Searching for recently-quenched galaxies in the SDSS

Using K+A galaxies to trace active evolution of the red sequence

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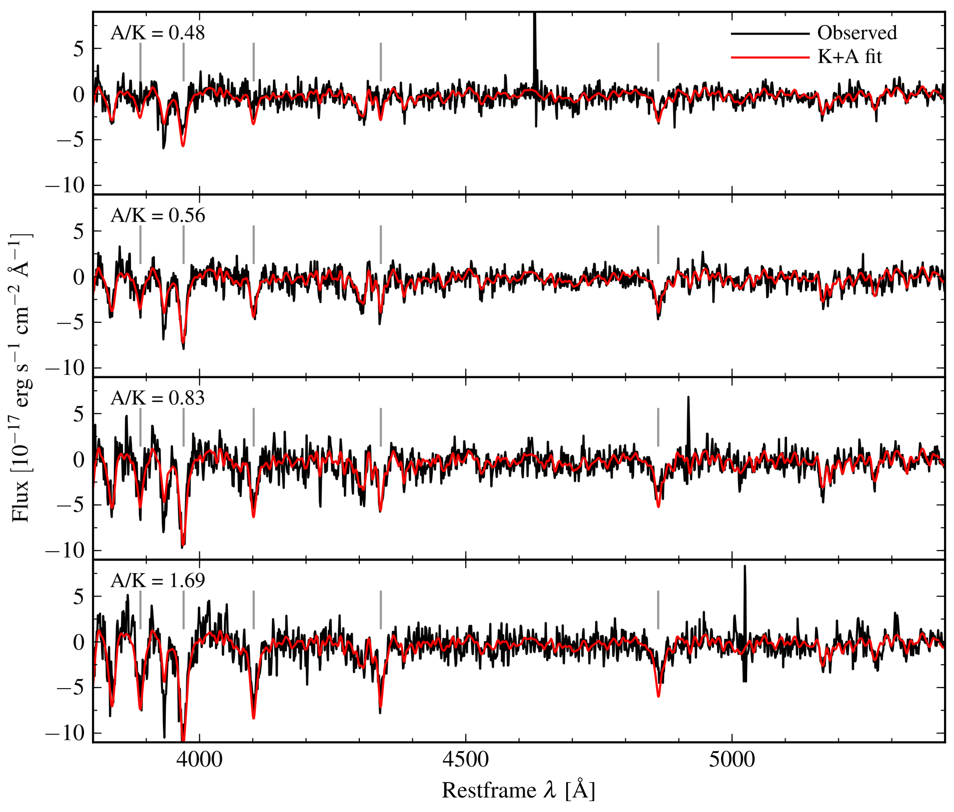
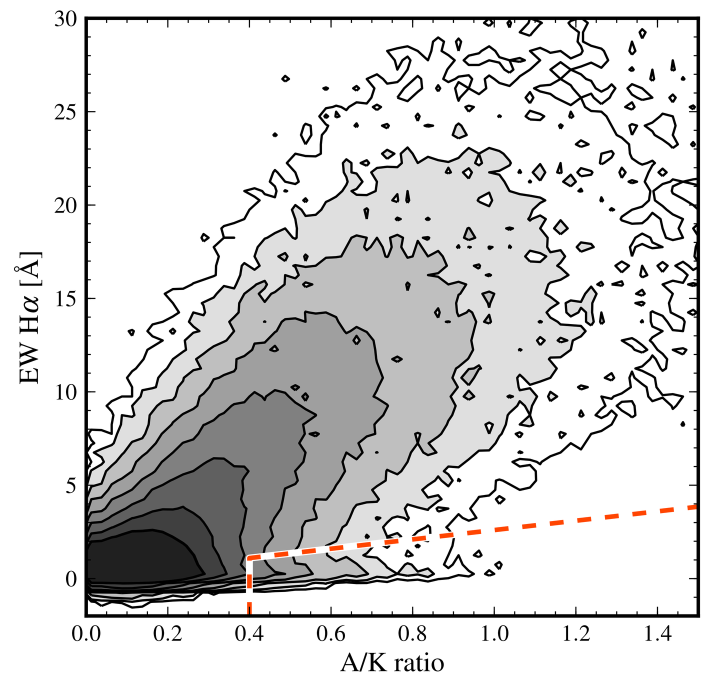
Idenfying a population in transit:

Our classification of K+A galaxies relies on two things: i) the detection of a young stellar contribution to a given galaxy's spectrum and ii) a relative lack on ongoing star formation.

