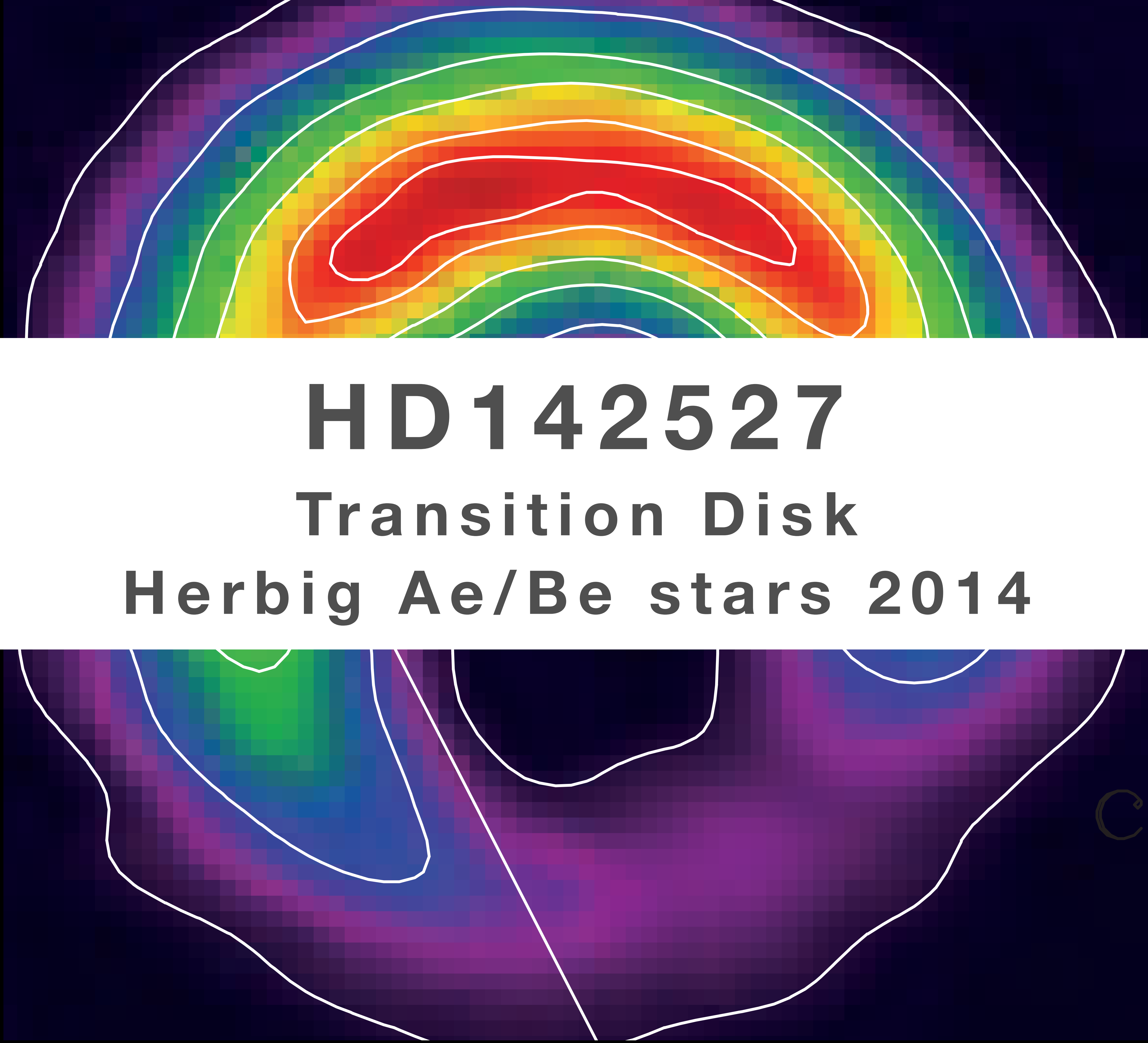


HD142527

Transition Disk

Herbig Ae/Be stars 2014

HD142527
ALMA results

MAD

by

Sebastián Pérez
Simon Casassus
Valentin Christiaens
Francois Ménard
also with
Gerrit van der Plas, Pablo Román, Christian Flores, and others.

@Universidad de Chile / MAD

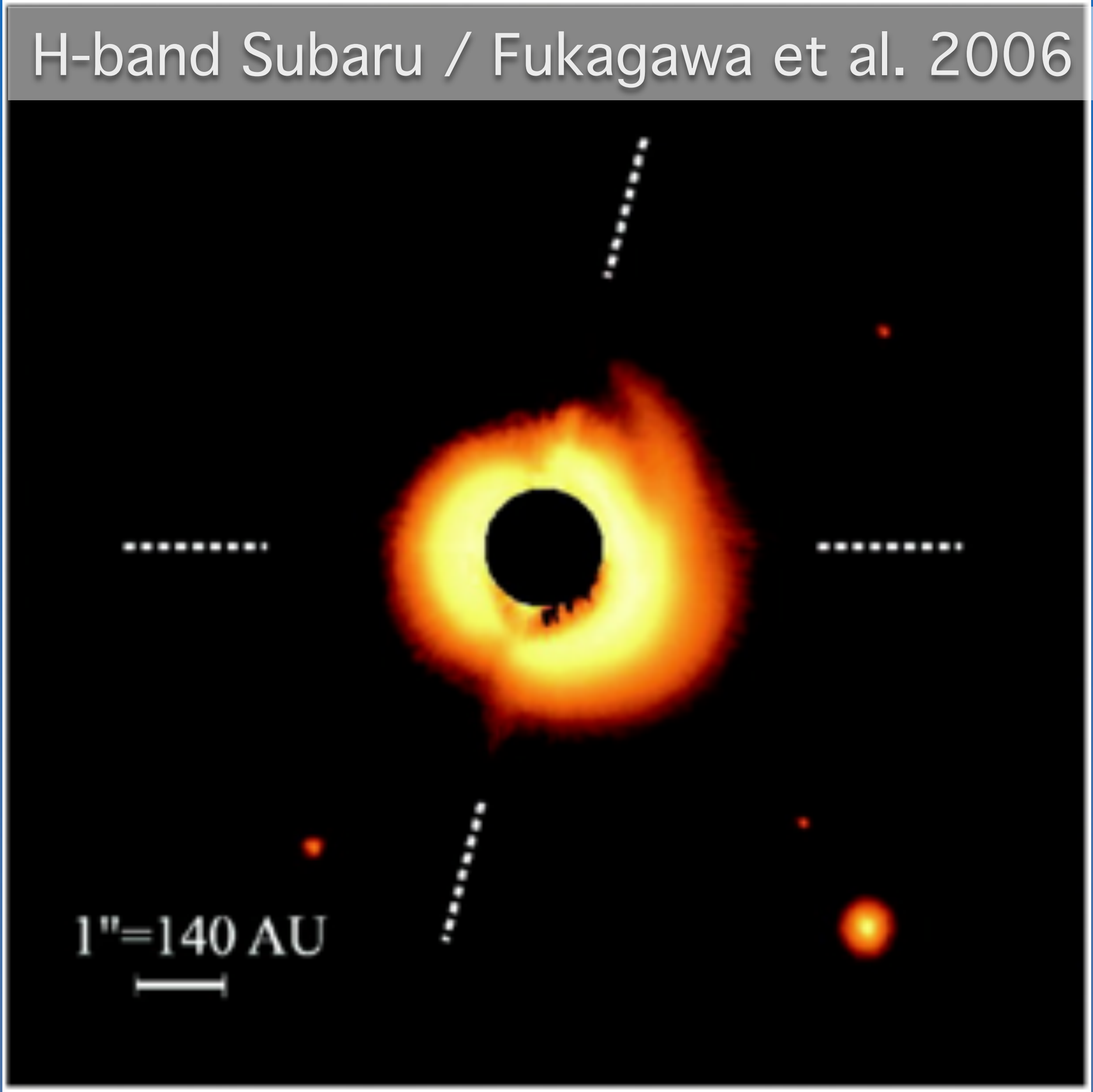
Talk Overview

1) HD142527 basics and introduction

2) ALMA CO observations of HD142527's cavity (Perez et al. submitted)

