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Microlensing scale estimation for 190 lensed quasars

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Gravitational lens occur when the light emitted for a background source is deflected by a mass potential in its path. One kind of configuration that has multiple cosmology applications and, in particular, is useful to study quasar structure is known as gravitational lens quasar, in which the source corresponds to a quasar and the lens corresponds to a galaxy. One of the problems for the strong lensing modeling of these systems is that the image fluxes could be affected by microlensing produced by stars in the lens galaxy. We present the automatic modeling of 190 systems to obtain an homogeneous modeled sample, and reduce systematic errors in lens parameters arising from different mass profiles. These models are used to estimate the microlensing timescales, i.e. the timescale in which the source crosses the Einstein radius of the microlens. We found median Einstein radius crossing time scales of 22 years, and median source crossing time scale of 8.5 months. This means that in ~ 10 years part of the sources will be on the caustics (i.e. affected by microlensing), and the other part will be quiescent.

To estimate those time scales, we develop an automatic pipeline to model all known gravitationally lensed quasars. We used the photometry, astrometry, and redshift of each lensed quasar images as well as the lens galaxy (with assumed redshift in case it is unknown) to build our database and applied the software *LENSMODEL* (Keeton, 2011), well tested by the community. For each system, a summary of the steps in our pipeline is:

1. A mass distribution is selected based on the number of images of the system.
2. The model is accepted if the separation between the observed image positions and those estimated by the model are less than 0.01 arc seconds (median of the sample's astrometric errors).
3. If the model is accepted a Markov Chain Monte Carlo it is used to estimate the posterior of the parameters.
4. If the model is rejected, the next step is to increase its complexity by adding an external shear and return to step 1.

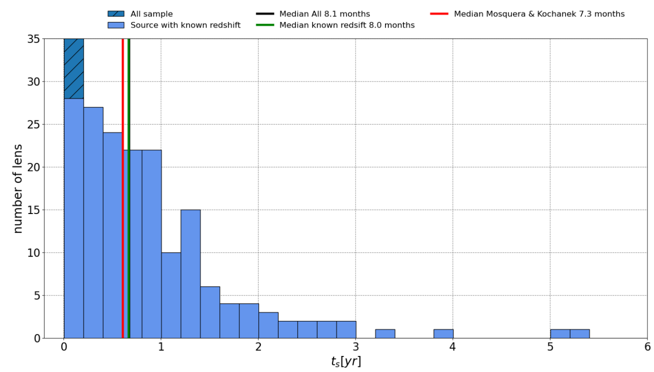

Figure 1. Histogram of t_S (unknown lens redshifts in dark blue) where the lines represent the median value obtained previously (red), the median for all the sample (black), and the the median for those systems with known lens redshifts (green).

The time scale, t_E, is defined as the time it takes the source to cross the Einstein radius of the microlens (R_E), defined as:

$$t_E = \frac{R_E}{v},\ R_E = D_{OS}\sqrt{\frac{4GM_\star}{c^2}\frac{D_{LS}}{D_{OL}D_{OL}}} \quad (1)$$

The other time scale is associated to short time variations, the so-called crossing time scale t_S, which is defined as the time it takes the source to cross its own diameter:

$$t_S = \frac{R_S}{v}, \quad (2)$$

being R_S the radius of the source and v the effective velocity of the source relative to the lens. This velocity has three components that correspond to the motions of the observer, the lens, and the source (see Mosquera & Kochanek (2011)).

We applied the analysis to a sample that is the double of previous studies, and obtained a median source crossing time of 8.5 months.

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