Why Do Galaxies Stop Forming Stars?

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Overview

We explore the connection between galactic star formation, quenching, and a variety of intrinsic and environmental properties of galaxies using the SDSS, and comparing to leading simulations (Illustris, L-Galaxies). Our key results are:

- Observationally, the tightest correlation with the quenched fraction of central galaxies is with estimated black hole mass (from either $M_{BH} - \sigma$, or $M_{BH} - M_{Bulge}$).
- This correlation is significantly tighter and steeper than the quenched fraction relationship with stellar mass, B/T morphology, or halo mass (from abundance matching).
- Using a sophisticated artificial neural network (ANN) technique, we determine that properties connected to the innermost regions of galaxies are the most constraining for predicting whether galaxies will be star forming or quenched. This is consistent with the above results.
- Comparing to a hydrodynamical simulation and a semi-analytic model, we determine that it is most probably radio-mode AGN feedback which is responsible for the trends witnessed in the observational samples.

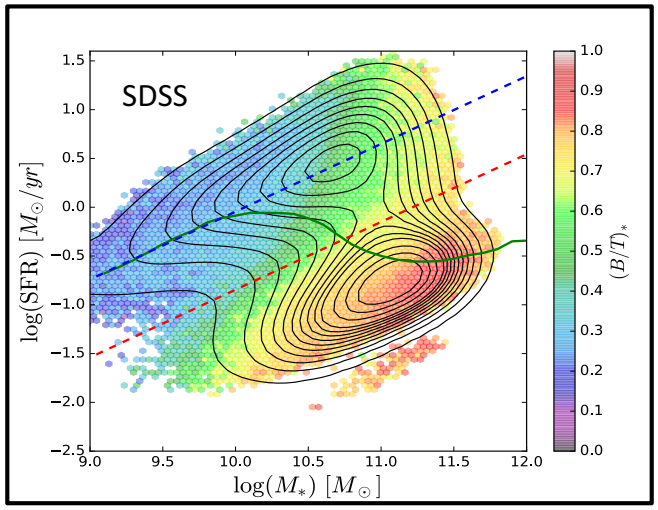


Fig. 1: The star forming main sequence for z < 0.2 galaxies in Sloan, colour coded by bulge-to-total stellar mass ratio (B/T). At a fixed M_*, spheroid-dominated galaxies have lower SFRs than disc-dominated galaxies.

