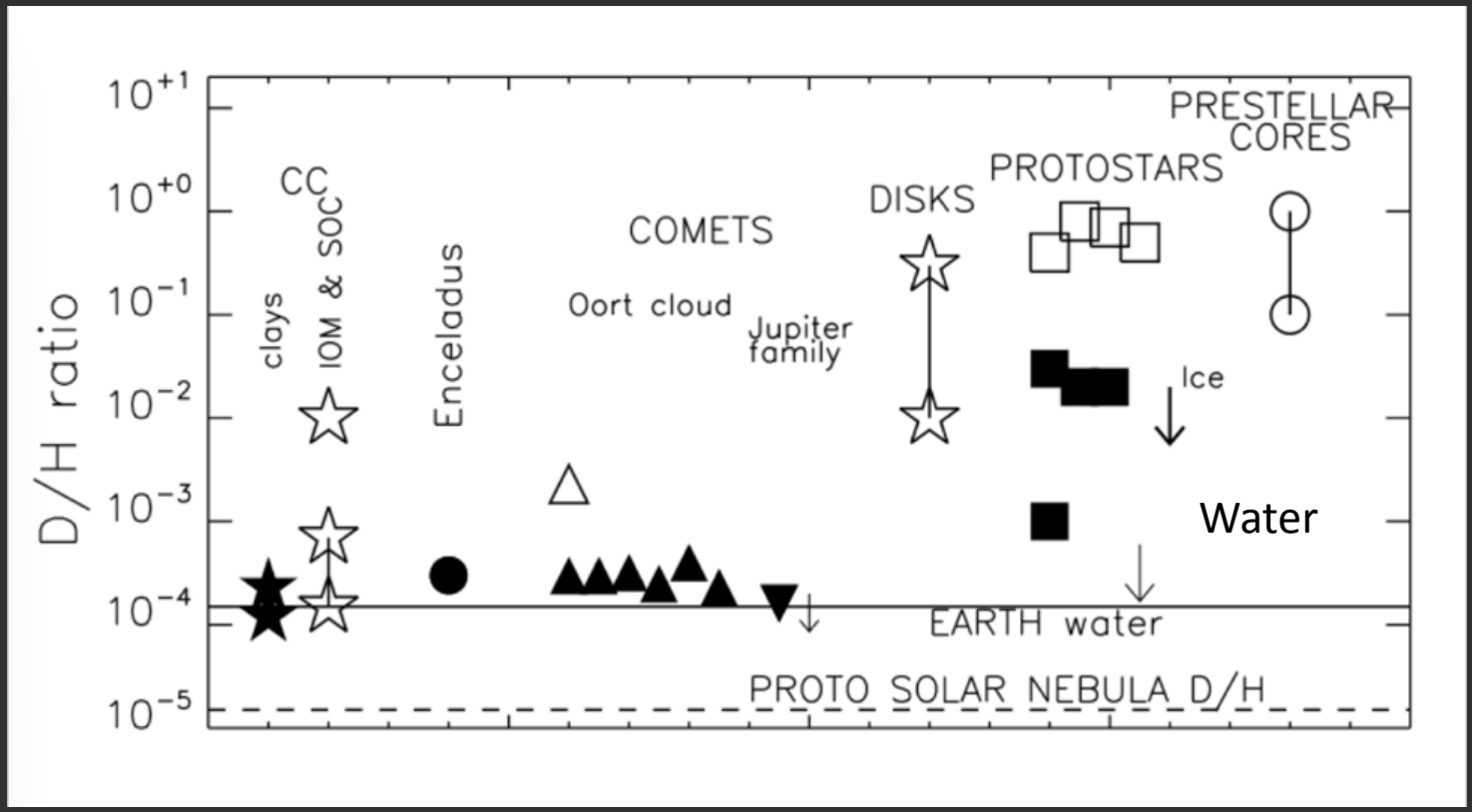
Hot and dense water in the inner 25 AU of SVS13A: (from Class 0 to Class I objects)

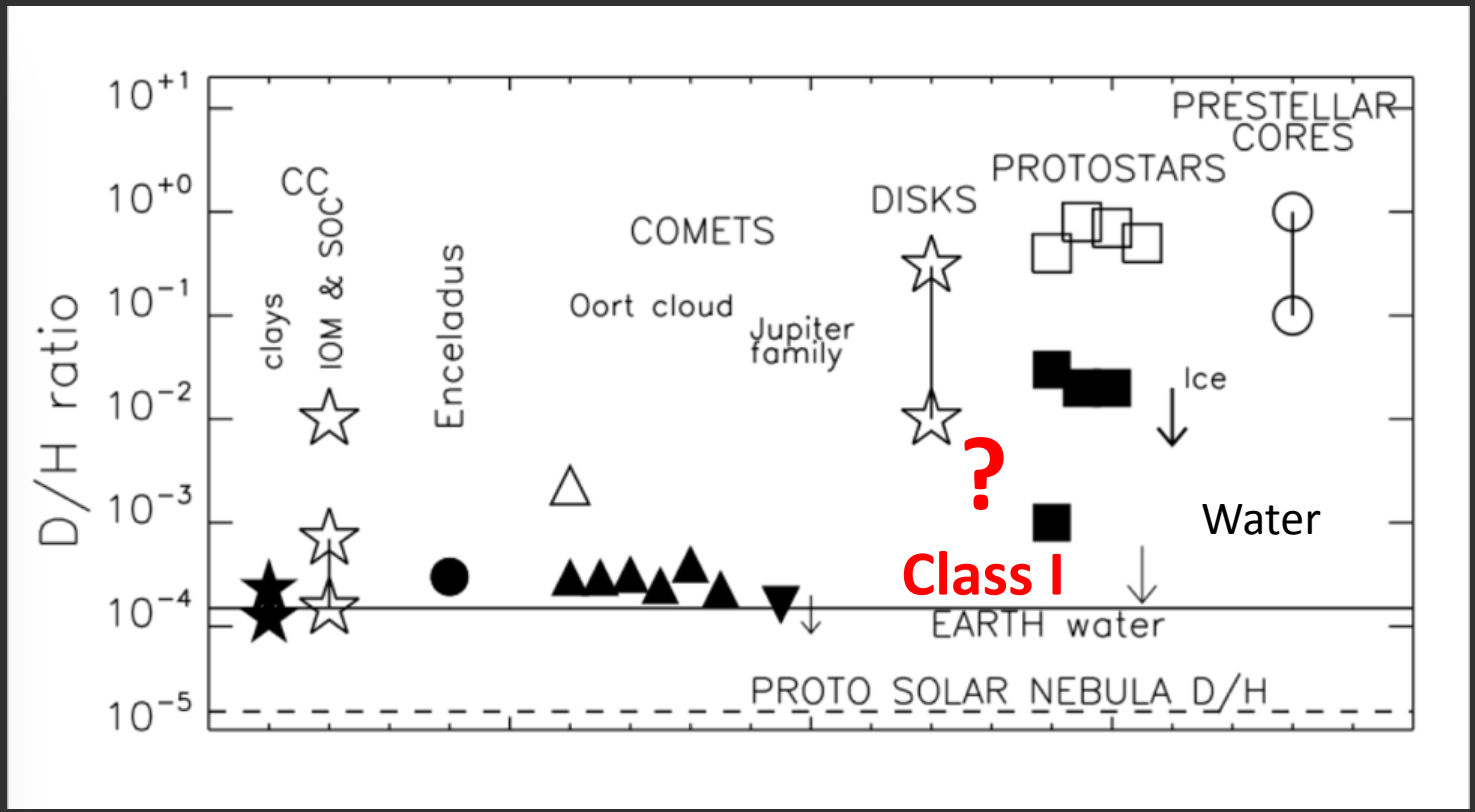
C. Codella (INAF, OA Arcetri)

