a mail room for freshmen in this buiding.
Then there is Memorial Hall, which looks like a big church, but in fact houses Sanders Theatre, a library, a food court and a freshmen dining room. Once a year (in September) every freshman gets its own lobster at diner. Further, parents of students can send in their favourite recipe and so it can happen that something your parents regard as their specialty is on the freshman menu. In the entrance hall of this building the names of the Harvard students that died in the Civil War are inscribed on the walls. In Sanders Theatre different orchestras and drama groups give performances.

There is a church located at the New Yard: Memorial Church. There are memorial tablets for different wars (World War I and II, Vietnam, Korea) in this church. Different classrooms and the Widener Library, one of the more than hundred libraries belonging to Harvard, are also located around the New Yard. This library was founded by Mrs. Widener, mother of Harry Widener, in 1912. Harry went to England and laid his hands on essays by Francis Beacon, but on his way back he and his essays sunk with the Titanic. There were three conditions Mrs. Widener made for the library: it should have a memorial room for Harry, there should be fresh carnations every day and no one should get a Harvard certificate without passing for a swimming test. This last condition was because Mrs. Widener thought Harry would have survived the Titanic-disaster if he had been able to swim.



After a glimpse in the direction of the Harvard Museum we walked to the Statue of John Harvard which carries the inscription: 'John Harvard, Founder, 1638'. This statue is also called 'The Statue of Three Lies', because all three statements of the inscription are not true. The lies are: John Harvard is not the real founder of Harvard, Harvard was founded in 1636 and not in 1638 and it is not a statue of John Harvard. Another former president of Harvard, namely Mr. Hoer, posed for the statue. Because of his name they didn't want to call a building after him, whereas all the other presidents were honoured in this way, so they compensated for this with the statue of John Harvard. On the statue there is a tablet with a scene including the motto of Harvard: "Veritas" (=truth) and a book which is lying with the cover to the spectator. There are two different theories about this book: you should do other things besides studying while being at Harvard or this way you can learn the cover of the book.

The statue ended the tour. A last question was asked about what Harvard thinks of all the jokes MIT plays with Harvard. Unfortunately Alette didn't know anything about these jokes. After some pictures of the statue (Casper on 'Mr. Harvards' lap) we went to the Lyman Laboratory of Physics to see the laboratories of Mrs. Lene Vestergaard Hau.

In the Lyman Laboratory we were welcomed by Mrs. Hau and she led us to a room where two third year graduate students were going to tell us about the work done in Mrs. Hau's laboratories. After some trouble with computers and networks and a short talk by Evert-Jan about the background of our group, Naomi Ginsberg told us about the stopping of light by means of Bose-Einstein condensates consisting of sodium atoms.

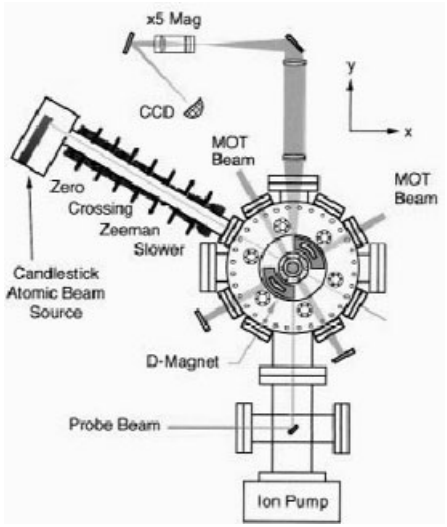


Figure 1: The condensation apparatus viewed along the z-axis

The process of forming a Bose-Einstein condensate is not very efficient so a lot of atoms are required. First the sodium atoms are warmed to 330 °C in the candlestick atomic beam source (see figure 1). Subsequently they are slowed down to about 50 m/s by the Zeeman slower and a slowing laser beam which is at an angle of 180° of the Zeeman slower. Then the atoms are trapped in a magneto-optical trap (MOT). This trap consists of three pairs of counterpropagating laser beams. Due to this trap and a linear magnetic field the Doppler cooled atoms are now at a temperature of 250 mK. To get the temperature further down to 50 mK the atoms are polarization gradient cooled; all dipoles are now aligned. At this point all laser beams are turned off and the atoms are confined in the '4-Dee' magnetic trap (see figure 2). The critical temperature for Bose-Einstein condensation (depending on several parameters, but about 450 nK) is reached by evaporative cooling using radio-frequency induced spin flips. A current is passed through coils placed around the confined atoms to excite a magnetic field. The frequency of the current is scanned from 32 MHz down to 1 MHz in 38 seconds. Due to this process the spins of the warmer atoms flip and this leads to the escape of the warmer atoms out of the atom cloud; only the colder atoms stay in the cloud. Now we have a Bose-Einstein condensate of oval shape. Because all atoms are in the same quantum mechanical groundstate you can treat the condensate as one entity.

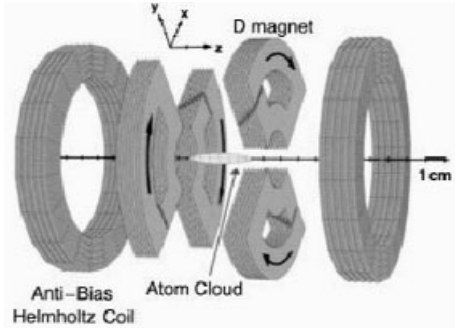


Figure 2: The 4-Dee magnetic trap used for evaporative cooling.

Now a coupling beam and a probe laser beam are applied (see figure 3). Figure 4a shows the calculated transmission of the probe beam and figure 4b displays the refractive index for the probe, both as a function of detuning from resonance. The group velocity of transmitted light pulses is inversely proportional to the steepness of the refractive index curve at resonance. Very low group velocities are reached in this arrangement, because the refractive index curve is much steeper than in any other technique. After penetration of the atom cloud the light pulses are recorded with a photomultiplier (PMT, figure 3). The results of a delay experiment are shown in figure 5. The open circles correspond to a reference pulse with no condensate in the system; the other pulse (filled circles) is delayed by 7.05 ms in a 299 mm long atom cloud. From this you can calculate the group velocity of the delayed ligth pulse, which is 32.5 m/s in this case.

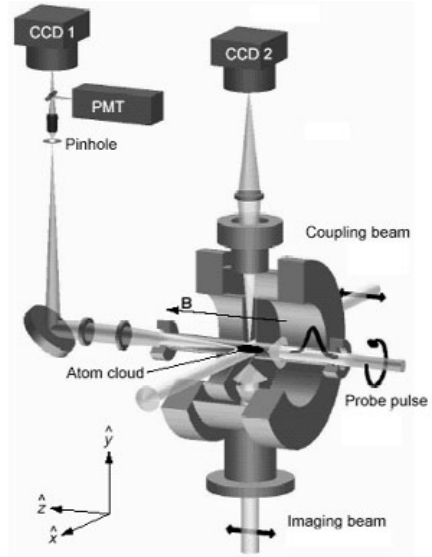


Figure 3: The experimental set-up.

After slowing down the light pulses to 17 m/s in 1998, Mrs. Hau's group succeeded in totally stopping light pulses for about 1 ms in sodium Bose-Einstein condensates in 2000. This is done by turning off the coupling beam after the light pulse is trapped in the atom cloud. The information of the light pulse is maintained in the atom cloud. The limit of the time a light pulse can be stopped depends on the coherence of the light pulse. By varying the intensity of the coupling laser one can make the light pulse broader or higher. A pulse train can be created by switching the coupling laser on and off. Applications of the stopping of light can for example be found in the fields of memory of quantum computers or atomic clocks.

Now it was Christopher Slowe's turn to speak a while about other things being done with Bose-Einstein condensates. He makes holes in condensates to see how they behave when they're not in equilibrium. From some 1- and 2-dimensional simulations it becomes clear that at the holes the vortices are stable but the solitons are breaking up. In the future the results of this kind of experiments can be helpful in the development of 3-dimensional tomography.

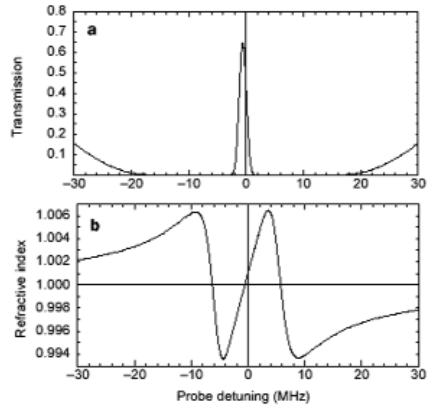


Figure 4a:Calculated probe transmission profile as a function of probe detuning.
Figure 4b (below): Calculated refractive index as a function of probe detuning.

After his talk it was time for a tour around the three labs of Mrs. Hau's group, starting with the oldest set-up in which Bose-Einstein condensates of sodium are being made. It's a rather impressive experiment to see: lasers, lenses and beamsplitters everywhere! We were told that when you start with about 10^9 to 10^{10} atoms you end up with only approximately 1 million atoms in your condensate.

In another set-up Bose-Einstein condensates of rubidium atoms will be made. Rubidium will be used in this set-up because it has two properties (different states of the atom are energetically easier separated and collisions between atoms occur less frequently

so that less information is lost) which lead to a longer time that a light pulse can be stopped in these condensates than in condensates of sodium atoms. Expected times of stopping a light pulse in rubidium Bose-Einstein condensates are up to tens of milliseconds.

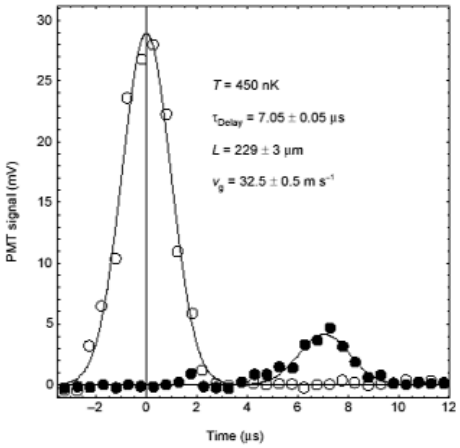


Figure 5: Pulse delay measurement. The open circles correspond to a reference pulse with no atoms in the system. The closed circles correspond to a pulse delayed by 7.05 ms in a 299 mm long atom cloud.

In the third lab, a student was working on wires. Mrs. Hau also called this lab a 'student playground', because in this lab students can do all kinds of experiments with Bose-Einstein condensates.

Around 5:00 PM we left the labs and the group split up in smaller groups. Evert-Jan, Ewoud, Rogier, Feike, Georg and I had coffee and hot chocolate at the Starbucks. After that we paid a little visit to the Harvard shop and had dinner at Bertucci's, an Italian restaurant where you can order very big pizza's. We found out that Ewoud is a bit clumsy (he knocked his beer over), Rogier isn't too good at mathematics (dividing the bill by 6 is too difficult for him) and wine is really expensive in the USA (unfortunately for me). We ended the day with one last beer at a Blues Bar where I was really surprised that the main subjects of conversation were laundry and ties...

The following day I found out a little of what other groups had done the night before. There were two extremes: Niels Maneschijn went to sleep very early (around 8:30 PM) although it was his birthday and Linda, Hylke and Ruud played darts till late at night. Hylke couldn't even find his bed and fell asleep on a couch at the hostel! It was a wonderful day.

Day 8: Friday, April 4th
Visit to Auto-ID Center

by Hans Timans and Wouter van Strien

Today's program consisted of a visit to MIT's Auto-ID Center in the morning and a visit to the MIT museum in the afternoon.

After the usual breakfast at Dunkin' Donuts around the corner, the group took the T to Kendall Station, with a quick transfer on Park Street. Upon arrival Ewoud took the lead of the group and we marched over to the campus. Unfortunately the map Ewoud brought showed nothing about the construction works being in progress on the site, so some improvisation had to take place. This resulted in the group walking a large circle before we actually got at the place we were supposed to be. After our arrival at the Auto-ID Center we were welcomed by Tom Ahlqvist and escorted into a large room with comfortable chairs. Shortly after Kevin Ashton - the executive director of the center - arrived and gave a presentation about the Auto-ID Center and Radio Frequency Identification (RFID) technology.

He started by explaining a few things about the RFID tags and readers that have been developed by the center. Assigning the tags as 'Amoebe wireless computers' he got quite some laughs, and after giving some short explanations about the silicon chip and the antenna most people understood the basic principles of tagging and reading using RFID. The technology's main goal is to be able to recognize extremely large numbers of different objects, and pinpoint their locations to a certain degree. Using this technology, companies can attach tags to all products in their inventory, making it easy to do inventory counts and refill their stocks very fast. The current ID-system that uses barcodes has been in use for about 25-30 years right now, and the Auto-ID Center expects this system to be gradually replaced by RFID within the next decade. Three systems are developed at the center, which operate on three different frequencies: 13,56 MHz, 915 MHz and 2,45 GHz.

Next Mr. Ashton talked about some theoretical applications of the technology. He showed a list of companies that participate in the development, and for each company the amount of tags that were needed by that company every year. The sum of all the tags needed was a little over 500 billion, from which he concluded that the tags should be very cheap to produce to make RFID a viable system (‘any number times 500 billion is a very large number’). He stressed the fact that there was a need for a worldwide standard for RFID technology, a point that Tom would come to later.

After a short coffee break, Tom gave a talk about the technical details and he gave a demonstration of the Savant software they developed at the center. For unique identification, every tag holds an electronic product code (EPC). The signal the antenna receives is modified by the tag in such a way that the scanner can recover the EPC using amplitude modulation. The current EPC is a 96-bit code, but the first 8 bits hold a version number making future expansion very easy. There are three different parts in an EPC: one for the producing company, one for the product class and one for the product itself. At the end of Tom's speech he gave a small demonstration of the Savant software with a reader and several tags. Everything seemed to work perfectly.

The next speaker gave a small presentation about practical problems the developers have run into. The most important one was the step between production and consumption. Often a product doesn't go straight to the store after production, but there are a few steps in-between. For example a chicken is grown at one company, then baked and packaged in a second one before ending up in a store. Now the problem is what company ID should be displayed in the second field of the EPC. A few solutions were mentioned, but none of them satisfied, since they all make significant distortions to the structured setup of the RFID network.

After the visit to the Auto-ID Center, the group went to the MIT museum for a short afternoon visit. The museum was rather small, but it held quite a few interesting artifacts. Interesting

were the test papers in both Physics and Chemistry from the 19th century, the assignment papers as well as the work handed in by some ancient student at MIT. There was also a lot to see about robotics at MIT, a large number of old testing robots were on display and TV screens showed these robots in action. A small group had loads of laughs at a large wall on which an image of your shadow was projected by fluorescence of the wall; high jumps and other weird positions presented very amusing sights.

In the evening nine of us went to a concert in the 'Middle East' podium where three bands were playing. The Kills started the evening, playing some fine stoner rock music. The next show was by the Immortal Lee County Killers II, a two-man formation consisting of a (sometimes blindfolded) drummer and a guitarist/singer. Last but not least a band having a large amount of sound effects in their music stepped on the stage. They produced the most enjoyable sound of the three bands that played that evening.

Daily reports - New York

Day 9: Saturday, April 5th
Journey to New York and exploring the city
by Ralf van den Broek

After we got up and packed our bags, we went to the Dunkin' Donuts for our last breakfast there, and then we went to Boston South Station to take the train to New York. The train left at 8:40 AM, and as we left we took a last look at Boston covered with snow. By the time we passed Providence, RI the snow was gone and replaced by rain. We arrived at New York Pennsylvania Station around 12:50 PM. While everyone was enjoying lunch, Georg got the local police on high alert because he left his suitcase unattended and a shopkeeper thought it was a bomb. We took the subway to 103rd Street and walked to our hostel.

After settling in our rooms, we went to Times Square. Getting out of the subway there is a pretty cool experience. There are huge neon signs and video screens all around you. We got some time to walk around and gaze at impressive New York.

After a short stop at the local McDonald's for a quick dinner, we went to the Metropolitan Museum. It is a beautiful and imposing building and the collection is also large. You could probably walk around there for several days if you wanted to see everything. There were a lot of different exhibits: paintings, statues, silverware, pottery and weaponry. They originated from different ages and from all over the world: ancient Greek statues, European Renaissance paintings, Asian art, Mayan pottery, medieval weaponry and so on.

I will mention some of the works I liked best. There was a large painting in the American wing by Emanuel Leutze, 'Washington Crossing the Delaware', which was very nice. I also liked the view from the second floor into the statue garden on the first floor. There was a beautiful French silver gold chalice with the insignia of archbishop Franqipani from the 16th century.

The modern arts section contained a painting of the Flatiron Building in New York by Samuel Halpot that was nice. The next day, we saw the same building from the top of the Empire State Building. There was a painting by Salvador Dali, called 'Madonna'. From close up, all you could see were small circles. From further away, you could see a woman with a child, and from far away, it looked like an ear.

Another nice painting was 'The Oxbow After Church, After Cole, Flooded' by Stephen Hannock. From further away, it looked like a photograph, but from close up you could see there was writing in the painting.

There was also a photography section. I didn't think the photographs were particularly beautiful, but the amount of interpretation given by these photographs was staggering. A portrait of a young man had several paragraphs of interpretation.

After that I went to see some Mayan, African and ancient Greek and Roman statues. Looking at my map, I saw I had missed the arms and armor section. They had armors of knights, the barding of their horses and a beautiful selection of medieval weaponry, like pole arms, swords and crossbows. They also had some Renaissance weapons such as rapiers and rifles, and a selection of Asian and Middle Eastern arms and armor.

Others went to see the section with 17th, 18th and 19th century European paintings. The museum had an enormous collection with beautiful paintings by Rembrandt, Vermeer, Rubens, Van Gogh, Degas, Cézanne, Monet and Renoir.

As the museum closed at 10:00 PM, we had to leave and went back to the hostel.

Day 10: Sunday, April 6th
Exploring New York
by Johan Brondijk

This day started, after a nice, but very heavy breakfast at the 'Metro Diner', at about 10:00 AM at the hostel. Today's goal was to 'chill' in Central Park, get an impression of Midtown Manhattan and its buildings, visit the Museum of Modern Arts and take a walk through Chinatown and Little Italy. Because the normal location of the Museum of Modern Arts was closed due to a renovation and the temporary location was too far away, we decided to go to the Guggenheim Museum instead.

First, we walked through Central Park, which is about 2 by 5 km in size. New York's Central Park was the first urban landscaped park in the United States. Originally conceived in the salons of wealthy New Yorkers in the early 1850s, the park project spanned more than a decade and cost the city ten million dollars. The purpose was to refute the European view that Americans lacked a sense of civic duty and appreciation for cultural refinement, but possessed instead an unhealthy and individualistic materialism that precluded interest in the common good. It's sad to know that during the lay out of the park, a population of about 1,600 people who lived in the rocky, swampy terrain, some as legitimate renters and others as squatters were evicted.

Nowadays, it's a nice, well-maintained park where we could make beautiful pictures.

After a one hour walk, we took the subway to the south, to go to the 443 meters tall Empire State Building. The construction of this building, designed by Shreve, Lamb & Harmon Associates started in 1930. After we obtained our tickets we could go up to the 391 meters high observatory. We were lucky to have sunny weather and a very clear sky this day; we had a great view over the city.

Next, we walked north to St. Patrick's Cathedral, which suddenly appeared between the high modern buildings. It was build between 1858 and 1879 and it is (of course) the largest decorated gothic-style Catholic Cathedral in the United States. Across the street is Rockefeller Center, a business and amusement complex built in the 1930's.

We took the metro to go further north to the Guggenheim Museum. The Solomon R. Guggenheim Foundation was incorporated in 1937 and the Museum of Non-Objective Painting, as it was then known, was established two years later. The museum took as its basis the radical new forms of art being developed by artists as Vasily Kandinsky, Paul Klee and Piet Mondriaan. Nowadays the Guggenheim Museum has 5 locations world-wide. The building, designed by Frank Lloyd Wright, is a symphony of geometric shapes and is very extraordinary, especially for the time it was built (1959). There was the permanent collection with works from artists like Chagall, Picasso and the artists mentioned above. The big, central spiral is used for temporal exhibitions, which was even more extraordinary. During our visit, there was the Cremaster Cycle, an exhibition of Matthew Barney. It was a self-enclosed aesthetic system consisting of five films that explore processes of creation. It consisted not only of these films, but also of photographs and sculptures the artist produced in conjunction with each episode. Its conceptual departure point is the male cremaster muscle, which controls testicular contractions in response to external stimuli. The meaning of this art was not always obvious and some people could appreciate it more than others.

