Title: Gravitational Lensing by Galaxy Gropus and Clusters

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In the frame of modern cosmology, the study of formation and evolution of the gravitationally bounded structures in our Universe becomes more and more important. The growing number of objects (galaxy groups and clusters) detected with different techniques provides unprecedented material to develop more advanced models and better understand the physical processes at play in our Universe. The future experiments (LSST and Euclid to start at the end of the decade) will produce billions of galaxies, and techniques such as gravitational lensing modeling coupled with dynamical analysis and weak lensing need to be ready when data arrive.

One topic that currently drives a lot of attention is the formation of groups of galaxies. Groups are barely studied because they are simply difficult to find and study. In contrast to galaxy clusters, they emit very few in the X-rays, and fortuitous over-density of galaxies due to projection effects along the line of sight can be a misleading hint of galaxy group. Nonetheless, galaxy groups are massive objects, and in this respect sometimes produce strong lensing events. In the Strong Lensing Legacy Survey (SL2S), we have used automatic engines to find strong lensing events, and galaxy groups (Cabanac et al. 2007, More et al. 2012). Strong lensing modeling (Verdugo et al. 2011) together with weak-lensing (Foëx et al. 2013,2014) and dynamical analysis (Muñoz et al. 2013) allows us to estimate the mass density profile of these objects. Furthermore, the collision between galaxy groups can give us information about the elusive dark matter particle, in particular, its self-interaction cross-section (Gastaldello et al. 2014, Fernández-Trincado et al. 2014).

Among the most challenging problems of the current LCDM cosmological model is the nature of dark matter (DM). It is assumed to be composed by still unknown elementary particles interacting gravitationally. Many solutions have been proposed to explain its presence but its nature remains obscure. We are using strong lensing produced by galaxy clusters to test alternative cosmological models (Cárdenas et al. 2013, Magaña et al. 2014).