

S.V.N.B. HOOKE

STUDY ASSOCIATION
NANOBIولوجY

**Internship
experiences
2017-2018**

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Introduction

Dear student,

In this booklet the Master Committee has tried to accumulate a collection of some of the experiences former nanobiology students have had with their Master internships. Some of these were done at companies, some at external institutions in the Netherlands or abroad and some were done at the familiar labs in the Erasmus MC and the BN department.

We hope their experiences can help you a little to make the choice for your internship a bit easier and the most enjoyable experience possible.

On the following page you will find the course info, the contact info of the featured (ex)-students and thereafter you will find all of their stories.

Good luck!

ML2



General information

Disclaimer: ML2 cannot be held responsible for any mistakes.
No rights can be derived from this information.

Your master internship is worth 18 ECTS, meaning you work 3 days a week for half a year or full-time for ~3-4 months.

Concerning Internship and Master end project within the Master:

- At least one of these should be followed within the Bionanoscience department or within Erasmus MC (i.e. you cannot perform both at an external institution)
- Both may be followed within the Bionanoscience department but not within the same group (same PI).
- Both may be followed within the Erasmus MC but not within the same group (same PI).

More information can be found on brightspace and in the study guide. For Brightspace go to:
Brightspace TU Delft > enroll in course Internship Office Applied Sciences

If you have further questions, you can contact the following people:
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AMOLF, Systems Biophysics

Nick de Lange

I chose to send an email to the Biophysics group leader Sander Tans (Systems Biophysics department) because of several reasons. First, we already had a visit at AMOLF before, which was organized in the Nanobiology Bachelor. Also I preferred to do something where I could combine my knowledge of physics and biology, so the Biophysics group was a logical choice. Additionally, I knew many of the staff also partly work at TU Delft (including Sander Tans), and with the moving BioNanoscience department in Delft I considered this as a good opportunity to work on an interesting project in a similar environment as I was used to in my Bachelor End Project, without potential problems of the move. And as an extra plus an allowance is provided (fulltime ~ €500,- per month) at AMOLF. Luckily Sander Tans replied that he had some available projects for me and I was given the possibility to choose the most appealing one. Shortly after I met the PhD student, Martijn Wehrens, who would guide me with my project.

To summarize, my project was to find the (potential) influence of cell size on protein expression & growth dynamics in E.coli. We grew filamentous E.coli cells by adding an antibiotic known as cephalaxin, which promotes cell size, and made phase contrast images as well as fluorescent images over time to study these phenomena. Additionally, we performed some experiments with addition of IPTG that activates *sulA*, a protein which disrupts the FtsZ ring formation and prevents thereby cell division, to again promote cell size. Also remarkable to see here was the fast recovery to normal sized cells when transferred to another medium without IPTG. These recovery experiments were further performed by Martijn Wehrens. During this project I have also written a new custom Matlab script to automatically detect the length of these filamentous (& normal) cells, and implemented this in the Matlab analysis software.

As result other group members could also benefit from this and were even able to adapt my code a little bit to artificially straighten cells, which was very beneficial for the whole group.

A regular week for me meant three days of working from 09:00 till 17:30 at AMOLF (and two days of electives and mandatory courses). Luckily, AMOLF was very flexible making changes in this schedule due to new courses during my internship. Also events like sportdag, 1-day trips and PhD graduations of group members make your internship more diverse.

In conclusion, I would definitely recommend doing your internship at AMOLF, as I personally liked it even more as the projects I performed earlier at EMC or TU as a whole. I can imagine myself working here, or in a similar environment, later. However, I would probably want to move closer then, because traveling around 2.5 hours each day for five days a week would become too much for me.



Corbion

Enes Sahin

The company Corbion focuses on the production of lactic acid and lactic acid derivatives like ingredients and supplements for food, cosmetics, bio-plastics and medical applications.

