The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

Clues to the formation of lenticular galaxies from the quenching of star formation in spirals

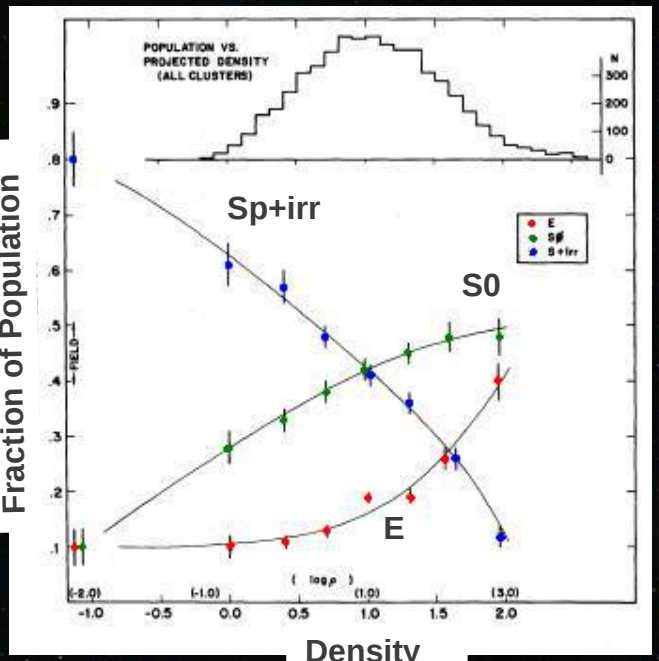
Evelyn Johnston
University of Nottingham

Supervisors: A. Aragón-Salamanca, M. R. Merrifield

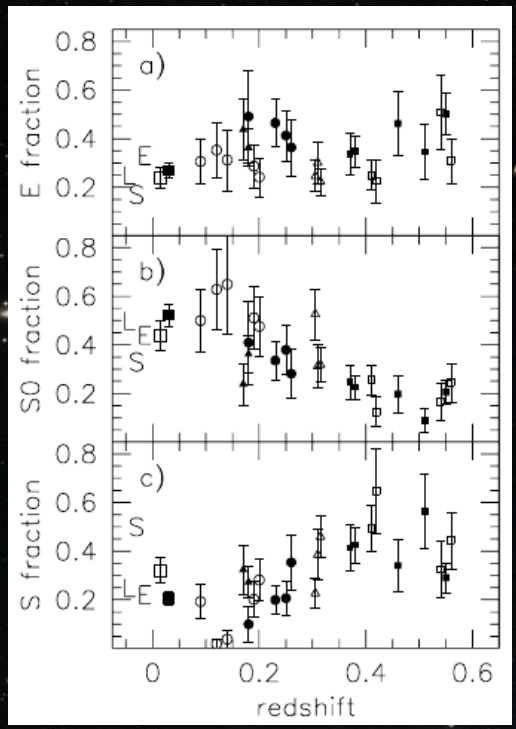
Submitted to MNRAS

Transformation of Spirals to S0s

- To transform a spiral into an S0 you need to
  - Quench star formation
  - Increase B/T
- The fraction of S0s increases with increasing environment density and decreasing redshift while the fraction of spirals decreases.