Deuteration: the Ariadne's thread from prestellar to comets…. (Ceccarelli et al. 2014)



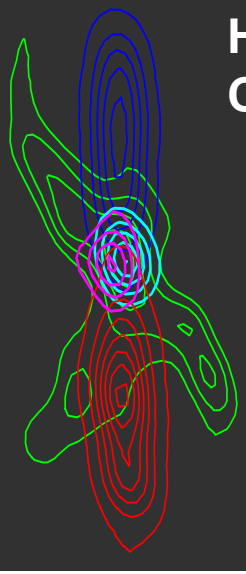
Time

Deuteration: the Ariadne's thread from prestellar to comets….
(Ceccarelli et al. 2014)



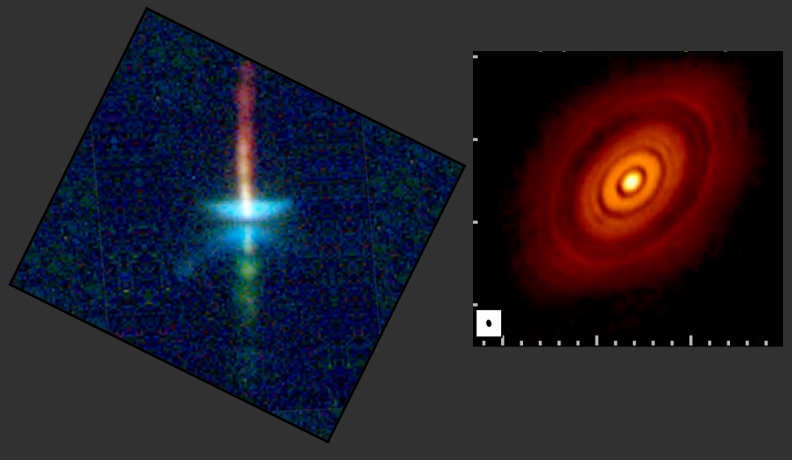
Time

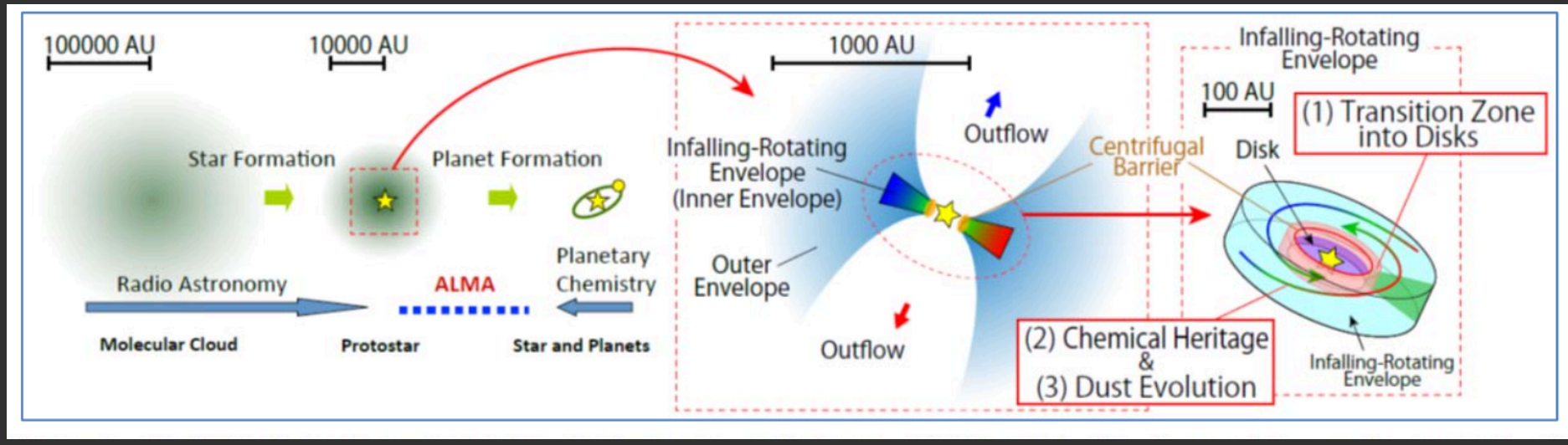
Ingredients for the Sun-like star formation recipe



