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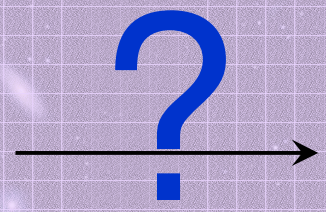
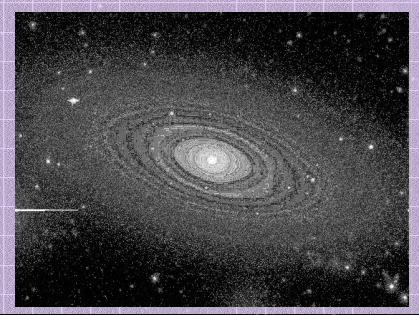
Spectroscopic Bulge-Disk Decomposition:
A New Method to Study the Evolution of S0s
Evelyn Johnston

My Research

- Evolution of lenticular galaxies in nearby clusters
  - Evolution from spirals
  - Investigating what caused SF to stop
  - Evolution of bulge and disk as individual components





Summary of Work

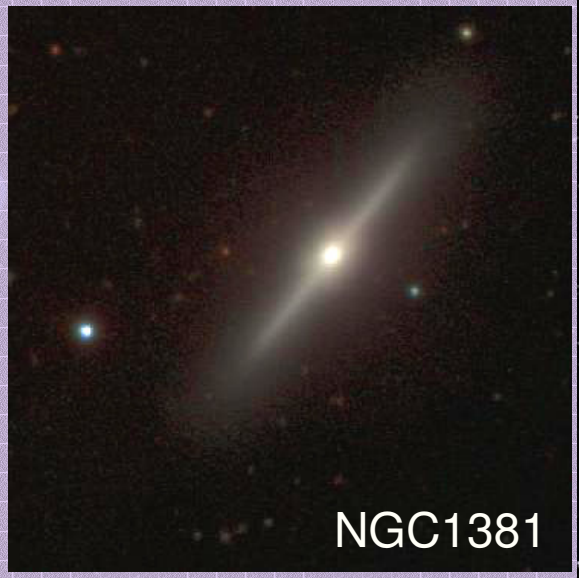
- New method for studying evolution of nearby galaxies:

Spectroscopic Bulge Disk Decomposition

- Separates a 2D spectrum into separate bulge and disk spectra

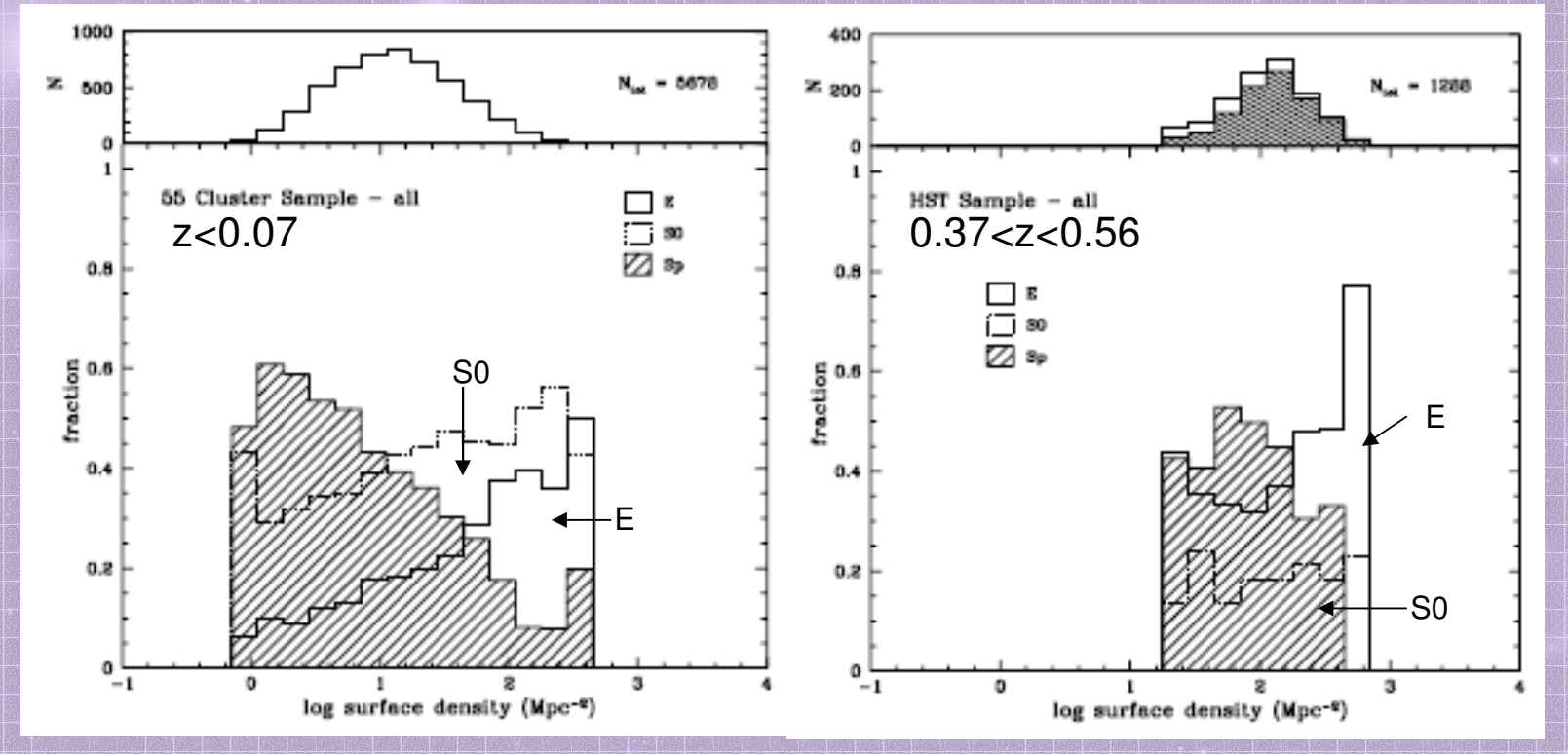
So, What Are Lenticular Galaxies?