We follow the approach of Quintero et al. (2004) and Yan et al. (2006) in assuming that galaxies' spectra are well described by the linear combination of two components, one old (our 'K' spectrum) and one young (our 'A' spectrum). We then quantify the relative fraction of young to old stellar light as a ratio of the two components' weights, the A/K ratio. For each spectrum in the SDSS DR7 we then have an estimate of its young stellar fraction.



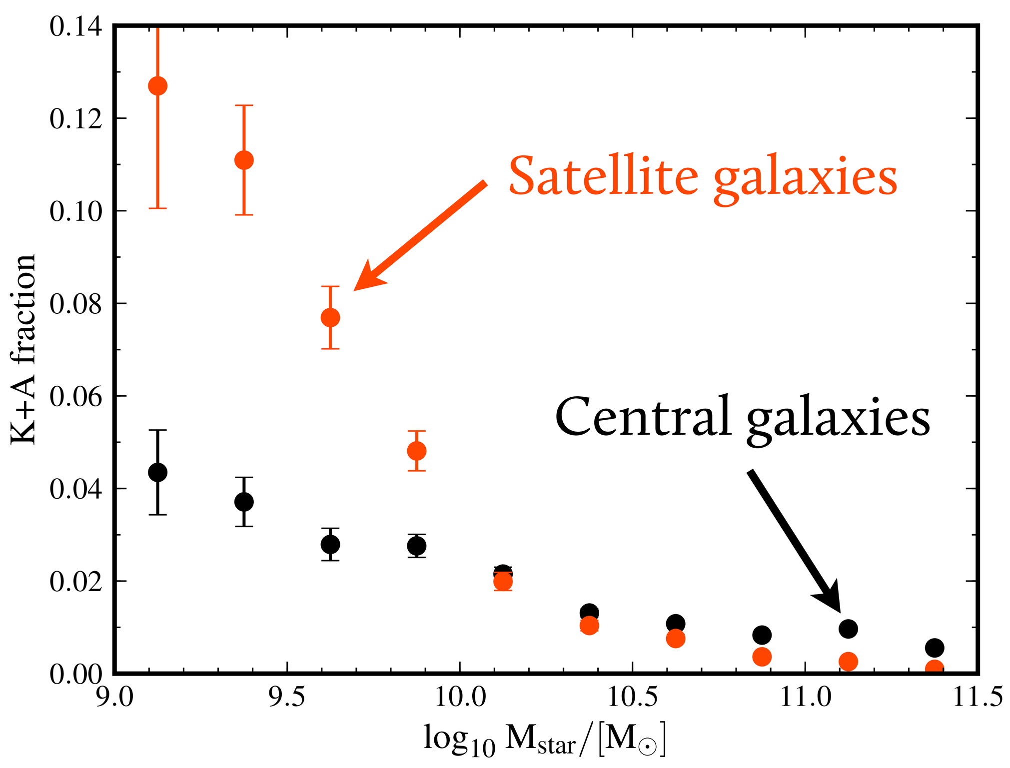
Optical emission-line luminosities -- [OII], Hβ, Hα -- provide an estimate for the rate of ongoing star-formation (Kennicutt 1998). While many studies have used a lack of [OII] emission to limit the presence of ongoing star formation Yan et al. (2006) have shown that, in addition to star-formation, non-stellar sources such as AGN can contribute significantly to a galaxy's [OII] luminosity. We therefore use Hα equivalent width as a proxy for star formation, requiring that K+A galaxies satisfy a (by-eye) selection in EW(Hα) vs. A/K ratio parameter space.

