Dark matter and stellar orbits in flattened ellipticals

We find outwardly rising mass-to-light ratios in regularized orbit models for Coma ellipticals. We achieve very good agreement between the stellar contribution to the total mass in dynamical models and in stellar population analysis of line indices, strengthening the need for dark matter to explain the remaining mass.

- **We construct regularized orbit models for a sample of flattened Coma early-type galaxies** and determine their mass composition and orbital structure. Figure 1 shows the match between orbit model and kinematic data for the E2 elliptical NGC 4807. We also plot the orbital structure of the galaxy, described by the anisotropy parameter β_ϑ. A positive $\beta_\vartheta > 0$ in the outer parts of NGC 4807 indicates predominant radial orbits there.
- **By simulations of galaxy test models under realistic observational conditions we optimize regularization in the orbit models** (Thomas et al. 2004b). The bottom panel in Figure 1 demonstrates that a proper choice of the regularization parameter $\alpha \approx 0.02$ allows us to reconstruct internal velocity moments up to second order with an accuracy of about $\Delta = 15\%$ in the mean over 60 Monte-Carlo realizations of pseudo-data with realistic error bars.

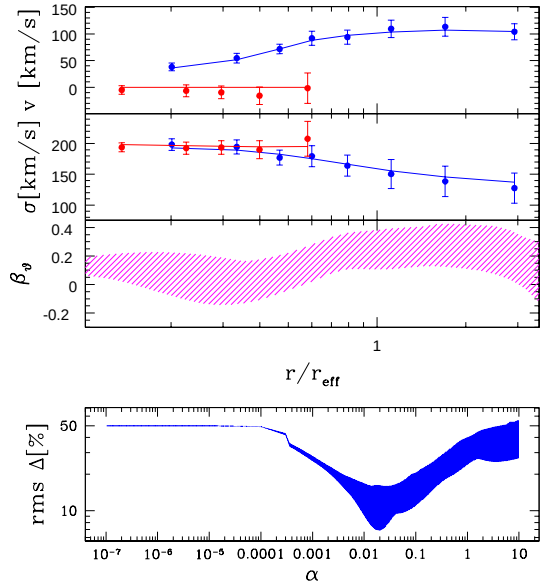

Figure 1: Upper two panels: rotation v and dispersion σ of NGC 4807 (red/blue: major/minor axis; dots/lines: observations/best-fit model); magenta: 68 per cent confidence range of velocity anisotropy $\beta_\vartheta = 1 - \sigma_\vartheta^2/\sigma_r^2$; bottom panel: accuracy of internal velocity moments as a function of regularization α.

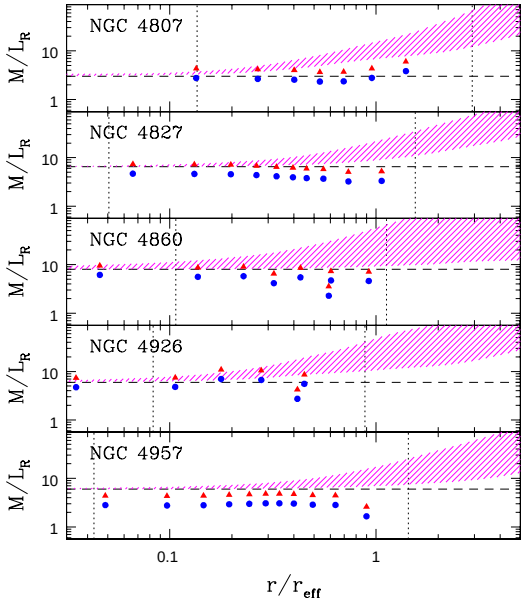

Figure 2: Recovered mass-to-light ratios M/L of 5 ellipticals in the Coma cluster. Dashed: best-fitting (projected) stellar M/L in orbit models; magenta: 68 per cent confidence range of total M/L in orbit models; triangles/dots: stellar M/L from population analysis of line indices based on Salpeter/Kroupa initial-mass-functions. Vertical lines: spatial extent of kinematic data.

- **We find evidence for dark matter in 5 Coma ellipticals.** As Figure 2 shows, the outwardly rising mass-to-light ratios M/L exceed the stellar masses by far, indicating a dark matter halo.
- **Dynamically derived stellar masses agree well with stellar population analysis of line indices** (Maraston 1998; Thomas, Maraston & Bender 2003; see Figure 2).

References:

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