3) Inferring the mass from hydro simulations (work in progress)

HD142527 basics



Herbig Ae star / spectral type F6IIIe

$$M_\star = 2 - 2.5\mathrm{M}_\odot$$

Most likely in Lupus molecular cloud at **140 pc**

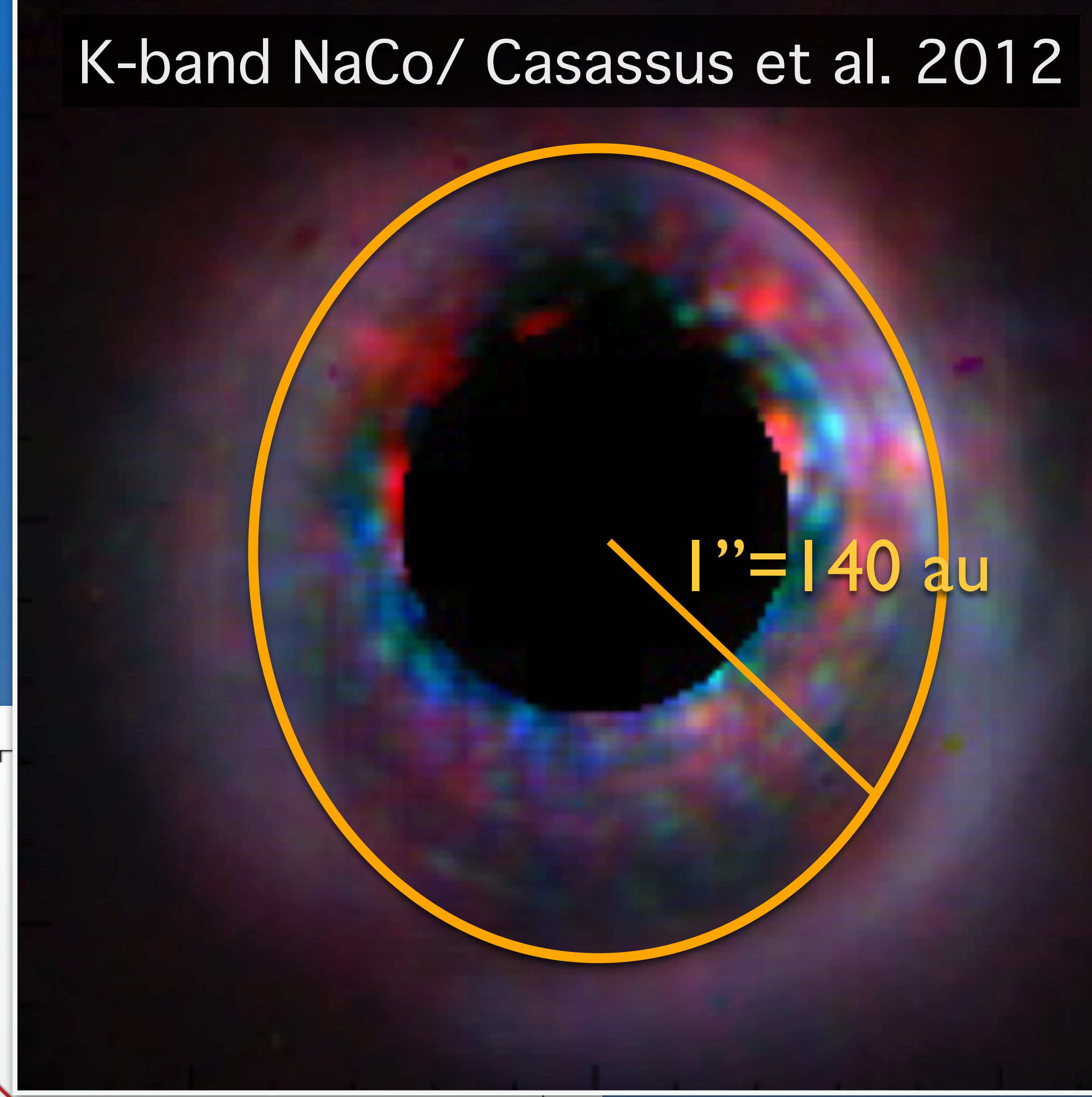
Age **~2 Myr**

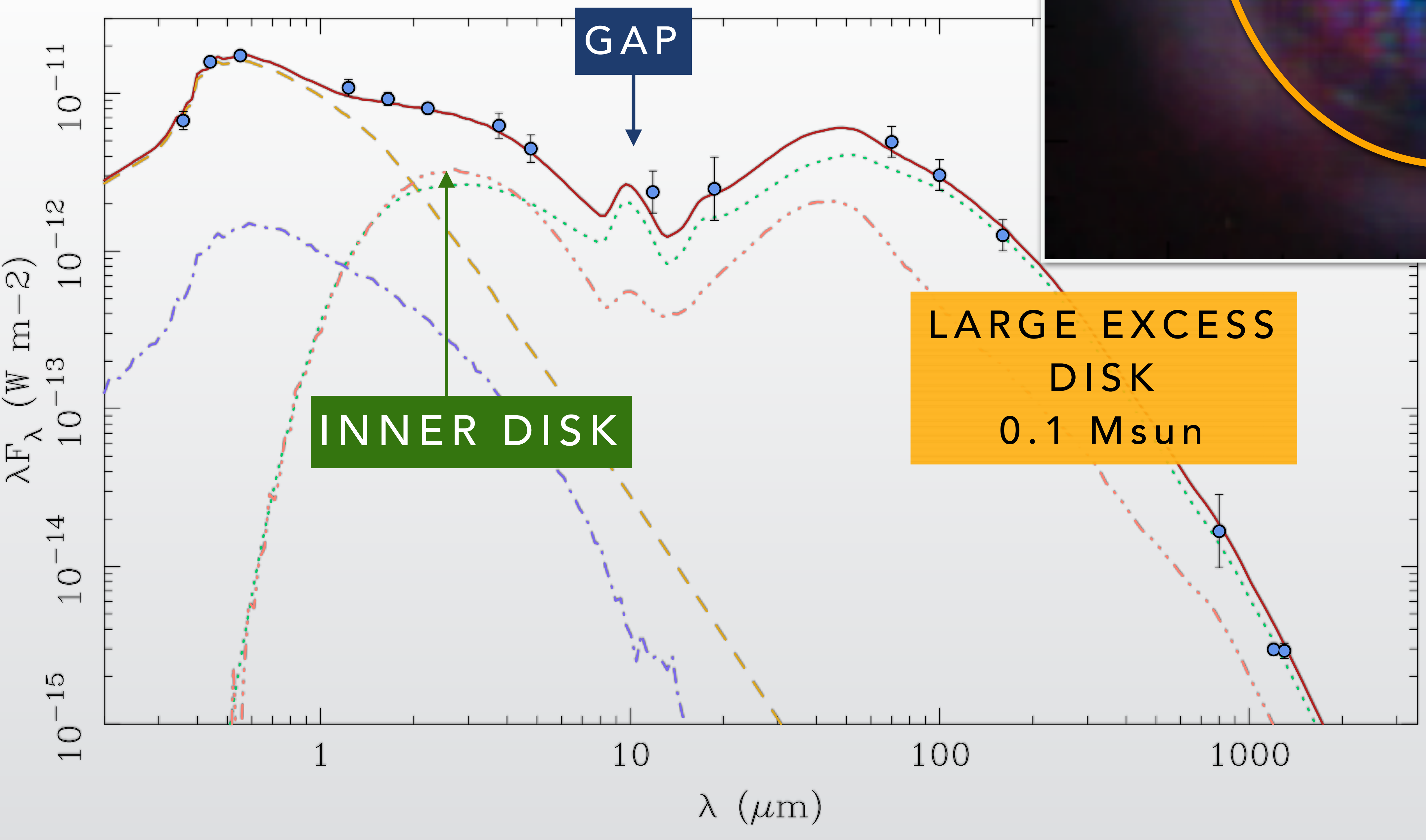
Large stellar accretion rate.