HH 212
Class 0

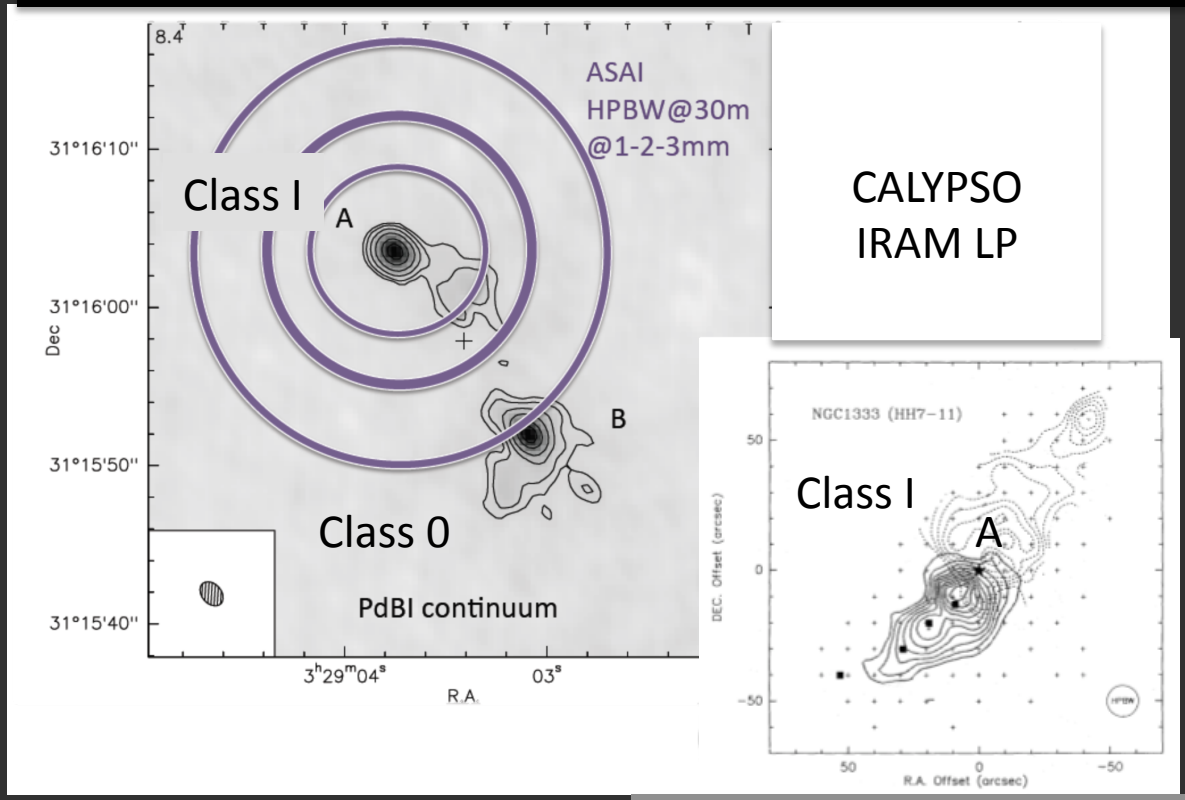
HH 30 - HL Tau





S. Yamamoto: FAUST synergy ©

The SVS13-A: a Class I laboratory

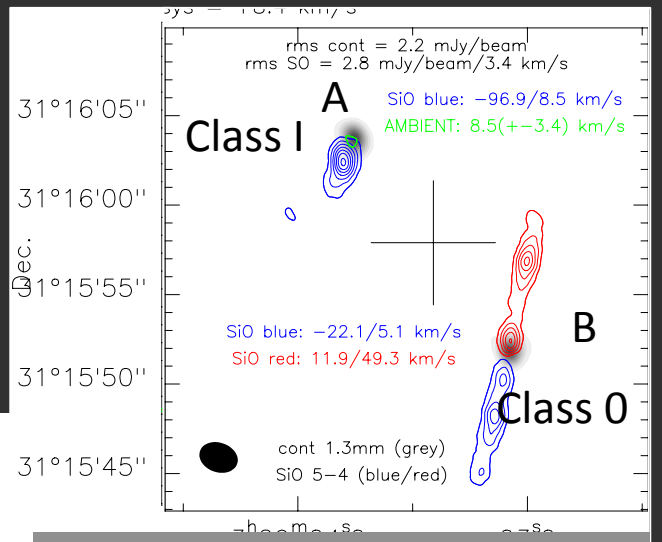


CALYPSO
IRAM LP

Bachiller & Cernicharo (1990)

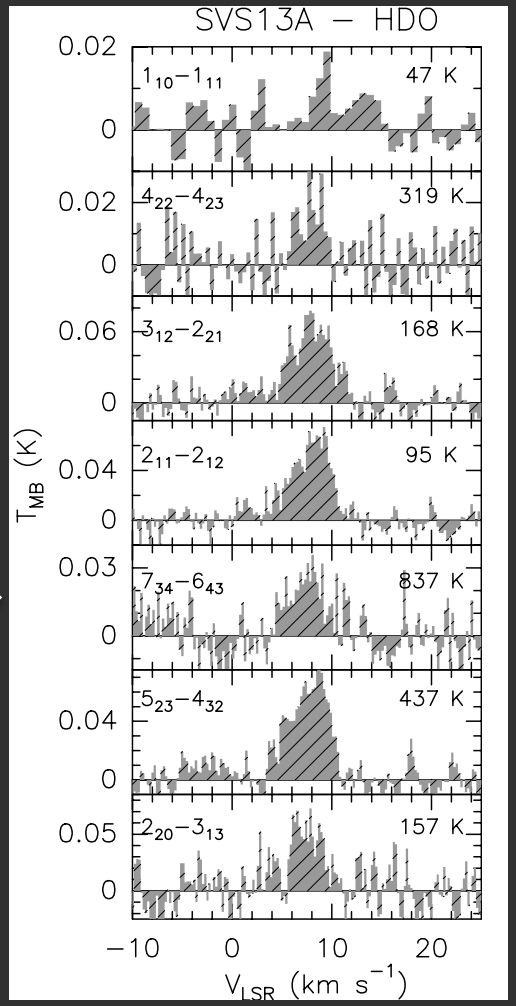
IRAM 30m Large Program
(PI B. Lefloch & R. Bachiller)
Arcetri leads the WG on D/H

Unbiased spectral surveys
(80-280 GHz)
HPBW = 9" - 31"



Podio et al. (in preparation)

