CHESS

CHEMICAL HERSCHEL SURVEYS OF STAR FORMING REGIONS

# News from CHESS

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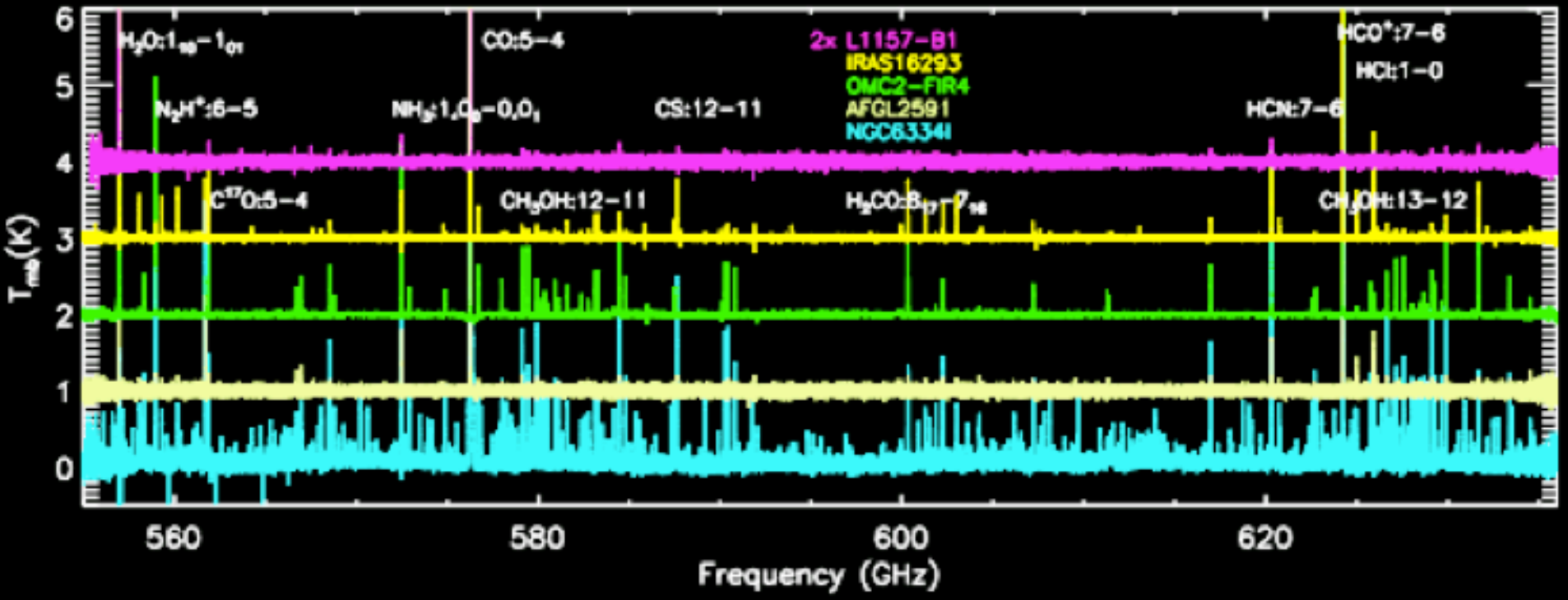
(on behalf of C. Ceccarelli)

HDO/$H_2O$ workshop. Garching, 15 Jan 2013

# CHESS overview: Band 1b




Ceccarelli, C., Bacmann, A., Boogert, A. et al. 2010, A&A, 521, 22

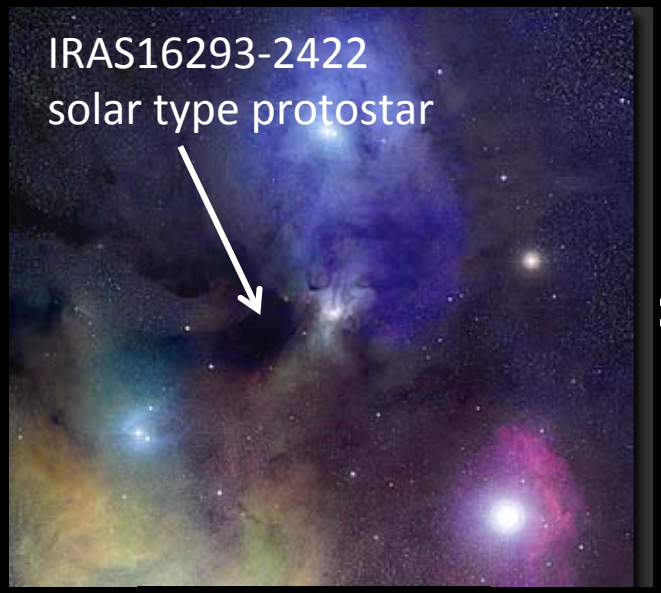
*Herschel*-HIFI unbiased spectral surveys of a sample of star forming regions covering a range of masses and evolutionary phases

