Orbital constraints for young low-mass visual M-dwarf binaries

Abstract

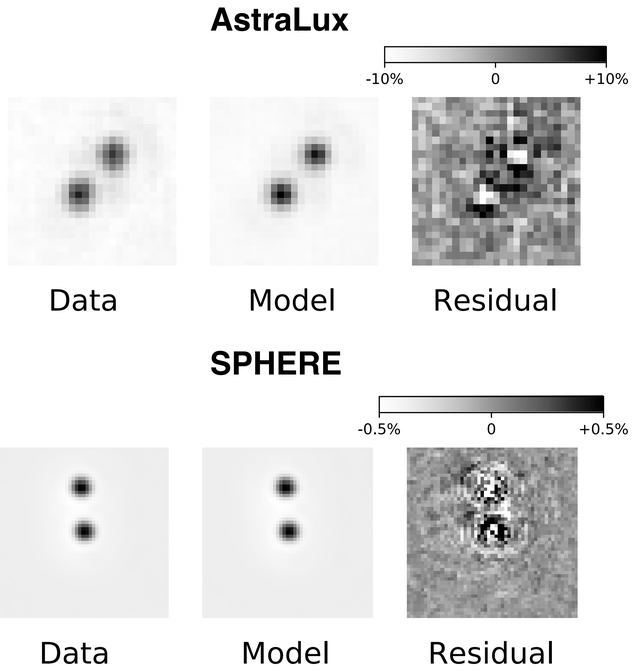
We have procured astrometric epochs for 15 low-mass visual M-dwarf binaries for which we are able to place orbital constraints. From the Keplerian motions of the binaries we are able to extract dynamical masses, which will be compared to current state-of-the-art theoretical evolutionary models. The dynamical masses will eventually be used for constructing empirical models, and to improve isochronal dating of young moving groups and associations. Here we present the current status and the preliminary results from the survey.

Main Contributors

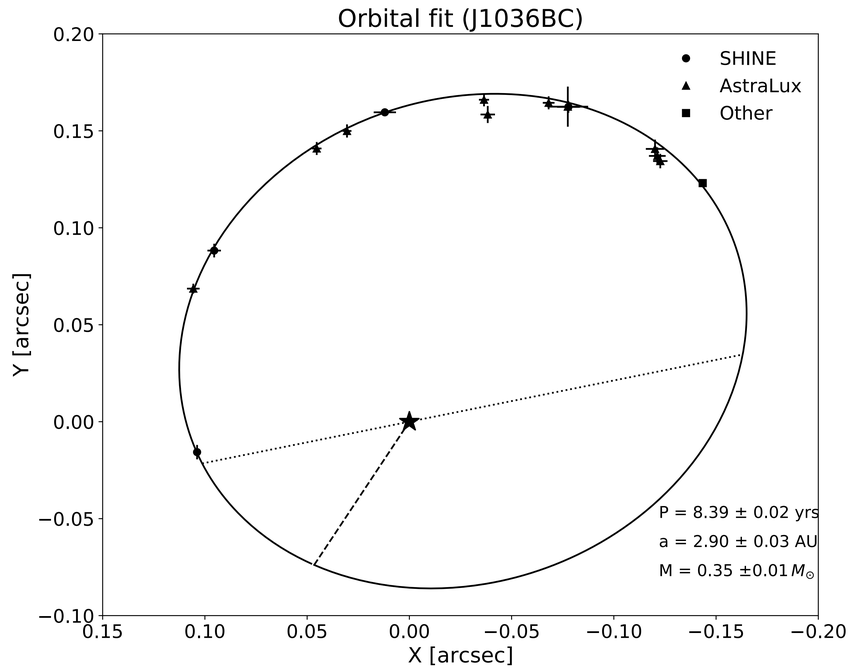
AstraLux team
SHINE collaboration

Current status

15 binaries with orbital constraints for which:
- 12 binaries have unplublished orbits.
- 9 orbits are of good or excellent quality with >180^{o} orbital coverage.
- 8 binaries have high probabilities to belong to young moving groups according to the BANYAN Sigma tool (Gagné et al. 2018, ApJ, 856, 23).

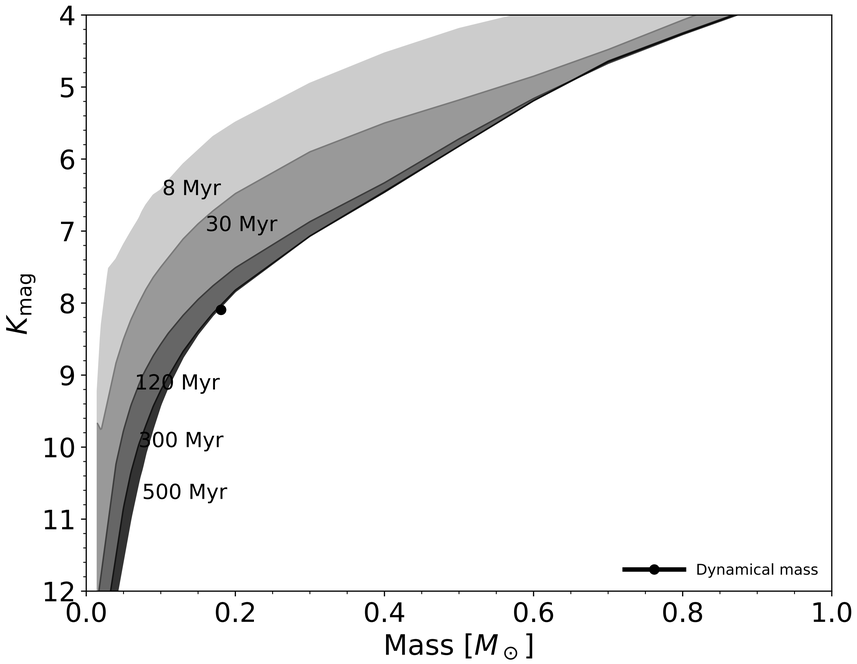


Relative astrometry is obtained by subtracting a model system from the observed data, utilising a grid-search approach in *x*- and *y*- positions as well as brightness scaling for the components until a minimum residual is obtained. The figure depicts the typical quality of the two major contributing sources of data for the survey, with a precision on the order of a few milliarcseconds.



Preliminary orbital fit for the 2MASS J10364483+1521394BC binary. The majority of the astrometric epochs are obtained from using the Lucky Imager AstraLux, located at the 2.2m telescope in Calor Alto and on the 3.6m New Technology Telescope in La Silla, as well as the high-contrast imager SPHERE at the Very Large Telescope in Paranal.

The astrometric epochs span from 2006 to 2019 for the system, covering more than one full orbital period.



Mass-magnitude diagram showing isochrones from the BT-Settl-CIFIST 2011-2015 evolutionary models (Baraffe et al. 2015, A&A, 577, 42) and the individual dynamical mass we obtain for the 2MASS J10364483+1521394BC binary pair. The symbols for the binary share the same space due to the components being of equal brightness and mass.

The newly constrained and updated dynamical mass is consistent with the theoretical mass obtained from assuming the system to be a member of the ~400 Myr old Ursa Major association (Jones et al. 2015, ApJ, 813. 58).

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