Astrophotography AST244 *(March 2020)*

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Assistants 2019/2020
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Goals

The aim of this course is to take high quality astronomical multi-wavelength imaging data of a 'deep sky messier object', reduce the data and produce a report, presenting your results, describing what you have observed, what you see in your final image, and how you took the data and how you reduced the data. Astrophotography is a great way of learning about astronomy, ccd imaging, image processing, attention to detail and more.

Our telescopes are high quality precision instruments, but they are not the Hubble Space Telescope. However, because of their large field of view (~20x the Hubble Space Telescope) they are well suited for astrophotography and with patience you can take beautiful images.

Ideally you will work in small groups of two or three, but no larger than three. You can set up the telescope together, but each person must choose their own object to observe and take and reduce their own data and write their own report. Possible objects should be taken from the MESSIER catalogue and could be nebula, star clusters or galaxies (https://en.wikipedia.org/wiki/List_of_Messier_objects).

Note that the CCD camera is not suitable for imaging planets or the Moon - they are too bright and need very short exposures (a fraction of a second). Your target from the Messier catalogue will require ~hours total exposure times (over ten minutes in each filter band). You will only see an interesting image on your computer after much hard work.

Who this course is for

This course is mainly intended for students enrolled in the Minor programs in either Astrophysics or Astronomy & Astrobiology. If space is available, students from any other subject may request to take the course.

Reserving the equipment

We have two telescopes with cameras and the equipment can be reserved one to four weeks at a time on a first come first served basis. The equipment is quite heavy and comes in several packages/boxes so you will probably need a car to transport these outside of campus. You will most likely need to reserve the equipment several times before you have successfully collected data. Reserve the equipment via the doodle or with the assistant and arrange collection and return on a weekday.

Before you pick up the telescope, research what object you wish to observe that is visible those nights and inform the course assistant of these details along with where you are going to take the telescope. Telescopius.com and Stellarium are useful for this task, which also let you compare the field of view of the telescope with the object you want to observe).

When you check out the telescope for the first time one of the assistants will help you in setting up the equipment inside the institute. If they have time and if you wish, one of the assistants may also accompany you on your first nights observing outside the institute.

When you are given the equipment there is a checklist. When you return the equipment this will be checked. The equipment is expensive – please take good care of it. The CCD cameras cost CHF5000, the telescopes and mounts a similar amount. The University does not have an insurance policy – any serious damages to the camera, tube, or mount may have to be covered by your own private insurance.

How to pass this course

Book out the equipment and take it to a site that is as 'dark' as possible. You can test and use the equipment on campus or from your balcony, but to take spectacular images you will need to be outside of the city. Take multi-wavelength images of a deep sky astronomical object of your choice. Not a planet or star! Present your stacked/reduced images in a report. Include the raw images with each wavelength, the flat field and bias frames, and detail the steps you took to obtain the final image. You will be graded on the quality of the report and final images. Reports must be submitted by the end of the regular exam period each semester.

This is not a 'point and shoot camera' - there are many steps to learn and you will need to research and practise these. You need to be able to set up the telescope and align it correctly. You will need to choose an object that can be observed that night, and understand the optimum filters and exposure times to use. You will need to merge and manipulate images, measure the astronomical 'seeing' and a whole lot more.

How to fail this course

We are not responsible for bad luck with the weather. Do not rely on taking this course to achieve the credit points - around half the students are typically unable to finish because of bad weather which limits the time available for observations.

Time & credits

This course is graded at 8 credit points, which is the equivalent time as a big lecture course and its associated problem classes. That is because this practicum is difficult – you will probably need to spend ~50-100 hours of time on your project to succeed. If you are not seriously motivated, do not start the course. However, if you stick with it and put in some time learning, reading, trying, failing, trying… then you will learn a lot about astronomy and you can produce quite spectacular images

You might be unlucky with the weather, and it takes time to take precision data, so this practicum may take two semesters i.e. you may take one year to complete. Therefore you do not need to register for this course, if you complete and pass then we will assign you the grade in the UZH computer system. You enrol in the course by emailing a request to Prof. Moore.

Before you go observing

On the website there is a "HOWTO" document describing the basics of how to set up the telescopes and cameras. Read this first. And before taking the equipment anywhere, **read the manuals and the HOWTO guide again** (the telescope tube manual, the mount manual for alignment) and read the CCD camera software manual SIPS (download from Moravian website), PHD autoguiding manual etc. Perhaps you want to also research the art of astrophotography online – in particular, how to align a telescope, how to use the autoguiding features, and how to obtain and reduce images. The software are all on the provided laptops or online in case you want to use your own laptop. Make sure the battery packs are charged up. Make sure the laptop is charged up. Make sure the date and time on the laptop are correct. Research what object is visible and what exposure times and optimum filters to use to take your data.

Where to go observing

The smaller telescope at a higher and darker location will take much better images than the larger telescope in a light polluted location.

You can find a 'light pollution' map of Switzerland online. You can take data from Zurich, for example from the Zurichberg, especially with the narrow line filter which remove some of the city light brightness. But you will get much better results if you take the telescope away from city lights and at higher altitudes to reduce atmospheric effects (twinkling of stars).

CAUTION

Taking astronomical data requires patience and long hours at night. Be careful working in remote places and do not drive when tired.
Never point this telescope at the Sun without a professional grade solar filter on the front, otherwise the internal optics will be destroyed.
Do not get the equipment wet.
Do not touch the lenses of the telescopes or the cameras.
Try to keep the equipment clean.
Do not lose the lens caps or cables.
Take a flashlight and warm clothes.
Take a sheet or blanket to lay out the equipment so you don't get dirt inside or lose things.
When bringing equipment in from a cold night water will condense on everything – leave the equipment unpacked in a dry place to remove the condensation.

Equipment summary

Two telescopes:

Takahashi 102mm refractor TSA-102 (1^o f.o.v.) Takahashi EM-11 mount
(total equipment weight ~30kg).
William Optics Star 71mm, wide angle (5^o f.o.v.) f/4.9 refractor, Skywatcher HEQ5 skyscan pro mount
(total equipment weight ~15kg)

Moravian G2-8300FW CCD cameras with filter-wheel 5x1.25
LRGB filters, H-alpha filter or OIII filter
Moravian G0 guide cameras, off axis adapter
Eyepiece, adaptors, cables
2x12v power packs
Bhatinov mask
Led light panel
Laptops running windows and with the telescope/CCD control software installed.