

Physics Laboratory 2020

Overview of PLab

- You will perform 6 experiments, one per week (normally with a partner).
- Each lab session is 3 hours (2-5pm), either Mon/Tue or Thu/Fri.
- You will be graded according to your **lab skills competency**:
 - Quality of experimental technique and analysis in your **lab book** (each week).
 - Quality and professionalism of **three technical reports**.
 - No final exam.
- Lab technicians, demonstrators, and academic staff are here to help you!

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The aim is to get good at some really important skills. These differentiate physicists from other subjects/careers and give us a competitive edge!

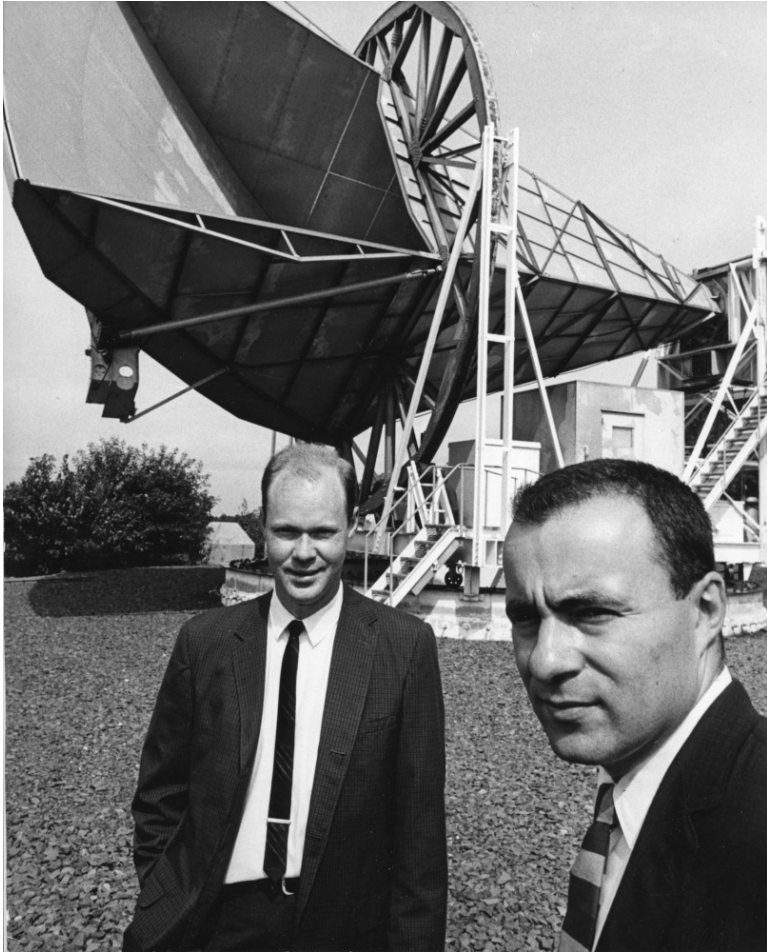
Key skills from lab work

- **Methodology:** Choosing and executing appropriate methods, understanding their strengths and weaknesses.
- **Observation:** Making sense of what you see, and using that information to gain a deeper understanding.
- **Interpretation:** Understanding the connection between (messy, imperfect) data and theoretical physical understanding.

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- **Problem solving:** Identifying issues and proposing (novel) solutions.
- **Quantifying uncertainty:** Working out how uncertainty and imprecision limit the physical conclusions you can draw.
- **Presenting information:** Describing your motivations and results with clarity and precision. Highlighting and justifying important conclusions.
- **Project management:** Planning complex projects, safety, managing your time.

How is this relevant to physicists?