# CHESS & HDO

| Source | Distance (pc) | Luminosity (Lo) | Type |
|---|---|---|---|
| L1544 | 120 | - | "Cold" Pre-Stellar Core |
| I16293E | 120 | - | "Warm" Pre-Stellar Core |
| L1157-B1 | 220 | - | Outflow shock spot |
| IRAS16293-2422 | 120 | 21 | Class0 low mass protostar |
| NGC1333-I4 | 250 | 40 | Class0 low mass protostar |
| OMC2-FIR4 | 440 | $1x10^3$ | Intermediate mass protostar |
| AFGL2591 | 1000 | $2x10^4$ | High mass protostar |
| NGC6334I | 1700 | $2x10^5$ | High mass hot core |
| NGC6334N | 1700 | $2x10^4$ | High mass hot core |
| W51e | 7000 | $2x10^6$ | High mass hot core |

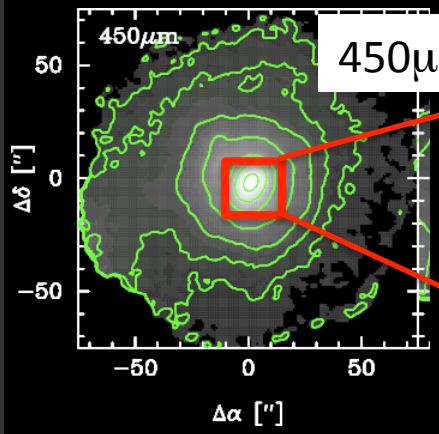
Studies of water deuteration only for 2 sources so far

# The low-mass protostar IRAS 16293-2422



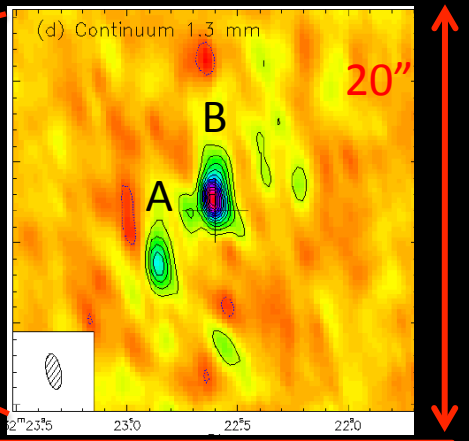

d = 120 pc

Schöier et al. 2002




450μm

Bottinelli et al. 2004




2-$M_{sun}$ ENVELOPE + BINARY SYSTEM +
a little of OUTFLOW in the HIFI BEAM (~36" @ 550GHz)

Dataset:

