Team project #3

Adaptive Optics
(+ everything else covered in course)

Team projects – proposed assignments

You can choose your project within or outside this list
OK to take a project and modify it along the way (email us if you do that)

Ground-layer Adaptive Optics for faint multi-object spectroscopy survey

- Follow-up to LSST: spectroscopy of large # of faint sources imaged by LSST
- Assume you can re-use LSST, or design new 8-m class telescope
- Use ground-layer adaptive optics to boost spectroscopy sensitivity
- Use multi-object spectroscopy design, with lots of spectra per pointing

Ground-based stellar interferometer + Adaptive Optics to image surfaces of M type stars

- Image stellar surfaces
- Image planet during transit: shape, rings, satellites ?

Ground-based AO+single mode injection system for Radial Velocity

- Use adaptive optics to inject light in single mode fiber
- Identify exoplanets with high precision RV fiber-based system

Ground-based AO to image galaxies lensed by clusters

- Measure the amount and distribution of dark matter in a galaxy cluster.
- Use the cluster as a magnifier to image faint high redshift galaxies.
- Explore what AO technologies would be appropriate.

Ground-layer AO for faint multi-object spectroscopic survey

Follow-up to LSST: perform spectroscopy of large number of objects identified by LSST
Build large catalog of optical spectra (~400nm – 1000nm)

Use ~8m wide field telescope (similar to LSST)
Use ground-layer AO to sharpen image → increased sensitivity → shorter exposure times

Design spectroscopic instrument to acquire simultaneously large number (~10000) of spectra

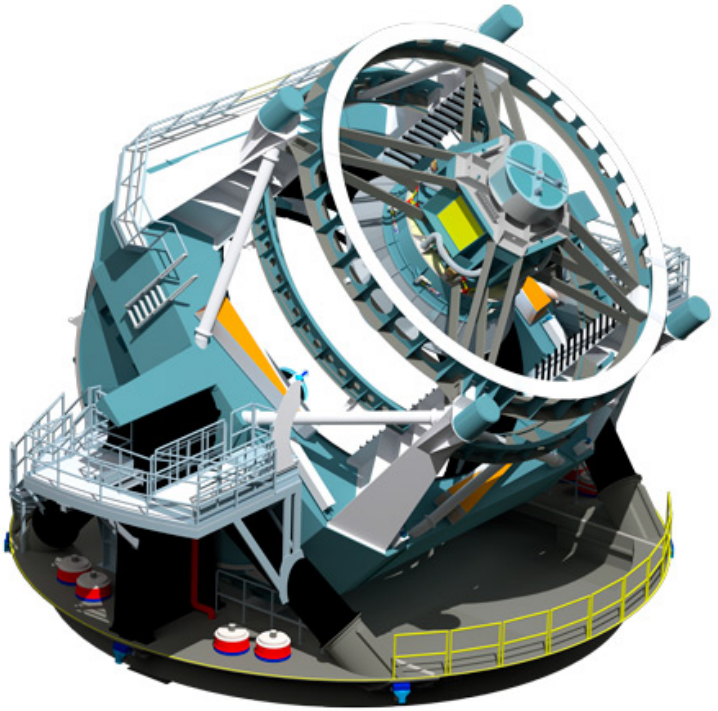
CHALLENGES, QUESTIONS:

Come up with telescope design compatible with ground-layer AO

What spectral resolution ? Detectors ?

