*Formation and Evolution of Galaxy Outskirts*
*Proceedings IAU Symposium No. 321, 2016*
*A. Gil de Paz, J.H. Knapen & J.C. Lee, eds.*

doi:10.1017/S1743921316009054

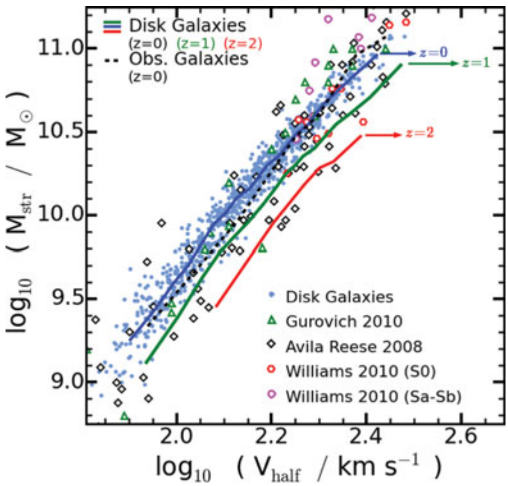
# Redshift evolution of Tully-Fisher relation

**Ismael Ferrero and Mario G. Abadi**

Instituto de Astronomia Teorica y Experimental (IATE), Observatorio Astronomico de Cordoba (OAC) and CONICET, Laprida 922 X5000BGR Cordoba, Argentina
email: `iferrero@oac.unc.edu.ar`

**Abstract.** Using the EAGLE cosmological simulation of galaxy formation we test the ability of the ΛCDM cosmological model to reproduce the Tully-Fisher relation (TFR) and its redshift evolution. We find that our simulated galaxies follow a TFR that is in good agreement with observed results up to $z = 1$, indicating no evolution in the slope and a weak decrease in the zero-point.

**Keywords.** galaxy:formation, galaxy: kinematics and dynamics, galaxy: structure




We use the EAGLE cosmological hydrodynamical simulation to study the redshif evolution of the Tully-Fisher relation (Tully & Fisher 1977). We select simulated galaxies resembling observed spiral galaxies. Imposing at redshift $z = 0$, a minimum stellar mass of $M_* > 10^9$ $M_\odot$ and a ratio between rotational-to-total kinetic energy parameter $\kappa_{\rm rot} = \Sigma V_{\rm rot}^2/\Sigma V^2 > 0.6$ to ensure that our simulated galaxies are rotationally supported. Furthermore, we restrict our analysis to galaxies with half stellar mass radius $r_{\rm half}$ at least three times larger that the softening length $\epsilon = 0.7$ kpc to ensure that our objects are spatially well-resolved. In the Figure we show the comparison of the TFR for simulated galaxies and observational data at redshift $z = 0$ (see labels). Solid lines are medians for simulated galaxies for $z = 0$, 1, 2 from top to bottom, respectively, and dashed line is median of observed data. A very good agreement can be seen between simulated and observed data. We found that at redshift $z = 0$ our simulated disk galaxies have a TFR slope of 3.3 which keeps approximately constant with redshift but shows a systematic decrease by a factor 3 in its zero point from $z = 0$ to redshift $z = 2$. The simulated TFR slope is steep, $M_{\rm str} \propto V_{\rm half}^{3.3}$, but close to the virial theoretical expectation ($M_{200} \propto V_{200}^3$). This higher slope can be trace back to the lower efficiency of smaller haloes to collect its baryonic material consistent with abundance matching predictions (see also Sales *et al.* 2016). The zero-point evolution interpreted as an evolution in the halo mass since changes in the stellar mass fraction seems to be counter-balanced by changes in the circular velocity profiles having no net effect.

## References

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