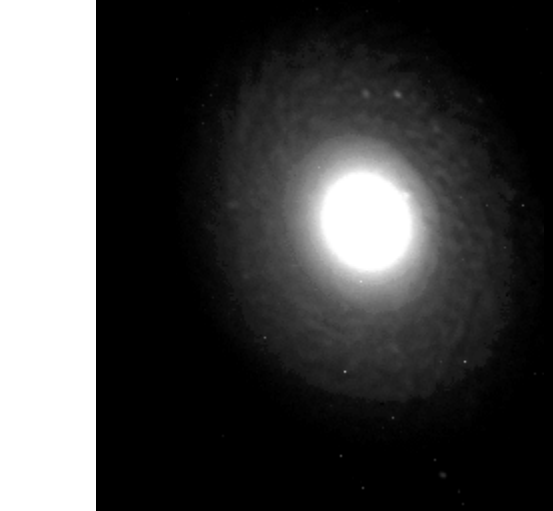
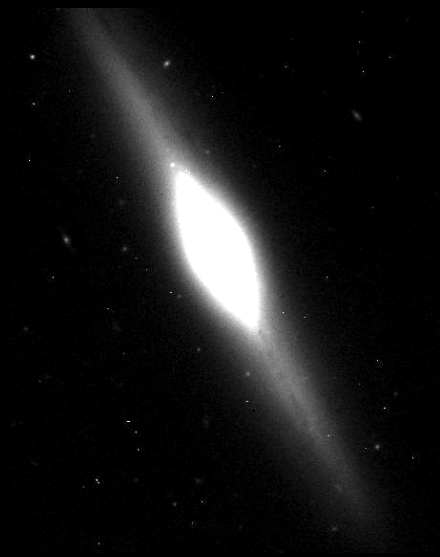
The Central Regions of Spiral Galaxies





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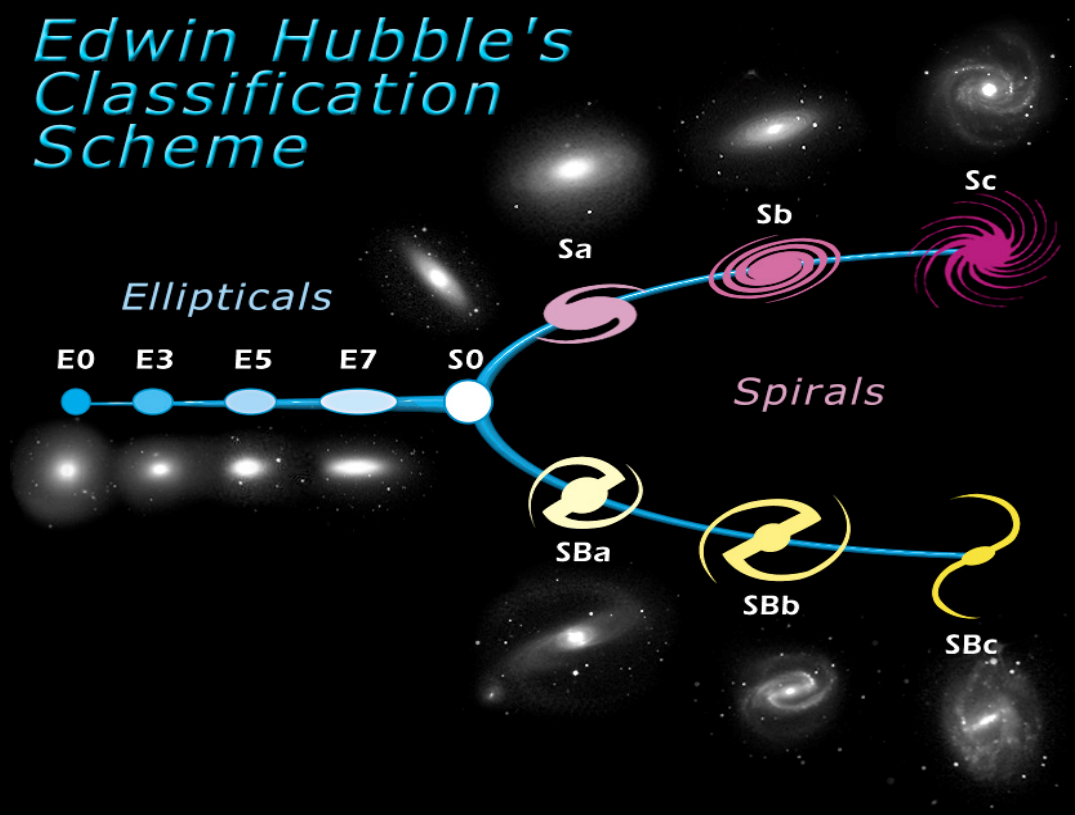
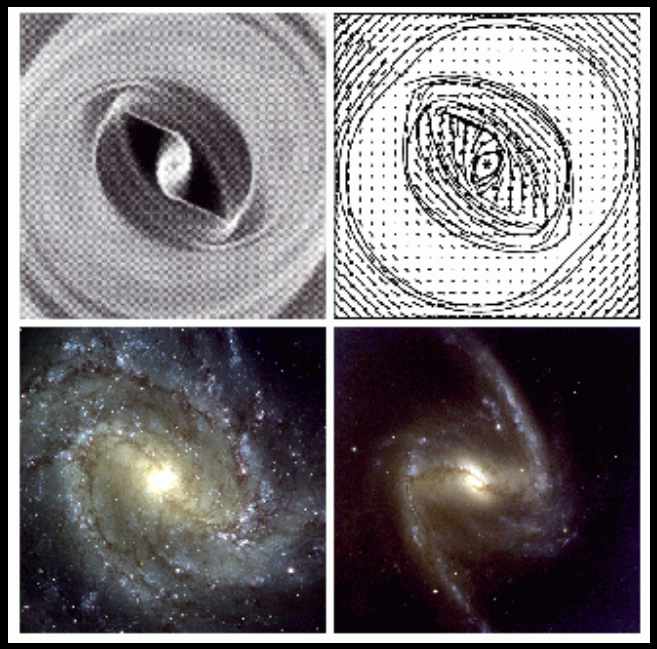
Galaxies: A Diverse Family

