The stellar initial mass function of early type galaxies from low to high stellar velocity dispersion: homogeneous analysis of ATLAS$^3$D and Sloan Lenses ACS galaxies

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Our work

Sample: 55 Sloan Lens ACS galaxies (Bolton et al. 2006)

Data: SDSS spectra (3800 – 9000Å) and HST F814W galaxy images

Aim: study the integrated mass normalization of the IMF

\[ \text{IMF} \rightarrow \frac{M_*}{L} \rightarrow M_* \]

Methods:
- stellar dynamics + gravitational lensing \(\rightarrow (M_*/L)_{\text{dyn}}\)
- stellar population synthesis models \(\rightarrow (M_*/L)_{\text{pop}}\)
\((M_*/L)_{\text{dyn}}\) from dynamical models

Treu et al., 2010, ApJ, 709, 1195:
- spherical symmetry
- isotropic velocity dispersion tensor
- light follows Hernquist profile
- NFW dark matter halo

**Constraints:** \(\sigma_*\) and \(M_{\text{EIN}}\)
(M*/L)_{dyn} from dynamical models

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The IMF of ETGs from low to high $\sigma$: homogeneous analysis of ATLAS$^{3D}$ and SLACS galaxies
$\left( \frac{M_*}{L} \right)_{\text{dyn}}$ from dynamical models

Treu et al., 2010, ApJ, 709, 1195:
- spherical symmetry
- isotropic velocity dispersion tensor
- light follows Hernquist profile
- NFW dark matter halo

Constraints: $\sigma_*$ and $M_{\text{Ein}}$

Posacki et al., submitted:
- axisymmetry
- vertical anisotropy $\beta_z$ (Cappellari 2008)
- light profile parametrized with a multi gaussian expansion
  (Emsellem et al. 1994)
- NFW dark matter halo

Constraints: $\sigma_*$, $M_{\text{Ein}}$ and HST images
MGE models

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The IMF of ETGs from low to high $\sigma$: homogeneous analysis of ATLAS$^{3D}$ and SLACS galaxies
\[ (M_*/L)_{\text{pop}} \] from stellar population synthesis models

- assume Salpeter IMF
- SSP models of Vazdekis et al. 2010
- 3540 – 7410 Å at 2.50 Å (FWHM) spectral resolution
- \( 1 \text{ Gyr} \leq t \leq t_{\text{Univ}}(z) \)
- \(-1.71 \leq [M/H] \leq 0.22\)

**Constraint:** SDSS spectra
The IMF of ETGs from low to high $\sigma$: homogeneous analysis of ATLAS$^{3D}$ and SLACS galaxies

$$\alpha = \frac{(M_*/L)_{\text{dyn}}}{(M_*/L)_{\text{pop}}}$$

- galaxies require different IMF normalizations
- confirmed trend: $\alpha \propto \sigma_*^{1.3\pm0.23}$
- lower correlation due to a more detailed parametrization
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Results

SLACS: \( \sigma \) selected sample, \( z \sim 0.2 \) (Bolton et al. 2006)

**ATLAS\(^{3D}\):** volume limited and nearly mass selected sample, \( M_K < -21.5 \) mag, \( z \sim 0 \) (Cappellari et al. 2011)

![Graph showing complementary samples follow the same relation consistent with a systematic variation of the IMF with \( \sigma \): not a simple power law?](image-url)
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ATLAS$^{3D}$: volume limited and nearly mass selected sample, $M_K < -21.5$ mag, $z \sim 0$ (Cappellari et al. 2011)

complementary samples follow the same relation
consistent with a systematic variation of the IMF with $\sigma$
$\alpha - \sigma$: not a simple power law?
The end