The LSST will obtain hundreds of images of 20,000 square degrees, integrating to 26.5 AB mag in each of 5-6 bands. Photometric redshifts will be available for the ~3 billion detected galaxies. The data set will provide deep multicolor photometry and variability monitoring. One of the many strengths of the LSST will be its ability to use strong gravitational lensing to study dark matter distributions on galaxy and cluster scales.

### Finding Rare Lenses

The unprecedented combination of depth and area provided by the LSST will be exploited to find rare alignments, such as clusters in which background sources are lensed into multiple images. By sampling the gravitational potential at several radii in these systems, the LSST imaging will allow accurate, high-angular resolution reconstructions of cluster mass distributions. Our simulations predict that the LSST dataset will provide at least an order of magnitude increase in the number of such systems known. Other rare lensed image configurations will provide important insights into cosmography and source astrophysics. These include multiply-imaged supernovae, multiple-plane lensing, and unusual strong lenses with higher-order catastrophes.

### Galaxy-scale Lenses

In addition to the rare cluster lenses that will be found in the LSST survey, the survey images will produce at least an order of magnitude increase in galaxy-scale lenses. Our simulations predict that the final stacked data set will contain approximately 5000 detectable cases of a background galaxy being multiply-imaged by a foreground system. In addition, we predict that there will be ~150 systems in which the lensed objects are AGN or quasars and the lens system can be identified in one-epoch image with an integration time of 20 seconds (assuming seeing of 0.7 arcsec). This number increases to ~1500 systems if the seeing is 0.4 arcsec. Figure 5 shows a Keck R-band image of the CLASS B1600+434 lens system, a double with a separation of 1.4 arcsec. More generally, with shapes and redshifts of billions of source galaxies LSST will measure the compact dark matter distribution on these scales with precision.

### The Time Domain

The LSST strategy of repeated imaging of the survey area will provide automatic monitoring of these lensed sources. Burud et al. (2002) have shown that it is possible to use a joint deconvolution method (the MCS method; Magain, et al. 1998) to extract accurate photometry in ground-based optical monitoring of arcsecond-separation lenses (Figure 6). The resulting light curves can be used to measure the difference in light travel time along the rays producing the multiple images of the background source. These time delays can either be combined with a well-constrained model of the lensing galaxy to produce a measurement of the Hubble Constant or, conversely, be combined with a knowledge of the Hubble Constant and model constraints from space-based imaging to provide a sensitive probe of the overall matter distribution in the lensing galaxies. Furthermore, these systems can provide information on the clumping of matter on sub-galaxy scales, through the investigation of flux-ratio anomalies and time-domain variations due to microlensing (Figure 7).

### Cosmography from time delays

In the several hundred special lenses of the sort shown on the left in Figure 4, there will likely be a few supernovae in the source galaxy. The resulting multiple time delays will be measured by LSST and, together with the strong and weak lens mass tomography, will lead to an independent measure of geometry. Since the times of the subsequent bursts are predictable, SN astrophysics could be addressed with JWST etc. targeted observing.