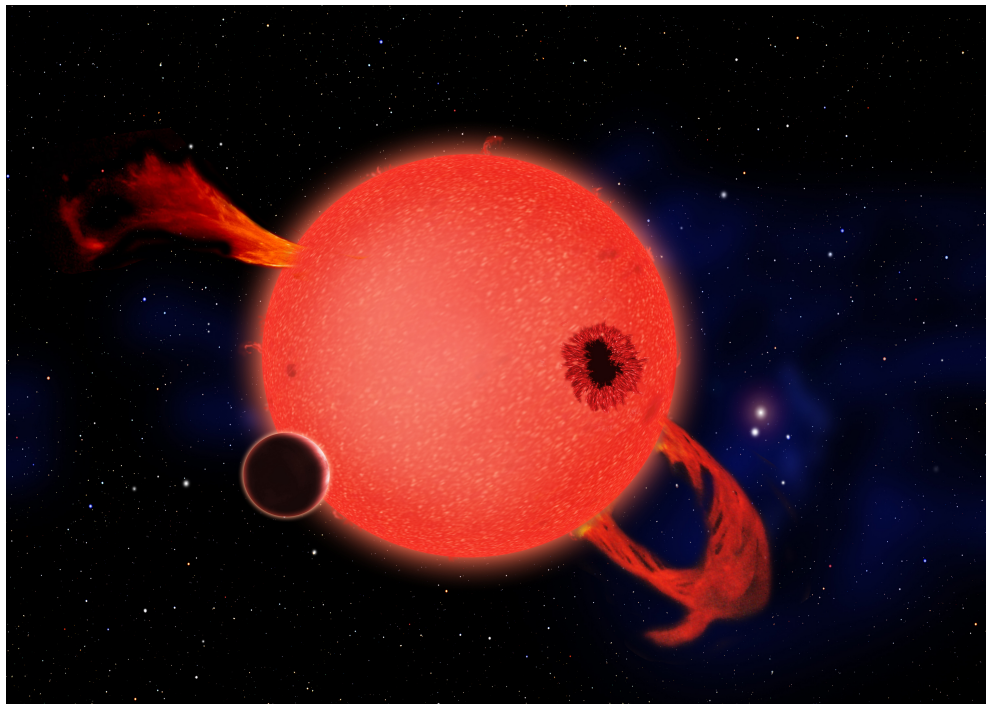
What does AO system look like ?

Sky specral lines removal ?



LSST

Ground-based stellar interferometer + Adaptive Optics to image surfaces of M type stars



Low-luminosity M-type stars are very good candidate for detection of habitable planets
Transit: stars are small, habitable zone is close-in with short orbital period
Imaging: Contrast is favorable
Radial velocity: signal is strong thanks to low stellar mass

Issues:
- Diameters of M-type stars are poorly known, and required to measure transiting exoplanet radius
- M-type stars have flares, potentially harmful radiations for habitable planets

Design an interferometer with Adaptive Optics on each telescope to:
(1) measure stellar diameters (aim for >100 targets)
(2) measure star rotation period and orientation
(3) image stellar surface: spots, flares etc...

Single-mode injection system for high precision radial velocity

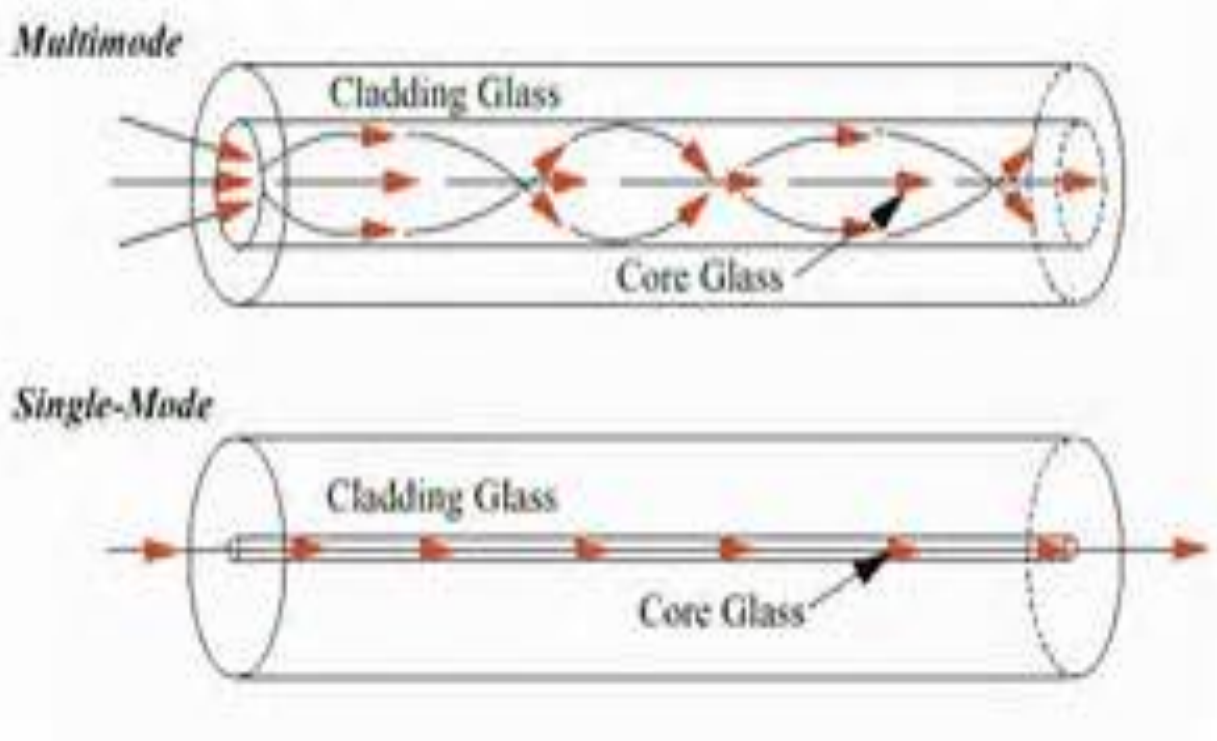
Design system to detect exoplanets using single mode fiber coupling