Ignacio Mendigutia's talk: $\dot{M} = 2 \times 10^{-7}\mathrm{M}_\odot\mathrm{yr}^{-1}$

HD142527's disk

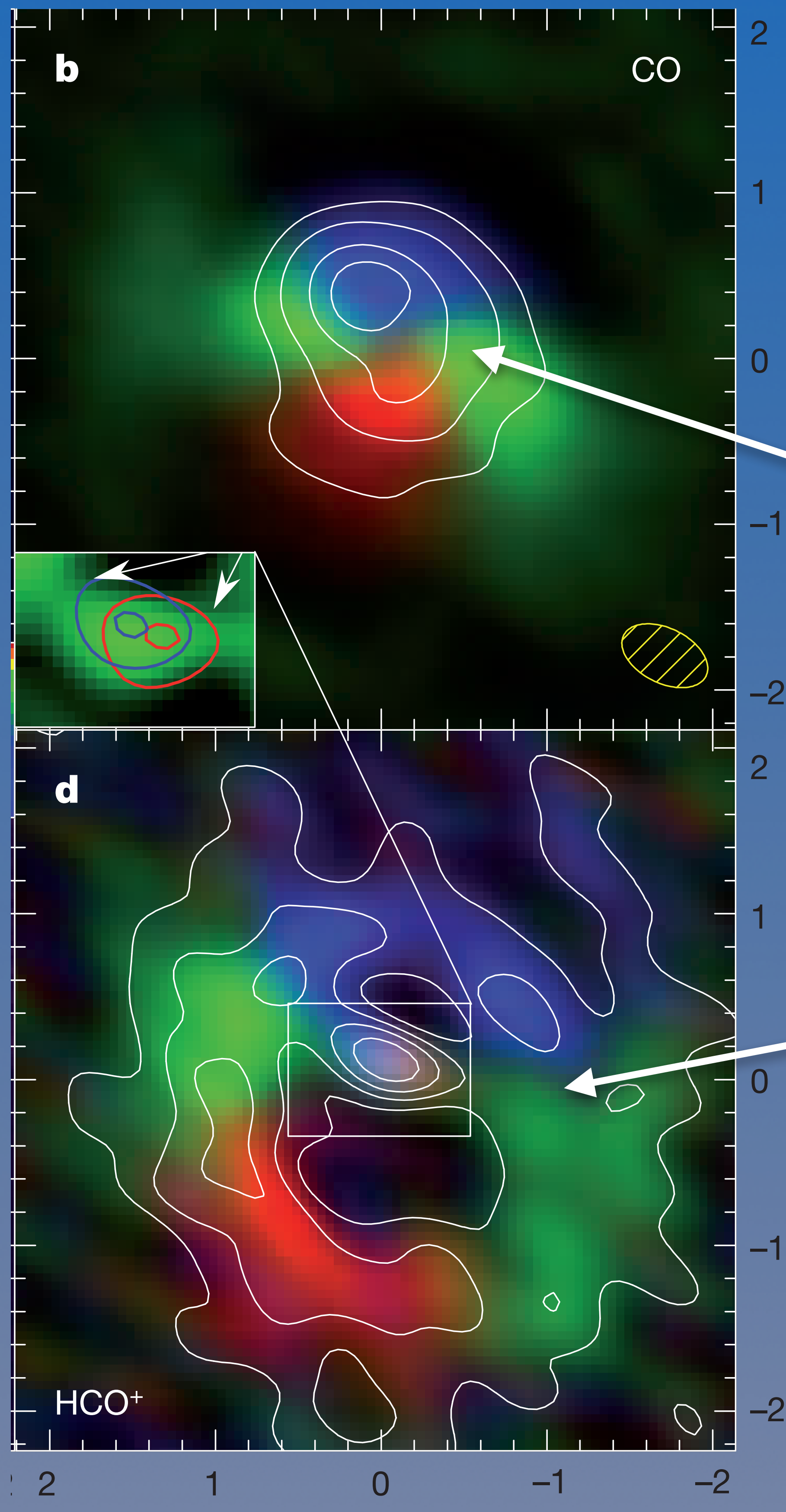
Nearly face-on **disk** with a large **dust-depleted cavity**





flows of gas through the gap

SIMON CASASSUS' TALK



CO(3-2) and HCO+ ALMA band 7 / Casassus et al. 2013 Nature

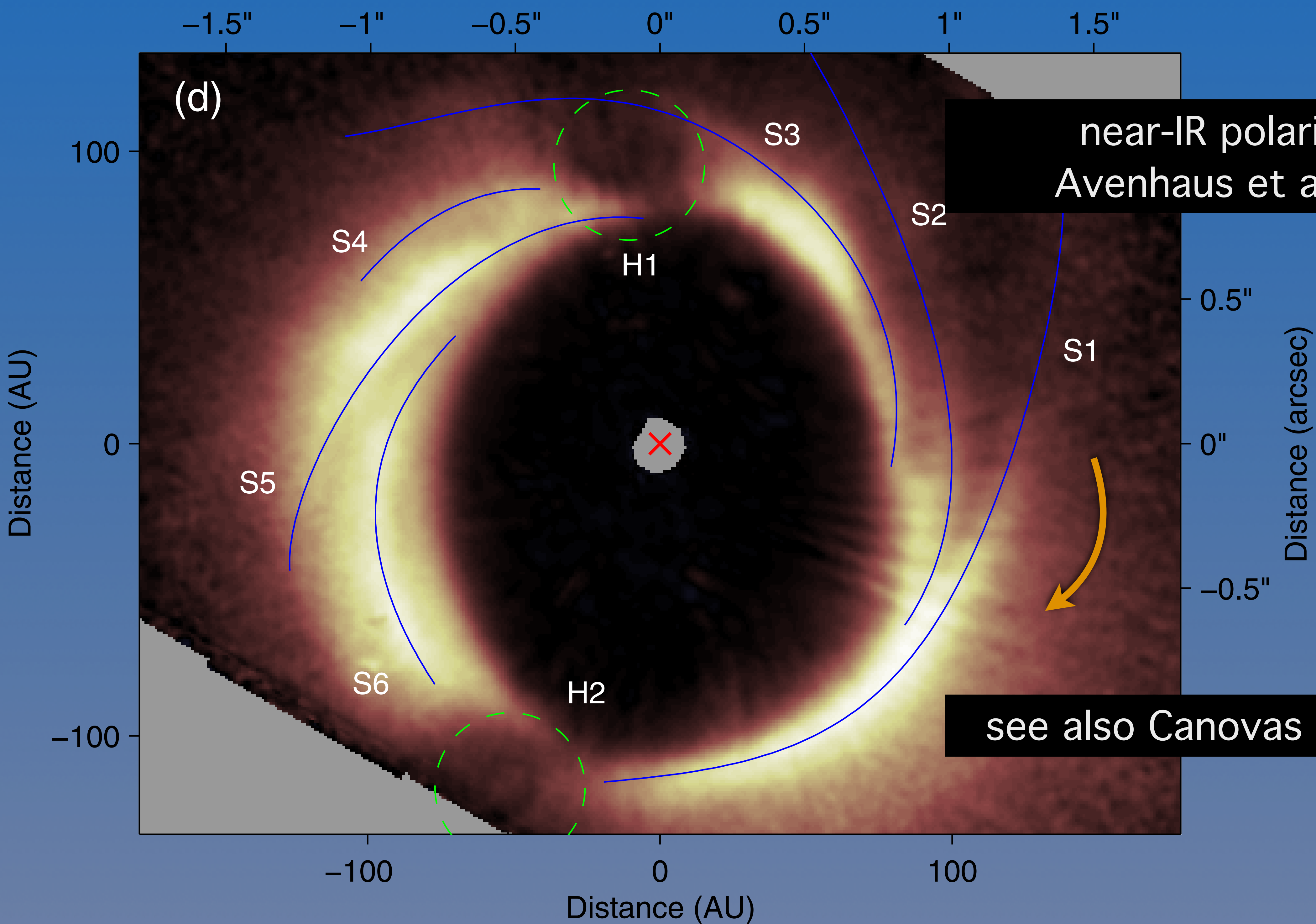
12CO detection inside cavity

non-Keplerian gas inside the cavity (skewed)

