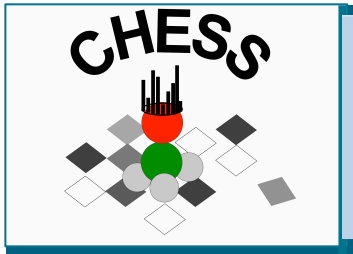
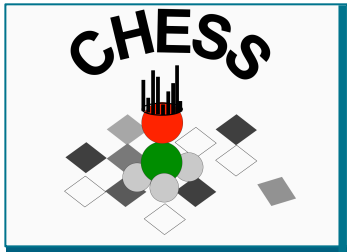


CHEMICAL HERSCHEL SURVEYS OF STAR FORMING REGIONS

http://www-laog.obs.ujf-grenoble.fr/heberges/chess/index.php

CHESS FIRST RESULTS

Cecilia Ceccarelli
A.Bacmann, A.Boogert, E.Caux, C.Comito,
C.Dominik, B.Lefloch, D.Lis, F.van der Tak
and the CHESS team



The CHESS KP in a nutshell

ULTIMATE GOAL

CHEMICAL SURVEYS during the EARLY PHASES of STAR FORMATION

FOCUS

A coherent study of the line spectra in the HIFI frequency range of Star Forming Regions

METHOD

HIFI (and PACS) unbiased spectral surveys in sources representative of SFRs and processes

QUESTIONS

What atomic/molecular lines are present? In emission or absorption? How many and when?

IMMEDIATE GOALS

Guide successive HIFI observations & provide a legacy database for the general community

Cecilia Ceccarelli

The CHESS KP in a nutshell

WHY ARE FIR/submm LINE SPECTRA SO IMPORTANT?

1. because FIR/submm lines are a very powerful *diagnostic of the physical conditions* in the Star Formation Regions (SFRs);
2. because FIR/submm lines spectra permit to reconstruct the *chemical composition* of the gas, which greatly affects the *physical and dynamical* evolution of the SFRs, and viceversa;
3. because the chemical composition in the first phases of star formation may *affect* the chemical composition of the objects that will eventually form the *planetary system*: planets, comets and asteroids.

CHESS TARGETS

From low- to high- mass protostars;
From pre- to post- collapse;
From the source to the surroundings.

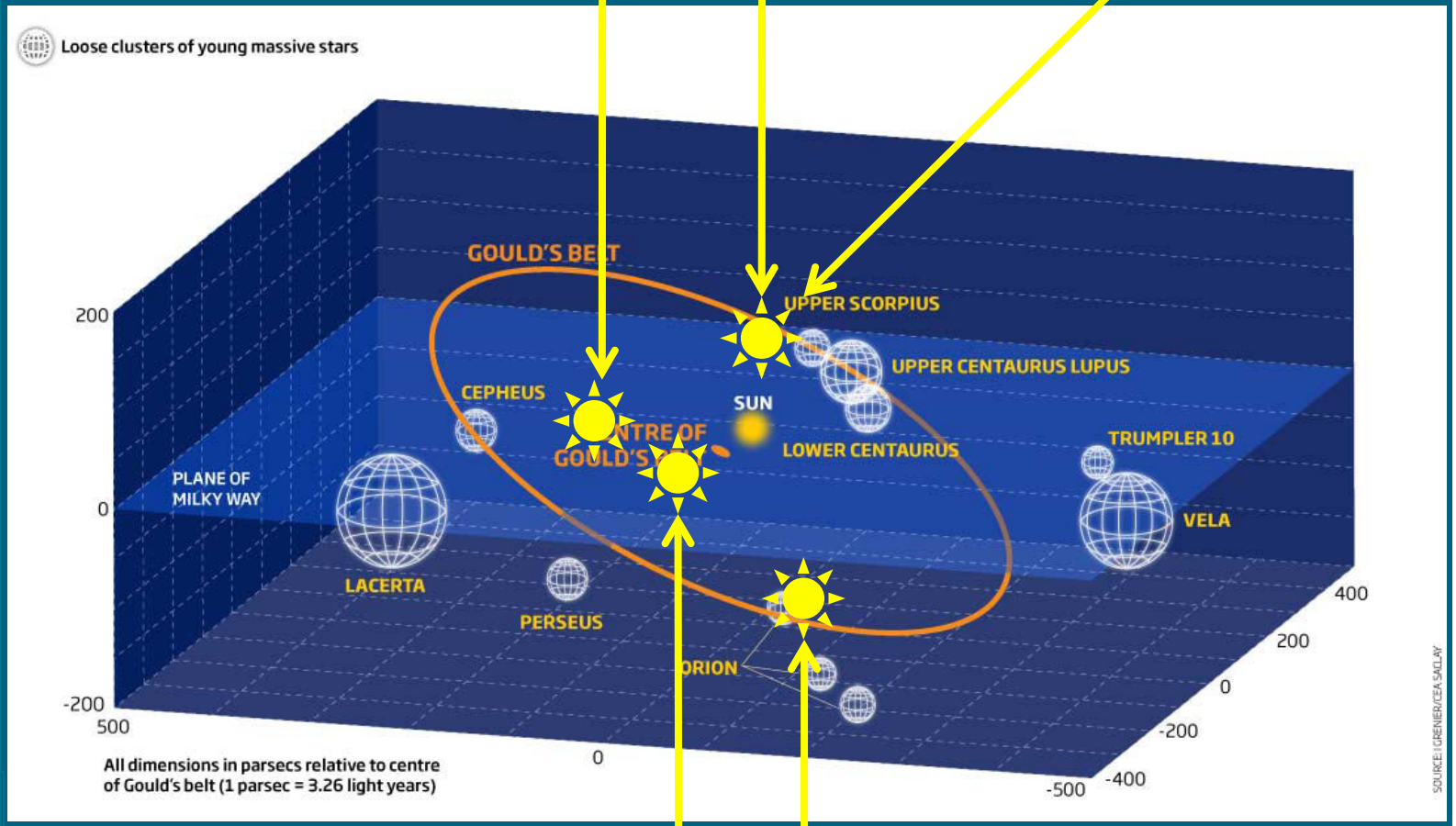
Source	Distance (pc)	Luminosity (Lo)	Type
L1544	120	-	“Cold” Pre-Stellar Core
I16293E	120	-	“Warm” Pre-Stellar Core
L1157-B	220	-	Outflow shock spot
IRAS16293-2422	120	21	Class0 low mass protostar
OMC2-FIR4	440	$1x10^3$	Intermediate mass protostar
AFGL2591	1000	$2x10^4$	High mass protostar
NGC6334I	1700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

