Testing Protostellar Formation Models: VLA1623A's disk and envelope unravelled with ALMA

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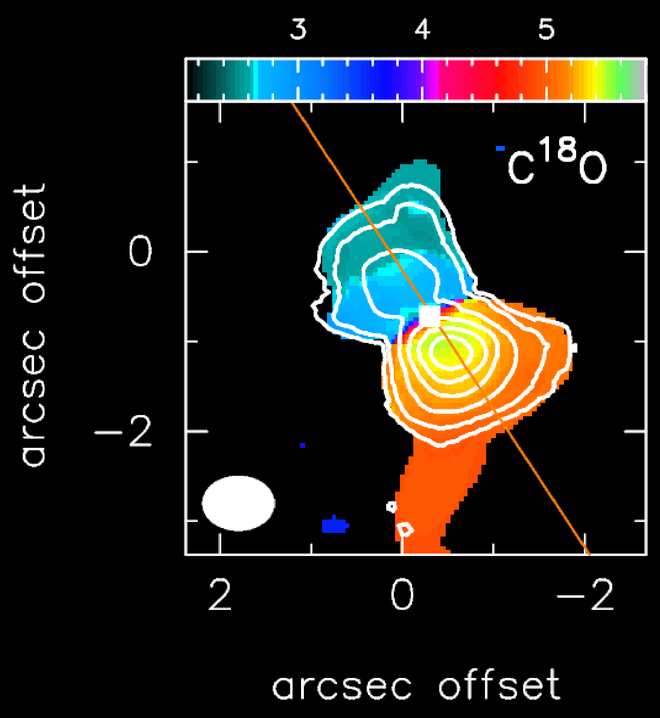
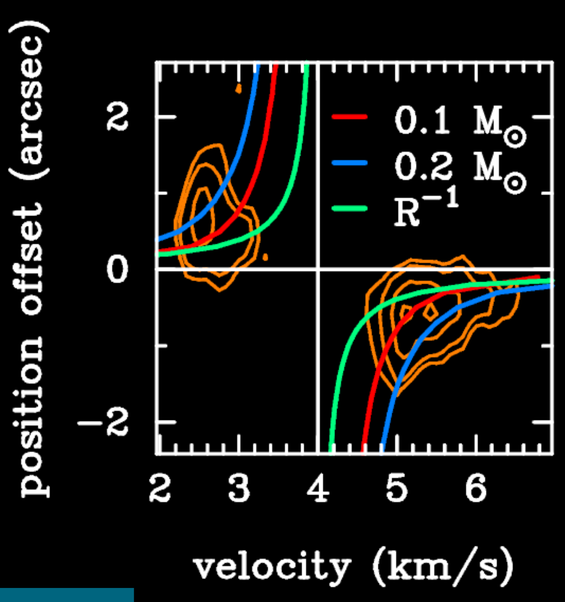
VLA1623A's disk



Velocity gradient suggests rotation

PV diagram:
Overlaid with v α $R^{-0.5}$ and v α R^{-1}.

Suggests rotationally supported emission



VLA1623

Located in ρ Ophiuchus (d~120pc)

VLA1623 is a triple non-coeval protostellar system
- VLA1623A: Class 0
- VLA1623B: First Core candidate?
- VLA1623W: Class I

Conclusions

Each component has a different environment, due to formation

VLA1623A shows a large Keplerian disk (R = 180 AU)

VLA1623B is cold and very young

VLA1623W is possibly an ejected component

Questions

How is the circumstellar material distributed in multiple protostellar systems?

What can the distribution tell us about the system and its formation?

Does VLA1623A (Class 0) have a rotating disk?

What is the nature of VLA1623B & W?

If you have any questions / comments / suggestions please contact Nadia Murillo at:
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We present the case of VLA1623, a triple non-coeval protostellar system in ρ Ophiuchus, the prototype Class 0 object. Its envelope is complex on the large scale, breaking down on the small scale to reveal that each component of the system has a different structure. Using ALMA cycle 0 observations of VLA1623 and combining the observations with models, we analyze the envelope of each of VLA1623's components, searching for rotationally supported disks, attempting to unravel what is going on in this system and to address some of the questions of its formation.

