Clusters and groups of galaxies: internal structure and dynamics

Strong constraints on cosmological theories and on the nature of dark matter can be obtained from the study of cluster masses, mass distribution, and internal structure. My main research lines in this field are:

1. the determination of the cluster (total and baryonic) mass distribution, using galaxies as tracers of the cluster gravitational potential;
2. the characterization of the properties of the dark matter, using the comparison of different tracers of the cluster gravitational potential;
3. the analysis of the dynamical status of clusters, using the shapes of their pseudo phase-space density profiles.

These analyses are based in particular on data from CLASH-VLT and WINGS.

I am also manager of one of the working groups of the Euclid ESA mission, that are active in the field of clusters of galaxies. Euclid is expected to lead to the detection of thousands of clusters at redshift $z>1$.

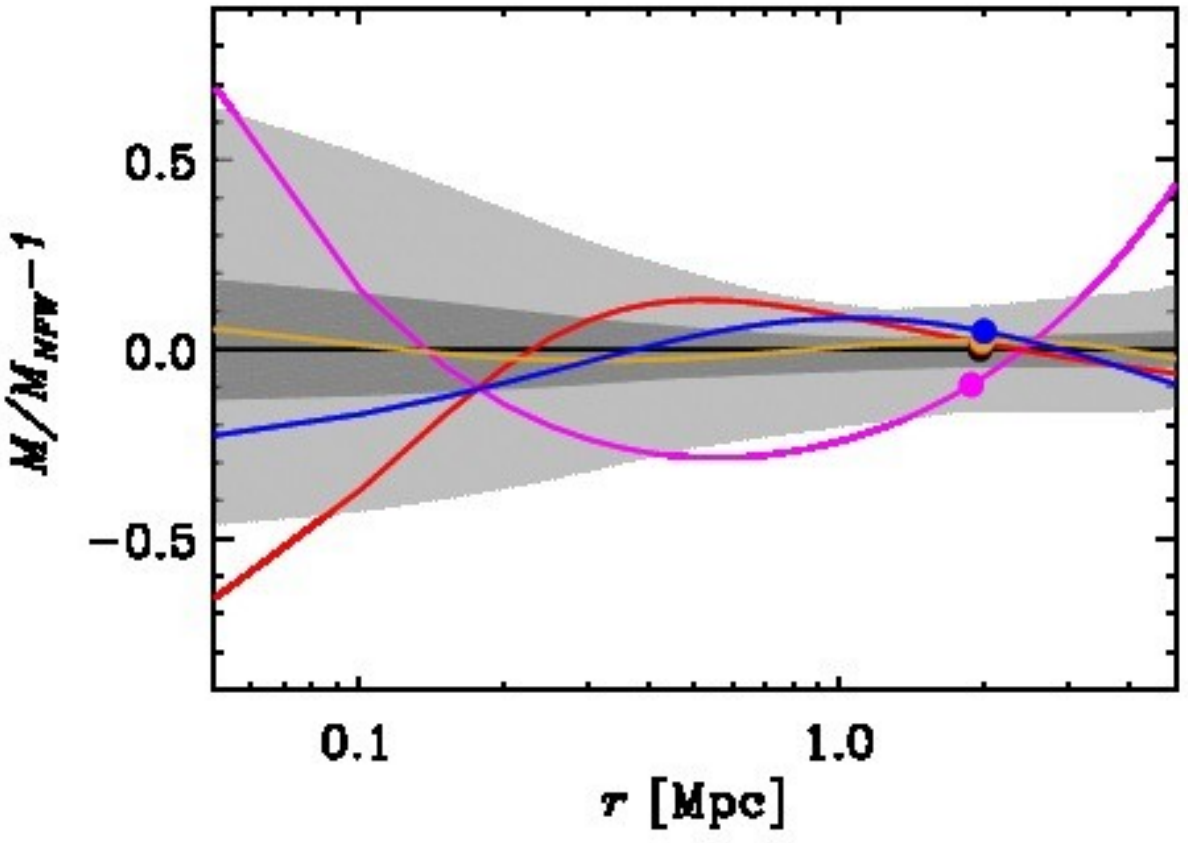

Fig.1: The mass profile of a z=0.44 cluster of the CLASH-VLT data-set, normalized by the best-fitting NFW model, as obtained using the MAMPOSSt technique applied on a sample of several hundreds cluster member galaxies. Lines of different colors correspond to different mass models (**NFW**, **Einasto**, **Hernquist**, **Burkert**, **Softened Isothermal Sphere**). The light shaded region indicates the 1-σ confidence region around the NFW best-fitting solution. The dark shading indicates how this confidence region will narrow when the same analysis will be applied to the full CLASH-VLT data-set of 11 clusters, allowing in principle to exclude all models except NFW and Einasto [adapted from Biviano et al. 2013, A&A, 558, A1]

