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Searching for Evidence of Accretion to Massive Protostars Beyond the Classical Feedback Limit

Observations on low radio frequencies have opened a new window for modern astrophysics by detecting and mapping non-thermal emission sources from relativistic accelerated particles in synchrotron radiation, a crucial indicator of accretion on stellar sources \cite{rodriguez-kamenetzky_investigating_2016}. The debate of whether the disk accretion observed in low-mass stars applies to very massive ones ($> 50M_{\odot}$) remains open \cite{mckee_theory_2007} \cite{tan_massive_2014} \cite{rosen_massive_2022}. While theoretical models suggest that material falling through accretion is their formation mechanism, observational confirmation remains challenging due to their rareness, distance and dense surroundings \cite{keto_observations_2006}. We present new high-resolution (0.11" - 0.06") multiwavelength imaging of the massive protostellar source $G45.47 + 00.05$, located at a distance of 8.4 kpc and observed with the Karl G. Jansky Very Large Array \cite{Zhang_2019}. Our study integrates archival data from the C, K, and Q bands with new observations at central frequencies of 15 and 33.2 GHz (Ka and Ku bands, respectively), achieving improved sensitivity. By combining wide spectral coverage with low and high-resolution imaging, we aim to isolate and resolve compact radio emission sources in the region, allowing for a detailed characterization of the emission from the central source and its surroundings. The radio continuum reveals an hourglass shape, marked by a central circumstellar disk, consistent with the anticipated effects of ionization feedback and its interaction with the environment. Spectral index analysis, with high and low-frequency observations, provides valuable insights into the underlying emission mechanisms, consistently revealing indications of partially optically ionized gas in both the central source and outflow. A jet candidate, detected with 3σ significance in the southern lobe, indicates the presence of two closely situated point sources. Although our current resolution does not permit individual source resolution, we analyze their combined contribution through spectral index mapping using both in-band and pixel-by-pixel methods. Results suggest this emission may originate from ionized dust clumps within a dense material envelope or from an embedded jet within a wide-angle molecular outflow. While we explore these scenarios through large-scale molecular outflow lines and maser search observations, further characterization and confirmation of negative spectral index values through proper motion or polarization analysis are crucial for drawing conclusions about the nature of the emission and direct confirmation of ongoing accretion in a recently transitioned massive source within an ultra-ionized compact region \cite{palla_pre-main-sequence_1993}.

Nivel de formación

Maestría

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