

Dynamical masses of the low-mass triple TWA 5

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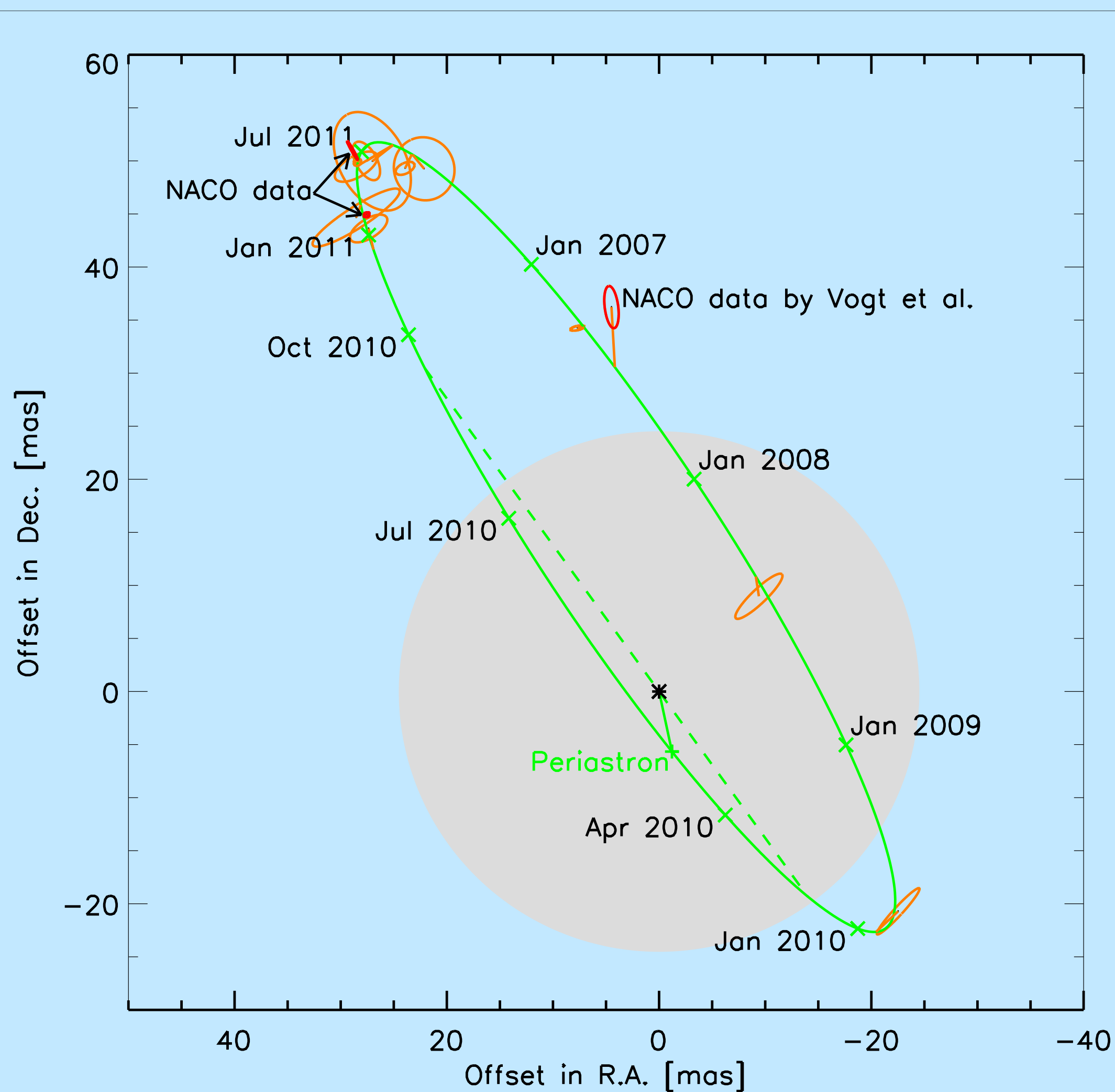
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Introduction

TWA 5 is one of the five original members of the TW Hydrae association. It is composed of a pair of low-mass stars (spectral type M1.5) and a brown dwarf ($\sim M8.5$). The short orbital period of the close pair (6 years) makes it an ideal target for a dynamical mass determination. Its semi-major axis of only 60 mas, however, makes it a challenge to spatially resolve the binary, even on large telescopes.