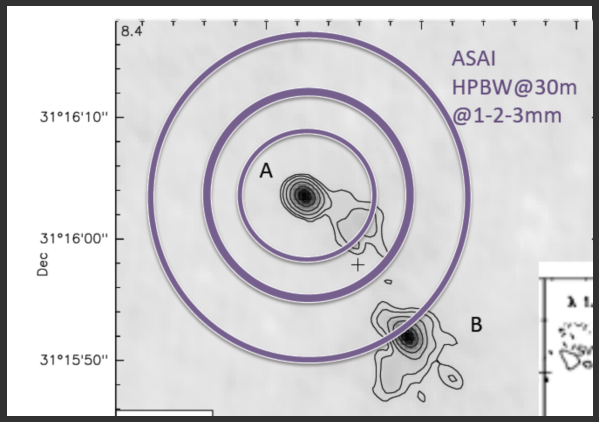
HDO survey towards SVS13-A



837 K

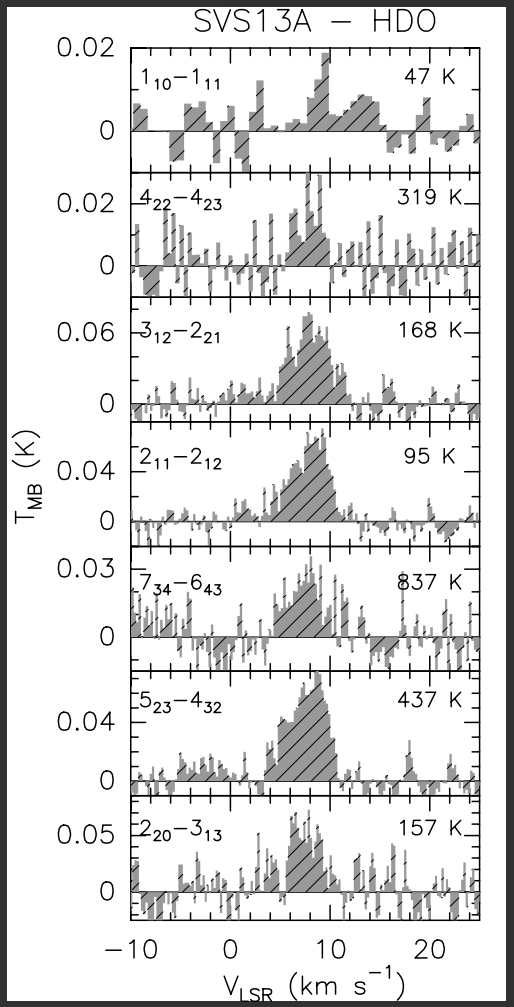
Codella et al. (2016)

7 HDO lines
Eu = 47 – 837 K
Vpeak close to VLSR
FWHM ~ 4-5 km/s

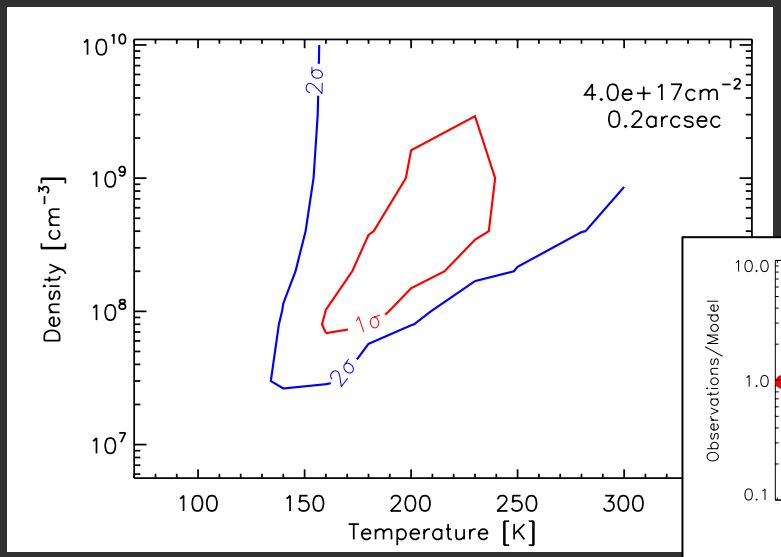


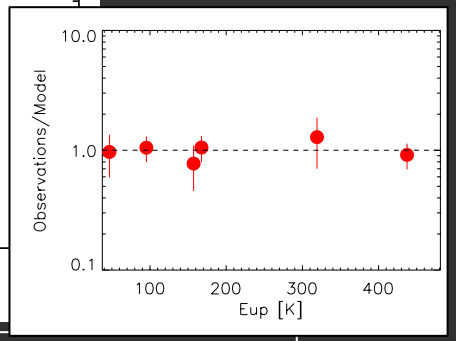
5 over 7 HDO lines
Observed with a HPBW < 11"
SVS13-A (Class I) is the emitting source
(and not SVS13-B, Class 0)

HDO survey towards SVS13-A



Codella et al. (2016)





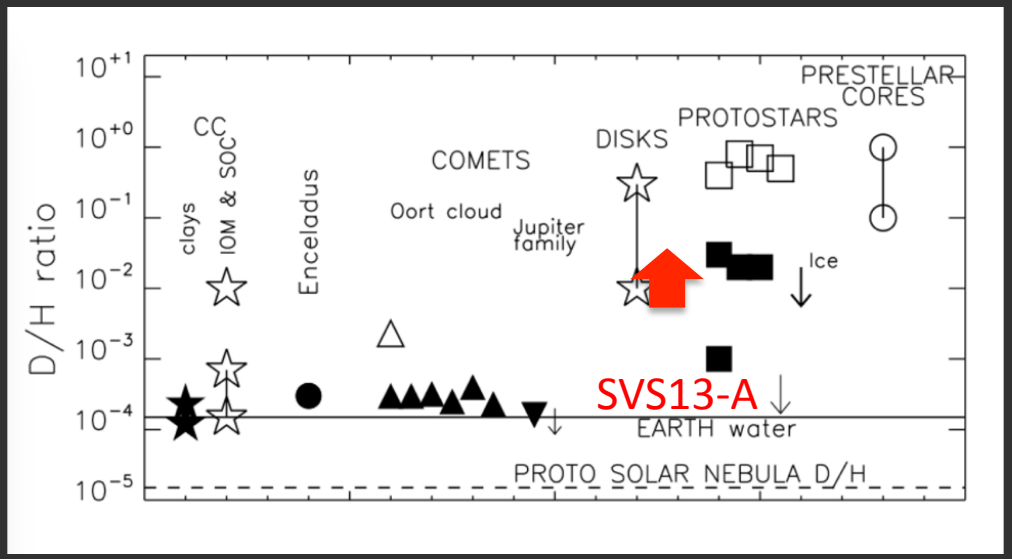
LVG analysis:

Hot (150 – 260 K); Dense (> 3 x 10^7 cm^{-3})
Compact (50 AU)

First hot-corino around a Class I protostar?
We need iCOMs ! (see the poster by De Simone et al. on glycolaldehyde)

Are we tracing a region inside the radius where water ices sublimate?