After a little break and an ice cream we continued our tour to China Town. In this very independent quarter, which looks like a totally different city, we had dinner. When we had finished our Chinese meal, we completed our Lonely Planet tour through Little Italy, though Nano Italy agrees better with its size. A part of the group returned to the hostel and a few people stayed for a little drink and looked back on another impressive day.

Day 11: Monday, April 7th
Visit to Bell Labs
(Lucent Technologies)
by Joost Massolt and Niels Heinis

It was Monday! We stood up early; we had a train to catch. Sunday morning, some of us discovered the 'Metro Diner' too, where they served a really tasty breakfast. At 7:30 AM there was a buddy-check at the hostel, and after all the buddies were checked, we went to the subway. While everyone was relaxing at Penn. Station where we had to wait for the train to Murray Hill, Vincent was running back tot the hos-

tel to pick up the committee wallet... Vincent made it, so with all 27 participants in the train, we travelled towards Murray Hill.

When we arrived at Murray Hill (9:45 PM), it started to snow. After a small walk through the small village, we reached Bell Labs. It was, as you might say, pretty awesome. Walking around the building to find the entrance will take you more than ten minutes. The coffee that was waiting for us inside the building was a warm welcome. Mr. Eric Isaacs welcomed us. A funny thing about Bell Labs is that its main areas of interests are mathematics, computer science and physics! All FMF members can work at Bell Labs! So we all liked Bell Labs very much. Especially Hylke and Evert-Jan, who thought Bell Labs was so cool that they just as well could arrange an internship there. So they did. But anyway, Mr. Isaacs started the day. He told us Bell Labs does fundamental research as well as the development of new materials, new components and information systems. All that is done for Lucent Technologies, a large networking company, which makes Bell Labs the R&D division of Lucent.

After Mr. Isaacs, Mrs. Cherry Murray (maybe the hill was named after her?), a senior vice-president, gave a talk. She also told us what Bell Labs does. Bell Labs is one of the oldest research labs in the US, only the labs of Du Pont and GE are older. Bell Labs has about 10,000 employees. 80% of the research is aligned with business and the remaining 20% is (fundamental) research which will effect the product lines in more than 5 years. Bell Labs is the number one company in telecommunication patents and the number one in physical science citations. In 1947, Bell Labs built the first transistor, an invention of which you can say it does affect daily life nowadays…

After that, Mr. Steven Simon, director of the theoretical physics department (are they doing theoretical physics there?), came to tell us something about the physics of wireless. He told us that they are practising theoretical physics at Bell Labs "for fun and for profit". Bell Labs is working on multi-antennas for sending more information through the air. They've tested their theory with 4x4 antennas, and the results compared well to the theory. The funny thing is that the receivers can't distinguish the different transmitters. Only when there are some obstructions in the path of the signal, like buildings, the different transmitters can be distinguished.

Between the physics subjects it was time for two computer science subjects, starting with a talk from Mr. Howard Huang about 'Multiple antennas for high speed data in wireless cellular systems'. The research group in which Mr. Huang is involved is mainly interested in the field of mobile phone systems and mainly focuses on CDMA and UMTS technologies. Their research areas are information theory, communication (algorithm design), implementation (chip and antenna design) and higher layer issues (protocols, applications). The current phone systems areas are divided into cells, where each

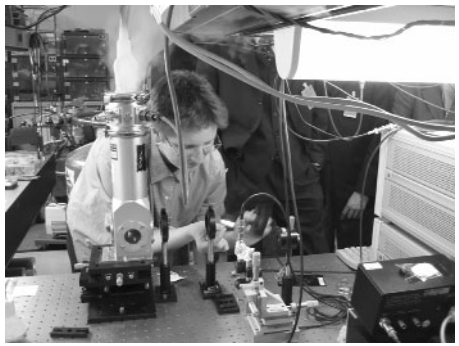
cell has an antenna. But since there is a need for more and more bandwidth, Bell Labs is developing the Bell Labs Layered Space-Time (BLAST) architecture to achieve the Shannon capacity. The Shannon capacity is the theoretical maximum rate at which error-free bits can be transmitted over a noisy channel. BLAST works best with spatially uncorrelated antennas; spacing of 4 wavelengths at the base station provides sufficient decorrelation (which means a distance of about 60 cm when using a 2 GHz wavelength). At the terminal side a space of half a wavelength suffices. Using the laboratory test bed in the 30 kHz bandwidth, the BLAST team measured a data rate of about 10 to 20 times as high as in traditional methods. Lucent is currently proposing BLAST to the 3G standards. To achieve this, there are standards required for interoperability. The currently expected time to market for BLAST is 3 to 4 years. This research group's future work will contain even more antennas, even higher data rates, lower latencies and ad-hoc networks. One of us asked the question if the European and US mobile networks would become more compatible. The answer was no, since there are very big differences in protocols etcetera.

The second computer science talk was some sort of an overview of "Computer Sciences research at Bell Labs" by Mr. Howard Trickey. Software like Unix, Yacc, Hobbit and Gnot and products like the programming languages C and C++ and the invention of the firewall are some highlights out of the past from the computer science research at Bell Labs. Today they are working on scientific computing, systems and networking (the dream of indestructible networks), theoretical studies, data management (XML) and software quality. The software quality research focuses on formal descriptions of requirements, code and tests. It makes better quality and decreased costs possible through automatic generation tools. Within Bell Labs, there is a lot of expertise about finite state concurrent systems, model checking, program analysis, logic and tool building. The rest of the talk consisted of the description of a number of tools, starting with uBET, a requirements capture and analysis toolset from around 1995. Other tools involved Spin (static analysis checker), FeaVer (feature verification) and Verisoft (runtime verification, preventing deadlocks, assertion violations etc.).

After this we had a break, a welcome one. During the perfect lunch, we looked outside and found out that it was snowing real hard! And the snow wasn't even melting! Joy! Realising that the snow would still be there when we were finished at Bell Labs, we went back to our chairs and started listening to Mr. Bernard Yurke. He was going to talk about DNA based nanostructures and molecular motors. They're fabricating DNA, which automatically makes contact with neighbouring molecules. One can also make specific structures with it, like 2-D lattices. With for example 24 blocks one can make a memory cell. Molecular machines are also in their research program, these 'molecular tweezers' have a force of about 15 pN. They work in a 'liquid fuel' solution.

To re-open the motor you need another molecule, so it's not that applicable yet. The activity of the motor has been demonstrated with fluorescence.

Nanophotonics was our next subject. Instead of sending electrical signals along wires, pulses of light are sent through very small (nano-size) fibres. Why nanophotonics? Cost, functionality, space and power. Photonics is mainly used for transport, but in the future also for processing. Around 1995 the first optical transponder was made. Optical transceiver chips also make use of optical waveguides. Currently there are 6” wafers with 200 chips on it. Some of those chips were shown. Another company that's working on nanophotonics is 'Little Optics', the name says it all.



The last speaker was Mrs. Claire Gmachl, who was working on Quantum Cascade (QC) lasers. These are semiconducting injection lasers, 10 µm in size. In conventional lasers, light is generated across the material's bandgap. In QC-lasers, light is generated across designed energy gaps. Light with a wavelength of 4,6 µm is generated in QC-lasers. The special thing about QC-lasers is that the layer thickness determines the wavelength, that it has high optical power and that it has a large fun factor. It is applied in trace gas sensing for spectroscopy. It is also useful for free space optical wireless communication. During an experiment they watched TV over a length of 200 meters using a QC-laser.

After a small break we split in two groups and we went to see the labs. We went to a lab where people worked with molecular beams and we went to see the QC laser. The laser was demonstrated by holding a match in the beam, which lighted!

Mr. Isaacs' opinion was that we should not walk through the snow to the station, so he arranged a bus for us. When we came back to New York, the drivers were called together to discuss the route for the next day.

After a quick change of clothes (away with the suit!) some of us went to 42nd Street for a quick McDonalds, because the cinema was waiting for us! We went to see 'Basic', a movie with John Travolta and Samuel L. Jackson. The story line wasn't very clear; some of us are still confused... But it was good entertainment! Afterwards, another burger (hey, you're still hungry after just some fries, and you can't eat and order more in 3 minutes!), and one homebound group and one first-the-internet-cafe-and-then-homebound group.

Day 12: Tuesday, April 8th
Visit to IBM Research

by Feike Kramer and Astrid Tuin

After a detour of about one hour our car arrived at IBM at 10:45 AM. We had missed the introduction, but were right on time for the first scientific talk. This talk by Jarg Appenzeller was about carbon nanotubes. These nanotubes arise from the roll-up of carbon. Single wall nanotubes (SWNTs) are about one nanometer in diameter and several millimeter in length. The applications of SWNTs are found in electronics. The electric properties of a carbon nanotube depend on the roll-up process: in one third of the cases the nanotube is metallic, in the other cases it's a semiconductor. The metal nanotubes can be used as wires whereas the semiconductor ones can be used in transistors. Though improvements have been made in these semiconductor applications (for example in transconductance), the gate oxide thickness is still too high (15 nm for a p-CNFET against 1.5 nm for a p-MOSFET). There is still a long way to go from the prototypes that are made nowadays to the process of manufacturing CNFETs.

Chris Murray was the next speaker. He told us about the chemical routes to nanostructured materials. The goal of his group is to find recipes for interesting materials that are suitable for manufacturing. First the possibilities for a certain material with certain characteristics are reduced to about ten with the help of literature. After this it's a matter of trial and error in the laboratory. Things that influence the crystallization process are the concentration of the organic in the solution, the temperature, the time of the reaction and the reactivity of the components.

The last talk before lunch was about molecular electronics. In the search for a replacement of the silicon transistor the goal of this group is to make computers out of one molecule or at least as few molecules as possible. The approach is to think about the properties you want (bridges, metal electrodes, etc.) and then decide how you can realize these wishes with certain molecules. There are a lot of things you could control, think of switching of potentials, reversibility or stability, solubility, etc. Devices made of a couple of molecules you can think of are memory cells or transistors. The work is very interdisciplinary: you need chemists to design the functions, physicists to characterize the different molecules and engineers to fabricate the devices. In the field of transistor scaling the distance between drain and source is getting smaller and smaller. The tunneling of 'stale-current' sets the limit to this distance. This implies that the distance must always be bigger than 2.5-3 nm. There were a couple of questions from our group for Mrs. Kagan. The first is about the metal electrodes; will they be superfluous at a given time? In the short term the answer is no, but the ultimate goal is to make everything out of one molecule. Will she be using the optical properties of molecules? This is not the focus of her group. The advantages of organic molecules are that the costs are low and that they operate at lower temperatures than silicon. What about the lifetime and stability of organic devices? The devices have to be shielded from oxygen and moisture as much as possible, but it is a fair question and Mrs. Kagan says that a lot of research still has to be done in this field.

After a very good lunch it was time for DNA micro arrays (GeneChips), presented by Glenn Held. He first explained the working of cells: DNA in a cell contains all information for every

protein that is made in the human body, RNA is a temporary copy of a certain piece of DNA (cell-specific) and the last step is that ribosomes decode the RNA and bind together polypeptides to create a certain protein. Proteins are very important: they regulate the glucose-levels in the blood among a lot of other things. During cell cycles gene expressions vary and an ill person often lacks certain proteins or has them in a mutated form. If you could make a snapshot of the RNA present in a cell at a certain time you know what this cell is going to do in the future.

A method to measure RNA-levels is the Northern blot: RNA is extracted from a pulverized cell, put on gel and an electric field is applied. In this electric field the shorter RNA-chains travel a longer distance in the gel than the longer chains. Now you can try to hybridize a probe with a base-sequence complementary to an RNA-sequence of interest with an RNA-chain of the same length. When there is hybridization you know that the particular RNA-sequence was present in the cell. To speed up the process of a Northern blot affymetrix micro-arrays are used. This is a chip on which spots with RNA-sequences (25-bases long) are fixed. Then the extracted RNA that is being investigated is hybridized with this chip. At places where hybridization occurs you see light because the bonding energy is released as fluorescence. At first there were troubles to grow RNA-sequences of 25 bases on the chips, 92% of the chains was shorter than 25 bases. This was solved by using photo resist on top of the substrate instead of light in the process of photolithography.

Another technique is cluster analysis. As a function of time the activity of a gene is monitored. When a piece of DNA colors green it's down-regulated, red means up-regulated. In this way genes with similar functions have the same color and can be grouped together. This presentation raised a couple of questions by some students of our group, like what the connection is between GeneChips and IBM's core business. IBM sees an enormous growth in life sciences and by exploring the possibilities of GeneChips they're trying to be on top of the latest developments in this field. Further it is expected that silicon will need replacement in 20 to 30 years because of the downscaling in all fields, and this research could be helpful to find a successor for silicon. Someone else wondered if the GeneChips can be used more than once. This is not the case because the unbinding of the RNA-chains is too expensive. The last question is about the costs of one GeneChip. The price of a GeneChip is a couple of hundred US dollars.

Now it was Yuhai Tu's turn to tell us about the project Genes@work. How genes are expressed is investigated through the following steps: fluorescence images are retrieved in the way described above, these give you the intensity data at each spot, and from these expression values biological knowledge is derived by cluster analysis, also as described above. The data are structured in a 2-dimensional matrix. It's rather difficult to draw conclusions about the functions of certain genes and what the difference between diseased and healthy DNA is because of data mining and experimental noises. Data mining means that on one hand you have too much data (for cancer research for example you have too many irrelevant genes in your sample), whereas on the other hand you have too little data: because of the costs of the technology you can't make thousands of samples and so your sample size is actually too small. To work around the problem of data mining samples of unknown DNA are compared with samples of healthy and (for example) cancerous DNA. Pattern discovery techniques are used to find genes with similar expressions, but there are still enough questions to be solved with this approach. To mention a couple: how do you know if these genes are close? You're only using a subset of all genes, so you can never find all similar genes. And how do you know you have retrieved the maximum pattern? Yuhai concluded his presentation with a demo of how the Genes@work protocol works and answered several questions.

The next talk, about how dislocations move, was given by Klaus Schwarz. A dislocation is a linear defect: it's the edge of a slipped surface in a solid. Research on dislocations is important for IBM because they can influence the behavior of materials in epitaxial layers, thin metal films and other devices IBM develops. Dislocations are also important when you think of strength, fatigue and work hardening of different materials. What Mr. Schwarz has done is writing a code named 'Paranoid' to simulate the propagation of dislocations in materials. The principle of this code is that the force at every node is calculated, and then moved by applying a response model and iterate this procedure. The simulations show much similarity with experimental results.

Quantum computing was also a subject we learned about this day at IBM. David Divincenzo first explained the difference between bits and q-bits. Bits are definite: they are either in the 1-state or in the 0-state. Q-bits on the other hand can be indefinite: they can be in a kind of superposition state. Why would one use q-bits in computers? A couple of examples illustrate that the use of quantum computing could lead to a tremendous speed up of certain calculations. It is expected that quantum computers can be useful in the fields of nuclear magnetic resonance and ion traps among other applications. More information than in classical computers can be transferred because the information is contained in the phase of the q-bit. A critical question about the realization of quantum computers was asked. Isn't it a waste of time to think of algorithms for quantum computers when it's really uncertain if they can ever be built? Mr. Divincenzo didn't think of it as a waste of time, but rather as a profitable use of time. Though it might take more than ten years, he is optimistic about the realization of the quantum computer.

Supratik Guha also talked for about 20 minutes; his subject was 'The challenges in silicon'. It was about the

trouble of making transistors smaller and smaller. The smaller the transistor, the higher its speed (inversely proportional with the scaling factor). It's not clear yet when or even if the limits of silicon transistors will be reached. A question that came up was if silicon would still be sold if one day a better material for use in transistors has been found. The answer would probably be yes. Right now the semiconductor industry is having a hard time, but for the future everything is still open.

After a short break, Jim Hannon talked about the way crystals grow. For a lot of technologies surface physics are important. You can think of catalysis, adhesion, friction, lubrication and electronics. Crystal growth is a complicated process at the atomic scale; it depends for example on the presence of holes, the dissipation rate, evaporation, etc. Hannon's group tries to discover the rules of crystal growth by looking at crystals growing in situ. He showed us pictures made with a low-energy electron microscope (LEEM) of phase transitions in silicon, the etching of silicon with oxygen and the growth of quantum dots when germanium is grown on silicon. Though a lot of complicated things happen at the surfaces you can often make out the general rules by which the crystals grow. The big question is if you can also discover the underlying mechanism of the growth in this way. This isn't always possible, but in several cases you can decide which of two proposed models is the right one.

The last talk this day was by Phil Batson and was about seeing atoms one by one. His group has improved scanning transmission electron microscopy (STEM) by realizing electron beams of 0.75 Å. They achieved this by solving the problem of spherical aberrations. Because of these aberrations objects seem to deflect. Seven sets of magnetic lenses in the microscope are adjusted real-time by using parameters of pattern recognition software that are fed back to the microscope. With this 0.75 Å beam it is possible to see single gold atoms, which is impossible with a beam of 2 Å. The question of course is: how far can you go? This depends very much on the atomic number and the smoothness of the substrate. Another question is about how the feedback to the microscope is realized. This is done by moving the microscope a couple of times; from the different magnifications you get enough information for the adjustment of the lenses.

The next thing on the program was a tour around the labs where we saw the following microscopes: a low-energy electron microscope (LEEM), an ultra-high vacuum transmission electron microscope (UHVTEM) and a scanning transmission electron microscope (STEM) with spherical aberration reduction. We were shown different demos and pictures made with these microscopes.

At 5:15 PM we were back to ask Mr. Tromp, who was with us for almost the entire day, the last questions. One of them was about the way research is done: can researchers just try things and hope something good will come from it or do they have more specific tasks? It really depends on how close you work to the manufacturing of products. The speakers of today are rather free in their research, but it's not like a university, to some extent researchers at IBM are always focused on what could be useful for IBM.

Someone else wonders what IBM's main products are. Important hardware IBM produces are for example: semiconductors (IBM is market leader in silicon techniques) and chips for Sun computers among others. Research is done on the improvement of storage capacity of harddisks and IBM tries to build an enormous wafer. Of the 2000 employees in the US 400 work in this hardware department. The others work in the software department. They provide services to customers, the integration of businesses, etc. There has been a shift from hardware to software within IBM and this shift hasn't stopped yet.

What are the topics of interest to IBM on the long term? Once a year this question is discussed within IBM. Mr. Tromp thinks it's everything from hardware to software. A good example is the search for an alternative for silicon transistors.

And the very last one: are the researchers under high pressure? Though they are rather focused, you can't speak of stress.

After these questions we said goodbye to Mr. Tromp, made a picture of the whole group in front of the IBM-building and returned to the Ford Windstars.

Day 13: Wednesday, April 9th
Visit to Princeton University

by Hans Timans and Wouter van Strien

Princeton University Campus is not situated in Manhattan. So today we left early for a one-hour train ride to Princeton Junction. From this station a small train travels back and forth to the Princeton Campus. After a little stroll we found ourselves at Bowen Hall where we would start our tour at the Princeton Materials Institute. But in order not to bore the computer scientists among us the first thing we went to see at Princeton University was a scalable, high-resolution display wall, consisting of a grid of beamers. The display wall was made with a low budget, and had been running for an extensive period of time and one could clearly see that the system was degrading. After showing the capabilities of such a big display wall, some stunning 3-D pictures and satellite images, we got to take a look at the 'heart' of this system. Behind the screen were the 24 beamers, assembled in some metal casing that had been designed by a personal friend of the professor that earns his money in the music industry. A single off the shelf Dell computer purchased in 1998 was driving every beamer. One central PC in the conference room bundled all the 24 machines (all named after Star Wars characters) together and there was another computer that handled the gyro-mouse movement. The system was running on

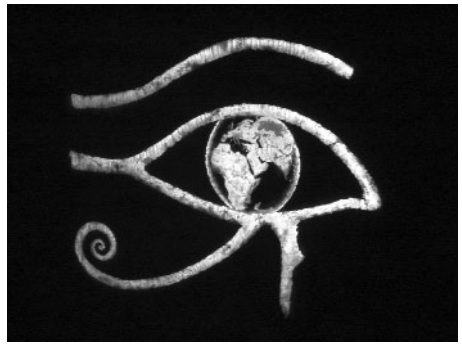
Java, and (thus) they had a few problems getting mpeg videos to run smoothly on the big screen. For scientific purposes the project has become a little outdated. Other groups outside computer science did most research involving the display wall, but it was an interesting toy to show off.

