Combining Weak and Strong Lensing in Galaxy Cluster Mass Reconstruction

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Gravitational lensing

- Slight image distortions of background galaxies.
- Galaxies also carry intrinsic ellipticity.
  ⇒ Weak lensing has to be treated statistically.

- Strong distortions of background galaxies to giant arcs or even rings.
- Takes place only near the core.
  ⇒ No reconstruction on full scale possible.
In our reconstruction method we try to combine the advantages of both lensing regimes into a joint method:

- Fully non-parametric, adaptive grid method (no initial model necessary).
- Reconstruction quantity is the lensing potential $\psi$.
- Maximum-likelihood method. We are searching for that lensing potential which is most likely to have caused the observations:

$$\chi^2(\psi) = \chi^2_w(\psi) + \chi^2_s(\psi)$$

- Input data are:
  - Ellipticity catalogue
  - Arc positions
  - Flexion catalogue (given a reliable measurement, work in progress)
  - Multiple image positions (Bradač et al. 2005-08)
- $\chi^2$-function is the minimised with respect to the potential on every grid position.
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The Reconstruction Method  
(JM et al. 2009)

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(Meneghetti et al. 2008)

- Use shapelet decomposition of real galaxies ($\sim 10000$ from HUDF (b,v,i,z) and $\sim 3000$ from GOODS (z)).
- Use simulated clusters or analytic profiles to add lensing.
- Add sky background, instrumental noises and the PSF.
- Produce a mock observation for different instruments.
(Meneghetti et al. 2008)

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A Realistic Test: g72  
(Meneghetti, Rasia, JM et al. 2009)