Gas and Stellar Kinematics of the Young Binary System IRAS 16293-2422 A

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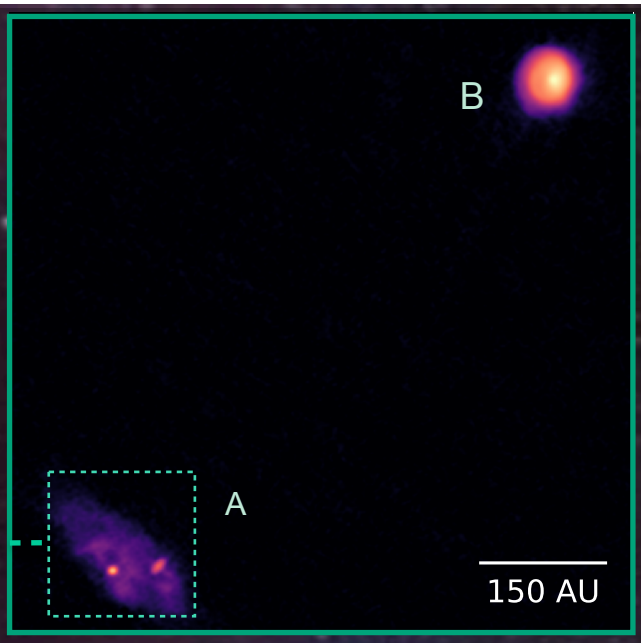
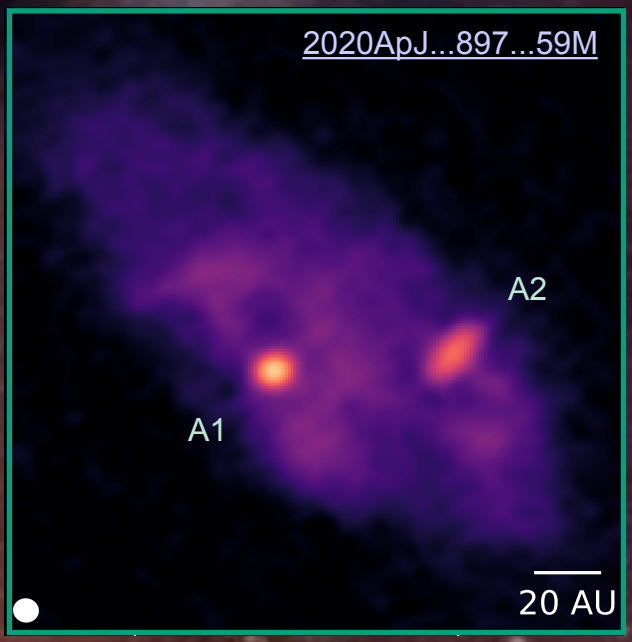
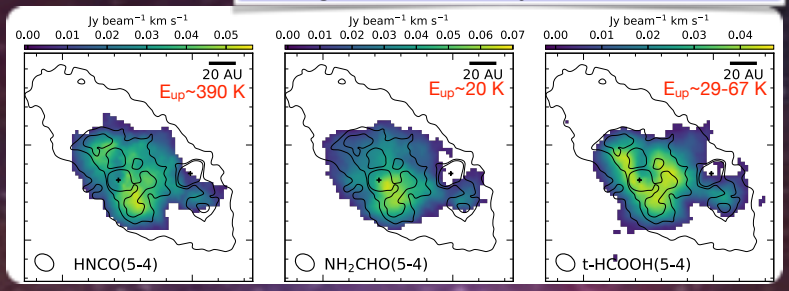
A new view of the multiple Class 0 system IRAS 16293-2422. ALMA 3 mm continuum observations with a resolution of 6.5 au finally confirm its triple nature. Source B hosts a single protostar, embedded within a 40 au across and close to face-on structure. Towards source A, two compact 3 mm sources are clearly detected. Their positions are consistent with two compact sources first seen ~ 30 years ago with VLA cm observations.





