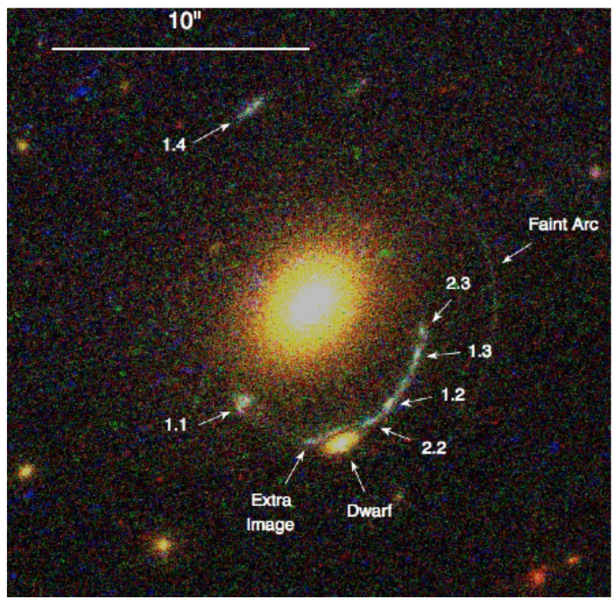
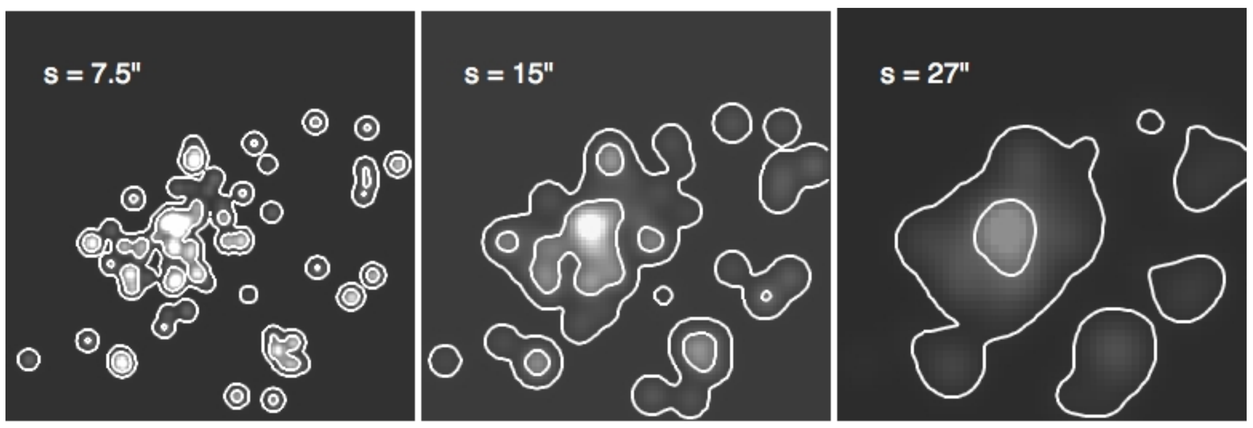
Strong Lensing as a Probe of the Mass Distribution *Beyond* the Einstein Radius
SL2S J08544-0121 - The *Bullet Group*

Marceau Limousin, E. Jullo, J. Richard, R. Cabanac, J.-P. Kneib, R. Gavazzi & G. Soucail, 2010, A&A, 524, 95
R. Munoz, V. Motta, T. Verdugo, M. Limousin et al., 2012, A&A accepted
F. Gastaldello, M. Limousin et al., in prep.