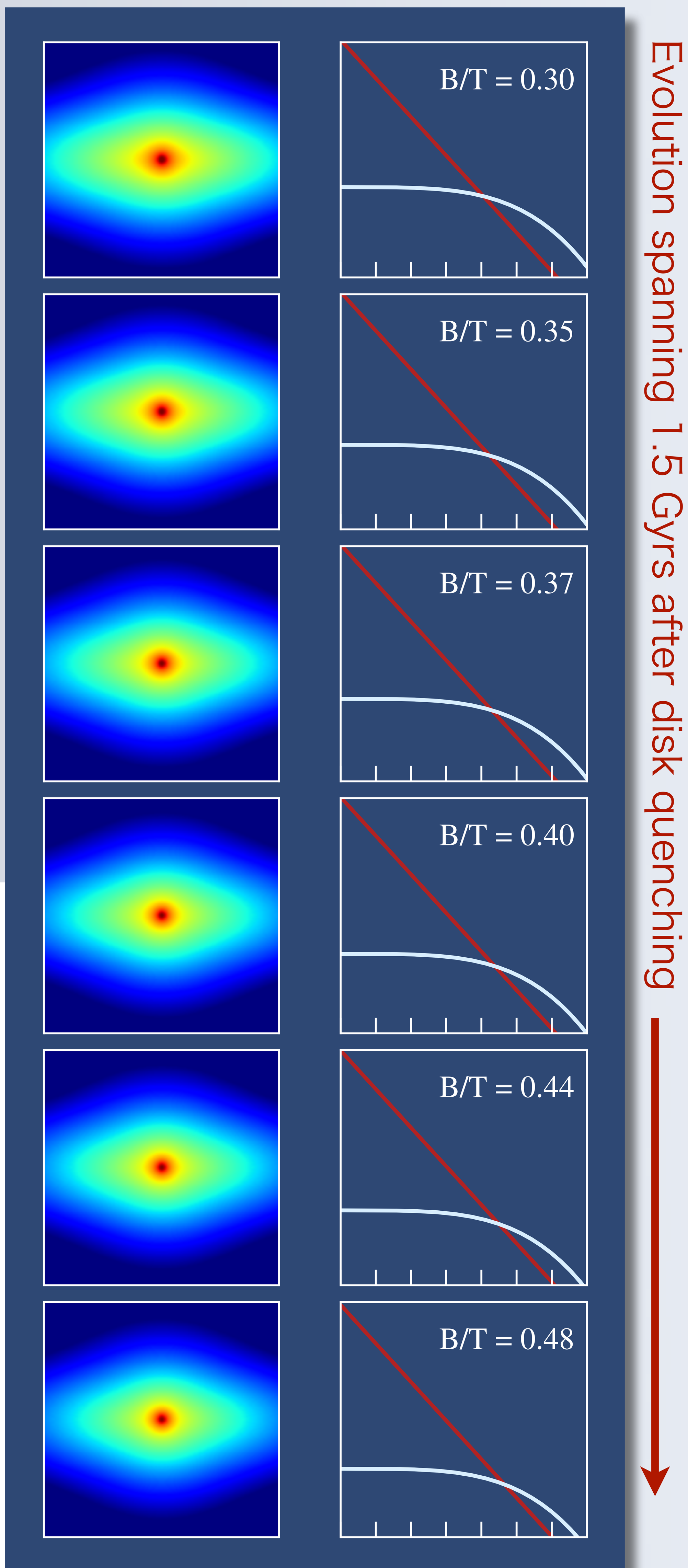


Evidence for two modes of K+A formation?

The fraction of K+A galaxies is a strong function of stellar mass, with low-mass galaxies up to 10 times more likely to host recently-quenched star formation than galaxies with higher masses.

