No escape from V_{esc}:

a local and global parameter in galaxy formation

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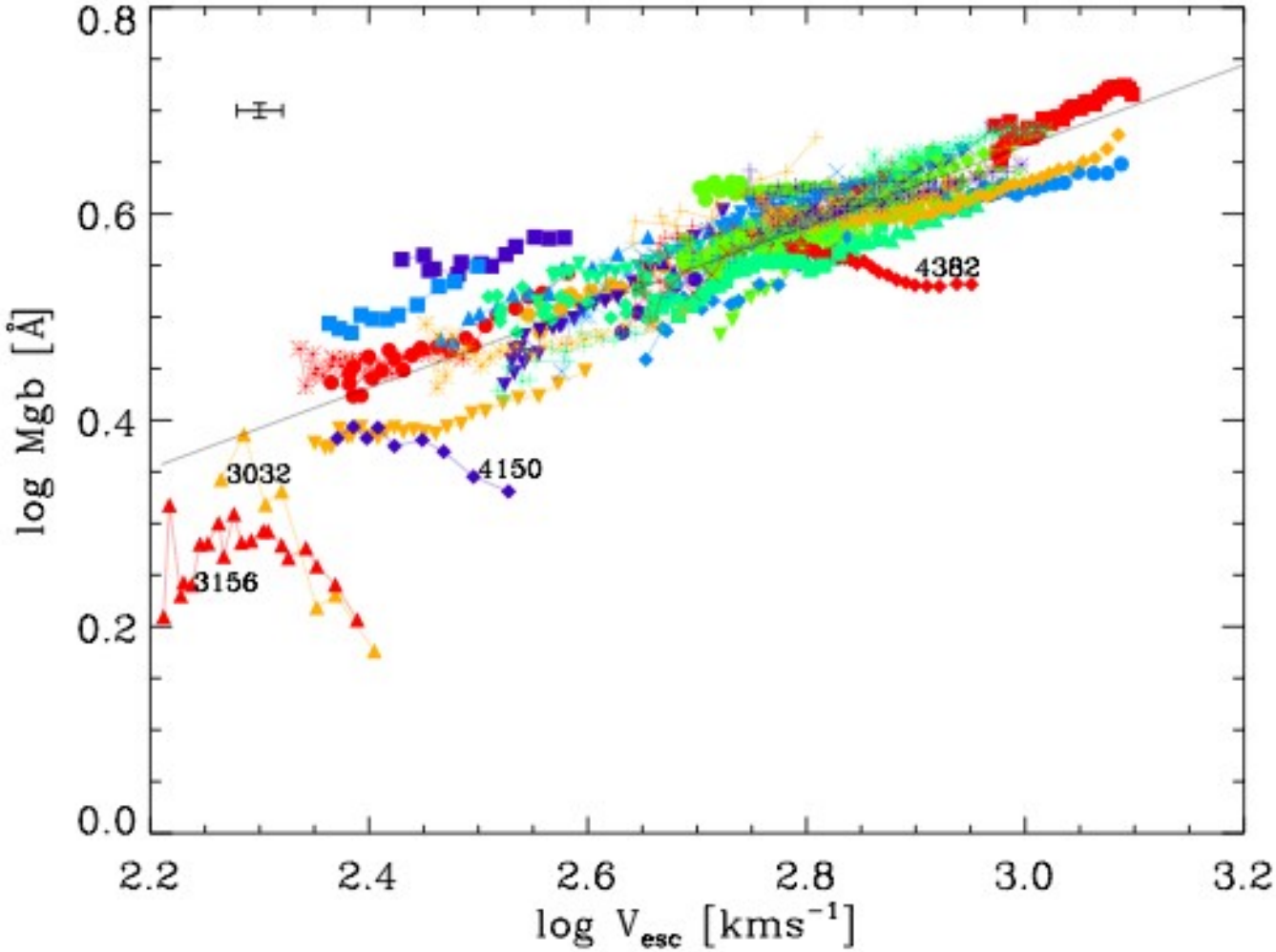
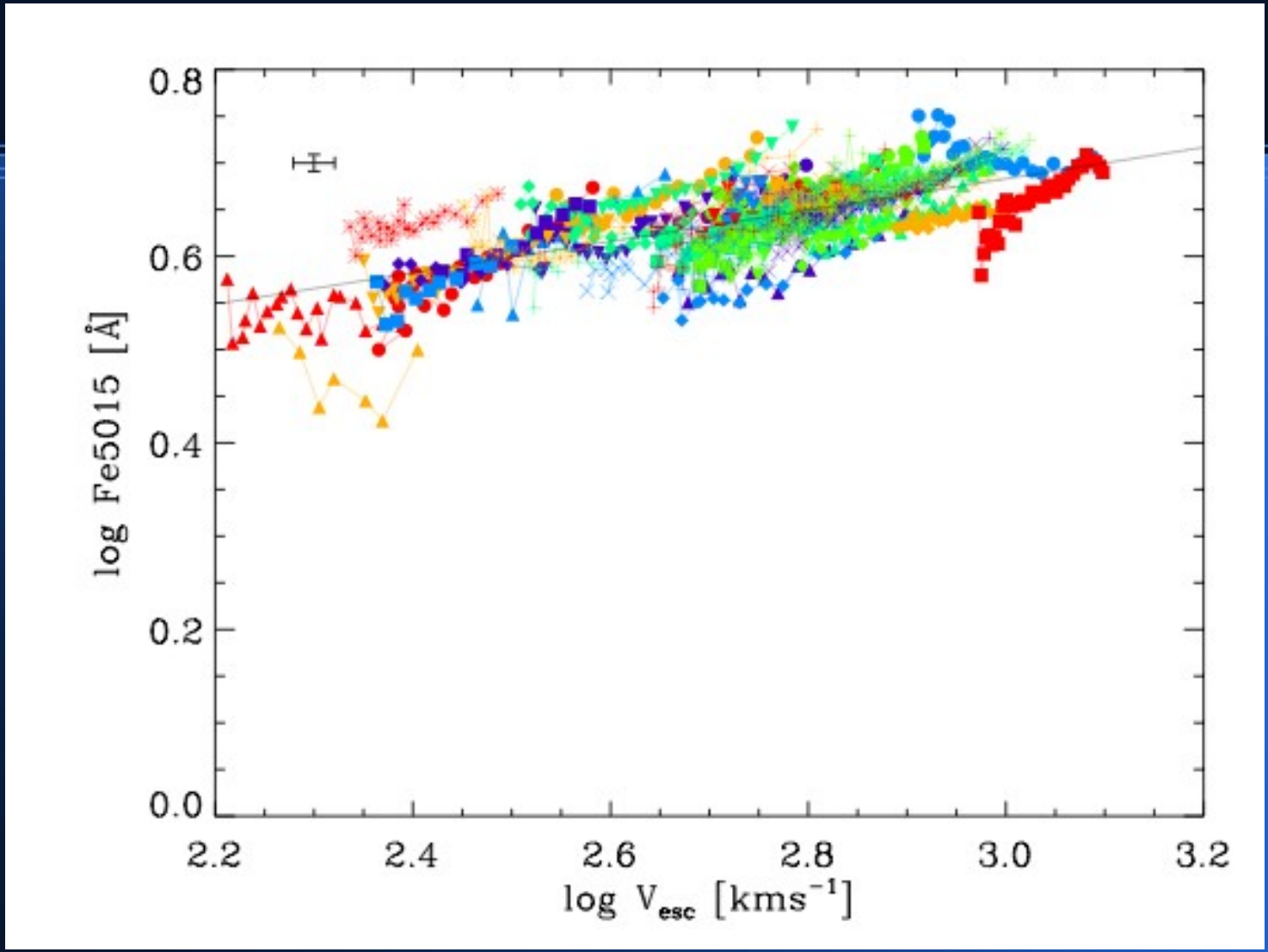
The Index-V_{esc} relations