The department in which my internship took place is the biotechnology department of the research and development location of Corbion. The main aim within this department is to optimize the lactic acid production process. The company is project orientated and I worked on a project to optimize the fermentation by controlling the whole process on the concentration of a specific component essential for fermentation. This implied the correct detection of this component during fermentation and subsequently making the whole process react in a specific way to maintain the desired concentration of this component. I have written a script in the fermentation control software which has to carry out this function. Afterwards we have performed a lot of fermentations to see whether we made progress and were able to optimize the whole fermentation process. Due to confidentiality agreements this is the 'most detailed' description of my project that I'm allowed to share. During my internship I had direct, both theoretical and practical, supervision from Jasper Meijer. I also got additional theoretical supervision and explanations from Suzanne Verhoef who mainly helped me on writing my report.

After having done my bachelor end project in one of the lab groups at TU Delft I wanted to get a taste of feeling how work it is to work in a real company. One of my teachers of my bachelor knew that I was interested in a company internship and informed me about the possibility of doing an internship at Corbion. I applied for this project and got accepted. It was a really nice experience to work in a company.

There was a special room for interns of different departments and different universities sitting together behind their own computer.

It was nice to meet and share information with people of different backgrounds. It was also interesting in how all those students with different backgrounds helped each other out whenever someone encountered a problem. The project I've been working on also brought me new experiences and especially improved my lab skills enormously. Also I got more familiar with new software and new analytical devices. A full week at Corbion was 3.5 days for me since I also had to follow courses. I'm happy that the schedule for the first year of the MSc Nanobiology has been updated which will ease the next students during the internship. This will enable them to focus fully on their internship. The organization and the atmosphere in Corbion is really nice and professional, which makes the idea of working here very attractive. The allowance that you receive during your internship is also a positive factor which potential interns for Corbion should keep in mind. However, the accessibility of this location is not the easiest so keep that in mind too.



Labonovum

Vinesh Badloe

The company supervisor was dr. François M. Verheijen in cooperation with dr. D. Poland. The university supervisor was Ben Tilly from the Erasmus MC. Labonovum BV has a focus on the development of new devices to collect body fluids. Hem-Col®, Ser-Col® and 24hU-col® are projects in development. The company exists of Clinical Chemists and Microbiologists.

I was working on the Ser-Col project to optimize to Ser-Col process and the validation of enzymes and lipids. An analyst of Labonovum (Ronald Huisman) was helping me with my daily experiments and measurements. Once a week we had a conversation with Dennis to keep everything up to date and keep the project on the right track. Once a month I had a meeting with Francois and a separate meeting with Ben to give an update about the progress and oncoming experiments.

My motivation to choose this organization was the chemical aspects that were combined with the development of a new method. Nanobiology has a few courses on chemistry, which is too little in my opinion.

The internship was indeed what I expected. It had a part of process optimization and a part of validation, which could be investigated on nanoscale. I managed to create an idea based on their developments, which combines Nanobiology with different projects of Labonovum. I really had a great time working with Ronald and I could see myself working with him in the future on my own idea for Labonovum to bring the company from microscale to nanoscale.

The main difference between working on the university and in this company is the ability to develop a mind-set that triggers you to get the best out of yourself. On the university it is working according to the guidelines, rules and the things you get told to experiment. In this company they gave the final achievements and you could figure out by yourself or with help of the supervisors how to get to this goal.

This gives you the chance to really experiment, fail and understand every detail of what you are doing.

The Albert Schweitzer Hospital Zwijndrecht was easy to reach with public transport. My allowance was 250 euro each month, which was meant as transportation cost.

It is a young and innovative organization that does not tell you what to do, but gives you the space to develop your own skills. I was allowed to join meetings and explain my own thoughts, to learn how this company shares their knowledge with each other. I would definitely recommend other students to do their internship at this company.



Labonovum

Innovative Laboratory Medicine

VSParticle

Amanda van der Sijs

I studied the possibilities of implementing (aerosol) nanoparticles synthesized by the VSP-G1 in biological research by mapping all the current implementations of nanoparticles in biology/healthcare research and looking where our particles could be of good use. Attended meetings with possible research collaborations. Big part of my internship (experimental) was developing a way to capture the aerosol nanoparticles in liquid and stabilizing them. Had also contact with researchers of the RID and Erasmus MC to create Palladium – Iron Oxide particles for cancer treatment, now setting up the outlines for that project to be continued.

How long did you work there, fulltime or parttime?