Konopacky et al. (2007, AJ 133, 2008) presented an orbital solution for the inner binary, based on data collected with the 10 m-Keck-Telescope. Vogt et al. observed TWA 5 in 2007 with NACO at the VLT in the K-band, where the diffraction limit of the telescope is larger than the separation of the binary.

We observed TWA 5 in the H-band in January and May 2011, and resolved the close binary.



Astrometric measurements of TWA 5Aa+b and the best orbital solution. Data from Konopacky et al. are shown in orange, new NACO data are red. The grey circle marks separations too close for NACO. The dashed line indicates the line of nodes.

Results – the orbit of TWA 5Aab

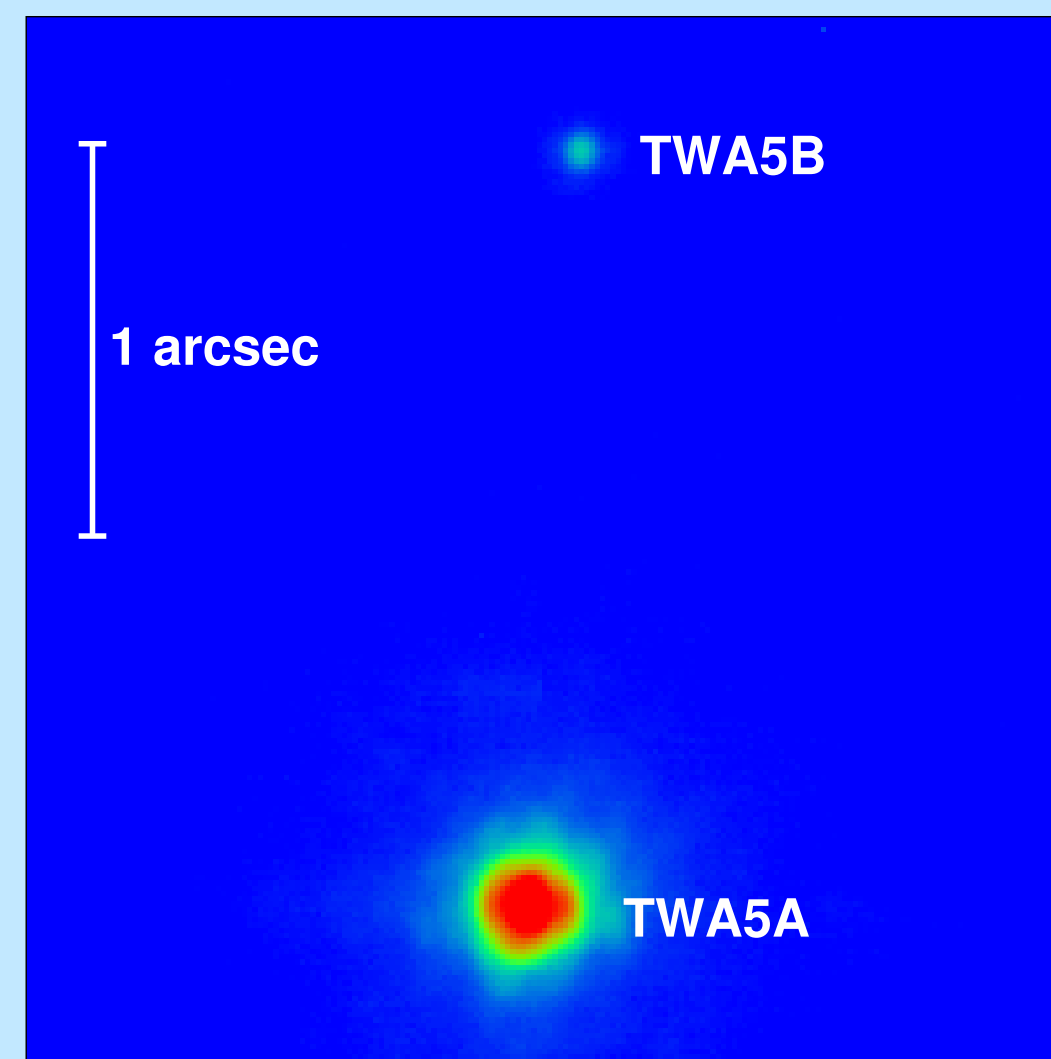
Semi-major axis: 60.6 ± 0.3 mas = 2.7 ± 0.3 AU

