Orbits and Masses in the young triple system TWA 5

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Introduction

TWA 5 is one of the 5 original members of the TW Hydrae association.
It is composed of three components: a pair of low-mass stars, **TWA 5Aa-b**, and a brown dwarf companion, **TWA 5B**.
TWA 5Aa-b had a separation of 55 mas when it was discovered in 2000, while TWA 5B is located about 2 arcsec away.
We obtained new relative astrometric measurements of all three components with NACO at the VLT.
We use these observations and data from the literature to derive an improved fit for the orbit of TWA 5Aa/Ab around each other.
Furthermore, we use TWA 5B as astrometric reference to solve for the individual orbits of Aa and Ab. This allows us to estimate the mass ratio of Aa and Ab, and hence individual masses of the two components.

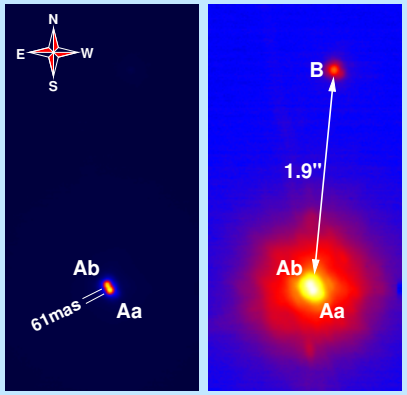
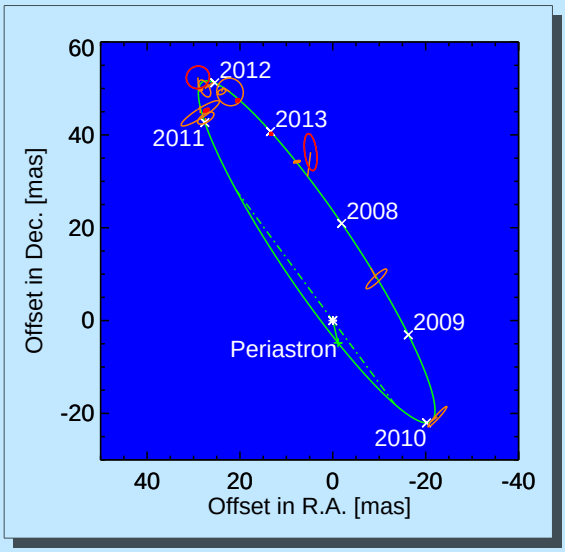


Image of TWA 5 taken with NACO in January 2012.
Both panels show the same image, on the left with a linear scale, on the right with a logarithmic scale to unveil the low-mass companion TWA 5B.

The orbit of TWA Aa-Ab

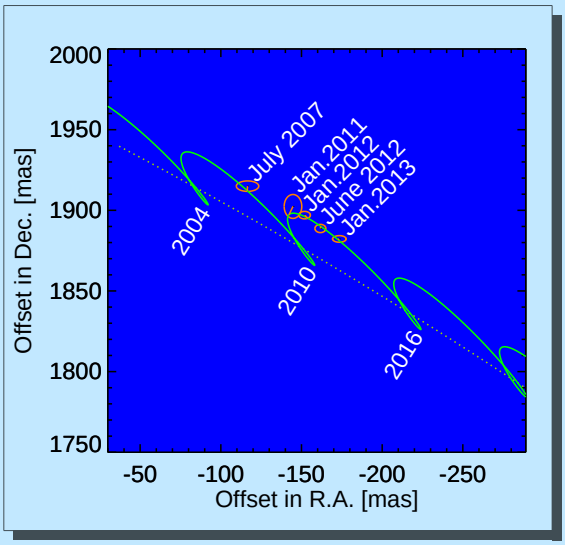


Left: The orbit of TWA Ab around component Aa.
Observed positions are marked by their error ellipses. The dash-dotted line indicates the line of nodes, the solid line the periastron. Crosses mark the expected positions at the beginning of the years 2008 to 2013.

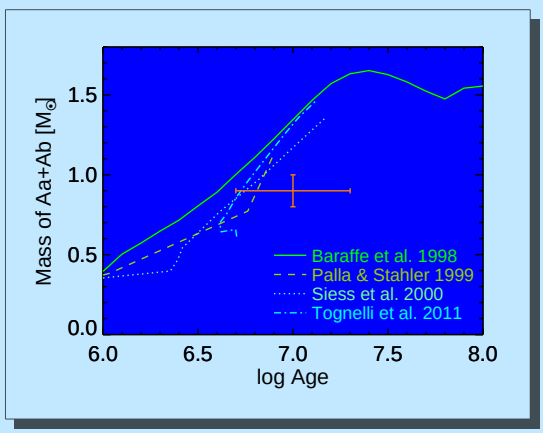
Right: The motion of TWA 5B relative to A.
Observed positions are marked by their error ellipses. The dashed line is the Kepler-orbit of TWA 5B around the center of mass of Aa and Ab.
The solid line shows the motion of B relative to Aa, i.e. the combination of the orbit of B around the center of mass, and the motion of the center of mass relative to Aa.

Semi-major axis: 3.2 ± 0.1 AU
Period: 6.025 ± 0.009 years
Binary Mass M_{Aa+Ab}: $0.90 \pm 0.10\,M_\odot$

The motion of TWA 5 B around Aa



Semi-major axis: 127 ± 4 AU
Period: 1380^{+111}_{-7} years
Triple Mass $M_{Aa+Ab+B}$: $1.1 \pm 0.1\,M_\odot$
Mass ratio M_{Ab}/M_{Aa}: $1.3^{+0.6}_{-0.4}$



Our dynamical mass(es) are in reasonable agreement with theoretical models for the pre-main-sequence evolution of stars.
The errors of the mass and age determinations are still too large to distinguish between the models.

It is a surprising result that the fainter star Ab is more massive than the brighter star Aa.
However, our measurements cover only the north-east section of the inner orbit, resulting in rather large uncertainties.
It will reduce the errors significantly if the system is observed again in 2015/2016, when Ab is in the south-west part of its orbit.

All the details are in a paper submitted to A&A.
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