Dressler et al, 1980



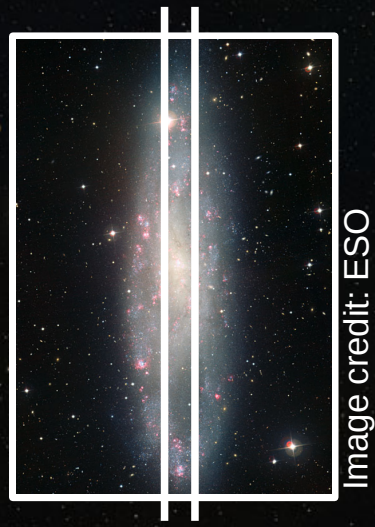
Fasano et al, 2000

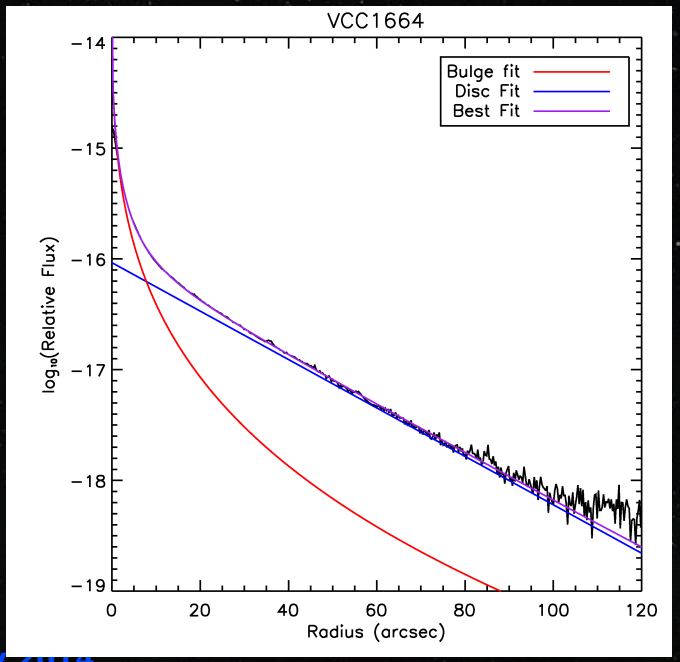
Sample Selection

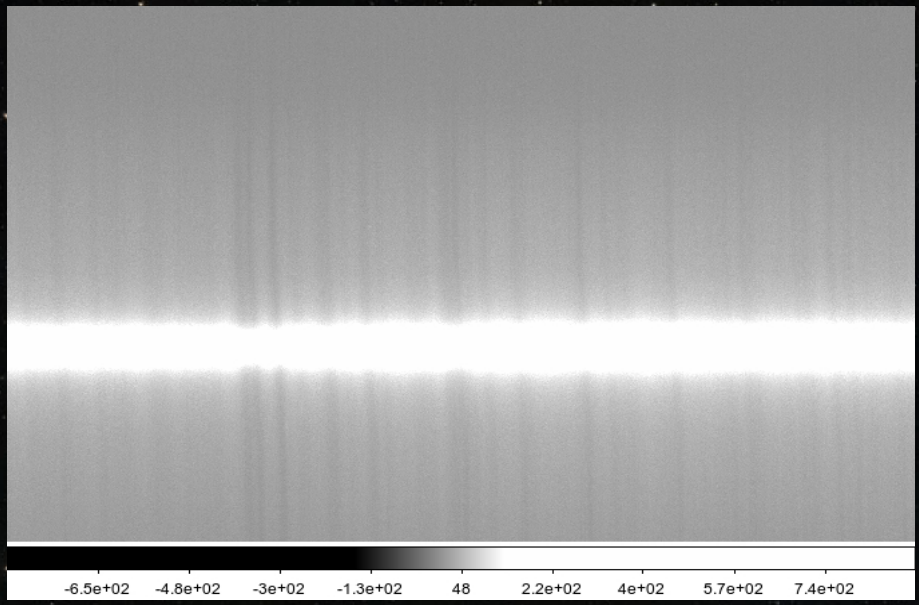
- 21 high inclination (i>40º) S0 galaxies from the Virgo Cluster
- Long-slit spectroscopy from Gemini/GMOS
- Wavelength ranges of $4300<\lambda<5500$ Å
- $-22.3 < M_B < -17.3$
- Exposure times ~ 20-200 minutes, S/N of peak of spectrum $\gtrsim 50$

Spectroscopic Bulge-Disc Decomposition

- Obtain a good quality long-slit spectrum of a galaxy
- Correct spectrum for kinematics
- Decompose light profile at each wavelength