Penzias and Wilson with their large radio antenna at Bell Labs, c.1967

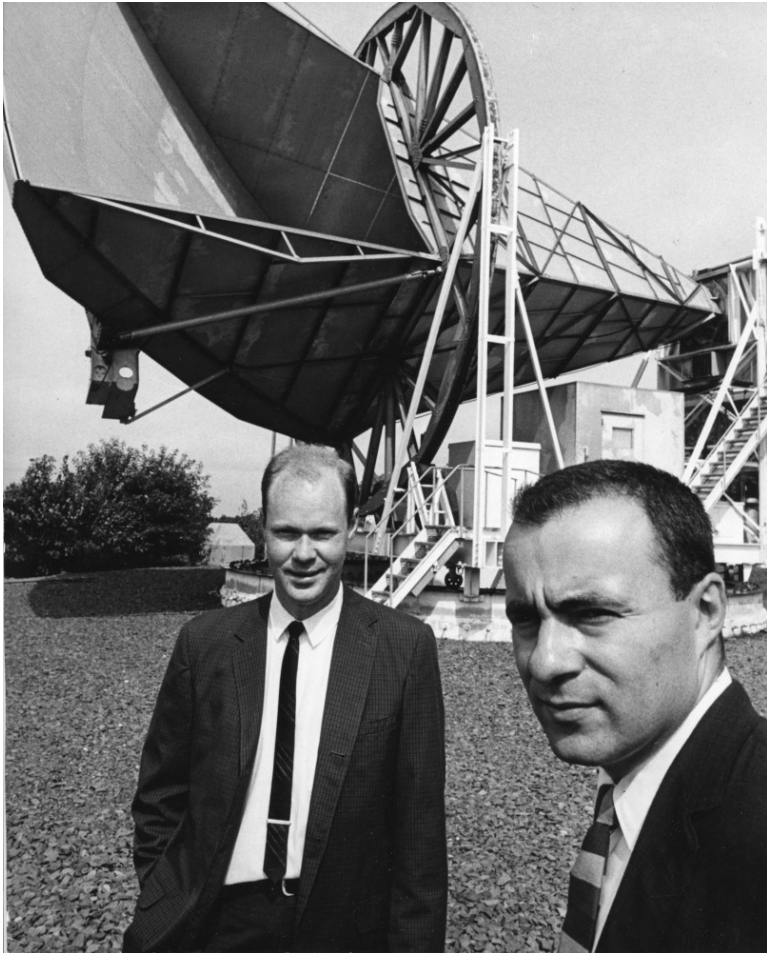
Observation: Noticed uniform radio “hiss” coming from all directions.

Problem solving: Tested many explanations, including “white dielectric material” in horn.

Uncertainty: Quantified size and errors on many other possible contributions to signal.

Interpretation: Only one conclusion remained – signal is extragalactic!

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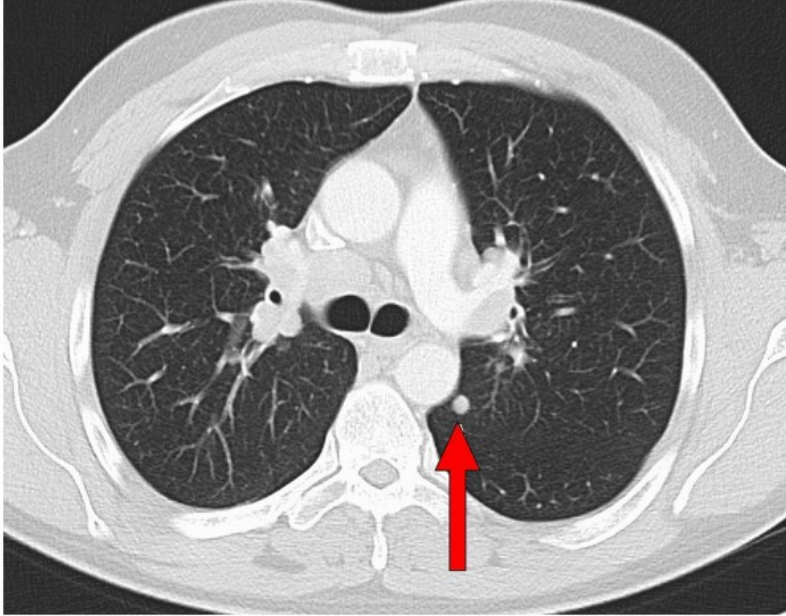
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Discovery of the **Cosmic Microwave Background radiation** (Nobel Prize 1978)