Almost full time, except from lectures I had. So in the end I did 18 ECTS internship and 12 ECTS courses in one semester.

What did the work entail?

Reading a lot of papers, mailing researchers and companies, building a setup in the lab, measuring size distributions in the lab and particle sizes at a lab in TNW, attending meetings with possible healthcare related research collaborations.

Was the project relevant to nanobiology or some other field?

When I started my project, I was actually the one to explore the biology related possibilities for the nanoparticle generator. I mostly learnt about nanotechnology, the science behind spark ablation and biosensors. At this moment there are many possibilities that are more nanobiology related than when I first started.

What did you think of the company/university outside of your project?

Very nice. Everyone is so involved in what the company is doing, you really want everything to succeed. The ambiance was very informal.

Did you enjoy the project?

Yes! Although I couldn't apply my nanobiology knowledge that much in the beginning, I learnt a lot about nanoparticles and their applications in the field of medicine. The company is also growing a lot, it was very nice to be so involved (as this startup contained only 12 people when I started here, and now it's already around 17, so you know everything that's happening)

How was working at VSParticle different from doing your BEP/MEP?

Would you recommend current and future students to take their internship at VSParticle?

You have to think about the implementation of the research you're doing. What are possible applications for other researchers that might buy our nanoparticle generator? What are the advantages compared to the current methods? What can you offer your clients, what can they benefit from? You learn to think outside the box, especially at VSParticle which has developed a tool that can do things you couldn't do before. This requires thinking more broadly in the possibilities for research and new applications that weren't an option before. I got the feeling that I was more involved, that my work was actually important for the success of the company (especially because it's a start-up), not just random research at an academic institute without sight on the relevance later. I would recommend it, but only if the company is doing research. Not sure if I would have liked it the same way if it was only business without direct science.



VSPparticle

Harvard Medical school

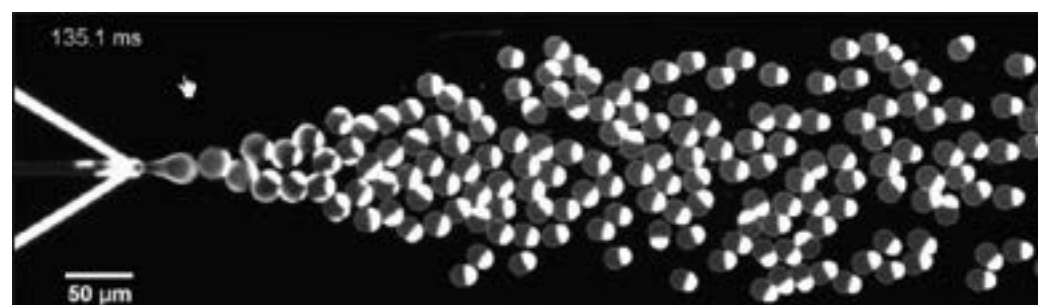
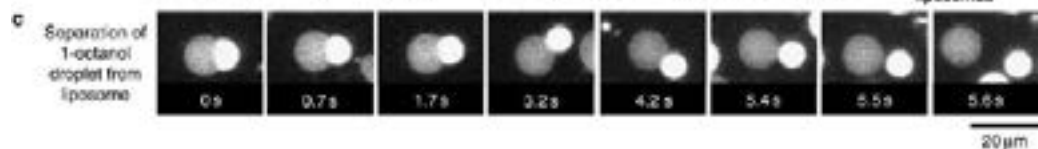
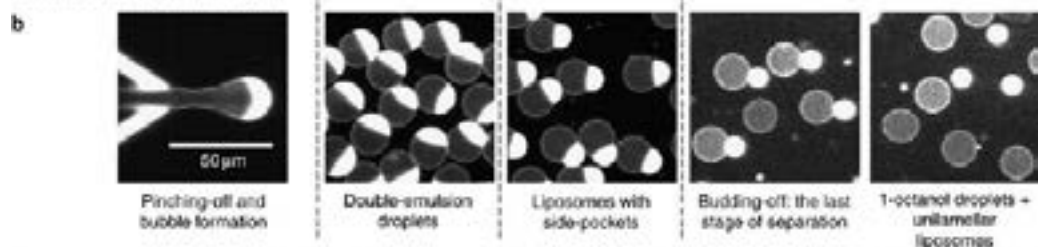
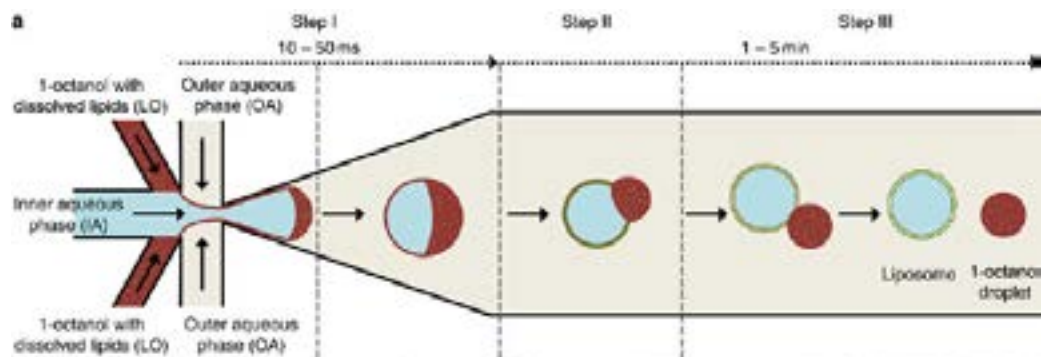
Kasper Spoelstra

