

## Exchange report

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majoring in Advanced Materials and Photonics

Study programme in KTH: Engineering Physics



## Why KTH?

Pursuing exchange studies emerged as a concrete idea in my mind only after completing my bachelor's studies. After participating in teekkari volunteering scene in various different roles throughout my studies, I felt a certain need to readjust my routines and have a decent break from all the activities in Finland and Aalto. On the other hand, I always felt that I never seemed to have the time I wanted to really focus in some parts of my master's studies, which led me to think that I would like to spend my exchange period in an academically highly-ranked university and in a thought-provoking atmosphere. After comparing the different options including mid-European, US-based and Nordic universities, I decided to stay in the Nordics. The reasons that led into my choice included the fact that the master's programmes are all taught in English, the relatively simple application process for students coming from other Nordic countries and the short distance from Finland. I finally ended up with KTH after comparing the course catalogs for Spring semester between DTU, NTU and some other Swedish universities. I was also keen in improving my skills in Swedish.

Finally, I ended up leaving to KTH at my 10th and final study semester. I had already (almost) completed my master's thesis, so in the exchange period my goal was to gather the missing credits to complete my degree.

## The application process and reception

In my opinion the application process to KTH was rather lean and simple. After getting accepted for the exchange studies by Aalto in spring 2018, the application process to KTH started at the autumn 2018. To apply, one needed the acceptance letter from Aalto, a copy of passport, a transcript of study records, description of current courses being taken and a plan including the courses to be taken at KTH. No visa or such was required from Nordic students. It is possible to announce in the application process if one needs help in the search of accommodation for the exchange period. Accepting this help is **extremely** advisable, since due to the regulation of rental market, it is basically impossible to get an apartment on your own at the timescale in question. KTH has solved the problem by attempting to offer a sub rental apartment for each incoming exchange student. I myself got lucky and got a studio apartment located straight in the main campus area at Östermalm; however, especially in the autumn period the amount of incoming students is so great that most of the apartments are located farther from the campus.

Travelling to Stockholm from Finland is relatively easy. You can either take the ferry or a plane. In 2019, flying was cheaper and faster if you're traveling alone and your conscience can handle the environmental effects. It is noteworthy, that the rental period of the KTH-offered apartment may not start at the exact same day as the semester, but in my case the day next to the arrival day. I solved the problem by booking an AirBnB for a few days and arrived in Stockholm a day before the arrival day. In addition to the international coordinator of KTH, I was contacted by a Swedish buddy student, which would be a counterpart to Finnish ISOs. Also the student union Tekniska Högskolans Studentkår (THS) contacted me offering early registrations to orientation events.

The arrival day registration and welcoming events were handled in a lean and concise Swedish manner. In the registration one was given a KTH account, which eventually enabled the registration to the courses. The course registry and workspace systems were quite similar in logic to the ones we have in Aalto. In addition to the registration by the university, THS offered some brochures and a possibility to pay for some events requiring payments. KTH also offered us a lunch and a lecture by some KTH alumni giving inspirational speeches. In addition to general KTH info, we also had meeting with the School of Engineering Science, under of which my program in KTH resided. Fika (Swedish coffee and pulla) was served, keycards to school premises were given

and a chance to get stamps and signatures from the KTH international coordinator for documents required for the Aalto exchange grant was given.

I used the free time of the first few weeks in KTH to finish my master's thesis, to which I didn't have the time in Finland before I left. Thus, I didn't take part in student grouping activities that much. I joined THS (costs about 350 kr, 1kr ~ 0.1€) to get access to social events and discounts, but the membership proved eventually to be quite useless as I decided to focus on exercising instead of partying.

## **Studies in KTH**

The academic year in KTH is divided into two parts, the autumn semester and the spring semester. Each of these is further divided into two periods. Compared to the spring semester in Aalto, KTH thus has only two periods instead of three in the spring semester. The semester started at 15.1. and ended in 4.6. Each period contains an exam period of roughly two weeks. In addition, no lectures were given during the week before the easter.