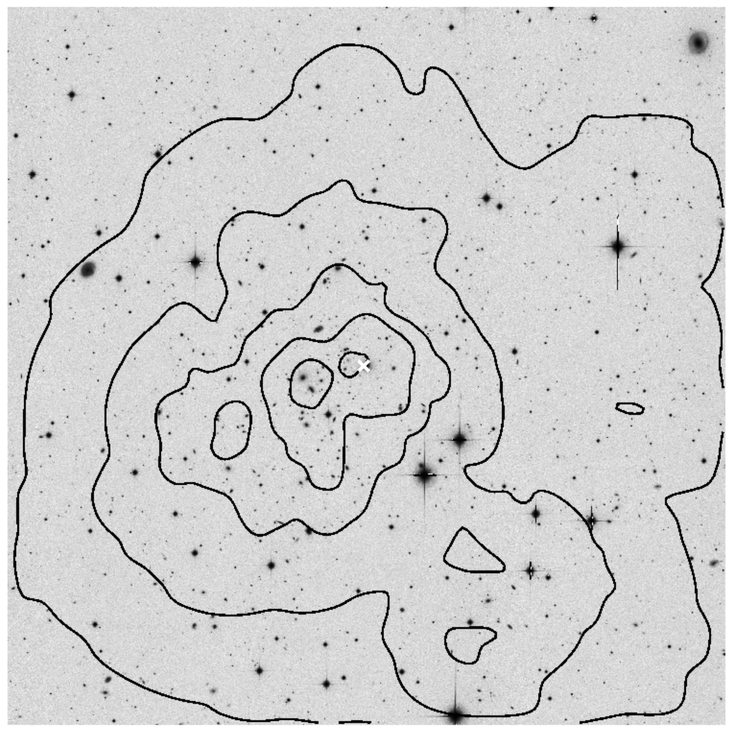
Strong lensing (SL) has been employed extensively to obtain accurate mass measurements within the Einstein radius. We here use SL to probe mass distributions *beyond* the Einstein radius. We consider SL2S J08544-0121, a galaxy group at redshift z = 0.35 with a bimodal light distribution and with a strong lensing system located at one of the two luminosity peaks separated by 54". The main arc and the counter-image of the strong lensing system are located at 5" and 8" from the lens galaxy centre. We find that a simple elliptical isothermal potential cannot satisfactorily reproduce the strong lensing observations. However, with a mass model for the group built from its light-distribution with a smoothing factor s and a mass-to-light ratio M/L, we obtain an accurate reproduction of the observations. The SL *only* mass estimate for the whole group agrees with independent weak lensing mass estimate of the group. Interestingly, this shows that a SL *only* analysis (on scales of 10") can constrain the properties of nearby objects (on scales of 100"). This SL *only* analysis provides strong hints for a bimodal mass distribution and a merger scenario. This has been recently confirmed by the spectroscopic survey of galaxy group members and by the X-ray follow-up. Actually, this is the first object at 10^{14} Mo presenting '*bulleticity*' (separation of X-ray gas and dark matter/light).



Strong lensing modelling: An Elliptical Isothermal Potential Centred on the Bright Galaxy ?
No way: rms=0.4", Chi2_red=29, ell ->0.6
Main arc at 5" from the galaxy whereas counter image (1.4) at 8"
Perturbed Lensing Configuration !

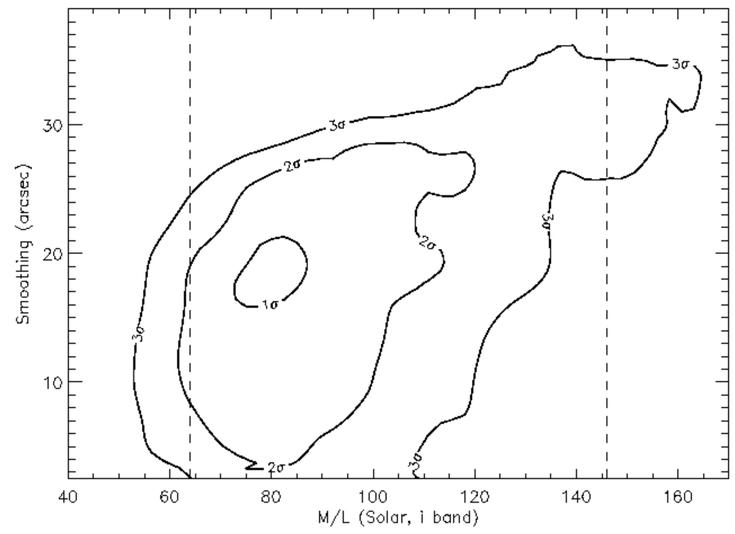


Taking into Account the External Mass Perturbation ?
From the Light Distribution (Mass is Traced by Light) : Mass and Smoothing Scale Luminosity Map → Mass Map [M_{ext}] (Jullo & Kneib 2009)



