Modern Astronomical Techniques (ASTR 257), Spring 2013

Instructor: Tesla Jeltema
Office: ISB 305
Office Hours: Wednesdays 11-12:30

Overview:
This class is a survey of observational astronomy across the electromagnetic spectrum. For each wavelength, we will consider: basics of the instruments and how they work, capabilities of current and next generation instruments (sensitivity, spatial and spectral resolution, FOV), major sources of emission and backgrounds, science highlights, calibration and major sources of instrumental error, data archives and data format.

Textbook: There is no required book for this class. Where appropriate, I will refer you to various resources throughout the class (books, articles, websites). The following books are available electronically from or are on reserve at the library:

"Measuring the Universe: A Multiwavelength Perspective" - Rieke
"Observational Astronomy" - Sutton
"Observational Astrophysics" - Lena
"Handbook of CCD Astronomy - Howell
"Handbook of X-ray Astronomy - Arnaud, Smith, Siemingowska
"Data Reduction and Error Analysis for the Physical Sciences - Bevington and Robinson

Outline:

1. Observing through the atmosphere, overview of current telescopes at all wavelengths
2. CCD basics, S/N and integration time, some basic concepts
3. Proposal writing (general intro with specifics later in the class)
4. Optical and UV
   - telescopes and instruments
   - intro to FITS data and optical data reduction
5. Infrared
6. X-ray
   - telescopes and instruments
   - data analysis examples in the photon counting regime
7. Data archives, object catalogs/databases
8. Statistics and regression analysis
9. Hard X-ray and Gamma-ray (space and ground)
10. Radio
    - telescopes and instruments, interferometry basics
    - data analysis examples
11. Non-photon signals: neutrinos, cosmic rays, gravity waves

Schedule Notes:
Professor Profumo will cover class on April 9. There will be at least one guest lecture in the second half of the class.

Assignments:

There will be no exams for this class. Grades will be based on a series of homework assignments and a final project in the form of a mock observing proposal.

Homework: There will be six homework assignments with a week to a week and a half given to complete them. The last assignment will be due during finals week.

Observing proposal: In addition to homework exercises, everyone will prepare a mock observing proposal. Proposal may be for either the Chandra X-ray Observatory (ACIS instrument) or the Hubble Space Telescope (ACS or WFC3 imaging). Proposals will be peer-reviewed by the class during the last class session. Preparation work for the proposal will be spread throughout the class.

Proposal Due Dates:

- 4/30 - present proposal topic ideas
- 5/9 - proposal feasibility study, pick final topic
- 5/23 - draft of the proposal introduction due
- 5/30 - **full proposal due**
- 6/6 - in class mock proposal review ∗**attendance required**∗