



The dusty, molecular, and ionized environment of the SVS 13 protobinary system

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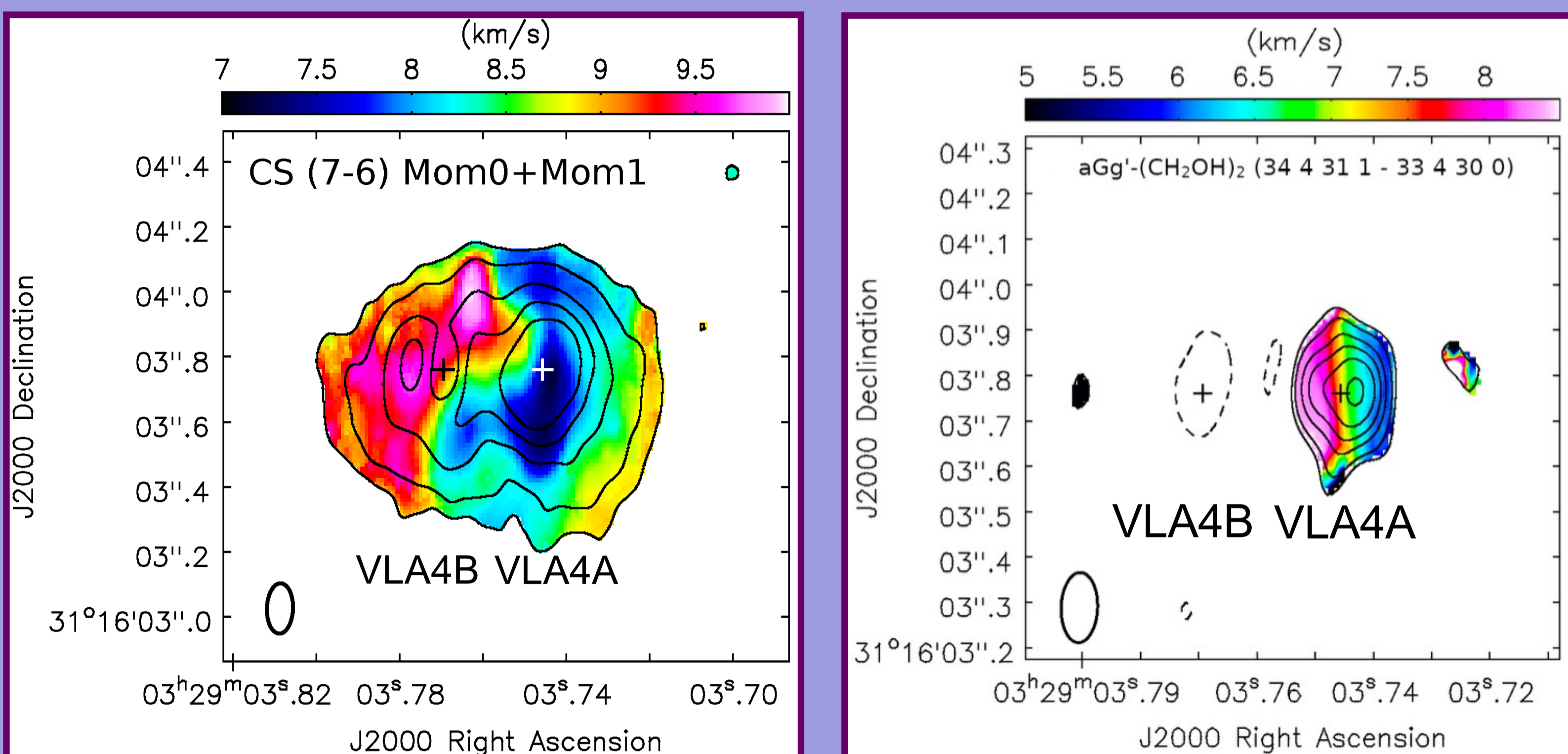