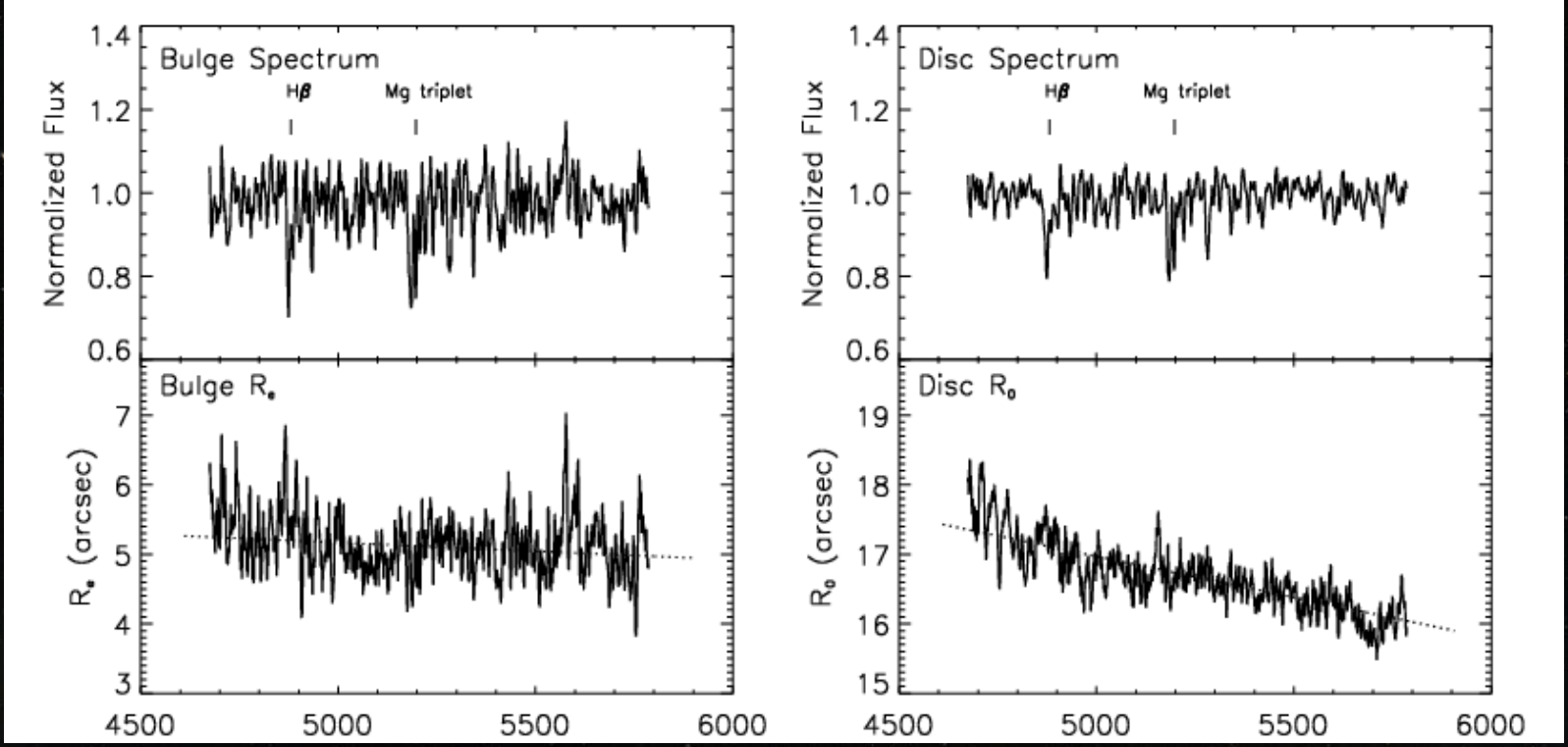






Spectroscopic Bulge-Disc Decomposition

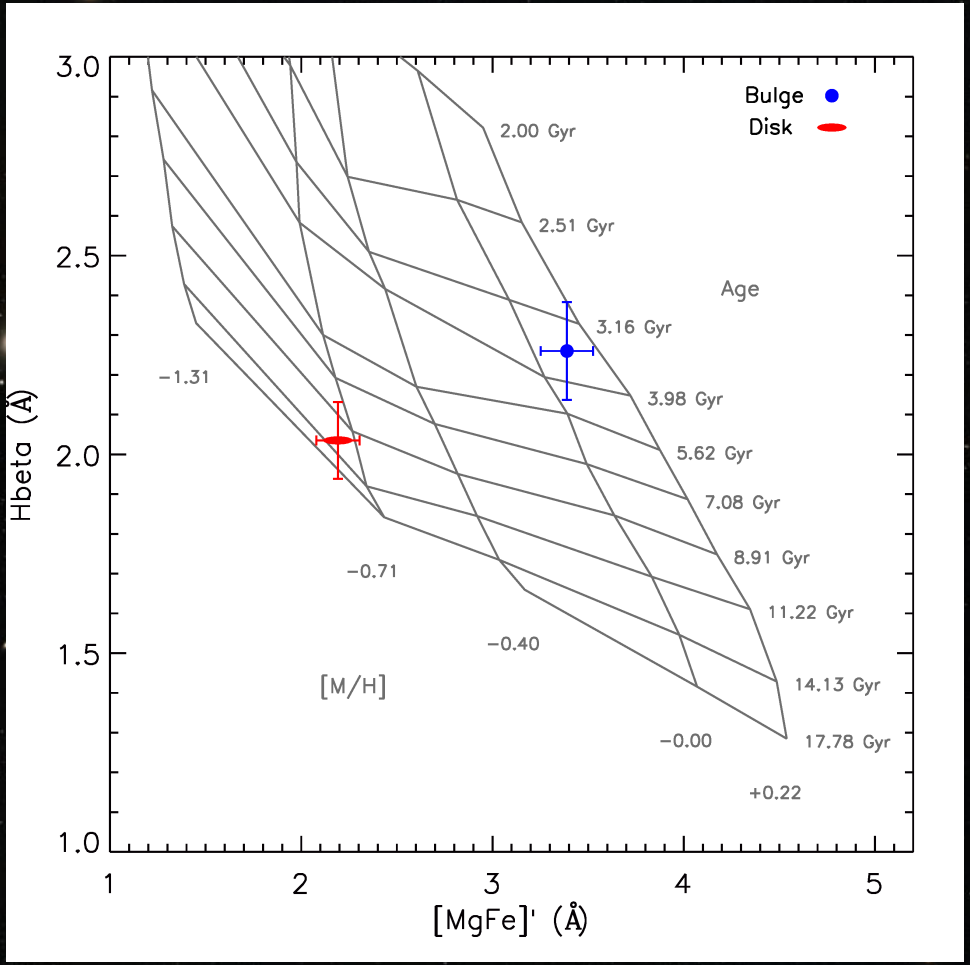
- Integrate to get total light of bulge and disc for that wavelength bin