I did my internship in the lab of Nobel laureate Prof. Jack W Szostak (Harvard Medical School/Massachusetts General Hospital). His lab aims to research the question “how did Life emerge on planet Earth”, from a biochemical perspective. I had done my bachelor project in the group of Cees Dekker (TU Delft), and there I worked with a system (the OLA system) that members of the Szostak lab also wanted to use. My primary role was to install that system and to make it compatible with the research they wanted to do with it. I worked there three months full time, and enjoyed it very much.

If you have any further questions do not hesitate to contact me via wkspoelstra@hotmail.nl



HARVARD
MEDICAL SCHOOL



McGill University, Biomed. Eng.

Marloes Arts

I did my internship project at McGill University (department of Biomedical Engineering) in the lab of Dr Maryam Tabrizian, in collaboration with the lab of Dr. Stéphanie Lehoux in the Lady Davis Institute in Montréal, Canada.

McGill is a prominent research university and the lab of Dr Tabrizian (which is called Biomat'X Research Laboratories) is a very diverse lab with members that have very diverse backgrounds (around 15 people). The main topics in this lab are regenerative medicine, nanomedicine, biomaterials and Lab-on-a-Chip platforms.

I mainly worked in the Lehoux lab, which is a small lab (6 people) that focuses on atherosclerosis. The LDI is one of the leading medical research institutions of Canada with work being done in a wide variety of areas, amongst others HIV/AIDS, aging, cancer, cardiovascular disease, epidemiology and psychosocial science. I worked together with Nicholas DiStasio, a PhD student from McGill who is making polymer nanoparticles that target specific cells in atherosclerotic plaque for the delivery of an anti-inflammatory gene. Stéphanie Lehoux is his co-supervisor. My project was to construct a plasmid encoding the anti-inflammatory gene and to produce and characterize peptides that can be conjugated to the surface of the nanoparticles to target specific molecules that are overexpressed at the plaque site. Moreover, we obtained some preliminary data for transfections with the nanoparticles.

This project included techniques like qPCR, bacterial work, cell culture, transfection and protein purification. I worked independently, but in consultation with my supervisors. Everyone was very kind and helpful and willing to show their research to you. There were also labmeetings and one-to-one talks with the PI, where you get advice and new ideas.



McGill

I also got the opportunity to go to a conference in Winnipeg (Canada) about Biomaterials, which was very educational and it was very captivating to see the newest innovations and techniques in this field (for example in 3D printing, drug delivery and scaffold construction), especially because this was not broadly covered in the Nanobiology program.