- Tight relation (similar to the well-known Mgb-σ relation)
- Outliers stand out clearly, showing qualitatively different behaviour
- These outliers all show recent star formation

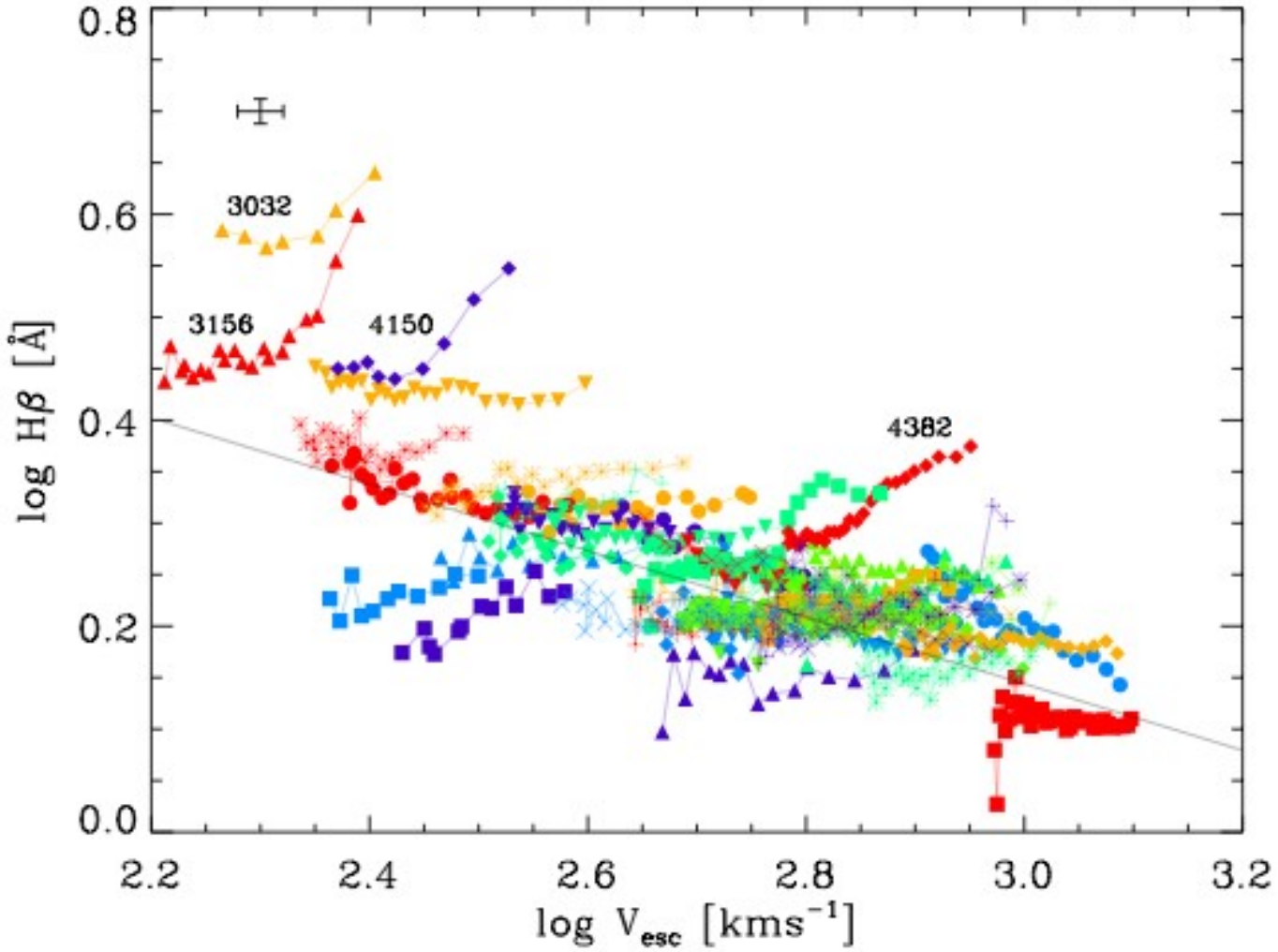
$$\log \mathrm{Mgb} = (-0.507 \pm 0.009) + (0.391 \pm 0.006) \log V_{esc} \ , \qquad \sigma = 0.032$$

The Index-V_{esc} relations



$$\log \mathrm{Fe} = (0.179 \pm 0.009) + (0.168 \pm 0.005) \log \mathrm{V_{esc}} \ , \qquad \sigma = 0.030$$