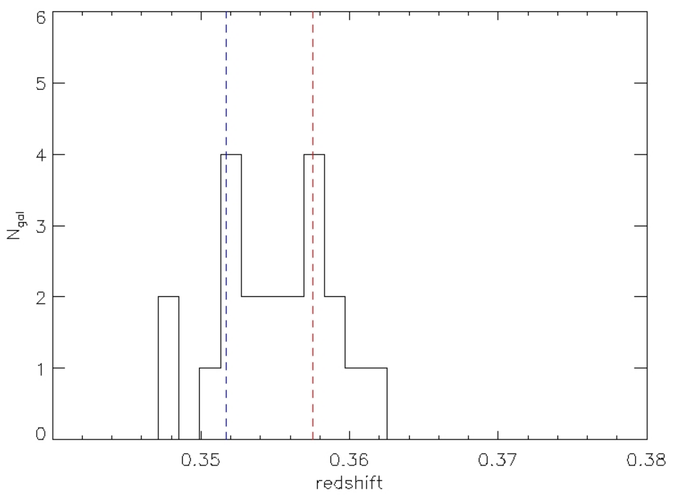
A Bimodal Light distribution

Perturber ? The lens is embedded in a galaxy group,
It is not located at the group centre

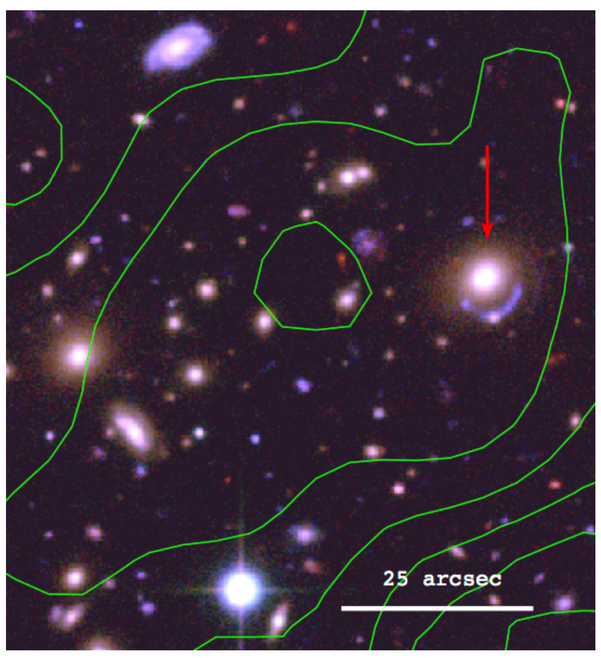


Good SL fits obtained for a range (s, M_{ext})
→ Constraints on the *Whole* Group
Agreement with independent Weak Lensing Mass estimate (dashed lines)

SL *only* analysis is able to constrain the mass of the *whole* group. Due to the perturbed SL system → strong hints for a bimodal mass distribution and a merger scenario. Confirmation from Spectroscopy and X-ray follow up.



FORS 2 spectroscopy of ~20 group members
Bimodality in velocity space (Munoz et al., 2012)
Further evidences for a merger scenario



SL2S J08544: The *Bullet Group*

XMM X-ray follow-up
(green contours shows the peak of the X-ray emission in the 0.5-2 keV band) :
The merger already took place !
It is the *first* object in the 10^{14} Mo mass scale presenting a clear separation between the Xray gas and dark matter/light component

(Gastaldello, Limousin et al.)