I chose McGill because I always wanted to go to Canada and McGill is one of the top research universities of the country. Even though the project was a bit more biological and less physics than I would have expected beforehand, I enjoyed the project and I ended up getting some nice results. If you are not that much interested in the biology part, the lab of Dr Tabrizian has multiple projects going on that are more technical, like constructing flow cells and performing simulations. Because I would like a bit more programming, I do not see myself working here, but I would definitely recommend doing an internship here.

Furthermore, Canada is a great country and Montréal is a very lively city, especially in the summer. The people in the lab and Canada in general are very nice. Everyone made me feel very welcome and I had a great time in Montréal. If you want to do an internship in Canada, make sure you start applying for your visa well in advance as it takes a lot of time and take a warm winter coat and snowboots with you because the winters are very cold and there is a lot of snow.



Timon Idema Lab

Berkalp Doğaner

The Idema group is a lab group in the Bionanoscience department of the TU Delft, with Timon Idema as the principal investigator. It is a theoretical group that mainly focuses on the study of collective dynamics phenomena in living systems ranging from the interaction of many proteins at the nanoscale to many organisms at the population level. It mainly uses theoretical models and simulations to study these systems in collaboration with experimental groups. My project was about further developing the program that allows the study of defects in a growing bacterial population, and conducting the first data analysis on these defects.

I decided to work on a theoretical project in the Idema Group, because I wanted to improve my coding skills. During my bachelor I realized that it is often useful to be able to quickly simulate something or to be able to calculate and analyze a biological process. I already had a lot of experience doing basic lab work and in conducting lab experiments, so instead of doing something I was very familiar with I decided to do something I was really bad at so that I could improve myself. In this project I mainly had to use two programs Matlab and Mathematica, and especially in the beginning I had a lot of trouble. There is a lot of help widely available on the internet, but sometimes the code that they suggest you to use just does not work in your specific application. As I have already stated in the acknowledgments section of my report there were tons of times that I could not figure out a way to make my code work and I just wanted to quit the project and cry. But for some reason every time I wanted to quit, I just continued to work on it and I eventually succeeded.

Thankfully I had great support from my supervisor, and my friend Raymond who was also working in the same lab group. Especially the knowledge that my supervisor has, and the ability to be always supportive of what I was doing or had done motivated me even more.

Although someone who is much better at coding could have done the same work in much shorter time, I really appreciated the fact that my supervisor allowed me to work on this project in order to improve myself. He was always available when I needed some help or some further explanation.

During my evaluation session both my supervisor and my second examiner said that they really found it amazing that I had decided to work on something I was not really good at, and that I should keep doing that in order to become a good researcher/scientist. They therefore wanted to give me a 7 with a "star" for my enthusiasm. This made me really feel good and appreciated. Even though I am not yet super at coding and programming, in the past 5/6 months I have developed myself immensely.

To conclude, I am therefore really happy that I had decided to work in the Idema group, and even after this experience my supervisor has motivated to develop myself further.



Timon Idema Lab

Jasper van Lopik

The group consists of the principle investigator, which is dr. Idema, and a number of PhD students among which was Afshin who was my supervisor.

The Timon Idema group is a part of the bionanoscience department at the applied sciences faculty. This group is a theory group. The main focus lays on the study of early development mechanics, self-propelled particle dynamics, bacterial colony growth defects and membrane mediated interactions.

My project was on membrane mediated interactions between non-uniform inclusions. My assignment was to model BAR-protein shaped inclusions and simulate their collective behaviour on a membrane and investigate the patterns they form. Furthermore, I studied the pattern formation of all kinds of non-uniform inclusions to see how the pattern formation changes with changing shapes of inclusions. Daily activities consisted of coding, running simulations, reading articles and analyzing data obtained from the simulations.

There were two main reasons for why I wanted to join Idema's group. Firstly, I followed his course on soft matter which I really liked and wanted to know more about. This also gave me a little advantage since I was already familiar with the topic. Secondly, I thought it would be very useful to obtain more programming skills, and in particular, to learn a new programming language, namely C++. The internship was as I expected. I could imagine myself working here in the future. The research done is very interesting and the work you have to do is also fun.

The applied sciences building is brand new and very easy to reach using public transportation.

I would really recommend dr. Idema's group. They do very interesting work, and for students it also a good opportunity to acquire new programming skills.