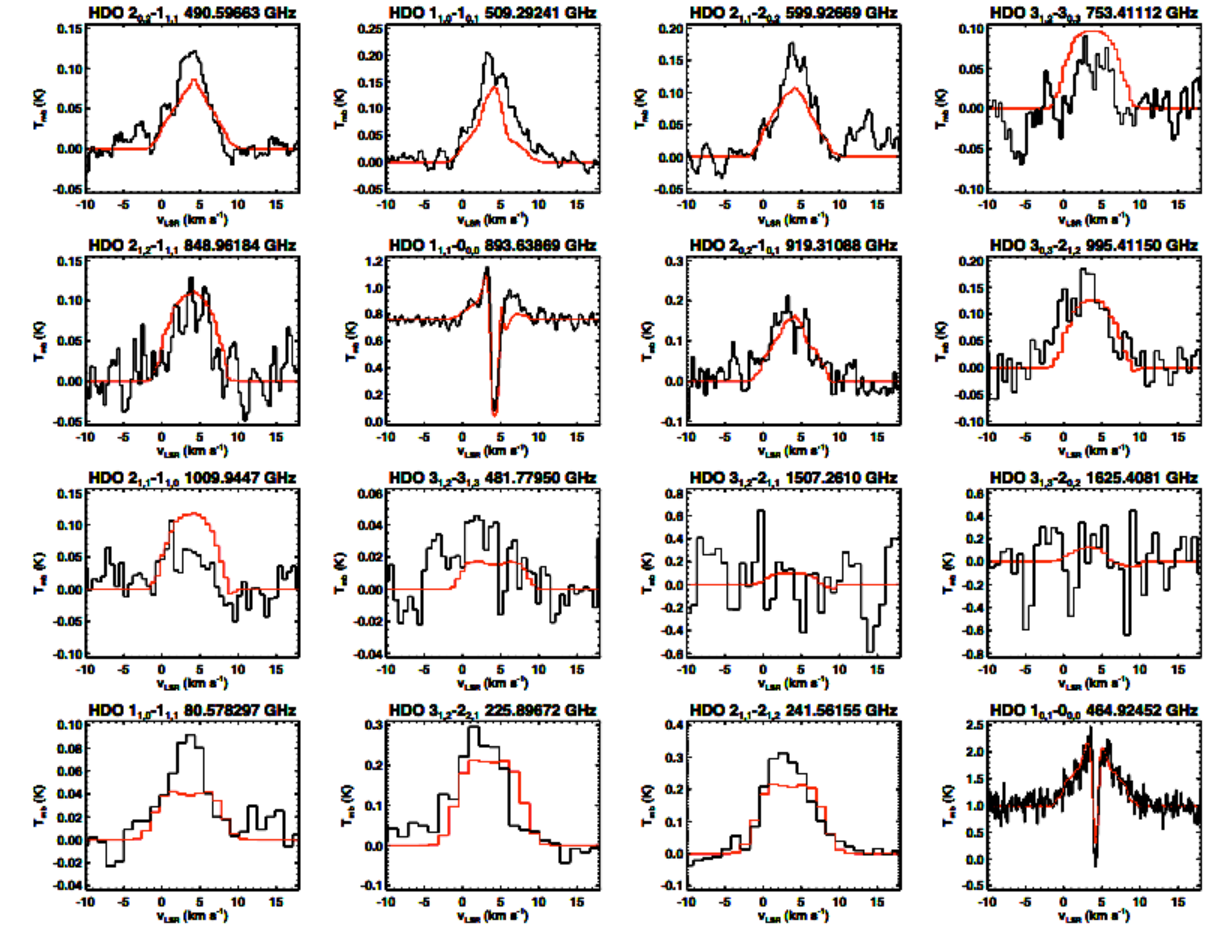
- CHESS HIFI spectrum (480-1900 GHz)
- IRAM+JCMT spectral surveys: TIMASSS (3-0.8 mm)