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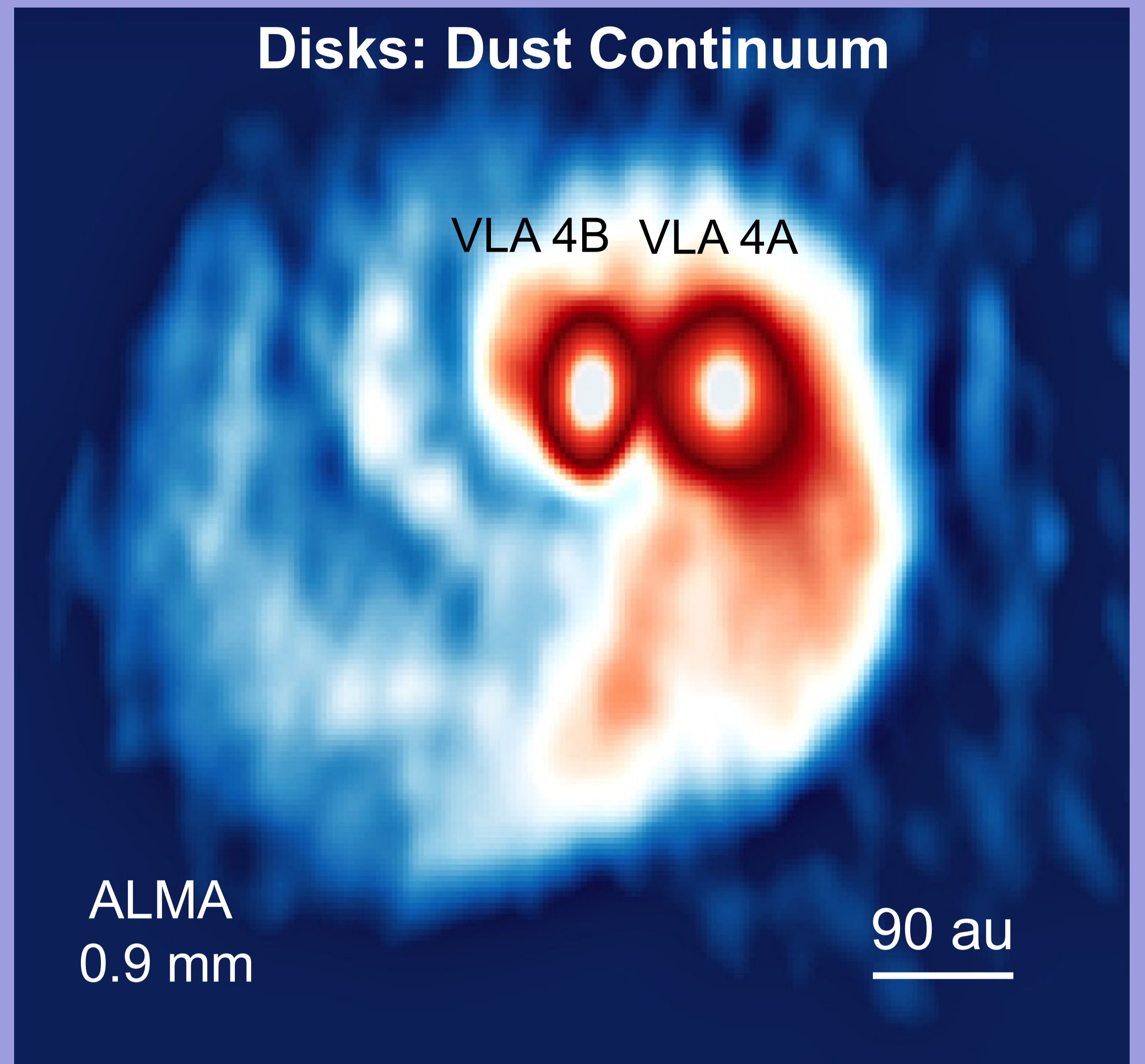
Abstract: We present a comprehensive VLA and ALMA study of the SVS 13 protobinary system (projected separation = 90 au) in NGC 1333. From our observation of dust, molecular, and ionized emission, we have derived the physical properties of the system and inferred chemical abundance variations on scales on the order of 10 au. We have imaged the jet, studied the 3D kinematics of the system, and measured the orbital motion of the two protostars and derived their masses. We have obtained images and the physical properties of two small circumstellar disks (radii of 10-12 au) and of a still-forming circumbinary disk with prominent spiral arms extending up to about 500 au.

Disks: Molecular line emission



Integrated line emission (contours) and mean velocity (color).
Left: CS emission of the circumbinary disk, showing a NE-SW velocity gradient interpreted as infall + rotation. **Right:** Ethylene glycol emission toward VLA4A showing an E-W velocity gradient interpreted as rotation in a circumstellar disk. Molecular transitions typical of hot corinos are detected toward all these disks.