Next item on the program was a tour of the Image Analysis Center by Dr. Nan Yao. The Princeton Materials Institute established the Imaging and Analysis Center (IAC) in 1993 to promote multidisciplinary collaborations in research and education and to strengthen efforts in materials science and engineering by providing a critically needed central facility. The IAC is a major imaging and analytic instrumentation center, which is supported by both PMI and the Princeton Center for Complex Materials (PCCM). Since its inception the IAC has occupied a pivotal role in materials research and education at Princeton. With continued financial support from NSF, AFOSR, ONR, the state of New Jersey, Exxon, Johnson & Johnson and the University, the IAC has become one of the most advanced imaging and analysis facilities in the world.

The IAC currently comprises advanced electron microscopy techniques, especially transmission and scanning. This provides high-resolution, energy filtering and low-temperature TEM, nano-diffraction EM, low-voltage SEM and in situ mechanical testing capabilities. It also has microchemical and microstructural analysis capabilities (EDS, PEELS, WDS, CL, OIM), probe microscopies, computer simulation (molecular dynamics and image processing), and materials preparation (ion beam sputtering, cryo-ultramicrotome, mechanical dimpler, and ion beam mill). More recently, a new Dual-beam Focused Ion Beam System is being added in the Center. With its precision of ion beam milling, high-resolution imaging, and gas chemistries, this new instrument provides the power and flexibility for full 3D structural analysis and characterization of sub-0.13 micron processes, including copper dual damascene, low-k dielectric, chemical mechanical polishing, and high-aspect ratio structure.

The IAC supports the research and educational activities of the faculty and students at PMI and PCCM and more broadly at the University. It also collaborates with researchers in industry 100-student enrollment.

Listening to all this we got kind of an appetite and we were fortunate to find a very nice lunch in the hall with other people attending the next item on our program, meaning the PMI Matinee Seminar by Jennifer A. Lewis on Colloidal Assembly of 3-D Periodic Structures. This seminar was probably not intended for students, as the material of discussion was not easy to understand. Colloidal assembly of 3-D periodic structures requires control over, and, hence, a fundamental understanding of interparticle forces, phase behavior, rheological properties, and structure evolution during fabrication and drying. Nanoparticles are explored by engineering colloidal fluids, gels and crystals. A combination of experimental tools, including confocal microscopy, has been used to study the phase behavior and structure of binary mixtures consisting of negligibly charged colloidal microspheres and highly charged nanoparticles. The directed assembly of 3-D periodic structures via robotic deposition of concentrated colloidal gel-based inks was described. Such components exhibit periodicity on length scales far exceeding colloidal dimensions. The myriad of colloidal systems and assembly techniques under development offers the potential to architect periodic structures needed for photonic band gap materials, functional ceramics, composites, and tissue engineering scaffolds.



We didn't want to leave Princeton without seeing the campus of course, so we arranged a tour by a girl from South Carolina who told us what Princeton life was all about. We saw all the nice old buildings and heard about their history and of course the sets of the movie 'A Beautiful Mind'. We were told that because Princeton is a small town, which holds just a few pubs, the main social means of gathering is in eating clubs. Our tour guide proudly showed her eating club's sweater with logo.

When we got back at Bowen Hall we had a talk by Prof. D. Srolovitz on 'Growing Diamonds'. Because of the many special properties of diamond it is used in a lot of technological applications like heat managing. Because diamond is very expensive, people try to make man made diamond. There are several techniques to do this and the most favorable is chemical vapor diamond. A composition of H_2 and CH_4 is heated. The heat breaks dilute methane into CH_3. The vacancies are filled with other carbon atoms and more heat breaks off hydrogen atoms and so the structure grows. This is a generic surface mechanism with step abstraction; adsorption followed by a combination of more abstraction and adsorption and finally desorption. Integrated modelling of chemical vapor deposition of diamond is done to understand the process and determine quantitative predictions for grow rates and grain size evolution as a function of reactor conditions.

Snacks and informal discussion at Bowen Hall ended our stay at Princeton University. This was our chance to talk to some staff members and students at PMI. We thanked everybody for their time and efforts and with a satisfied feeling we left for New York City again.

Because we had little time to eat before attending a real Broadway musical we each went our separate ways and enjoyed a real fast American fast food meal in one of the places at Penn. Station or at the McDonalds' restaurant near the theatre. The theatre we were going to was the Palace Theatre on Broadway where we saw a wonderfully performed Aïda. The theatre was very big and deliciously kitsch. If you like musicals, a show performed as this one is a must. Some of us bought the CD with the soundtracks written by the one and only Elton John. Every day comes to an end and so did this day. Very tired after a long day we all went to bed after a small beer in the hostel.

Day 14: Thursday, April 10th
Visit to Brookhaven National Laboratory
by Arend Dijkstra

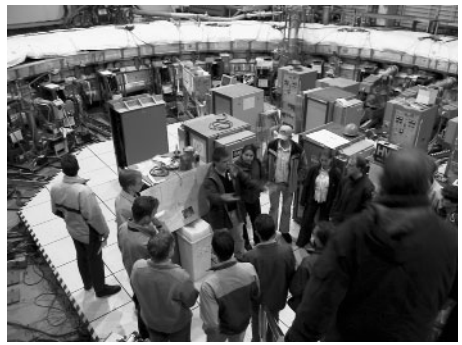
The day at Brookhaven started with a word of welcome by Mrs. Elaine Lowenstein, who composed today's program, followed by an introductory video on research at Brookhaven National Laboratory. As we already noticed while driving around, Brookhaven is a very large institute. Many facilities have been brought together to be able to do research in fundamental and applied science.

The first visit showed us two examples of using modern physical techniques in medical research. Positron Emission Tomography (PET) is a technique commonly used in brain research. An advantage of the center at Brookhaven is that the necessary radioactive isotopes are produced next door. In PET studies a positron emitting radiotracer is injected into a person. Light from positrons recombining with electrons tells where in the brain the tracer moved. The PET lab at Brookhaven is dedicated mainly to addiction research. David Schlyer gave examples of cocaine, alcohol and toluene addiction, effects of Ritalin in treating ADHD and obesity studies.

PET studies clearly show that both cocaine and alcohol greatly reduce the number of dopamine - the 'feel-good' neurotransmitter - receptors available in the brain. Consequently, dopamine levels increase significantly, giving the 'feel-good' effect of these drugs and starting the addiction process. The hypothesis, yet to be proven, is that people who naturally have few dopamine receptors get addicted easier than people who have many receptors. Experiments on rats seem to support this hypothesis. Another drug, abused by many children in the USA, is toluene. The center is studying the effect of toluene on the brain. Maybe surprisingly, studies on obese subjects compare well to addiction studies. Mr. Schlyer told us their studies show that obesity can be looked at as a form of addiction.

Charles Springer is working with another technique to image the human brain, Magnetic Resonance Imaging (MRI). MRI uses the resonance of nuclear spins in a very high magnetic field to determine the type of material. The Brookhaven scanner is equipped with a 4 Tesla magnet, about 80.000 times stronger than the earth magnetic field. Because of this strong magnet, we could only visit the scanner after putting away all the metal objects we carried. Mr. Springer showed us the strength of the magnet by putting a coin into the scanner. It only slowly tips over because the currents induced in the coin by the magnetic field compensate gravitational pull.

Ernst Sichtermann from Yale University and Klaus Jungmann from the KVI in Groningen are working on the muon g-2 (g minus two) experiment. The muon, the heavier version of the ordinary electron, is one of the elementary particles. All elementary particles and their interactions are described in the Standard Model of elementary particles. Up to now, all predictions from the Standard Model can be verified experimentally in great detail, making the model extremely successful. One of the parameters the Standard Model predicts for elementary particles is their g-factor (essentially the same as the magnetic moment). A simple model (the Dirac model) gives a value of 2. The Standard Model predicts differences from 2, the g-2 value. Recent measurements of the muon g-2 factor differ from theoretical predictions. This could possibly mean that the Standard Model is either incomplete or wrong. For this reason, the experiments in which the muon g-2 factor is measured are very significant for our understanding of physics.



In the Brookhaven experiment, muons are injected into a large storage ring. The ring essentially is a very large superconducting magnet. After cycling through the ring for a while, the muons will decay, producing positrons. Measurements of the positrons give away the direction of the muon spin at the time of the measurement. From the precession of the muon spin - the difference between the speed of rotation of muons through the ring and the rotation of the spin - the magnetic moment can be calculated. In fact, as a critical member of our group remarked, this whole large apparatus has been built to measure one number (in fact, two numbers are measured). Measurements of the g-2 factor have been done with positively charged muons, and are now repeated with negatively charged muons.

The huge amount of data the measurements yield is processed in a very careful manner. Five Ph.D. students analyze an experiment. Each student gets the same data, but shifted by an offset which is different for all five. Only after all results have been calculated the offsets are subtracted and final results are obtained. In this way it is possible to get a fair analysis of measured data, without being influenced by known theoretical results.

Brant Johnson and Achim Franz showed us the Relativistic Heavy Ion Collider (RHIC). RHIC is one of the few huge accelerators in the world, built to shine light on fundamental properties of nature. This machine accelerates heavy ions, often gold-79+, to highly relativistic energies. Ions in the accelerator move with 99.95 percent of the speed of light. The 2.5-mile ring contains two separate tubes. In each tube bunches of ions are running, in one tube clockwise and in the other counterclockwise. There are six spots in which the ion beams collide, logically these are the places where detectors are located.

Colliding heavy ions at very high energies gives physicists a window on the fundamental properties of matter. The data from RHIC may give answers to numerous open questions in physics.

It is now agreed on that the universe began in a gigantic explosion, called the Big Bang. The first moments after the Big Bang the universe must have been extremely dense and hot. Quarks and gluons, elementary particles described by the Standard Model,

formed a plasma, the quark-gluon plasma. Nobody knows what happened exactly in the first seconds of our universe. Maybe experiments at RHIC can tell more about the forces between quarks and gluons and about the fact known from astronomical observations that the universe contains hardly any anti-matter. It also is still unknown how the quarks in the proton build up the total spin of the proton. Simple models give wrong results. It is hoped that high-energy collisions in RHIC will give a clue.

To be able to do research on nanomaterials, a subject that gets a lot of attention in physics, Brookhaven is building its own Center for Functional Nanomaterials (CFN). Tom Vogt explained that the Center, which still has to be built, has the great advantage of being near Brookhaven's National Synchrotron Light Source (NSLS). Light from this facility can be very helpful in materials studies. The nanolab will be equipped with various electron microscopes, nanopatterning machines and synthesis equipment. Mr. Vogt quickly went through the six scientific thrusts: strongly correlated oxides, magnetic nanoassemblies, nanoscale catalyst materials, charge injection and transport in nanoscale materials, structure and self-assembly of nanostructured organic films and applications of functional nanomaterials. The CFN must become the place where Brookhaven's efforts in Nanophysics are combined.

The National Synchrotron Light Source (NSLS) is in fact a very large lamp. The purpose of the machine is producing an intense X-ray light beam. High-energy electrons are forced into a circular orbit. Thereby they are accelerated, thus emitting light. To obtain low wavelength (high-energy) light, high-energy electrons are necessary. With light of smaller wavelengths, smaller details in the sample can be observed. The light from this high tech "lamp" can be used for many purposes. Most users are from the fields of Life Sciences (40%) and Material Sciences (30%). Wolfgang Caliebe and Cecilia Sanchez Hanke enthusiastically showed us around the facility, briefly describing many experiments.

After a day of many scientific talks, which showed us an interesting part of the research done at the huge Brookhaven complex, we went to the beach. Brookhaven is located on Long Island. The southern part of this island has a long, beautiful beach. Since it was cold and windy, we had the privilege to be almost the only visitors to the Smith Point County Park. Enormous parking lots showed that in summer this place can get very busy.

Day 15: Friday, April 11th
Exploring New York
by Georg Muntingh

In contrast to the past two weeks we were allowed to sleep late. You must read `sleep late' in the broader sense of the word, because at 10:30 AM everybody was supposed to have had breakfast and show up in front of the hostel.

The weather was pretty bad, but that didn't hold Arend, Guido and myself back from walking to the Hudson River and examining it more closely. This river is named after Henry Hudson who was looking for a quick passage to China in 1609. Hudson traveled about 150 miles up the river before realizing it would not lead him to China. As Hudson was hired by the Dutch trading company VOC, 'Verenigde Oostindische Compagnie', his explorations led to the first Dutch settlement in the area. Anyway, since there wasn't much to see we soon returned to the hostel.

From the hostel we took the subway to the Financial District in downtown Manhattan. We walked through Wall Street and visited Ground Zero. Because of the heavy rain and stormy wind (which appeared to be a bad combination for people using their umbrella), we kept the visit short and ended up in a Starbucks to drink a nice and warm cup of coffee.

In the afternoon, we had a few hours off. A part of our group went to the United Nations. Unfortunately, the over one hundred flags of all the countries being members of the UN where not hung out. After the UN they walked to 5th Avenue and the Rockefeller Center for some shopping. The other part of the group, including me, went to the Statue of Liberty and Ellis Island.

At the south of Manhattan we took the boat to the Statue of Liberty. From the boat we had a terrific view of the skyline of the Financial District and of course of the Statue of Liberty. After a 2.5 kilometer boat trip we arrived at Liberty Island where we were able to examine Miss Liberty in more detail. She turned out to be much taller than I had expected. At the island we learned many interesting things about her construction. The United States received the statue as a gift from France in 1884. I read that the Americans like to say she is in good shape for her age. For some reason, maybe out of fear for terrorism, we were not allowed to enter the statue and to take the elevator to the top, which was a pity. After having read all there was to read, we went to the store to buy some souvenirs and took the boat to Ellis Island.

Ellis Island is well-known because of the immigration center which was located there. Between 1892 and 1924 12 million immigrants entered Ellis Island to go through the necessary procedures to get permission to live in the United States. We entered a museum, which used to be the immigration center, and read a lot of things about the immigration center including a lot of statistics. We also entered the main hall, in which the immigrants arrived. I

actually thought it to be pretty small for such a load of people. After an interesting visit, we took the boat back to Manhattan.

After a long walk we ended up in an Irish Pub for a very nice dinner, which was in my case fish and chips. At 6:00 PM we had to gather at the American Museum of Natural History. Unfortunately it was closed, Linda's Lonely Planet was a bit indistinct and the Rose Center for Earth and Space Planetarium of the museum was the only part being open. The exhibit showed us the creation of stars, planets and life on earth from the Big Bang till nowadays. The exhibition was nice, but clearly meant for laymen. After the museum and a drink we returned to the hostel.

Daily reports - Mexico City

Day 16: Saturday, April 12th
Journey to Mexico City
by Ronald Hoogma

The day started early. At 5:15 AM everyone was standing in front of the hostel with his or her bags packed. Today we would fly to Mexico! Upon entering the subway station we discovered that due to repair activities on the railway system the subway would not stop at our station. After a small detour we ended up at Penn. Station, but with a 50 minutes delay so we missed the train of 6:14 AM. To make sure this delay would not endanger our flight, Evert-Jan called Continental Airlines to make sure it would not be a problem. 'Should be no problem' they said. We took the 7:08 AM train and ended up on the airport at 7:50 AM with our flight leaving at 8:55 AM.

It was really crowded and chaotic around the check-in desks. Soon we discovered that the conveyer belt behind the check-in desks, used to transport all luggage, was broken. This work was being done by hand by some guys who were loading all luggage on a cart and then rolling it to the planes. When we finally got to talk to a Continental Airlines officer, we were told we would not make it to our airplane; we had to take the next plane that would leave at 5:00 PM! Several people started to get angered since we still had about 40 minutes before our plane would leave; it was scheduled for take-off at 8:55 AM. After some more minutes a Continental Airlines officer must have realized that moving 27 people to the next flight would not work because most likely there would not be 27 seats available. We were allowed to check in very very rapidly.

While check-in went on, people who had checked in were told to go to the security checks and customs. People in a hurry make mistakes. Niels M. didn't get his boarding pass. Others ran across the airport to find Niels. Astrid handed over his boarding pass to him, while she was in the middle of a security check (she still had her shoes off). Everyone was allowed to go through the customs now and the last person exited this point around 9:02 AM. At 9:05 AM everyone was seated. This must have been one of the most stressful moments for the organizing committee; having half of the group in New York and the other half in Mexico is not what you want. Anyhow, everything turned out okay and soon the airplane took off with destination Mexico City.

Though the USA was great, we were glad to leave for Mexico, because there was one thing we almost had not seen in the USA: sun. Our stay in the USA had been pretty cold and rainy. In Mexico however, we were sure not to be disappointed by the weather! During the flight we flew past

Washington DC and past the Gulf of Mexico. Again our flight showed beautiful hilly landscapes when we flew above Mexico. From the plane we could already see a glimpse of the pyramids of Teotihuacán. When we got closer to Mexico City the sky became very cloudy, when we flew above Mexico City, one could notice some clouds had a yellowish/brownish color, probably not very healthy.

After landing and checking out we waited for the vans from the hostel to arrive to pick us up and bring us to the hostel. Our hostel was located in the middle of Mexico City. El Zócalo, the main square, was located at the end of the street of our hostel! El Zócalo is the second biggest plaza in the world after Red Square in Moscow! Since it was kind of busy in the streets with people selling their wares, the cars dropped us off about 3 streets from the hostel. We walked the last part to the hostel. Hostal Moneda was a really nice hostel being so close to El Zócalo, having clean rooms and a roof terrace on top where one could order food, beer and tequila! Some people went for a walk, others stayed at the hostel and had a few drinks. Soon enough people went to bed, being tired and wanting to be in shape for the next morning.

Day 17: Sunday, April 13th
Exploring Mexico City
by Rogier Falkena

After a fine breakfast with the usual cereals, fruit and mugs of coffee we were ready to go on our first exploration tour in one of the largest cities of the world. The tour started at El Zócalo, a huge square of 40 thousand square meters seen as the heart of Mexico City. Traffic travels around a huge Mexican flag. The Cathedral Metropolitana makes up one side of the square, the Palacio Nacional another. El Zócalo and its surrounding neighborhoods are known as the Centro Histórico (Historic Center) and are full of notable old buildings and interesting museums. El Zócalo was paved in the year 1520 by Hernán Cortés with stones from Aztec buildings. At El Zócalo our extremely intelligent and attractive tour guide Boyana gave us an overview of the rich Mexican culture and history. Next we visited the Palacio Nacional, built on the site of the Aztec palace where emperor Moctezuma once lived and which formerly housed the viceroys of New Spain. It now holds the offices of the president, a museum and the historical murals of Diego Rivera. Rivera is Mexico's best known artist and some say he is also the best! The murals around the courtyard are very impressive, telling the Mexican history from the arrival of the Quetzalcóatl (the Aztec plumed serpent god) until the 1910 revolution. The Palacio Nacional also houses a beautiful garden.

We left the palace and headed for the Torre Latinoamericana, a 180 meter high tower near the Alameda Park. The view from the top is nice; besides the smog blanket we could even see our hostel! While we were high up in the tower, it was nice to know that it survived the 1985 earthquake.

Next to the Torre Latinoamericana is the white-marble Palacio de Bellas Artes (Palace of Fine Arts). This building houses a concert hall and a museum with modern murals from several Mexican artists. After some construction problems, the Palacio de Bellas Artes was finished in the 1930's.

Right beside the Palacio de Bellas Artes is Alameda Central, the leafy city-center park. In the park we saw the Juárez Memorial (Benito Pablo Juárez, 1806-1872), honoring Mexico's first president of Indian descent. The shade found under the trees was very welcome; the sun was burning hot! After a nice short walk trough the Alameda Central it was time for lunch. We ate in a small restaurant and had our first encounter with the Mexican kitchen. With tortillas and chicken in our stomachs we continued our tour to the Sanfrancisco Church. A service was being held there at the moment of arrival, so we couldn't enter the church. By a street with lots of shoe stores we walked back to El Zócalo, to visit the Catedral Metropolitana. This cathedral was built by the Spanish between 1573 and 1813 on the site of the Aztecs' Tzompantli (a place where the Aztecs kept their sacrificed skulls). The story goes that Cortés found more than 136 thousand skulls at this spot. The Catedral Metropolitana is built in the Spanish colonial style and of course dedicated to the holy maid Maria. With its 109 by 59 meter, the cathedral is the largest in Mexico. Because of the 'Semana Santa' (the holy week that runs from Palm Sunday to Easter Sunday) the cathedral was full of Easter decorations. Outside we witnessed a play on the crucifixion of Jesus Christ.