Explore/explain/quantify advantages:

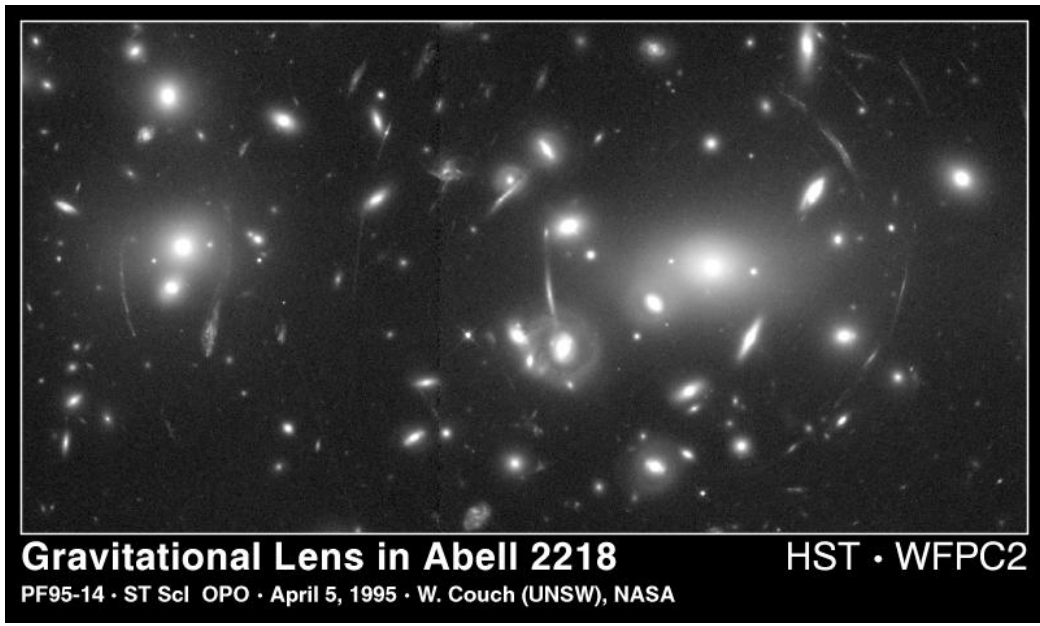
- Spectrograph design (size)
- Fiber modal noise

Describe overall system design and science strategy

AO system design
Spectrograph design
Telescope Design



AO imaging of lensed galaxies.



Explore the use of a ground-based system to measure the distribution of matter in galaxy clusters.

Explore the AO technologies that are best suited for the science. (NGS, LGS, SCAO, MCAO, MOAO)

Design a conceptual system, including telescope, AO, and camera capable of addressing this science.

Is the end product general purpose or focused on this project?