Water deuteration towards SVS13-A



If we assume
$X(H_2O) < 2\ 10^{-4}$

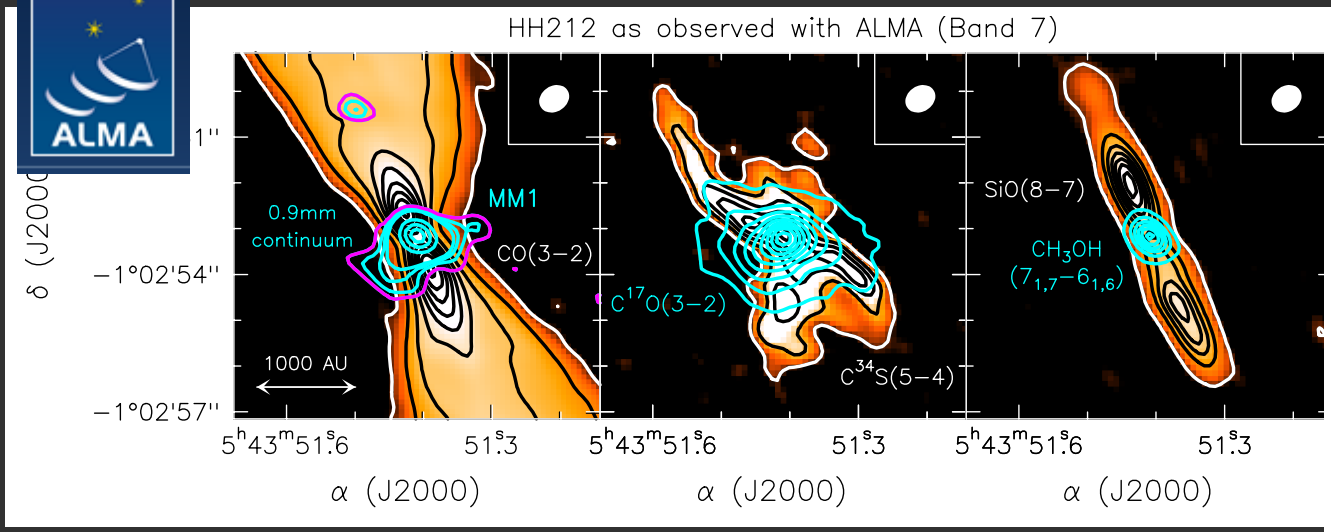
Then:
$D/H > 2\ 10^{-2}$

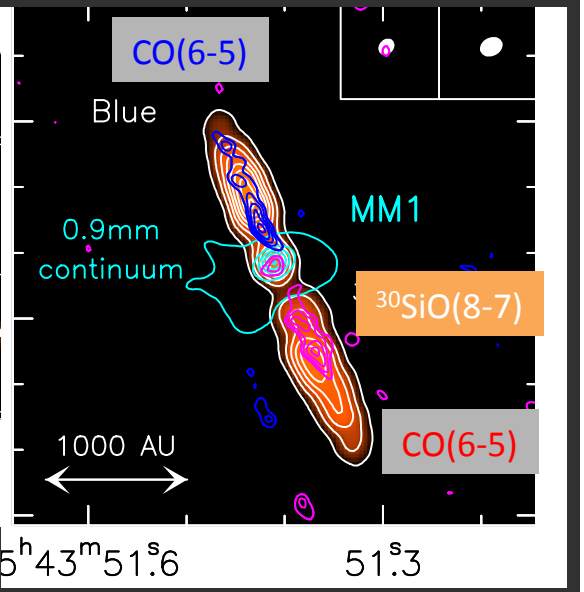
Ceccarelli et al. (2015), Bianchi et al. (2016)

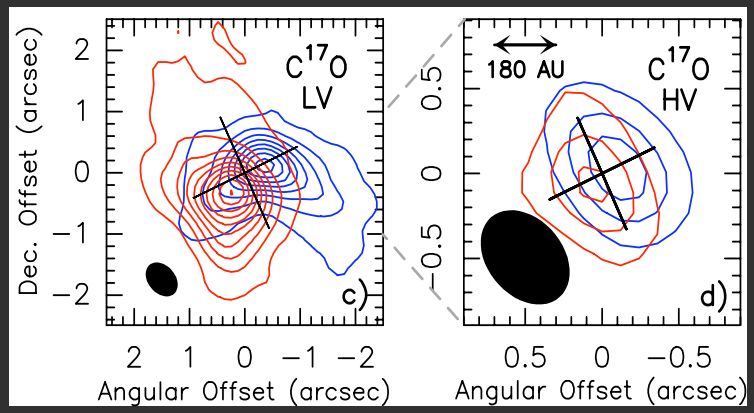
See Bianchi's talk on CH_3OH and H_2CO deuteration !

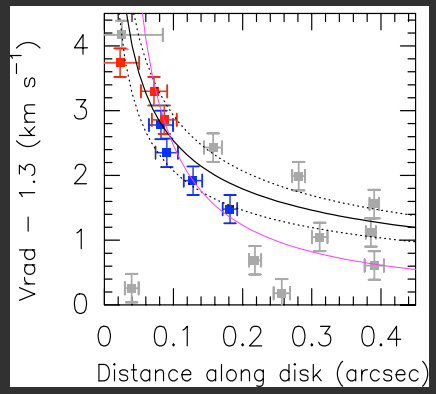
We need interferometric (ALMA) studies.....