The last part of today's tour led us to the Templo Mayor, the main temple of the Aztec capital Tenochtitlán. Its excavation in 1978 commenced after electricity workers came across an eight ton stone-disc carving of the Aztec goddess Coyolxauhqui. The temple is thought to be on the exact spot where the Aztecs saw their symbolic eagle with a snake in its beak perching on a cactus. This is still the national symbol of Mexico today. The Aztecs believed the temple was the center of the universe. Like many other sacred buildings in Tenochtitlán, the temple, first built in 1375, was enlarged several times. Each rebuilding was accompanied by the sacrifice of captured warriors. What one sees today are sections of several of the temple's different phases. On the Templo Mayor site we visited the museum which houses many artifacts found during the excavation giving a good overview of the Aztec civilization.

After a well deserved Mexican dinner we walked back to the Palacio de Bellas Artes for the Ballet Folklorico. Several colorful and energetic dances were performed by a large group of folkloristic dressed men and women during the beautiful show. Each dance told a story, but we couldn't make them up from the Spanish booklet. Afterwards we drank a Corona on the roof terrace of our hostel. Our first impressions of Mexico City were made today and they were very good!

Day 18: Monday, April 14th
Visit to UNAM
by Teake Nutma

The schedule of the 18th day of our trip finally promised a few scientific bites, after a day and a half of adjusting to the climate and sipping from Mexican culture. It almost goes without saying that a few of us enjoyed our all-you-can-eat breakfast upon an ill-slept stomach that morning. Among them were not just those who stayed up until 3:30 AM drinking and shouting their laughter down the wells of the hostel, but also the few who couldn't help hearing these shouts while trying to catch a few hours of sleep.

And no one knows exactly why (though one can make a fairly accurate guess), but we ran about ten minutes late. Fortunately the commission members in charge had done a good job preparing the day, and soon we were on our way to our very first Mexican subway adventure.

The wise words of Evert-Jan, telling us to watch out for pickpockets on Hidalgo station, could not have prepared us for the rubber-tire driven subway cars that were crowded with people and heat. Although the ride from Zócalo to Hidalgo wasn't too bad, it was quite stunning from Hidalgo on. Never since leaving our trusty Dutch railways behind we had to force ourselves in such a densely filled subway car. Packed like sardines in a can we collectively sweated our pants off, save the few ladies who were wearing skirts. (Though I don't think the choice between losing a few kilos of body fluids and wearing a skirt in a Mexican subway, can be a difficult one for a white woman, given the nature of some Mexican men.) The widely opened windows didn't help at all; through them only hot air was blown in our faces, which, if they hadn't done so already, began to sober up completely. Luckily more and more people left the subway as we approached the Universidad station, our final destination for the day.

Once the subway was left behind, we had to wait for a few minutes before our contact at the Universidad Nacional Autónoma de México (UNAM), professor Roelof Bijker, arrived. During the wait some of us seized the moment to capture another beautiful Mexican scenery on film, while others replenished the liquids lost during the ride on the subway. When professor Bijker arrived we set out on foot to the nearby located campus of the UNAM, and in particular to the Centro de Ciencas Fisicas. There we were awaited by Dr. Maria Ester Brandan Siqués, a scientist at the Instituto de Ciencas Nucleares. After we had settled comfortably in the shadow and had had a quick word of welcome, she showed us in two groups around the Accelador Peletron, one of the four particle accelerators the UNAM possesses.

The Peletron is, in sheer contrast with Brookhaven's RHIC, a 3.5 MeV tandem accelerator and can produce a large variety of different particle beams. It is used for many purposes. Dr. Siqués' main concern was with dosimetrics, i.e. the study of the effect radiation has on

living tissue. Next to that the Peletron is also used for PIXE (Proton Induced X-ray Emission), Rutherford backscattering and material sample analysis. And where we didn't get to see any detection setup at the RHIC in Brookhaven, here we could even look at the currently running proton beam directly as it ionized air particles and was stopped after about one meter...
After we said farewell to Dr. Siqués, an enjoyable talk on muon detection in the Pyramid of the Sun was next. This pyramid located at the Teotihuacán site is believed to have no hidden chambers. In fact, up to three times a few blunt archaeologists dug a tunnel in it, and did not find any evidence of an internal structure whatsoever. These fruitless and destructive efforts made the Mexican government call a halt to all digging activities in the Pyramid of the Sun, discarding trivial ways of discovering anything about its internal structure.

This is where a few enthusiastic scientist with a limited budget from the UNAM jump into the picture. Motivated by an experiment originally done by Luis Alvarez in the great pyramid of Cheops, they planned to unravel whatever mysteries the Pyramid of the Sun has to offer. Alvarez' experiment used the differences in intensity in the flux of naturally occurring muons to 'see through' the pyramid.

Almost all the muons that one measures at the earth's surface are created by the interaction of cosmic particles with the upper layer of our atmosphere. The number of muons that reach the surface is nearly constant, but their intensity is reduced when they travel through matter. By virtue of a muon detector placed in the bottom center of the pyramid, Alvarez was able to indirectly measure the amount of matter by the intensity of the muon flux in any given direction. The folks at the UNAM are trying to do the same in the Pyramid of the Sun with an almost finished self-built modular muon detector.

After this enlightening talk and a tour around some equipment that will be used in the experiment, our stomachs craved for a decent lunch. Problem was there wasn't a restaurant that served one nearby. So we set out for what seemed an endless pilgrimage for food under a nearly scorching sun.

Untroubled by the weather and undistracted by the quite special campus, Nanne and Ralf crossed their egos in a hopeless Windows versus Linux discussion, entertaining the rest of the group. They were about to hammer their arguments down each others throat when the smell of Mexican cuisine quickly settled the argument. Food over principles!

And not just any ordinary food it was! On Bijkers recommendation one single meal was ordered for the whole group (except, of course, for the vegetarians among us). It was more like an eat-all-you-can-barbecue than a lunch. Those of us who liked some vegetables were greatly disappointed: it was meat for as far as the eye could see.

As soon as all stomachs were feasted on this meat-o-rama, we headed out

for the main library for the start of our tour around the campus. The campus dates back some fifty years ago, when the UNAM decided to move out of down-town Mexico City in order to regroup their scattered facilities to a place with more expansion capabilities.

We were told that in 1984 the number of students at the UNAM already measured 300.000, and nowadays their number had doubled in size. Because our visit coincided with a mayor holiday in Mexico, the campus was virtually deserted and a defiant professor Niesen refused to believe the astronomical number of students normally walking around.

Due to this sharp increase in student population over the last few years, the UNAM has been forced to make some modifications to the original design plan of the campus. Places that were intended to be open space are now occupied by different buildings, although the main green square in the center of the campus is and will be left unchanged.

After we were shown around a few places and got a chance to see the murals that decorate the walls of almost every building around the center of the campus, a few of us definitely wanted to see UNAMs own Olympic Stadium from the inside. This stadium has been built in a natural crater, and although it doesn't seem very large from the outside, it extends reasonably far down on the inside. But we didn't get to see that, the security guards were not as flexible as one could hope Mexicans to be and our campus tour ended with a dipper.

Luckily a water selling booth ran by a Mexican hoping to make a few dollars out of passing tourists was near, and we quickly settled down in the cool shade, replenishing our drained water supply once again. Once the bottles had been emptied we walked back to the subway station, said goodbye to professor Bijker and were quickly on our way back to the hostel. That evening, quite like any other evening during our week in Mexico, was spent with drinks and laughter on the roof terrace.

Day 19: Tuesday, April 15th
Visit to Corona Brewery

by Feike Kramer and Guido van der Wolk

There were two items on our schedule today: the brewery of the real Mexican beer Corona, Cervecería Modelo, and the Museum of Anthropology, about the origin and culture of the Mexican people.

Since 1987 Corona is the number one export beer in the USA instead of the Dutch beer Heineken. The brewery we visited is part of Grupo Modelo. Grupo Modelo, founded in 1925, is the market leader in the production and marketing of beer in Mexico with more than 60% domestic and export market share. It has eight brewing plants in the country, with a total installed capacity of 46 million hectoliters per year. The one we visited in Mexico D.F., Cervecería Modelo, is currently the largest brewing plant of the group with an installed capacity of 11 million hectoliters. Grupo Modelo brews and distributes ten brands; Corona Extra, Modelo Especial, Victoria, Pacífico, Negro Modelo and other regional brands.

After an introduction video with this information, we got a tour through the brewery, where the whole process of brewing beer, from the delivery of the malt to the filling and distribution of the Corona bottles, was shown and explained. Grupo Modelo has the ambition to have a good reputation. This is achieved by sponsoring a lot of events and showing their concerns about the environment. A clean environment is important for Grupo Modelo, because the Mexican government has decided, in order to reduce the pollution, that factories responsible for too much pollution must reduce their production to 50% or 75% of their total capacity. Grupo Modelo is very proud of its status of running at 100% of its capacity, proving its concerns about the environment.

At the end of the tour we had a great lunch with the opportunity to taste some different kinds of Corona beer. Everybody got some gadgets from Corona and a lot of people also bought some merchandise. Most of us left Corona satisfied and with a very positive impression.

After Corona we went to the Museo Nacional de Antropología (Museum of Anthropology) situated in Mexico City's largest park: Bosque de Chapultepec. This park offers a diversity of museums, a castle, a zoo and a lake. The Museum of Anthropology gave an impression of the pre-Hispanic culture: the museum's ground floor halls were dedicated to Mexican societies and civilizations before the Spanish conquest.

Rooms on the upper level covered the way modern Mexico's indigenous peoples, the direct descendants of those pre-Hispanic civilizations, live today.

The first room (when you walked through the museum in counterclockwise order) exhibited an introduction of the studies of anthropology, ethnology and pre-Hispanic culture in general. The Origins room showed evidence of the first people in this hemisphere, explaining their arrival from Asia, and showed findings from central Mexico and displays on the beginnings of agriculture. The next interesting hall was Sala Teotihuacana, which had models of the awesome city of Teotihuacán, near Mexico City, plus many artifacts. A highlight was the full-size replica of part of the Templo de Quetzacóatl, showing its original colors. Later that week we would visit Teotihuacán itself and view the original Templo de Quetzacóatl. The hall at the west end of the courtyard was devoted to the Mexica, or Aztecs. Here we could see the famous sun (or 'calendar') stone, with the face of the sun god Tonatiuh at the center of a web of symbols representing the five worlds, the four directions, the 20 days and more. Unfortunately some halls were closed. Especially the Sala Maya should have some wonderful exhibits. Yet, this museum is worthwhile for sure and it’s very interesting to learn about the rich history and culture of Mexico.

Day 20: Wednesday, April 16th
Visit to Dutch Embassy
by Ruud Vinke

The day started with taking the subway to Tacuba station. From there we had to take the pesero (a little bus) to the district Santa Fe. We thought of splitting the group in two in order to fit in the peseros, but the Mexicans convinced us that we would all fit in one pesero. With the door open and Evert-Jan hanging out of it, it took us about 30 minutes to reach the Dutch Embassy where we arrived at 10:00 AM. This embassy is housed in a very modern building, together with a few American companies. This building has a beautiful but remarkable architecture, designed by Agustin Hernandez. Unfortunately, it was not allowed to take pictures outside the building. Inside, we attended a presentation about the history and the present situation in Mexico.

First a brief overview was given about the Mexican history. The different peoples that inhabited the country, the Spanish colonization, the independency in 1821, the war against the United States and the Mexican Revolution were treated by Mr. Braune.

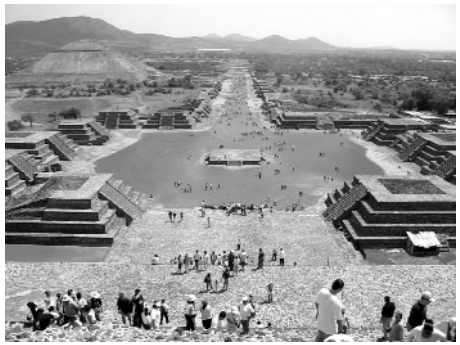
After this, the present political and economical situation was sketched. The present government tries to execute structural reforms. These are necessary because there are still a lot of problems that need to be solved in Mexico. For example, the tax policy needs to be improved, because a lot of services are offered free of charge today. This is also important for fighting the corruption. Social facilities like public drinking water need to be improved. Mexico also needs to remain an attractive place for foreign companies to settle and a competitive culture needs to be stimulated. A lot of things have already been realised, like an open economy. Macroeconomically, Mexico is on the right way, but there still exist sub-economies that are self-providing.

The Dutch Embassy is trying to promote the trade between The Netherlands and Mexico. Being the third exporter of the world, The Netherlands export mostly technology to Mexico. Examples are telecommunication, water technologies, logistics and technologies for energy and infrastructure.

Finally, we asked questions about our experiences in Mexico City, like our observations of the large difference between the rich and poor parts of the city. It also seemed the Mexican people were not familiar with the presence of tourists. Mr. Braune answered that Mexico City isn't that touristic yet.

In the afternoon, the group was split in subgroups that went to different locations. One group went to the Museo de Arte Moderno, with paintings by Rivera, Kahlo and a lot of other Mexican painters. Our group visited Castillo de Chapultepec. This was a nice looking castle up in the hills in the big park of Mexico City, Bosque de Chapultepec. In this castle impressive murals on historical themes could be seen. Outside there were six statues.

These represented the six brave cadets that defended the military academy when in 1847 invading American troops attacked Mexico City. They would rather die than surrender and so they did. Part of the castle was built in 1785 as a residence for the viceroys of Nueva España. The building was converted into a military academy in 1843. When Emperor Maximilian and Empress Carlota arrived in 1864, they refurbished the castle as their main residence. After their fall, the castle remained a residence for Mexico's presidents until 1940, when president Lazero Condenas converted it into the Museo Nacional de Historia.



Day 21: Thursday, April 17th
Exploring Teotihuacán
by Hylke Akkerman

Day 21 promised to be an excellent day. Every single participant of this trip was looking forward to this day. The alarm clock woke us up and at that first moment it was realised by all of us, that reality would fail to meet or agree with the expectations. No one could have guessed that reality would even be better…

Teotihuacán was our destination. For a few people the day started with a small deception: the buses, 'supplied' by the hotel, did not go straight to the ancient site, located about 35 km from Mexico City. No, we first went to the Basilica de Guadalupe. Fortunately this turned out to be nice for all of us. The place had been given the holy status by the pope about one year ago. At first sight the place consisted of three buildings: a very large modern church, a cathedral (about 200 years old) and smaller church next to it. There was a huge square in front of these buildings. The interior of the cathedral was really beautiful, mainly because of the fact that nothing in the cathedral stood straight. In fact, it is a miracle that it still stood there in such a geologically active area. Behind the cathedral was a beautiful garden with long stairs going all the way up to the oldest cathedral dating back to 1531, when the famous miracle happened. The Virgin, in guise of the Indian princess Guadalupe, spoke to the Indian Juan Diego and said: "No estoy yo que soy tu madre" (Is it not I who is your mother?). She also printed her portrait on his cloak, which can be seen in the modern church nowadays. From the oldest cathedral we had an excellent view over the city. It looked like the place was pulled out of a fairytale.

After about an hour we left to Teotihuacán, the place where men became gods. On our way we saw some really poor suburbs. Families living in small houses made of sheets of corrugated iron. People trying to find food and useful stuff on a huge garbage dump. For us it is a situation we only know from TV. It was a view that we will not forget.

After this short but impressive trip we finally arrived at our main destination. First we were guided to a small 'village' where a traditional clothed Mexican told and showed us the traditional ways to make Mexican things like drinks and clothing. Really nice to see, and after the shot of tequila we all wanted to buy the things they offered in their shop. We drove to the entrance of the ancient site where we could walk around for about 4.5 hours. The first things that came to mind when seeing these ancient buildings are things like awesome, breathtaking, huge or gigantic. Some had seen it on the Discovery Channel, but really no one had been capable of realising its true size. This feeling can only be understood when you walk on the 'Calle de los Muertos' or 'Street of the Dead'. To give an impression of the size of this site: 'Calle de los Muertos' is about 2.5 km long and the Pyramid of the Sun has a base the size of the Great Pyramid of Gizeh in Egypt (213 m) and is 65 m high. It is not known who built these pyramids and when. Some claim they do but hard evidence has never been given for their theories. The builders have been given the creative name 'Teotihuacans'. The site was found abandoned by the Aztecs in the 14th century. They called it 'Place where men became Gods'. They also named the main axis Street of the Dead, assuming people were buried along this road. Other theories nowadays say that these spaces were filled with water. The whole site is rotated about 15 degrees from north-south direction. In this case the axis of the Pyramid of the Sun exactly points to the position of sunrise on the longest day of the year.

First we went to the citadel with the temple of Quetzalcóatl, the Feathered Serpent. Magnificent statues were present here, though a lot had been restored. We walked along the main axis towards the Pyramid of the Sun. Because of the holiday week in Mexico, the pyramid was crowded with people. The view from the top was excellent. Finally we had to walk (read: climb) up the Pyramid of the Moon. The steps of the first stairs were huge. But the view was certainly worth the effort. Because the Pyramid of the Moon is located at the northern end of the Street of the Dead, the view over the whole site is magnificent. We had an excellent time, but in the end the sun became too intense for most people. A lot of us milky white people got sunburned. But it was worth it. In the evening we all talked about this beautiful day with the enjoyment of a fine Corona.

Day 22: Friday, April 18th
Exploring Mexico City and Tula
by Guido van der Wolk and Arend Dijkstra

Palacio de Bellas Artes

In March 1904, the Italian architect Adamo Boari presented the Mexican government his plans to replace the old theater known as Gran Teatro Nacional which was located in the small plaza opposite the Alameda Central. The inauguration of the Palace of Fine Arts finally took place on September 29, 1934, when the play "La verdad sospechosa" by Juan Ruiz de Alarcón was performed by a company lead by María Teresa Montoya and Alfredo Gómez de la Vega. The physical and moveable set mounted on the revolving disc was the work of the painter named Carlos González.

The palace consists of two sections: one part is the theater itself and the other part is a place where there are museums, conference rooms, exhibition halls, offices and a library. The three levels of the theater seat as many as two thousand spectators. Our main interests for visiting the Palace a second time were the paintings of Diego Rivera. His largest work there was a comment on industrialism. There was also an exhibition of the work of Echeverria, which was also quite interesting. On the top floor there was an exhibition about the architecture of hospitals in Mexico City.

Museo Frida Kahlo

An one hour walk through the oldest quarter of Mexico City - Coyoacán - took us to the Museo Frida Kahlo. The colorful houses and old churches in the quarter show a lot of the history of Mexico City. From here Cortéz charged Tenochtitlán, the main city of the Aztecs.

Hidden behind high cobalt blue walls at the corner of Londres and Allende in this charming southwestern suburb, the museo is where the surrealist artist Frida Kahlo was born, grew up and later lived with her muralist husband Diego Rivera, from 1941 until her death at age 47 in 1954. Fascinating not only for the collections and personal effects it contains of the two great artists, the museum also affords a window on the lifestyles of affluent Mexican bohemians during the first half of this century.

The colonial-style house, a.k.a. the Casa Azul, forms a U-shape around a verdant central courtyard. Off the courtyard, the first room one enters is the formal living room, a place where the Rivera's entertained their international and eclectic set of friends, including Sergei Eisenstein, Nelson Rockefeller, George Gershwin, the Russian émigré Leon Trotsky, caricaturist Miguel Covarrubias and actresses Dolores del Rio and Maria Felix. Now it's a gallery where some of Kahlo's paintings can be seen, including paintings of her family and her last work, Viva la Vida, a vibrant still life of watermelons.

Other rooms contain her colorful Tehuana costumes and pre-Columbian jewelry, her diary, masks, more idols, and giant papier-mâché Judas figures,

monsters traditionally filled with firecrackers and exploded on Sabado de Gloria, the Saturday before Easter. Also on display are paintings by Rivera, Paul Klee, Jose Maria Velasco and the couple's friends Marcel Duchamp and Yves Tanguy.

The physical pain she endured along with the traumas of her stormy 25-year marriage to Rivera is reflected in some of her paintings. A large black and white reproduction of "The Two Fridas," painted during the Rivera's short-lived divorce in 1939 (they remarried a year later) can be seen in the house. (The original is in the Museo de Arte Moderno in Bosque de Chapultepec, Mexico City.)