CHESS NEARBY TARGETS

L1157-B1

IRAS16293-2422

I16293E

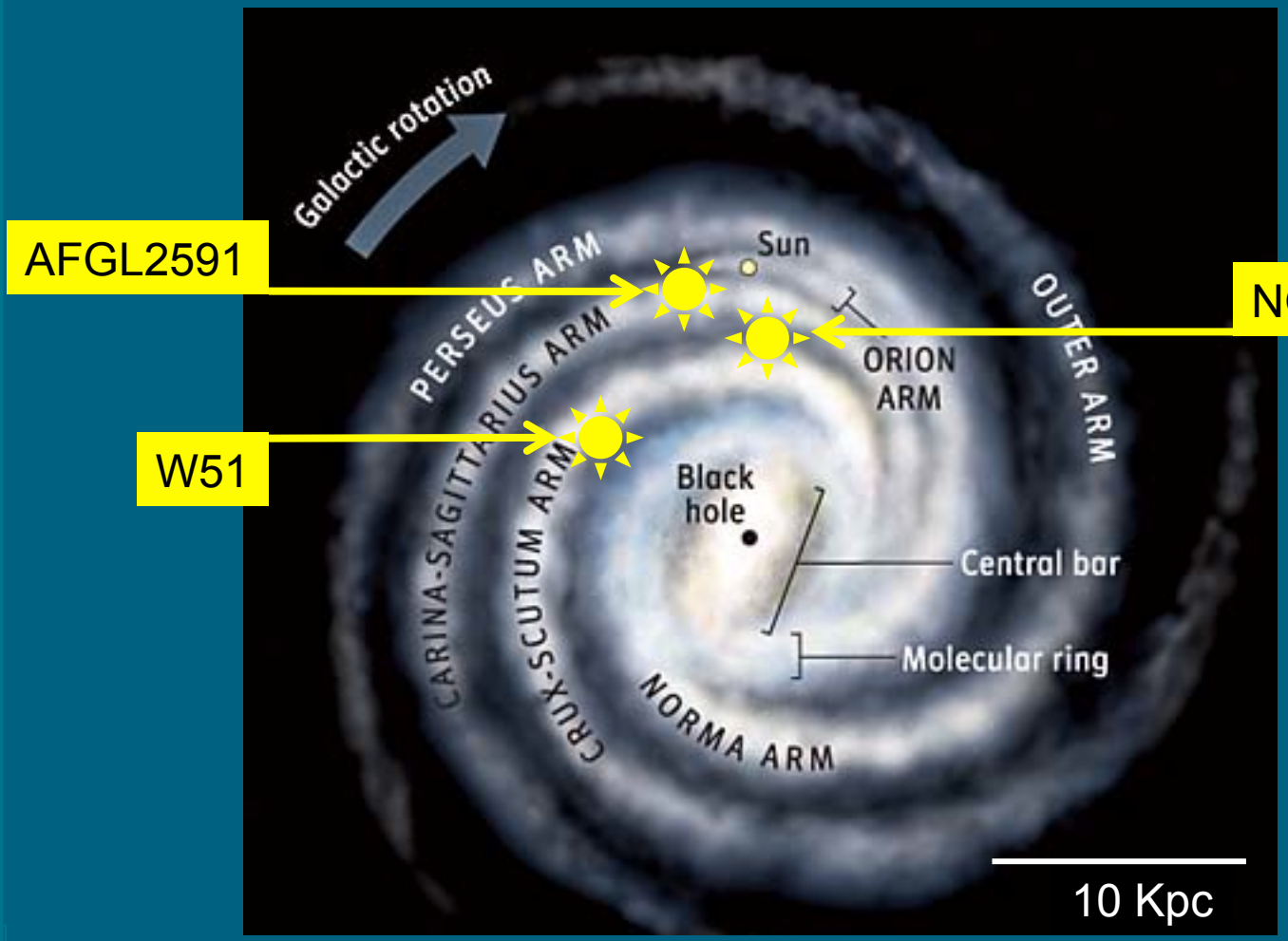


L1544

OMC2-FIR4

Cecilia Ceccarelli

CHESS DISTANT TARGETS



NOTE: ISM clouds at different galactocentric distances in the line of sight

OBTAINED OBSERVATIONS

NOTE: OBTAINED DURING MARCH-APRIL, SOME ONLY TWO WEEKS OLD….

Source	Hr	Range (GHz)	Type
L1544	0	-	“Cold” Pre-Stellar Core
I16293E	0	-	“Warm” Pre-Stellar Core
L1157-B	2	555-636	Outflow shock spot
IRAS16293-2422	32	480-1790*	Class0 low mass protostar
OMC2-FIR4	6	480-960*	Intermediate mass protostar
AFGL2591	6	480-960*	High mass protostar
NGC6334I	14	480-1185*	High mass hot core
W51e	0	-	High mass hot core

NOTE: not fully covered frequency range

OBTAINED OBSERVATIONS

NOTE: OBTAINED DURING MARCH-APRIL, SOME ONLY TWO WEEKS OLD....

Source	Hr	Range (GHz)	Type
L1544	0		
I16293E	0	-	
L1157-B	2		
IRAS16293-2422	32		
OMC2-FIR4	6	480-960*	Intermediate mass protostar
AFGL2591	6	480-960*	High mass protostar
NGC6334I	14		
W51e	-	-	High mass hot core

