

## Notes\_course\_improvement

Meeting 2020-02-12:

Present: David Haviland, Gunnar Björk, Vlad Korenivski, Valery Zwiller, Ilya Sytjugov

David presented results of CANVAS Survey / Course Evaluation. See Excel sheet.

Discussed:

Should we require that they have their lab partner proof read the report?

Should we make the theory questions mandatory for the lab?

Question for course evaluation: Was this course too much or too little work for what you learned? For the number of credits received?

Next year we will have one additional intro lecture which will cover writing style, and grading methods.

Discussion on grading methods:

Agree to do A-F on each lab

How many times should they be able to correct?

Give grade on second lab?

Will think about this and meet in August to nail down

grading methods / criteria

Will post an explanation of grading criteria on each lab

Will give clear indication of deadline for each lab.

Some students are using the same figures. Discussion about if this was OK. Risk that one student does all the work. I think I told them that they could work together on 'a' figure, if they acknowledge the other person. We need to be clear that they should do the figures and make the fits themselves.

Discussion of order of labs next year:

David can go first – give extensive feedback on writing

Gunnar should go directly after Val.

Order for next year:

1- David

2- Ilya

3- Vlad

4- Val

5- Gunnar / Marcin

**Evaluation was done as a 'survey' in canvas. Question structure was not well-suited to evaluation.**

**Results were tabulated and moved, by hand, to excell.**

**15 of 26 students answered. 3 did not close/finish the survey, so I could not see any results.**

**one or two were not completely finished.**

**about 10 respondents gave useful data.**

**Tables show the results to the questions. Each entry is the number of responses with that ranking for than lab.**

Which lab challenged you the most in terms of learning new experimental physics?

	Lab1: Q. Cond.	Lab2: SQUID	Lab3: Q. Key	Lab4: Q Erasure	Lab5: FMR
Most challenging		2	3	2	4
	1	1	2	5	1
	3	1	2	2	2
Least Challenging	1	4		1	4
	5	2	3		

Which lab challenged you the most in terms of learning new theoretical physics?

	Lab1: Q. Cond.	Lab2: SQUID	Lab3: Q. Key	Lab4: Q Erasure	Lab5: FMR
Most challenging		1	2	4	4
	1	6		1	2
	2	3	1	4	
	3		3	1	3
Least Challenging	4		5		1

Which lab had the best organization and execution?

	Lab1: Q Cond.	Lab2: SQUID	Lab3: Q Key	Lab4: Q Erasure	Lab5: FMR
best			3	3	5
		1	2	4	3
	1	5	2	1	1
	6		1	2	1
worst	3	4	2	1	

Which lab had the best written lab description and pedagogical material?

	Lab1: Q Cond.	Lab2: SQUID	Lab3: Q Key	Lab4: Q Erasure	Lab5: FMR
best	2	2	3	1	3
		2	2	4	2
		3	3	2	2
	4	2	1	2	1
worst	4	2	1	1	2

Which lab had the best lecture before the lab?

	Lab1: Q Cond.	Lab2: SQUID	Lab3: Q Key	Lab4: Q Erasure	Lab5: FMR
Best			3	5	2
	1	1	2	2	3
	2	5	1		2
	4	1	2	1	1
worst	2	3	1	1	1

Which lab had the best lecture after the lab?

	Lab1: Q Cond.	Lab2: SQUID	Lab3: Q Key	Lab4: Q Erasure	Lab5: FMR
best		1	1	5	2
		2	3	1	2
	1	2	2		3
	2	2		2	
worst	5	1	2		



**Please give some specific feedback on how to improve Lab 1 - Quantized Conductance.**

+ ) Transport to and fro Kista worked well. Lab assistant always available.

- ) The post-lab lecture was short and touched only errors and other mistakes seen in the lab reports submitted so far. It would have been good to discuss the theory with the results obtained.

It would have been good to have better instructions and more coherent. In my group, different teachers (Ilya and the lab assistant) told us to do different things when measuring, which messed up our results. If the instructions would have been written, we probably wouldn't have had any problem.