- Plot against wavelength to obtain high-quality spectra representing purely the bulge and disc light.



Johnston et al, 2012

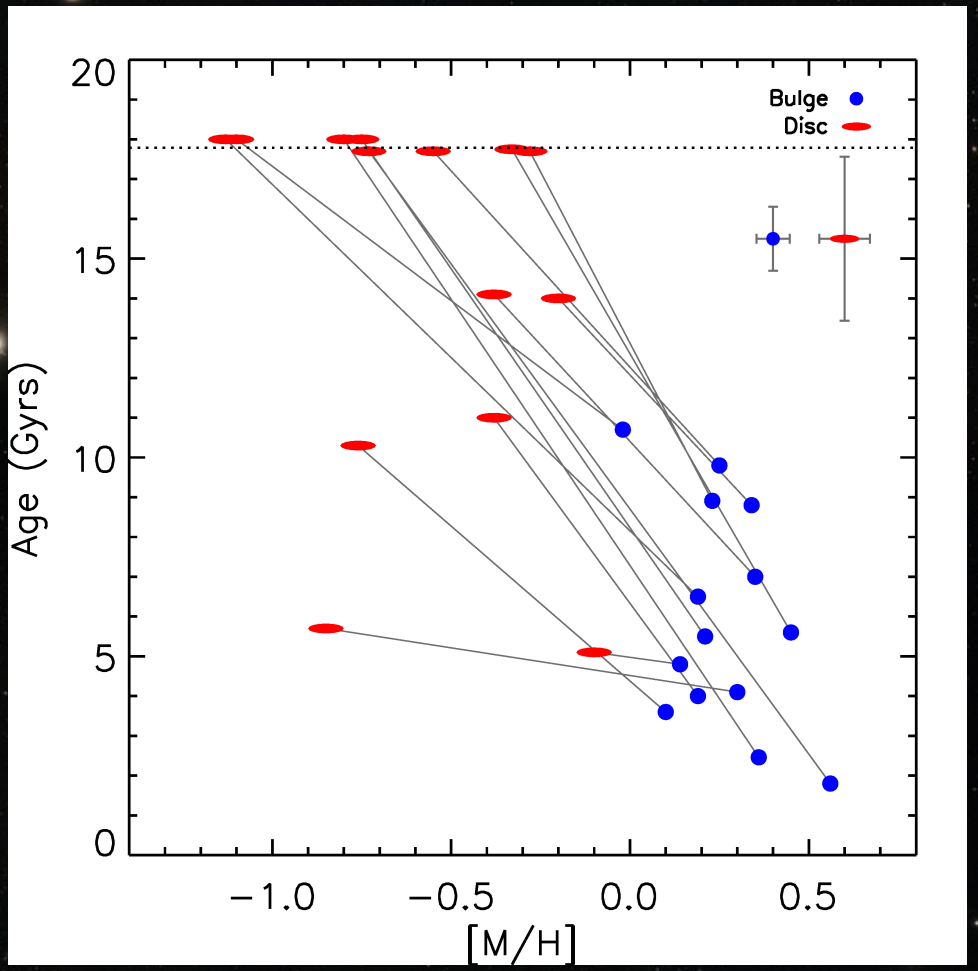
Star Formation Histories of the Bulge and Disc