accretion streamers flowing through the gap

Spiral arms in the outer disk

VALENTIN CHRISTIAENS' TALK

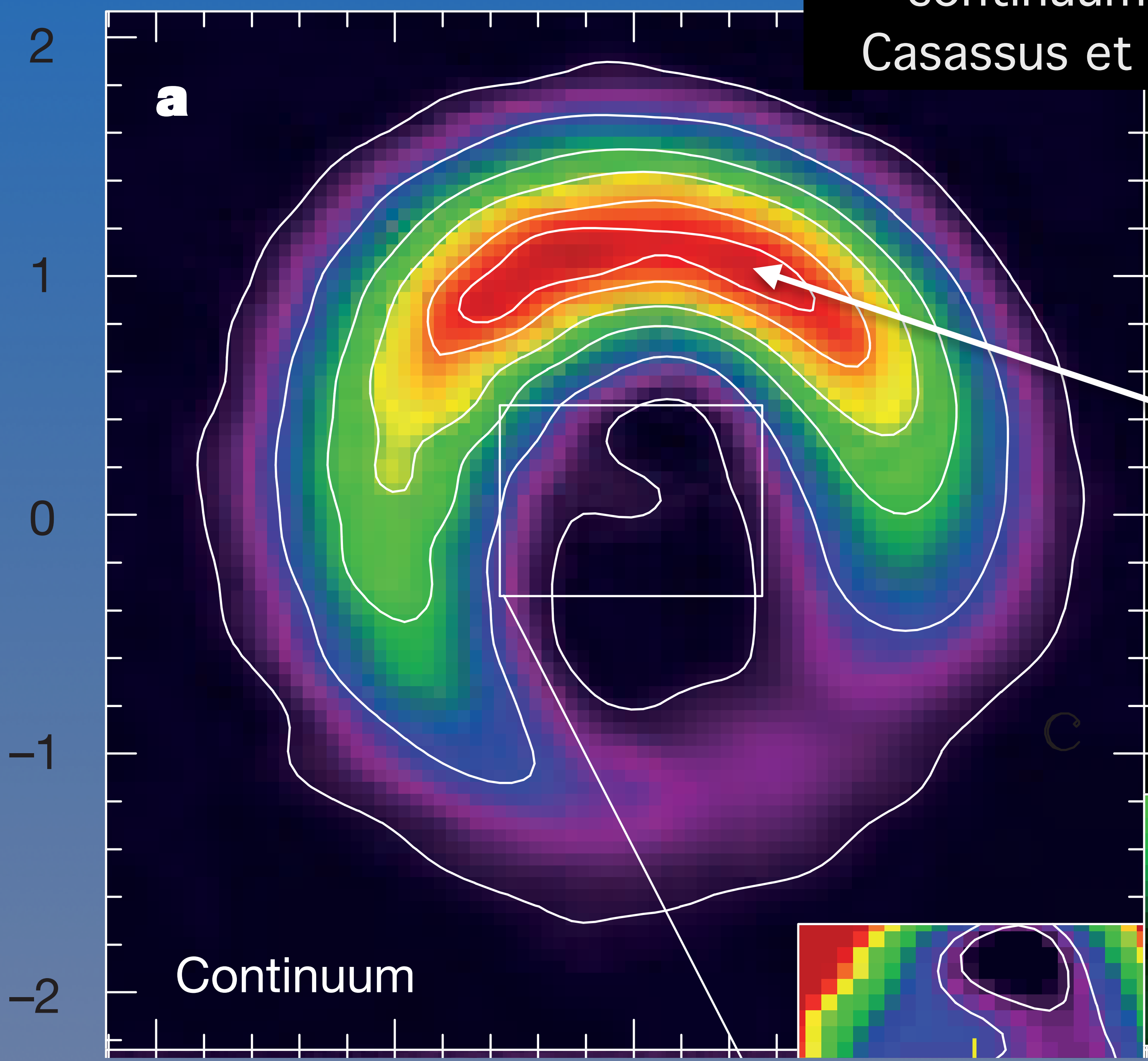


near-IR polarimetry
Avenhaus et al. 2014

see also Canovas et al. 2013

Outer disk horseshoe

FRANCOIS MÉNARD'S TALK



continuum at 345 GHz / Casassus et al. 2013 Nature

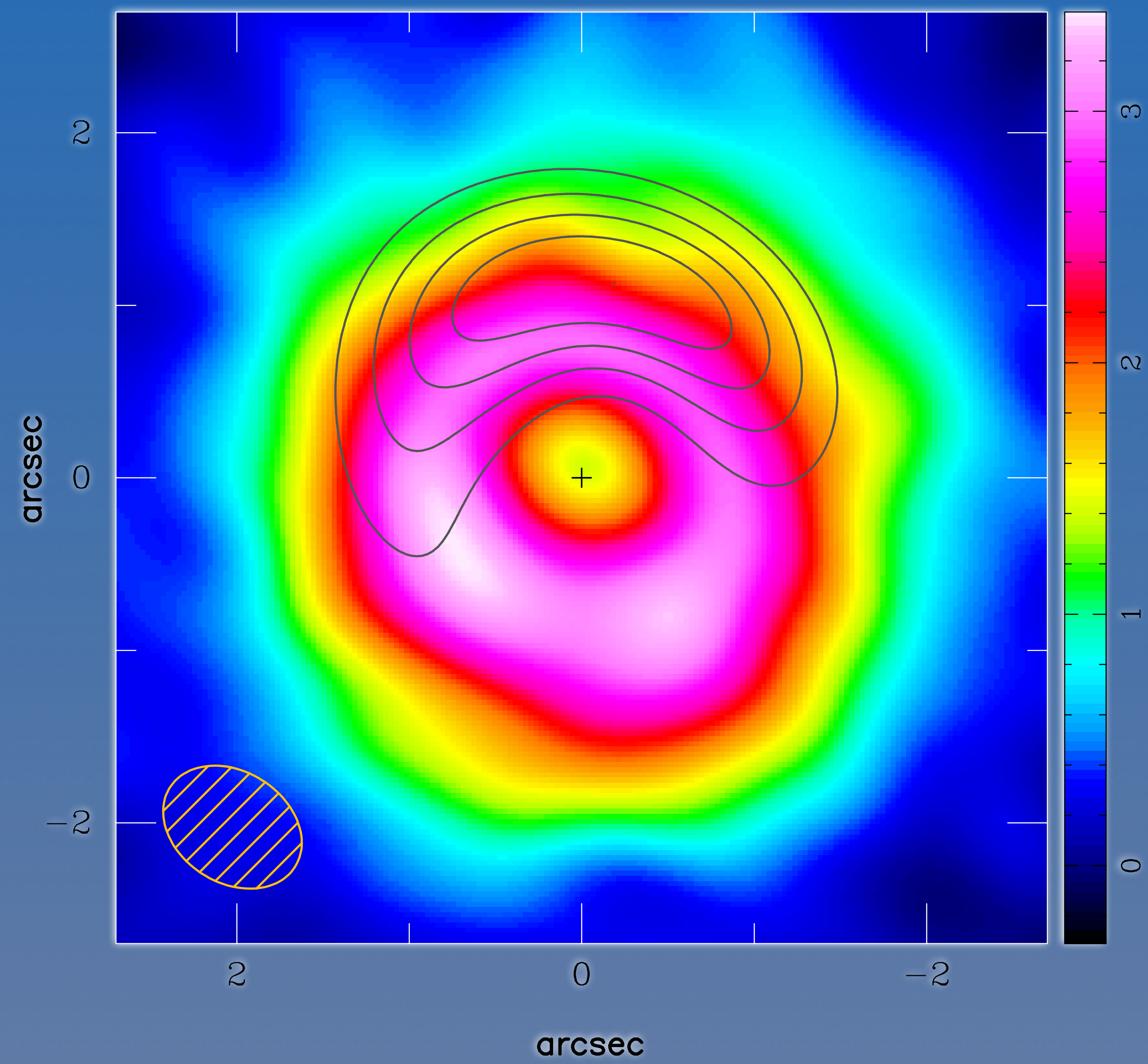
Asymmetry in dust continuum.