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CT scan cross-section showing lungs

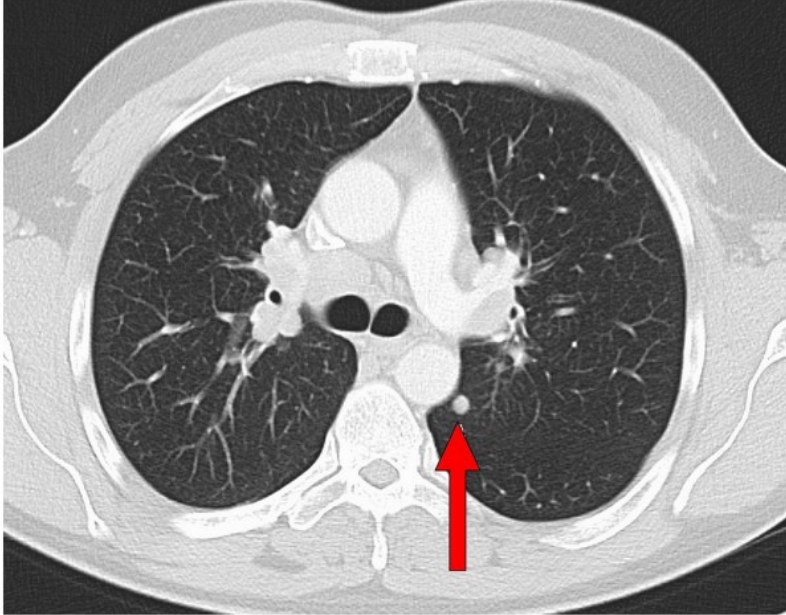
Methodology: Choose right apparatus for affected part of body; control radiation dose.

Uncertainty: *Very carefully* quantify level of confidence that mass is real.

Presentation: Make clear identification on image to help medical diagnosis and avoid dangerous errors.

Project management: Reduce waiting times for patients; ensure safety of scan operator!

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43 million diagnostic imaging tests done in the UK alone in 2017/18!

Lab schedule and attendance

- 4 intro lectures this week
- “Intro to PLab” test on QMPlus (you **must** complete this before Week 2)
- 6 weeks of lab time, 2x 3hr sessions per week
 - Weeks 2,3, 5,6, and 8,9
 - Group 1: Mon + Tue from 2-5pm
 - Group 2: Thu + Fri from 2-5pm
- You have been assigned to particular sessions and experiments (see QMPlus)
- Please work with a partner who’s doing the same experiment as you
- Because every week is assessed, **attendance is compulsory**. You must have a valid EC to miss a session, otherwise you will miss out on marks.

“Intro to PLab” test

- This is an online test on QMPlus
- You **must** complete this before your first lab session, otherwise you can't start the experiments!
- It's a simple multiple choice test of your understanding of the following:
 - *Safety principles*
 - *Basic lab skills (time management, writing a good lab book)*
 - *Analysis of uncertainty*
 - *Plotting graphs and fitting data*
 - *What counts as plagiarism*
- It should take ~20 mins and doesn't count towards your final grade (but you must get 100% to pass).

How to do the experiments

Each experiment involves the following activities:

- **Preparation work:** Background reading and planning experiments at home (2-3 hours per experiment)
- **Practical work in labs:** Performing experiments in the lab (6 hours per week)
- **Write-up of experiments:** Finalising analysis and writing-up discussion and conclusions in lab book (2-3 hours per experiment)

How to do the experiments

There is a lab script for each experiment

- Read the script well in advance and **research the physics!**
 - Preparation and good time management is key.
 - Part of your grade depends on your understanding of the physics!
- You can practice using the equipment beforehand if you like (ask Peter or Saqib). **Don't** bring your lab book though!

