Laurea Magistrale Interateneo in Fisica AA2015-16:
LAB OF ASTRONOMICAL TECHNOLOGIES - 6 CFU
Prof.: Marisa Girardi – 36 h + Prof. Stefano Cristiani – 36 h

with the collaboration of Dott. Giulia Iafrate, Giuseppe Murante, Giuliano Taffoni.

SUGGESTED BOOKS: Fundamental Astronomy, Karttunen et al. (already used for Astrophysics course, here telescopes and catalogs) "To measure the sky", Chromey (basics); "Principles and Practice", Roy and Clarke; "Astrophysical Techniques", Kitchin (advanced); Observational Astrophysics, Lena' et al. (maybe a little too much advanced). Handbooks for the computational and data reduction practicals.

OUTDOOR ACTIVITY: astronomical observations at the telescopes of OATS/INAF, with the addition of an extracourse of 4 nights of observations at the Cima Ekar Telescope (Asiago, PD Observatory). MANY PRACTICALS in linux environment at the informatics laboratory of LAB-INFIS (Dept. of Physics - Univ. of Trieste, ubuntu op. system).

1 Part of Prof. Cristiani

The program of the course and a lot of stuff can be found in http://wwwuser.oats.inaf.it/cristiani/LECTURES/index.html This is only for TS Univ. students. Please ask to Prof. Cristiani (at oats.inaf.it) for the entering password.

1.1 Channels of astronomical information

Radio, mm, sub-mm, IR, optical, UV, X, gamma, cosmic rays, neutrinos, gravitational waves. Effects of Earth atmosphere. CMB. Telescopes in space: Planck, Spitzer, Herschel, HST, JWST, Euclid.

1.2 Detectors

Human eye. Detectors in astronomy: photographic plates, phototubes, CCD and their characteristics, infrared CCD, bolometers, STJ, TES.

1.3 Photometry and imaging

Principles of astronomical photometry. Imaging: computation of S/N. Calibration and reduction of astronomical images. Application to the measurement and study of the flux variations of a star.

1.4 Spectroscopy

Optics for spectroscopy. Gratings and spectrographs in modern astronomy. Dispersion. Spectral purity. Resolution. Uncertainties in the position and equivalent width of spectral lines. Spectra: computation of S/N. Applications to astrophysical problems.

1.5 Computational activity: UNIX, C-language, Python-language

Unix: basics and main elements. C language: basics, arrays, pointers, arithmetic of pointers. Structures in C-language. Practicals. Phyton: basics, variables, list comprehension, language structures, moduli, numpy, arrays. Many practicals. This part is in collaboration with Drs. G. Murante and G. Taffoni.

2 Part: Prof. Girardi

Stuff of the Lectures can be found in http://moodle2.units.it/course/view.php?id=437 Please, enter with your univ.student login for additional reserved/secret pages.

2.1 Optics for Astronomy and Astronomical Telescopes

Principles of geometrical optics. Lenses, mirrors, and simple optical elements. Simple telescopes. Image quality: telescopic resolution and optical aberrations. Telescope mount and drives. Reflecting telescope optics. Telescopes in space. Ground-based telescopes. (BOOKS: Karttunen 3.2; Chromey 5(part) and 6; Hack - Corso di Astronomia).

2.2 Catalogs and web archives

Name, catalogs, databases, stellar maps and finding charts. (BOOKS: Karttunen 2.12 p.39-42 Chromey cap.4 p.105-117 (interesting tables) KarttunenCat.ps, ChromeyCatTab.ps). The use of several web-sites for literature, catalogs, and data archive: ADS, arXiv, CDS/Vizier, CDS/Aladin, NED + Practical/Homework (see Topic 1 in Moodle).

2.3 FITS format of images and DS9 visualization

Astronomical images and their FITS format: HDU, Header, Data Unit. Array and operations with arrays. WCS. CCD (a short introduction, Chromey p.236). The use of the DS9 tool for visualization and treatment + Practical/Homework. See Topic 2 in Moodle.

2.4 Astrometry and Photometry and GAIA tool

Astrometry of astronomical images and the use of GAIA + Practical/Homework. Basics of Photometry: standard stars, instrumental magnitudes, calibration and zero-point correction. Photometry of stars and galaxies. The use of GAIA, in particular for aperture photometry + Practical/Homework. Object detection and catalogs using GAIA. Star/galaxy classification. Data from the SDSS archive + Practical/Homework. (Starlinks BOOKs, see Topics 3 and 4 in Moodle).

2.5 CCD reduction of images and Spectra calibration and IRAF tool

IRAF tool and its application to images. Basics of CCD reduction of images (bias,dark,flat) and spectra calibration (trace and extract the spectrum, identification of arc lines). The use of IRAF to CCD reduction and spectra calibration to obtain a redshift measurement with Practical. (see Topic 5 in Moodle).

2.6 Outdoor and Indoor/Remote Observational Activities

Presentation and use of the instrumentation at the local Astronomical Observatory of OATS/INAF at Basovizza: the SVAS Telescope Celestron C14 and the Solar Telescope Coronado HELIOS 1. During the 3 nights: image acquisition of several astronomical objects, in particular nebulae, variable stars, recent supernovae and their host galaxies. During the day: image acquisition of the Sun. The use of Radio SALSA Onsala Telescope in remote to measure the velocity of the HI clouds in the Milky Way. Related Practicals/Homeworks (see also Topic 6 in Moodle). The use of Stellarium. This part is in collaboration with G. Iafrate. In addition, there is the possibility of 4 nights and days to be performed at Cima Ekar in Asiago (OAPD/INAF) to measure extinction and reddening of nebulae (supervised by G. Iafrate). This last part is performed after the end of the course and is on voluntary base.

This year the long-term topics related to the final exam are: Study of the flux variation of a variable star as measured at C14; Calibration of a NTT galaxy spectrum; Kinematics/structure of Milky Way using SALSA radio measures of HI clouds; Results of the observational nights at Cima Ekar (planned: Study of extinction and reddening of nebulae).