POSTERS by Bacmann et al. 1.08

POSTERS by Lefloch + & Codella +

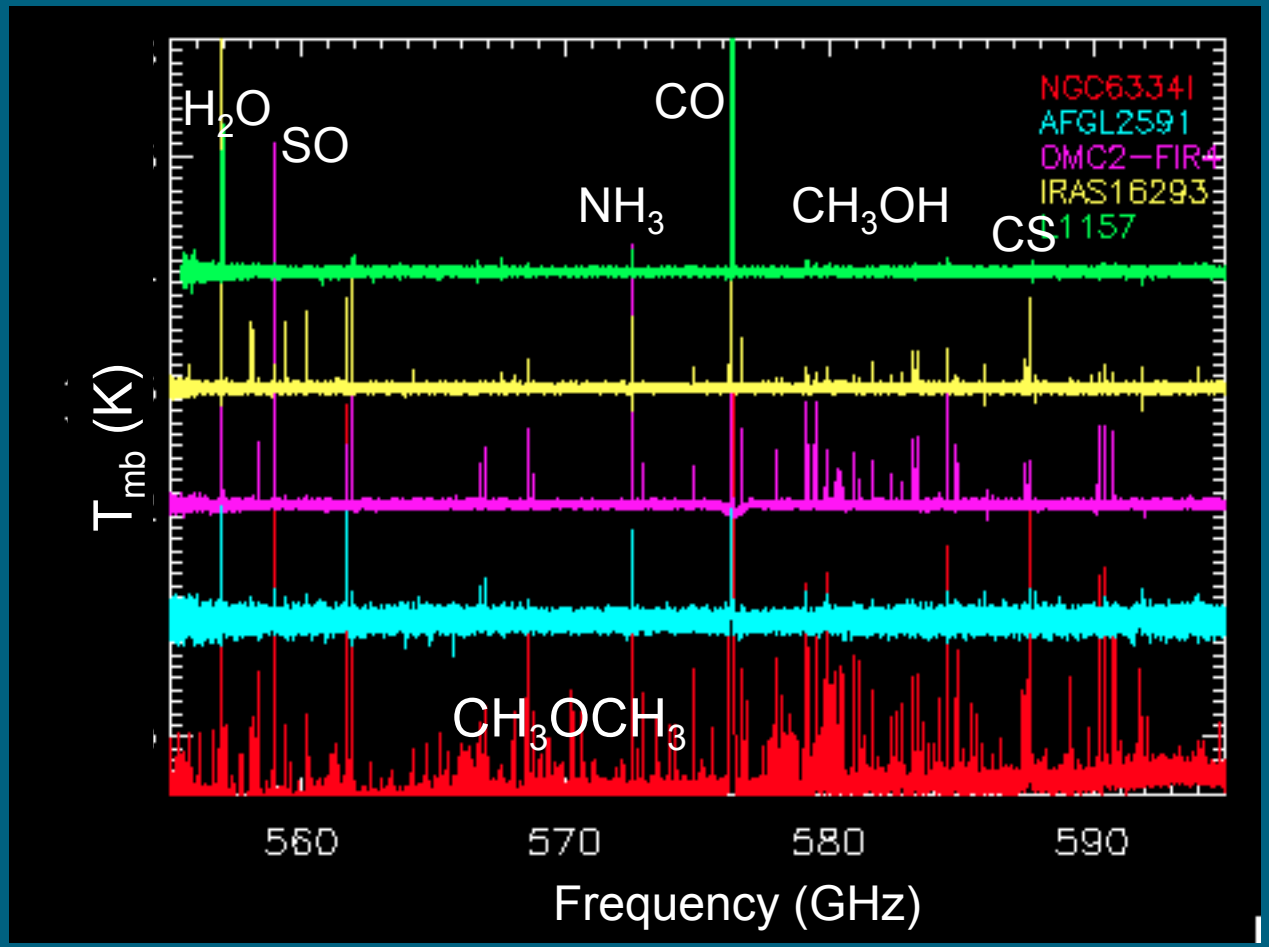
TALK by E.Caux

TALK by D.Lis

NOTE: not fully covered frequency range

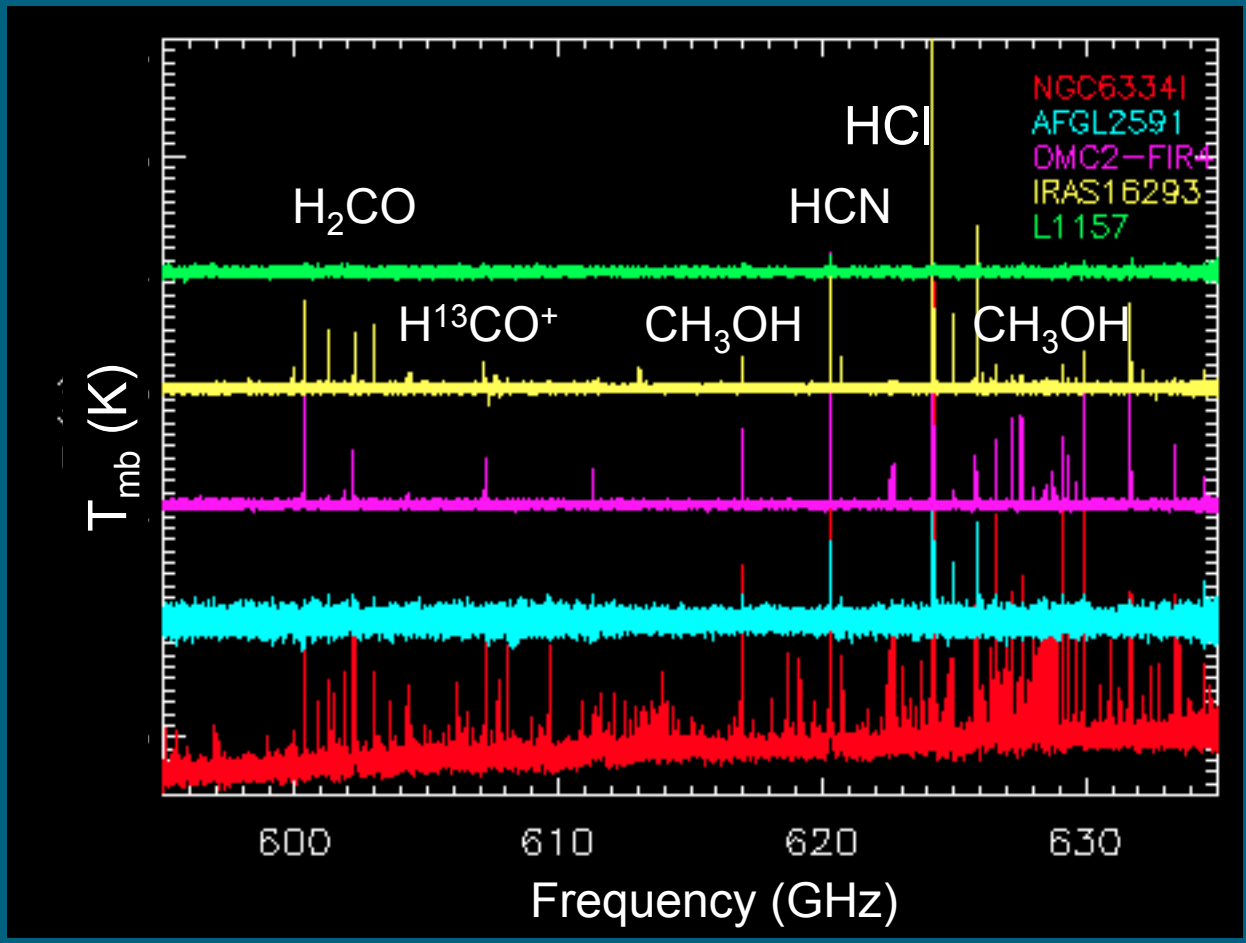
OVERVIEW of 555-635GHz SPECTRA

(NOTE: some sources observed only two weeks ago!)



OVERVIEW of 555-635GHz SPECTRA

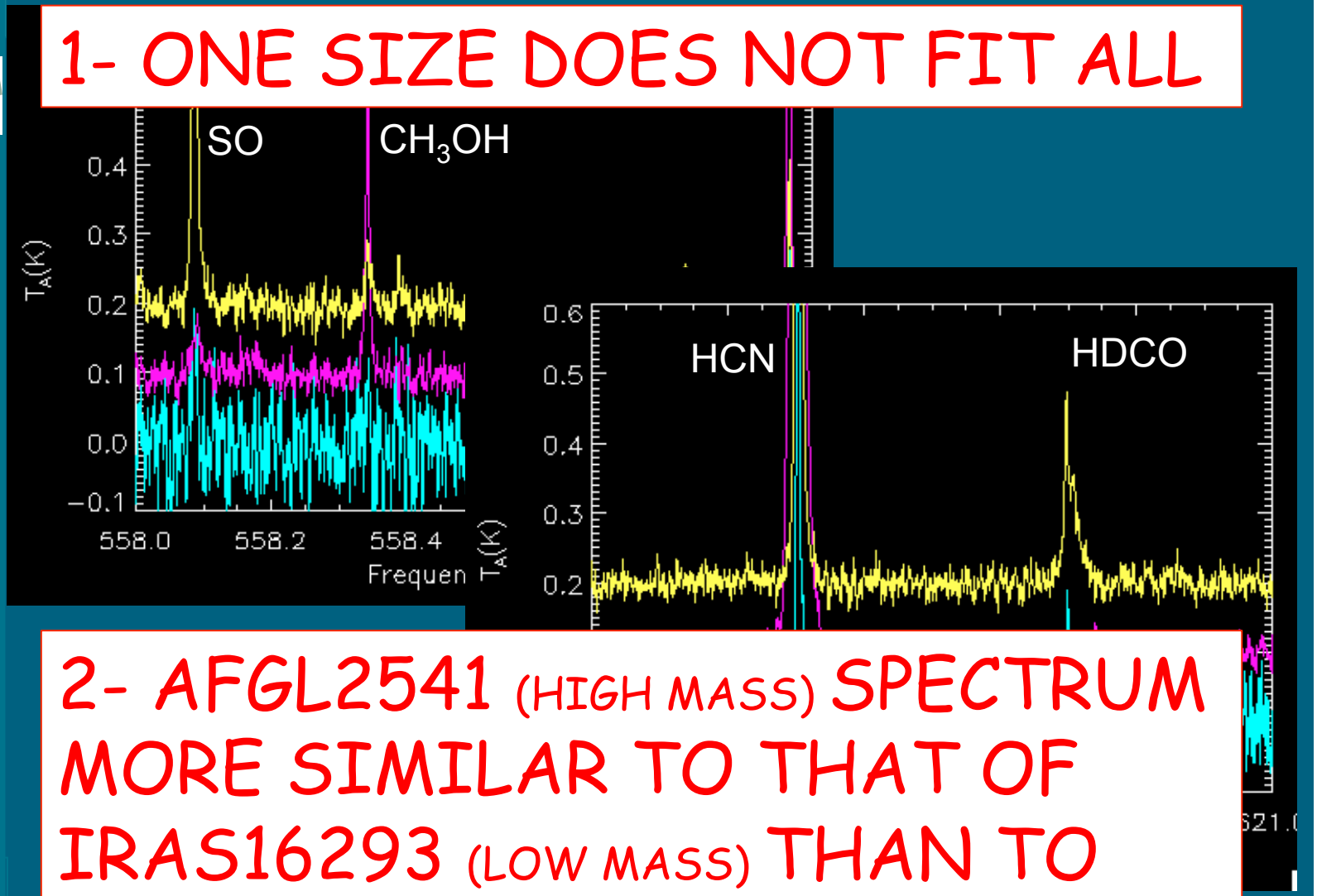
(NOTE: some sources observed only two weeks ago!)



