THE ORIGIN OF THE SÉRSIC PROFILES OF GALAXIES: ENVIRONMENTAL EFFECTS

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NGC 474 (Credit: Duc Atlas3D)
Sérsic (1968) law:

\[ I(R) \propto \exp \left[ - \left( \frac{R}{R_e} \right)^{1/m} \right] \]

- \( m \): Sérsic index
- \( m = 4 \): de Vaucouleurs \( R^{1/4} \) law

→ Inner and outer slopes are anti-correlated
Surface-brightness profiles of ellipticals

Bertin et al. (2002)
Sérsic index $m$ vs. luminosity: Virgo ETGs

Dissipationless collapse and $R^{1/4}$ law

van Albada (1982)

see also Aguilar & Merritt (1990)
Dissipationless collapse and $R^{1/m}$ law

Nipoti et al. (2006)

Sérsic index $m$

see also Trenti et al. (2005)
Sérsic index $m$ and dry mergers

→ Sérsic index tends to increase with dry merging
Origin of Sérsic profiles: Gaussian random field fluctuations

Cen (2014)
Environment of galaxy formation

"Quiet" environment

"Busy" environment

Power spectrum $P(k)$ vs. wave number $k$
Smooth/clumpy collapse and Sérsic profiles

(Nipoti 2015 ApJL)
Fluctuation power spectrum and Sérsic profiles

→ Dissipationless collapse
→ Initial fluctuations: Gaussian Random Field
→ Power spectrum $P(k) \propto k^n$

Nipoti (2015)
Conclusions

Sérsic profiles related to galaxy formation environment

- **Low Sérsic index $m$**
  - ‘‘Quiet’’ formation environment
  - Weak small-scale fluctuations
  - Shallow power-spectrum
  - Few mergers

- **High Sérsic index $m$**
  - ‘‘Busy’’ formation environment
  - Strong small-scale fluctuations
  - Steep power-spectrum
  - Many mergers