- Lie between Spirals and Ellipticals on Hubble Sequence
- Colours & stellar populations ➔ Ellipticals
- Stellar disks ➔ Spirals
- True nature still debated today


NGC1381

How do they Evolve?

- Morphology-density relation for Clusters



Dressler 1980, Dressler et al 1997

How do they Evolve?

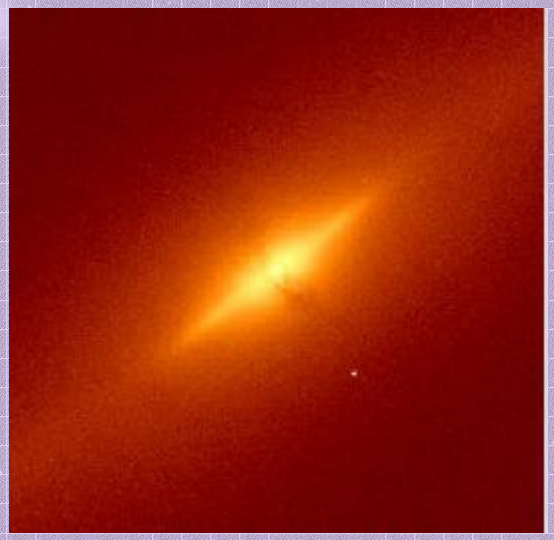
- Theories for evolution from spirals mainly centre on stopping the star formation
  - Ram pressure stripping
    - Gunn & Gott 1972
  - Starvation/Strangulation
    - Larson, Tinsley & Caldwell 1980
  - Galaxy Harassment
    - Moore, Lake & Katz 1998
  - Unequal-mass galaxy mergers
    - Mihos & Hernquist 1994)


NGC4402


M51

Bulge-Disk Decomposition

- Draw ellipses of constant luminosity
- Fit components to light profile
- Integrate and subtract from original image



Images taken from GALFIT examples

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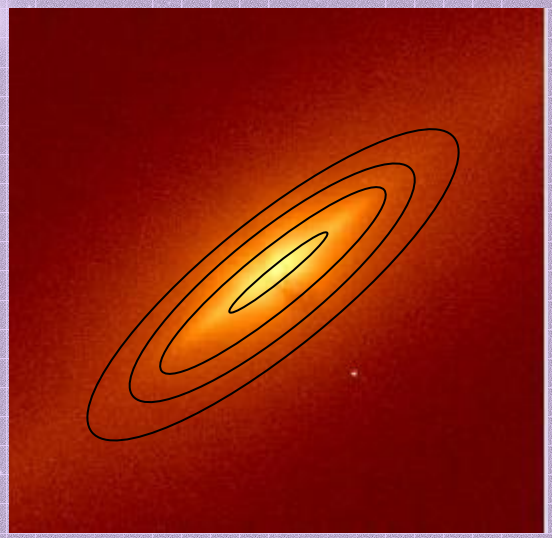

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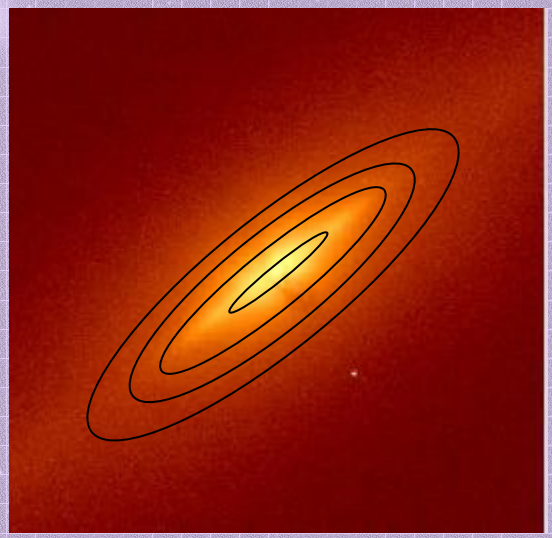

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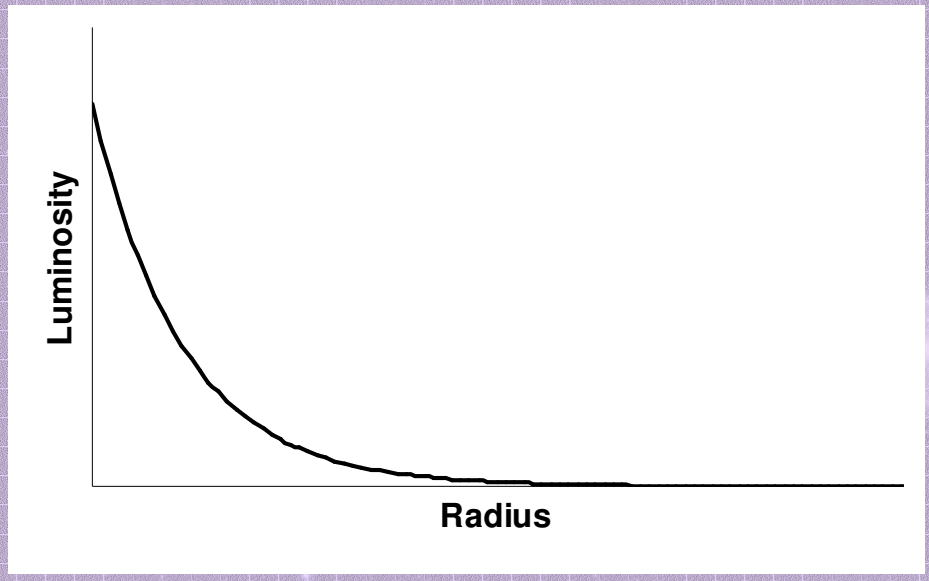