# The low-mass protostar IRAS 16293-2422

16 HDO lines
$E_{up}$ = 22 – 170 K

15 $H_2{}^{18}O$ lines
$E_{up}$ = 53 – 450 K

Coutens et al. 2012, A&A, 539, 132

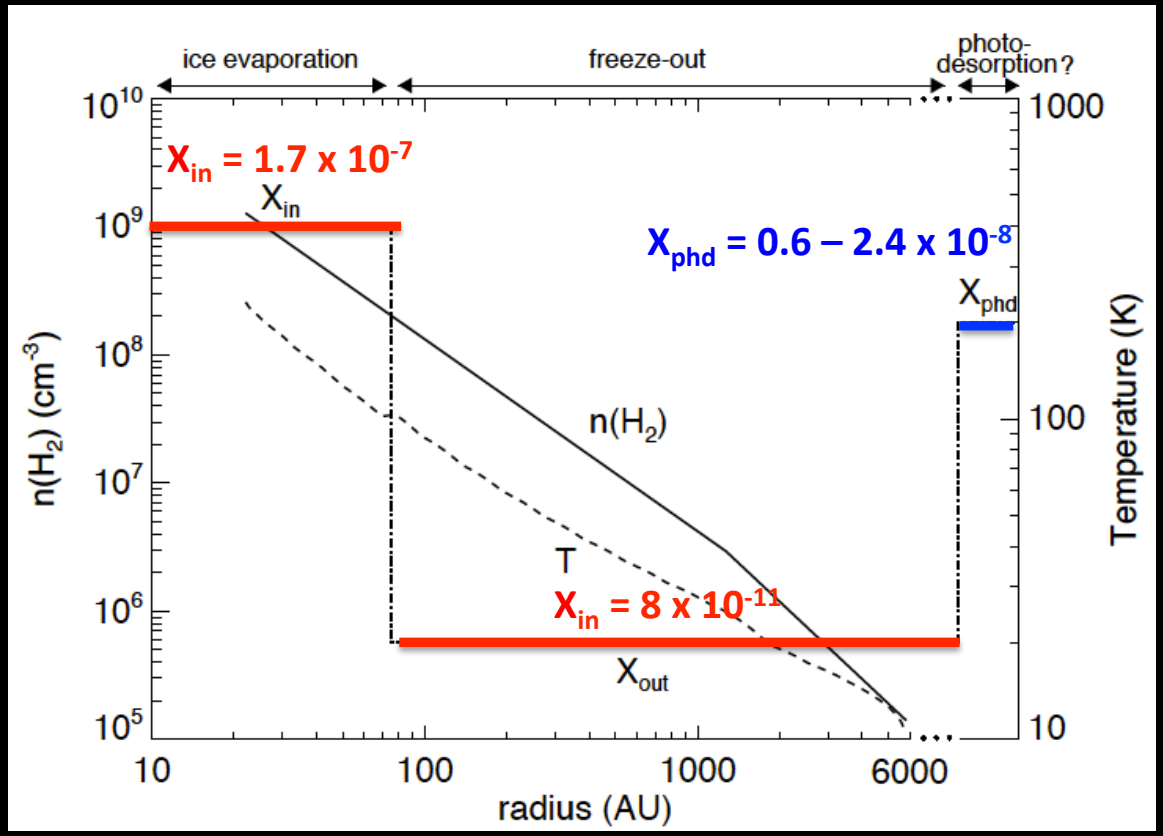



**OBSERVED** and **MODELED** HDO SPECTRA

# The low-mass protostar IRAS 16293-2422

Modelling: RATRAN code (Hogerheijde & van der Tak 2000)

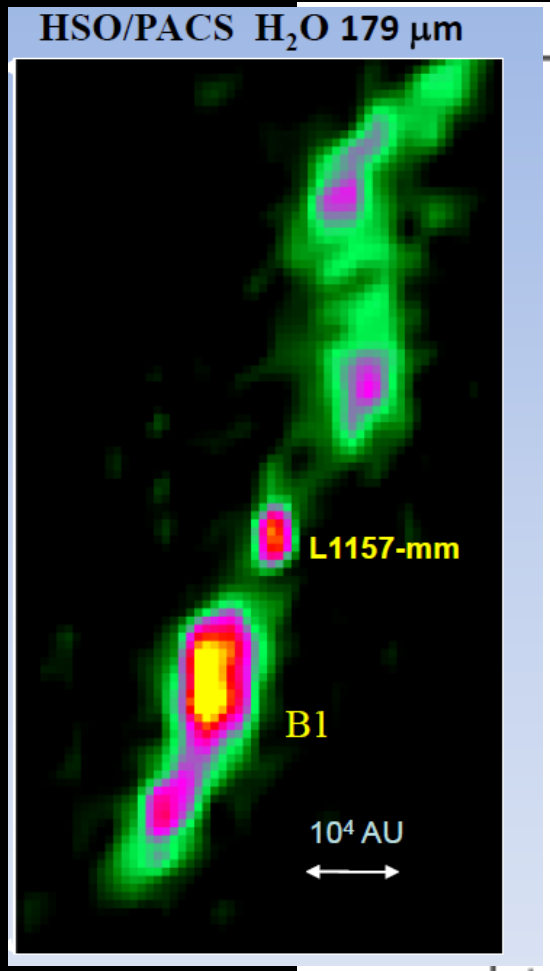
Source structure from Crimier et al. (2010)

