Accretion flows accross the HD 142527 gap

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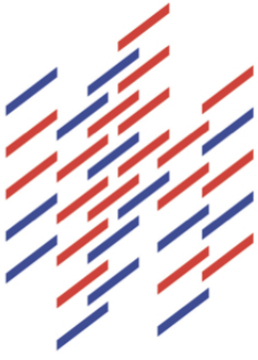
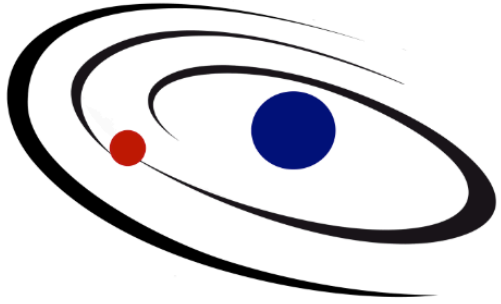
2 **M**illenium nucleus for **A**LMA **research in** **D**isks

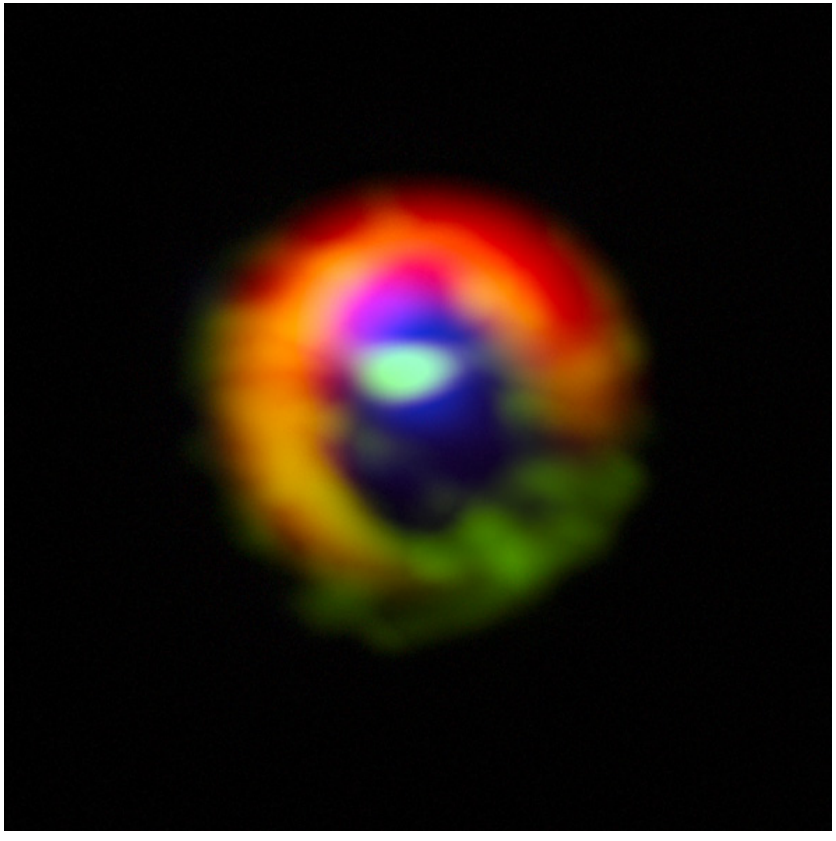


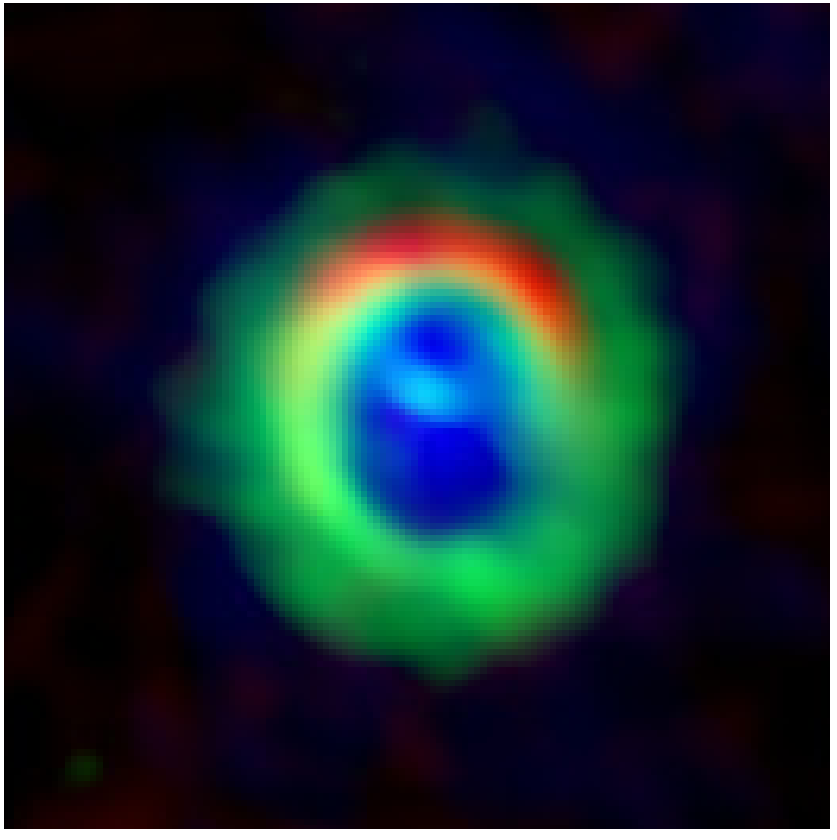
NLHPC
National Laboratory for High Performance Computing Chile