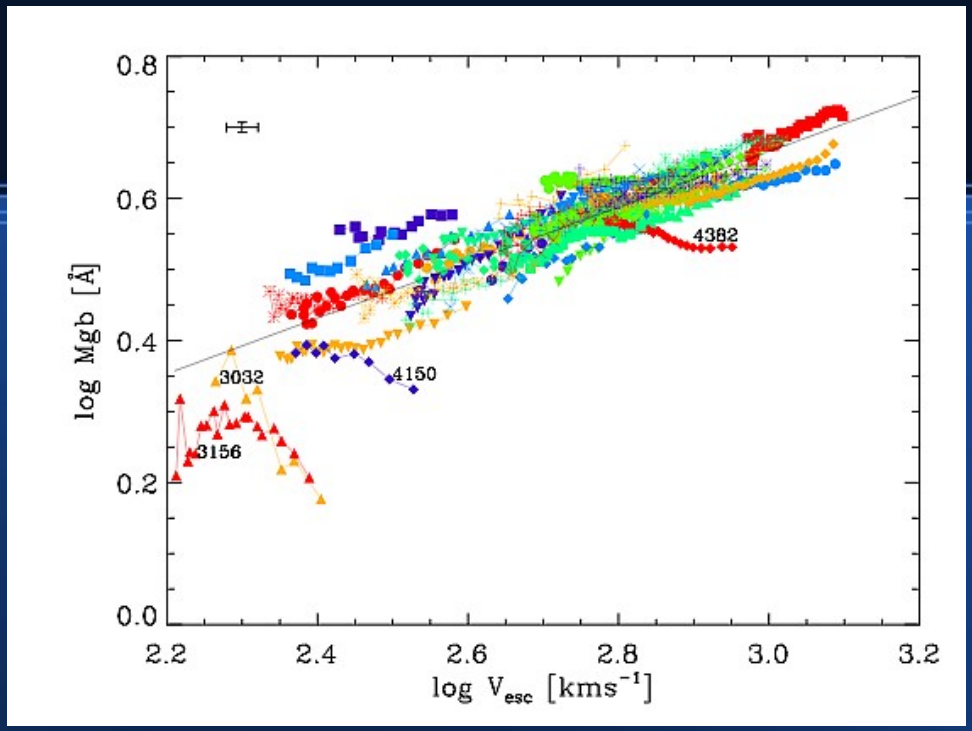
The Index-V_{esc} relations

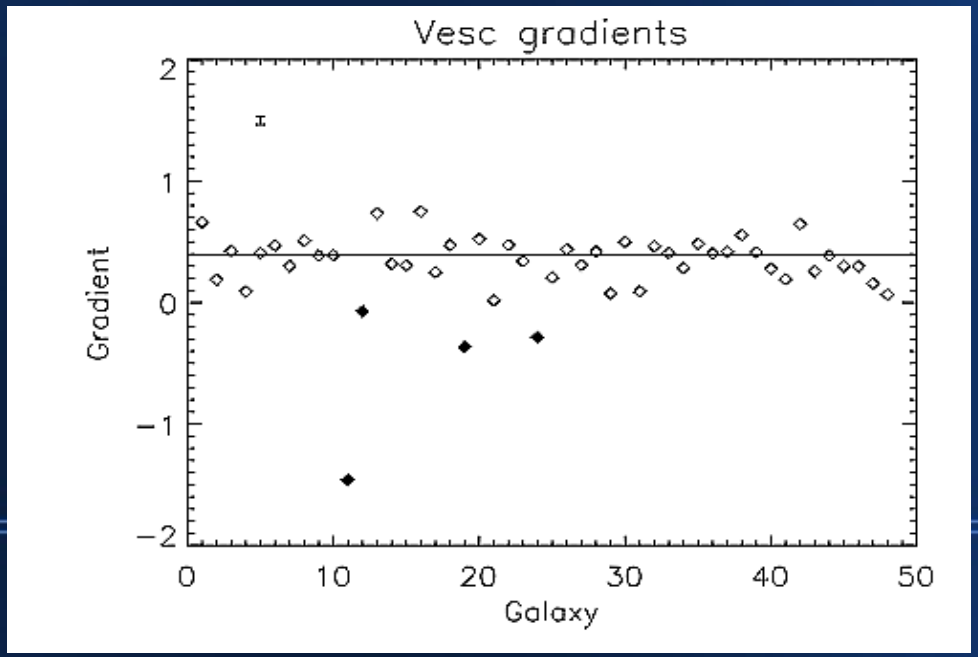


- Relation still obvious but larger scatter
- Outliers in Mgb–V_{esc} are all outliers here too – the highest Hβ