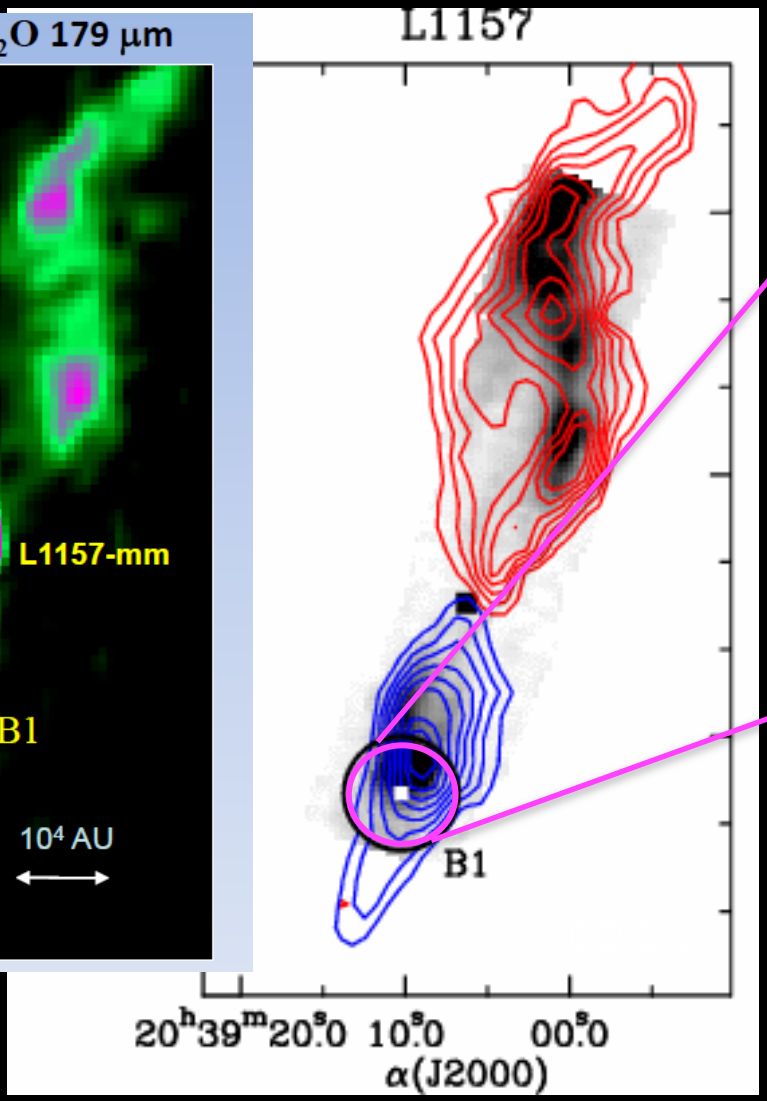


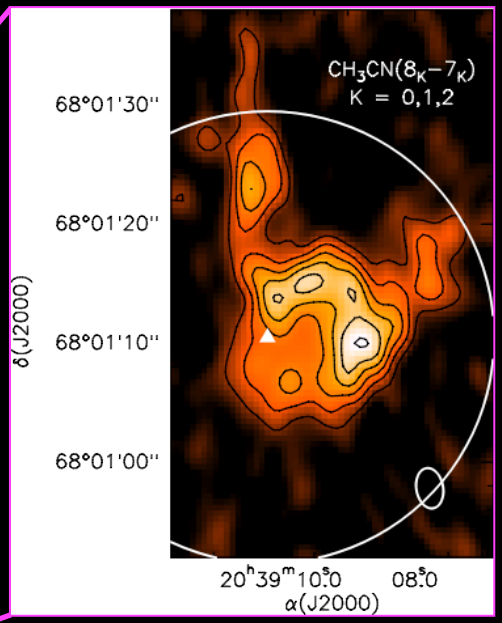

HDO/$H_2O$ ratio:
Inner: 3.4 %
Outer: 0.5 %
Abs layer: ~ 4.8 %

Coutens et al. 2012, A&A, 539, 132

