

Multiplicity study of T Tauri stars in the Lupus star forming region

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Abstract. We carried out a high contrast imaging search for (sub)stellar companions of young pre-main sequence stars in the Lupus star forming region. For this project we utilized NACO/ESO-VLT, operated at the Paranal observatory. On this poster, we presented the results of this survey. In several observing campaigns we could obtain diffraction limited deep IR imaging data and detected faint co-moving companions around our targets, whose astro- and photometry was determined in all observing epochs. The co-moving companions found in our survey exhibit angular separations in the range between about 0.1 and a few arcsecs, i.e. projected separations between about 10 and a few hundreds of au, at the average distance of our targets of about 140 pc. Beside several new binary and triple star systems, whose multiplicity was revealed in this survey, also faint co-moving companions in the substellar mass regime could be identified close to some of our targets.

Keywords. binaries (including multiple): close, visual, stars: pre-main-sequence, low-mass, brown dwarfs, techniques: high angular resolution

As T Tauri stars are young only few Myr old pre main-sequence stars, they are the most favorable targets for a direct imaging search for (sub)stellar companions, because their companions are also young, and therefore self luminous, due to still ongoing contraction.

Among all known T Tauri stars in the Lupus star forming region, we have selected those as targets, which were not observed with NACO/ESO-VLT before, exhibit well known and sufficiently high proper motions, and are bright enough to be imaged at a high Strehl-ratio with NACO/ESO-VLT in the Ks-band but do not saturate the used infrared detector, most important to obtain accurate astro- and photometric measurements of the detected (sub)stellar companions.

In total, more than 60 mainly weak-lined T Tauri stars are selected as targets for our multiplicity study and deep high contrast AO imaging data could be taken in multiple observing epochs (Mugrauer *et al.* 2019). Examples for co-moving (sub)stellar companions, detected in the course of our multiplicity study around the observed targets, are shown in Figs. 1 and 2.

Reference

Mugrauer, M., *et al.* 2019, in preparation

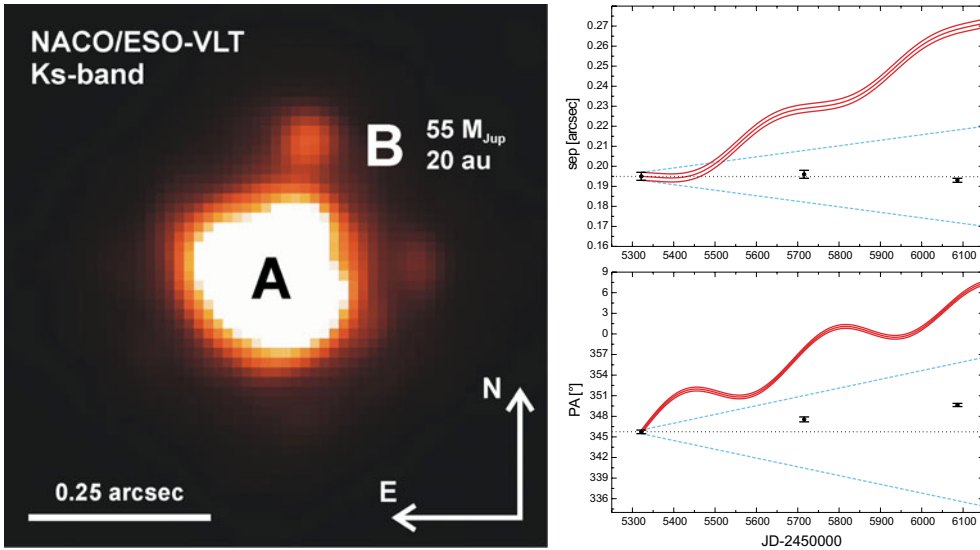


Figure 1. As example for the companions detected in our project, we show here a new brown dwarf companion imaged in three observing epochs close (only 20 au of projected separation) to one of our targets in the Lupus star forming region. As it is shown in the two plots on the right the companion clearly shares a common proper motion with its primary star and even orbital motion is significantly detected in position angle. The expected maximal change of separation and position angle due to orbital motion is shown as straight blue dashed lines. The expected change of both quantities for a non-moving background source is illustrated as red wobbled lines. Based on its infrared photometry the newly found co-moving companion exhibits a mass of about $55 M_{Jup}$.

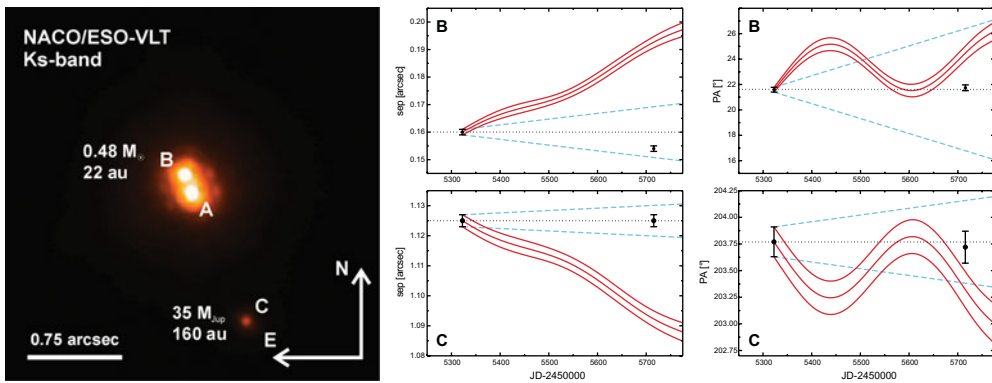


Figure 2. Here we show another example for our targets with detected co-moving companions, all identified in our high contrast imaging survey of T Tauri stars in the Lupus star forming region. This target exhibits a close bright companion (B) at only 22 au of projected separation, which is clearly co-moving to its primary star. The infrared photometry of this companion is consistent with a low-mass star of about $0.48 M_{\odot}$, whose orbital motion could also be detected in separation (see the relative astrometry of the companion, illustrated in the plots on the top). In addition to this close stellar companion we identified a further but much fainter companion (C) of the star at a projected separation of about 160 au. The detected companion is clearly co-moving with our target (as shown in the plots at the bottom) and its infrared photometry is consistent with a brown dwarf with a mass of about $35 M_{Jup}$. Hence, this T Tauri star, previously only known as a single star in the Lupus star forming region, is actually a hierarchical triple system with a wide substellar companion.