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 ?

Space-based interferometer to IMAGE the surface of habitable planets around Sun-like stars

- Use space-based adaptive optics to clean wavefront
- Large telescopes in an array

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

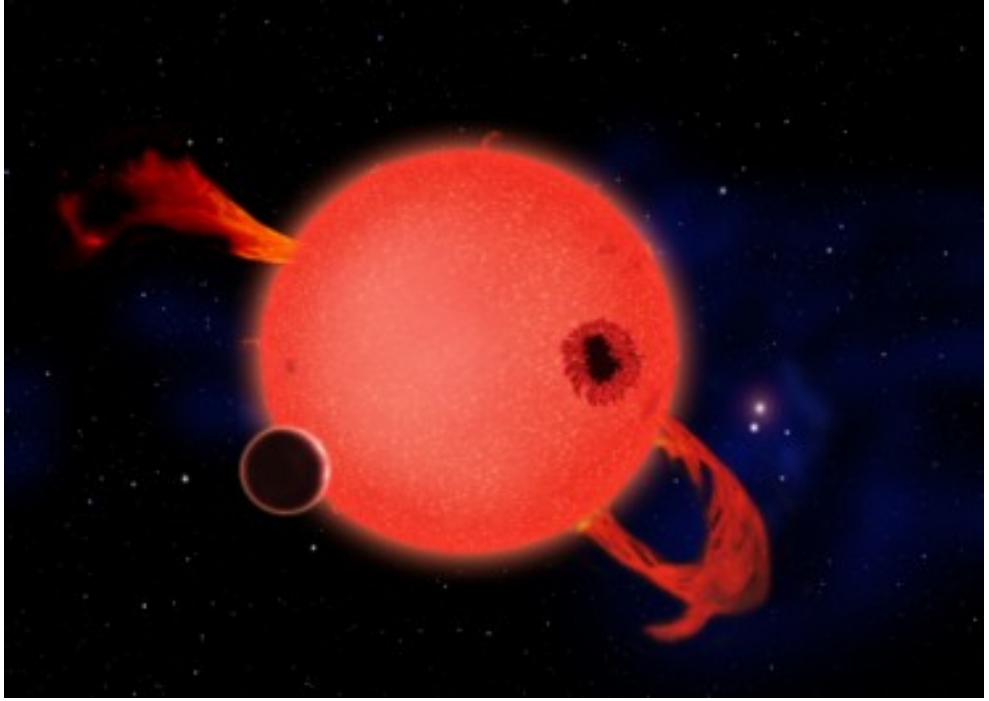
Design spectroscopic instrument to acquire simultaneously large number (~10000) of spectra

CHALLENGES, QUESTIONS:

Telescope design compatible with ground-layer AO
What spectral resolution ? Detectors ?
What does AO system look like ?
Sky 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 AO 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...

Imaging nearby exoplanet surfaces with a space-based interferometer

Use space-based network of large telescopes to image nearby exoplanet surfaces
Each telescope will have high precision AO system + coronagraph to cancel starlight

Planet image obtained by coherent combination of telescope beams

How many telescopes ?
How large ?
Baseline ?
# of targets

Spectroscopy ?