# The outflow shock spot L1157-B1



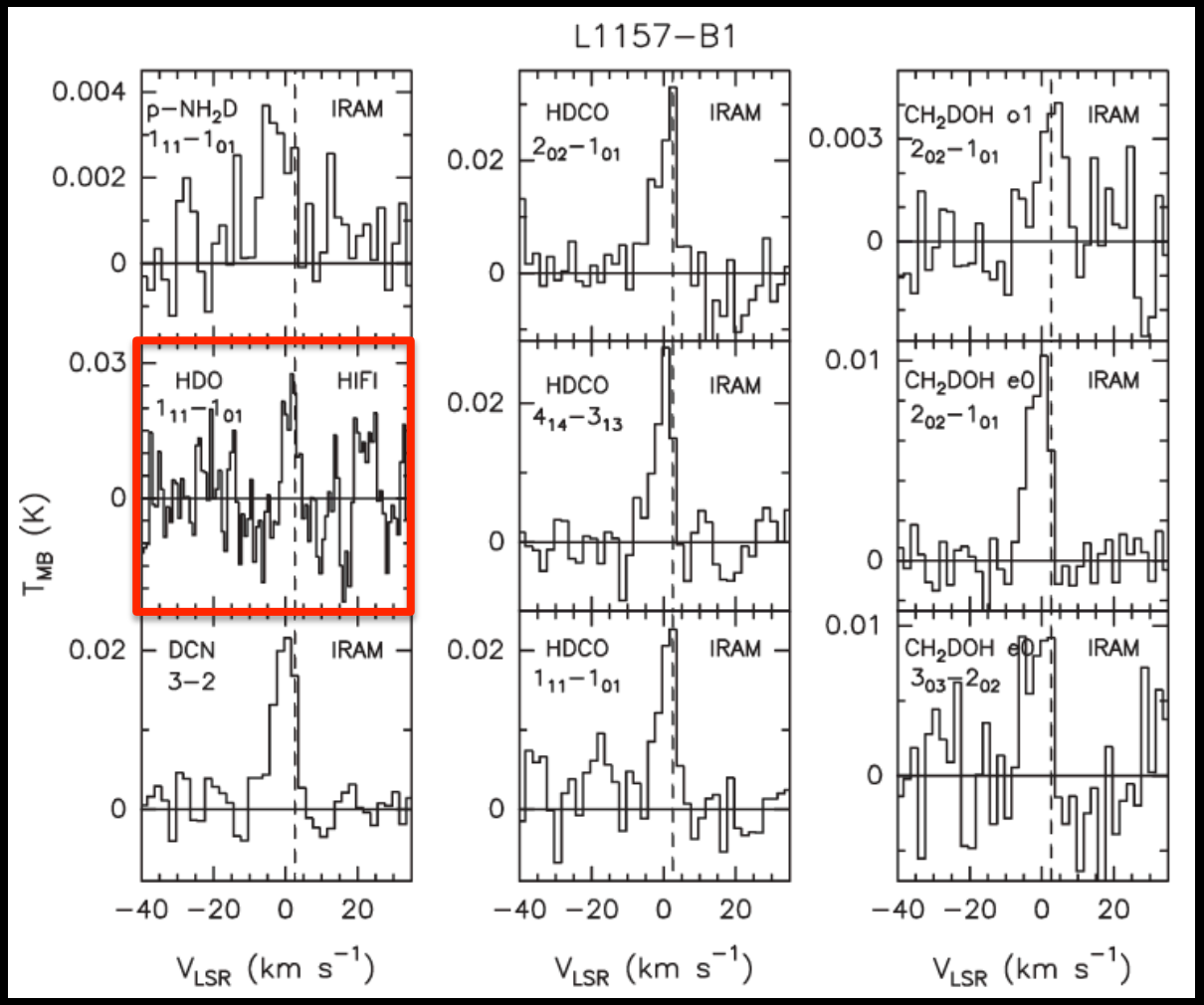

PdBI (Codella et al. 2009)

d = 250 pc

Dataset:

- CHESS HIFI spectrum (480-1900 GHz)
- IRAM spectral surveys (3-0.8 mm)