Planet induced pressure maxima / vortex?

or azimuthal grain size segregation / varying gas-to-dug ratio?

what's going on with the gas?

CO gas emission from inside the cavity
(Perez et al. submitted)



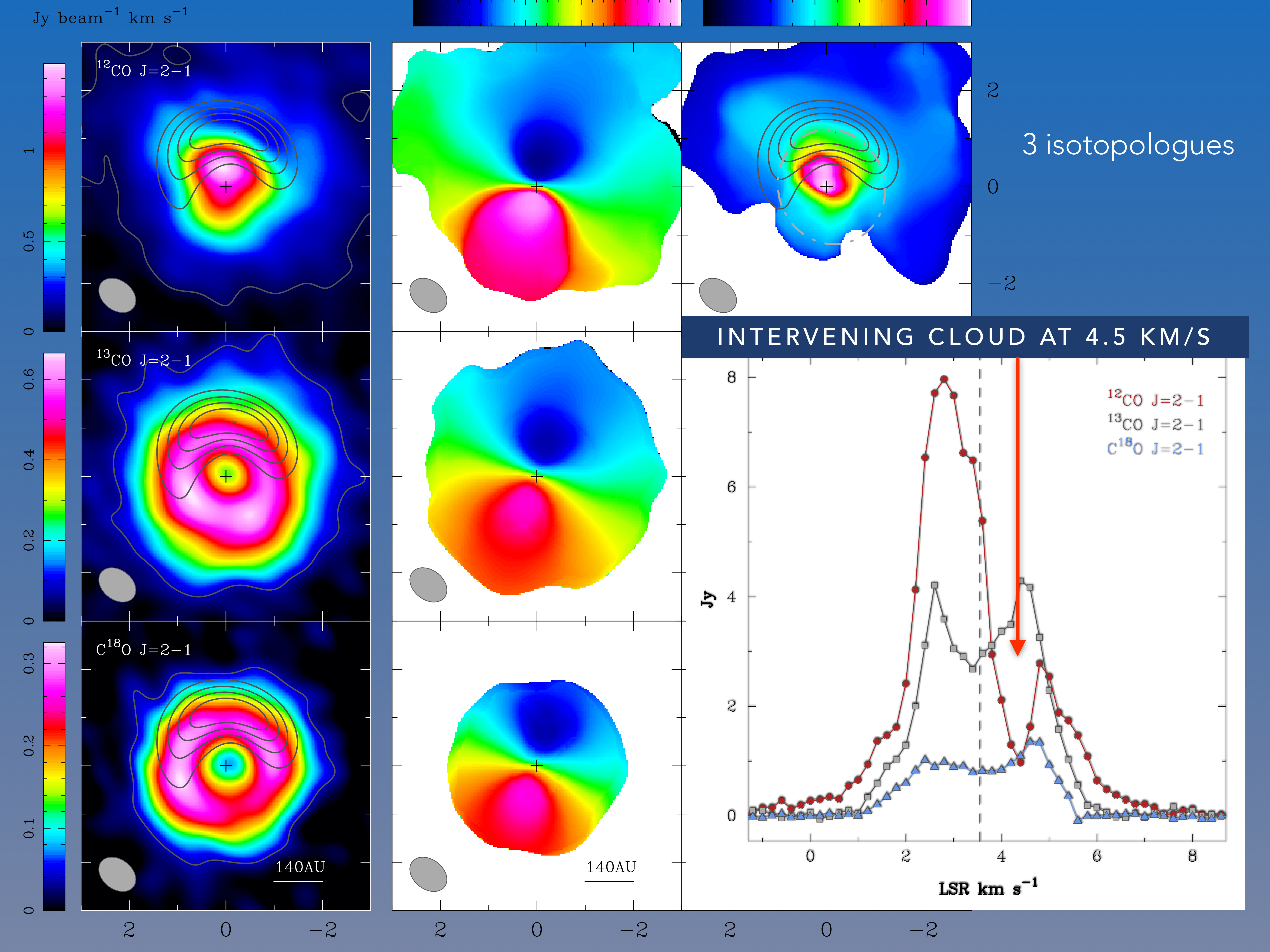
Band 6 ALMA data

Beam 0.82” x 0.56”