There have been numerous publications on Frida, and she has been the subject of at least three documentaries and one feature film. Madonna, an avid Frida Kahlo collector, still promises her Frida film, as does La Bamba director Luis Valdez. Mexican actress Salma Hayeck's Trimark production in which she stars as Frida is more of a sure thing. Frida speaks to many people - the physically handicapped, indigenous peoples, Chicanos, feminists, leftists.

In Teotihuacán and in the Mexico City anthropological museum, we had already learned much about the peoples that inhabited ancient Mexico. Still, a group of participants was interested in paying a visit to the archaeological site near Tula.

Tula is a town about 75 kilometres north of Mexico City. Between 950 and 1150 AD the town, then known as Tollan, was the capital of the Toltecs. Legend has it that, in 987 AD, the priest and king Topilzin was banished from the city, promising to return from over the seas. When the Spanish conquistador Cortés arrived in Tenochtitlán many years later, inhabitants still knew this myth and believed the long-gone king had returned. Cortés quickly proved them wrong.

The four 5 metre high Atlantean statues of Tula, standing on top of the pyramid of Quetzalcóatl are the best-known remnants of the old town. Today, two of the original statues remain. The other two have been rebuilt. The statues depict the god Quetzalcóatl, wearing a militaristic outfit. They have stern faces, overlooking the valley. Archaeologists believe that the statues carried a wooden roof on top of the pyramid.

The Tula archaeological site was much quieter than Teotihuacán. Only a few Mexican tourists were looking around. Many flowering cactuses and small trees gave the area a sense of beauty and peacefulness. Apart from the Atlantean statues, archaeological investigations in the ceremonial precinct have revealed pyramidal structures and ball courts. The ball courts, found in many places in Mexico, were used to play a ceremonial ball game. Players were only allowed to touch the small ball with their knees, elbows and hips. Members of the losing team were sacrificed to the gods. Excavations in Tula are far from complete. Many buildings still have to be uncovered. Stones sticking out of the ground show the presence of a lot of archaeological material.

Driving back from Tula gave the opportunity to see a little of the region outside the built-up area of Mexico City. Apart from cactuses and small bushes there is little vegetation. Closer to the city, chemical plants, power lines, slums and highways take over.

Days 23 and 24: Saturday, April 19th and Sunday, April 20th
Journey back home

by Ralf van den Broek

At about 9:00 AM we had our last Mexican breakfast. Nanne, Arend and Evert-Jan held some speeches, Nanne on behalf of the board of the Foundation GBE-FMF, Arend, who also presented some gifts to the committee, on behalf of the participants and Evert-Jan on behalf of the committee. After that, we went to the airport and arrived at around 10:30 AM. We had plenty of time for tax-free shopping, as we couldn't board until 1:45 PM. We were driven to the plane with the same kind of bus that was used when we arrived, and the plane left at 2:50 PM. We got a nice view over Mexico City, including a small dust tornado. We didn't fly over the Teotihuacán site, which would have been nice to see from above.

At around 4:30 PM we arrived at George Bush Intercontinental Airport in Houston, where we had to go through customs. It didn't take long this time. We had to retrieve our bags and drop them off again for the transfer, and then we could go to the gate. We boarded at 6:45 PM. Before take-off, a pillow fight erupted between some people in the center aisle (I'll only mention the fight between professor Niesen and Boyana). Our flight took off at 7:20 PM for a nine hours flight to Amsterdam. We couldn't see Houston as it was clouded. The movie was pretty good though, Steven Spielberg's `Catch me if you can', starring Leonardo DiCaprio and Tom Hanks. By the time the movie ended we were flying over the Atlantic Ocean and it was already dark, so I went to sleep.

We arrived over Ireland at around 9:00 AM local time, our first sight of Europe in three weeks. It was also clouded over Amsterdam, but the plane made several turns below the clouds to get into position for its final descent, so we got a nice view of the Dutch coast. We touched down in Amsterdam at 11:30 AM. Immigration went a lot smoother than in the USA and Mexico. It took a long time before our bags arrived. Arend didn't find his bag though; it was left behind in Houston. Airport officials said it would be delivered the next day. Some people were picked up by family and friends, the rest of us took the train and some beers (at 07:00 AM Mexican time!). I went to Apeldoorn where I was picked up by my parents, the rest went straight to Groningen. These die-hards had French fries with mayonnaise. We were back home.

CASE STUDIES

INTRODUCTION TO THE CASE STUDIES

A study tour cannot take place without funding. Besides the contribution of the participants and subsidies, the participating students had to do a case study. A case study is a research or training assignment for a company or institute. One or two students work for a period of about three weeks for the company. The students who work on the case study are selected on their skills and motivation, so the commissioning company can expect a result at academic level. A professor will keep an eye on the students and advise them if necessary.

A case study is a good opportunity for companies to get a piece of work done (in case their own employees have a lack of time or in case the assignment should be contracted out to another company) to relatively low costs. A case study also brings senior students in close contact to the company and is a great opportunity to show the students the activities of the company. Possible case studies are research or trainee assignment in the fields, which the FMF covers: Mathematics, Computer Science, Physics, Astronomy and Biomedical Engineering. You can think of a literature study, a statistical analysis, modeling a physical or production process, building a database or image processing. The students have access to university literature and equipment.

For this study tour, case studies for eleven different companies and institutes were performed. You'll find a report of these case studies, which give a good overview of the possibilities. We worked for five companies: SKF, Schuitema N.V., Microsoft, Nederlandse Aardolie Maatschappij B.V. (NAM) and Testprint B.V. Further we worked for Astron, the Academic Hospital of Groningen (AZG) and for the to the University of Groningen related Faculty of Medical Sciences (FMS), Department of Biomedical Engineering (BME), research school GUIDE and the education and IT center ECCOO.

Case study Astron

Martijn Bodwes used his computer skills for Astron, a foundation that promotes research in astronomy in the Netherlands. His case was supervised by Drs. J. Jongejan from the computer science department (RUG) and Martijn van Veelen of Astron.

Astron is working on the LOFAR project. The LOFAR will be a major new multi-element, interferometric, imaging telescope designed for the 10 to 240 MHz frequency range. To build this new telescope all kinds of hardware are needed. Because of the size of the LOFAR project it is important to know the characteristics of every specific hardware component.

Those components are for example FPGA's (field programmable grid arrays). Certain techniques can be implemented (like a Fast Fourier Transform) on such components. The implementation of a technique on a component has a certain performance (speed, power use, the number of used logic elements etc.). Researchers at Astron have tested a lot of different basic techniques on basic components. The results of these tests, also called mapping results, are stored in a database. The amount of generated data is huge. To control the amount of the data a comprehensive and easy user interface was needed. Such an interface must be straightforward to use and the data have to be organized in a structured manner. A web interface is the first step in the direction of a combined knowledge system for techniques, components, implementations, test results and complete simulations of embedded systems.

To achieve these goals a web interface was designed and created. The different components and techniques are displayed in a multi-level tree structure, very much like the tree structure used in the Windows Explorer file browser. Descending down the tree one can click on different nodes. Each node, containing a component or technique will cause a datasheet and menu bar to appear on the screen. In the menu bar different actions can be chosen. A possible action is adding web links to a particular component, for example the website of the manufacturer of the component. Another feature is the storage of test results of a technique or a component.

All these results can be used in another application that can simulate the overall performance of combined components and techniques. The use of this knowledge can reduce cost and improve the performance of the system that is being developed.

The web interface to the database was made with PHP and JavaScript. The database itself is a MySQL database. The whole system is built to run on a Linux web server. The clients can request the information with their local web browser at their own workstation via the Internet.

There are a few disadvantages to such a system. First, if many users are updating and inserting data in the database, the state of the database presented to the user can be out of date. Due to the nature of web browsing there is no way to avoid the system displaying out-of-date information.

The second disadvantage is the variety of web browsers that all hold their own principles and implementations of HTML and especially JavaScript. This makes it difficult to make a system that on one hand is compatible with all browsers and on the other hand is very dynamic and easy to use.

Case study AZG PET-center

Wouter van Strien did his case study at the Positron Emission Tomography center at the Academic Hospital in Groningen (AZG). His case was supervised by W. Vaalburg (PET-center).

What is PET?
Positron Emission Tomography (PET) is a technique for measuring the concentration of positron-emitting radioisotopes within the tissue of living subjects. A wide range of compounds is used in PET. These positron-emitting radio nuclides have short half-lifes and high radiation energies. The main positron-emitting radio nuclides used in PET are Carbon-11, Nitrogen-13, Oxygen-15 and Fluorine-18, with half-lifes of 20 minutes, 10 minutes, 2 minutes and 110 minutes respectively. These compounds are commonly known in PET as tracer compounds. These tracer compounds are administered by means of injection or inhalation, the purpose being simply to enter the compound into the bloodstream. The short half-lifes of these tracers allow large doses to be administered to the patient with low radiation exposure and enable studies to be repeatedly performed. The compounds are produced with a cyclotron in the basement of the hospital. The chemical form of these compounds is simple, so before injecting these in the patient the radio chemist synthesizes the desired complex molecules.

The imaging in PET is all indirect. It relies on computerized reconstruction procedures to produce tomographic images. It is performed by means of detecting positron emission by use of tomography. Two ways in which radio nuclides decay that will reduce the excess of positive charge in the nucleus include the neutralization of a positive charge with the negative charge of an electron or the emission of a positron from the nucleus. The positron will then combine with an electron from the surroundings and annihilate. Upon annihilation both the positron and the electron are converted to electromagnetic radiation in the form of two high-energy photons which are emitted 180 degrees away from each other. This annihilation radiation can be detected externally and is used to measure both the quantity and the location of the positron emitter. Simultaneous detection of two of these photons by detectors on opposite sides of an object places the site of the annihilation on a line connecting the centers of the two detectors. At this point mapping the distribution of annihilations by a computer is possible. If the annihilation originates outside the volume between the two detectors, only one of the photons can be detected, and since the detection of a single photon does not satisfy the coincidence condition, the event is rejected. Simultaneous detection provides a precise field of view with uniform sensitivity. Wherever the disintegration takes place between the two detectors, the event is recorded whenever the photons in sum have travelled the full inter-detector distance.

This technique is mainly used to measure deviations from normal metabolism, but as in the AZG also brain research is done with this technique.

My job
Part one:
The cyclotron used for bombarding the targets to produce the desired compounds is controlled by a Programmable Logic Computer. It allows the operator to define the presets of the cyclotron to control the amount of radioactivity produced and gives readouts of the actual values of all kinds of parameters. The wish was to log all the presets and readouts in order to have information about the amount of produced radioactivity and to have information about the working of the cyclotron so that faults can be detected and investigated. In order to do this a program was written in Labview that constantly monitors serial data output by the PLC and puts it in a spreadsheet after processing it.

Part two:
An existing Labview program controlling the synthesizing process was adapted so that more parameters and process values were automatically logged.

The part I played for a few weeks in this interesting group at the AZG PET Center was only small, but still a lot of fun. The fact that I could work on two different parts of the entire process was really nice because by programming these programs, a deeper understanding of the processes was necessary and so I learned a lot by talking to the staff of different disciplinary backgrounds. Thank you everybody! I had a great time!

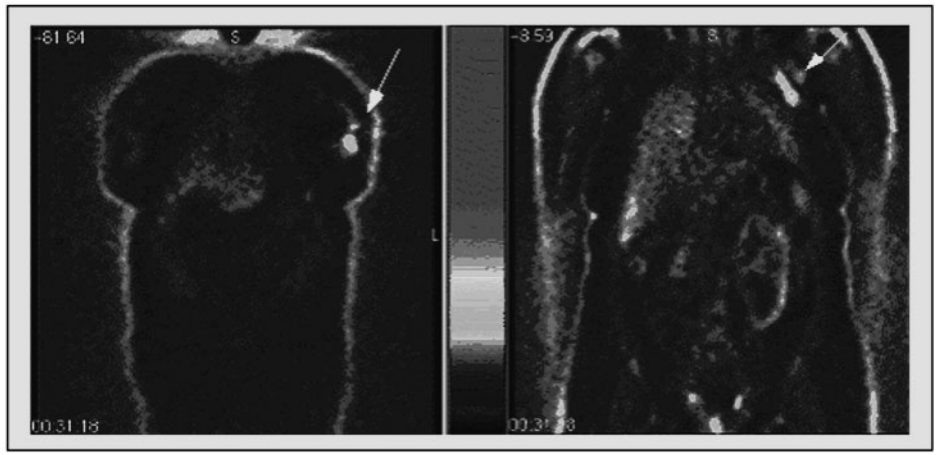


Figure 1: PET-scan of patient with breast cancer. The arrow points out the tumour.

Case study BME

Joost Massolt performed his case study at the Biomedical Engineering department at the University of Groningen. His case was supervised by Prof. dr. ir. H. Duifhuis of the BME department.

Because of a European treaty signed in Bologna the complete educational system at the University of Groningen had to change from a 1+4 "propedeuse/doctoraal" system to the 3+2 Bachelor/Master system. The Biomedical Engineering (BME) program in Groningen, which starts in the third year for physics students, also has to change.

Mural by Diego Rivera in the Palacio de Bellas Artes, Mexico City

Because of this change in program, the staff of BME in Groningen wanted to know how the BME-programs in the USA are organised.

My task was to go to the websites of several universities and take a good look around. Because of the complexity of some websites and the variety in programs between universities, a report would become very unclear. Instead of a report, I decided to build a website with all the information on it. The website can be found at http://www.fmf.nl/~joost/case.

I've visited various universities. From the prestigious and in our country well-known universities like Harvard, Berkeley, Yale, Stanford, MIT and Princeton to the not so familiar but well-rated universities like Duke, San Francisco, Purdue, Johns Hopkins, Boston, Louisiana and Miami. The type of education varies: from only a Bachelor or only a Master to a Bachelor/Master with a major and a minor, only a minor or only a Ph.D. etc. etc. The BME-departments vary a lot, but at almost every university, the departments in Groningen (Biomaterials, Instrumentation and Medical Imaging) are also present.
The BME-staff was also interested in the number of students at every university. This cannot always be found at the websites of the different universities, so I sent e-mails to a lot of study coordinators. The result of every mailing is also found at the mentioned website.

Finally, a quote from the Boston University website:

Why BME?
BME is booming. Outgrowths of the human genome project will lead to newer and better diagnostics therapies, including gene therapy; specific engineering studies of nervous and cardiopulmonary systems are revolutionizing neural and tissue engineering; and medical imaging at minute and organ-level scales is providing virtually harmless diagnostic tools. And as these technologies develop, they change our world. They change medicine, law, science, and industry. The industrial revolution changed forever the way the world works; the recent networked information biotechnological revolution has changed the way the world communicates, and this revolution promises to change the way the world lives. Unpredictable, fortuitous results in the field of biomedical engineering in the past few years, some discovered by researchers at Boston University, have already become part of our everyday lives - and these results, in pharmacology, imaging, and gene therapy, are an optimistic prediction of the future - a life wholly free of devastating diseases may be achievable before the end of the next century, and biomedical engineers will guide us into this next incredible era.

Case study ECCOO

Six students from the ManeaX group did a case study issued by ECCOO (Expertise Centrum voor Computer Ondersteund Onderwijs), the expert center for computer-aided education at the Rijksuniversiteit Groningen (RuG). Their expertise lies where information technology and education meet. One of their current projects is the development of the new website for the RuG. This new WebPlatform should be an interactive website where people can easily add, modify and remove content to keep the site up-to-date. One of the design goals of the WebPlatform is that everyone should be able to use this content management system.

Our task was to transfer content from the old RuG website to the new WebPlatform. Rogier Falkena and Feike Kramer worked on migrating information from the old website of the Faculty of Arts to the new one, Ronald Hoogma en Teake Nutma worked on the corporate website, Ralf van den Broek worked on the website for the Faculty of Psychology, Education and Social Sciences and Guido van der Wolk worked at the website of Astronomy. Their cases were supervised by Rein Smedinga from the department of computer science and the webmasters of the four departments, A. Kok, W. van Dijk, T. de Maree and J. Poutsma, respectively.

One of the components of the content management system is the Xopus editor, an online Word-like editor that gives the possibility to edit all pages inside the WebPlatform. During the transfer of the content several problems arose. For example the old website contained many out-of-date pages, and the question was whether to transfer these pages or not. Often, we had to go in consultation with the maintainers of the pages. In addition, the conversion of the education system that is going on at the moment made some pages unusable in the new WebPlatform. New curricula had to be made, as well as new course descriptions, and so on and so forth. Webmasters often made beautiful websites for their departments. Due to the strict format of the WebPlatform, transferring these sites as they were was not possible. The format had to be mapped to the WebPlatform format and concessions had to be made.

Internet engineering
The core of the WebPlatform is formed by an Oracle database. This database contains the articles on the WebPlatform in XML format, and can be accessed using Oracle's Internet File System (IFS) through FTP, Samba, WebDAV etc. The database can also be accessed using Xopus and SpyX, the online editors.

All articles, menus and other information (such as link objects and internal data used by Xopus) are stored as an XML file. Multiple copies of the same file or directory structure can be created using Oracle's share facility, where the same entity is accessible through different paths. This functionality ensures that information shared between different faculties, for instance, only needs to be updated in one place.

These XML files are rendered to HTML by the presentation layer. This layer implements the look and feel of the website, and thus ensures a consistent web site. The presentation layer uses the contents of the XML file to generate the article part of the page, as well as any links and banners associated with the article. Associative links and banners are also inherited from the directory the article resides in and its parent directories. The menu on the left-hand side of the page is generated from the directory the article resides in, and the menu at the top of the page as well as the color scheme of the page from the top-level directory (portal). The breadcrumb path is generated using the path to this article, each directory representing a breadcrumb.

The new website of the University of Groningen

The pages generated by the presentation layer are cached on a cache server to decrease load times, as generating a page can take several seconds. This will also help to decrease the load on the servers.

Results
With the new WebPlatform the RuG has entered a new era of digital information technology. Student, professors and administrative staff can all manage their pieces of content on the platform, making it a highly accurate and easy to use website.

Please take a look at the new WebPlatform of the RuG and especially at the sites we worked on:

Corporate
http://www.rug.nl/

Faculty of Arts
http://www.rug.nl/let

Astronomy
http://www.rug.nl/sterrenkunde

Faculty of Psychology, Education and Social Sciences
http://www.rug.nl/ppsw

Case study FMS

Niels Maneschijn en Nanne Huiges performed their case study at the Faculty of Medical Sciences (FMS) at the University of Groningen. Their case was supervised by Drs. J. Jongejan at the computer science department and Robert Hofstra at FMS.

Introduction
Together with hospitals in, amongst others, Genoa and Paris, the Faculty of Medical Science of the University of Groningen and the Academic Hospital in Groningen perform research in the field of Hirschsprung's disease. This is a transmissible nerve disease that results in a malfunction of the intestines. Both patients and their families will be examined. All acquired data will be gathered in Groningen for further statistical analysis.

At this moment all data are written down or stored in a spreadsheet. This hinders getting an overall view of the gathered data and makes automated analysis almost unusable. Furthermore, entering data is complicated and prone to errors.

Goal
The goal of this case study is to build a database in which the participating hospitals can store their data and which then can be used to send the data to Groningen for analysis. This analysis will be aimed especially at whole families.
Microsoft Access was chosen as the database management platform. This way the hospitals will not need to buy additional hard- and software. Also, the database will need to be user friendly and should only be changeable in Groningen, so the different databases will have to be able to be merged again.

The data
The patients are arranged by family. Because more copies of the database are being used, one cannot guarantee the uniqueness of a personal ID-number. Therefore his number within his family, his family-ID and a code representing his geographical location is referencing to a person. For each family the location, the kind of Hirschsprung's disease and the kind of inheritance (dominant or recessive) is being stored. For each person a range of clinical and DNA data is stored, as well as gender, children and the type and activity of the disease.

For entering the data in a consequent way, the data can be selected from look-up tables, which have been compiled in Groningen. The family relations are stored by entering the children for each person. Using these data, the whole family tree can be reconstructed.

The database
Because different people, spread over different countries will use the database, the database needs to be foolproof. It should be impossible to enter wrong or inconsistent data. Some fields are obligatory, and some combinations of fields are impossible and thus forbidden.

Furthermore, families need to be consistent. No one should be entered as his own son or grandfather, and enough family members should be entered to make the family form a whole. Checks are built in to deal with these matters. For maintenance reasons the database should be protected against modifications.

Status
The choice for Access was not always the easiest one. Some things turned out to be harder than expected. Fortunately, there were no real showstoppers.
The database is now being tested on usability and functionality. When it turns out to be successful, the database will be split up and distributed over all participating hospitals.

