On the evolution of simulated galaxies: the mass dependence

Maider Miranda[1,2], Patricia Sánchez-Blázquez[2], Chris Brook[2], Brad Gibson[3,1]
[1] University of Central Lancashire, Preston, UK
[2] Universidad Autónoma de Madrid, Madrid, Spain
[3] University of Hull, Hull, UK

contact: msancho@uclan.ac.uk

Introduction

Making use of a fiducial set of simulated disc galaxies spanning a wide range of mass, we examine the influence of stellar mass with various fundamental galactic characteristics, comparing to observations of radial metallicity gradients [3] and spin parameter [2]. Our aim is to distinguish between scenarios of galaxy evolution.

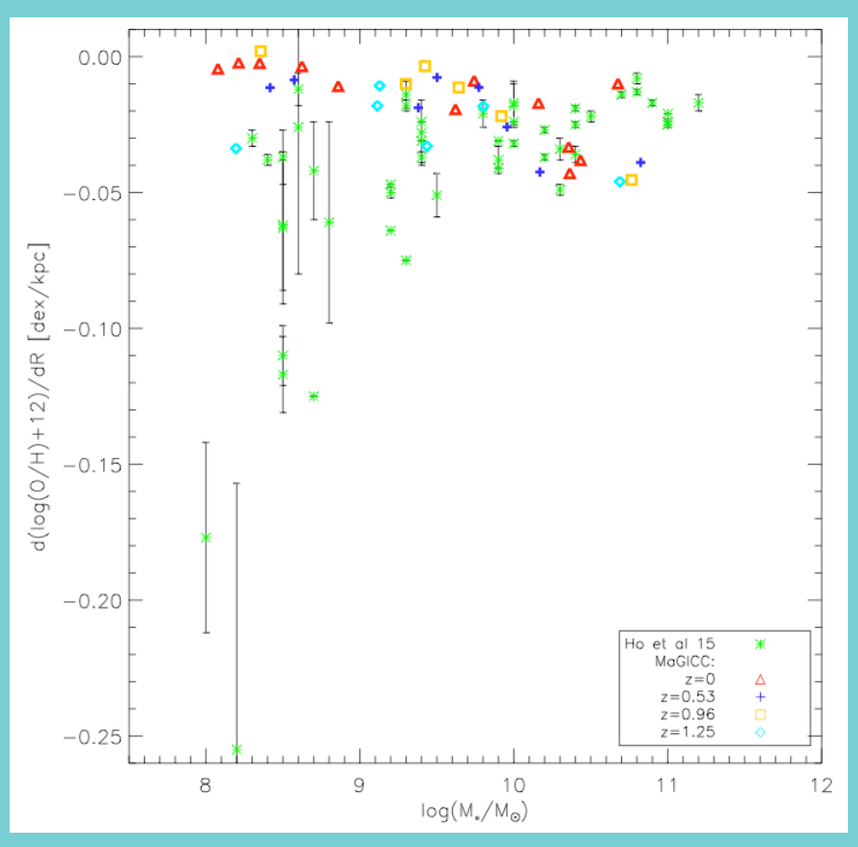
Are the same trends found in simulations? If not, how could we adjust them to reproduce the observations?