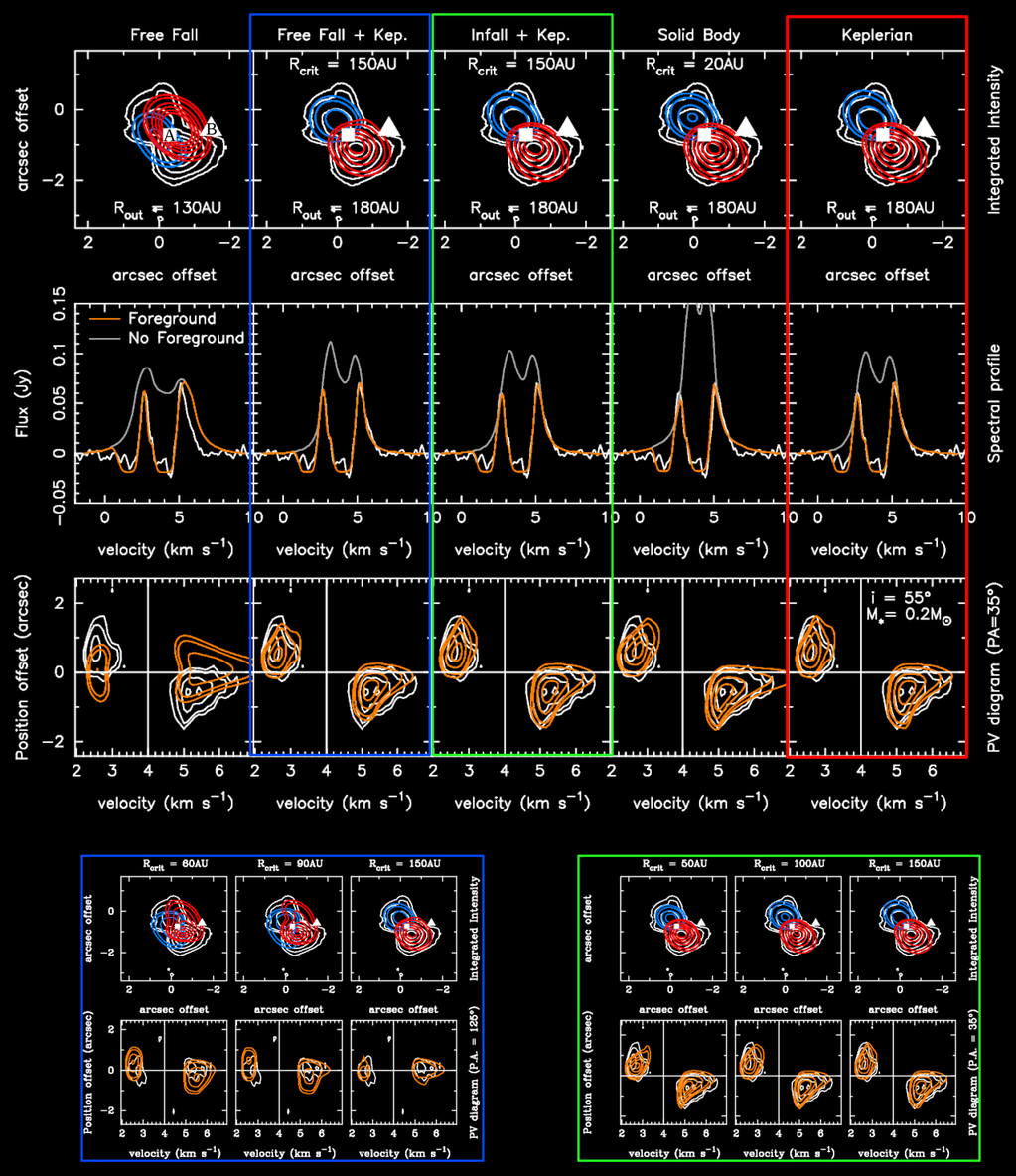
VLA1623A's $C^{18}O$: Thin Disk Model

Thin disk model with foreground
Five cases examined: (1) Free fall, (2) Free fall + Keplerian, (3) Infall + Keplerian, (4) Solid Body, (5) Pure Keplerian.