MAD
Millenium Nucleus For Disk Research with Alma

Cycle 0 summary images





ESO press release

In-house MEM models

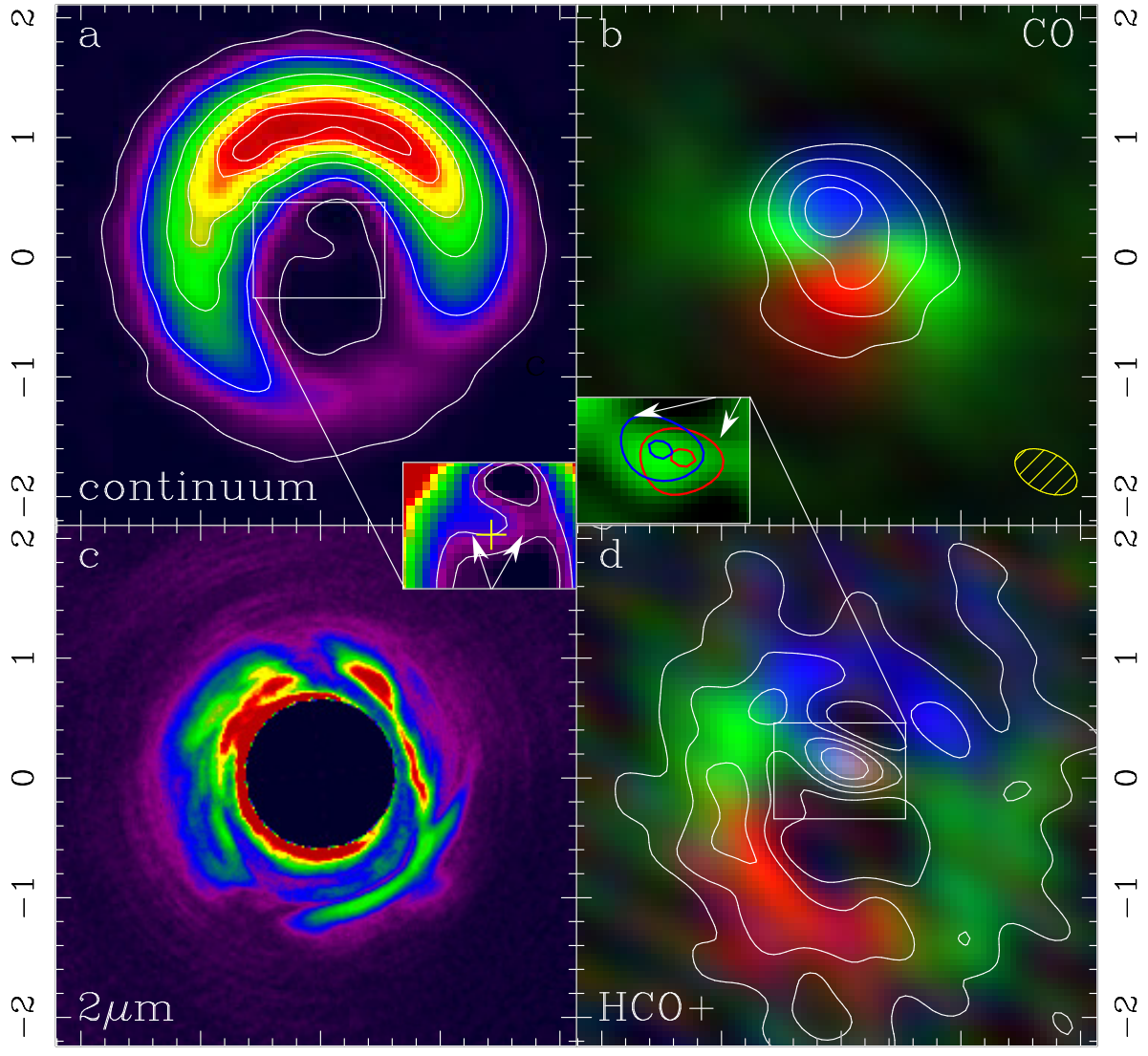
345 GHz, **HCO(4-3)$^+$**, **CO(3-2)**

The data on HCO^+(4-3).

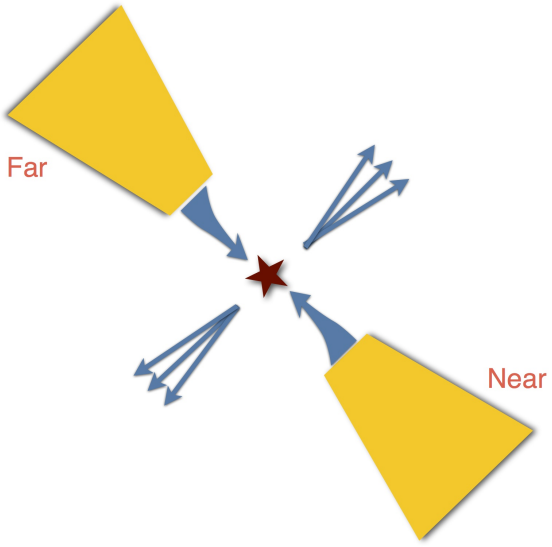
Stellar accretion

- Crystalline inner disk ($r < 0.1''$, van Boekel et al. 2004) with dust mass $\sim 10^{-9}\ M_\odot$ (Verhoeff et al. 2011).
- $dM_\star/dt \sim 10^{-7}\ M_\odot\ yr^{-1}$.
- $\Rightarrow$ Inner disk is a steady state feature of accretion
- Mass reservoir is in the outer disk, with a mm-continuum mass $\sim 0.1\ M_\odot$ (Oberg et al. 2011),
- $\Rightarrow$ Somehow material must cross the gap.
- **Not because of HD 142527 B**, cavity is 140 AU, too big for a low mass star at 10AU!