*KTH main campus is beautiful.*

Since I felt a strong need to test my learning capability and improve my skills, I ended up taking mainly courses suitable for my major from the Engineering Physics programme (everything was master's level). KTH requires to choose at least half of the courses from the school one is accepted to. I didn't have any problems with the restriction, since with the exception of a course on Swedish culture and society, all of the courses I was interested in were offered by the School of Engineering Sciences. I felt that the course repertory was good and I would certainly have found even more interesting courses to take if I only had had the time. I ended up choosing courses worth of 40.5 ECTS in total. KTH, most of the courses are either 6 or 7.5 ECTS wide. The general workload level was comparable to the level in Aalto, although individual courses had deviations in both directions. The higher ECTS amount given per course is explained by the longer

duration and thus greater amount of material per course than in Aalto. All the courses were taught in English.

If I had to name any differences in the teaching methods used in KTH, I'd say that the courses had in general more presentations than in Aalto. Also, in the courses I took great emphasis was placed on understanding the fundamental phenomena and mechanisms instead of concentrating on mathematical quirks. Most of the professors seemed to have had quite a great freedom in designing their courses, which, in my opinion, resulted in devoted class in teaching. Also, the considered subjects at the courses were way closer to research and applications than in most courses I've taken in Aalto. I'll consider the properties of the different courses in greater detail in following section.

## Courses I took in KTH

I ended up choosing the courses listed in the table below. Course codes, names, periods, credit amounts and links to descriptions are provided. In addition, below the table, I added short descriptions of my own thoughts regarding the subject.

Course code	Course name	Period	Credits	Link to description by KTH
SK2400	Quantum Electronics with Electro-optics	P3	12	<a href="https://www.kth.se/student/kurser/kurs/SK2400">https://www.kth.se/student/kurser/kurs/SK2400</a>
SK2550	X-ray Physics & Applications	P3	6	<a href="https://www.kth.se/social/course/SK2550/">https://www.kth.se/social/course/SK2550/</a>
SK2560	Nanophotonics and Bionanophotonics	P4	7,5	<a href="https://www.kth.se/student/kurser/kurs/SK2560">https://www.kth.se/student/kurser/kurs/SK2560</a>
SK2900	Quantum Photonics	P4	7,5	<a href="https://www.kth.se/student/kurser/kurs/SK2900">https://www.kth.se/student/kurser/kurs/SK2900</a>
AK1213	Swedish Society, Culture and Industry in a Historical Perspective	P3-P4	7,5	<a href="https://www.kth.se/student/kurser/kurs/AK1213">https://www.kth.se/student/kurser/kurs/AK1213</a>

### Quantum Electronics with Electro-Optics

This was actually two 6 ECTS courses tucked into one with increased risk of getting nothing in case of a failure for the student. Easily the hardest course I've taken during my studies, partly due to my lacking skills of quantum theory before the course. Half of the course was basically fundamental quantum optics theory and the other half was fundamental theory of electro-optic and photonic devices. The course was held by two professors, each responsible for one part. The course consisted of lectures, 8 home examinations each worth of 1 ECTS and an exam worth of 4 ECTS. Even if it was very difficult, it was probably one of the most educational courses I've taken.

### X-ray Physics & Applications

The aim of this course was to introduce the students to the properties of x-ray radiation and its many uses and applications in research. The course covered the basics of x-ray theory, including also the properties of different sources, optics, detectors and applications. The course was executed as lectures, home assignments, lab work, presentation and an oral exam. The home assignments and the lab work with a corresponding report were graded pass/fail while the final grade was given as an average of the presentation and oral exam grades. Having basically no earlier experience in x-rays, I found the course very interesting and eye-opening.



## Nanophotonics with Bionanophotonics

In this course, the light-matter interaction in nanoscale structures was discussed thoroughly. The course was centered around two main applications, quantum well infrared photodetectors (QWIP) and quantum dot bioimaging. The theory behind light-matter interaction was well covered and explained by the aid of home assignments. In addition, two lab works were conducted: first a computer simulation on QWIPs and then a microscopy lab on QD-assisted imaging of live cells. Both of the laboratory works were interesting and the home assignments usually had a clear point. Both the home assignments and the lab reports were graded pass/fail, while the final grade was based on an examination. I found the course very useful considering that my main interests lie in photonics and nanotechnology.

## Quantum Photonics

This course discussed quantum theory from the viewpoint of quantum information and quantum entanglement. The course was executed as a type of discussion forum, where in each lecture a pair of students presented a research paper central to the field. After the presentations, the participants discussed the subject together with extra insight from the professor. Usually, the second part of the lectures consisted of a lecture on the topic or a related topic given by the professor. The course also included a laboratory work in quantum entanglement. The grading was based on the lab report. I hadn't been on a course executed in this way before, but I really liked this type of teaching and would like to see it more in Aalto. The subjects covered in the course included quantum teleportation and quantum key distribution among many other central areas in quantum information. Highly recommended.