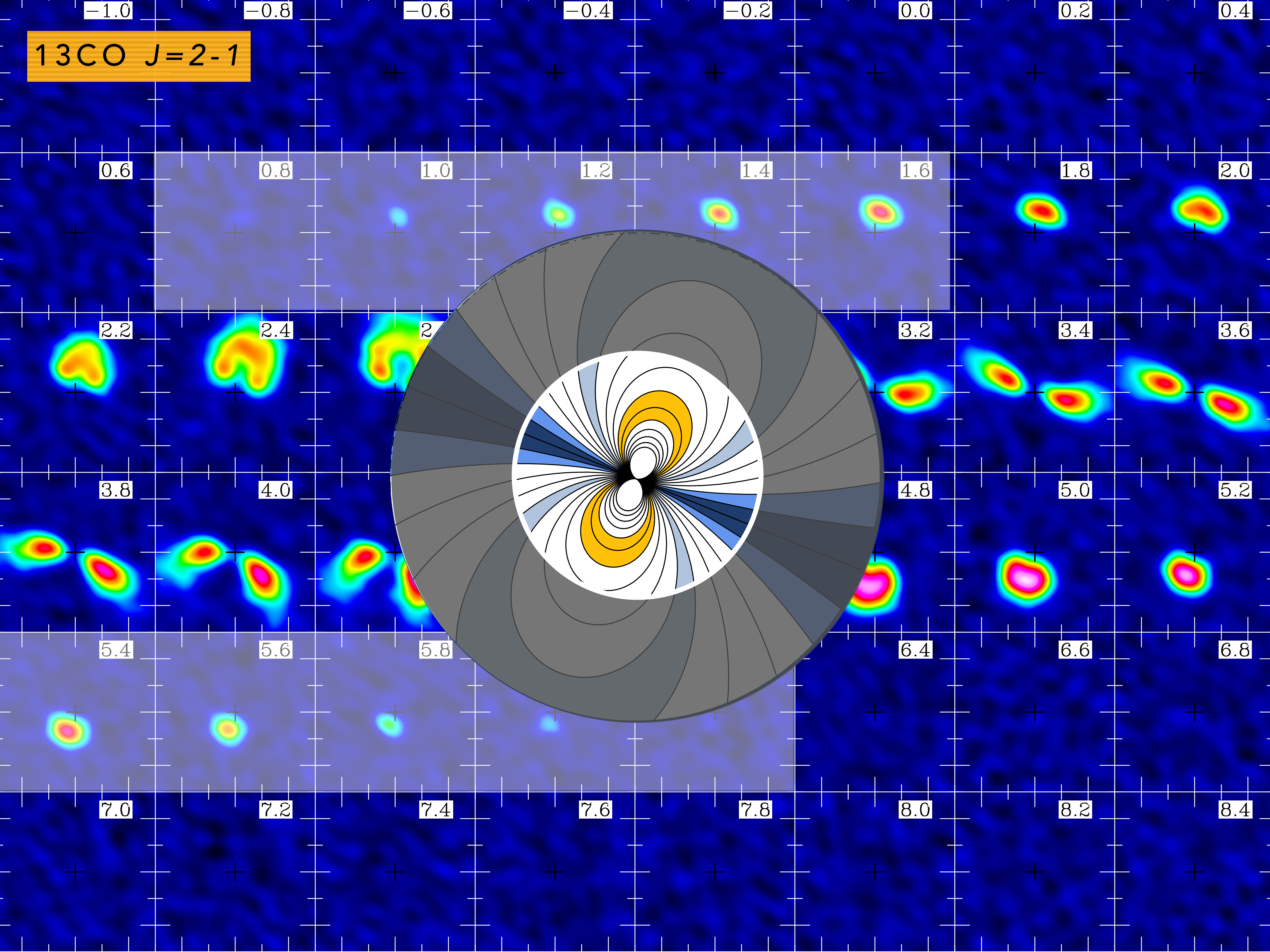
4 beams inside cavity

Aim: estimate gas conditions and mass inside the cavity

*only gas. not continuum



Jy beam^{-1} km s^{-1}
^{12}CO J=2−1
^{13}CO J=2−1
C^{18}O J=2−1
140AU
3 isotopologues
INTERVENING CLOUD AT 4.5 KM/S
Jy
LSR km s^{-1}



13CO J=2-1
−1.0
−0.8
−0.6
−0.4
−0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
3.2
3.4
3.6
3.8
4.0
4.8
5.0
5.2
5.4
5.6
5.8
6.4
6.6
6.8
7.0
7.2
7.4
7.6
7.8
8.0
8.2
8.4

once identified the emission from inside the cavity

isotopologues' line ratios give us optical depth

inside the disk cavity, 12CO is optically thick, while 13CO and C18O are mostly optically thin.

13CO and C18O trace better the underlying density distribution

$$M_{\rm gas} \propto \text{line intensity} \qquad \Rightarrow M_{\rm gas} \sim 2 \times 10^{-3} M_{\odot}$$