- Hβ, Mg and Fe line strength indices measured, and plotted on SSP models of Vazdekis et al (2010)
- Estimates of relative global, light weighted ages and metallicities for the bulge and disc were made from these models



Relative Ages and Metallicities

- Bulges appear to contain younger and more metal rich stellar populations than the discs of the same galaxy.
  - Star formation continued in the bulge after it had finished in the disc

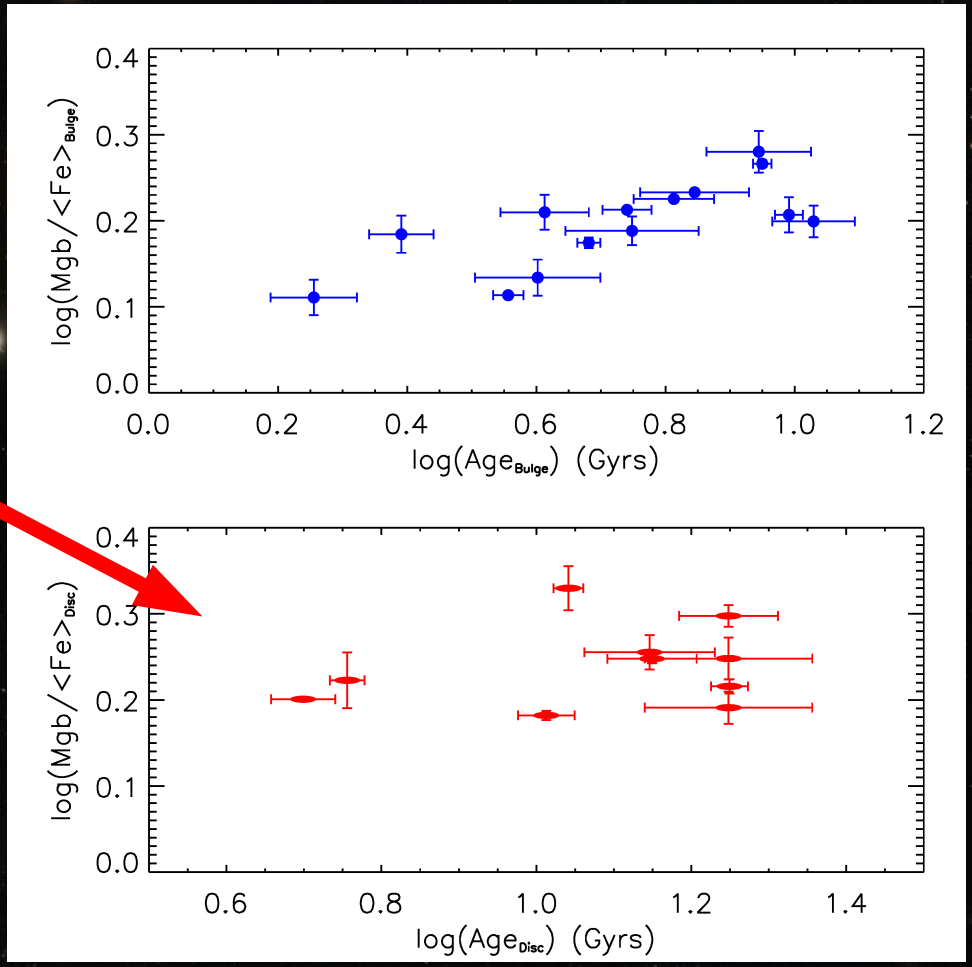


Star Formation Histories

Mg/Fe abundances tell us about the SF timescales

- Large Mg/Fe => shorter τ_{SF}
- Small Mg/Fe => longer τ_{SF}

- Discs show no correlation:
  - Since discs are old, the observed ages and metallicities represent the sum of all the different disc stellar populations

