Astro 512
Extragalactic Astronomy

During this quarter, you will become an expert in an extragalactic topic of your choice. You will do so by:

- Reading at least 1 highly referenced paper on the topic a week.
- Reading at least 1 new astro-ph paper on the topic a week.
- Reproducing at least 1 calculation from a theoretical paper on your topic.
- Writing a proposal for a space-observatory, to address a current issue in your chosen field.

Each week, you'll be expected to drop by my office and talk about the papers you've been reading, possibly in a small group with a few other people who are developing expertise in a similar topic.

Possible Specialization Topics

The Internal Properties of Galaxies

- Dust in galaxies
- Stellar populations in galaxies
- Cold gas in galaxies
- Star formation in galaxies
- Bulges of spiral galaxies
- Extraplanar gas in disk galaxies
- Models of the formation of disk galaxies
- Models of the formation of elliptical galaxies
- Chemical enrichment of galaxies

The Galaxy Population

- The distribution of galaxy properties (luminosity function, surface brightnesses, etc) at $z = 0$ and through cosmic time
- The structural parameters of disk galaxies
- Differences between satellite and central galaxies
- Bars in galaxies
- The origin of the color bimodality in galaxies
- The metallicity of galaxies

- The fundamental plane of elliptical galaxies
- The Tully-Fisher relation
- Properties of central black holes (correlations with galaxy properties, evolution with z)
- The mass evolution of galaxies and their halos

Special Galaxies

- Ultra-luminous starburst galaxies (ULIRGs)
- Compact "red-nugget" galaxies
- The origin of ultra-faint and dSph galaxies

Galaxy Evolution

- High redshift galaxies
- The star formation rate over cosmic time
- The evolution of the galaxy merging rate
- The buildup of the red sequence of elliptical galaxies
- Large-scale winds & outflows from galaxies
- Circumgalactic gas
- How do galaxies get their gas?

Groups & Clusters of Galaxies

- Hot X-ray emitting gas in clusters of galaxies
- Galaxy groups
- The dependence of galaxy populations on environment
- Cluster gravitational lensing
- Evolution of galaxy clusters

Active Galaxies & Their Absorption Lines

- AGN-driven winds
- Models of AGN
- The evolution of QSO's
- The Lyman-alpha forest

- Damped-Lyman alpha absorbers

Cosmology

- Quantifying large scale structure
- The value of the Hubble Constant (i.e. the extragalactic distance scale)
- Reionization of the universe
- Density profiles of dark matter halos
- The overabundance of low mass galaxies in CDM