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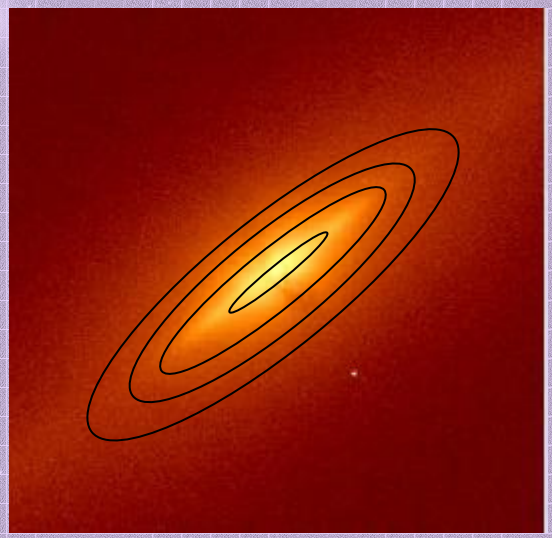

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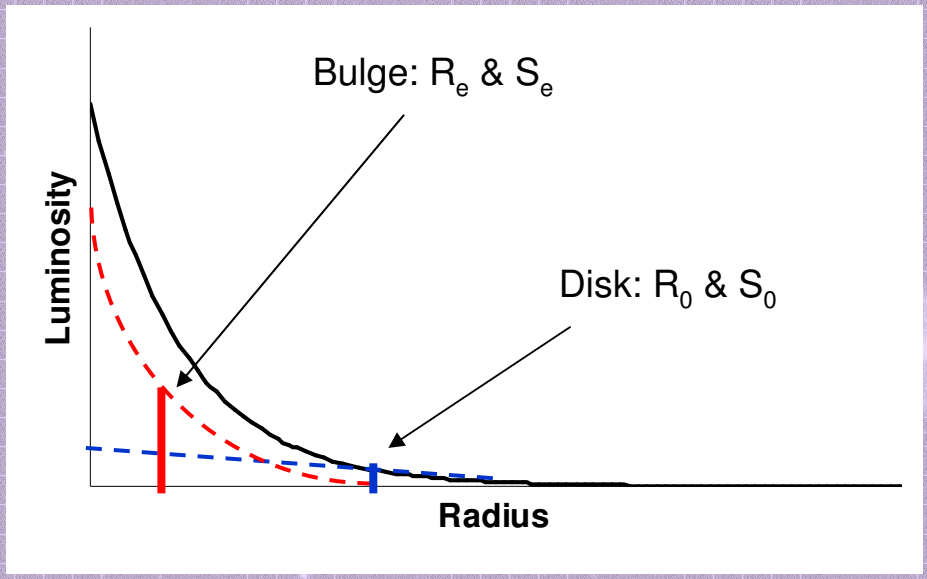