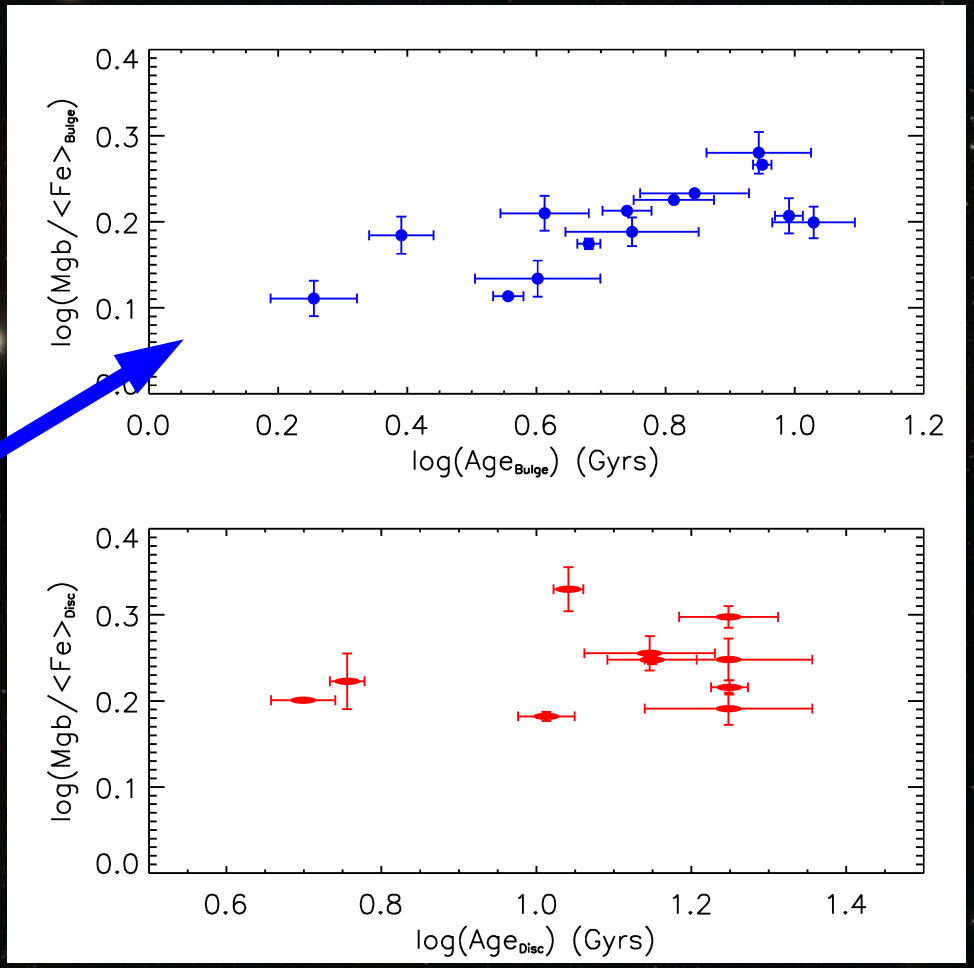


Star Formation Histories

Mg/Fe abundances tell us about the SF timescales

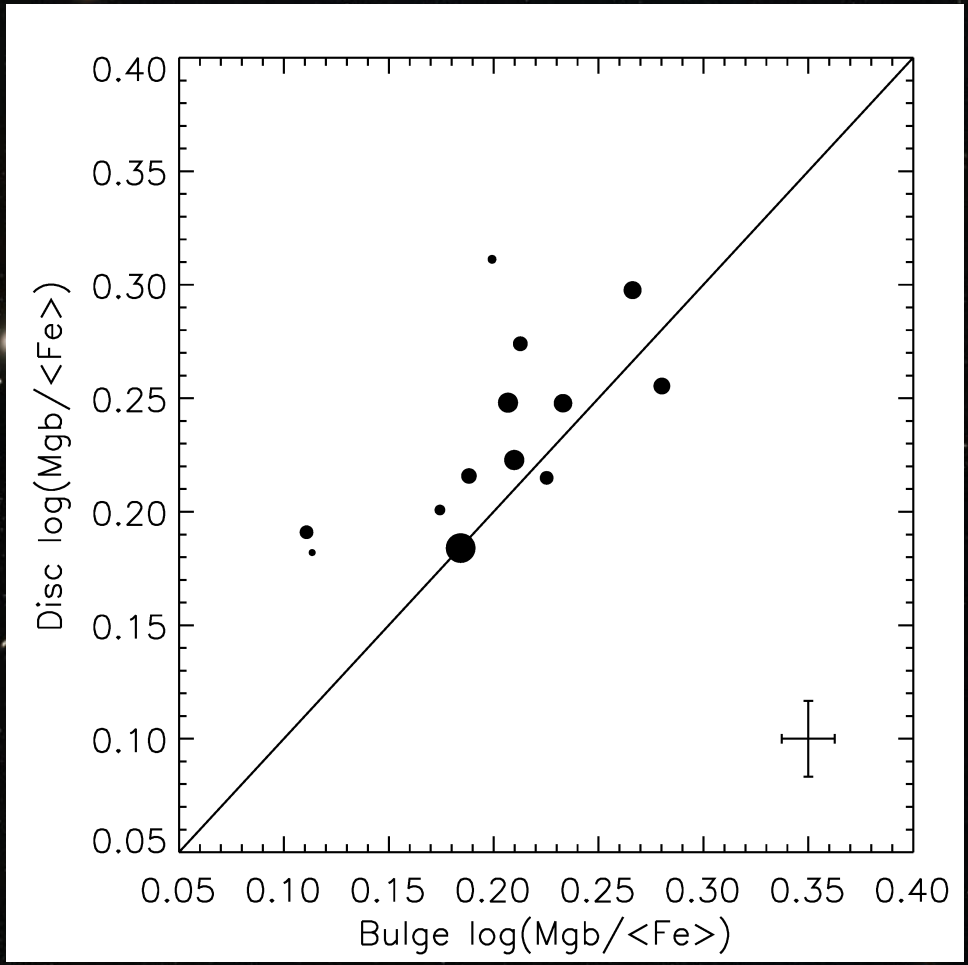
- Large Mg/Fe => shorter τ_{SF}
- Small Mg/Fe => longer τ_{SF}

- Bulge stellar populations show increasing Mg/Fe ratios with increasing ages:
  - Continuous SF since bulge was created?
  - Bulge stellar populations created from Fe-enriched gas in later SF event?



