Strong Lensing Legacy Survey.

Einstein Rings in the CFHT Legacy Survey

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http://www.cfht.hawaii.edu/~cabanac/SL2S/
Introduction

*DM halos mass function (from N-body)*

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*Recipes for baryon physics (eg HOD)*
Galaxy-scale strong lensing systems are useful for:

Properties of Elliptical Galaxies

- Small scale dark matter content
- Formation scenarios (dry merger, dissipation...)
- Evolution over cosmic time

Cosmological Parameters through:

- Statistics
- Cosmography (distance ratios $D_{ls}/D_s$)
- time delays (with lensed galaxies??)
The Sloan Lens ACS Survey has been providing us with the largest sample of low redshift lens galaxies ($N \sim 80$). Limited by SDSS depth.

How can we go beyond $z \sim 0.4$?

No suitable spectroscopic survey yet.

No suitable space-based survey for the next 10 years...

Must look into deep, multiband, good seeing wide field survey.

We can push the quest toward higher redshifts with CFHTLS imaging data.
Distribution of splitting angles (2x Einstein radius) Oguri 2006

Predicted $n / 1 \text{ sq}^o$
- Galaxies $\rightarrow$ ~10
- Groups $\rightarrow$ 1
- Clusters $\rightarrow$ 0.4

Expected in CFHTLS
- Rings $\sim$ 1500
- Groups $\sim$ 150
- Clusters $\sim$ 70

Visual inspection and identification of lenses: Cumbersome! Quantitative predictions? Reproductibility of results? We need automated detection procedures

**Arcfinder @ group/cluster-scale (Alard 2007)**
**Ringfinder @ galaxy-scale (Gavazzi et al, in prep.)**
a) **Lens-oriented**: Needs "targets"

   Early-types from multicolor (photoz) ($i<22.5$)

**GOAL**: find faint blue background sources embedded in bright red foreground lenses.

b) **Lens subtraction**: Tune $\alpha$ such that lens vanishes in a (Blue $- \alpha$ Red) image and analyse residuals.

c) **Selection in size, shape, orientation, multiplicity**

   Per deg$^2$ at stage a) 3000 targets

d) **Eyeball classification or direct follow-up.**

   b-c) 50-200 with residuals

d) **visual inspection**: ~10 candidates
HST Snapshot confirmation follow-up

C15 - 50 ACS orbits, 2 observed, 2 confirmed

C16 - 130 WFPC2, 15, 7, 5?.... STILL IN PROGRESS

C17 - 100 WFC3 (F475X,F600LP) awarded...
Keck LGSAO confirmation follow-up

Keck LGSAO K-band observations of 9 systems: 3 ruled out, 6 inconclusive. Unfortunately, blue-selected rings are too faint at 2μm. WE NEED BLUER AO
Spectroscopic follow-up

Lens and source redshifts being measured at Keck and VLT.
Hard work since blue residuals have $g_{AB} \sim 24-25$.
So far, about 10 observed.
Conclusion

In T04 CFHTLS data release (125 deg$^2$ in gri, ~50 in ugriz)

about 210 candidates among which ~80 are selected for confirmation follow-up
26 re-observed, of which ~8 confirmed (models in progress)
~15 inconclusive (WFPC2 snap or 2$\mu$m AO not optimal,
C17/WFC3 will do a lot better)

If confirmation rate conserved or slightly improved to 50%: we could have ~40 definite
SL2S systems by the end of C17.

Many more 0.4<z<1 lens galaxies well suited to build a high redshift comparison sample.

Search of multiply-imaged extended galaxies around massive elliptical is possible from the
ground… certainly not complete though.