New constraints on the disk characteristics and companion candidates around T Chamaeleontis with VLT/SPHERE

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Abstract

Context. The transition disk around the T Tauri star T Cha possesses a large gap, making it a prime target for high-resolution imaging in the context of planet formation.

Aims. We aim to find signs of disk evolutionary processes by studying the disk geometry and the dust grain properties at its surface, and to search for companion candidates.

Methods. We analyze a set of VLT/SPHERE data at near-infrared and optical wavelengths. We performed polarimetric imaging of T Cha with IRDIS (1.6 mu m) and ZIMPOL (0.5-0.9 mu m), and obtained intensity images from IRDIS dual-band imaging with simultaneous spectro-imaging with IFS (0.9-1.3 mu m).

Results. The disk around T Cha is detected in all observing modes and its outer disk is resolved in scattered light with unprecedented angular resolution and signal-to-noise. The images reveal a highly inclined disk with a noticeable east-west brightness asymmetry. The

significant amount of non-azimuthal polarization signal in the U-phi images, with a U-phi/Q(phi) peak-to-peak value of 14%, is in accordance with theoretical studies on multiple scattering in an inclined disk. Our optimal axisymmetric radiative transfer model considers two coplanar inner and outer disks, separated by a gap of 0.'' 28 (similar to 30 au) in size, which is larger than previously thought. We derive a disk inclination of similar to 69 deg and PA of similar to 114 deg. In order to self-consistently reproduce the intensity and polarimetric images, the dust grains, responsible for the scattered light, need to be dominated by sizes of around ten microns. A point source is detected at an angular distance of 3.5 '' from the central star. It is, however, found not to be co-moving.

Conclusions. We confirm that the dominant source of emission is forward scattered light from the near edge of the outer disk. Our point source analysis rules out the presence of a companion with mass larger than similar to 8.5 M-jup between 0.'' 1 and 0.'' 3. The detection limit decreases to similar to 2 M-jup for 0.'' 3 to 4.0 ''.

Keywords

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