Cecilia Ceccarelli

SAMPLEs OF OBSERVED SPECTRA

1- ONE SIZE DOES NOT FIT ALL

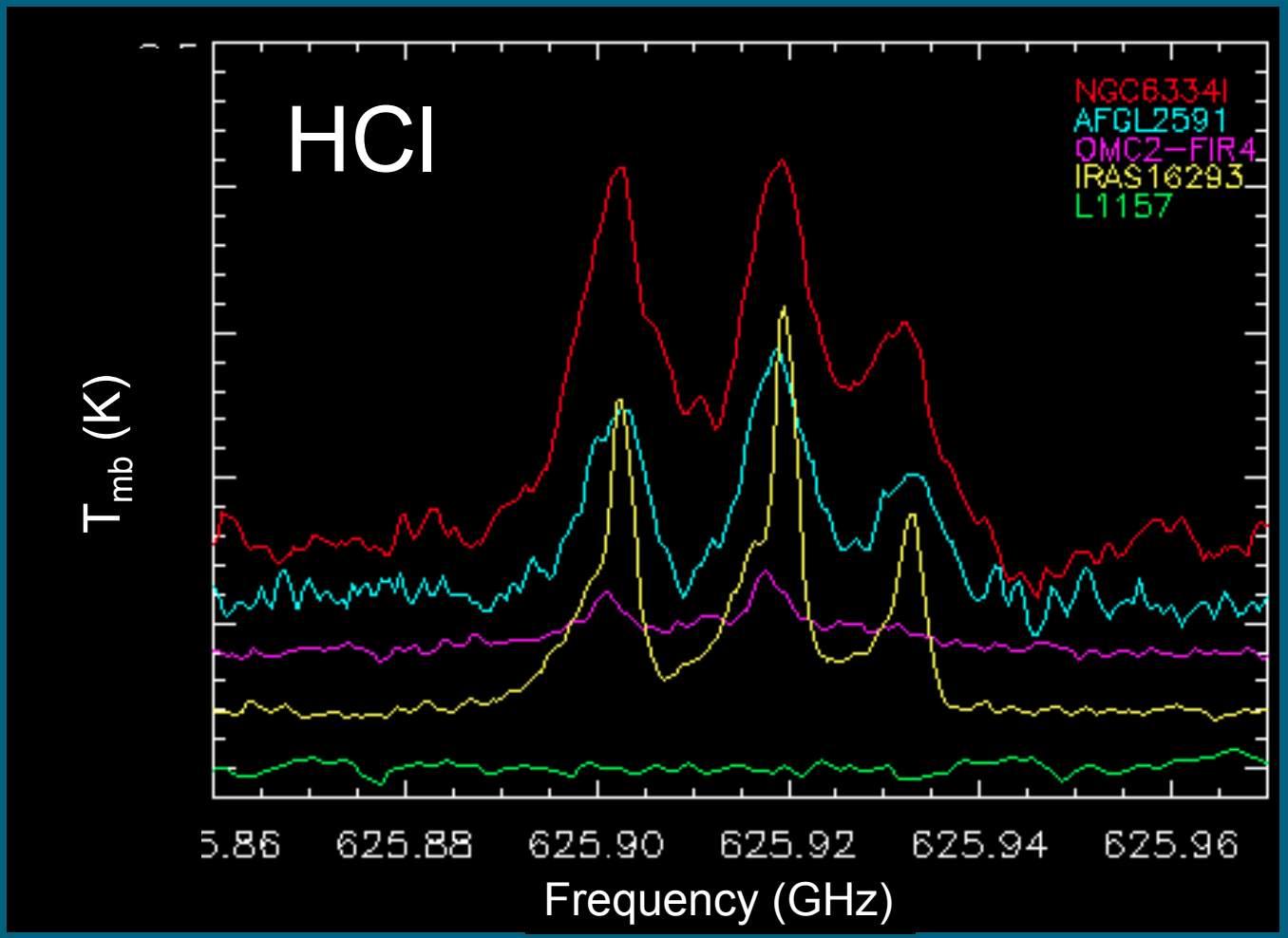


2- AFGL2541 (HIGH MASS) SPECTRUM MORE SIMILAR TO THAT OF IRAS16293 (LOW MASS) THAN TO OMC2-FIR4 (INTERMEDIATE MASS) ONE

Cecilia Ceccarelli

LAOG

ZOOM ON HCl



REACHED RMS ~ 10-20 mK

IN OPTICALLY THIN LINES, THE HYPERFINE COMPONENTS INTENSITY ARE 2:3:1

ZOOM ON HCl

PRELIMINARY ESTIMATES from CHESS obs

SOURCE	SIZES	N(HCl)	x(HCl)	N($H^{35}Cl$)	$^{35}Cl/^{37}Cl$
IRAS16293	35”	$1.5x10^{13}$	$\sim5x10^{-10}$	$1.2x10^{12}$	3.3
OMC2-FIR4	35”	$2.5x10^{12}$	$\sim1x10^{-11}$	$3.3x10^{11}$	3.9
AFGL2591	35”	$1.6x10^{13}$	$\sim6x10^{-11}$	$7.0x10^{12}$	2.2
NGC6334I	10”	$4.0x10^{14}$	$\sim1x10^{-10}$	$1.5x10^{14}$	2.7
				Solar	3.1

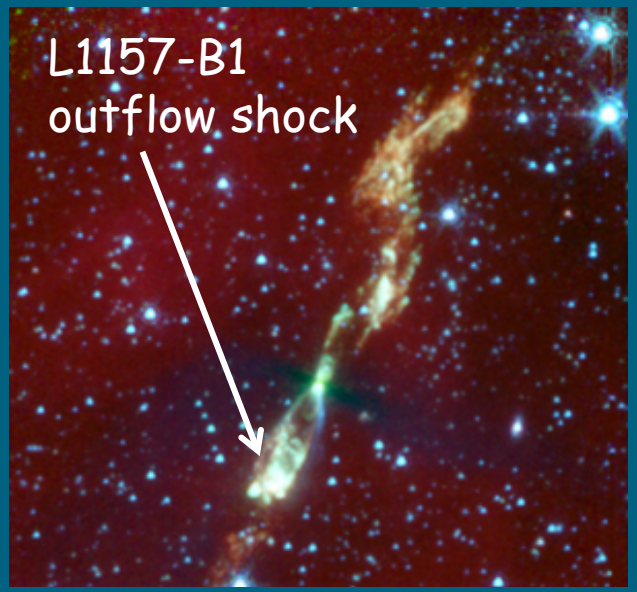
HCl PREDICTED TO BE THE MOST ABUNDANT Cl RESERVOIR IN MOLECULAR GAS, ~70% (e.g. Neufeld & Wolfire 2009).

