Comparison of stellar populations of simulated and real post-starburst galaxies in MaNGA

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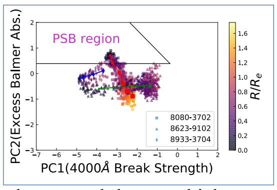
1) Introduction

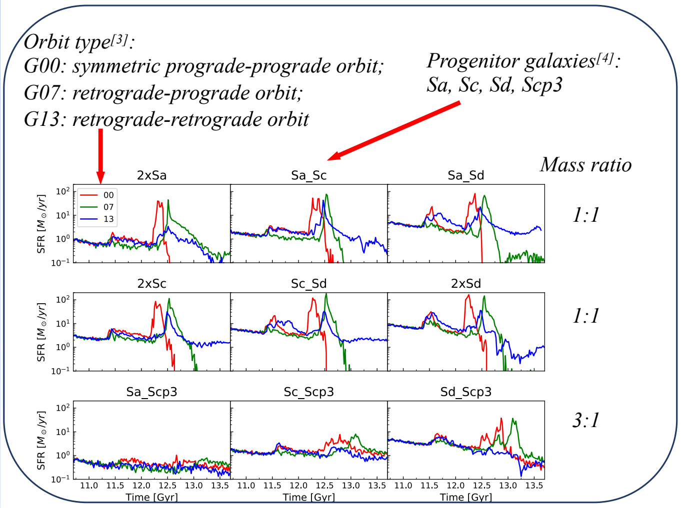
Post-starburst galaxies (PSBs) are galaxies in which star formation has recently been sharply truncated. MaNGA, an integral field unit survey, has produced datacubes for more than 100 galaxies which contain post-starburst (PSB) regions. Stellar continuum spectral index and nebular emission line maps give us information about the star formation history and, therefore, formation mechanisms of these galaxies.



A small fraction of these galaxies show very strong radial gradients in their Balmer absorption line strengths, ranging from positive, flat to negative.
Simple toy models indicate that these observations are consistent with two simple scenarios: a single co-eval burst which was stronger in the central regions, or a starburst that has progressed from outside-in[1]. However, the toy models are unable to distinguish between the two options. We need the help of simulations.

2) Simulations

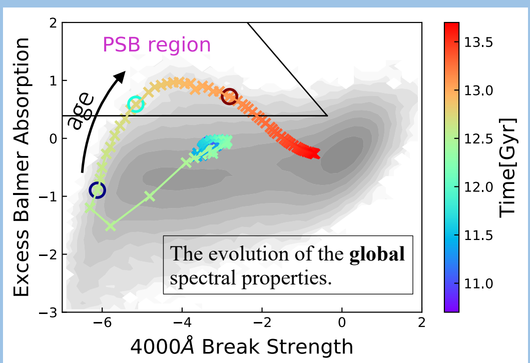
To investigate the origin of these strong radial gradients, we use Gadget-3[2],. to run a set of binary merger simulations with varied progenitor galaxies, mass ratio and orbits.

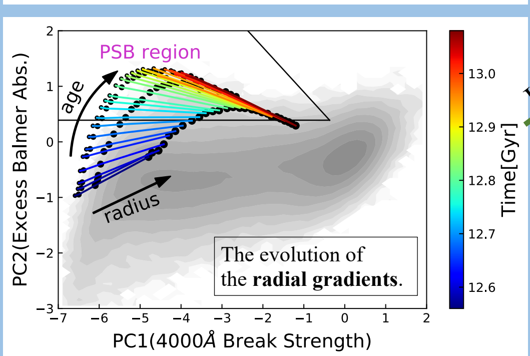


The star formation histories of the merger simulations demonstrate that sharp quenching is only achieved in particular circumstances: progenitor galaxies with similar mass, approaching each other in either prograde-prograde or retrograde-prograde orbits. Neither unequal mass merger nor retrograde-retrograde merger can reproduce fast quenching. We also find that strong kinetic AGN feedback is required.

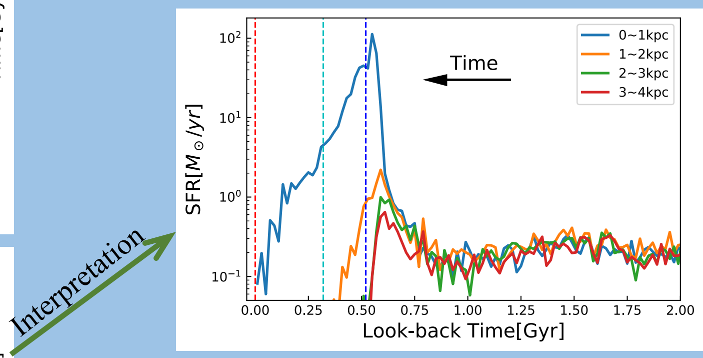
3) Galaxy properties

Post-starburst galaxies can be identified with spectral continuum indices which describe the 4000Å break and Balmer absorption line strengths[5]. Here we display the 2xSc_07 simulation. In this simulation, after the starburst is shut down at 12.5 Gyr, these spectral indices evolve as the galaxy becomes dominated by A-type stars due to the aging of the post-starburst stellar population





We create mock datacubes for the simulated post-starburst galaxies following the MaNGA observing strategy and data reduction pipeline. We find that the radial gradient starting out positive, flattening and then becoming increasingly negative with time. The range of gradients observed in MaNGA PSB galaxies can be reproduced in the same simulations.



To interpret the origin of the gradient, we check the star formation history at different radii of the galaxy. The star formation rates peak at roughly the same time at all the radii but have stronger burst at the galaxy center. The co-eval starburst hypothesis is supported by our simulations.

Conclusion

The range of gradients observed in MaNGA PSB galaxies is simply due to different times of observation rather than different underlying processes.

The radial gradients in the Balmer absorption line strengths in these PSBs are consistent with simulations with a single co-eval burst which was stronger in the central regions.

Reference: [1] Weaver, in prep. ; [2]Hu et al. 2014; [3] Naab & Burkert 2003; [4] Johansson et al. 2008; [5] Wild et al. 2007