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- Arrive before 2pm, find a station and log into computers. (If you're late, you might miss the register and be marked as absent.)
- You can take your lab book home to work on analysis/conclusions, but must hand it in to the 2nd floor lab by the following deadlines each week:

Group 1: Thursday at 4pm

Group 2: Monday at 4pm

Getting help

Lab technicians, demonstrators, and academic staff are here to help!

- **Peter** and **Saqib** are the lab technicians
 - They know all the equipment and are great at solving problems
 - They are often very busy!
- **Jelena**, **Junning**, **Frini**, and **Lubos** are the demonstrators
 - They are really good with the experiments and software
 - They can give you pointers on how to operate the equipment
 - They won't do the experiment for you, tell you what to write etc...
- **Elise**, **Theo**, **Francesco**, and **Phil** are the academic staff
 - They will check in with you regularly in each session
 - They are responsible for grading your work
 - They will help you understand the physics and how to write good lab books/reports

Lab Techs



Peter Crew



Saqib Qureshi

Teaching team

Academic Staff



Dr Elise Agra



Dr Phil Bull*

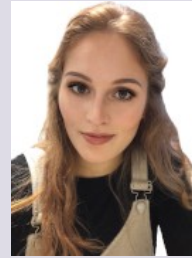


Dr Theo
Kreouzis



Dr Francesco
Volponi

Demonstrators



Frini Taifakou



Junning Li



Jelena
Gorbaciova

Lubos
Vozdecky

Feedback and assessment

Every piece of work is graded, and you can ask for feedback any time

- **Lab books** (60% of final grade): graded according to a mark sheet every week
 - Read the feedback form. Think how you can improve next time!
 - Extra feedback will be written in your lab book by the grader.

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 - You'll get detailed feedback on the first two lab reports. Read it carefully...
 - This feedback will help you do well on the subsequent reports.
 - 1st report worth 5%; 2nd report worth 10%; 3rd report worth 25%

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- **Ask us for more feedback on your work**
 - The academic staff are there to help you!
 - Ask them how you can do better next time.

What you *aren't* being graded on

This module is about developing skills, not getting the “right” answer!

- Experiments and equipment often go wrong, and weird/unexpected results crop up
- We're *much* more interested to see how you deal with this than in whether you get the expected answer
- You'll get a lot more marks for a thoughtful analysis of why something went wrong (and how you tried to diagnose the problem), than a basic analysis and write-up that happens to get the “right” measurement value

Time management (in labs)

Prepare beforehand, make a plan, and know when to move on!

- Make sure you've read the lab script and know what to do before arrival.
- Be efficient, but not hasty. Think about whether your results make sense as you record them!
- Think about ways to save time (e.g. Can you get good results with fewer measurements? Can you record the results in a spreadsheet instead of transcribing from your lab book?)

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- Be disciplined and think about the assessment criteria – is it worth spending 50% of your time on error propagation when it's only 15% of the total mark?
- Don't rush to finish the measurements if it means sacrificing time on analysis.
- You **must** do some analysis and interpretation as you do the experiment. Otherwise you won't have time to go back and improve/fix/reanalyse things!

Time management tips

- Write down a plan for how long to spend on each stage of the experiment (including analysis/errors).
- Get the experiment set up ASAP and try some initial measurements. Analyse them as you go along – think about whether you're using the equipment correctly and have chosen sensible settings.

Time management tips

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- Get the experiment set up ASAP and try some initial measurements. Analyse them as you go along – think about whether you're using the equipment correctly and have chosen sensible settings.
- **First session:** Aim to have most measurements and some analysis done by the end of this session.
- **Second session:** Aim to finish the measurements early, and spend a solid couple of hours on more thoroughly analysing the results.
- Make sure you leave time to go back and adapt your method if needed!

