



Welcome to the Astrophysical Labs for the Master of Astrophysics and Master of Physics programs Somme-Semester 2025

<https://www.usm.lmu.de/Lehre/Lehrveranstaltungen/Praktikum/>



Organization of all labs: Arno Riffeser
responsible for numerical lab: Klaus Dolag
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Astrophysical Labs for the Master of Astrophysics and Master of Physics programs SoSe2025

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General information

Place and Times:

Tuesday 13:30–18:00, **University Observatory (lecture hall, ground floor)**

Briefing for the Summer Semester 2025:

Tuesday, 29th of April 2025, 13:30

*Note: Master's students in astrophysics or physics **who have already completed** their first semester of labs **do not** have to participate in this introductory briefing **if** they correctly inscribe in the LSF **confirming** that they will attend this course.*

You may ask for other students as possible partners than last semester, but there is no guarantee.

If you have e.g. Covid-19 / flew symptoms but are fit for a lab, inform your supervisor/colleagues and please ask your supervisors about the possibility to attend the lab remotely.

Date of first lab:

Tuesday, 6th of April; 2024, 13:30

This lab course is for:

Master students in astrophysics and physics only.

LMU Bachelor's students in physics can be admitted **if** they are already admitted to the Master's program in astrophysics or physics **and** if we have enough tutors!

Students who **have applied** for the Master's program in astrophysics or physics but have **not been admitted** **cannot participate** in this lab.

In case you have questions or need further information (regarding P 2.1/2 · WP 16.1/2 · WP 17.1/2 + ...):

Please contact Dr. Arno Riffeser (arri_at_usm.lmu.de) by email.



You can take the following lab-course variants:

LSF-NR	Title			
17187	(P2)	Astrophysical (Basic) lab with exercises	9 ECTS	(Master Astrophysics)
17202	(WP16)	Instrumental lab with exercises	9 ECTS	(Master Astrophysics)
17204	(WP17)	Numerical lab with exercises	9 ECTS	(Master Astrophysics)
17133		Small astrophysical practical course	3 ECTS	(Master Physics)
17134		Large astrophysical practical course	6 ECTS	(Master Physics)

Master students of Astrophysics have to take the “basic” 9 ECTS lab, they can choose another lab in another semester.

We highly recommend to do the **instrumental/observational or numerical lab in the first the semester** and the **basic lab in the second semester!**

Master of Physics students can mix the experiments (depending on availability, no guarantee).

For the labs you will need VPN & VNC:

You can download a PDF file **VNC_for_praktikum_2025SoSe.pdf** via email

Please read it carefully, install and test it before the labs start.

THE SUCCESSFUL INSTALLATION (PRIOR TO THE LAB) IS PART OF THE FIRST EXAMINATION TAKING PLACE NEXT TUESDAY IN YOUR FIRST LAB.

YOU WILL NOT BE ALLOWED TO PARTICIPATE IF THIS IS NOT SUCCESSFULLY INSTALLED (“FAILED”).

If you have problems with your installations you can visit T. Hoffmann in his office, 5. May., 13:30-15:00



I. How the lab course is organized

- 1 The course supervisor organizes the students into **teams of usually two to three people** for each experiment. In rare cases it may happen that a "group" consists of a single member only for various or all experiments in one semester.
- 2 Each team has to do **six experiments** (for 9 ECTS). Each experiment lasts **2 weeks**.
- 3 The experiments take place on **Tuesdays** and (for 9 ECTS) last for **4.5 (full) hours**. They are starting at **13:30** and lasting usually **until 18:00**.
- 4 In general the experiments are *assigned* to the teams, They cannot be chosen by the team members.
- 5 Who is doing **which experiment** will be announced on time on the **web pages** of the lab course.
- 6 **All** members of each team must be **present** on each of the afternoons **physically** and **mentally**. If you cannot attend a lab due to illness, please inform your lab supervisor in time (via e-mail or phone) and hand in a medical certificate if possible. If only *one* person from your team is ill, this does not mean that the lab will be postponed for the *other members* as well! The supervisor will make another appointment with the absent student.

In case of absence due to illness or some other justifiable reason, the knowledge of the missing student will be evaluated at a later date and the lab will have to be performed by the student at another time (then usually alone).

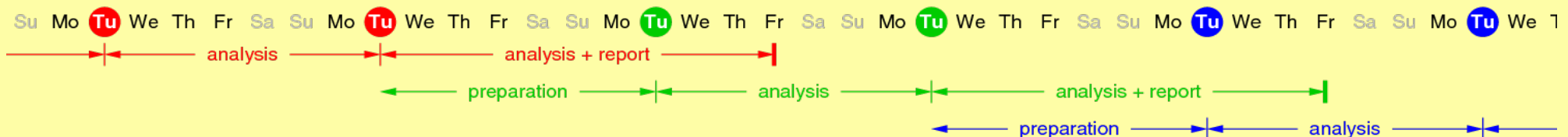
- 7 The **evaluation scheme** will be explained orally during the introductory briefing and can also be found on the web pages of the lab
- 8 You will connect to the **USM lab computers** via [VPN/VNC](#). Please install the required VNC client and the VPN client on your own computer **before** the first lab day, and verify that they work. This is mandatory!
- 9 You will submit your **lab report** via a web interface (information will be provided via email). You will not receive any credit points if your report is submitted late.