# The outflow shock spot L1157-B1



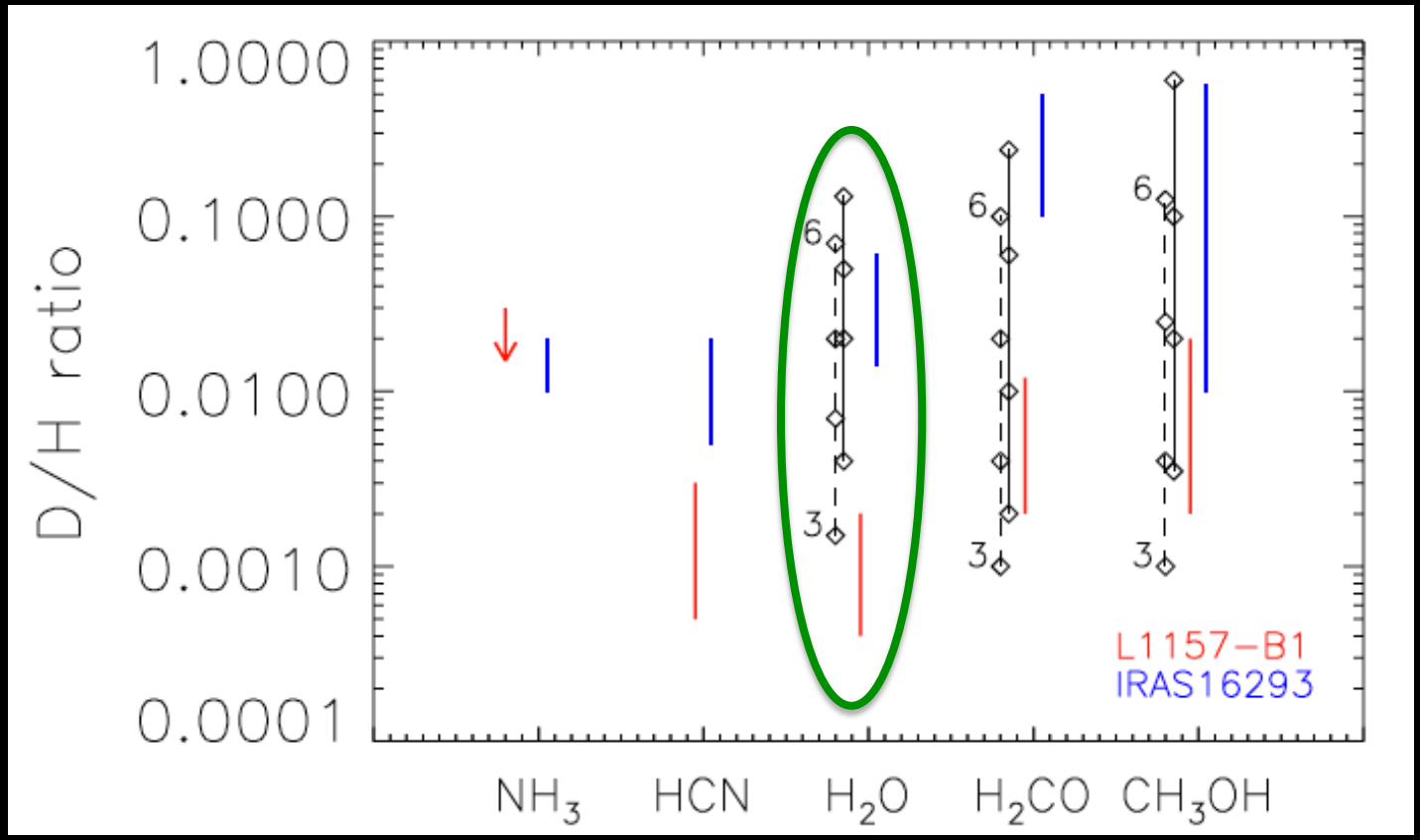

Codella et al. 2012, ApJL, 757, L9

HIFI:
HDO($1_{11}$-$1_{01}$) line
p-$H_2O$($2_{02}$-$1_{11}$) line

Column densities derived using LVG code (Ceccarelli et al. 2003)

$HDO/H_2O$ ratio:
0.04 – 0.2 %

# Comparison between the two sources




Codella et al. 2012, ApJL, 757, L9

IRAS 16293-2422: 0.5 - 5 %
L1157 - B1: 0.04 – 0.2 %

# THANK YOU