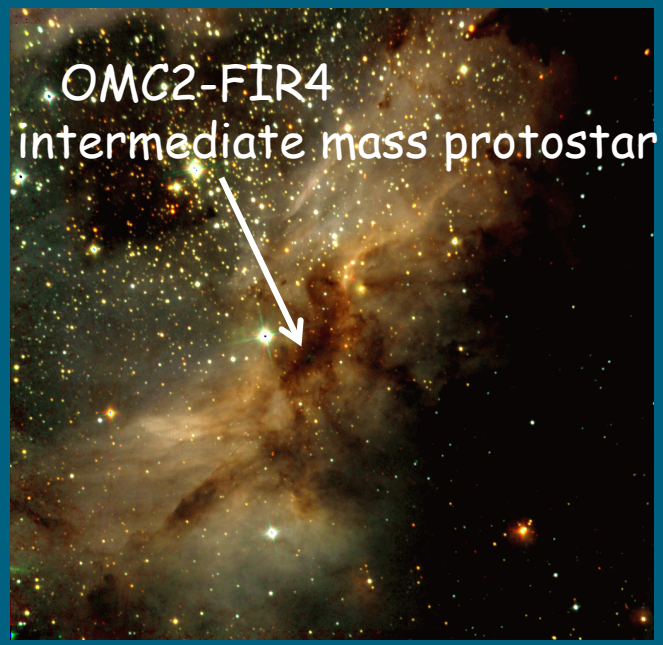
Cl FORMED IN >10Mo STARS IN SN EXPLOSION

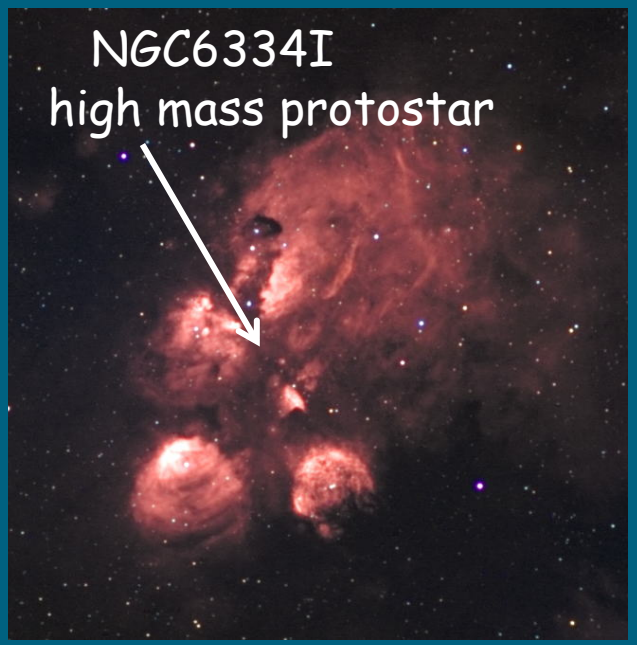
OBSERVED DIFFERENCES DUE TO DIFFERENT “INITIAL” CONDITIONS ?

POSTER Cernicharo et al. : HCl in W3: x(HCl)~$7.5x10^{-10}$, $^{35}Cl/^{37}Cl$=2.1

The CHESS observed targets

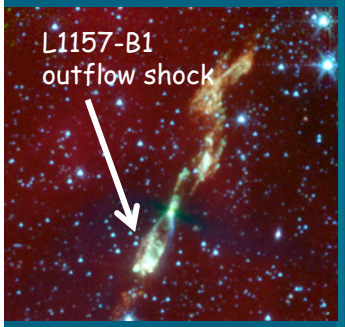


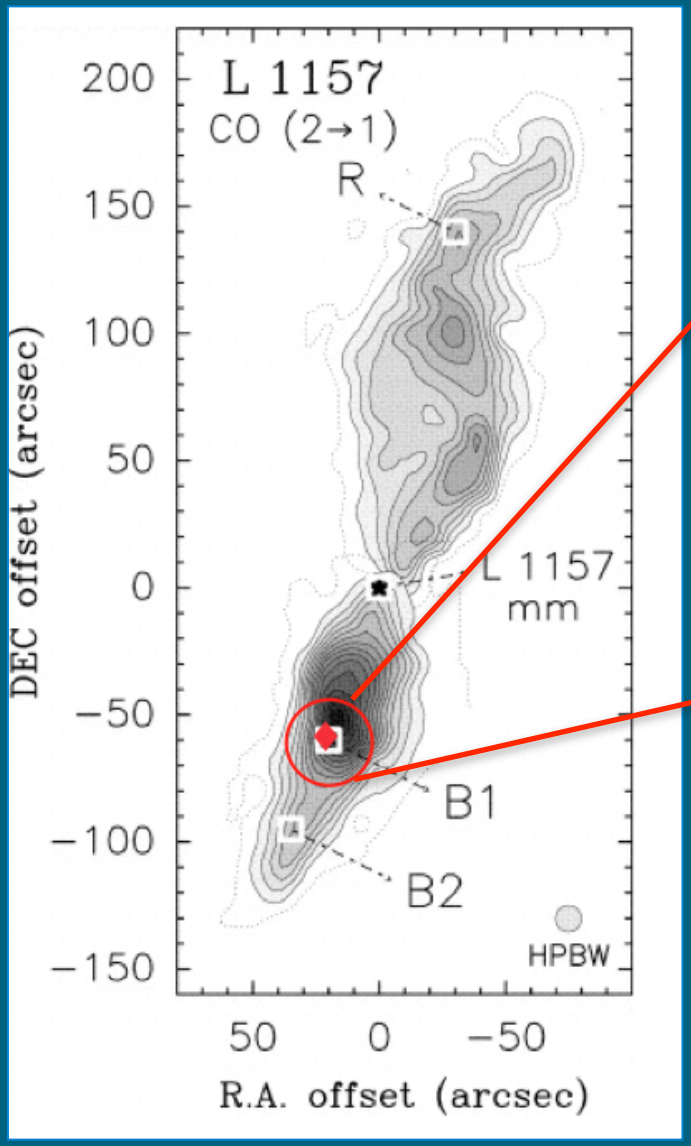


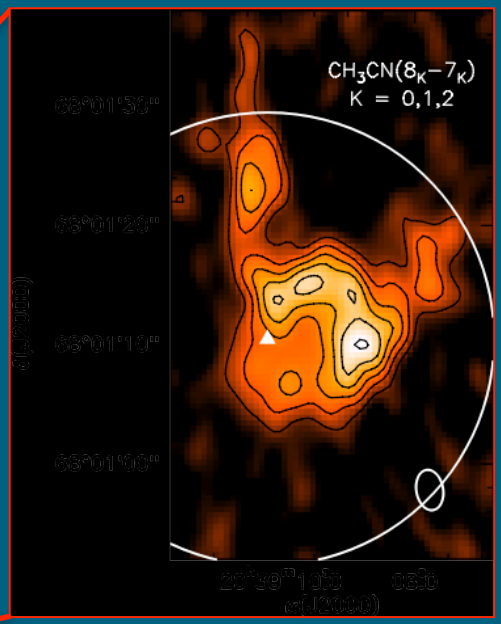


Cecilia Ceccarelli

The CHESS PV observations of L1157-B1







PV data, Aug 2009

Spectrum between 561 and 633GHz (HIFI band 1b) at the position B1, a spot with a molecular shock.