Case study GUIDE

Georg Muntingh preformed his case study at the Groningen University Institute for Drug Exploration (GUIDE). His case was supervised by F. Jilderda of GUIDE.

Introduction
The aim of this case study was to chart all publications (and patents) of the research school GUIDE. This was done using a database on the internet (Web of Science), several local databases and manual submissions of the researchers themselves. All references were combined in a single Refmanager file, from which (together with other information) the Annual Report 2002 was created.

About GUIDE
The best way to give a short introduction to GUIDE is probably by quoting its mission: 'The mission of GUIDE is twofold. Firstly, GUIDE promotes innovative drug research. This is done by combining an in-depth understanding of the pathophysiology of disease with the development of new medicines. Secondly, GUIDE offers a full-fledged educational programme for both graduate students and M.D./Ph.D. students interested in a research career in academia or (pharmaceutical) industry.'

Charting the publications
The process of charting the publications is summarized in figure 1.

As can be seen in the figure, three (types of) sources for references to publications were used, namely Web of Science, several local databases and manual submissions.

- Web of Science. Web of Science is a database available via the internet. By entering the name of the author (and sometimes more information), Web of Science retrieves references to (for example) articles written by that author. The used method in this case study was to write a few long queries with about 50 author names first and then submit these at once to Web of Science. The result could directly be imported into Refmanager.
- Local databases. Several databases (for example Biological Abstracts, Embase and Medline) were locally available. For a fast conversion from these local databases to Refmanager I wrote some filters. These filters were applied to the (manually selected) relevant references.
- Manual submissions. In addition to these sources all researchers from GUIDE sent the remaining references and patents in their own favourite format (mainly Word) or as a Refmanager file. The Refmanager files could be merged easily with the existing databases. The other formats were added manually to the database.

After this several corrections had to be made upon the database.

- There were a lot of references referring to the same articles.
- Web of Science seemed to relax the restrictions of using the OR-operator, so a lot of references were not supposed to be there.
- A lot of names of researchers were not written in the right format, so this had to be adjusted.
- The book chapters found in Web of Science were written as being articles.
- To give every researcher a rating, the journals that did correspond to a rating had to be separated from the magazine articles that did not.

Finally the Refmanager file was handed over to GUIDE to generate (together with other information) the Annual Report 2002.

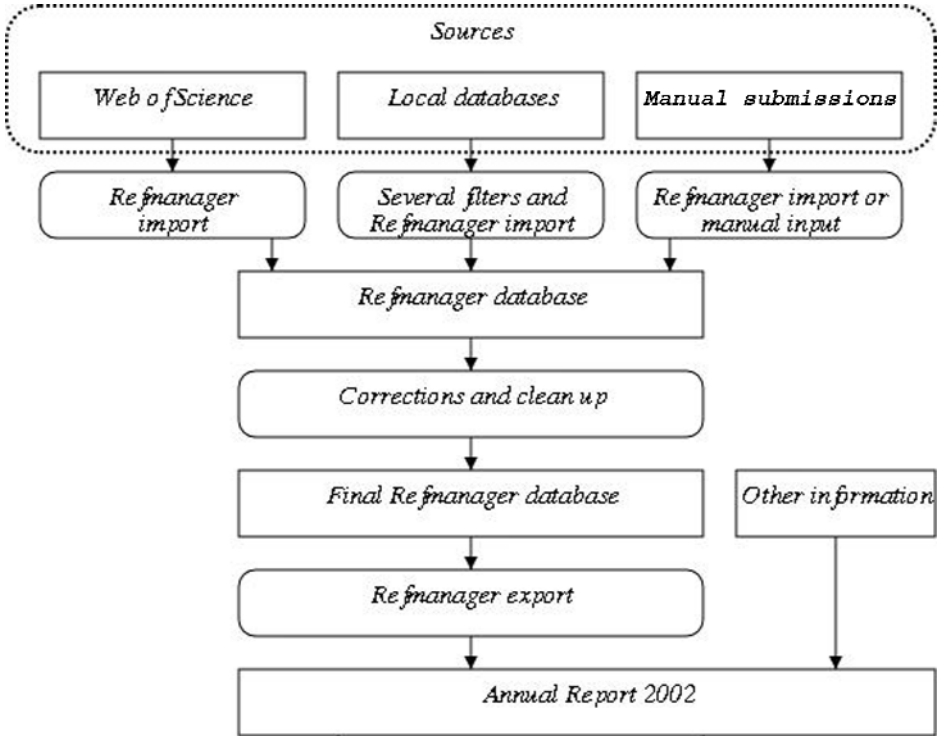


Figure 1

Case study Microsoft

Casper Bodewitz and Niels Heinis performed a .NET case study for Microsoft. Their case study was supervised by Peter Groenewegen of Microsoft and Ir. S. Achterop of the department of computer science.

Introduction
This report of our case study for Microsoft contains a per day overview of the first week, which we spent in Nijmegen, and a short description of the weeks thereafter.

Day 1
This first day was scheduled to get a theoretical background for the upcoming days. Ewoud Janse from Microsoft's Intelligent Staffing, whom we already knew from an Xbox meeting at the university, presented to us the ins and outs of the .NET framework; how it works, what the pros and cons of the framework are and which products belong to the .NET framework. It was a very clear presentation and critical questions from us and the ROC teachers were answered very well.

After a general introduction to the .NET framework, Ewoud Janse took a closer look at "Web Services", which is the buzzword within the business community to finally integrate the internet in a business model very well. Web Services form an integral part of the .NET framework and the Microsoft Product Line of which Visual Studio is the central product.

Halfway this presentation we were introduced to attribute based programming. This technique uses keywords or tags in the program code that tell something about a certain piece of code. For example, the tag [WebMethod] indicates that the upcoming method is presented as a Web Service. Instead of writing all the accompanying code, the code is generated behind the scenes. The generated code can always be edited manually. This can all be done using only one IDE, Visual Studio.NET and no knowledge about the underlying protocols SOAP, UDDI, WSDL and XML is necessary to build simple web applications.

We had a very good lunch, which was the start of a week of very creative lunches at the ROC Nijmegen. There was a cook that liked to serve us very good lunches every day. The ROC Nijmegen is a very hospitable school, everything was managed very well which contributed to a productive week.

Besides Ewoud Janse there were two other people from Microsoft in Nijmegen this first week, Peter Groenewegen and Peter Criellaard. Peter Groenewegen provided us with a place to sleep in a very good hotel near the station. After the end of the first course day we went to the city center to eat a pizza in one of the numerous restaurants in Nijmegen where mister Groenewegen told us about his work experience and work at Microsoft in Seattle.

Day 2
After a good breakfast we started the second day. This day we started to work on the main goal of this week, which was to get acquainted with Visual Studio.NET and explore the possibilities to integrate it into MBO education. This course/brainstorm session was meant to get an overview of the contents of the specialist course "Application Developer" and the application development part of the middle management course "ICT manager" that will be used in the new competence focussed qualification structure of MBO education. This overview had to be compared with some Microsoft Certification exams to see if any streamlining could be accomplished.

During the course week we tried to accomplish this by a combination of:
- Defining projects covering certain final terms meant to:
  - o Get teachers started with the software.
  - o Accomplish the covering of studies with recognition of the MBO-ICT counter.
- Compare covered skills of MCP-exams (MCAD, Microsoft Certified Application Developer) with the final terms of the course concerned.
  - o This gives an added value for the students and thus of the education institute (compare MCP W2000).
  - o This can provide exemptions for the normal and continuation courses.
  - o Course material available via Microsoft Press, MOC and E-learning (coming soon).
  - o Offers better opportunities to external projects.
- This course can be a motive to develop Dutch course material for the ROC's.

After Peter Criellaard had outlined the course week, we continued brainstorming about useful books and started with the exploration of Visual Studio.NET. From that time on everyone was programming and trying to develop some nice programs. Our general knowledge on software development was tested by means of answering quite a lot of small questions about .NET. Using the available books we could solve most problems and learned a lot about the .NET framework at the same time.

Day 3 and 4
On the third and fourth day we continued supporting the teachers. Our task was to convert existing assignments to Visual Studio.NET solutions. The teachers developed some useful projects and this together with our assignments is collected and put on a CD-ROM so that it can become available to the MBO counter. Our first program in the .NET environment was the pyramid of Galton, which visualizes a binomial distribution.

Day 5
We spent this last day finishing the projects we started during this week and also determined the continuation track. After the last lunch, we all got some sandwiches for the trip back to Groningen. We are especially thankful to the ROC for the very hospitable week at their school in Nijmegen.

Next 3 weeks
With an evaluation DVD containing Visual Studio.NET as tools, some help from the books for further study and personal interest we started our continuation track. We have chosen a set of projects, varying from very simple to quite extensive, and implemented them in Visual Basic.NET and/or C#.NET.

An overview of the .NET framework can be found on the pages of de MSDN network: http://msdn.microsoft.com.

CASE STUDY NAM

Ruud Vinke and Hylke Akkerman performed a case study for the NAM, the Dutch mineral oil company. Their case was supervised by W.M. van Gestel of the NAM and by Prof. J. Th. M. de Hosson from the physics department. This case study was performed at the Materials Science group of Professor De Hosson at the University of Groningen.

The problem for this project was the following: Why and how originate cracks near girth welds in gas pipelines made of 13% Cr supermartensitic stainless steel?

The following points were investigated:

1. Where do the cracks emerge? (Heat-affected zone (HAZ), inside tube, carbides, etc.)
2. What are the phases and structures inside the HAZ? (Indentation, etching, X-ray diffraction, stress measurements, SEM and TEM).
3. How is the crack propagating? (Inter- or transgranular, structures, load test)
4. What are the welding conditions and what is the effect of these conditions on the material?
5. Does the material first corrode and then crack or vice versa, caused by stress in the material?

To find the answer to question five, more samples of different ages are needed, for example one from a just welded tube and another from a one-year-old one. These could not be supplied, so this question could not be answered. However, the general opinion is that the two mentioned effects occur almost simultaneously.

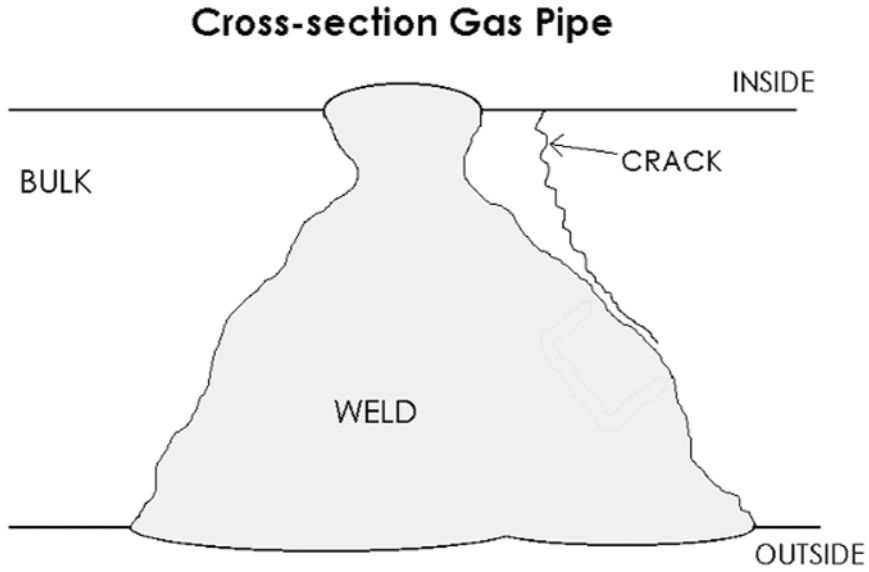


Figure 1. Cross-section of a piece of pipeline containing cracks.

Research
With the supplied X-ray photographs of a weld, some parts were selected where probably the most cracks were present. Cross-sections were made of pieces containing cracks and samples were made (see figure 1) for the optical microscope, Scanning Electron Microscope (SEM), etching and the Transmission Electron Microscope (TEM).

With etching different weld layers could be made visible. With the optical microscope the weld/bulk interface (WB-interface) could be investigated. Grain structures in the bulk and different phases, differing in colour caused by etching, were visible.

On the etched sample a Vicker's hardness measurement was performed. This was done to map the hardness at the WB-interface. In general there could be concluded that the hardness is the lowest in the weld, the bulk is a little bit harder and the hardest is, as expected, the WB-interface.

With the SEM so-called mappings were made of the elements in the samples with the help of EDX. It was clear that a higher concentration of chromium was present in the weld. Next to this, little could be said about the concentration differences (caused for example by carbides) at grain boundaries and near the crack. It was made clear that all kinds of pollution can come from the crack when the sample is drying and this makes it more difficult to look at different concentrations near the crack.

For the nano-indenter a new sample was made. This was used to map the differences in hardness near the end of the crack at a very local scale. The hardness in front of the crack was bigger. These differences were probably caused by the fact that the crack is propagating between the grains. These grain boundaries have a larger hardness. This was confirmed by OIM measurements, which made very clear this is an intergranular cracking process.

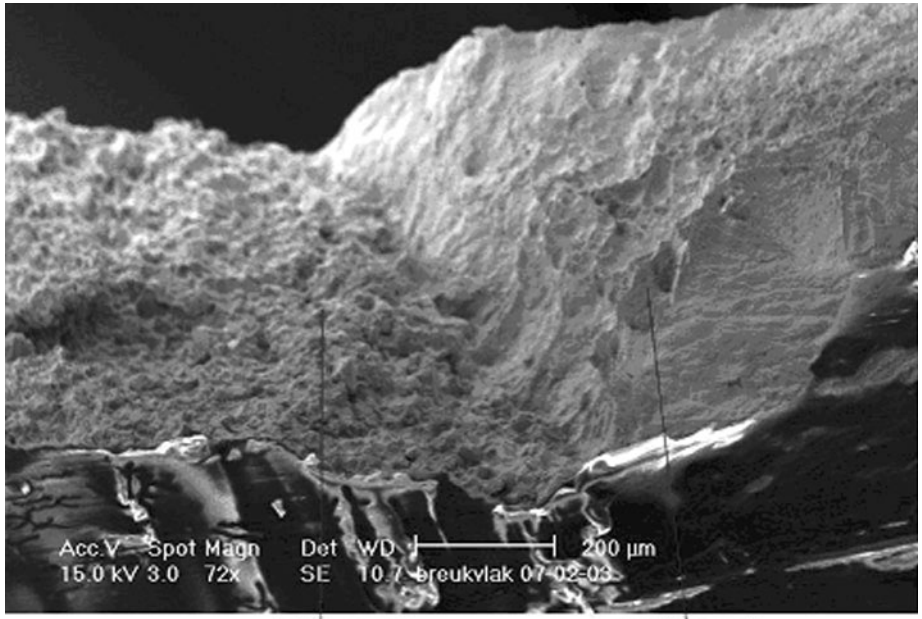


Figure 2. Crack transition from brittle to ductile.

With X-ray diffraction measurements, high stress differences could be seen around the weld. These differences could be caused by the different phases present in the material, but this is not clear.

Load tests were performed and it was made clear that uncracked samples do not start to crack at the same position just next to the weld. This is a good indication that the cracking process is not caused by external influences. A load test on a cracked sample was also done. The crack transition could be investigated with the help of the SEM. Clearly the crack that was already present was intergranular and the grains were clearly visible. These were torn apart in the region which was cracked due to the load test (see figure 2).

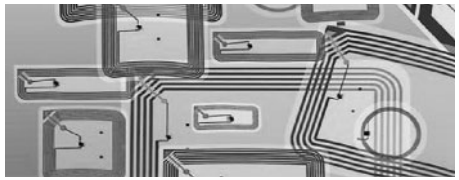
With the TEM structures were made visible which could be carbides, but this was not very clear.

Conclusively no unambiguous cause could be determined for the cracking of 13% Cr supermartensitic stainless steel near girth welds. However, this research contributed to the knowledge in this field and furthermore gave a number of probable causes for the cracking.

Case study Schuitema

Hans Timans and Arend Dijkstra performed a case study for Schuitema on RFID technology. Their case was supervised by Frits Jonker of Schuitema.

Schuitema, the main organization behind the C1000 supermarket chain in the Netherlands was interested in the development of Radio Frequency Identification (RFID), and in particular the use of this technology in their supermarkets. Therefore they took the opportunity to have us chart all recent and future development of RFID, mainly done by the Auto-ID Center at MIT in Boston.



RFID is a technology that uses radio waves to communicate between tags and a reader, each tag holding a specific code for the product it is attached to. Tags consist of two parts: an antenna and a small integrated circuit, which is the heart of the tag. The reader emits a radio wave that triggers the tag, after which the tag is activated and starts to modify the radio wave it has just received using amplitude modulation. The modified radio signal now contains the electronic product code (EPC) that is stored inside the IC and will be transmitted back to the reader, who can use the information from the tag to query a database using the EPC. After this process the main computer knows which tag is located on which position, and using several readers and thousands of tags it is possible to locate a very large number of objects.

In a supermarket the optimal scenario would be to tag every single product on the shelf by installing several readers inside the store. This way the inventory of the store can be monitored in real time, checkout time will be reduced significantly, easy theft prevention methods will be available, article prices can be adjusted in a nanosecond, and many many more features will become available. To implement this technology lots of changes have to be made to the supermarket supply chain network, as well as inside the supermarket itself. The cost and time period in which all these modifications can be completed are points of great interest to Schuitema, and required some thought by us. Our job was to chart all the developments in the sector and carefully make a prediction on the applicability and the cost of adapting RFID technology in the supermarket chain.

RFID is a technology still in its infancy. Maybe applications in logistics will soon be available. More than ten years may pass before each item in our own supermarkets is tagged and all the promises of RFID can be realized. This is due to the fact that the production and distribution of articles that can be bought in the supermarket is a complicated process, as well as to the fact that a lot of development needs to be done before tags in each article can be accurately read.

During this case study we had frequent contact by email with Tom Ahlqvist Scharfeld, which eventually resulted in a visit to the Auto-ID Center at MIT with the entire ManeaX ’03 group.

Case study SKF

Johan Brondijk performed a case study for SKF, a company specialized in rolling bearings. The case was supervised by J. Th. M. de Hosson and by Erik Vegter of SKF. This case study is performed at the Materials Science group of professor De Hosson at the University of Groningen.

Introduction

Most SKF bearings are made of one type of steel: SAE 52100 bearing steel, which contains typically 1.0 wt% C and 1.5 wt% Cr. Bearings are designed and produced to outlive the construction they are part of. The majority will satisfy this condition, but a small amount (less than 1%) shows failure much earlier than predicted. There are many possible failures, but one frequently occurring type of failure is not well understood. In the sub-surface region, about 0.7 to 1.8 mm below the surface, so called white-etching areas (WEA) are observed. These areas have other material properties and along these areas cracks start to grow, which will damage the bearing. The WEA are probably initiated by hard inclusions.
My task was to determine the hardness and microstructure of these WEA’s. The sample I investigated came from an outer ring of an SKF bearing, which was used in an industrial gearbox.

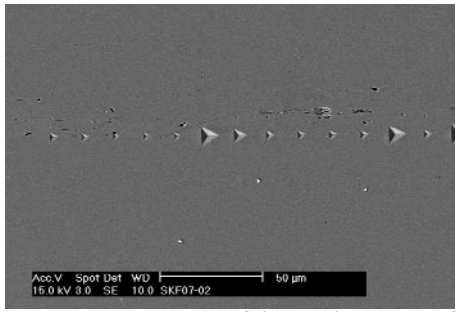


Figure 1: A cross section of the sample. A series of nanoindentations is shown along a WEA, which is orientated along the cracks.

Experimental Techniques

The hardness has been measured with nanoindentation; the microstructure has been investigated using SEM and TEM.

At its most basic level, a nanoindenter employs a high-resolution actuator to force an indenter into a test surface, and a high-resolution sensor to continuously measure the resulting penetration. From these load-displacement data, the hardness and modulus of the sample can be derived. This technique has been developed for the purpose of probing the material properties of very small volumes of material. For this case study it was very useful, because the WEA’s have a thickness of only a few micron.

Scanning electron microscopy (SEM) was used to investigate where the indentations where placed: in a WEA or in the matrix. SEM was also used to look at the sample at high magnification (more than 100.000 x).

Transmission electron microscopy (TEM) was used to investigate the microstructure of the WEA at very high magnification.

Results and Discussion

A row of nanoindentations is shown in figure 1. After etching, it can be revealed using SEM whether an indentation was made in a WEA or in the matrix. This technique reveals that the hardness of the WEA’s is 15% to 65% higher than of the surrounding matrix.