I liked this lab, I would however like some more information on how the selection on "good" data can be made. Because this is something that I was not used to do and I could have used some more either guidance or discussion on how to do this properly.

Need for better study material.

Automate the repeated contact breaking.

The theory was clear. A more detailed explanation of the experimental apparatus, such as the piezo stage and the electronics, could be beneficial for those who encounter these devices for the first time.

Automatic data acquisition

An automated experimental setup where we used all data and not just the best looking peaks.

It will be better if the lecture before the lab is more about the lab itself, however the information was not bad but not just near the lab and was about Fermi vector about gold

**Please give some specific feedback on how to improve Lab 2 - Superconducting Quantum Interference Device SQUID.**

+ ) Well-written and well-explained manual.

- ) A bit short. Did not immediately connect the experiment with the theory covered.

It would have been good to have a more extensive description of the experimental setup in the instructions, with pictures and explanation of each device. Also, the instructions could have been more detailed or specified in steps.

1: The theory of SQUID was not easy to grasp. The fact that there is an entire course (almost) in it later in the year suggests that it is more complicated than the lab instruction suggested. This could be helped by having a more detailed lecture in the introductory lecture.

2: What I liked about the follow up lecture on lab 3-5 was that they held a lecture on how to interpret the data collected from the experiment. This would have helped because I really struggled with the calculations on this lab.

Improvements on study material. Unclear tasks.

The experimental section could be more challenging and engaging. It felt too easy.

Assistance by somebody during execution

A more theoretical first lecture where the Josephson relations are derived and the RSJ model too.

I think this lab was very interesting but too short. I would add another task.

I think it was ok

**Please give some specific feedback on how to improve Lab 3 - Quantum Entanglement and Quantum Key Distribution.**

+ ) Good pre-lab lecture. Lab assistant always available.

- ) No plan for the post-lab lecture.

There were two parts of the instructions: one in Canvas and one in the lab. We were not aware that there was this second part and we only found it at the end, so it was a bit confusing and we didn't take all the right measurements because of that. This lab lacked organization and Lily didn't help us much.

I like Val and I thought this labb was the most fun. A bit more well planned second lecture might have been good.

More details on the experimental setup and procedure

The extent to which the experimental apparatus actually matched the model experiment was confusing. Therefore the interpretation of the results felt sometimes arbitrary.

Assistance during execution

It was great.

The lecture after the lab had almost nothing to do with the lab itself

**Please give some specific feedback on how to improve Lab 4 - Quantum Erasure.**

+ ) Good use of pre-lab and post-lab lecture. Lab assistant always available.

- ) Sometimes unclear analysis (required extra help).

Nothing to improve on this Lab. It was well organized, the instructions were perfectly clear and Gunnar made sure we understood every part of the setup and the experiment perfectly. 10/10.

Gunnar is great, let him do his own thing next year aswell.

More details on the experimental setup and procedure. The whole calibration procedure was very confusing

Overall this was a very well done lab.

More focus to applications

Too many measurements.

OK

**Please give some specific feedback on how to improve Lab 5 - Oscillatory Exchange studied by Ferromagnetic Resonance.**

+ ) Well-prepared experimental setup. Lab assistant always available.

- ) The lab instructions for the final calculations and analysis were unclear.

Nothing to improve on this Lab. Although the instructions were not detailed on the paper sheet, Milton walked us through each step of the experiment backing up his explanations with some theory on the whiteboard. 10/10.

Nothing to improve on this Lab. Although the instructions were not detailed on the paper sheet, Milton walked us through each step of the experiment backing up his explanations with some theory on the whiteboard. 10/10

Same answer as #4. It was one of the better planned experiments and lectures

Add some connection of all the theory to the actual experiment. Although I could understand each part, something was missing when I was trying to understand what's happening in our system.

Add missing information to the lab manual: Unit of layer thickness; meaning of variables  $t_1$ ,  $t_2$ ,  $M_s$ ; ...

