The mass and candidate planet of the AGB star L2 Puppis from ALMA and SPHERE observations

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Abstract

The nearby AGB red giant L2 Puppis is surrounded by an almost edge-on circumstellar dust and gas disk. We observed this star with ALMA as well as with SPHERE/ZIMPOL at identical, very high angular resolution ($<$ 20 mas). The ALMA spectro-imaging data cuves allowed us to resolve the radial velocity profile of the molecular disk, from which we derived the mass of the central star from its Keplerian rotation velocity ($m_A = 0.66$ Msun). Evolutionary models indicate that L2 Pup A had a near-solar main sequence mass, and is therefore a close analog of the Sun in 5 to 6 Ga. The ALMA continuum map and SPHERE images also reveal the presence of a faint secondary source (B) at a radius of 2 au. From the coincidence of the center of rotation of the gaseous disk with the position of the AGB star, we constrain the mass of the companion to be in the planetary or low mass brown dwarf regime. L2 Pup therefore emerges as a promising vantage point on the interactions between the mass-loss of an AGB star and its surrounding planetary system. This is a precious test case to study the (probable) first phases of the formation of a bipolar planetary nebula as well as the distant future of our Solar System.

Keywords: AGB, circumstellar matter, exoplanet, bipolar planetary nebula, ALMA, SPHERE

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