## Swedish Society, Culture and Industry in a Historical Perspective

The aim of this course was to give exchange students an overview of the development of the Swedish identity, society and culture. The course was executed as lectures, excursions and discussion seminars. The lectures were gathered around three different main subjects: Swedish identity, Swedish urban planning and the role of Sweden in international politics. The excursion destinations were the *Nordiska museet*, *Stockholmsrummet* and *Skansen*. The discussion seminars included writing an attendance paper and were centered in discussing the topics with peers. In addition, the course included an online exam and a final essay if one wanted to pursue the highest grade.

All my major courses were located in Albanova, which is a centre for physics teaching and research co-operated by KTH and Stockholms Universitetet (SU). I had an approximate 10 minute walk to there from my apartment in campus. Excluding the culture course, most of the courses had approximately 10 participants. Some of my fellow students who had stayed at KTH for longer than I had told, that there were lots of overlapping courses in the program. However, as KTH is currently upgrading their course repertory at the moment to fix the above mentioned issue.

## **Leisure and living in Stockholm**

As one living in Finland might guess, living in Stockholm is not that much different from Finland. The climate is very similar, except that in spring 2019 the snow was gone in Stockholm in the beginning of February and we got to enjoy almost +10°C weather by the end of the month. Less rain and more sun, too. The grocery stores have very similar selections compared to Finnish chains and the prices of food and other goods are quite on the same level. The public transport system in Stockholm is great. The price for a single journey is approximately 30 kr. It probably gets even lower if one buys the transport ticket for a longer period, but since I lived in the campus I didn't have the need to look into it.

I reactivated my sports hobby in terms of running while living in Stockholm, and I can certainly recommend *Haga Parken* and *Kungliga Djurgården*, of which especially the latter I warmly recommend: located right north from the KTH main campus, the area was a total forest with nice running trails right in the centre of Stockholm. I'd also be happy to recommend places for partying, but since I decided that I would have a fitness exchange period I didn't visit them. However, each guild (*sektionen på svenska*) has their own bar in the campus which are open on

different days during the week. Instead of places to party, I can although warmly recommend different cultural destinations in Stockholm; *Kungliga Djurgården* (The one with *Skansen* and *Gröna Lund*) [No idea why the king decided to name two *Kungliga Djurgårdens* in the same city. I'd bet dementia or communication failure] offers nice views to the sea and lots of different places to see. *Rosendals Trädgård* is a great place to stop for a fika and *Spiritmuseum* offers a great and sharp-sighted perspective on alcohol culture.



*Scottish highlands or Kungliga Djurgården just north of KTH campus?*

## Conclusions

The instructions for this report asked me if I'd recommend KTH as an exchange destination for other students. I think the answer to the question is both a yes and a no. When I decided to pursue exchange studies, my goal was to have enough time to study as much as I want, get rid of different liabilities in Finland and break down bad routines while creating new ones. I also felt that I needed a time-out to think about the direction of my future and the stuff that I'd want to do next.

How it turned out, then? I had all the time to study subjects that interested me in a professional guidance, fixed most of my routines and started exercising again. For me, KTH was the perfect exchange destination. Only thing that didn't come out as well as I had hoped was the improvement in my Swedish skills - my language skills definitely improved, but since most of my course mates were english speaking, I certainly didn't develop fluent Swedish.

For the no, if your goals for the exchange period are to travel and experience exotic stuff, I'd definitely check something else. All in all, I'd start the search for the destination from defining the objectives for the exchange before looking too much into different countries and universities.

If I'd go for exchange in KTH again, the only thing I'd do differently is that I would use more time in socialising in the first few weeks instead of finishing a thesis; I found eventually lots of good friends from the courses I took, but the process would have probably been a lot faster if I had been more active in the beginning. As what comes to going abroad for an exchange period overall, I strongly recommend scheduling the exchange into an earlier phase of one's studies than the last semester. That way all the growth in one's thinking due to new experiences and people will be more fruitful during the rest of the studies. However, I still recommend exchange studies even if in the last semester of the degree as I did.

I hope this report was useful for the reader, especially if you're considering KTH as an exchange destination. Feel free to contact me by email for any questions regarding studying at KTH or living in Sweden if you feel that I left something unanswered!