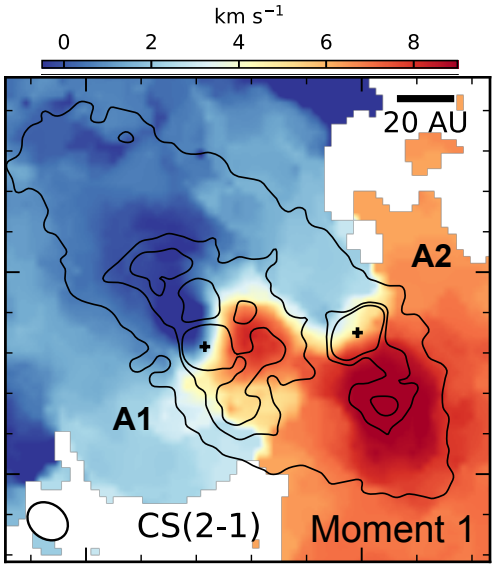
Zoom-in view of the binary source A. The bright and compact (FWHM<12 au) sources, separated by 54 au, are tracing two circumstellar disks. The semi major axis of the circumbinary structure is misaligned by 90 degrees with respect to the compact dust disks. The continuum emission also shows substructures possibly related to hot spots, also traced by lines.

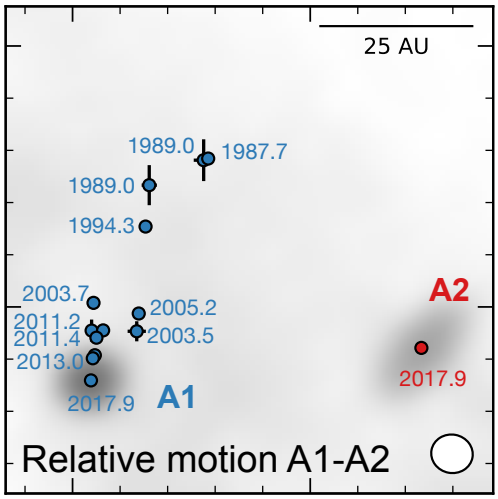
Integrated Intensity molecular lines



Molecular line distribution for source A in color. Contours show the 3 mm continuum emission. The emission from the iCOMs, typically associated with the hot corino (T > 100 K), overlaps with the lower brightness substructures seen in the 3 mm emission around the dust disks. These features might correspond to higher temperature spots and/or shocked regions.

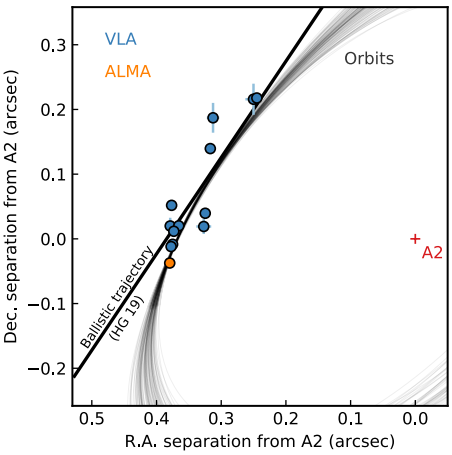
Gas and stellar kinematics





Gas kinematics (A1+A2) $2.2 \pm 0.5\ M_\odot$

Stellar kinematics (A1+A2+gas) $4^{+1}_{-1}\ M_\odot$



Left: Gas kinematics towards source A. We find that the relative A1-A2 line of sight velocity is about 3.7 km/s. The high-velocity regions close to the protostars are consistent with either Keplerian motion or streaming-like motion, both requiring individual protostellar masses of about ~1 Msun. ***Middle:*** Proper motion of A1 relative to A2. Following a linear fit, the relative velocity on the plane of the sky is about 5.2 km/s. Based on the total velocity difference and separation, we concluded that A1-A2 are bound together, and also likely bound to B. ***Right:*** Orbital fit to the stellar kinematics provided orbital parameters and a total mass consistent with the gas kinematics. The most recent positional data seem to show a turn in the orbit. Follow-up high-resolution observations are needed to further improve the orbital parameter constraints presented in this work.

Questions? Contact me for more info at ***maureira@mpe.mpg.de*** **www.mpe.mpg.de/~maureira**

References: Maureira et al. 2020, ApJ, 897, 59~ Hernández-Gómez et al. 2019, ApJ, 875, 94~Wootten, A. 1989, ApJ, 337, 858