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Orbital solutions for the OSSOS binaries

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Abstract

The OSSOS Survey discovered more than 800 Trans-Neptunian Objects between 2013 and 2017. Among them were at least 5 binaries. We here present orbital solutions for binary objects, based on OSSOS images, supplemented by additional surveys. We obtained the orbital solutions thanks to a Markov Chain Monte Carlo algorithm, in a 6-dimensional phase space. These orbital solutions permitted us to constrain the masses and densities of the involved objects.

1 OSSOS

OSSOS, for Outer Solar System Origins Survey, is a wide-field imaging program, which operated between 2013 and 2017, with the 3.6-m Canada-France-Hawaii Telescope. It surveyed 155 deg^2 of sky up to the magnitude 24.5, and detected 952 objects. Among them are 843 discoveries, which orbits around the Sun have been accurately determined [1]. Among them are at least 6 binaries [2].

2 The OSSOS binaries

This table gathers the 6 binary TNOs involved in our study. The last 4 of them were discovered by OSSOS.

For all of them, we not only dispose of OSSOS images, taken with the CFHT/MegaCam instrument, but we also supplemented our collection with images from different surveys, in which the object is present.

On each of them, we modelled the Trailed-point Spread Function of the two components of the binary object, which takes its motion into account during the exposure. We deduce from it the location of the center of mass of the main component of the binary, the angular separation between the two components, and the orientation of the second with respect to the first one.

Table 1: The 6 binary objects involved in this study. The orbital elements, i.e. semimajor axis, eccentricity and inclination, are osculating orbital elements at Epoch 2458600.5, given by the JPL small-body database browser.

Object	Sma	Ecc.	Inc.
2001 XR254	42.79 AU	0.037	1.23°
2002 VD131	44.95 AU	0.066	0.86°
2013 SQ99	44.12 AU	0.095	3.47°
2014 UD225	43.28 AU	0.133	3.66°
2015 RR245	81.37 AU	0.583	7.58°
2016 BP81	43.62 AU	0.078	4.19°

3 Fitting their mutual orbits

Once the astrometric data have been derived from the images, we dispose of a set of positions, from which we fit a mutual orbit. Given the accuracy of the data, we fit orbital solutions in using an algorithm based on a Markov Chain Monte-Carlo method. The fit is made in a 6 parameters phase space, to get the 6 required orbital elements. These orbital solutions contain the orbital period, which is itself an information on the total mass of the binary. This directly gives its density, and insights on its composition.

Acknowledgements

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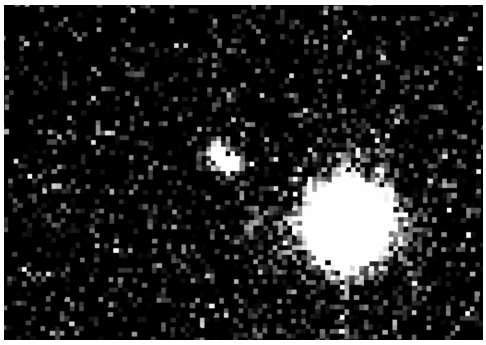

Figure 1: A binary object (center of the image) detected by OSSOS.

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