DO NOT try to finish all of the measurements if there's no time

Good, thoughtful analysis is more important!

Time management (for lab reports)

Rushed lab reports get terrible grades!

- Start at **least** 2 weeks before the deadline and chip away at it, a section or so at a time. Build it up piece by piece.
- Leave yourself time to do background reading into the physics (>2 days).
- Leave yourself time (>1 day) to re-read and edit the report, fix typos, and improve presentation.
- Think about whether what you've written satisfies the criteria for a good technical report. Could someone use it to reproduce the experiment?

Handing in your lab book

- After you've finished the lab sessions for your experiment, you can take your lab book away to finalise the analysis, interpretation, and conclusions
- This is so you can take time to think it through and do a solid, professional job
- Don't write lots and lots, you'll actually lose marks for being less clear/concise...
- **Deadlines (hand in to 2nd floor lab):** Thu 4pm (Group 1); Mon 4pm (Group 2)

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- **Deadlines (hand in to 2nd floor lab):** Thu 4pm (Group 1); Mon 4pm (Group 2)
- *Late hand-in penalties:*
 - 10% deduction in marks if handed in within 24 hours (and you email me!)
 - 50% cap (maximum grade) if any later than this
- *Lost/forgotten lab books:*
 - **Forgotten:** 50% cap (max. grade) on that experiment (since it's bad practice)
 - **Lost:** Disaster! You might not be able to write your lab report(s)!

Working as a pair

Most of you will have a lab partner

- Work together on the experiment (find a good and equal division of labour)
- Don't stick to a single role; make sure you get experience in all aspects of lab.
 - You will struggle with your lab reports if you don't try everything yourself!

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- Don't stick to a single role; make sure you get experience in all aspects of lab.
 - You will struggle with your lab reports if you don't try everything yourself!
- Write your lab books **independently**. Both of you should be keeping a good and complete lab book as the experiment progresses.
- Discuss the physics and interpretation between yourselves and other groups.
- But **don't** copy analysis/conclusions/etc. between lab books. This might be interpreted as **plagiarism**. Ask if you're unsure what's OK and what isn't.
- Be punctual and professional for the sake of your lab partner!

Fair assessment and plagiarism

ZERO TOLERANCE POLICY IN EFFECT!

- The experiments are timed (3+3 hours per week). You can't bring previous measurements etc. in with you.
- You can work on the planning, analysis, and conclusions at home, but should properly document your work in the lab book.
 - The work in your lab book should be your own
 - Please don't prepare typed pages and then stick them in (plots/tables are OK)
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 - Please don't copy text directly from lab scripts, websites, partner's lab book etc.
- **Plagiarism** (in lab books or reports) is a serious offence and is easy to detect. Don't risk it! If you're unsure about what constitutes plagiarism, just ask us!
- Fabricating or manipulating data is a serious offence (professional misconduct).
- Make sure you properly cite/quote sources in lab books and reports.

Safety

SAFETY IS PARAMOUNT!

- Several experiments involve radioactive sources, lasers, and pressurised containers, which are dangerous if mishandled.
- They are perfectly safe if handled carefully and with respect however.
- **Follow all safety instructions very carefully.**
- Eating and drinking in the lab is **strictly, strictly prohibited**. (Go outside and wash your hands first if you need to eat/drink.)
- Always report possible safety issues to any member of staff **immediately**. You will never get in trouble for responsibly reporting an issue.

Summary

- PLab is about developing a range of useful skills at a high-level
- You are in charge of your work. Experiment, try new ideas, solve problems...
- Talk to us! We want you to succeed, and can give you all sorts of tips/advice
- Next 3 lectures:
 - How to write a good lab book (*next lecture*)
 - Uncertainty and errors (*Friday 2pm*)
 - Plotting and fitting with the Origin software (*Friday 3pm*)

Don't forget the test on QMPlus!