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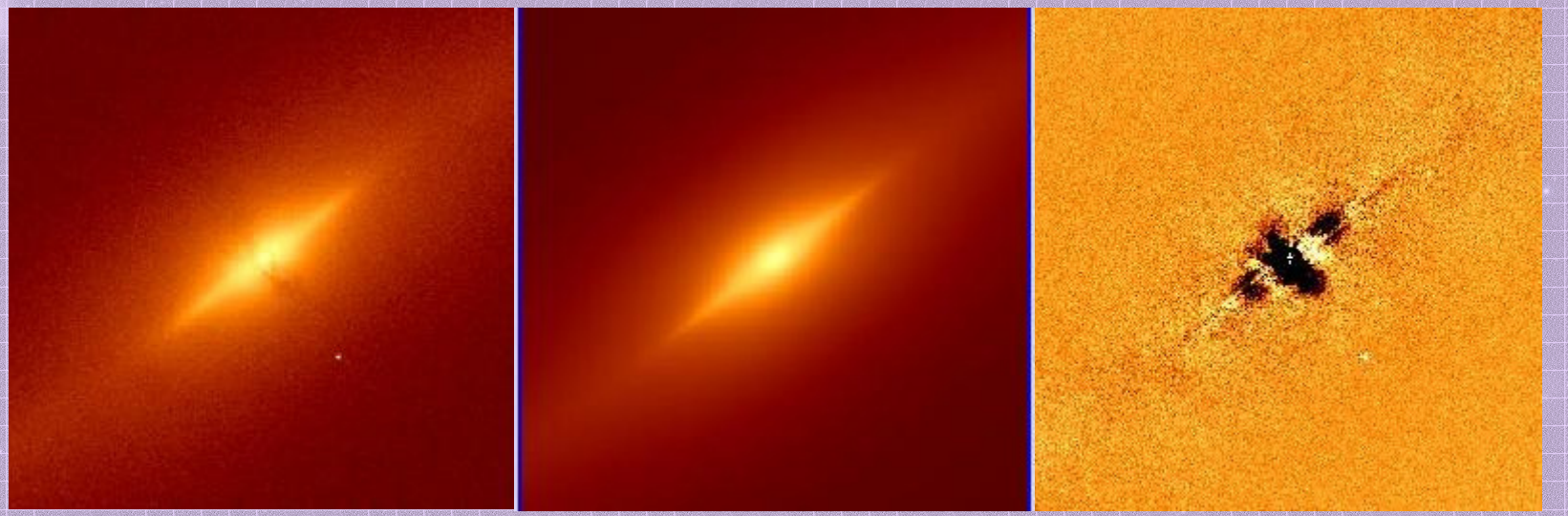
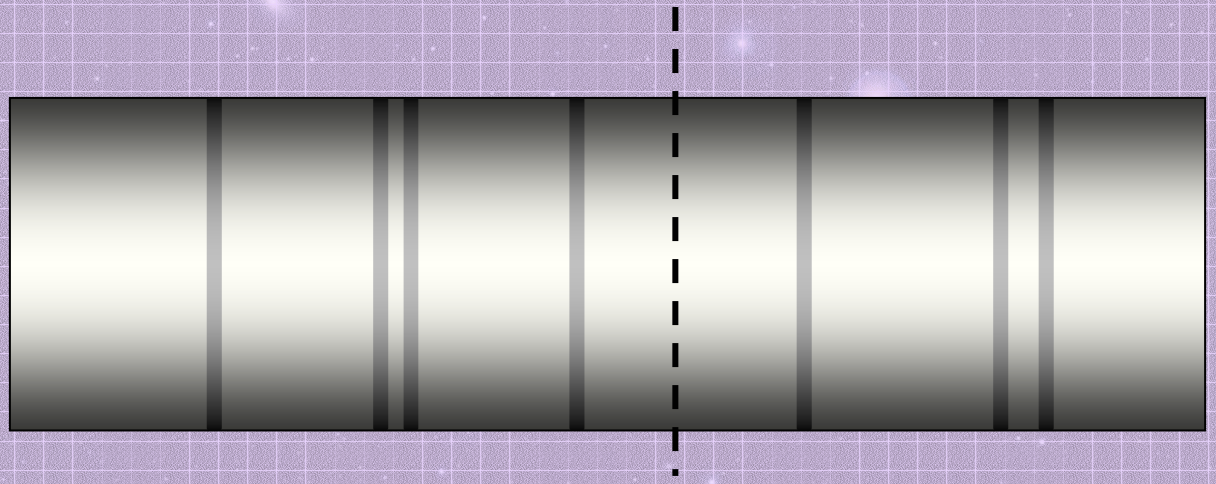


Images taken from GALFIT examples

Bulge-Disk Decomposition

- Multi-waveband photometry
- Next step… looking at variations with wavelength
  - Spectroscopy



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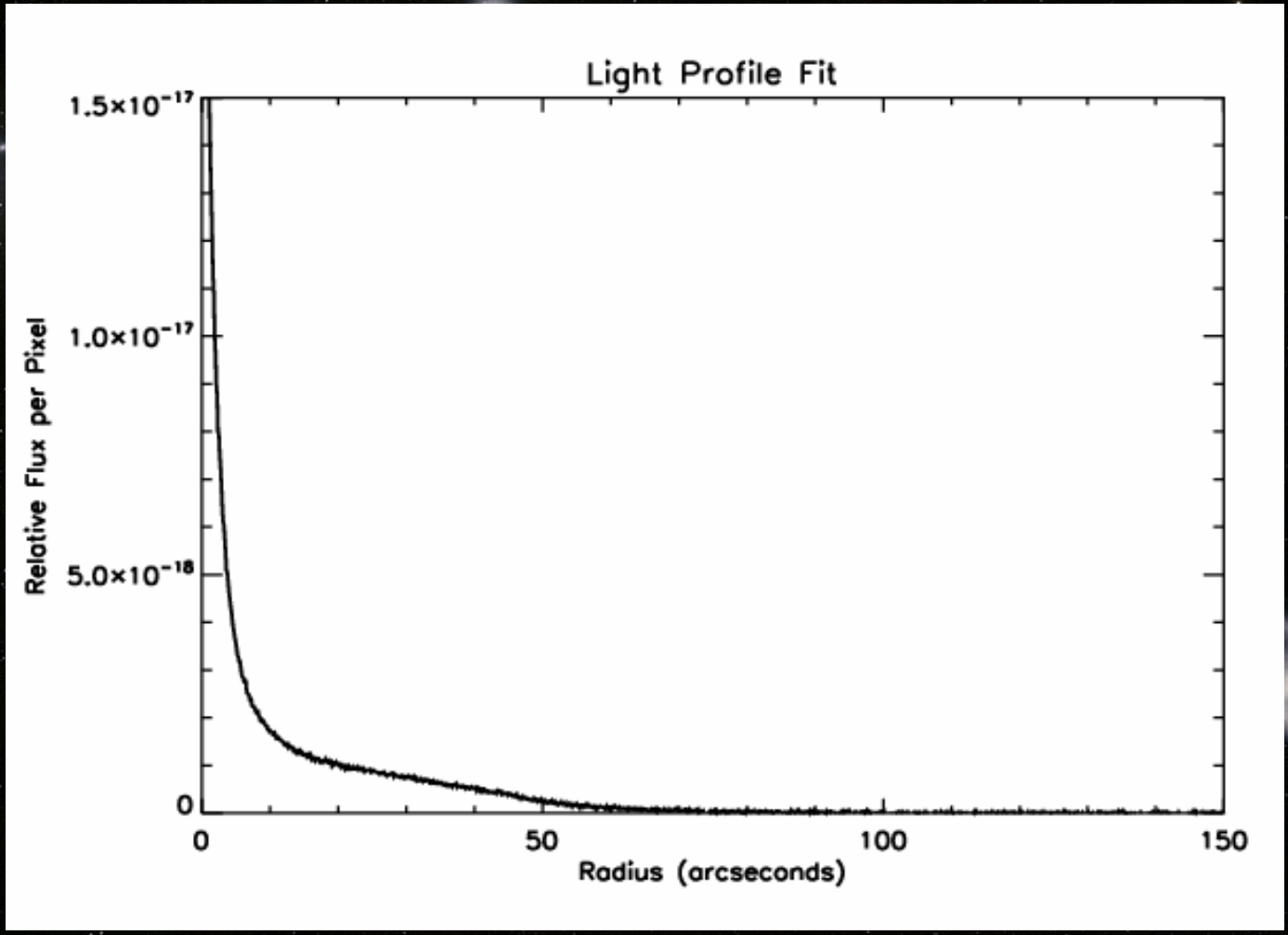