The inner 100 AU of a Class 0: HH212-land





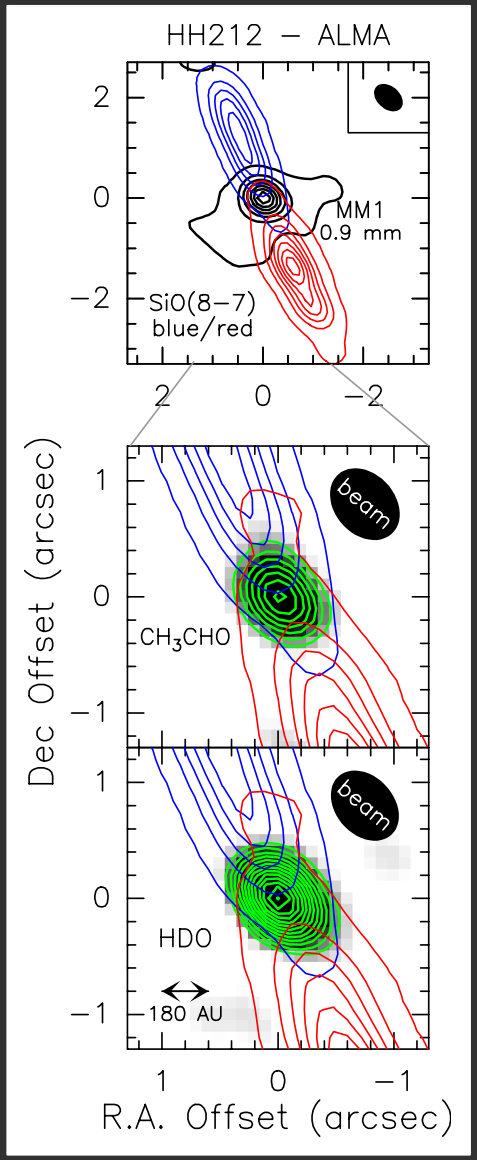


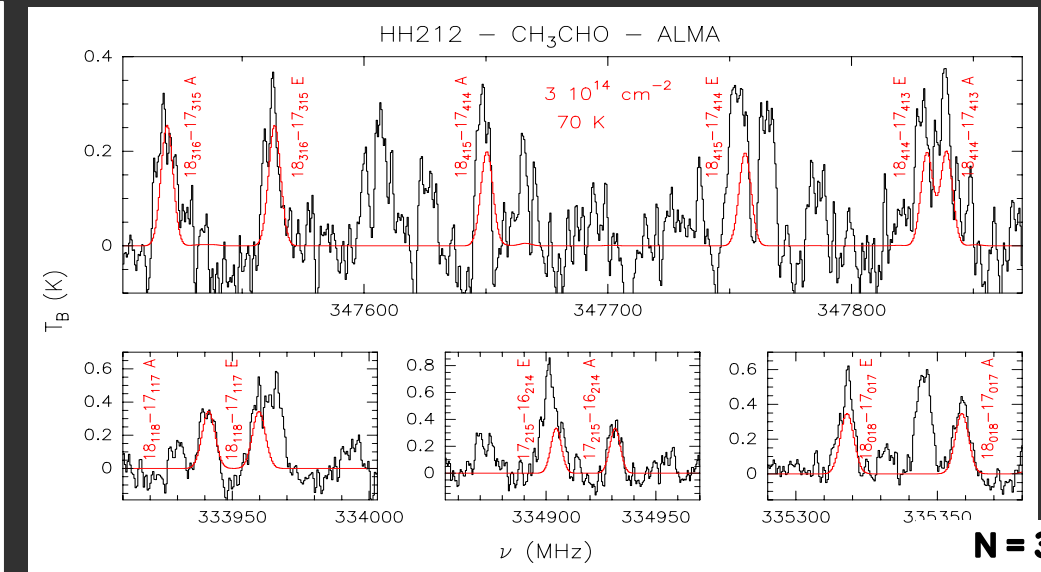


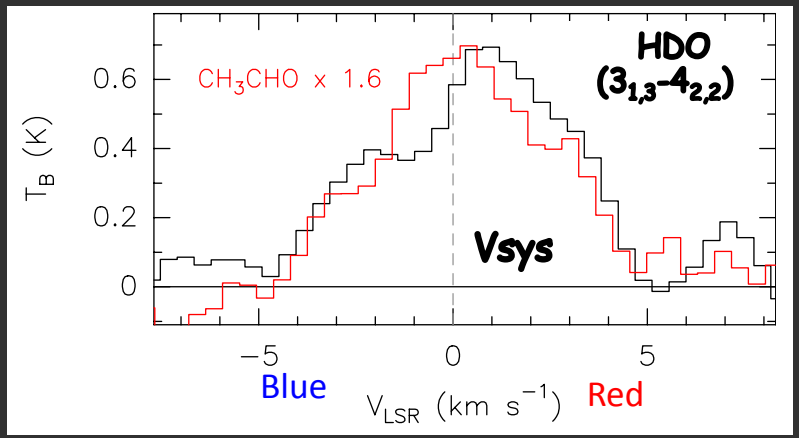
Codella et al. (2014, 2016), Gueth et al. (in preparation)

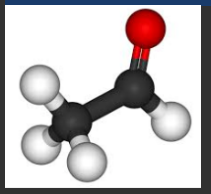
These findings are consistent with keplerian rotation out to 90 AU around a 0.3±0.1 $M_\odot$

The inner 100 AU: The jet, the disk, and the wind









N = 3(2) x 10^{14} cm^{-2}

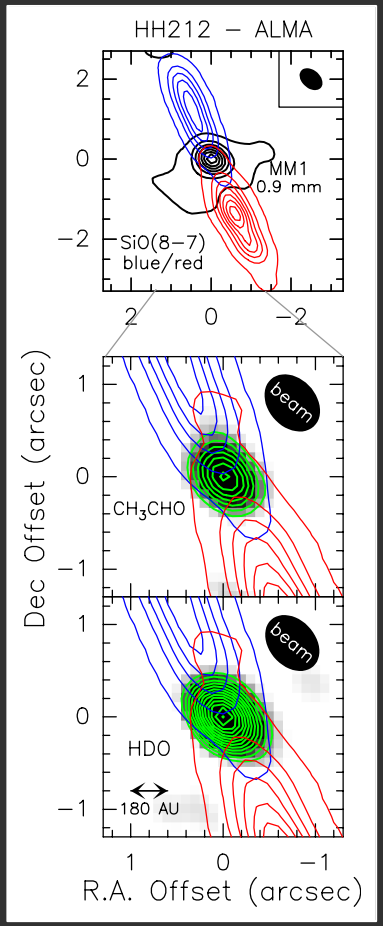
Trot = 87(47) K

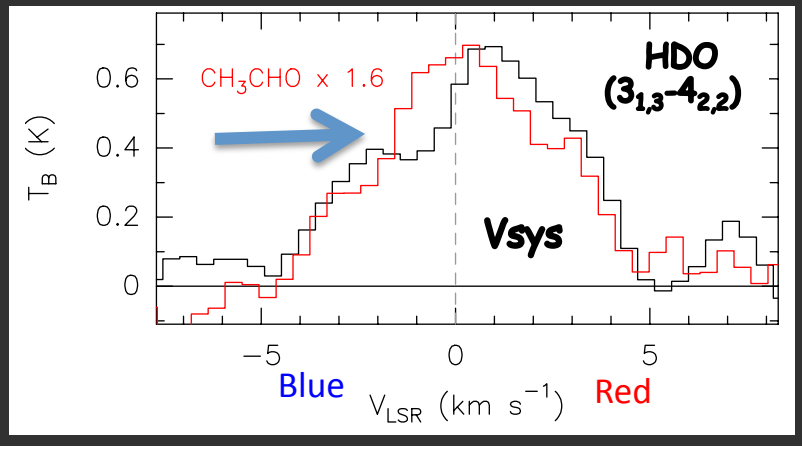
X(CH_3CHO) = 10^{-9}-10^{-8}

VERY High-Eu (up to 335 K) CH_3CHO and HDO compact (< 100 AU) emission

Codella et al. (2016)