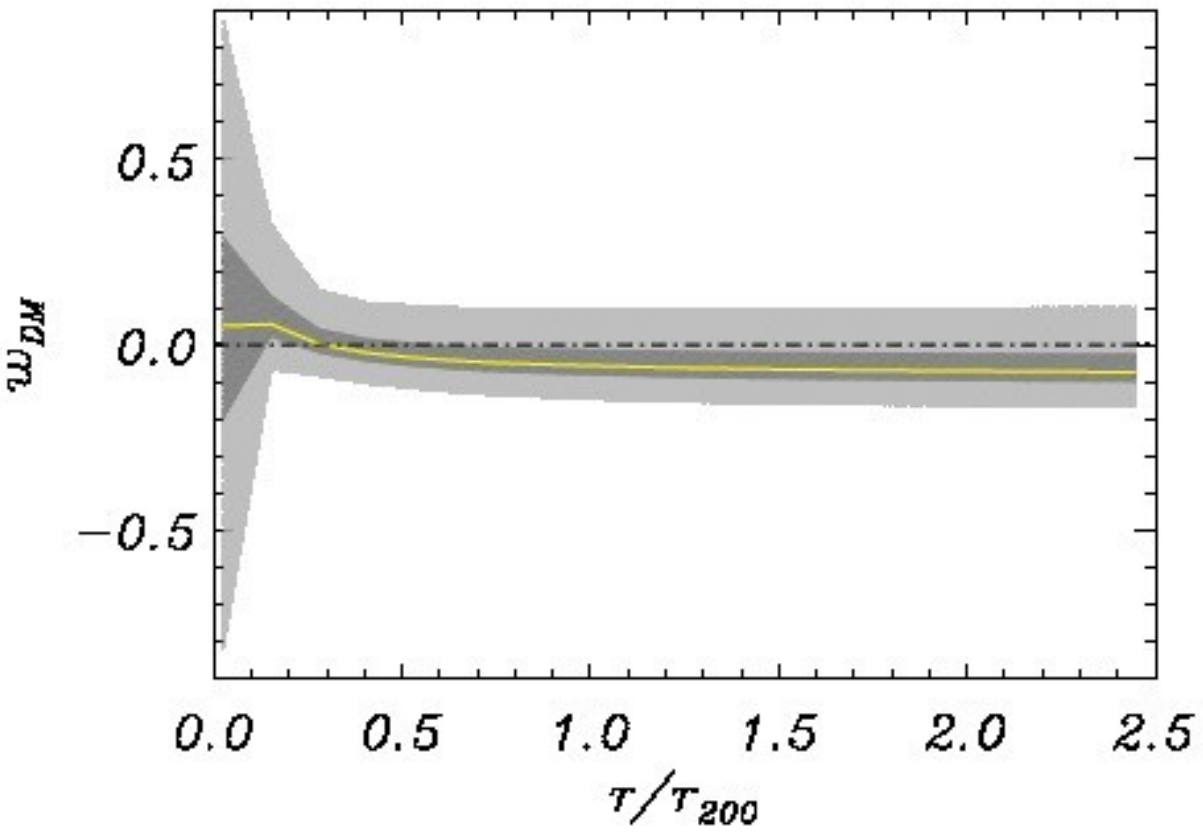

Fig.2: The equation of state of dark matter evaluated on a z=0.44 cluster from the CLASH-VLT data-set, as a function of cluster-centric distance (yellow line). Light shading indicates the 1- σ confidence region, and shows that current constraints are compatible with a pressure-less dark matter component. Dark shading indicates how the confidence region will narrow when the same estimates will be done by considering the full CLASH-VLT clusters data-set [adapted from Sartoris, Biviano et al. 2014, ApJ Letters, submitted]