- Individual galaxy profiles mostly flat

$$\log \mathrm{H}\beta = (1.113 \pm 0.013) + (-0323 \pm 0.008) \log \mathrm{V}_{\mathrm{esc}} \,, \qquad \sigma = 0.046$$

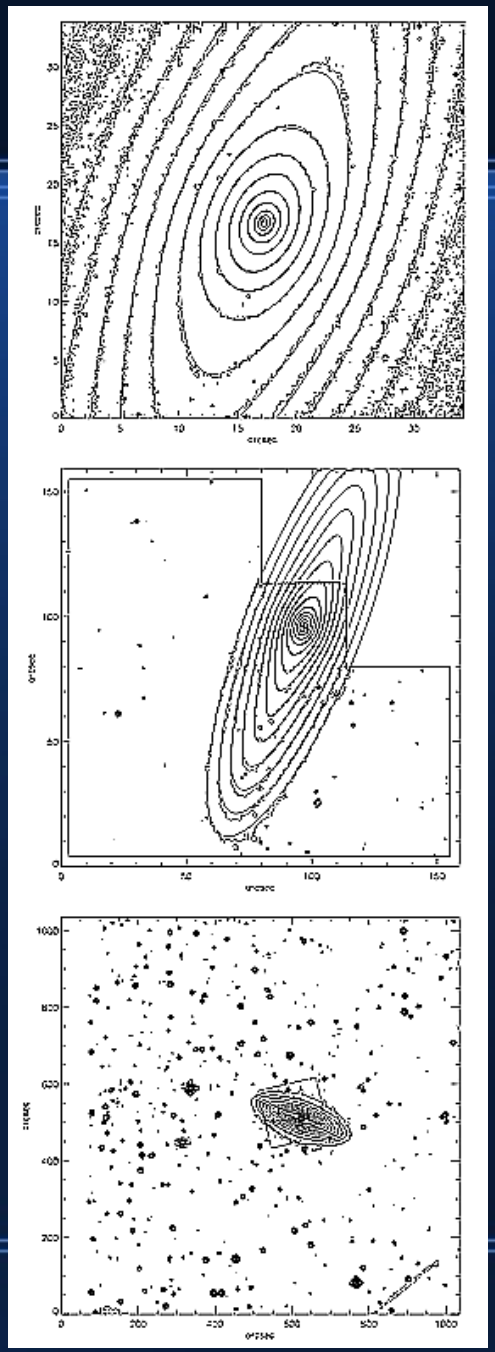
The Mgb-Vesc relation – local and global