- Can be arranged in a sequence from pure ellipticals to pure disks
  - Origin of the sequence still unclear
- Bulges bridge together properties of disks and ellipticals
- Provide insight into formation and evolution of galaxies in general



Proposed Galaxy Formation Mechanisms

- Ancient Violent Formation - Ellipticals formed from a collapse or merger and spirals are ellipticals which subsequently acquired a disk
- Secular Evolution - Instabilities in disks produce bars which drive material towards the center to produce a bulge
  - Unclear whether the central mass concentrations can eventually destroy the bar



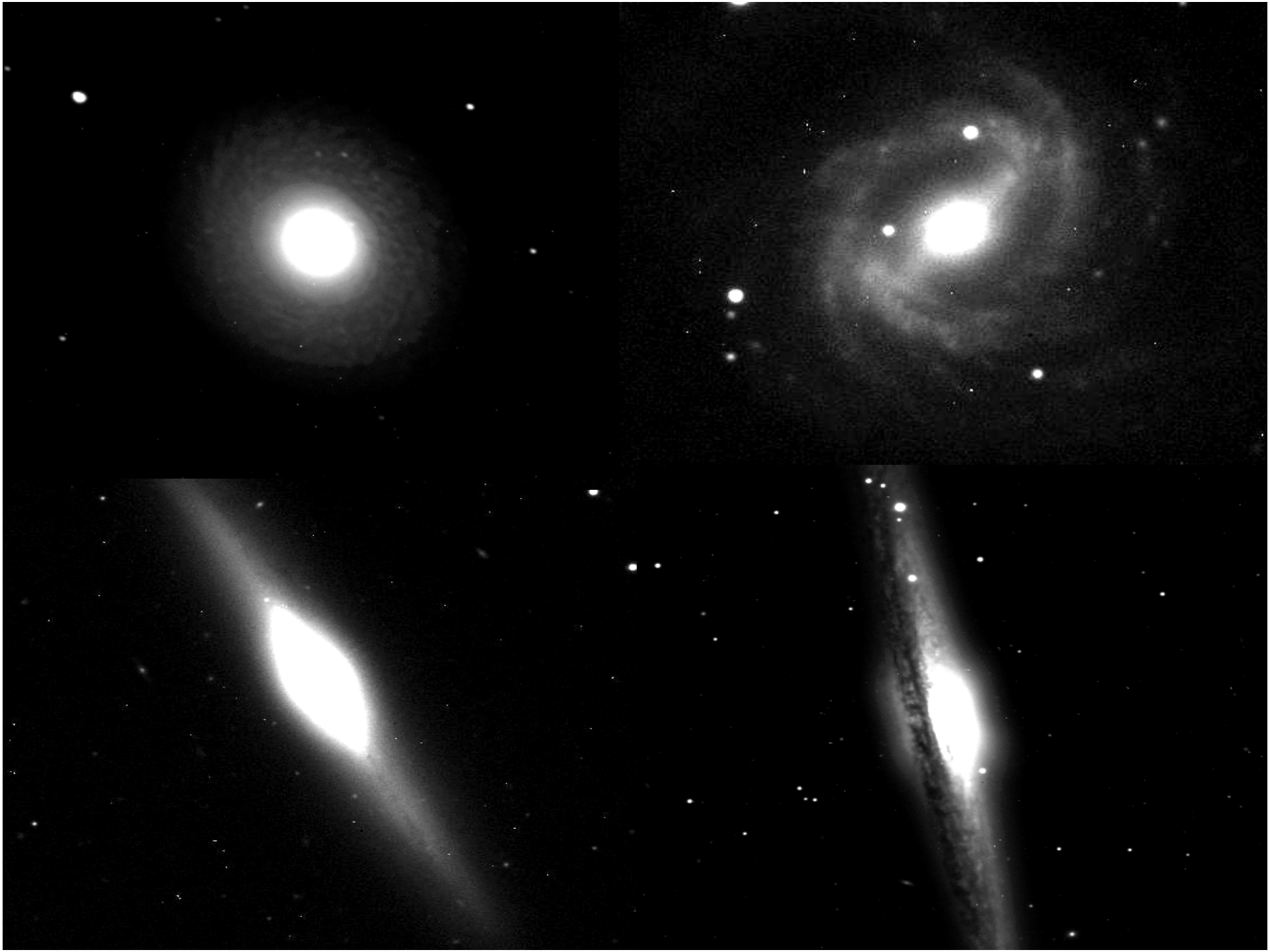
Kormendy & Kennicutt 2004

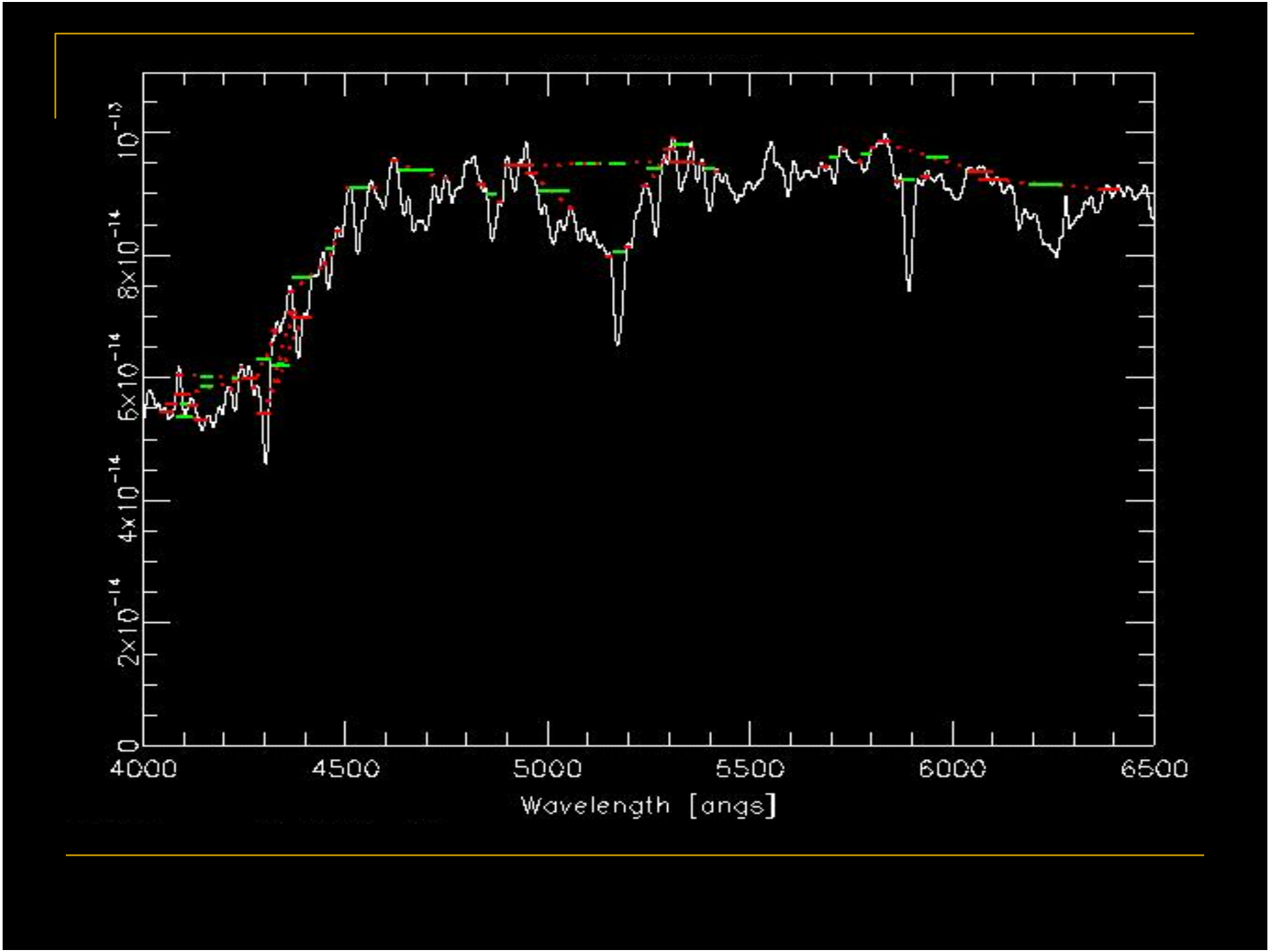
Our Project