Disks: Dust Continuum

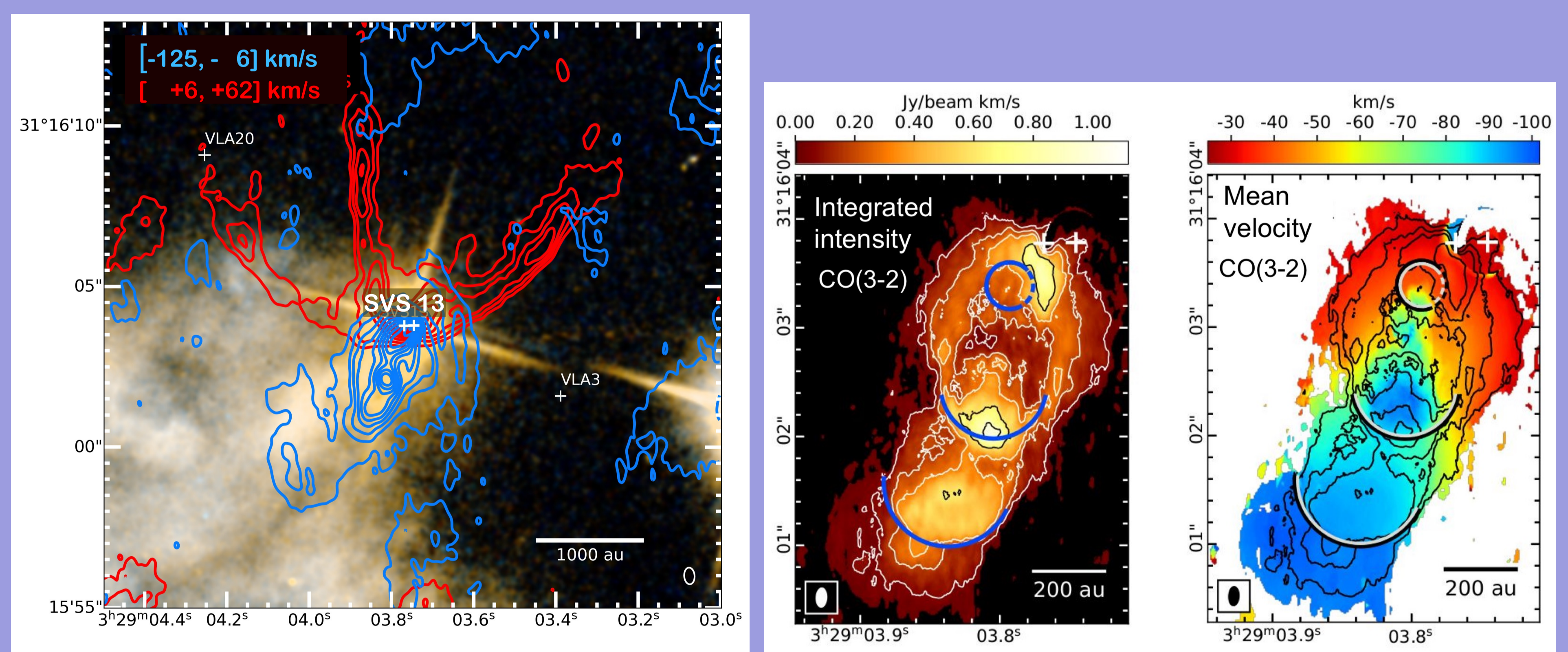


ALMA image of the dust emission of the SVS 13 disks. Two circumstellar disks and a still-forming circumbinary disk with prominent spiral arms.