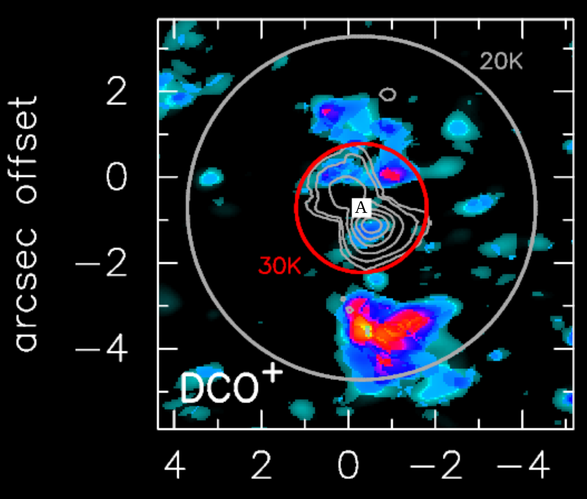
R_{crit} determines velocity structure transition in (2), (3) & (4)
Fixed parameters: M_* = 0.2M_{sun}, P.A. = 35, v_{lsr} = 4.0 km/s
Foreground, R_{out}, R_{crit} and i obtained on best fit basis

Results: Pure Keplerian out to 150 AU; outer 30AU difficult to determine (S/N too low).

(Murillo et al. 2013, submitted)

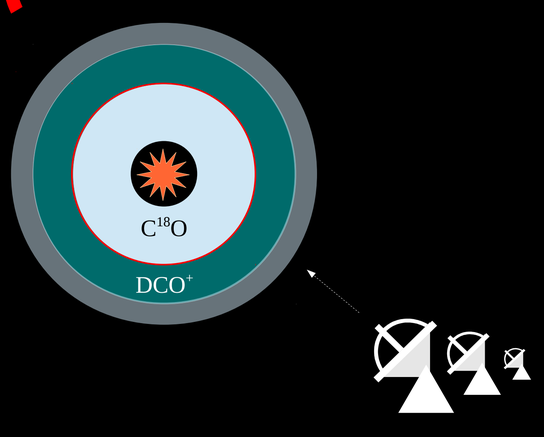


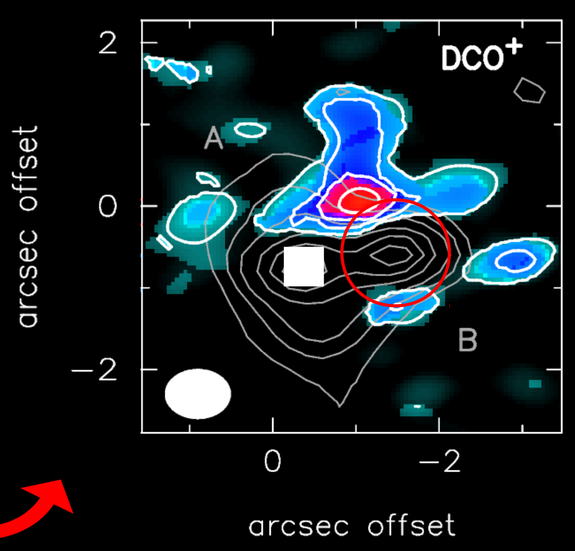
DCO^+: VLA1623A & B



← VLA1623A
DCO^+ "ring" surrounding the $C^{18}O$ emission
Distribution consistent with models of significant fractionation <30 K
(Jorgensen et al. 2002, 2005)

↓VLA1623B
Very cold and compact object
High CO depletion
DCO^+ bordering the core





VLA1623W

Class I source

Little circumstellar material, may be Keplerian disk

Possibly ejected from a close triple