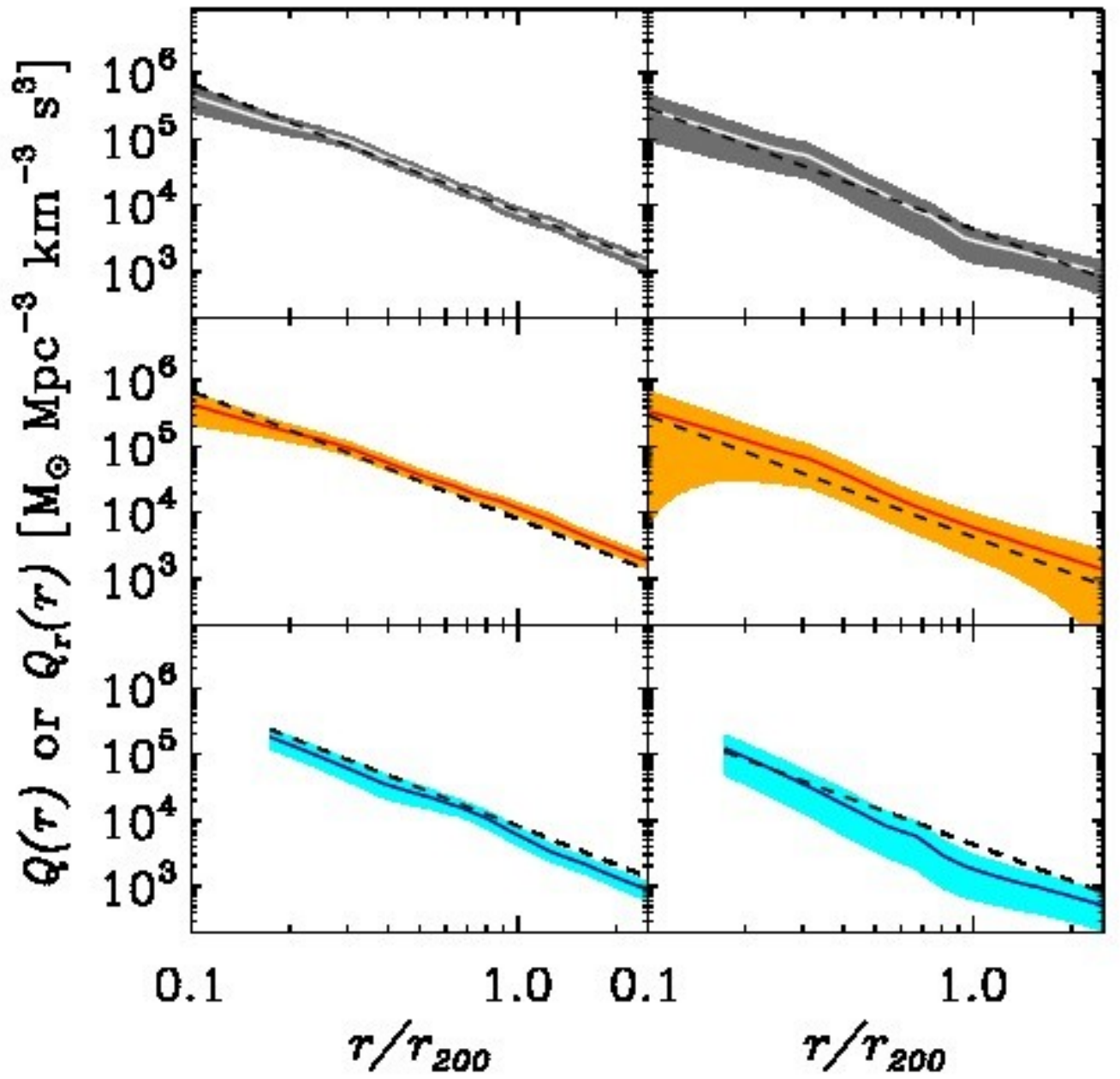

Fig.3: The Pseudo-Phase Space Density profiles, $Q(r)=\rho/\sigma^3$ (left panels) and $Q_r(r)=\rho/\sigma_r^3$ (right panels) evaluated for a z=0.44 cluster from the CLASH-VLT data-set. The top, middle, and bottom panels show the PPSD profiles evaluated using all, passive, and star-forming cluster galaxies, respectively. The colored lines are the best-fit results, and the colored regions are 1- σ confidence regions. The dashed lines are theoretical predictions from Dehnen & McLaughlin (2005) [from Biviano et al. 2013, A&A, 558, A1]