Origin of the Young Bulge Stellar Populations

- Bulge and disc stellar populations show a correlation
- The offset shows bulges have enhanced Fe-enrichment
  - Fe-enriched disc gas dumped in the central regions, until a final SF event created the young bulge stellar populations and quenched all star formation



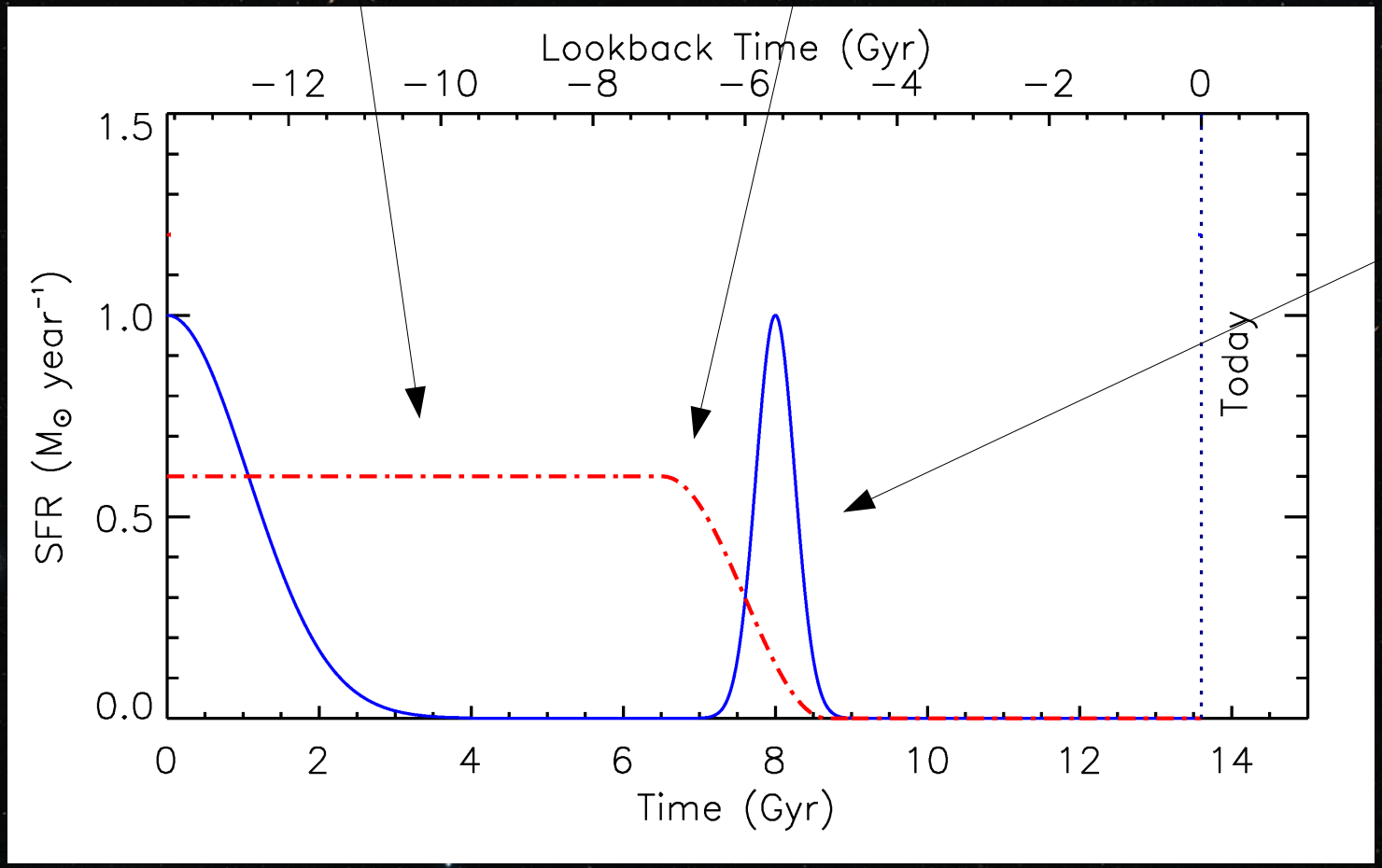
EJ, Aragón-Salamanca & Merrifield, Submitted

Transformation of Spirals to S0s

- To transform a spiral galaxy into an S0 you need to
  - Quench star formation ☑
  - Increase B/T ☑
- Our results give a clearer picture of how this transformation occurs

1. Disc undergoes continuous SF until quenching begins

2. During quenching, Fe-enriched gas is dumped in the central regions



3. Bulge undergoes a final SF event, using up the dumped disc gas and truncating all SF in the galaxy

4. After all SF has been quenched, the spiral galaxy transforms into an S0