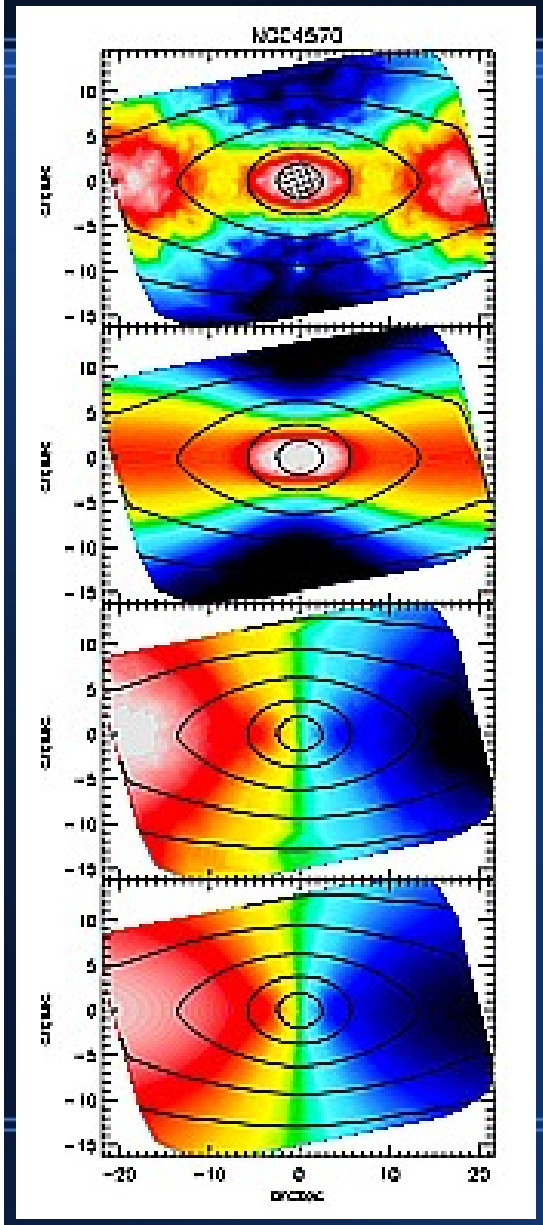




- Gradient within individual galaxies the same as that between galaxies
- Some exceptions – galaxies showing recent star formation (again!)
- Mgb-V_{esc} relation both local and global