PROPERTIES OF THE DISKS

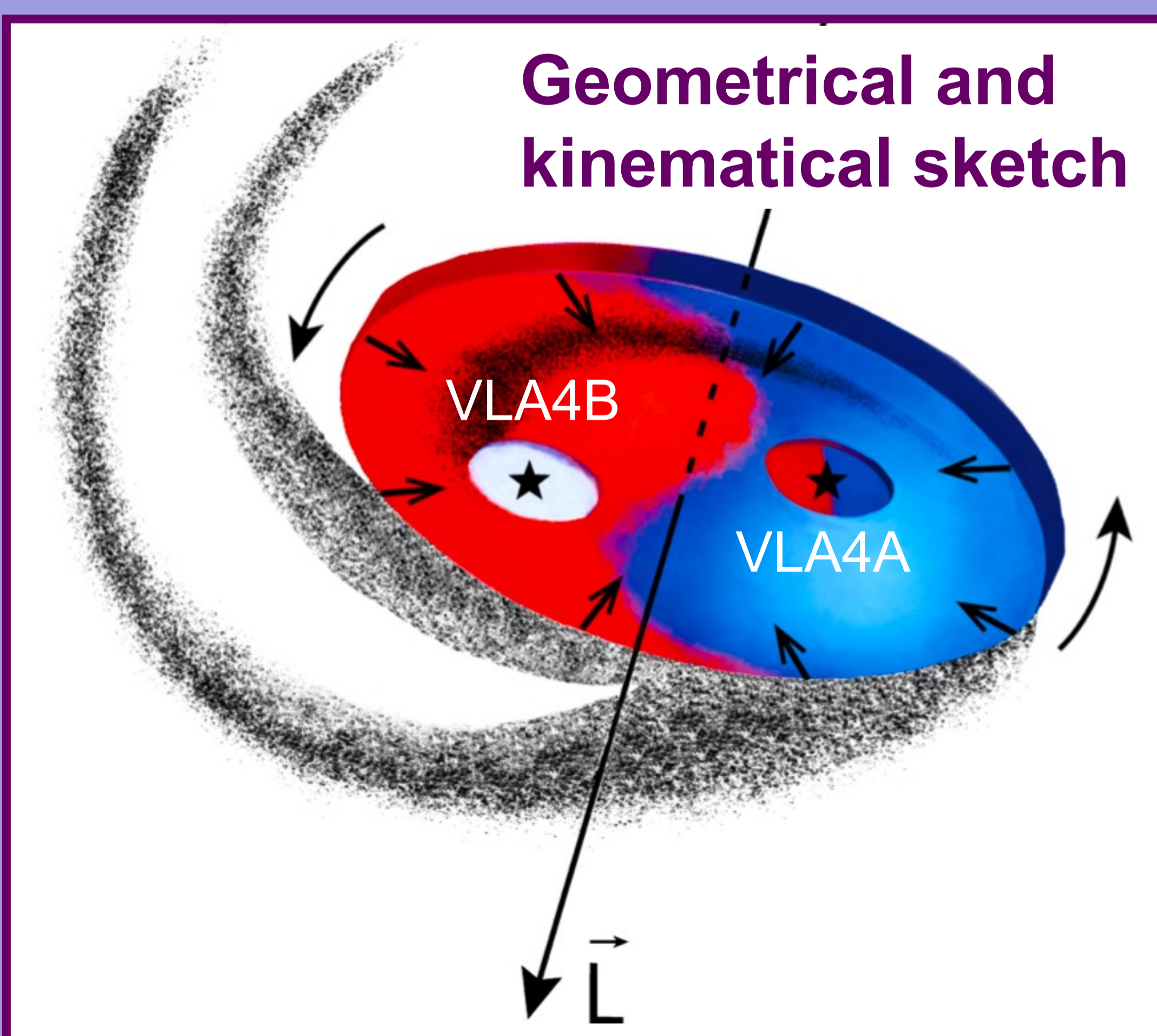
	VLA4A	VLA4B	Circumbinary
M^*/M_{\odot}	0.27	0.60	1
$M_{\text{disk}}/M_{\text{Jup}}$	4-9	9-30	50
$R_{\text{disk}}(\text{dust})/\text{au}$	12	9	375
T_k/K	126-260	90-430	138
$H(R_{\text{disk}})/\text{au}$	2.4-3.5	1.1-1.9	40
$Q(R_{\text{disk}})$	22-81	5-25	13

The Molecular Outflow



Left: ALMA CO(3-2) map (resolution $\sim 0.5''$) of the blue-shifted and red-shifted outflow lobes overlaid on an HST image. The map covers a region of ~ 2500 au in radius (the ALMA primary beam) around the SVS 13 protostars, and shows the arc-shaped walls of the outflow lobes, as well as the blue-shifted extremely high velocity molecular bullet closest to SVS 13 (Bachiller et al. 1990). **Right:** Close-up (resolution $\sim 0.1''$) of the molecular bullet, showing the integrated emission and the mean velocity. The velocities are line-of-sight velocities relative to the systemic velocity of the ambient cloud (+8.5 km/s). A clear global velocity gradient is seen along the major axis of the bullet. The H_2 arcuate features imaged by Hoddap & Chini (2014) are plotted as arcs.

Geometrical and kinematical sketch



References:

Bachiller et al. 1990, A&A, 231, 174
Blázquez-Calero et al., in preparation
Diaz-Rodriguez et al. 2022, ApJ, 930, 91
Hoddap & Chini 2014, ApJ, 794, 169

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