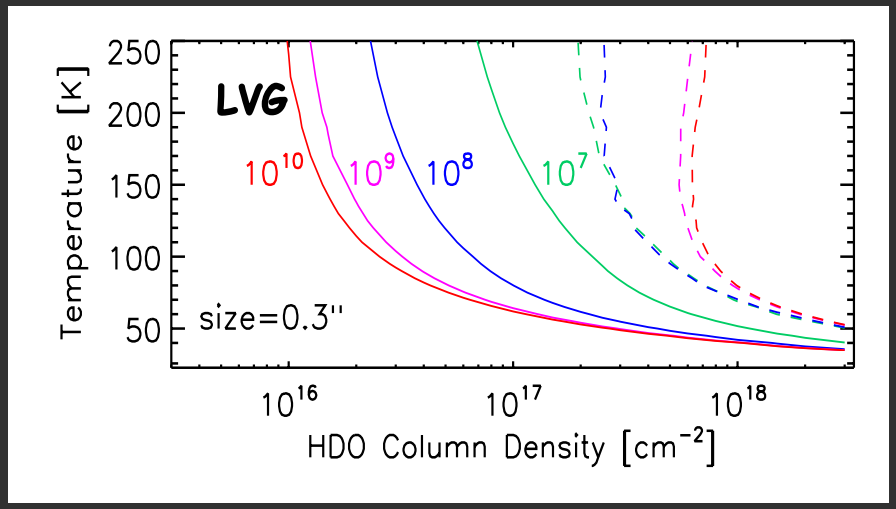
The inner 100 AU: The jet, the disk, and the wind





Asymmetric broad (6 km s^{-1}) HDO profile:

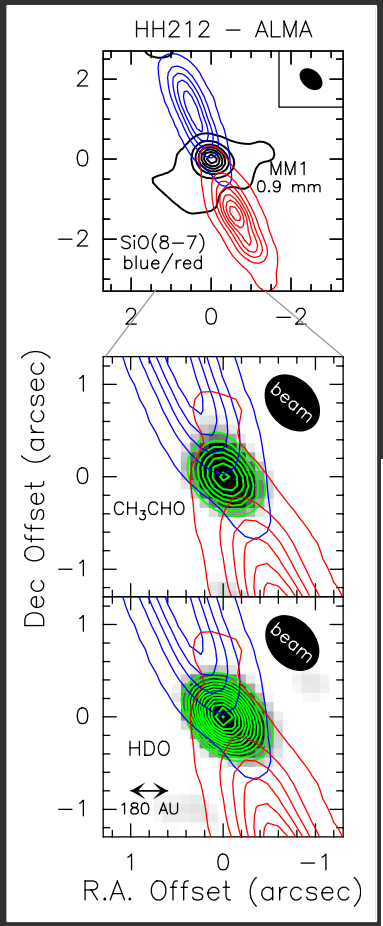
Red brighter than blue: indicating outflowing (and compact) gas

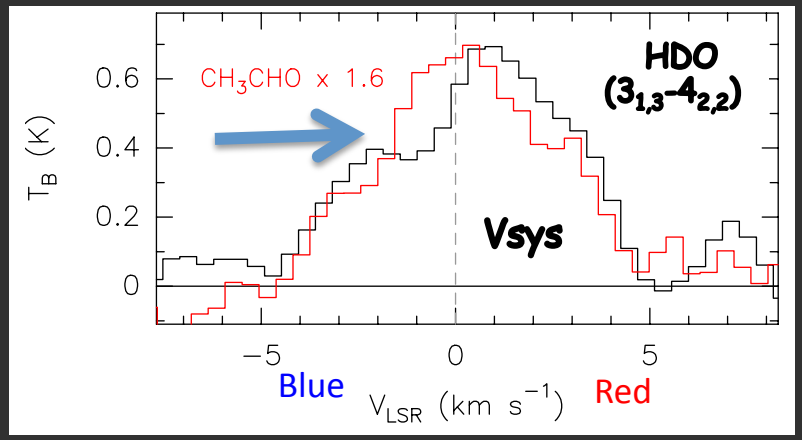


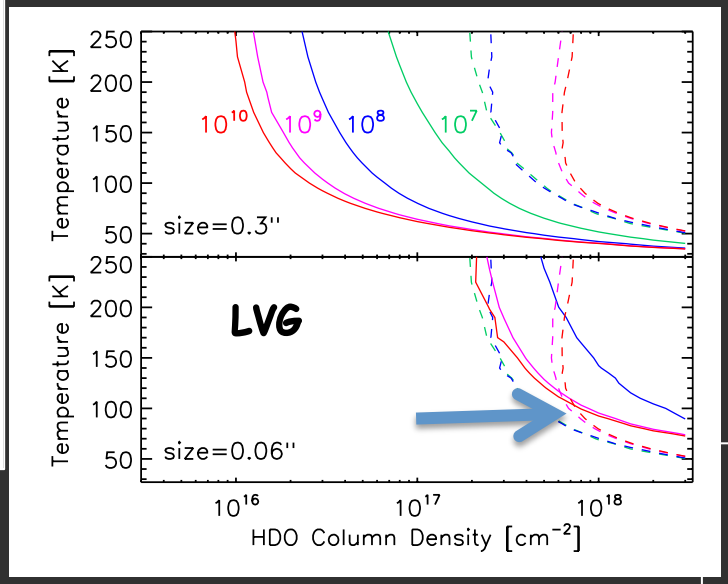
If we assume X(HDO) < 0.1 (D/H)el then $n_{H2} > 10^7$ cm^{-3}

Codella et al. (2016)

The inner 100 AU: The jet, the disk, and the wind







Asymmetric broad (6 km s^{-1}) HDO profile:

Red brighter than blue: indicating outflowing (and compact) gas

What happens if the HDO emission is optically thick?

