Observational Techniques
Final Project: Observing Proposal
Due date: First draft - Feb 15, 2009, final version - March 1, 2009

Write an observing proposal, based on one of the topics listed below (chosen in coordination with me – one topic per student or per student pair, i.e., you may submit a proposal as a pair). Your proposal must be written (in English) using the official forms available on the web for each observatory, as if this were a real proposal. I will also evaluate your proposal as if I were judging a real proposal (well, not quite, I will be more lenient, as writing a proposal will be a new experience for most of you, but anyway...). There will be two stages to this project. You will write a first draft of the proposal (as best you can), and submit it to me. I will mark it up with comments about things that need to be improved. You will then implement this feedback and submit your final version. I will grade each of the drafts, and each will have equal weight in the final project grade (the final-project grade constitutes 1/3 of the course grade).

The things I will look for are:
1. Does the proposer understand the scientific background of the project's topic?
2. Has the proposal identified an important, yet unanswered question(s) that is worth investing valuable telescope time in?
3. Will the proposed observations answer these questions?
4. Are the proposed observations technically feasible?
5. Is there a clear path from observation to analysis to answering the questions?
Remember that the TAC (Telescope Allocation Committee, in this case, myself) is reading many good proposals, the telescopes are oversubscribed, and you need to convince me that your proposal is the best possible use of the telescope. Get rid of spelling and grammar mistakes, there is no excuse for them in a written document, and therefore they make an impression of sloppiness on the reviewer. Avoid needless repetition, and wandering back and forth between different subjects and points; the proposal should have a clear and focused direction and flow: background, problem, observation that will solve the problem, why the specific method proposed is the best. Use plots and images, within the space limits set by your proposal form, if they can help explain the scientific problem and/or the observations or the data analysis. Let some of your fellow-students read your proposal and make corrections, comments, and suggestions. Most proposal forms will have two main sections, one called "Scientific Justification" (or something like that), and one called "Experimental Design" (or "Time Justification", or "Technical Description" or something like that). In the first you need to explain the science case, basically to answer questions 1, 2, 3, and 5 above. In the second you need to address 4 and 5. This is where you will mainly need to apply what we learned in the course, i.e., give the technical details of the

experiment, exactly how you will do the observations, and what are the parameters and properties of the data you expect (S/N, resolution, etc.). You may not have to calculate in detail these things, as we did in exercise No. 1; Many facilities have online programs called Exposure Time Calculators (ETCs) for the particular facility, which you can use. You can then write in your proposal, e.g., "According to the HST ETC, a 10-min ACS exposure in the I-band with median background conditions on a 23 mag point source gives a S/N of ...".

The topics are:

1. Intermediate-mass ($100 - 10,000 M_{\odot}$) black holes are sometimes theoretically predicted to exist in the centers of globular clusters, but none have been clearly identified to date. Miocchi(2007) http://adsabs.harvard.edu/abs/2007MNRAS.381..103M has identified a sample of 7 globular clusters that may host central intermediate-mass black holes, based on their stellar light distributions. Write a *Chandra* X-ray Observatory imaging proposal to search for signatures of such black holes in some or all of this sample.

2. Write an *HST* proposal using COS UV spectroscopy to observe two high-redshift quasars, HE 2347-4342 and HS 1700+6416, that are sufficiently bright in the far UV, in order to study cosmological intergalactic-medium HeII reionization at redshift $z \sim 3$, and compare it to theoretical reionization scenarios. See http://adsabs.harvard.edu/abs/2005A%26A...442...63R

3. Write a Subaru 8.2m telescope proposal using SuprimeCam to measure the mass distribution of the galaxy supercluster CL1604+4304/4321, at redshift $z = 0.9$, using deep images to discover strong and weak gravitational lensing signatures. See http://adsabs.harvard.edu/abs/2008ApJ...684..933G

4. Write a proposal to find a light echo of the Crab supernova of 1054 and to measure its spectrum, in order to determine its SN type. Use the Megaprime optical imager on the Canada France Hawaii 3.6m telescope to search for echoes based on their proper motions. Then use LRIS on the Keck 10m telescope to get a spectrum. See http://adsabs.harvard.edu/abs/2008Sci...320.1195K

5. Use NICMOS on Hubble to search for near-IR spectral signatures in the atmosphere of the newly discovered transiting super-planet or brown-dwarf, CoRoT-Exo-3b. See http://adsabs.harvard.edu/abs/2008A%26A...491..889D

6. RE J1034+396 is the only known active galactic nucleus with quasi-periodic X-ray variability, with period of $\sim$ 1hour; see http://adsabs.harvard.edu/abs/2008Natur.455..369G Write a SWIFT target-of opportunity proposal (the only kind there is for SWIFT), https://www.swift.psu.edu/secure/toop/too_request.htm to monitor this source simultaneously in X-rays and UV, to see if the periodical variations extend to the UV, and if there is any timelag between the bands. Write another proposal to simultaneously monitor the object spectroscopically in the optical, in order to perform

"reverberation mapping" of the broad Balmer emission lines and thus measure the mass of the black hole. For this, use ALFOSC on the 2.6m Nordic Optical Telescope.
7. Write a Target-of-Opportunity proposal to observe the next Galactic supernova (it has been 400 years since the last one was seen, but who knows, maybe this will be your lucky year). Assume that the SN will be at a distance of 5 kpc, and it will be discovered 2 weeks before maximum light. Note that the great brightness of the event will pose a challenge for most professional telescopes. Find what are the best data to obtain, at what wavelengths, and how to obtain them.
8. B[e] stars are B-type stars with emission lines. When their distances and extinctions (and hence luminosities) are not well known, it is hard to say whether they are pre-main-sequence B stars, or post-main-sequence supergiants, i.e. the evolved descendants of main-sequence O stars. Kraus (2009) has recently proposed a method to distinguish between the two using the abundance of the ^{13}C isotope in supergiant winds, as observed in CO absorption bands in the near IR. (see http://il.arxiv.org/abs/0901.0714). Write a VLT 8m telescope proposal using ISAAC to do resolution $R = \lambda/\Delta\lambda \gtrsim 1500$ K-band spectroscopy of the Magellanic Cloud sample of B[e] stars listed in this paper, in order to resolve their nature.
9. In the recent paper: http://www.sciencemag.org/cgi/content/abstract/1165243 it is found that, in 2003, methane was released into the atmosphere of Mars from plumes coming from localized regions. The methane was gone by 2006, indicating a fast destruction process. The methane could be of biological origin. Write a VLT/SINFONI proposal to perform near-IR integral-field spectroscopy of Mars, to see if the effect repeats itself, if it is always localized to the same regions, and improving on the previous single-slit observations by means of the integral field spectroscopy that permits mapping the entire Martian disk simultaneously.