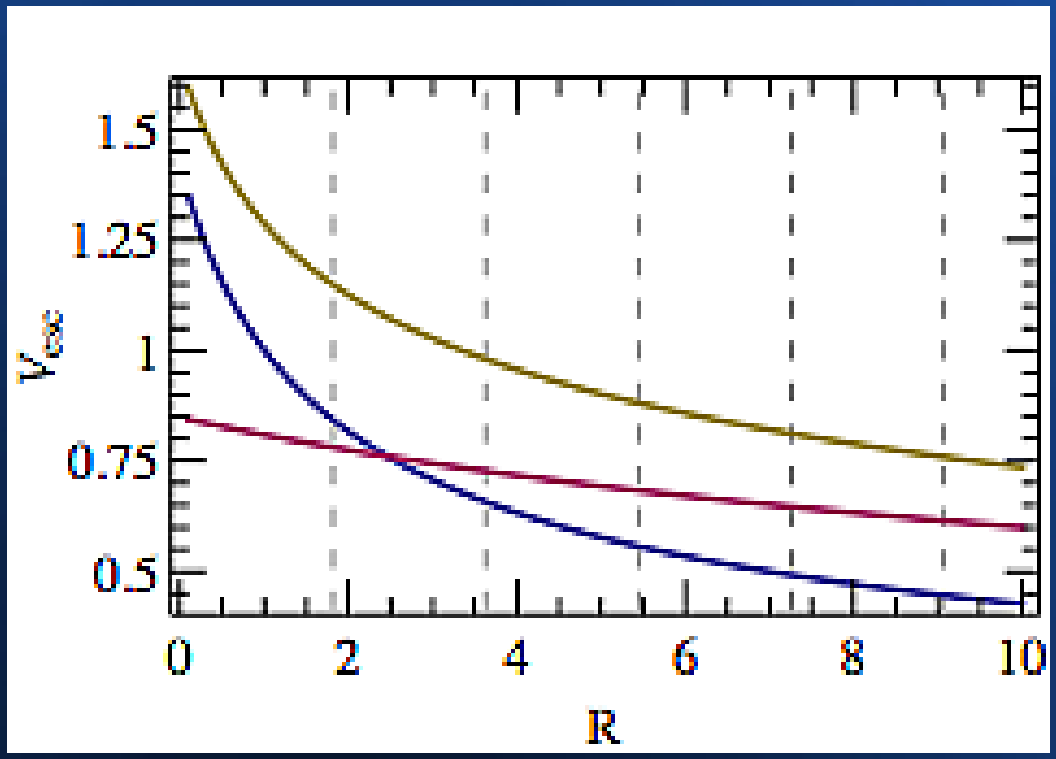
'Measuring Vesc' – Dynamical Modelling





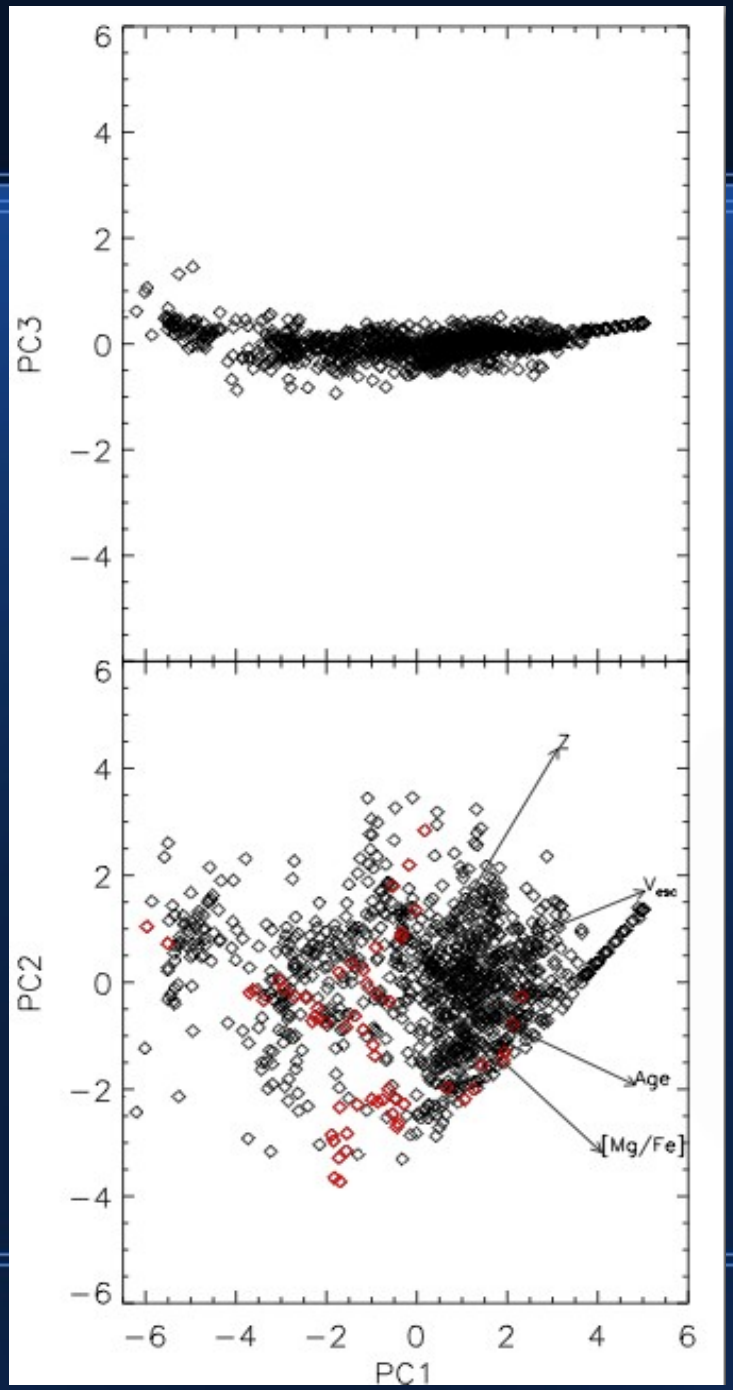
- Fit MGE model (Emsellen et al. 1993) to ground-based and HST photometry
- Use axisymmetric Jeans Anisotropic Modelling (JAM – Cappellari 2008) matched to SAURON kinematics to find Φ/V_{esc}
- Assuming constant M/L and anisotropy