More importantly, the relationship between K+A fraction (that is, the fraction of galaxies classified as K+A) and stellar mass is a strong function of environment; central galaxies - defined here as the most massive galaxies in a given halo (e.g. Yang et al. 2007) - constitute the majority of the K+A population at high masses, while satellite galaxies dominate the K+A population at masses below 10^{10} $M_\odot$. That the distinction between central satellite galaxies results in two separate mass regimes for the dominant K+A population suggests that there are multiple, environmentally-dependent mechanisms driving the formation of K+A spectral types.

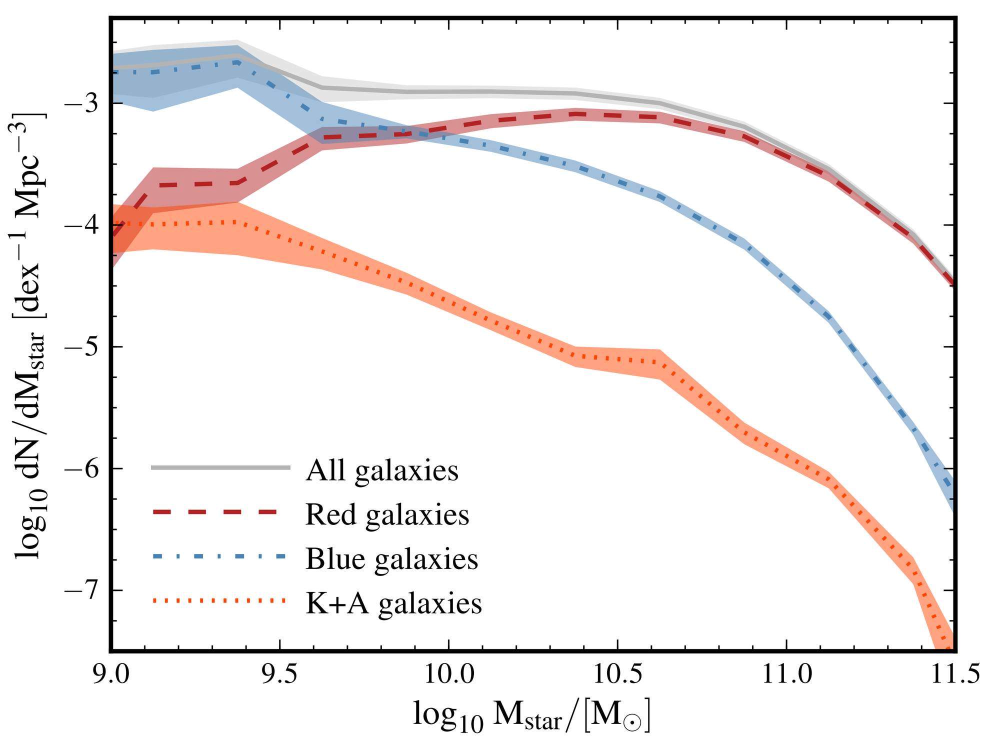




Do low-mass K+As trace the formation of cluster S0s?

The abundance of low-mass K+A galaxies in high-density environments motivates us to look at their properties in more detail to determine both where these galaxies are coming from and where they are going.

Comparing the mass function of K+A galaxies with those of galaxies in the red sequence and blue cloud (shown below), we find that the K+A population can be plausibly be created from the blue cloud assuming an environmental quenching efficiency independent of stellar mass. A fixed quenching efficiency is also observed when considering the transition of all satellite galaxies (not just K+As) from blue to red (e.g. van den Bosch et al. 2008).



The endpoint for K+A galaxies is unclear, however the structural characteristics of galaxies in our sample suggest their destination is the red sequence; they have sizes, stellar densities and light profile shapes (Sersic indices) consistent with early-type galaxies. How can we rectify late-type progenitors with early-type remnants? One possible mechanism (show right) is the simple truncation of star-formation in disks, which results in a rapid evolution in galaxies' bulge fraction and colour.

References

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