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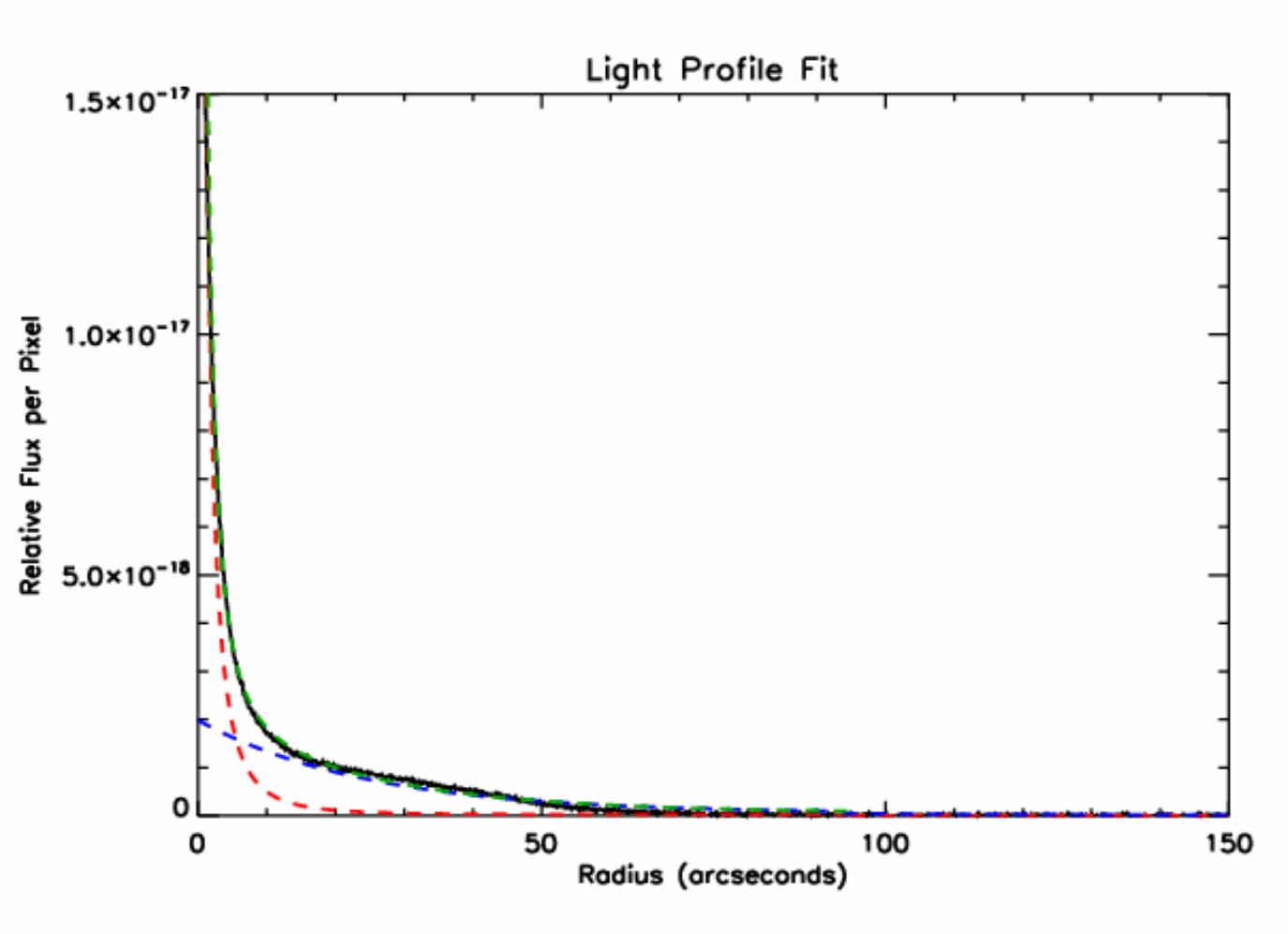