- Study the structure, stellar content, kinematics, and dynamics of bulges to understand how they form and evolve
- Key question is whether bulges are more similar to ellipticals or to disks
  - Morphology
    - Boxy bulges are likely bars seen edge-on
  - Ages and chemical abundances
    - Stars in ellipticals are older, more metal-rich, and enhanced in Mg with respect to Fe
  - Rotational and random motions of the stars and ionized gas
    - Disks are supported by rotation while ellipticals are supported by random motions

The Data

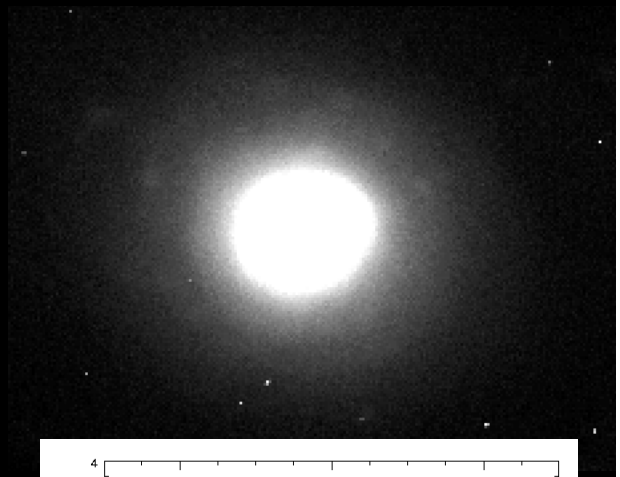
- Spatially-resolved spectra and images for 39 galaxies using APO 3.5m telescope
  - Study a small sample of galaxies in great detail
- Central spectra and images of thousands of galaxies obtained by the SDSS 2.5m telescope
  - Statistically significant study at the cost of spatial resolution