DETECTED SEVERAL LINES FROM SEVERAL SPECIES

Cecilia Ceccarelli

The CHESS PV observations of L1157-B1

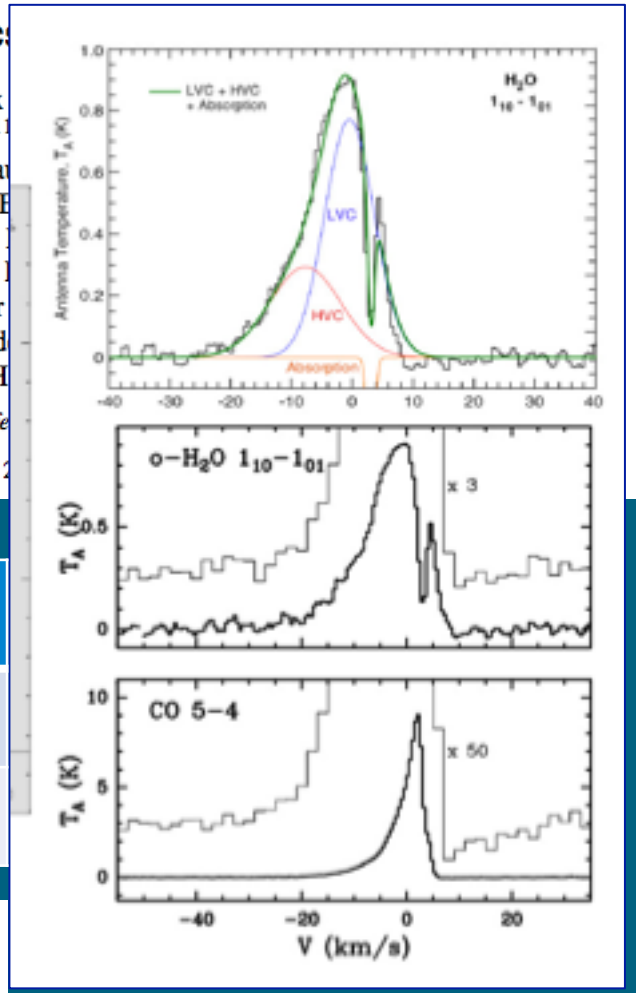
The CHESS Spectral Survey of Star Forming Regions : Peering into the protostellar shock L1157-B1. ⋆

II. Shock Dynamic

Lefloch B.[1], Cabrit S.[2], Codella C.[3], Melnick G.[4], Cernicharo J.[5], Caux
Ceccarelli C.[1], Gueth F.[10], Hily-Blant P.[1], Lorenzani A.[3], Neufeld D.[11]
J.R.[5], Parise B.[13], Salez M.[2], Schuster K.[10], Viti S.[14], Bacmann A.[1], Ba
Comito C.[13], Coutens A.[6], Crimier N.[1,5], Dominik C.[17,18], Demyk K.[6], E
M.[2], Goldsmith P.[20], Helmich F.[21], Herbst E.[22], Jacq T.[15], Kahane C.[1],
Lord L.[16], Maret S.[1], Pearson J.[20], Phillips T.[16], Saraceno P.[7], Schilke
Wiel M.[18], Vastel C.[6], Wakelam V.[15], Walters A.[6], Yorke H.[20], Bachiller
Kramer C.[23,25], Larsson B.[26], Lai R.[27], Maiwald F.W.[20], Martin-Pintad
Stutzki J.[23], and Wunsch J.H

(Affiliations can be found after the refe

Preprint online version: March 31, 2



Vel. comp	Size (“)	N(CO) 10^{16}cm^{-2}	n(H_2) cm^{-3}	T K	x (H_2O)
LVC	25	8	~10^5	100	~10^{-6}
HVC	7	5	~10^4	400	~10^{-4}

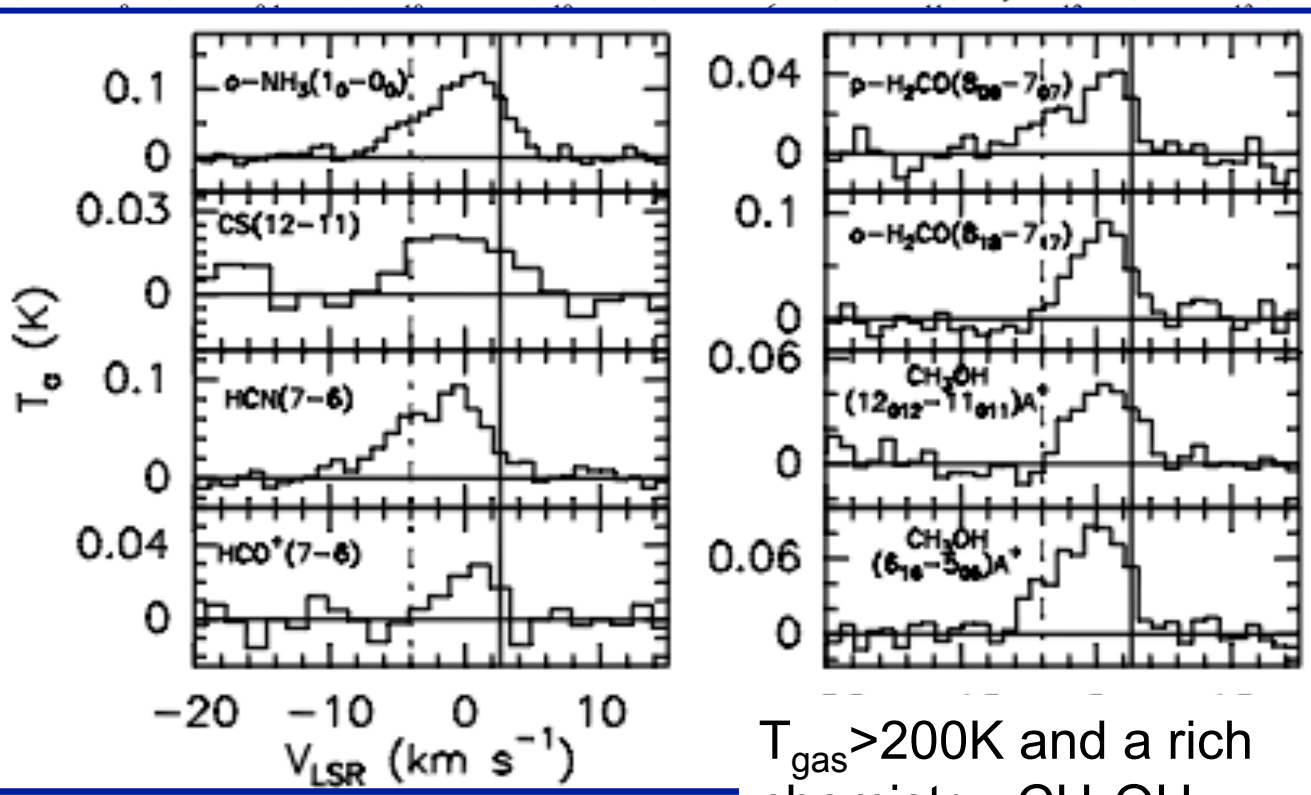
POSTER 1.15 Lefloch et al.

The CHESS PV observations of L1157-B1

The CHESS Spectral Survey of Star Forming Regions: Peering into the protostellar shock L1157-B1

I. Shock Chemical Complexity*

Codella C.[1], Lefloch B.[2], Ceccarelli C.[2], Cernicharo J.[3], Caux E.[4], Lorenzani A.[1], Viti S.[5,6], Hily-Blant P.[2], Parise B.[7], Maret S[8], Neufeld[9], S.[4], Com[10], Gerin M.[11], D.[16], L[17], M.[18], Va[19]