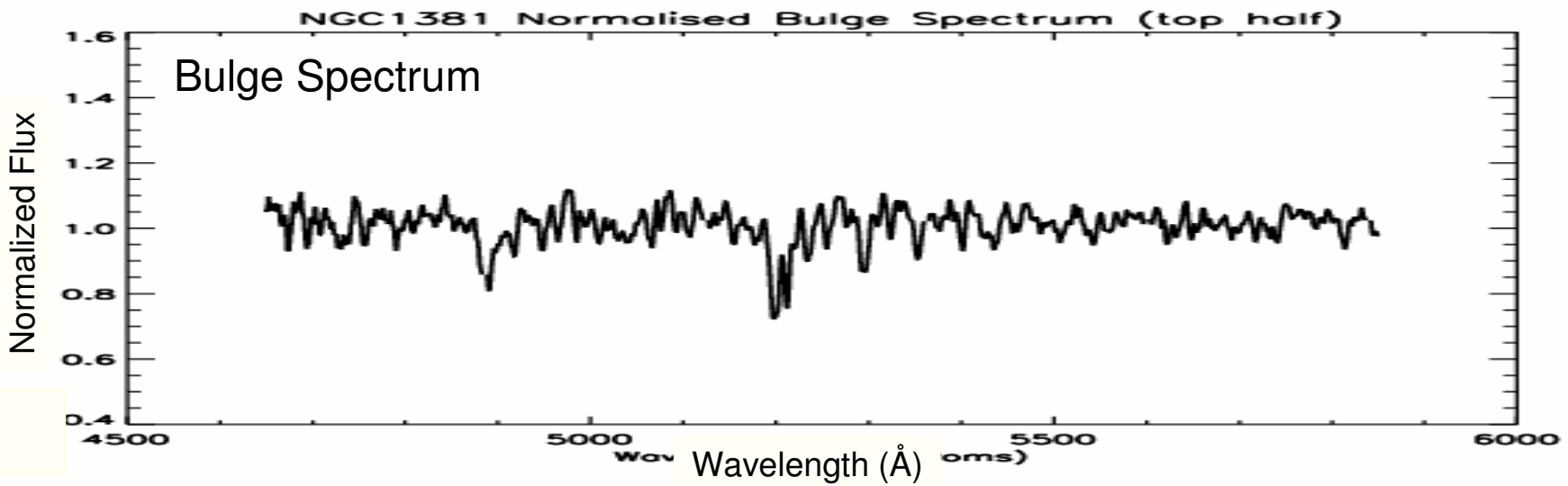
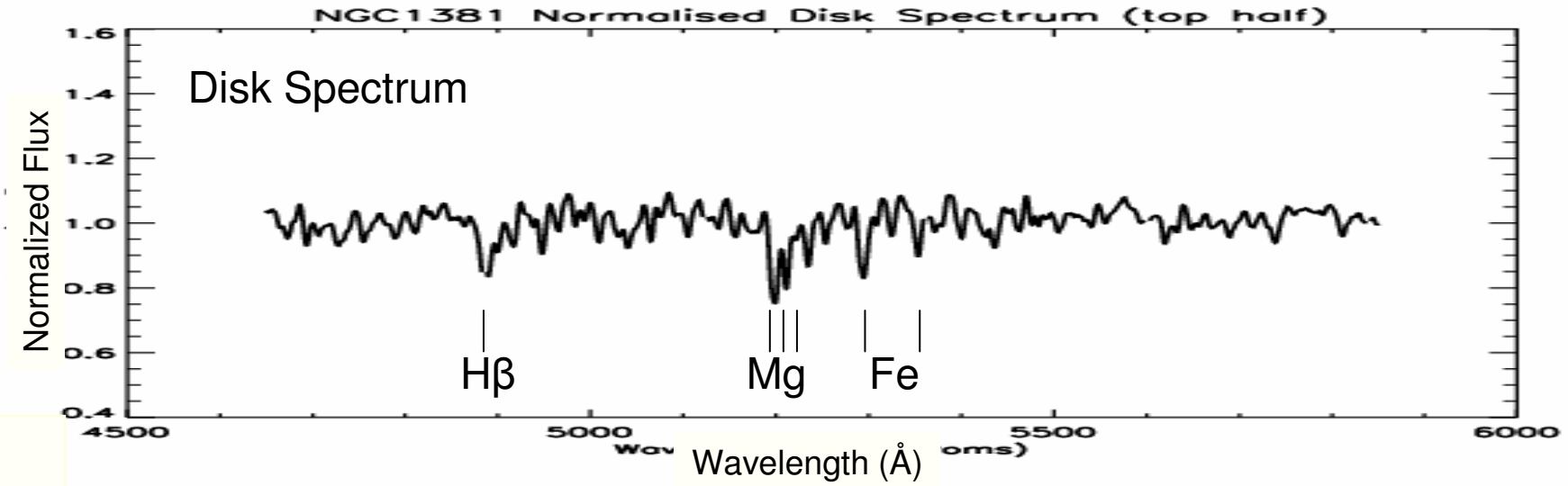