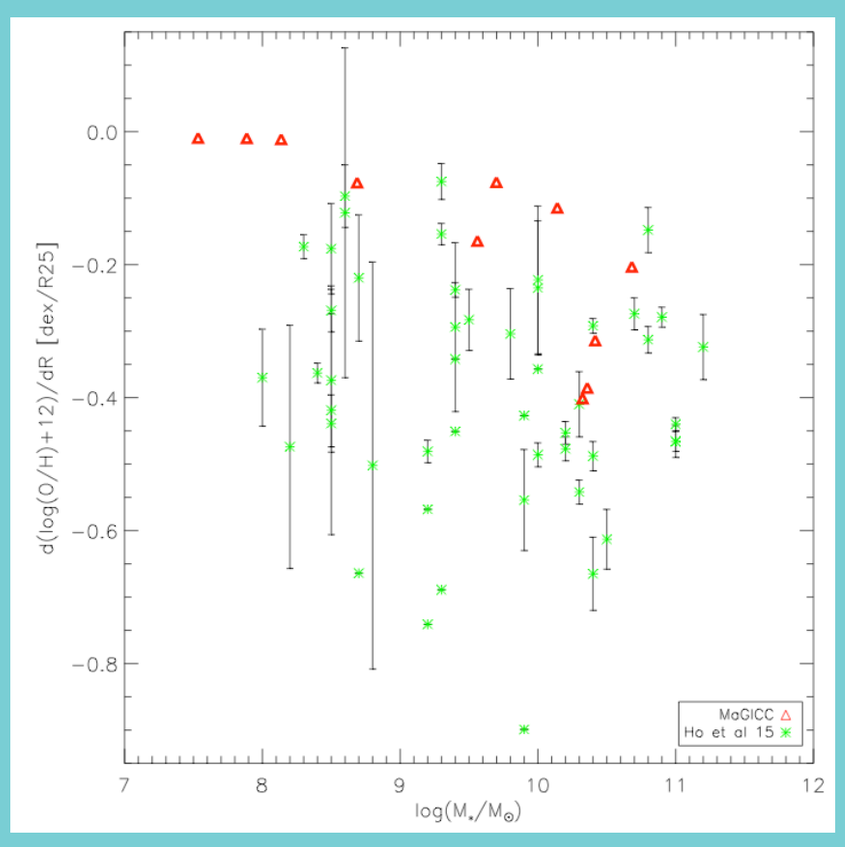
Cosmological Simulations [1],[4]

- Drawn from the MaGICC project
- They form a homogeneous suite of field galaxies
- Milky Way analogues and irregulars
- Complete set covering a wide mass range

Radial metallicity gradients

We show gas-phase oxygen gradients overplotting simulations and observations [3], in dex/kpc (left) and normalised to the R25 (right)





In [3] they believe that the mean gradient in absolute scale (kpc) steepens when moving to lower galactic masses, while they do not see any trend for gradients in relative scales

MaGICC galaxies fulfill scaling relations like Tully-Fisher and mass-metallicity but do not reproduce the measured metallicity distribution.

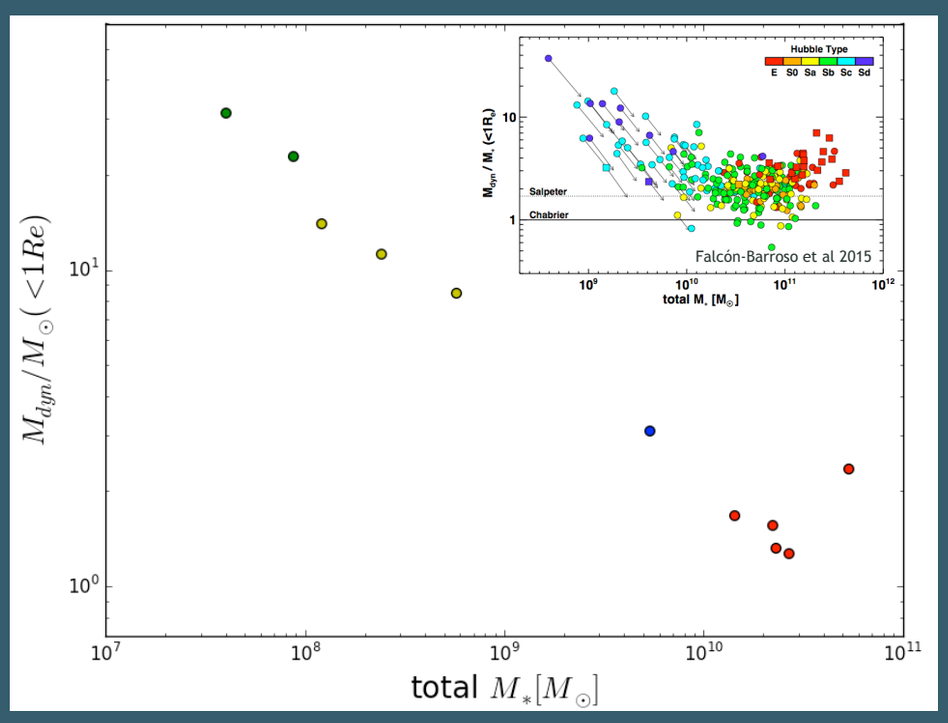
Our gradients are too flat for stellar masses $M_* < 10^9\ M_\odot$, at all redshifts. The total metal content is consistent with empirical scaling relations [5], but distributed incorrectly.