II. Lab procedure and evaluation criteria

A. The schedule is as follows:

- 1st week: oral or **written examination** of the required background knowledge; experimental work.
- 2nd week: further oral or **written examination**, finishing experimental work (if necessary); analysis of the data and discussion of the results with the supervisor.
- 3rd week: submission of the lab report to a link provided to you and starting the next experiment (Tuesday). **The deadline for the download of your lab report is Friday 18:00. You will get no credit (“failed attempt”) for the lab if this deadline is not met.**
- 4th week: short feedback from your supervisor (Tue 13:10) on the lab report (no grade at that time). (“failed or not failed”, plagiarism can lead to failure also at a later time).





- B** Each experiment must be prepared and executed by *all* participants. You need to demonstrate sufficient knowledge on each of the afternoons, otherwise this counts as a *half of failed attempt for each afternoon*.
- C** The *lab report* has to be written as described under “lab report guidelines” below. One report per team and experiment is usually sufficient. All group members must certify by signing the lab report that they are familiar with its contents and agree with it. In case of disagreement, any team member may hand in their own version of the lab report. In this case, submission of the lab report will be also accepted in the 4th week of an experiment (communicate it before the first deadline!). As soon as the lab report has been submitted, it cannot be changed anymore. For reasons of equal treatment, the reports will be finally evaluated not before the end of the term. If an essential part (including the questions and exercises) is missing, the lab report will be considered insufficient (*failed attempt*). The same is true if the report contains blatant errors in terms of understanding and results, or if the report has been copied from another group from the same or a previous semester. Illegible or sloppy reports are also considered insufficient (*failed attempt*).

The rules of referencing/citing of literature have to be followed, otherwise the lab will be also result in a “failed attempt” (no credit). If you use AI like Chat-GPT you have to add this information in your report and you have to state for which parts of the report you used it. You are fully responsible for the correctness of the content when using AI, too.



To be specific and more clear: how do you **fail the lab course** ?

- A) **PLAGIARISM** : If any lab report (with your name on it) copies text from elsewhere without proper referencing you fail the whole lab without a possibility to cure this.
Examples: You copy from the lab report of a previous group or a group in the same semester, you copy from a resource that you do not mention in your references (includes lab manual, literature, “Wikipedia”, “ChatGPT” etc.)
- B) If more than one lab report (after the submission) is considered as insufficient (does not receive a grade of 4.0 or better) then you will fail the whole lab.
If at most one of your lab reports in this semester is considered a “failure” and if you do not do anything about it then you fail, too.
But in this case you have the chance to repeat parts of the experiments and improve on this lab report. You will receive a special date and deadline for this.
The latest date for this is the first Tuesday after you submitted the last, 6th report. If the report then still is not acceptable you fail the whole lab.
- C) If your performance during ONE lab afternoons is unacceptable you get “**1/2**” a **failure** like the yellow card in soccer. *Examples* are: no preparation, insufficient understanding of the lab material, insufficient work with the experiment itself or lacking participation in the discussion about the lab work with the supervisor and your fellow students.
If you receive at most one yellow card (1/2 failure) during the whole semester you will pass. Otherwise you fail. So insufficient performance in 2 afternoons make you fail the whole lab.
- D) If you do **not submit a lab report in time** you will fail the whole lab. So do not submit at the last second. If a problem occurs during your submission please write to your supervisor immediately.



More about Plagiarism:

Have a look here – what is plagiarism?

<https://mediatum.ub.tum.de/doc/1236069/1236069.pdf>

and in particular read this part of the above text (on page 11):

“

There are different forms of plagiarism. The main types are⁵.

- **Complete plagiarism / copy & paste plagiarism:** to use another author's text unchanged, without citation, and pretend it is one's own work (VroniPlag Wiki - Plagiatskategorien, 2014; Weber-Wulff, 2004a).
- **Clause splicing / Shake & paste plagiarism:** combining fragments of different texts or sentences to form a new text without citation, thus presenting it as one's own line of thought (Weber-Wulff, 2004a).
- **Idea plagiarism / obfuscation:** presenting another author's ideas in your own words without citing the source (VroniPlag Wiki - Plagiatskategorien, 2014).
- **Translation plagiarism:** Translating an original text from another language without citing the source (VroniPlag Wiki - Plagiatskategorien, 2014; Weber-Wulff, 2004a).
- **Bibliography balloon:** Listing references in the reference list that have not been cited in the text (Projekt Refairenz, 2017).
- **Bibliography amnesia:** giving in-text citations without listing the complete reference in the reference list (Projekt Refairenz, 2017).
- **Pawn sacrifice:** only part of the cited content is marked as a citation (VroniPlag Wiki - Plagiatskategorien, 2014).