NGC1381 Normalised Bulge Spectrum (top half)
Bulge Spectrum
Normalized Flux
1.6
1.4
1.2
1.0
0.8
0.6
0.4
4500
5000
5500
6000
Wavelength (Å)

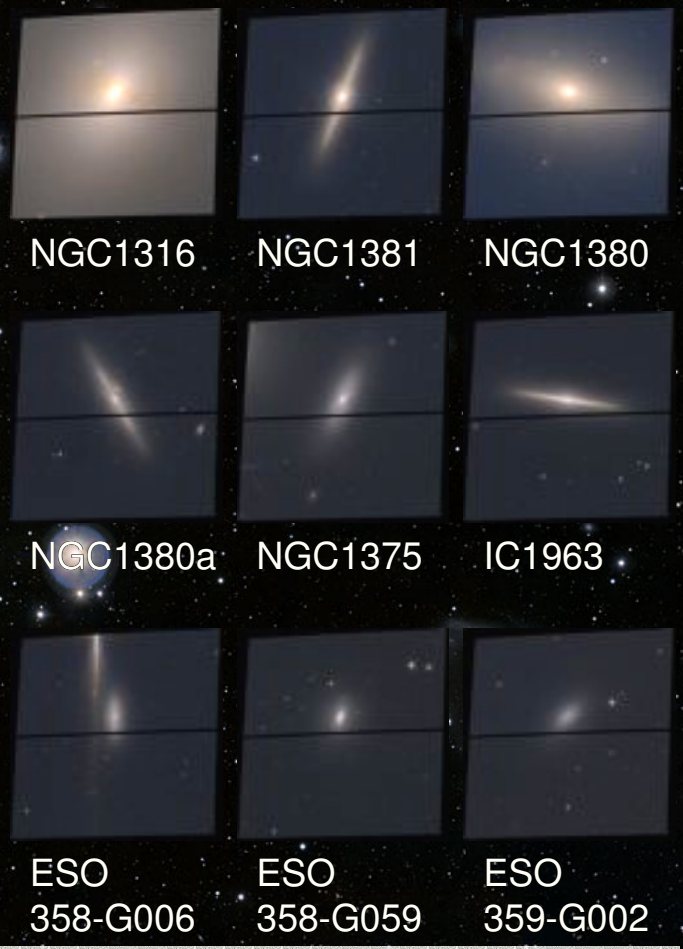

NGC1381 Normalised Disk Spectrum (top half)
Disk Spectrum
Normalized Flux
1.6
1.4
1.2
1.0
0.8
0.6
0.4
Hβ
Mg
Fe
4500
5000
5500
6000
Wavelength (Å)

Minor Complexities

- Gaussian smooth spectra to central velocity dispersion
- Correct for rotational velocity

Data Sample

- 9 S0s from Fornax Cluster
- Flux calibrated long slit spectroscopy from VLT
- Reduced and analysed by Alejandro Bedregal (Bedregal et al 2006a, 2006b, 2008, 2010)
- Range of masses and luminosities



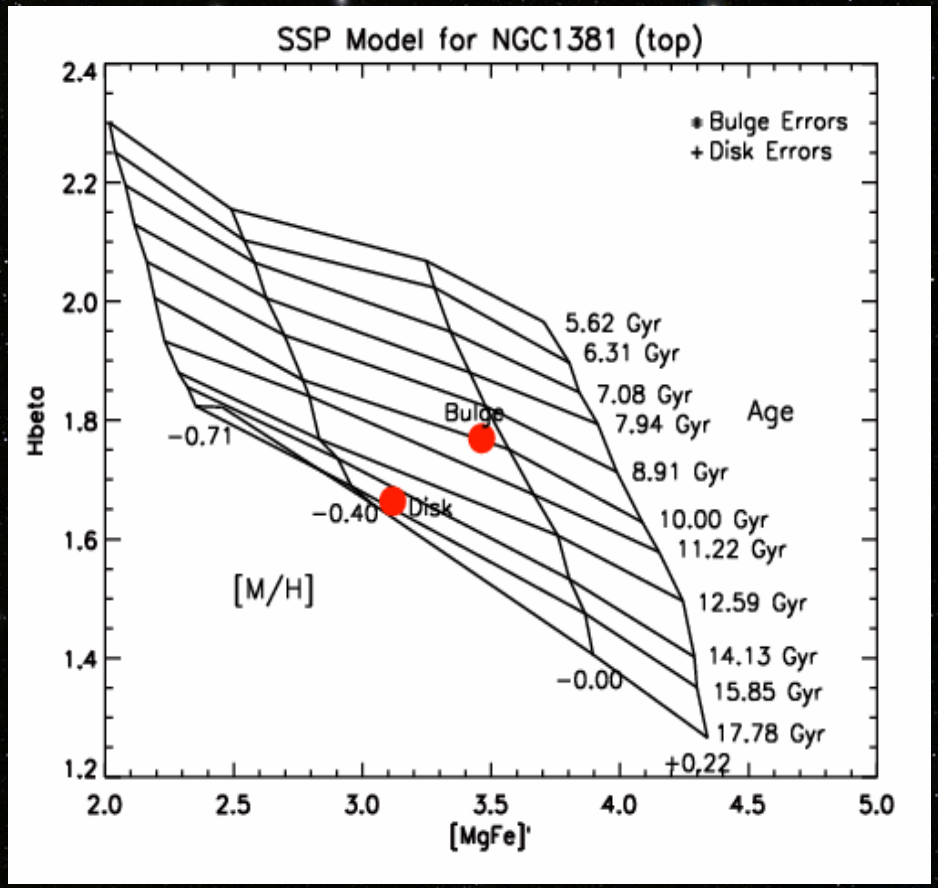
Credit: ACS Virgo and Fornax Cluster Surveys