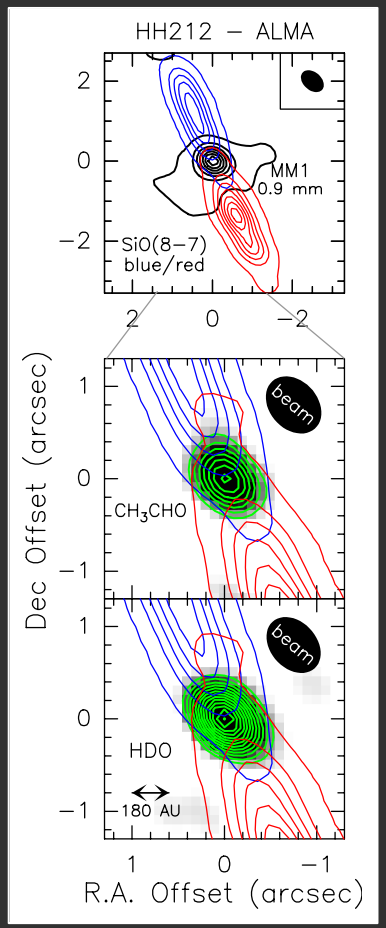
⬇

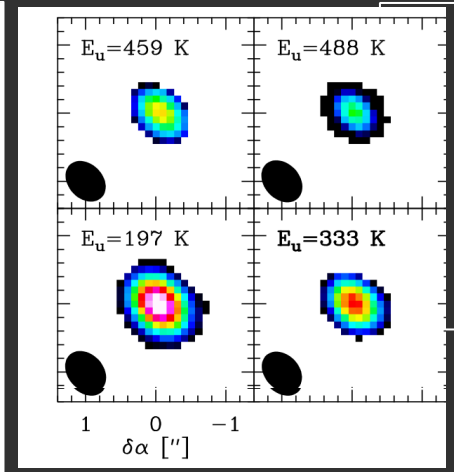
Extremely small (18-37 AU) and dense (> 10^9 cm^{-3}) gas. Tkin ~ 100 K

<u>If</u> so, we could <u>speculate</u> we are observing a signature of a disk wind gas, accelerated at the base

Codella et al. (2016)

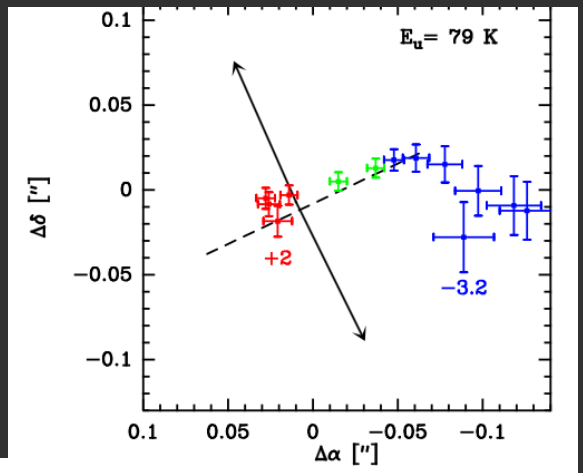
The inner 100 AU: methanol !





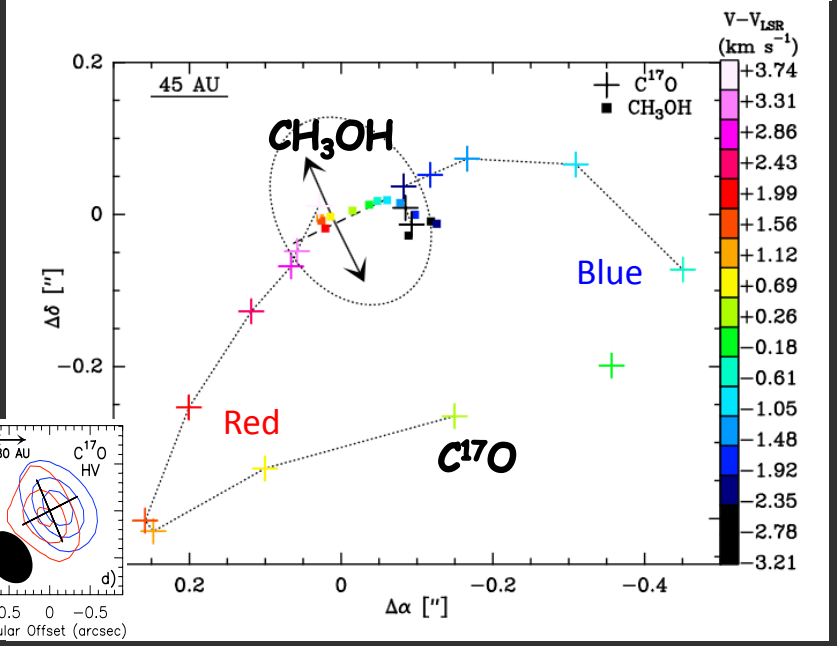
Methanol emission
up to Eu = 747 K
FWHM = 4-5 km/s

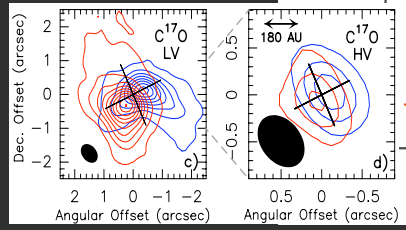
Radius < 75 AU
T ~ 300 K



The velocity increases moving away from the protostar
Disk: no
Outflowing gas: yes

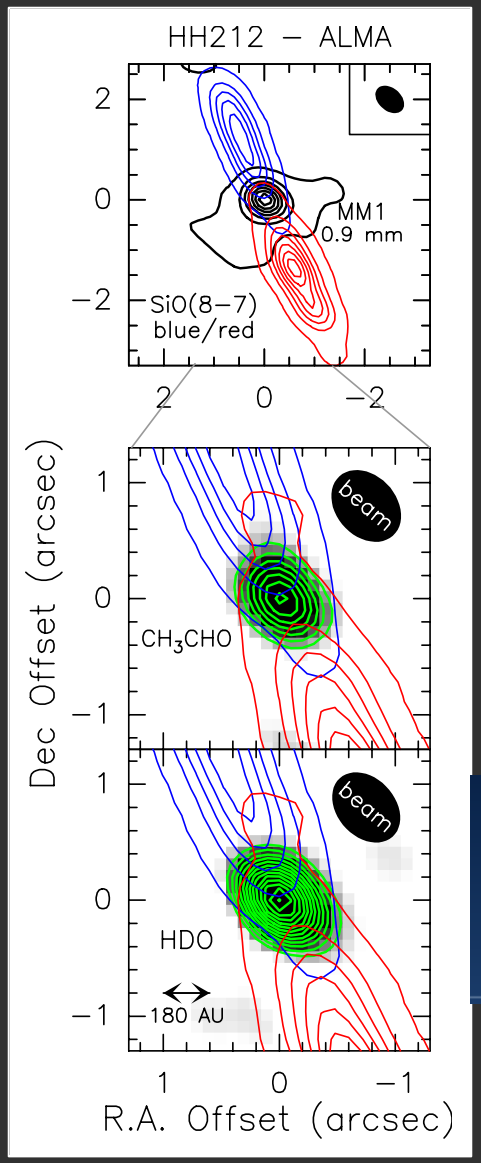
Disk wind ?
If so, launching radius around 1 AU





Leurini et al. (2016)

Conclusions



Deuterated water as a powerful tool to knock at the 10-20 AU door of a protostar

Water deuteration does not decrease from Class 0 to Class I ?

Perfect ALMA cases….