With SEM and TEM the grain size was determined and element concentration measurements were done.

Conclusion

The formation of the WEA usually starts at an inclusion between 0.7 to 1.8 mm below the surface. Nanoindentation reveals that the hardness of these areas is 15% to 65% higher than the surrounding matrix. TEM and SEM measurements show that the WEA consist of elongated areas of very small grains, 30 to 45 nm of Ferrite. It is suggested that this is the reason for the higher hardness of the WEA, according the Hall-Petch equation, which tells us that a smaller grain size leads to a higher hardness.

Further investigations should concentrate on more precise measurements of element concentrations and dislocation densities.

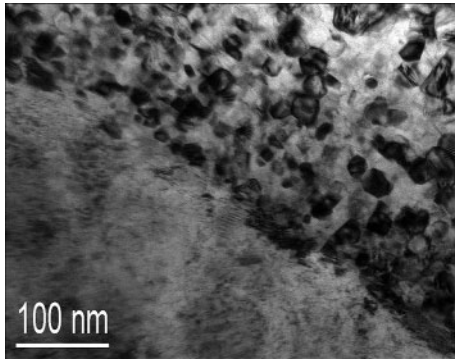


Figure 2: Cross section of the sample, the sharp boundary between a WEA and the matrix can be seen. The grain size in the WEA is about 30 to 45 nm.

CASE STUDY TESTPRINT

Astrid Tuin performed a case study for Testprint, a company specialized in printing. Her case was supervised by Prof. Dr. Ir. L.P.B.M. Janssen and by P. Massolt of Testprint.

To calender or to stir?
In this case study an attempt is made to develop mathematical models for two different systems used for testing printing inks. From these models the flow regime and the stresses the ink undergoes should become clear. The first system consists of two rotating calenders, the second system is a marine type propeller stirrer placed in a cylindrical vessel.

The approach is the same for both systems: the Navier-Stokes equations reduce to a second order differential equation, which is solved for the appropriate boundary conditions to obtain the ink velocity in the middle of the nip (the smallest space between the two calenders) in the case of the calendering system and between the propeller and the bottom of the vessel in the case of the stirring system. The volumetric flow can be calculated and with this value and the equation for the velocity the pressure gradient is computed. By integration of this pressure gradient, with the boundary condition that the pressure is zero at infinity, the pressure is determined. Further, the shear stresses that act upon the ink at the walls of the nip (calenders) and at the stirrer and bottom of the vessel (stirring system) can be calculated. The elongational stress upon the ink in the middle of the nip (calenders) and between the propeller and the bottom of the vessel (stirring system) are also determined.

This whole process was first done in both systems for a Newtonian fluid. For a Newtonian fluid the shear stress is proportional to the shear rate and the constant of proportion is the viscosity (h) of the ink. The calculations were repeated for power-law fluids, because printing inks are usually modelled as power-law fluids. In power-law fluids the shear stress is proportional to the shear rate to the power n (about 0.5 for inks); the constant of proportion is the consistency K (for inks between 100 and 200).

With these equations four programs are written in Matlab: for both systems one for a Newtonian and one for a power-law fluid. The output of these programs are graphs of the ink velocity, the pressure gradient, the pressure, the shear stresses and elongational stresses; all plotted against the position in the nip (calenders) or the position under the propeller (stirring system). In these models the geometry of the system and other parameters of the system and the ink can be changed easily. The effect of changes of the radius of the calenders and stirrer, the number of revolutions per second of the calenders and stirrer, the width of the nip (calenders), the viscosity of the ink (for a Newtonian fluid) and the consistency and power of the ink (for a power-law fluid) are predicted.
The following conclusions are drawn:

- The ink velocities are of the same order of magnitude in both systems and the flow is totally laminar for the calendering system and also predominantly laminar in the stirring system. In the latter there is a turbulent vortex flow at the tip of each propeller blade.

- The main difference between the systems is that the flow in the calenders is completely symmetrical, each revolution an ink particle undergoes the same stresses, whereas in the stirrer you don't know how often and at what height between the stirrer and vessel bottom a particle passes, you only know the mean number of passages per second for all ink particles. This uncertainty is increased by the turbulent vortices at the tips of the propeller blades.
- The order of magnitude of the shear stresses is the same for both systems.
- The pressure gradient and the elongational stress in the calendering system are two orders of magnitude bigger than those in the stirring system (for the elongational stress this is based on hand-waving arguments).

A critical remark has to be made that though the model for the calendering system is a good representation of the real system, the model for the stirring system ("spreading with a knife") is a considerable simplification of the real system.

Scientific staff

Prof. Dr. L. Niesen

ManeaX through the eye of an accompanying professor

Friday, March 28 I find myself, still sleepy, on the platform of the Groningen railway station. With me 24 students and another companion. Wait a moment, didn't we have 25 students....? Unbelievable, Vincent is still in Morpheus' arms and will come one train later. He is our treasurer. Will the same thing happen with our money? It is just one of the questions that come to my mind.

When Evert-Jan Borkent asked me some time ago to be a companion of the big excursion of the student association FMF, my first reaction was: "But I'm already retired then". "We know" was the flat answer. Mmm, no simple escape for me. But do I want this? I once took part in a small excursion of the FMF, but that was twenty years ago. What would be my role? I'm allergic to group holidays. Would I fit in this group? I know practically none of the participants, although I assisted in selecting them. My most important problem for the moment is: which name belongs to which face.

At Schiphol Airport everything proceeds smoothly, apart from the fact that our group is chosen to test a new safety procedure of Continental, our carrier. Will take some time, but it will result in a fast check-in on return, we are assured. 30 minutes later, when some ten participants have been processed, one suddenly realizes that we do not return via Newark. End of the happening.

Boston

Already the first day, in Boston Common Park, we are confronted with a big demonstration against the war in Iraq. It serves well to readjust our prejudices concerning the USA: not everybody lines up behind the president. "Drop Bush, no bombs" is the most popular slogan.

That day the weather is nice; it turns out to be the only day. The cold occupies Boston and us. When leaving home I decided to take a summer jacket with me, which turns out to be a terrible mistake. Well, I'm not the only one with that problem.

The hostel is simple but well organized. Lying in a bunk bed is not a custom for me, but it does not present problems. Breakfast is another story. Dunkin' Donuts are here on every corner, but I did not imagine that I ever would start the day there. "Next in line", calls the sour boss. Well, I too would have a bad temper if I had to work there the rest of the day.

The group surprises me in a positive way. No fragmentation into subunits and no long faces, in spite of the freezing weather and the impressive walks we go for in order to reach Sun Microsystems and Microsoft. Our outfit is impressive, everybody in smart suit. It raises some excitement, because it is definitely not the local costume, even not in the companies we visit. But we make a good impression, because the group is alert and not afraid to ask questions. I still don't know what my role is, but the other companion, Frank van Steenwijk, assures me that I should not worry. He is the expert, because he participated in the big FMF excursion ten years ago. It takes time, but finally I get used to the fact that the slowest member determines the speed of a group.

This is the week for the computer scientists among us: Sun Microsystems (nice, easy going), HP (ditto, this is the old DEC lab), Microsoft (hmm, not the right approach and no drinks) and the Auto-ID Center at the MIT campus. I especially like this last visit, mainly because of the philosophical introduction of the director with his typical British tongue-in-cheek humor. For the physicists we have MIT (somewhat loosely organized), Harvard (the Harvard-Smithsonian Center for Guido, our only astronomer, the lab of Lene Hau, well known to many of us from her "Hendrik de Waard lecture" in Groningen, and a campus tour with a very Harvard female). We also visit the Science Museum. I know the enthusiastic stories of my elder colleague about the demonstration with the Van der Graaff generator. He did not exaggerate, it is very spectacular.

Our nicest outing is the visit to the Boston Celtics. There is so much action during the time-outs that we regularly miss the continuation of the play. We teach an impressing wave but the Bostonians don't learn easily. Prior to the match I'm exposed to the *power-snack* phenomenon in the Burger King. My God...

New York

Penn Station is big, like so many things in this metropolis. Georg creates excitement by losing his luggage in a dining area. In no time his suitcase is surrounded by a regiment of armed officials and after having spotted the unlucky owner, he is asked friendly but pertinently to take his belongings and keep them in sight. The New Yorkers are a bit nervous, with a war on. A few hours later we watch in awe the skyscrapers and huge billboards on Times Square, and later we do the same in the Metropolitan Museum. *Big* indeed. In the evening a number of us wants to go on the loose. Ruud has put all his valuables in a big bag, which he carries around. He does not like it and neither do we. Fortunately everything ends nice and cool in a Greenwich Village jazz club.

The next day we are lucky; our free Sunday is cold but crystal clear. A beautiful view from the Empire State Building. The queue is long, but it's worth it. Digital camera's buzz around me. I have a decent 10-year-old compact camera with me, but that is history. From now the world is ruled by megapixels and megabytes. During our first scientific excursion, Bell Labs, we are treated to a real snowstorm. So the weather can even go worse. Other excursions are to IBM (where Ruud Tromp is our host), Princeton and Brookhaven. All physics, all nano. It sounds pretty familiar to me because our Materials Science Center plays the same game. Too bad for the computer scientists, even at IBM they don't get much. We rent vans for two days. That turns out to be long enough, because during the second day, Brookhaven, the drivers get already rowdy. The scientific part is nearly over then.

Friday we visit Ground Zero. A sinister place, especially when it rains and storms as it does today (the weather can still go worse). There is still a lot of activity in what looks like a very big bomb crater. It seems a miracle that the surrounding buildings are not damaged much more. Here you start to understand something of the collective trauma this terrible event implanted in the Americans and especially in the New Yorkers.

Mexico

We got no blessing for our travel to Mexico City. An hour was planned to go by subway to Penn Station (normally 15 minutes), but it is insufficient. From our subway station trains depart only in the wrong direction, to the North. Only after six stations we can change direction, and this takes oceans of time in the early morning. Finally we are one hour before departure at Newark Airport, where we find ourselves in a real soap. At Continental neither the check-in counter nor the luggage belt is working. Nobody seems to know what to do. First we hear that we can forget our flight, but five minutes later one decides to check our group in. The *Continental power check-in*, three people per counter per minute. In the absolute chaos Niels M. did not recieve his boarding pass, but it is returned to him by the other Niels and by Astrid, our hero on socks. All is well that ends well.

After a surrealistic walk through a Mexican market, a kilometer with our entire luggage, we finally end in our hostel, 100 m from El Zócalo, the old central square of Mexico City. Slowly it dawns in our musty heads that this hostel has a cafe-restaurant-disco on the roof terrace, with a fantastic view of the cathedral. Armed with a Corona beer, the world suddenly looks fantastic to all of us.

Mexico City turns out to be full of contradictions. Beautiful architecture and beautiful mural paintings go together with garbage and poverty. Plugged with cars, but with a good subway system. Figures don't mean anything: the university (UNAM) appears to have 300,000 students at first, but later the number is doubled. It is a big number anyway, even for an agglomeration with about 20 million inhabitants. Lectures are given from early in the morning to late at night. We do not really watch it, because this week the university is formally closed and the students are absent.

So this week is filled predominantly with tourism, culminating in the impressive temples of Teotihuacán. If there is really an extra underground chamber in the great pyramid we possibly know in a few years, when the result of the UNAM muon absorption project will become available....

The day of Easter we land at Schiphol Airport, slightly knocked up. At parting with all ManeaX participants I feel melancholic. Three weeks together, in rain or shine, means something. Group processes are very difficult to control. This time there was no need: it was simply great.

(Mr.) Bert Niesen

Dr. F.J. van Steenwijk

Three weeks in ManeaX

The organising committee had done a good job: the tour was "all in". The programme covered the full day, always from the early morning, often till the late evening.

It was sufficiently exhausting that quite a number of the participants - take notice: not only the 50+ section - were caught nodding at times that were mistakenly perceived as rest points in the programme. Though the sleeping rooms in a youth hostel are not quite a five star accommodation, they served their purpose wonderfully well: I slept excellently during the three weeks of the tour.

Also in another respect the trip proved to be all-in. Treasurer Vincent distributed once every few days a fair amount of pocket money to each of the participants, thus enabling them to foot up the bill in pubs and restaurants. The greenbacks were physically handed out to each of the participants: It really makes you enjoy the value of money.
Being asked to join the excursion as a supervisor less than two months before departure - apparently several colleagues failed to grab the opportunity - I was determined to make the most out of the tour. The art of supervising is actually synonymous to the art of doing nothing. The heaviest task I had to perform is writing this contribution to the final report. I appreciate it that the committee confronted me with this burden first when we were back home already. I might have refrained from the tour if I had known in advance.

The second heaviest task to cope with, was marching a several-miles-detour conducted by committee member Boyana, under a heavy, high altitude, mid day burning, Mexican sun. Only the presence of a water booth along the way prevented us from serious dehydration. Marching was also practised when we visited some of the companies in the US (SUN, Microsoft, IBM, Lucent). These companies are located in area's that can hardly be reached by public transport. I am not sure that we were fully adjusted to the American way of life when we covered several miles by marching dressed in suit, tie and shiny shoes, and such in a zero to five centigrade, sometimes even snowy, environment.

Possibly we were better in line with American traditions on the occasions that time for dinner was short. Then, the so-called art of 'power snacking' came into play. The phrase 'power snacking' refers to stuffing the human interior with the products of McDonalds hamburger restaurants. I refrain from further commenting on this way of dining, in order not to offend possible American readers of this final report.

Maybe I should make a few remarks on the scientific part of the tour. After all, that was what ManeaX was to be about in the first place. Personally I consider the visits to the Auto ID Center (MIT), Lucent (wide band cell phone technology), IBM (nanoscience) and Harvard (Bose-Einstein condensates) as the highlights in the scientific programme, but, actually all the universities and companies we visited offered quite interesting programmes indeed. In some of the places you really got the idea: this is the place where the important progress is made. The scientific programme appeared to be rather more oriented to physics than to computer science, which might have been in place in view of the background of the participants: a majority of computer science students. Nevertheless almost all the students actively engaged in the discussions after the seminars and tried to get the maximum out of the visits.

Ten years ago I also took part in a FMF-excursion. I wouldn't mind if the interval to the next trip is reduced.

Frank van Steenwijk.

Organization

Overview

It is now about one and a half year ago that we started organizing this tour. We started of course with choosing a destination. India, Australia, Indonesia, Argentina, Canada, Cuba, Peru, Egypt, Brazil and South Africa went into the dustbin after lots of discussion. We agreed on the United States of America in combination with Mexico. The only fight we had to solve was to go to the East or West Coast: San Francisco or Boston and New York. The outcome is known and the real work could start.

A name was found soon, the logo and letter paper followed. Orienting on our destination started; what are the interesting universities and companies and which cultural phenomena can we visit in our limited time. The universities were no problem, with Harvard, MIT and Princeton nearby. Also a few of the companies were picked soon: Lucent's Bell Labs and IBM Research. We chose to visit 'local' companies; read local as American companies. In our field, companies like HP, Microsoft and Sun Microsystems immediately came up. Another problem was making contact with people at the universities and companies who were willing to organize a visit for us. From the scientific staff at the Department of Physics we got lots of contacts, the contribution of the scientific staff of the Department of Computer Science and Mathematics was rather disappointing. Just looking up e-mail addresses and telephone numbers and contacting people turned out to be a very successful approach.

The other (very) important thing was funding. Subsidies were no problem; we soon raised the estimated amount of money. The participants just had to pay their contribution, but the most important part of our revenues, the case studies, were a big problem. Despite the overwhelming charm of the two ladies, Boyana and Linda, it appeared to be very hard to convince companies that they should hire our students. We estimated ten case studies; at a certain moment we expected the tour could take place if we had six case studies. But one week before Christmas 2002, we only had two. Our mood became very somber; we'll never make it. But in the last week before Christmas, like a miracle, we raised three more case studies and got perspective for even three more. Things went fast from then and soon we were in the position to refuse companies: a luxury position.

We had already selected our participants. Unfortunately, we had to disappoint a few students, but we are confident that our selection with help of professor Niesen was objective and fair. About a week after the selection took place, Guido came to us with the question: Why didn't I hear yet if I can join the trip? Gulp, did you sign up? After some research, it seemed there had been a few-hour bug in our subscription system and because of that two subscriptions ended up in the wrong directory. Stress!! What to do? We decided to redo the selection; with a possible consequence that one of the already selected participants had to be disappointed now.

The organization went on and time ran fast. We had enough money, participants, one member of the scientific staff to join the tour, Professor Bert Niesen, plane tickets, hostels and an almost complete program. Finding a second member of the scientific staff appeared to be very hard. Again the scientific staff of the Department of Computer Science and Mathematics was very disappointing; none of them was willing to participate. As our departure date came closer and closer, we found Frank van Steenwijk, education co-ordinator at the Department of Physics, willing to join.

Our last task was to finish the program. Arranging some last visits went pretty easy. Just making a single phone call and a few e-mails were enough to arrange the visit to Sun, the Astronomy Department of Harvard University and the Corona Brewery. All this happened about one month before departure. Only the script for the participants and the committee had to be set up. The Internet was THE resource for almost everything we wanted to know: time tables, maps, opening hours and other useful information.

The participants were already in the right mood. The gatherings with talks (by Mr. Papousek from the Center for Mexico Studies and Michelle Knight, who worked for reporter Max Westerman in New York), a short introductory course in Spanish and a real Mexican film ('Y tu mama tambien') took care of that. Knowing that everything was arranged, we had a rather relaxed last week in which we could pack everything we had to take, including our gifts (university mugs and a picture of the whole group).

What followed were three fantastic weeks as you can read in this report. Everything went very smooth and according to our schedule. Ewoud and Evert-Jan guided everyone strictly (but fair) to the scientific visits, where we always arrived right on time. Boyana and Linda guided us around in the three fantastic cities and Vincent always took care of the financial part. The co-operation between the five of us during the tour was good.

The interesting scientific visits, the fantastic museums and other sightseeing's in three gorgeous cities and overall the fun we had during these three weeks, made the one and a half year's work more than worth it. Both the organization and the tour itself are an experience we will never forget!

Evert-Jan Borkent	chairman
Vincent Hindriksen	treasurer
Ewoud Werkman	foreign relations
Linda Bralten	business relations
Boyana Petkova	business relations

Chairman

Five committee members, 2 members of the scientific staff, 20 students, one and a half year of organization, over 2000 incoming and outgoing e-mails, over 1500 letters, 14 case studies, a turnover of 70,000 euros, 38 committee meetings, 3 preparatory gatherings with all the participants, over 100 phone calls to the USA and Mexico with our 20 contacts, and finally about 20,000 kilometers to travel.

Only a few numbers to indicate what it takes to organize a three-week study tour to three amazing cities: Boston, New York and Mexico City. Being chairman of all these numbers means feeling responsible, stress, no time-off, but most important: lots of fun!

During the organization process, I learned that being a chairman is not always easy. You have to govern the committee, sometimes more, sometimes less. Now and then some of them gave me a hard time, by not showing up at our meetings (with some silly excuse…), or not doing the things they had to do. But in the end the organization went pretty easy and smooth and almost everything went according to my tight schedule. Of course, things got delayed, but that was accounted for (at least by me). The only thing that really kept me awake was the 'delay' in obtaining the ten case studies, a few weeks before Christmas I thought we would never get enough case studies, and as a consequence have to cancel the trip. A nightmare to me, that would mean that one year of work was flushed down the toilet and 20 students had to be disappointed. But Christmas gave us the presents we needed and the money problem suddenly disappeared. Thanks to the great work of Ewoud, a few weeks before departure the program was almost set and done, which made the last weeks quite relaxed. Well relaxed… Thoughts like "Didn't we forget anything? Will everything go the way we planned? How will the group react on our 'orders'?" kept me busy.

March 28, 2003 was D-Day. We gathered at 7:15 AM at Groningen Central Station. Vincent overslept!! I was stupefied such a thing could happen! After arriving safely in Boston and with everything going smooth, I slept well. The two following days we followed tour guide Linda who guided us through beautiful Boston. Ewoud and I were in charge for the rest of that week and that went very well. We knew the script by heart and that made things pretty easy. Internet rules, the Lonely Planet sometimes.

In New York the script was the same, tour guide Linda guided us through the Big Apple and Ewoud and I guided everyone smoothly (except for small detours of some of our mini vans) to the scientific visits. The arrangement of an internship position at Bell Labs was a personal highlight of this week.