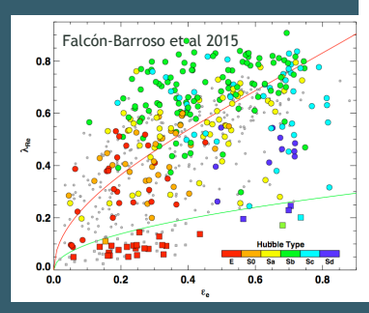
We propose a mass-dependent modulation of feedback and/or star formation efficiency. Implementing such a mass-dependency must be handled with care, in order not to violate said empirical scaling relations.

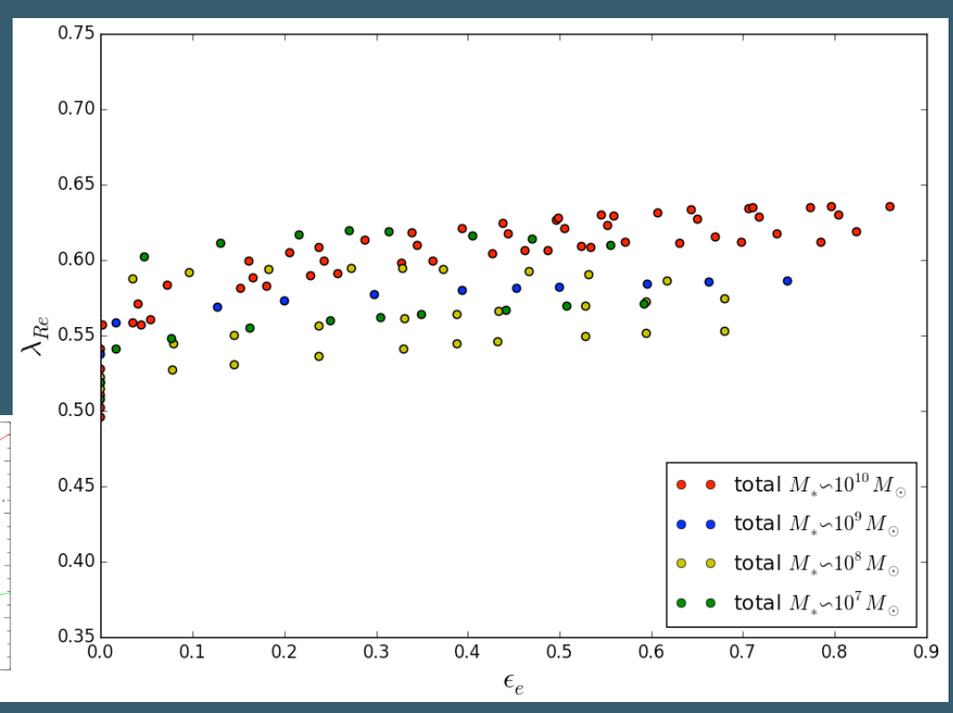
Spin parameter

The combination of the spin parameter and apparent ellipticity is used to constrain the dynamical structure and evolution of galaxies. We compare our homogeneous set with CALIFA galaxies [2].

The intrinsic mass distribution is similar for simulations and Sc-Sd galaxies in observations, although our galaxies span a wider mass range.







While data from CALIFA [2] covers the whole spin spectrum, our galaxies rotate at a comparatively more constant rate.

Observations find a population of low mass Sd galaxies with spin parameter much lower than expected.

Our simulations do not recover this population of low-spin systems, but there is a hint that the spin decreases with mass until an inflexion point at M_* ~10^8-10^9 $M_\odot$ where it starts to increase again.

References
[1] Brook, C. B. et al., MNRAS, 424, 1275 (2012)
[2] Falcón-Barroso, J. et al., in prep. (2015)
[3] Ho, I.-T. et al., MNRAS, 448, 2030 (2015)
[4] Obreja, A. et al., MNRAS, 442, 1794 (2014)
[5] Pilkington, K. et al. MNRAS, 425,969 (2012)