The properties of lenses and sources in the CASSOWARY survey

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We investigate the strong lensing effect to explore the properties of lensing galaxies and lensed faint sources at redshifts between 1.5 and 3.0 (Kostrzewa-Rutkowska et al., 2014). Our sample consists of 9 strongly-lensed galaxies discovered by the Cambridge And Sloan Survey Of Wide ARcs in the skY (CASSOWARY) in the Sloan Digital Sky Survey (SDSS) data. We find that despite some limitations of the original SDSS data, the homogenous sample of lensing systems can provide a useful insight into lens and source properties. The magnification extends above 5, hence we are able to analyse potentially smaller and less massive galaxies at high redshifts. We study the relative alignment of mass and light in fitted lens profiles and the size-mass relation for sources.

The CASSOWARY survey was developed to search for multiple blue companions (or arcs) separated by a few arcseconds from luminous red galaxies (Belokurov et al., 2009). The typical CASSOWARY system consists of a star-forming galaxy at $z \sim 1-3$ strongly lensed by an early type galaxy at $z \sim 0.2-0.7$. The current CASSOWARY catalogue includes more than 50 spectroscopically confirmed lens systems. The CASSOWARY lenses are the ideal homogenous sample for studying the statistical properties of the lens and source galaxies.

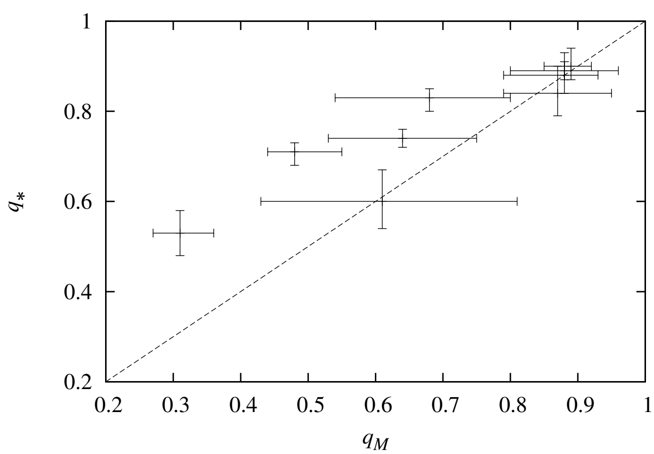

Fig. 1: The correlation between lens axis ratio of the mass (q_M) and of the light distribution (q_*). The light distribution generally follows the mass distribution in the CASSOWARY sample ($\langle q_M/q_* \rangle = 0.89 \pm 0.15$).

Figure 1 compares the ellipticity of the mass model to that of the stellar component of the lens. Previous studies showed that the relation between light and mass ellipticity should be linear. For the CASSOWARY sample we found $\langle q_M/q_* \rangle = 0.89 \pm 0.15$ that is not significantly different from the earlier results.

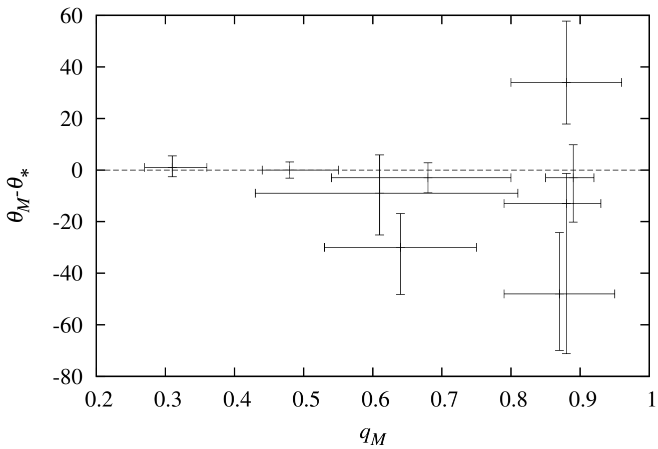

Fig. 2: The angular offset between the major axis of the lens mass distribution and that of the light as a function of axis ratio of the mass distribution.

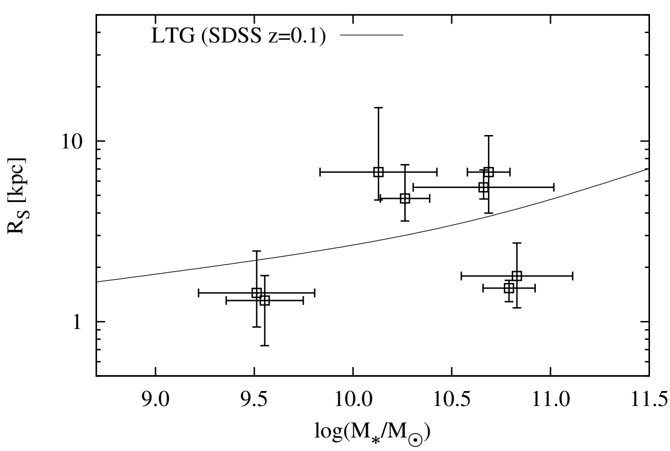

Fig. 3: Size-mass relation for 8 CSWA lensed source galaxies with known redshifts (large squares with error bars). For comparison we present the size-mass relation for late-type galaxies in local Universe from Shen et al. (2003) based on the SDSS galaxy sample. The stellar masses were computed using the spectral energy distributions converted to a Chabrier IMF normalization.

Koopmans et al. (2006) showed for the SLACS sample that $\langle q_M/q_* \rangle = 0.99 \pm 0.11$ and Gavazzi et al. (2012) presented for the SL2S sample significant more dispersion $\langle q_M/q_* \rangle = 0.95 \pm 0.48$. However, for the vast majority of systems the lens mass ellipticity is slightly larger than the light ellipticity distribution. We also find that the position angles of the mass (θ_M) and light (θ_*) are well aligned (Fig. 2).

Our source sample is a set of galaxies at redshifts between 1.5 and 3.0. In Fig. 3 we explore the size-stellar mass plane. We find that the stellar masses (M_*) of sources span a range of stellar masses typical of star-forming galaxies at these redshifts. It is clearly not possible to obtain a reliable parametrized stellar mass-radius relation due to the very low sample size and large uncertainties in the mass profiles. The uncertainties in source masses are caused by using low resolution data and indirect fitting of source light profile. However, we can confirm that the extended sample from low resolution data will be useful in similar studies.

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