Mexico City was (besides the trip to Mexico) even more relaxed, but in a certain way also more exciting. More relaxed, because the program was less busy and there was more time off. More exciting, because we knew less. Mexican public transport companies had not discovered the Internet yet and of course, we didn't speak Spanish. But tour guide Boyana knew almost all the time what she was doing (the 2 kilometers detour could not be prevented by me, I was delivering some ill people at our hostel…) and had great knowledge about the Mexican history and the story behind the things we visited. This last week was interesting, relaxed and fortunately warm. A perfect end to a busy trip. A cold Corona beer on our roof terrace with a perfect view over the old historic center of Mexico City makes everyone a happy person.

In the end all the thoughts that kept me busy before the trip, were groundless concerns. We forgot nothing, everything went according to plan and the group was very easy to handle. The overall feeling of the trip is best described by the words: tired, satisfied and proud. Tired speaks for itself, satisfied because everything went well, and proud about the fact that the five of us have been able to provide 27 people, including ourselves, three weeks they will not forget. Well, the five of us. That would wrong a lot of other people. I'll not mention them here; you can read the acknowledgement for that. Personally, I just want to thank the participants for their positive attitude and for the fun we had and I want to thank Ewoud, Boyana, Linda and Vincent for their hard work and for the fun we had during our meetings and of course during our ManeaX-dinners. My liver is still working on the Corona beer and Californian wine… a great souvenir.

Evert-Jan (a.k.a. El Jefe)

Commissioner for foreign relations

While cleaning my room, I found my agenda of 2001-2002. I picked it up and while browsing, I saw an appointment which drew my attention: Thursday December 20, 2001 @ 4 PM: GBE, BONK.

Browsing back I see that it is the first appointment that mentions GBE, BONK. Browsing forward, I see and know that it won't be the last...

At one of the first monthly FMF-drinks of that college year, I was asked if I would like to organize the study tour of 2003. Not really knowing what it would mean to organize such a trip, I said: I'll think about it (this usually means: I'll do it, but don't know it myself yet…).

So I became the Commissioner for Foreign Relations for GBE ManeaX '03. The BONK was the usual room for our meetings about the journey. We had a brainstorm session to create a list of possible companies and universities to visit, which was quite impressive: MIT, Bell Labs, Harvard, Princeton, Yale, IBM, UNAM. I remember myself thinking: if I could arrange this… no, no way, stop dreaming! But how do you arrange these visits?

First of all, the Internet is your friend! The University of Groningen (especially the Department of Physics) has quite a lot of researchers that have contacts in America. I created a list of all these contacts and their e-mail addresses and started to send out emails with a request for a visit. E-mail was stage one of my Masterplan™ and is a very convenient way to get in touch with people, but there is one drawback: maybe it's too easy. Important people tend to get a lot of e-mail, and apparently too much, since not all of my e-mail got a reply. That's where stage two comes in: sending a reminder within 10 or 15 days. Usually that didn't help enough, so I went to stage three of my Masterplan™. Every university has a public directory of all the employees on their website (did I already mention that the Internet is your friend?), so it was easy to find out which telephone number I needed to get in touch with somebody. For companies I usually called the general access number (found on their website) in stage three of my Masterplan™ and used my prepared introduction combined with my sexy voice to overwhelm the nice female person at the other end of the line (yes, … always women!).
Because most of the people I wanted to contact were quite busy people, stage three failed often. So stage four was invented: repeat stage three infinitely or until success. And that worked!

With help of my Masterplan™ I was able to arrange most of the intended visits. It was very nice to talk to the contacts personally and every one of them was very enthusiastic about our trip and wanted to co-operate as much as possible. If they couldn't arrange a visit, they got me in touch with someone else who could.

The day of departure came closer and closer and it was a big relief that also the financial situation was going to be fine. Thanks to the strict planning by our chairman, in the two weeks before our departure there was time to arrange the final small details and it gave us some time to relax a bit.

Then, finally, after one and a half year of work, we started our journey with almost no problems (I won't mention here that Vincent overslept, everybody else will…). My biggest doubt during the tour was related to all the visits to the universities and companies: do they expect us?? Of course, I arranged most of the visits and to my knowledge everything was arranged in very little detail, but you're always dependent on the party you visit. Not even my Masterplan™ could do anything about this. Maybe something went wrong and we get, totally dressed up in nice suits, the question: "Who are you??!! University of Groningen? Never heard of. A tour?? We don't do tours!" or "We're expecting you tomorrow, not today?!" It was always a relief for me when people were expecting us and had everything arranged tiptop. Lots of thanks go to the people who made these visits possible!

I won't tell much about the journey itself, you can read that in the rest of this report in much more detail, but I will mention the group of participants, the committee, the companies and universities, the Budweisers, the Corona's and tequilas, the beautiful cities Boston, New York and Mexico City; they all made it an experience I'll never forget! Thanks!

While checking my current agenda, I see an appointment: June 26, 2003 @ 1 PM: GBE BONK. It's the last...??!!

Ewoud

COMMISSIONER FOR BUSINESS RELATIONS

Because it's always nice to travel and see new things, it was not difficult for me to be enthusiastic when I was asked if I was interested in being a member of the GBE committee. Of course! The last committee warned us: it would take a lot of your time, it's difficult to get case studies, if you don't get enough case studies all your time and effort will be wasted. Okay, my enthusiasm got a little bit more realistic. They also told us about their trip to Japan and we were brainstorming about our destination. Southeast Asia, Mexico, the US, Australia, just imagine! Then there was no way back, I really wanted to be in this committee!

One of our first meetings was dinner at Vincent's place. The big question was who wants to do what in this committee? The girls (Boyana and I) were very ambitious and wanted to take care of arranging the case studies. Our charms had to be sufficient for at least 10 of them (we thought then). The whole committee was happy with his/her task and the evening ended in everybody having a great time (some proof of this can be found somewhere on our website).
The moment was finally there, we had to decide where we wanted to go, and what was doable. There were two destinations left on our list (after skipping Cuba, Florida, and the whole of Latin America): San Francisco and Mexico City or Boston, New York and Mexico City. The voting could begin: San Francisco, San Francisco, Boston and New York, Boston and New York, and… blanco. After a few days of trying to persuade each other, there finally was a result: New York, New York! We were going to the Big Apple, we would visit the number one university Harvard in Boston, and we were going to be on the Middle And North Eastern America Excursion!!! (It's not difficult to guess what my preference was.)
I really have to admit that the excursion was even better than I thought it would be. The US was just like Friends and Ally MacBeal learned us, in Mexico City I learned that I am actually extremely tall, all Dutch songs really sound great translated in English, we learned a new move from our Harvard tour guide, if you say it takes long it doesn't take that long anymore and chilling at a roof terrace with a Corona is rather nice. But especially the group was great! Because I was only a first year mathematics student and there were mostly physics and computer science students on this trip, I didn't know the group very well in the beginning. I had only met them on a few meetings we had organized for the group: talks about Mexico City and New York, learning Spanish (un poco) and watching a Mexican movie. But as soon as the trip had begun, we were one happy group together. And also after the excursion, at the reunion, we still were ManeaX '03 and we'll probably remember this trip forever, or else the enormous amount of photographs will help us!

Linda

TREASURER

The story behind the walking ATM

Inexperienced I joined the GBE 2003. To me it seemed to be incredibly interesting and exciting to organize such a big event, but what to expect I did not know. During the start-up of the committee I put my energy into making the web page and thinking about the logo. To that last part I only introduced the X of ManeaX. But having an overview what to do? No, but happily enough we had Evert-Jan.

When Bas quit, I was asked to be the treasurer. My father is an accountant and the FMF organized a crash course in accounting, so that shouldn't be a problem, should it? But after questions like 'What are assets and debts?' the people of the board of the foundation started to sweat. Luckily we had a joint enemy: the ABN-Amro bank. I once had to explain to the bank employee how to unblock my bankcard, heard another tell me I had to come back the next day because he didn't know anything about travelers cheques, was not able to order a credit card because the computer network of the company had some troubles, etc. But I have to say: they did all their mistakes in suit! Reason enough to go to their desk every week, to repair the mistakes that were made and being recognized. Some people may also recall some mistakes I made. Something with the subscription script, an online diary with inaccessible days and the infamous I-don't-know-how-to-set-my-alarm-clock on the day of departure.

The day of all days came closer and closer, the sound of drums rolled through my head and suddenly there was our take-off! Before that, on Schiphol Airport, I gave 2700 dollars to the participants, so they knew that they had to be very nice to me. One month before I bought a Palm and of course our computer science student wanted to take it with him. I wasn't unhappy with it: besides playing Patience, waking up my roommates with a cat-sound, I also could register all the transactions I made. I was even more proud of the wallet around my calf. Kneeling down and getting some money without using some sort of bank code or having to talk to bank employees (even if they weren't ABN-Amro's) was great fun. Now I go to the ATM for much smaller amounts of money. Sometimes I had to talk to myself not to go completely mad by carrying thousands of dollars on me. Just smiling at the people on the street and trying not to be noticed, really helped and after some time the feeling of being robbed and killed went away. Throwing with money also had its advantages. The people of Hostal Moneda (Mexico) thought I was the big boss, but after it was cleared up it was EJ, the number of drinks on the house got less.

Besides being Santa Claus I also had three incredible weeks and I'm now going back to administrating and hopefully also back to study. I would personally like to thank Evert-Jan, Boyana, Linda en Ewoud for the fun and learning during the past one and a half year.

I also would like to thank all world travelers for your participation in 3 weeks full of nano and other subjects.

Vincent

Commissioner for business relations

Being a member of the committee, I'm supposed to write something for the final report. And being a member that has a 'mañana mañana' lifestyle at the end of the academic year, I wrote this on the very, very last day (the deadline is postponed twice already because the other committee members think the same way).

In the meanwhile El Jefe has left for the United States and Ewoud has taken over his job as a strict but just chairman. The part of the committee that is still in 'Grunn' has returned to the Dutch rhythm of life. Exams and work that has piled up while we were gone cause long days with little sleep. Of course our friends all want to know what we experienced during our trip. I have spent nights telling passionately in noisy Dutch bars about how great the view over the Mexican plain is once you stand all sweaty on the Pyramid of the Sun in Teotihuacán while you're trying to catch your breath. And how awful it feels to walk uphill through piles of snow in a skirt and high heels to a computer company. Or how much I liked the American universities and how I'd love to study there. And so on and so forth.

Not only the impressive surroundings, the beautiful buildings and the state of the art technology made this trip an unforgettable experience for me. My dearest memories are of the people that went on the trip.

I recollect the puking Casper, who kept telling me that he wasn't sick while he tucked himself in under a woolen blanket because 'it was so cold'. The temperature was 25 degrees Celsius. Or Georg and Johan, with whom I chased away many hotel guests at the hammocks by singing loud and especially out-of-tune songs from the musical Aïda. Fortune favors the brave, guys!

And every time I see Huge Nanny, I have to think about how easy it is to make contact with Americans in a Mexican airport bus. Haha, and how could I forget Ralf, who told us indignantly how his currant bun got dissected at the New York customs because it could have been a terrorist weapon.

Since this trip I'm addicted to Bubbilicious. I'm practicing my bubble blowing skills every day and one day I'm sure I'll beat you, Hylke!

Anyway, I like to tell my friends about the trip. And especially about you guys, the people that made this trip so fabulous. I'm sure I could tell an anecdote about every single one of you, but my space is limited. I'd like to say to you all that I have had the most amazing time and I'd love to go on another journey with you!

Finally, I would like to address my committee.

Evert-Jan, dear monkey tail, thank you for your leadership and patience. In difficult times we could always rely on you. You did a hell of a job! Lots of success with you internship in the States!

Linda, why didn't we make up a nasty nickname for you? I'm glad you were part of the committee. This way there was at least one other person that couldn't laugh about sick computer jokes. I wish you the best during your medicine studies and I hope you fulfill your ambitious plans and find a great internship in the US like EJ. You have a lot going for you, girl!

Vincent, dear Fonz, although we didn't always get along, I could really laugh with you. Maybe not everyone gets our kind of humor but I had some great moments with you. I'll see you next year in the corridors of the IWI, I think we both have to get some credit points....

Ewoud, monkey sandwich, I really appreciated your unbridled dedication during the trip. You played a big part in making ManeaX '03 the success it was. Thank you for the teamwork, which was never unpleasant due to your dry humor and your charming smile. I'll see you at the next FMF-party!

Boyana

Board Foundation GBE-FMF

It is often heard that it is difficult to reach the top, but even more difficult to stay at the top. After the successes of NIPPON '01, however, we had no difficulties in finding a committee motivated to repeat such an achievement.

We all know planning a trip for 25 students is not the same as planning a holiday with one's partner. Although many of the problems are the same, there are differences. The argument: 'Sweetheart, I am going to Mexico, join me or stay here', does not work in a committee of 5 people.

I expected to write the preface of this final report and was not prepared to be in the committee chapter. Now I have to explain what we have done. Fortunately, there was not much for us to do. Most of the time, we supported the members of the committee and made sure that mistakes from the past would not happen again.

Our main activity was to keep an eye on the daily businesses and especially on the finances. Therefore, we regularly met with the chairman, both in a formal and an informal manner. Here, we discussed ideas, problems and the schedule. Thanks to the experience gathered by NIPPON and de competence of the committee, the organization went fast and precise.

The last thing I want to do, is to thank everybody who helped to make ManeaX a success. I want to call some specifically, The Rijksuniversiteit Groningen, the FMF, all the institutes who supported us financially, the professors who assisted the cases and of course all the participants. But the people who made it all possible are Evert-Jan, Vincent, Linda, Boyana and Ewoud.

In a few months, we will start the search for members of a new committee. We will try to find a successful mix of experienced people with youthful enthusiasm. If you are interested, do not hesitate to contact us, or the former committee and organize your own intercontinental excursion!

Mark Hagedoorn
Sybrand Jissink
Nanne Huiges
Niels Maneschijn
Gerard Wolters

Financial Report

Balance and Settlement

Here you can find the financial report of the study tour in the form of the settlement of revenues and expenditures and the balance sheet. A few remarks on these numbers are in place.

The settlement is quite straightforward. A few remarks on the reservations: we decided to reserve the revenues of one case study as a starting capital for the next study tour organized by the Foundation GBE-FMF. This money will give the next committee some air on the difficult track of raising enough money. The reservation for the foundation itself is for changing the foundations regulations and to cover expenditures between study tours. The reservation for computers goes to the FMF. Since we used their computer infrastructure for almost two years, the FMF expects us to participate in their expenditures on computers. Parts of the subsidies from the University of Groningen were warranties; we will restitute them.

About the balance, next to the mentioned reservations, only the final report has still to be paid.

Balance
September 1, 2003
All numbers are in euro's.

ASSETS	
Postbank	1
ABN-Amro	8513
Credit Card	3
Total	**8517**

LIABILITIES	
Reservations	7000
Final report	1517
Total	**8517**

Settlement
November 1, 2001 - September 1, 2003
All numbers are in euro's.

REVENUES	
Subsidies	**12590**
RuG - Faculty of Mathematics and Natural Sciences	2500
RuG - Department of Mathematics and Computer Sciences	1600
RuG - Department of Physics	1200
RuG - Department of Astronomy	400
RuG - Nuclear Physics Accelerator Institute	750
RuG - Materials Science Centre	500
Foundation Roode- of Burgerweeshuis	1750
Netherlands' Physical Society	1250
Foundation FOM	750
Foundation GUF	640
Astron	500
Space Research Organization Netherlands	500
Chamber of Commerce Groningen	250
Participants contribution	**25300**
Scientific staff	2800
Students	22500
Case studies	**32650**
ECCOO	9900
Nederlandse Aardolie Maatschappij N.V.	3300
Astron	1300
SKF	1650
Schuitema N.V.	3300
Microsoft Nederland	3300
RuG - Faculty of Medical Sciences	3300
RuG - Department of Biomedical Engineering	1650
RuG - Research school GUIDE	1650
Testprint B.V.	1650
Academic Hospital Groningen	1650
Initial balance	**960**
Interest	**50**
Total	**71550**

EXPENDITURES	
Organization	**4310**
Participant meetings	830
Banking costs	220
Representation and gifts	620
Vaccinations participants	2010
Miscellaneous	630
Printing costs	**2080**
Final report	1520
Letter paper	255
Miscellaneous	305
Transportation	**20890**
Plane tickets	17340
Train Boston-New York	2830
Train Groningen-Schiphol	720
Stay in USA and Mexico	**36850**
Hostels	13970
Meals	15320
Excursions	3240
Travelling	3920
Mobile phone	400
Reservations	**7000**
Commission	3300
Foundation	1000
Computers	1700
Restitution RuG-subsidies	1000
Loss on currency exchange	**420**
Total	**71550**

Acknowledgements

Of course, five hard working students cannot organize a three-week study tour like this by themselves. Though we claim all the credits and we did indeed suffer the heavy responsibility, we want to express some words of thanks to all the people who contributed to making this study tour a success. The words of thank are expressed in a 'random' order.

First of all we want to thank all the student participants: Hylke, Martijn, Casper, Johan, Ralf, Arend, Rogier, Niels H., Ronald, Nanne, Feike, Niels M., Joost, Georg, Teake, Wouter, Hans, Astrid, Ruud and Guido. Your hard work on the case studies, enthusiasm during the preparatory gatherings and especially during the tour itself, dedication, jokes, photo shooting, intelligent questions during visits and not moaning a single moment during the tour made it very much worthwhile for us to organize this tour. We also want to express lots of thanks to Bert Niesen and Frank van Steenwijk, the two members of the scientific staff who joined us. Both of you were wonderful, nice, easy and interesting company. Everything mentioned for the students, except the hard work on the case studies, also counts for you two.

Lots of thanks also to the board of the Foundation GBE-FMF consisting of Mark, Niels, Nanne, Sybrand and Gerard. Your advice, help and pressure kept us on track. Thanks also to the board of the FMF, your almost always perfect facilities (computers, coffee, tea, envelopes and carbohydrates (read: sugar)) made life much easier for us. And thanks for the money of course!

A study tour like this cannot take place without funding. We want to thank the subsidizing institutes from the University of Groningen:
- Faculty of Mathematics and Natural Sciences
- Department of Physics
- Department of Astronomy
- Department of Mathematics and Computer Sciences
- Materials Science Centre (MSC)
- Nuclear Physics Accelerator Institute (KVI)
- Foundation Groningen University Funds (GUF).

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- Foundation for Fundamental Research on Matter (FOM)
- Foundation Roode- of Burgerweeshuis
- Chamber of Commerce Groningen (KvK)
- Space Research Organization Netherlands (SRON)
- Astron.

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- Astron (Martijn van Veelen)
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- Department of Biomedical Engineering (Prof. Dr. Ir. H. Duifhuis)
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- Faculty of Psychology, Education and Sociology (Thomas de Maree)
- Faculty of Natural Sciences and Mathematics (Jan Poutsma)
- Office of the University (Wybe van Dijk)
- ECCOO (Hans Beldhuis).

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- Massachusetts Institute of Technology - Prof. Subra Suresh and Kenneth Green
- Harvard University - Eugene Avrett, Bill Carter and Prof. Lene Vestergaard Hau
- Auto-ID Center - Tom Ahlqvist Scharfeld
- Bell Labs (Lucent Technologies) - Eric Isaacs
- Watson Research Center (IBM) - Rudolf Tromp
- Princeton University - Prof. David Srolovitz and Daniel Steinberg
- Brookhaven National Laboratory - Elaine Lowenstein
- Universidad Nacional Autónoma de México - Prof. Roelof Bijker
- Embajada del Reino de los Paises Bajos en Mexico - Katja Schoemaker
- Corona Cerveceria Mexico D.F. (Grupo Modelo) - David Pérez.

Also lots of thanks to all the other people that kept us busy by giving a talk or walking us around the labs. We really appreciate the time and effort you put into it.

Furthermore we want to thank our Board of Recommendation:
- Mr. B.J. van Eenennaam, Dutch Ambassador in the United States of America
- Drs. R.A. Vornis, Dutch Ambassador in Mexico
- Drs. Jacq. Wallage, Mayor of Groningen
- Prof. Dr. F. Zwarts, Rector of the University of Groningen
- Prof. Dr. H. de Waard, Professor emeritus of Physics
- Prof. Dr. Ir. L. Spaanenburg, Professor of Computer Science.

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- Prof. Dr. Ir. P.W.M. Blom
- Prof. Dr. Ir. E. van der Giessen
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- Dr. H. Hasper
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