Success Rates

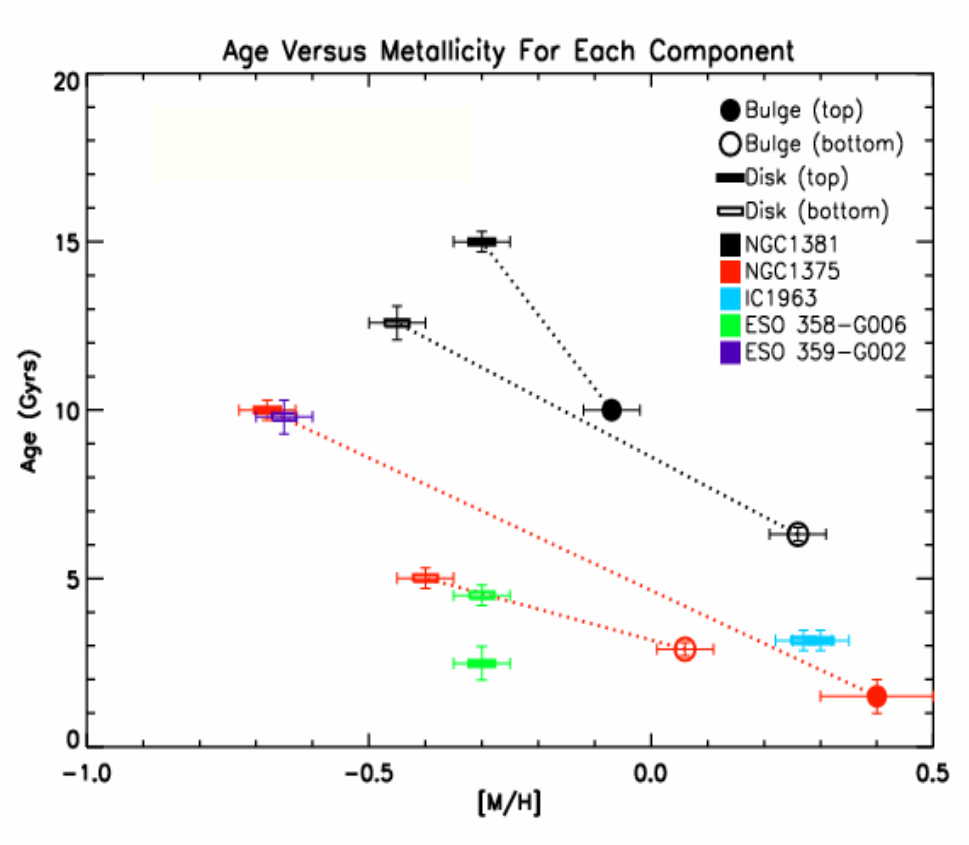
- 9 galaxies
  - 2 ➔ bulge and disk spectra
  - 3 ➔ disk spectra (disk dominated from very small radii)
  - 2 ➔ strange bulge and disk spectra
  - 2 ➔ unable to decompose

Measurements

- Measured line strengths
- SSP models from Vazdekis et al (2010)
  - MILES stellar library
  - σ_{lib}=2.3Å
- Estimated ages and metallicities

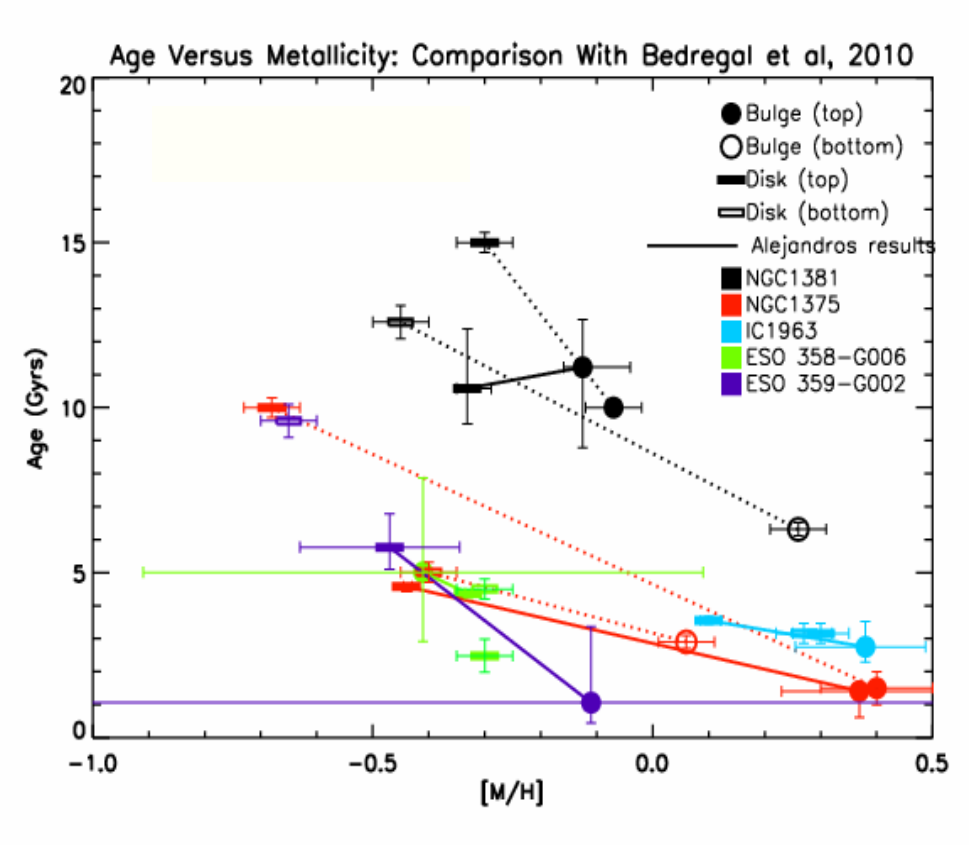


Initial Results



- In general bulges
  - contain younger stellar populations than disks
  - have higher metallicities than disks
- Final bursts of SF in galaxies were in the bulge

Initial Results



- In general bulges
  - contain younger stellar populations than disks
  - have higher metallicities than disks
- Final bursts of SF in galaxies were in the bulge

Conclusions

- We have developed a new method to study the evolution of nearby galaxies
- Initial results show that final bursts of SF occurred in the bulge
- But, current sample too small to make any real science claims

Future Plans

- Analyse spectra that have strange bulge and disk spectra
- Look at $R_{e,\lambda}$ and $R_{0,\lambda}$ for information on gradients
- To analyse another sample of 21 S0s from Virgo Cluster
- We hope to extend the method to Spiral galaxies