Note: Even if an author (e.g. a classmate) willingly consents to the uncited use of her text, you are nevertheless guilty of plagiarism, unless you cite the contribution! (Neville, 2010, p. 30)

Plagiarism arises not only through failure to cite, but also then when you do reference another's work, but do not make it clear to the reader how far the citation extends. This happens, for example, when a summary

“

gives the impression that it is the author's own work when it is not.



Another point about text writing:

It makes no sense if you just combine literature text even if you fully follow the citation rules.

Not allowed :

Your TEXT =

“{Text of Author 1}”, Citation + “{Text of Author 2}”, Citation + ... +

Because, if **no text is from you**, you can not get a (positive) credit, since one can not judge whether you can develop your own logical thoughts etc.

If you feel unsecure you can always ask your supervisor during the first and second lab day and show her/him your first text examples.



III. Guidelines for your lab report

“a lab report is like a report on a mini science project & each report prepares you for working and writing on your master thesis project !”

1. The lab report is an essential part of the lab. It should not just be an enumeration of results, but also **briefly** summarize the whole experiment in a way that would allow a fellow physicist to understand what you did and how and why you have done the experiment. The lab manual and your lab report should provide a complete description of the experiment to a third person who was not involved in your experiment.
2. As a part of the lab, the report should demonstrate to the supervisor that you have understood the experiment and its implications.
3. Do not just copy from the literature, however, you may, where necessary (e.g. equations). Explain clearly and **in your own words** the most important points of the experiment. Always elaborate on the logical framework of the experiment.
Never copy parts of the manual in the report, you can refer to it.
4. If the pure text of your report contains more than **12 text pages**, check whether you can trim the text. In case you have less than 6 pages, check whether you have explained enough.
Introduction 1-2 pages, Summary not more than 1 page.



Your lab report check-list:

Total length of pure text ≤ 12 pages.

We recommend to use latex (e.g. overleaf), also to prepare for the master thesis write up.

The lab reports can differ in structure from topic to topic.

For this reason we also do not predefine the same structure for all lab report topics.

Before handing in, check the report for intelligibility and regarding the following aspects:

- What is the point of the experiment?
- **Introduction** to the theory behind the experiment (1-2 pages)
- Description and explanation of the execution of the experiment.
- Original **measurement record** (if applicable).
- Citation and mentioning of all non-trivial equations used in the text.
- Numeric results with a sensible number of digits, *including intermediary results*.
- Discussion of errors; if applicable: error calculation.
- Thorough interpretation of the results.
- **Summary** & conclusion (≤ 1 page)

In some cases it may be expedient to deviate from this scheme.

Please make sure on time that you have sufficient information for doing and analyzing the experiments.

If in doubt, talk to your supervisor.



Astrophysical Lab: Summer Semester 2025

Title of experiment:
Supervisor (1st afternoon):
Supervisor (2nd afternoon):
Group (number):
Names (of the students):
<small>(Please also indicate whether you are a Master's student in Astrophysics (MA) or in Physics (MP) and in which semester you are.)</small>
1st afternoon (date, times of start and end):
2nd afternoon (date, times of start and end):
Time you needed to work on the report (at home) in person-hours, sum over all group members: <small>(This information does not enter into the evaluation, but it helps us to adjust the lab content.)</small>
Here is space for your comments:
What did you like? How would you improve the labs? Would you actually like to implement these improvements yourself?
Signatures of the students, with date:
<small>With your signatures you confirm that you have not used any references for your work other than those quoted in your lab report, and that you have not copied any content from other students' reports.</small>
Evaluation of the lab report and the performance of the students during the lab (by the supervisor):
Signature of the lab supervisor, with date:

- Use this cover sheet for your report:
<https://www.usm.uni-muenchen.de/Lehre/Lehrveranstaltungen/Praktikum/coversheet.pdf>
- 1 ECTS point corresponds to a work load of 30 hours !
 - The lab is worth 9 ECTS ~1/3 of your semester work (15 weeks)
 —> it is a serious amount of work.
 (compare : a Bachelor thesis is 12 ECTS)
 = $30 \times 9 / 15 = 18$ full hours per week
 only 4,5 present in the lab!
 factor 3 at home

Take it serious!



Feedback to students performances during the lab period and regarding their lab reports:

At the end of each lab day you can have feedback regarding your performance

- in the examination (mini-test & oral) at the beginning of each lab day
- regarding carrying out the experiment

This feedback does not imply any grades but an orientation
“good/satisfying/insufficient”.