Simple toy model

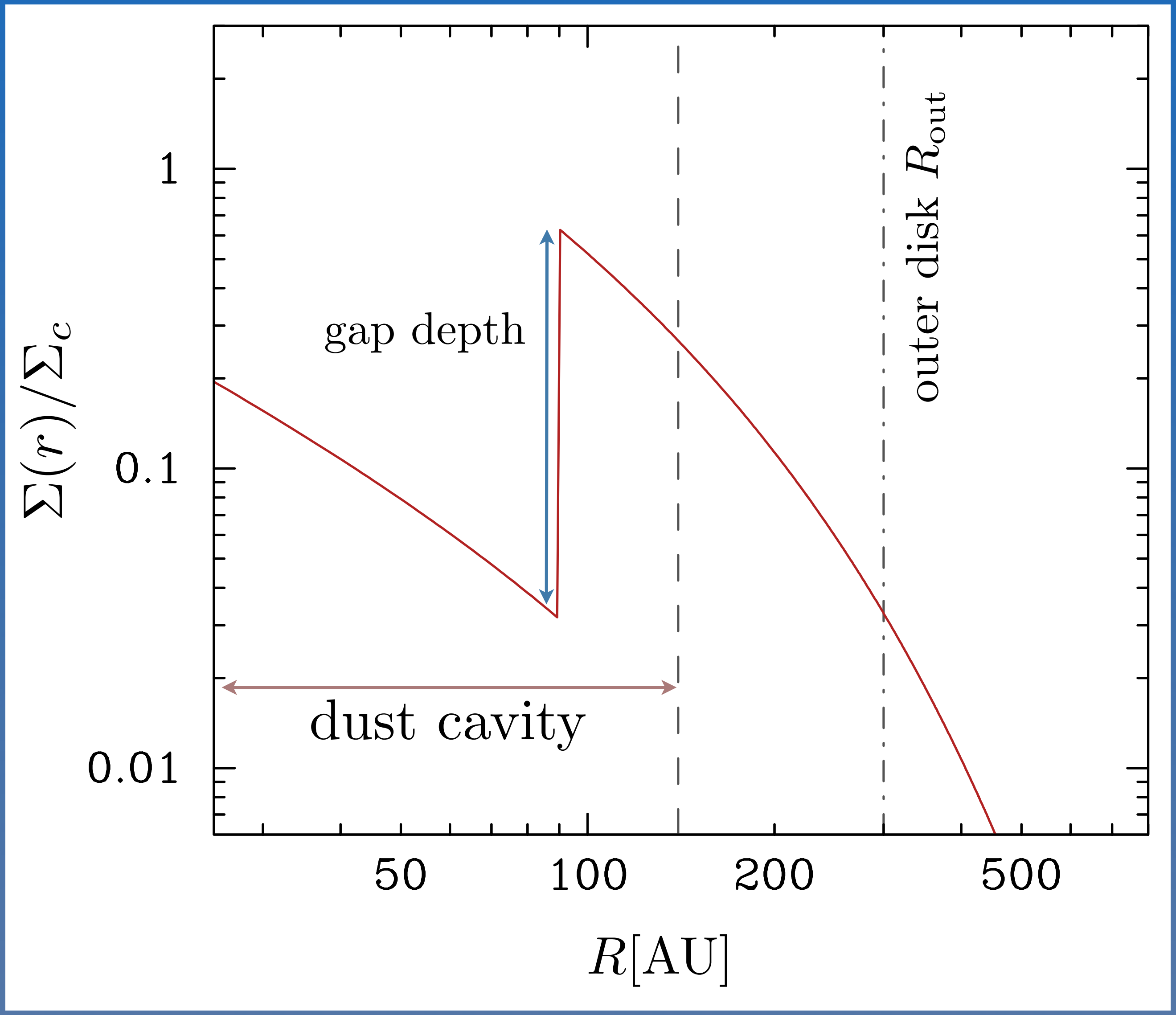
axisymmetric tapered disk

constant abundance

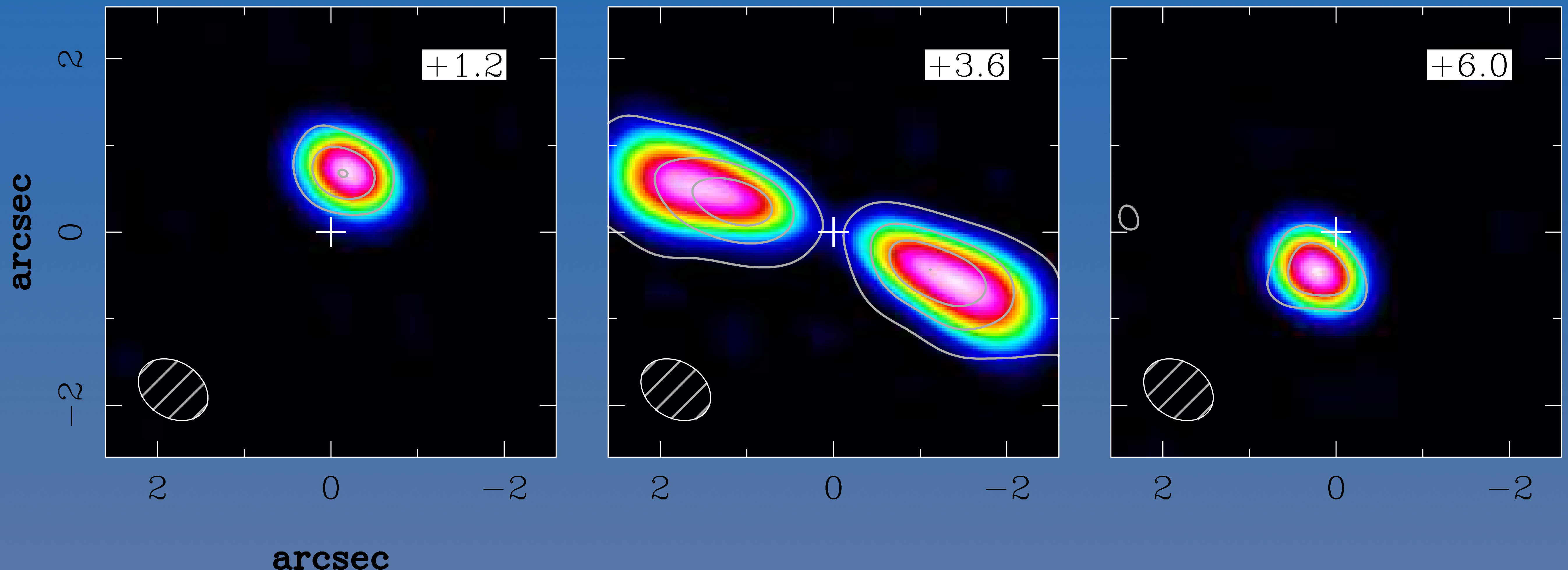
hydrostatic equilibrium

use LIME for radiative transfer

fit in visibility plane



high velocity gas is spatially sensitive to inclination and central mass



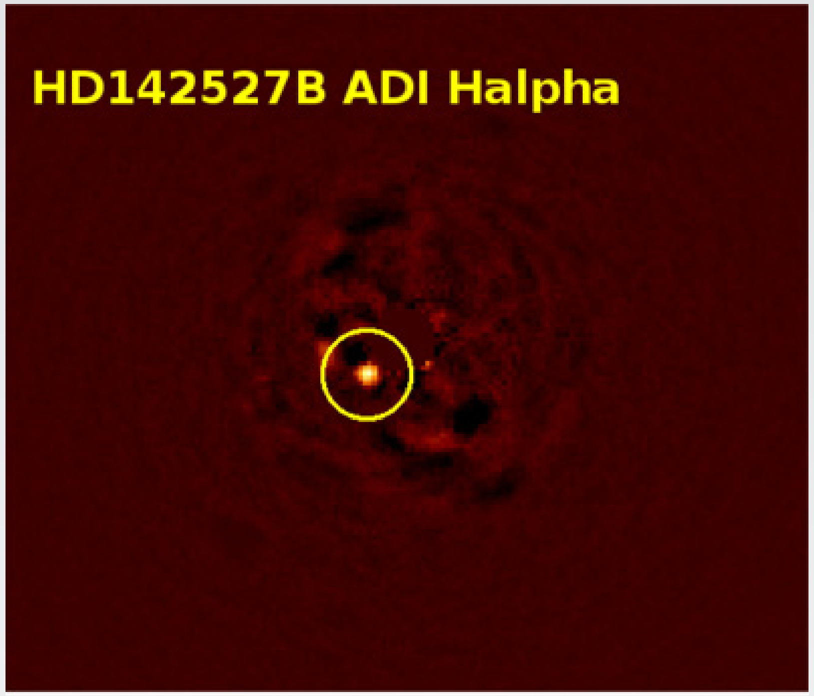
Best fit yields: $i \approx 28^{\circ}$ $M_{\star} \approx 2.5 M_{\odot}$

$M_{\rm gap} = 1 \times 10^{-3} M_{\odot}$

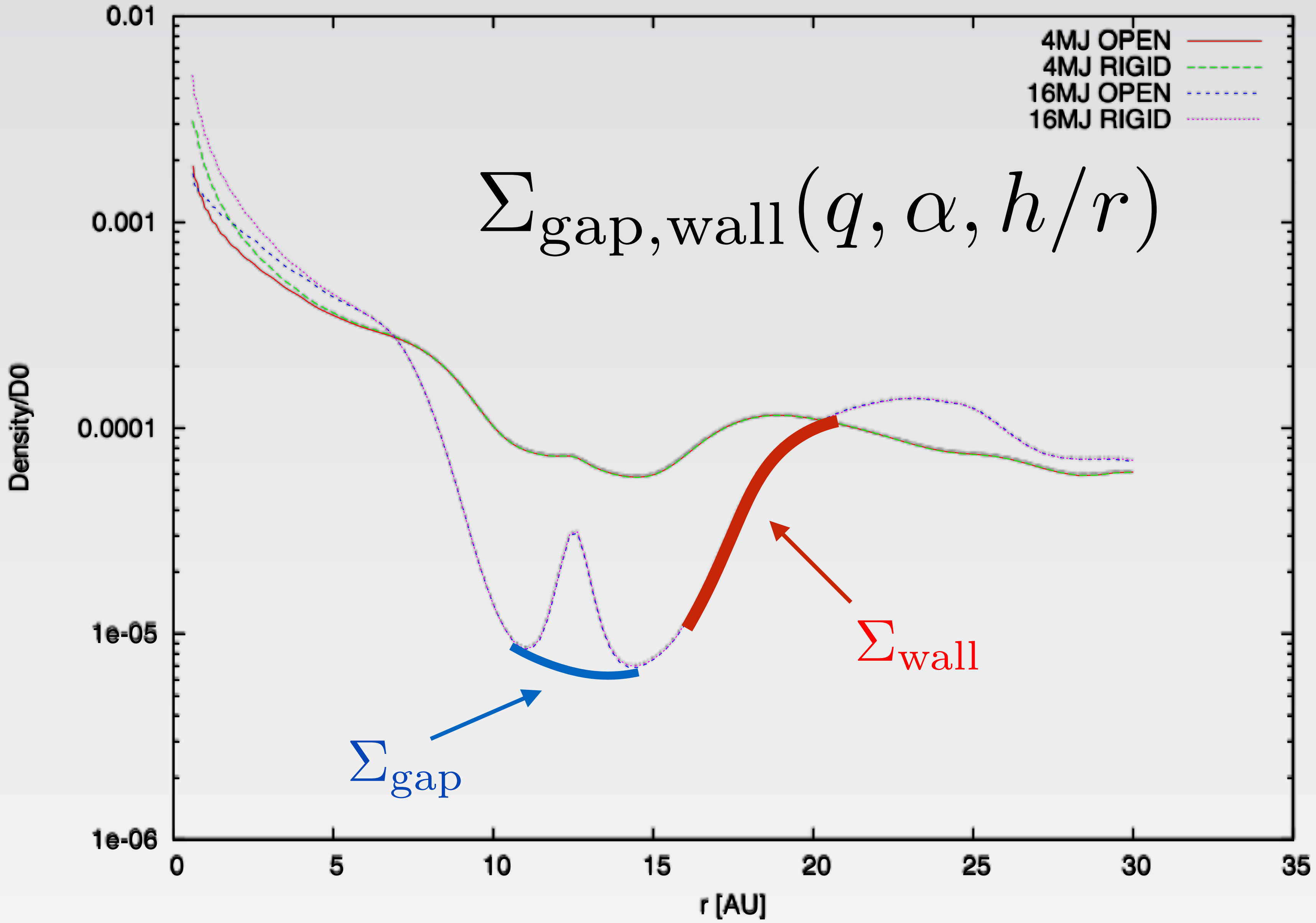
$R_{\rm gap} \approx 90$ au

Gas cavity < dust cavity

Work in progress..