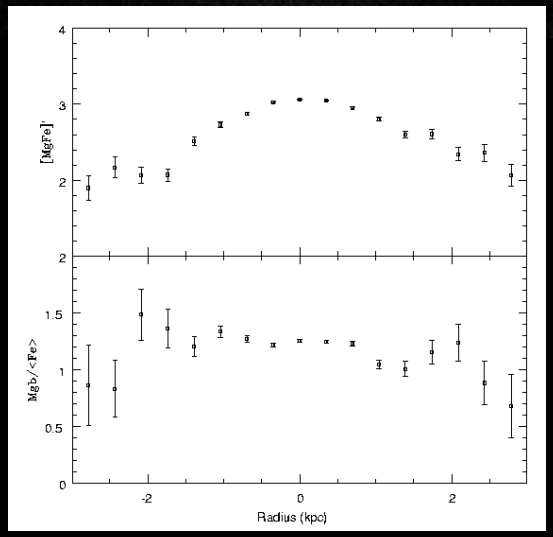



0
2x10^-14
4x10^-14
6x10^-14
8x10^-14
10^-13
4000
4500
5000
5500
6000
6500
Wavelength [angs]

NGC 2599 – An Unbarred Secular Evolution Candidate

- Has among the lowest mean ages of any of our galaxies
- Has a metallicity gradient but the central metallicity is still much lower than those of ellipticals with similar mass
- Has disk-like [Mg/Fe] throughout
- Suggests that bars must be destroyed





A Peculiar Galaxy – NGC 5719

- Barred galaxy with misaligned dust lane
- Ionized gas rotates but stars do not
- Composed mostly of old stars
- Metallicity distribution is typical of ellipticals with similar mass
- [Mg/Fe] is enhanced in the bulge
- Has the stars of an elliptical even though it is currently undergoing violent changes