Overall a well done lab. A more complete set of references would have been helpful.

Less micro-corrections of the report

Confusing literature.

OK

**Was the lab report style guide helpful? Did this course help to improve your writing?**

Yes, very much so.

I feel that I successively improved my writing over the five lab reports, in particular concerning figure captions and the figures themselves. I particularly appreciated that the style guide focussed not only on how to section the text (introduction, measurements, analysis, ...) but also on how it should flow between these sections.

On the other hand, it was sometimes difficult to adapt the style guide to a particular experiment, as the guidelines for the write-up were sometimes left vague.

Yes! I think one of the strongest points of this course was how focused it was on the writing and the style of the reports. Thanks for doing that :)

This course was good for my writing to improve.

Yes it was helpful and the guide helped a lot. And I think my writing improved a lot, this is the main thing I will take away from this course.

Yes, in terms of format and content organization.

Yes and yes. The two-column layout leads to rather narrow columns on A4 paper though.

Yes!

Yes and yes

yes!

Yes, I tried to follow it for every report. The course definitely helped to improve my writing.

I understand that this lab is not just about technology, but also that you have to write the report correctly

**Do you have any general advice on how to improve the course as a whole, or any suggestions for new laboratory modules?**

1) *Setting specific deadlines for the submission of the reports, for both student and grader.* As a suggestion, all students have to submit within two weeks exactly after completing the experiment, the grader provides feedback within one week, the students have to resubmit within one week of receiving the feedback. Naturally, this might be difficult to coordinate, but a systematic approach to deadlines would have alleviated some of the confusion.

2) *Setting the expected level on the written report from the onset.* There was some confusion from several parties concerning the expected quality level of the report and it was not always clear what should be included in the report. Different graders solved this in different ways, but a "benchmark" might have helped.

3) *The use of the pre- and post-lab lectures.* For me, the most effective module was laboratory 4 (Quantum erasure). Prof Björk used the pre-lab lecture to frame the context of the experiment and set up particular questions or aspects to think about during the lab. He systematically returned to these points during the post-lab lecture, which helped understanding the connection between the theory discussed and the experimental aspects we had tried out ourselves.

No, I think it was a great course overall. I would only improve the organization of the first 3 labs, because I was a bit lost, but in terms of content and structure it was a very nice course.

Some more coordination on what should be covered in the second lecture. Because as it stands now everybody did kinda their own thing. I think people should follow the style of Gunnar, it was the most helpful.

The introductory lectures were insufficient to say the least. The need improvement and probably more hours are necessary.

A lab which somehow involves qubits.

No

Introduce theoretical problems that have to be solved prior to the lab and maybe introduce a second lecture introducing the problem and lab.



not yet

**Did this course help you to better understand the connection between experiment (measurement) and theory (calculations) in quantum physics?**

Yes, it provided a good bridge between the theoretical aspects and the "real" setup used. The theory covered in class is often underpinned by a figure from a seminal paper or an equivalent circuit diagram, which can be difficult to translate to an "experimental understanding" in a laboratory environment.

The course served as a wide introduction to many different areas, as the time for each laboratory module was short and the time to ask deeper questions about the setup was limited.

For me, the main skills developed during this course were writing the reports and using Python to take raw data provided by the apparatus and producing figures with the corresponding analysis (which was great practise!)

Definitely!

Yes, it was great opportunity to understand it.

Somewhat, but not much.

Yes

Yes for labs 3 and 4. No for labs 1 and 5 since the quantum nature of the experiments was difficult to relate to the measurements and formulas. Lab 2 is kind of in between.

Yes!

Yes

In general yes, but mainly because of the lectures before, the lab and lab report did not really aid that much in increasing my knowledge. I am very happy to have learnt how to write a proper rapport though.

Yes, it was very helpful but mostly as a way to practice scientific writings.

I could not finish this course and hopefully I'll come back next year but I understood some things but I have to work harder