Transverse velocities of multiply imaged QSOs from microlensing parallax

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Abstract

Multiply imaged quasars are, in many ways, unique astronomical objects. This talk will describe how photometric monitoring of microlensing variability observed in some of these sources can be used to estimate the transverse velocity in the system via measurements of an annual parallax effect. Within the Galaxy, the annual parallax detection has produced a number of interesting results. However, the methods used to describe the effect in this case are based on an assumption of a simple lens configuration that is not an adequate description for multiply imaged QSOs. The high optical depth due to microlensing observed in these systems makes any attempts to model the light curve in exact detail hardly possible. One therefore has to introduce some approximations. A natural choice in this case is to consider Taylor expansion of the magnification as a function of observer's position and restrict oneself to its first few terms. Parallax parameters one obtains by fitting the observed photometry can then be used to determine the transverse velocity in the source-lens-observer system – at least, when the multiplicity of the quasar exceeds two. This procedure and different ways to incorporate other information about the system will be described in the talk, along with a discussion on how the validity of the method can be tested. This analysis is then extended by asking the question what are the systems where the transverse velocity can be most easily measured. It turns out that the answer, and especially the relation between the lens and source redshifts depends sensitively on the photometric accuracy. A number of other factors will also be identified. There will also be given the results of an application of this method to OGLE-II release of data for QSO 2237+0305 – a publicly available dataset of a suitable accuracy and coverage. However, the geometry of the system is highly unfavourable and the method fails for this system giving a value for the transverse velocity projection – (15 ± 10) km/s if attributed to the galaxy or (420 ± 300) km/s if attributed to the source – that is unreasonably low. The talk will be concluded with a short discussion on possible developments of the technique and an outlook into the future.