Timon Idema Lab

Raymond Padmos

TU Delft focuses on research and education. Research is done in a group led by a principle investigator and typically has several PhD students and post docs working on different projects.

My internship project was at the department of bionanoscience at the group of Timon Idema. The research group is a theoretical biophysics group that studies various subjects from self-propelled particles to membrane inclusion. My project was on the formation of orientational defects in growing bacterial colonies. The plan was to simulate a growing bacterial colony and determine whether orientational defects can form solely from mechanical interaction and to characterize their behaviour. Orientational defects can form due to mechanical interaction but their behaviour remains to be characterized in detail. Daily activities mainly included reading papers and books, group meetings, creating a simulation and data analysis.

I chose this group because the principle investigator teaches some very interesting courses and I wanted to do a theoretical project. The internship went as I expected since it was with a research group and not a company. I could see myself working at TU Delft and getting a PhD. Although I'm not sure if I would stay for a post-doc position. I had a lot of fun working with the group and on my project. I would recommend trying an internship project at the university. The university is easy to reach by public transport, although the applied physics building and the bionanoscience department are on opposite sides of the campus.

Chirlmin Joo lab

Tim Allertz

For my internship project, I worked as a researcher in Chirlmin Joo's lab, under daily supervision of Viktorija Globyte. The Joo lab is a biophysics group that specializes in the use of single-molecule fluorescence microscopy techniques, and is part of the Bionanoscience (BN) department of the Applied Sciences faculty at the TU Delft. In the group, several post-doctoral researches and a large handful of PhD candidates study the biophysics of many different systems. The group is particularly adept at using single-molecule Förster resonance energy transfer (smFRET), a technique that allows for the determination of inter-molecular distances on a single-molecule scale in real time.

The bionanoscience department consists of ~16 research groups of different sizes. Every group does research on life of the smallest scales, but the specific interests and experimental techniques vary between groups. As such, a wide range of potential projects for students is possible. Every two weeks, two speakers present their research for the whole departments during the BN Forum. Additionally, more specialized meetings are held on weeks between the BN forums (e.g. theory forum, single-molecule forum, lipid forum, etc.).

My project involved the study of the CRISPR/Cas9 system, an immune system found in many bacteria species that protects them against viruses. It does this by targeting specific regions of a virus' DNA, and cleaving with DNA backbones at that location. Where the DNA is cleaved can be programmed with relative easy, making the CRISPR/Cas9 system extremely useful for genetic engineering. However, people noticed that the efficiency of CRISPR/Cas9 is lower in living systems than it is in a test tube, even when cutting the exact same target DNA. We therefore hypothesized that the flanking regions, regions on the DNA that are adjacent to the DNA target, could have effects on the target search of the CRISPR/Cas9 system.

Using smFRET, we were able to directly observe when Cas9 (the active protein in the CRISPR/Cas9 system), binds to a synthetic DNA construct containing a target for cleavage. Six constructs were tested, with different flanking region sequences. We found that flanking regions effects did not significantly affect the target search dynamics of Cas9, indicating that flanking effects, if at all present, represent only a small fraction of the total interactions between Cas9 and the DNA.

I had previous experience working in the BN department, as I had already done some small projects for my Minor, as well as my BEP at the department. I therefore already knew what to expect from working at BN. BN offers a relatively relaxed working environment, but with an emphasis on efficient work and results. Cooperation between co-workers and frequent discussions is key in achieving this. Students can apply for a PhD position after graduating from a Master's program. An internship project (or a BEP/MEP) at BN gives a good idea of what it is like to work as a PhD at the department. Additionally, BN recently moved to the new building of Applied Sciences, located at the very south of the campus (across from the Fellowship/ next to the Reactor Institute), which provides state-of-the-art laboratories and is easily reachable using public transport (2 close bus stops, Delft Zuid train station). However, there are currently no desk spaces openly available for students, so bring your laptop if you wish to work at one of the public tables in the main lobby.