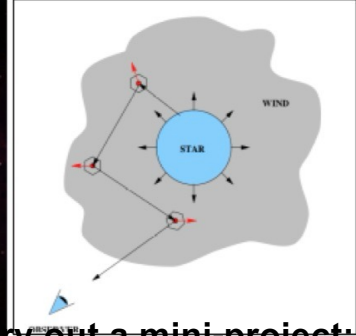
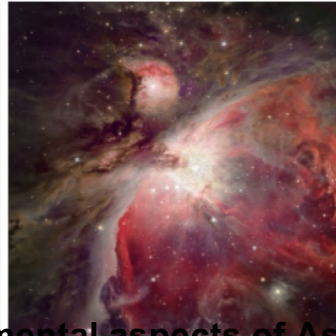
After submission of your lab reports you can have an approximate feedback regarding the lab report quality (no final grade implied, just trying to spot if there is anything problematic (or very good) about a report such that you can avoid (keep) this for future reports).

Please come to see your supervisor **Tuesday** at **around 13:10 before starting the next lab after submission** of the report or arrange another date for feedback (can be also via zoom). This takes place every 2nd Tuesday, please make an appointment with your recent supervisor! (first on 27 May, then 10 June, ...)

One goal is to spot insufficient lab reports in time (such that you can partly re-do one experiment / lab report). The feedback does not guarantee that you finally pass this one lab report as there could be still plagiarism found at a later time.



<https://www.usm.uni-muenchen.de/Lehre/Lehrveranstaltungen/Praktikum/anleitungen.php>



You deepen your knowledge about various fundamental aspects of Astrophysics and carry out a mini-project:

- [Search for extrasolar planets](#), overview over all detection methods, application of the transit method
- [Spectroscopy of exoplanetary atmospheres](#)
- [Planetary nebulae and their central stars](#): Balmer emission line spectra, forbidden lines of ONS, analyze a spectrum to get T_{eff} of the central star.
- [Star formation](#): Multi-Wavelength Studies of the Coronet Star Forming Region; empirical classification of YSOs by their SEDs in the mid (Spitzer) and near IR (2Mass), X-ray emission of SF-Regions.
- [Lyman-alpha forest](#): learn about the IGM using spectra of QSOs
- [Galaxy photometry](#): SFB-profiles & Scaling laws for Spiral and Elliptical Galaxies
- [Galaxy evolution](#): from broad band photometry of galaxies
- [Strong lensing](#): Gravitational Lensing effect & Cosmology, multiple images & parametrized lens models, derive constraints for the DM-distribution in the center of the cluster Cl0024.
- [Weak lensing](#): Statistical description of the Universe's matter density field & how to measure the matter density field with WL & dependency on cosmological parameters.
- [Gravitational wave follow-up](#)
- [Galaxy Clusters](#)



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https://www.usm.uni-muenchen.de/~paech/Astro_Num_Lab/

WP 17.1/2 Computational methods Lab

- [Matrix inversion](#)
- [Integration methods](#)
- [Ordinary differential equations](#)
- [N-body simulations](#)
- [Random numbers and Monte Carlo simulation](#)
- Monte Carlo Markov chains (MCMC) and lensing profile of galaxy clusters



<https://www.usm.uni-muenchen.de/Lehre/Lehrveranstaltungen/Praktikum/anleitungen.php>



You learn about instruments, observing techniques, data reduction and analyzing own data for a science project:

- **Adaptive optics**: Atmospheric blurring, wave front sensing, wave front correction —> improve sharpness of images from $\sim 0.5''$ to 40milli-arcsec for a 8m telescope.
- **Spatial Interferometry** from 50milli-arcsec (8m) diffraction limited resolution to milli-arcsec resolution
- **Observing with our 2.4-m radio telescope**: How does a radio telescope work? Target HI clouds in our MW, measure their spectra and determine the rotation velocity of the MW
- **Wendelstein (WST) I**: Imaging observations with our 43cm telescope on Mnt, Wendelstein, learn about CCDs and data reduction
- **Wendelstein (WST) II**: Use your data to determine the age of a globular cluster (learn about CMD of stars, isochrones, metallicity, extinction)
- **Wendelstein (WST) III**: Stellar Spectroscopy with PSPEC. How does a (fibre) spectrograph work? Observations and data reduction, wavelength calibration, stellar classification.
- **Building a CD spectrograph**: grating vs prism spectrograph, build your own spectrograph with a CD.
- **Gravitational Wave counterparts**



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for WST 1 lab only (instrumental):

planning session for the Wendelstein trip :

next **Tuesday 6/5/2025 at 13:00** in the lecture hall at USM

for questions please ask

Raphael Zöllner rzoeller@usm.lmu.de