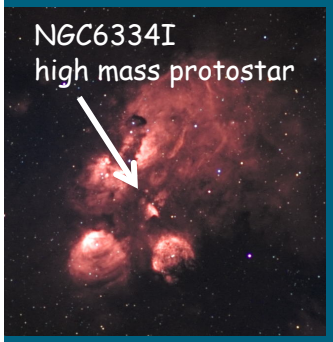


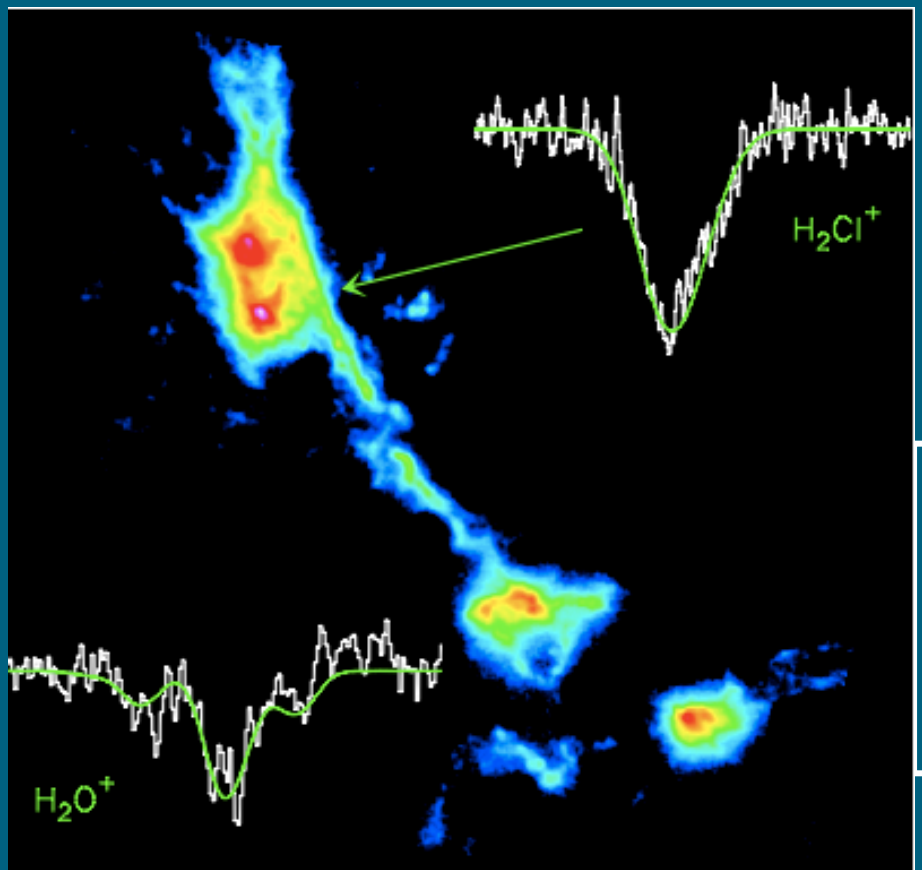
POSTER 1.11 Codella et al.

T_{gas}>200K and a rich chemistry: CH_3OH, H_2CO, NH_3,HCN,….

Cecilia Ceccarelli
LAOG

The CHESS PSP observations of NGC6334I





2 NEW DETECTIONS: H_2O^+ and H_2Cl^+

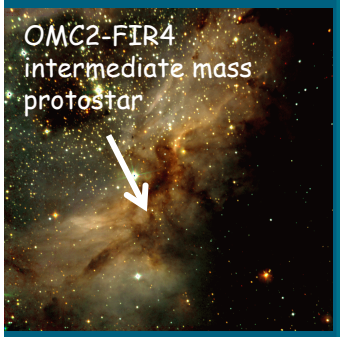
Darek Lis's presentation tomorrow

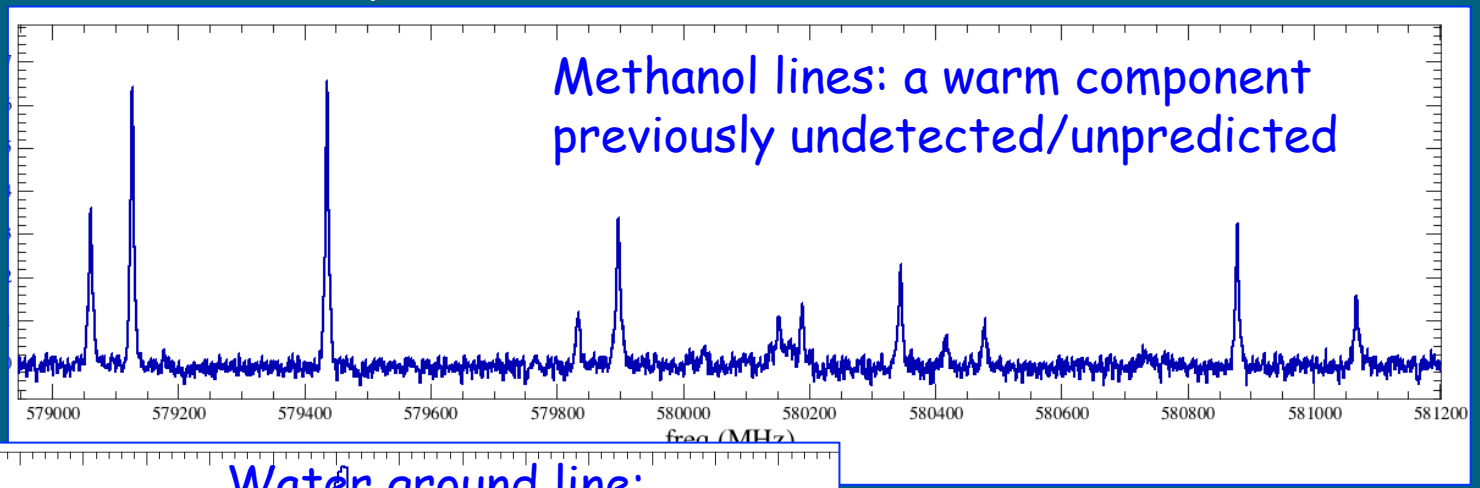
Detection of interstellar oxidaniumyl: abundant H_2O^+ towards the star-forming regions DR21, Sgr B2, and NGC6334★

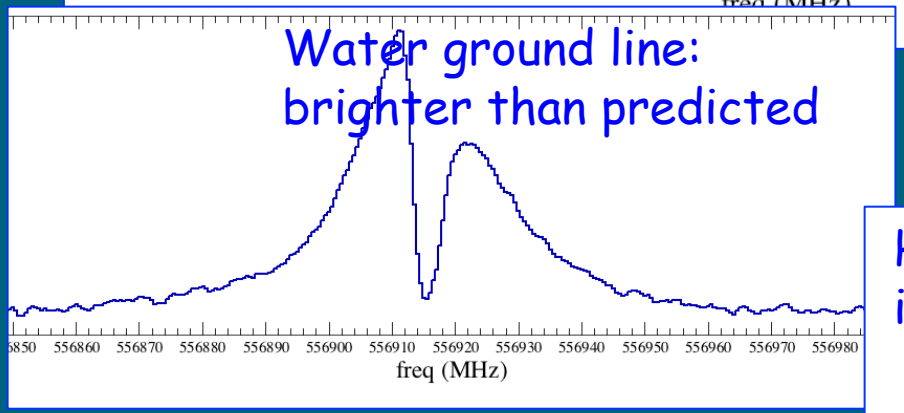
V. Ossenkopf[1,2], H.S.P. Müller[1], D.C. Lis[3], P. Schilke[1,4], T.A. Bell[3], E. Bergin[5], C. Ceccarelli[6], C. Comito[4], J. Stutzki[1], S. Bruderer[8], A. Bacman[6,7], A. Baudry[7], A.O. Benz[8], M. Benedettini[9], O. Berne[37], G. Blake[3], A. Boogert[3], S. Bottinelli[13], F. Boulanger[10], S. Cabrit[11], P. Caselli[12], E. Caux[13,14], J. Cernicharo[15], C. Codella[16], A. Coutens[13], N. Crimier[6,15], N.R. Crockett[5], F. Daniel[17], K. Demyk[13], P. Dieleman[2], C. Dominik[18,19] M.L. Dubernet[20],