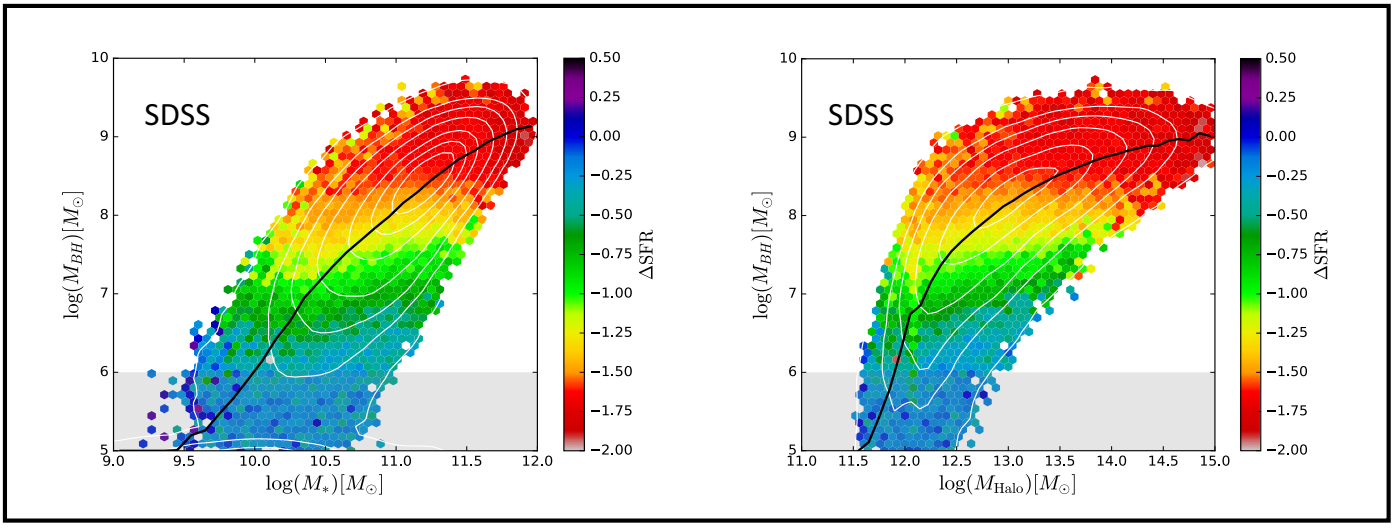
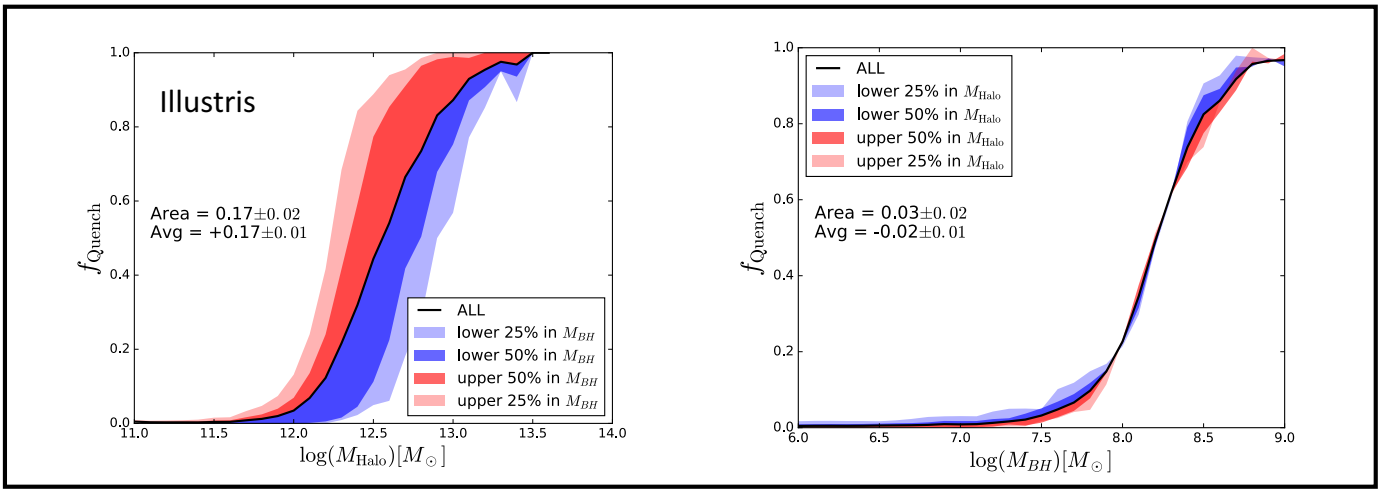


Fig. 2: The supermassive black hole mass relationship with stellar mass (left panel) and dark matter halo mass (right panel) for central galaxies. Both plots are colour coded by the logarithmic distance to the star forming main sequence (blue indicates star forming and red indicates quenched/ passive). ΔSFR varies more strongly with M_{BH} than M_{Halo} or M_*. Could this be explained by AGN driven quenching of central galaxies? Comparisons with contemporary cosmological simulations suggest this may be the case.



For more see – Bluck et al. (2014, 2016)
Teimoorinia, Bluck & Ellison (2016)
Bluck et al. (in prep.)

Fig. 3: The fraction of quenched central galaxies in the Illustris simulation, as a function of dark matter halo mass (left panel) and black hole mass (right panel). As in the SDSS, the relationship between f_Q and M_{BH} is tighter than with M_{Halo} (or M_*, B/T etc.).