A disturbed cavity with residual gas, and gap-crossing flows

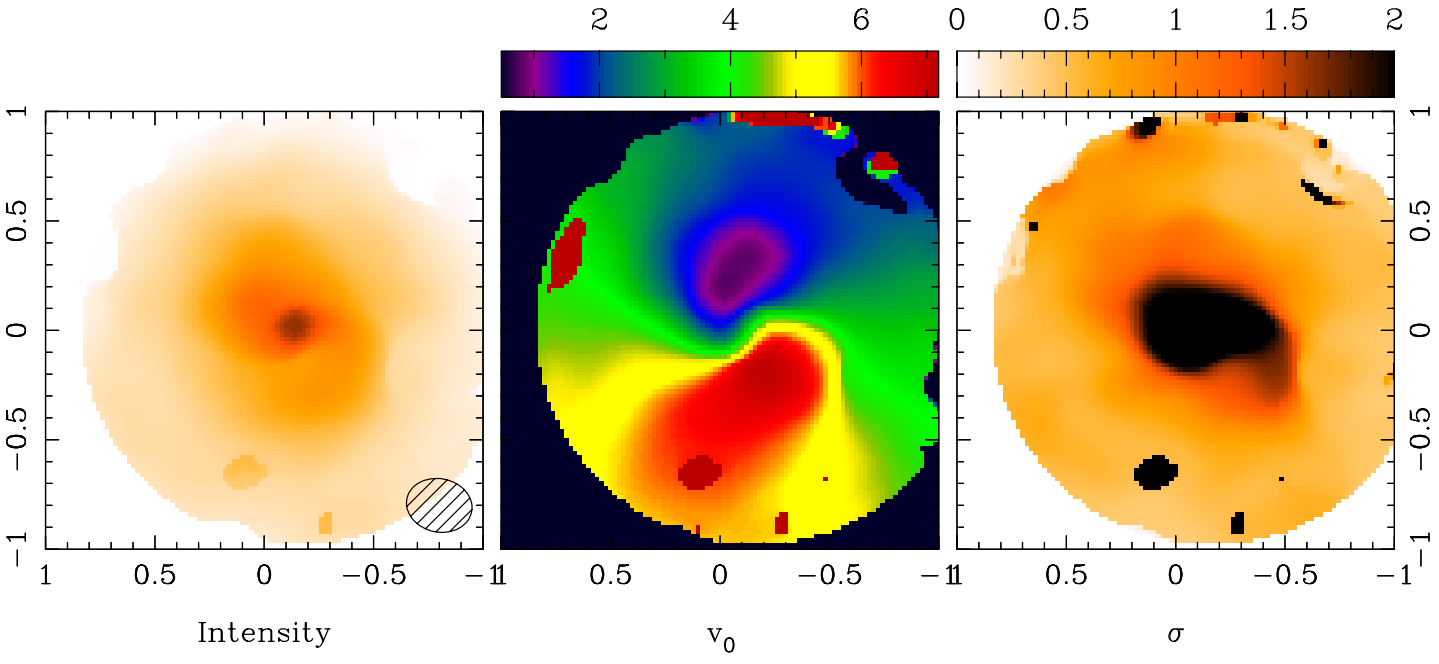


Is HCO^+ tracing an outflow?



- Multiple trailing spirals $\Rightarrow$ East is far side (`talk by Christiaens`).
- Approx. perpendicular alignment of HCO^+ flow axis with disk, but apparent obtuse 'v' shape with star at vertex.
- Systemic velocity HCO^+ filament connect with the outer disk $\Rightarrow$ outflow with zero-velocity terminal velocity?
- $7\ 10^{-9} < \dot{M}/\ M_\odot\ \mathrm{yr}^{-1} < 2\ 10^{-7}$ $\Rightarrow$ close to stellar accretion rate $7\ 10^{-8}\ M_\odot\ \mathrm{yr}^{-1}$.