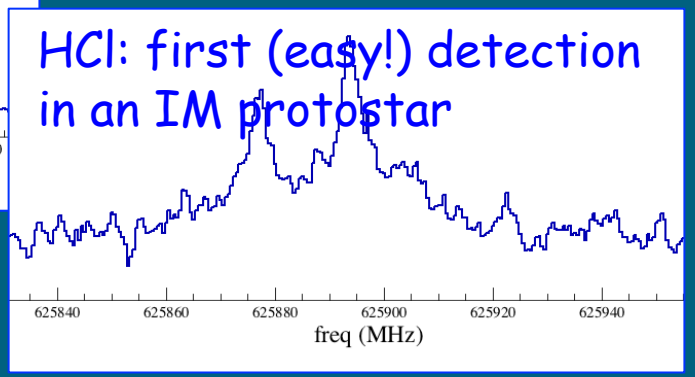
The CHESS PSP observations of OMC2-FIR4

Band 1b in PSP2: rich spectrum
Some examples:





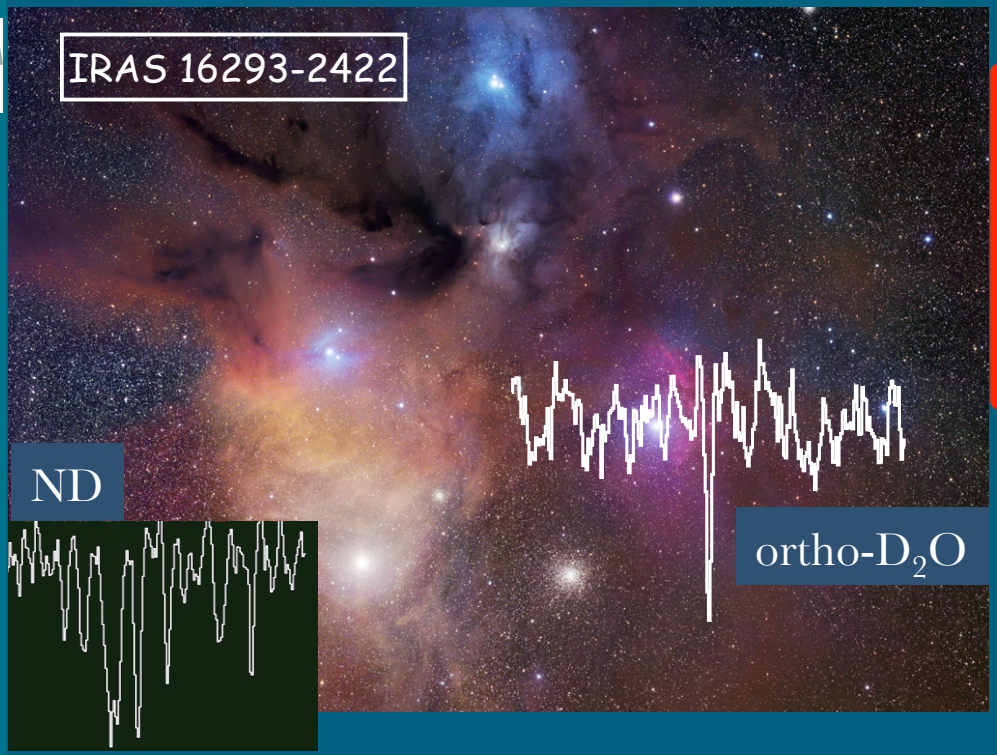




Kama et al. HIFI Special issue
Crimier et al. HIFI Special issue

Cecilia Ceccarelli

The CHESS PSP observations of IRAS16293-2422



2 NEW DETECTIONS: ortho-D_2O and ND

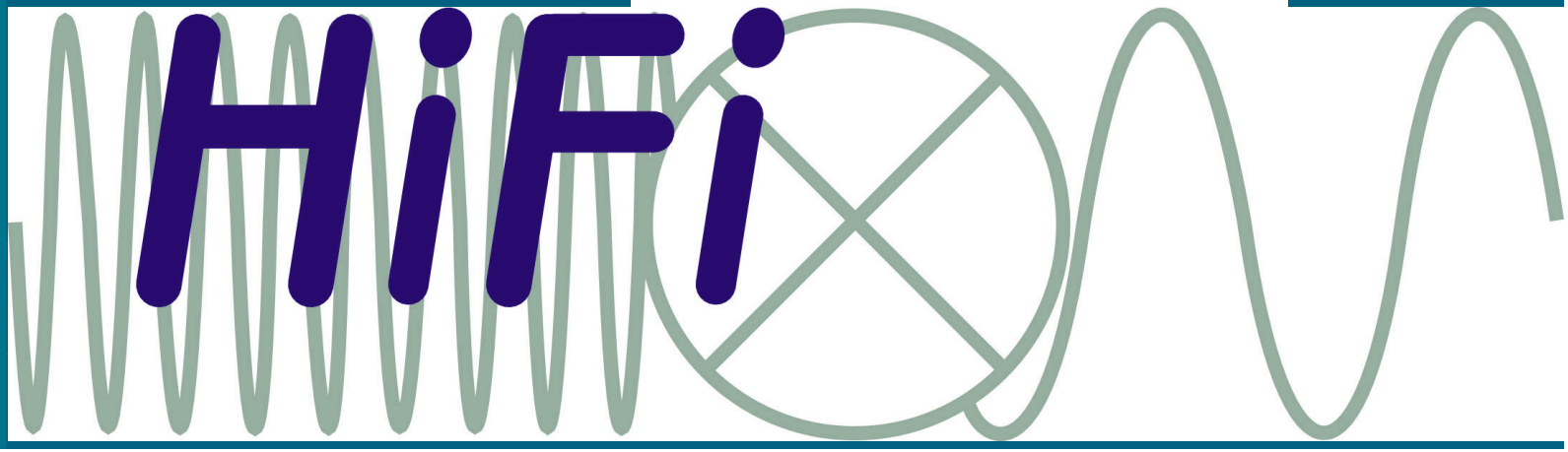
Emmanuel Caux's presentation friday

Cecilia Ceccarelli

HIFI & CHESS : a very successful **molecule-hunter couple** !

- FOUR NEW DETECTIONS OF SPECIES IN ONLY HALF A BAND (1A), 80 GHz….
(and after 1 month from the data reception)
- MUCH MORE EXPECTED IN THE REMAINING 1400 GHz OF UNEXPLORED FREQUENCIES!

THANKS



Cecilia Ceccarelli
LAOG

On behalf of the CHESS team

Baudry Alain
Castets Alain
Klotz Alain
Lorenzani Andrea
Fuente Asunción
Coutens Audrey
Bacmann Aurore
Parise Berengere
Lefloch Bertrand
Adwin Boogert
Nisini Brunella
Dominik Carsten
Caselli Paola
Vastel Charlotte
Comito Claudia

Kahane Claudine
Codella Claudio
Lis Darek
Neufeld David
Falgarone Edith
Caux Emmanuel
Herbst Eric
Wyrowski F.
van der Tak Floris
Helmich Frank
Melnick Gary
Blake Geoffry
Yorke Harold W.
Pearson John
Cernicharo Jose
Schuster Karl

Pagani Laurent
Maryvonne Gerin
Matthijs van der van der Wiel
Mihkel Kama
Milena Benedettini
Montmerle Thierry
Morvan Salez
Paolo Saraceno
Patrik Hennebelle
Paul Goldsmith
Peter Schilke
Pierre Encrenaz
Pierre Hily-Blant
Sandrine Bottinelli
Sebastien Maret

Serena Viti
Steve Lord
Sven Thorwirth
Sylvie Cabrit
Ted Bergin
Thierry Jacq
Thijs de Graauw
Thomas Henning
Tom Bell
Tom Phillips
Valentine Wakelam
Walters Adam
William Langer
Xander Tielens

THANKS

HiFi