MagAO / Close et al. 2014



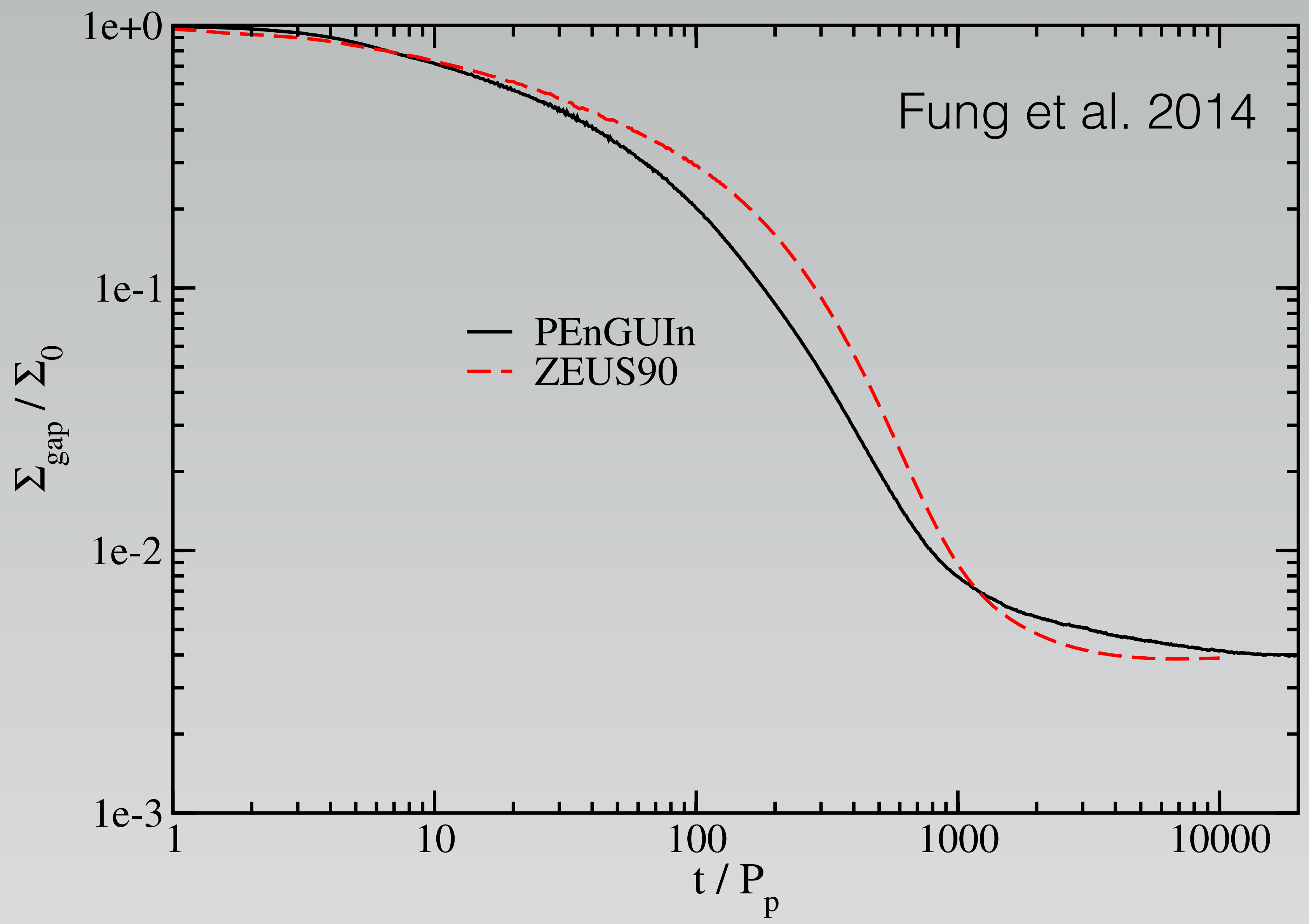
Properties of the underlying planetary system (if present) may be inferred from the disk geometry.

Constrain planet and disk parameters by comparing our data with hydro models.

Simulations

$$\Sigma_{\mathrm{gap,wall}}(q, \alpha, h/r)$$

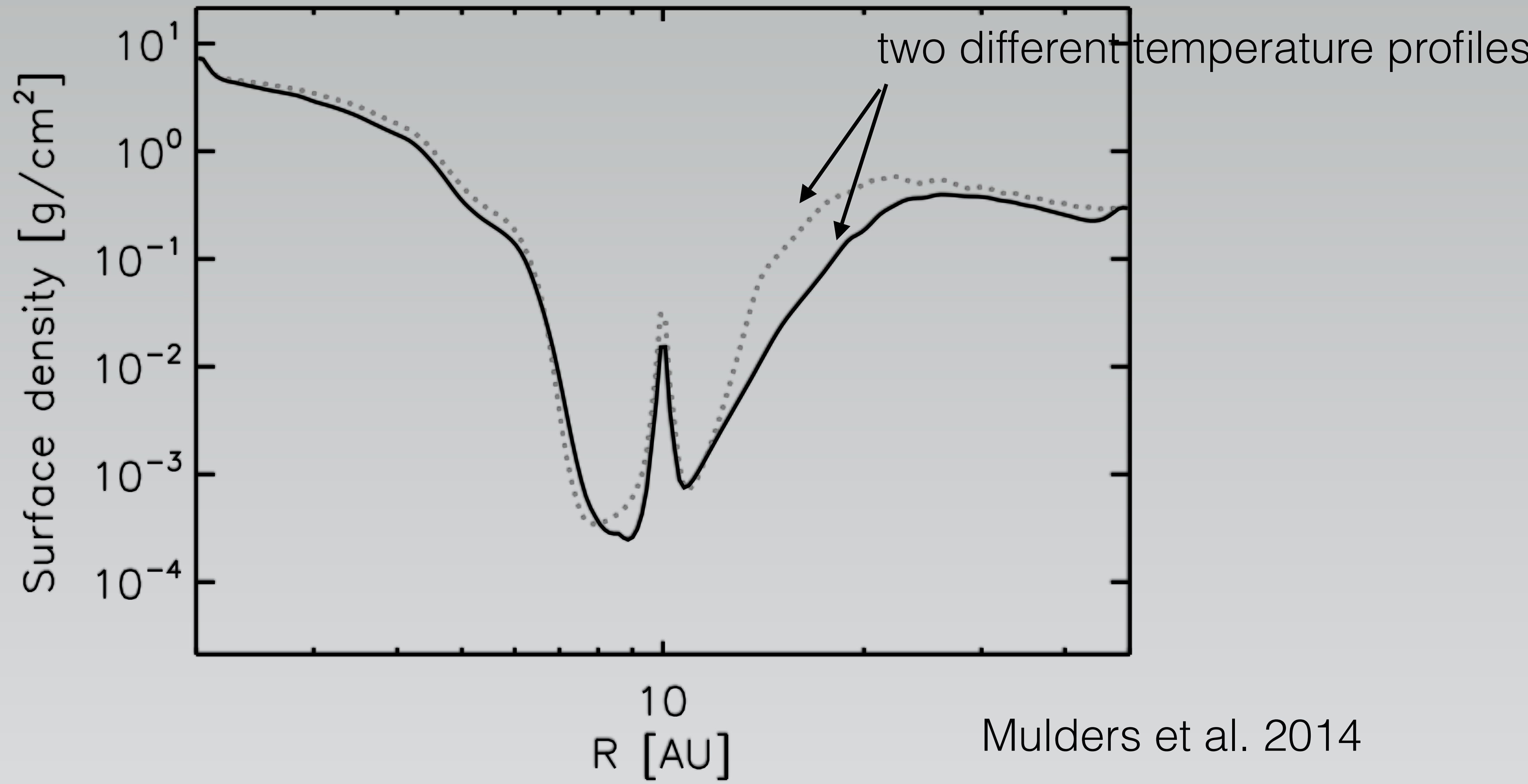
1) resolve the disk well in 2D, and hopefully 3D
2) cover a large range of density gradients
3) the gap converges to a steady state
4) planet accretion



Simulations

$$\Sigma_{\mathrm{gap,wall}}(q, \alpha, h/r)$$

1) resolve the disk well in 2D, and hopefully 3D
2) cover a large range of density gradients
3) the gap converges to a steady state
4) planet accretion



Mulders et al. 2014

Large gap probably carved by a companion object. (photoevaporation ruled out by accretion and amount of gas)

For the contrast we see in gas, the planet must be between 1 and 10 Jupiters.

We now know there are about 2 Jupiter masses of gas available inside the cavity.

(Perez et al. submitted)

Now let's hear Simon, Valentin and Francois!