Period: 5.99 ± 0.02 years

System Mass: $0.53 \pm 0.15 M_{\odot}$

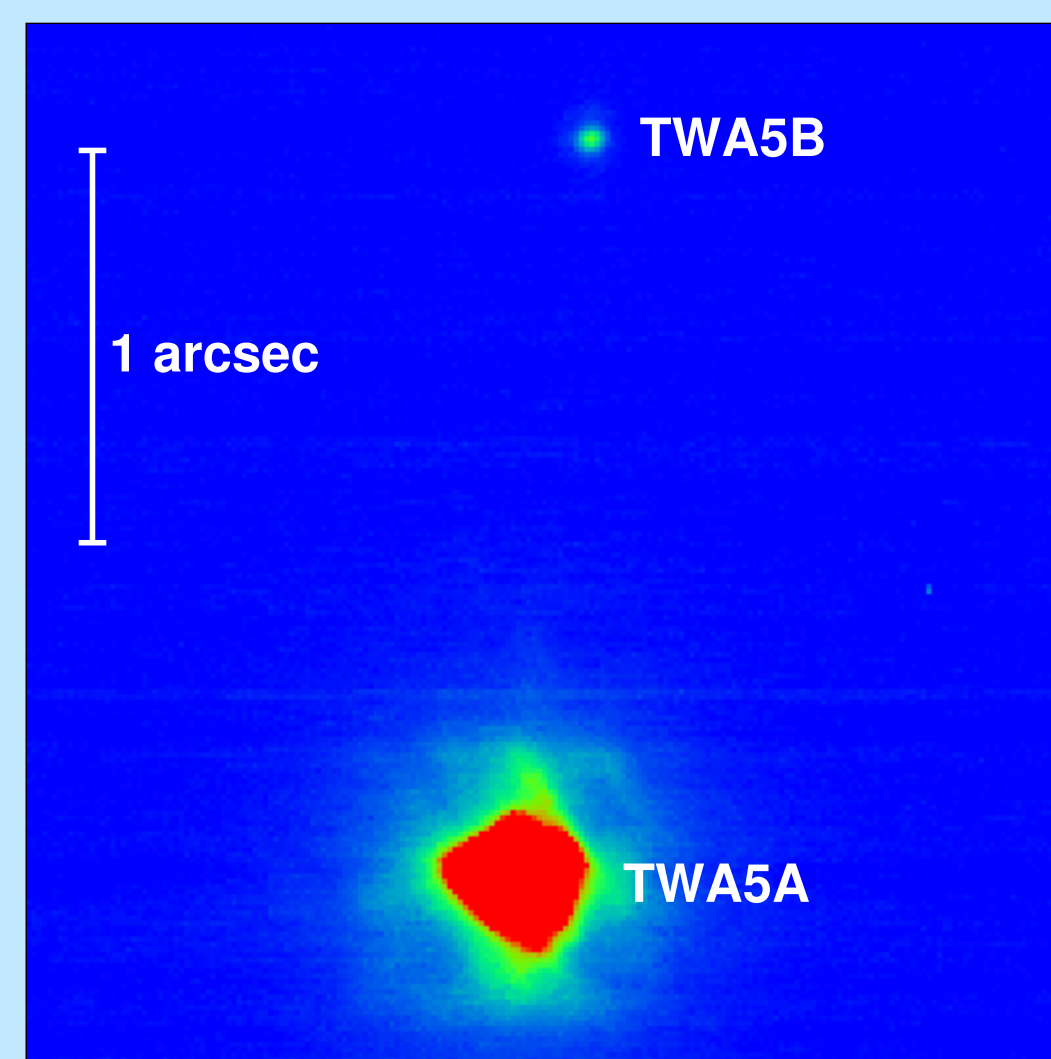
Inclination: $98.4 \pm 0.2^{\circ}$

Eccentricity: 0.720 ± 0.005



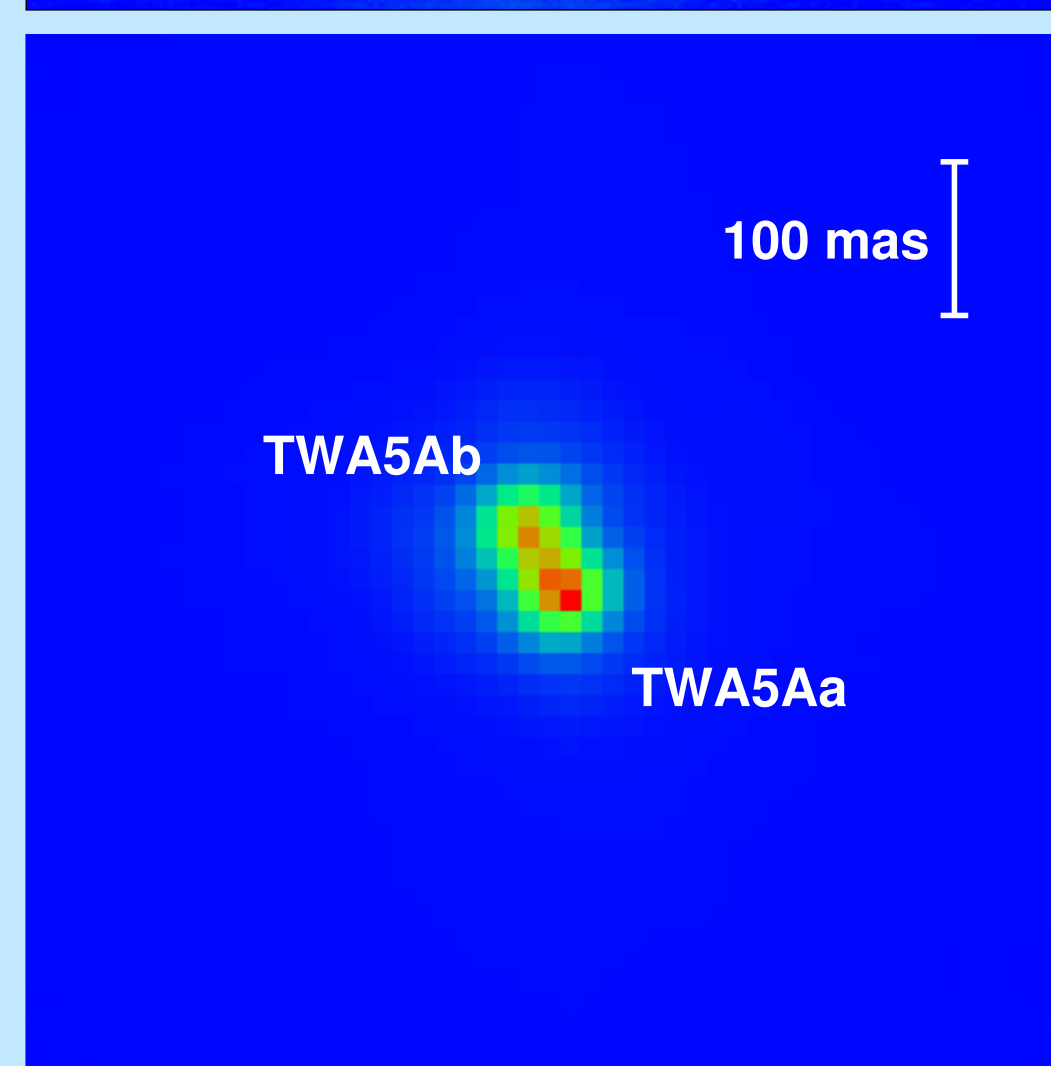
K-Band image of TWA 5A and B, taken with NACO in July 2007 (PI: N. Vogt).

The inner binary is not really resolved, but with the help of Speckle-Interferometry, we could get an estimate for the separation and position angle.



H-Band images of TWA 5, taken with NACO in January 2011.

The upper image is displayed with a logarithmic scale to show the faint companion TWA 5B.



An enlarged view of the close binary TWA 5Aa+b, shown with a linear scale. At the time of the observation, the separation was about 53 mas.

Outlook

We will continue to monitor TWA 5 and measure the positions of all three components relative to each other. The third component TWA 5B will serve as astrometric reference to determine the motion of TWA 5Aa/b around their center of mass. This will allow us to measure the mass ratio of TWA 5Aa/b and compute the individual masses of TWA 5Aa and TWA 5Ab.

We can use Kepler's third law to estimate the period of the orbit of TWA 5B. With the observed separation, we arrive at about 1100 years. Determining the orbit of TWA 5B and its mass is therefore a long-term project.