Chirlmin Joo Lab

Ilias Zarguit

During my internship I worked in the Bionanoscience in the Chirlmin Joo lab under the daily supervision of Tao Ju (Thijs) Cui. The Bionanoscience department studies life in the smallest in which each research group studies a different aspect of life using different techniques as well. My motive to do my internship here was mainly to get a feeling how it is to do a PhD in Bionanoscience, which I now have a better idea of. The Chirlmin Joo lab, where I did my project, is a lab which is specialized in single molecule biophysics. They apply their molecular understanding to genome editing and gene regulation. Using cutting-edge single-molecule fluorescence tools, they investigate how non-coding RNAs trigger anti-viral defence via CRISPR immunity and regulate transcriptome via RNA interference. The main technique which they use is called Förster resonance energy transfer (FRET). With this technique we can estimate small distances between two fluorophores (which can be attached to a molecule of choice), making FRET ideal as a molecular spectroscopic ruler. In combination with a microscopy technique called Total Internal Reflection Fluorescence microscopy (in short TIRF), which can image the surface of a sample (about 100 nm in the surface), it is possible to study the dynamics of single molecules. In my own project I study one specific protein which is called RecA. In bacteria RecA plays a major role in DNA repair mechanisms, making this protein essential for bacteria. RecA monomers bind in triplets to the damaged single stranded DNA and will form a continuous nucleofilament. This filament can be ordered in three structural phases. From in bulk experiment performed by the Eric Greene lab only 1 specific structural phase has been found. This could imply that one structural phase is favored over the other two structural phases, namely an optimal structural phase. This optimal structural phase is according to the Greene lab where there is a maximum number of RecA monomers on the microhomologous site of homologous DNA.

Another approach rather than the maximum number of RecA monomers is that there is a minimal number of gaps in between the RecA monomers, which should be energetically favourable. We have designed a single molecule biophysical experiment which combines fluorescent microscopy technique with FRET to study if there is an optimal structural phase or not. From the data I obtained it indicated that there is no such thing as an optimal structural phase, although personally I still think more experiments need to be performed to be able to give a more solid conclusion.

What I personally really liked is that this project was started from scratch, meaning that I had to design an experiment myself, this was of course with help of Chirlmin, Thijs and Sung Hyun (a former post-doc of the Chirlmin lab which had previously worked with this specific protein). As part of the Bionanosciene department, which consists of roughly 17 research groups, it is important to broaden your knowledge in the whole field of bionanoscience and not only your own work. Hence every 2 weeks a big forum is organised in which every PhD student will at one point tell about his work and achievements. This is also an ideal moment to learn about new techniques (which could even be handy in your own research). Additionally, more specialized meetings are held on weeks between the BN forums (e.g. theory forum, single-molecule forum, lipid forum, etc) and several seminars from visiting professors etc.

BN recently moved to the new building of Applied Sciences, located at Van der Maasweg 9 (next to the Reactor Institute), which provides new state-of-the art laboratories. Fortunately this location is easily reachable using public transport (2 close bus stops and Delft Zuid train station is about 15 min walk). However, the desk spaces openly available for students are very limited at the moment.

Anne Meyer Lab

Robin van Albada

For five months I have been working in the Anne Meyer lab in the Department of Bionanoscience, part of the Kavli Institute of Nanoscience at the Delft University of Technology. Their research focuses on understanding and manipulating the conserved pathways used by organisms to defend themselves against damaging environmental agents. They use quantitative techniques in the fields of biophysics, biochemistry and microbiology to study structural dynamics, macromolecular interactions, and physiological responses to environmental stressors. In addition, they are also using tools of synthetic biology to engineer novel functions into microorganisms. Their focus is on the production of improved biomaterials and the development of new pathways for inducing transcriptional responses. This approach will lead to tunable fabrication of materials in a simple, environmentally-friendly manner.

During my internship, we have investigated the influence of different types of ions on the growth behaviour of an E.coli strain deficient in *dps* and an E.coli wildtype (WT) strain. The strains were grown on HiDef azure medium, M9 minimal medium, and M9 minimal medium variants in which either phosphate, iron or magnesium was absent, limitedly present or abundantly present. The growth was monitored in a spectrophotometer, and growth curves were analyzed and compared in Matlab. We have found that the expression of *dps* was not crucial for cell growth, since both strains were able to grow on the same media. The growth behaviour of both strains in the exponential phase seemed to be roughly similar in a wide range of ion-limited and ion-abundant media.