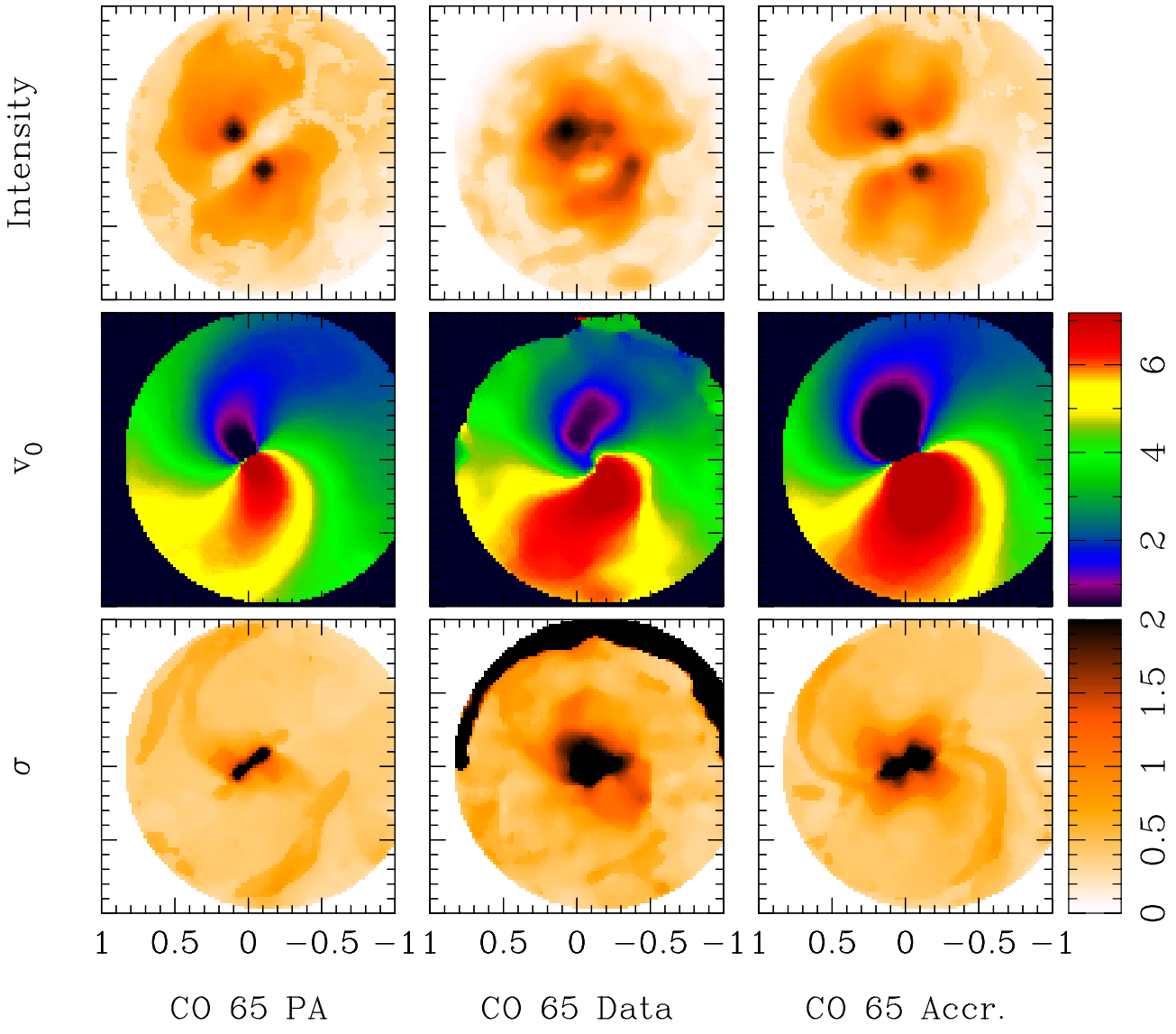
Complementary info: non-Keplerian flows in CO(6-5).



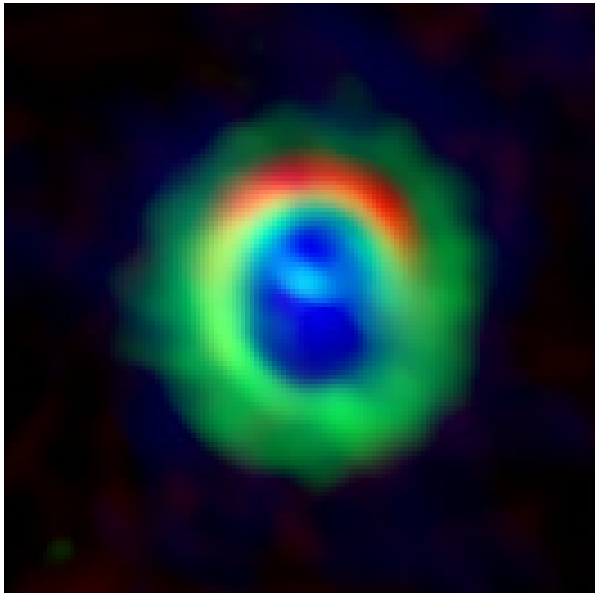
Possible scenarios

- If east is far, not an outflow.
- Could be a warp, such that the position angle rotates with stellocentric radius and the innermost regions match the rovib CO PA, of 294deg (Pontoppidan et al. 2011).
- Or could be accretion, but with **a radial velocity comparable with Keplerian rotation**, all the way into the rovib CO region.
- $\Rightarrow$ Compare data with parametric models of warps and accretion:
  - Warp: linearly connect PA of -10 at 140AU, with PA of 294deg at 10AU.
  - Fast accretion: linearly connect zero accretion at 140AU, with free-fall at 10AU.

Simulations



Conclusions



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- Non-Keplerian CO flows, clearest in CO(6-5).
- CO kinematics not consistent with an outflow $\Rightarrow$ HCO^+ fast flows unlikely to be a jet.
- CO/HCO^+ kinematics are both consistent with accretion, but require free-fall velocities.
- An alternative interpretation involves a warp, or a continuous change in disk PA from the inner to the outer disk.
- If warped kinematics, how is the star fed?