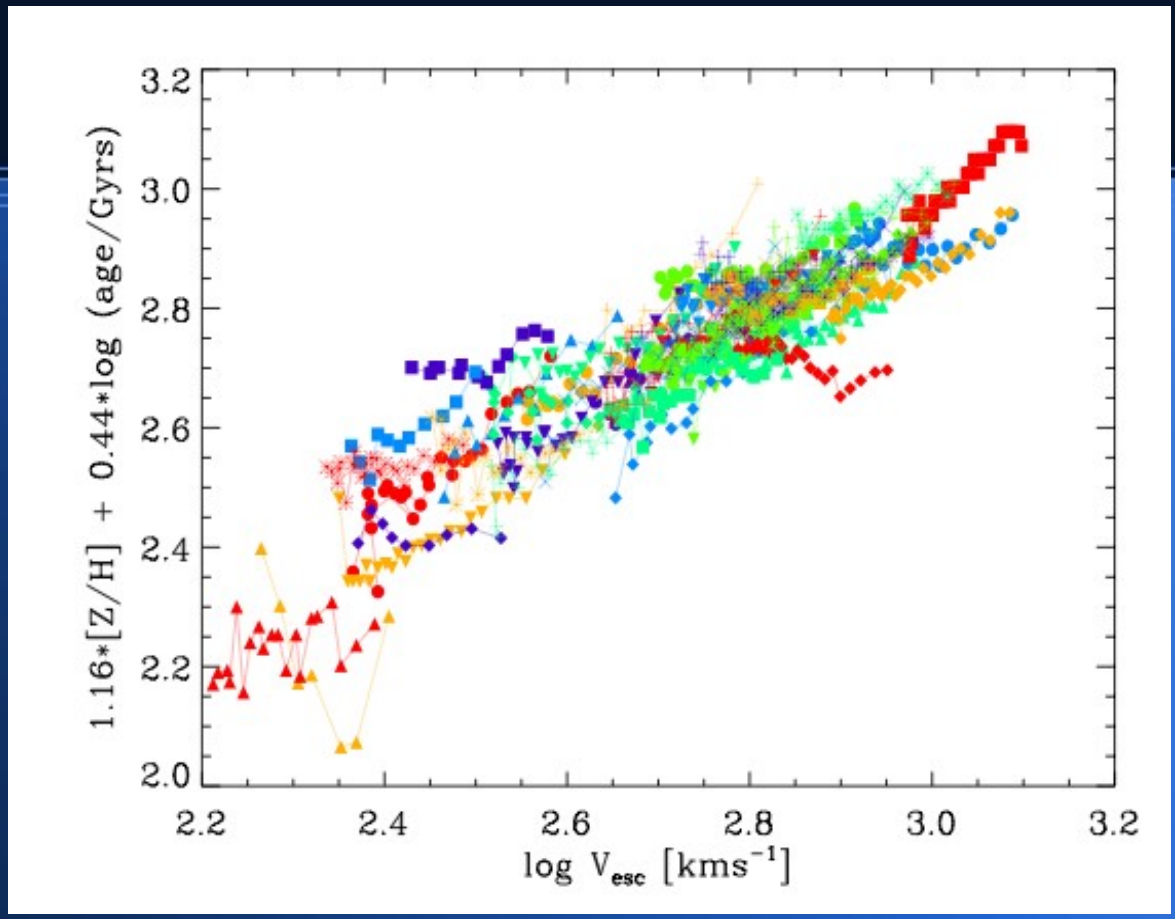
The impact of Dark Matter



- Initially assumed DM followed light
- Test the impact of a separate DM profile using a Hernquist profile
- Changes slope of Mgb-V_{esc} relation within a galaxy by ~0.07 dex over 1Re
- Impact at larger radii more significant but limited data in this region

The 'SSP hyperplane'





- In 4D V_{esc}, Age, Z, [α/Fe] space galaxies confined to a 2D plane:

$$\log\left(\frac{V_{esc}}{500 kms^{-1}}\right) = 1.16\left[\frac{Z}{H}\right] + 0.44\log\left(\frac{t}{Gyrs}\right) - 0.20$$

Conclusions

- Using V_{esc} instead of σ preserves the tight relations with line strength indices
- The Mgb-V_{esc} relation is both local and global: relation is the same both within galaxies and between galaxies. This suggests that it is more fundamental than the σ relation.
- V_{esc} at large radii sensitive to the DM profile (Δ gradient ~ 0.07 dex) but require more observations in this regime
- In the 4D SSP space of V_{esc}, age, Z and [α/Fe] ETGs are confined to a 2D plane

Questions?