The main reason for choosing this organization was that I wanted to work with bacteria. However, I expected to be more involved in the creation of the knockout strain. I do not think that I want to further research in this subject, while I am more interested in research that could help in clinical applications.

However, I am happy that I have worked here for those five months while gaining a lot of experience and improving my practical and writing skills. As a nanobiology student, I advise you to not follow many courses during your internship, because the internship is time consuming. If you want to do your internship in a company instead of at the TU Delft or at the Erasmus MC, I advise you to inform yourself already in the first period. I was a little bit late with deepening in companies, and therefore I decided to work at the TU Delft, where I was already familiar with the available labs. In addition, I believe that it is important that you set a final date at the beginning of your internship, make a good schedule, and stick to it so that you finish your internship on time.



Anne Meyer Lab

Jeroen de Vries

I did my internship project in the Bionanoscience department on the TU Delft in the Anne Meyer group. The project I did was done in cooperation of the Marie-Eve Aubin-Tam group. This Bionanoscience department focusses on biological research on the nanoscale. Research topics can include the fabrication of nanopores for DNA sequencing, but also include the manipulation of bacteria to produce highly wanted chemicals or products. The topic I did my internship on was of the latter category.

In my internship, masters and bachelors projects I wanted to do very different things to see what I liked to do most in research. My bachelor project consisted of purely in-vitro experiments with a piece of DNA, so now I wanted to do something with bacteria and the production of chemicals in bacteria. I looked for different groups in this Bionanoscience department, but this topic stood out for me due to its many different uses if brought to completion. Being able to produce a very strong material from only bacteria would be very useful, it could be improved upon really well and most of all: it was green. Green production of a possible strong building material would be very useful in the future. The latter reason was the main reason for me to choose this topic.

I came in the group as a masters student to work on a project regarding the production of nacre-like materials. Nacre is a material found in shells. It is a composite material and extremely strong. It consists of tiny platelets of calcium carbonate and layers of elastic biological molecules. Calcium carbonate can be found in cement, however, nacre is far stronger and tougher than cement. Mainly due to its strength and fracture toughness, nacre is a much wanted material. In the Anne Meyer group they were pretty much able to make thin layers of calcium carbonate and now needed an elastic molecule to fit inbetween layers of calcium carbonate to fabricate a nacre-like material. For this biofilm was chosen, which is already readily made in bacterial colonies. For my internship I was focusing on making bacteria for the production of biofilm by IPTG induction.

This seemed to work, however, not as expected, since IPTG seemed to halt the bacterial growth. Even tests were done where we induced biofilm production in wells of microtiter plates covered with calcium carbonate. This seemed to work, however, experimental results were lying far apart and thus not a lot could be said yet about those specific experiments in the end of my internship. Biofilm formation was observed in most strains that were tested.

Activities done in this internship mainly involved inserting DNA in plasmids. These plasmids were then transformed into an E. coli strain for the production of CsgA (main constituent of a biofilm) with different binding domains attached to it. These binding domains bound to different calcium carbonate crystalline structures. When this was done assays were done where biofilm growth was tested for in these strains. This was done in microtiter plates to be able to test multiple strains at once. These tests took up to 3 days and thus sometimes took most of the time. In downtime the main thing done was producing new strains or strains that did not work the first time etc.

The internship was pretty much what I thought it would be. Working with bacteria, transformation, growing bacteria and then testing them for their biofilm production. Work was sometimes a bit monotonous due to the number of microtiter plate assays I had to do, however, not annoyingly monotonous. Variation and the interesting results were more than enough to keep me interested for the duration of the internship. Overall, this group promoted self-initiative, but helped whenever necessary. Sometimes I would work on the microtiter assay alone for days to inform my supervisor a week later of my results. They, however, always were there if any problems or questions were raised. The working experience was overall a very pleasant one. The PhD students were very nice and always willing to help. I would definitely recommend doing an internship here.

I found out that my main interest does not lie in working with bacteria. If you, however, are interested in doing this, I would even more so recommend this group.