HDO project

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Outline

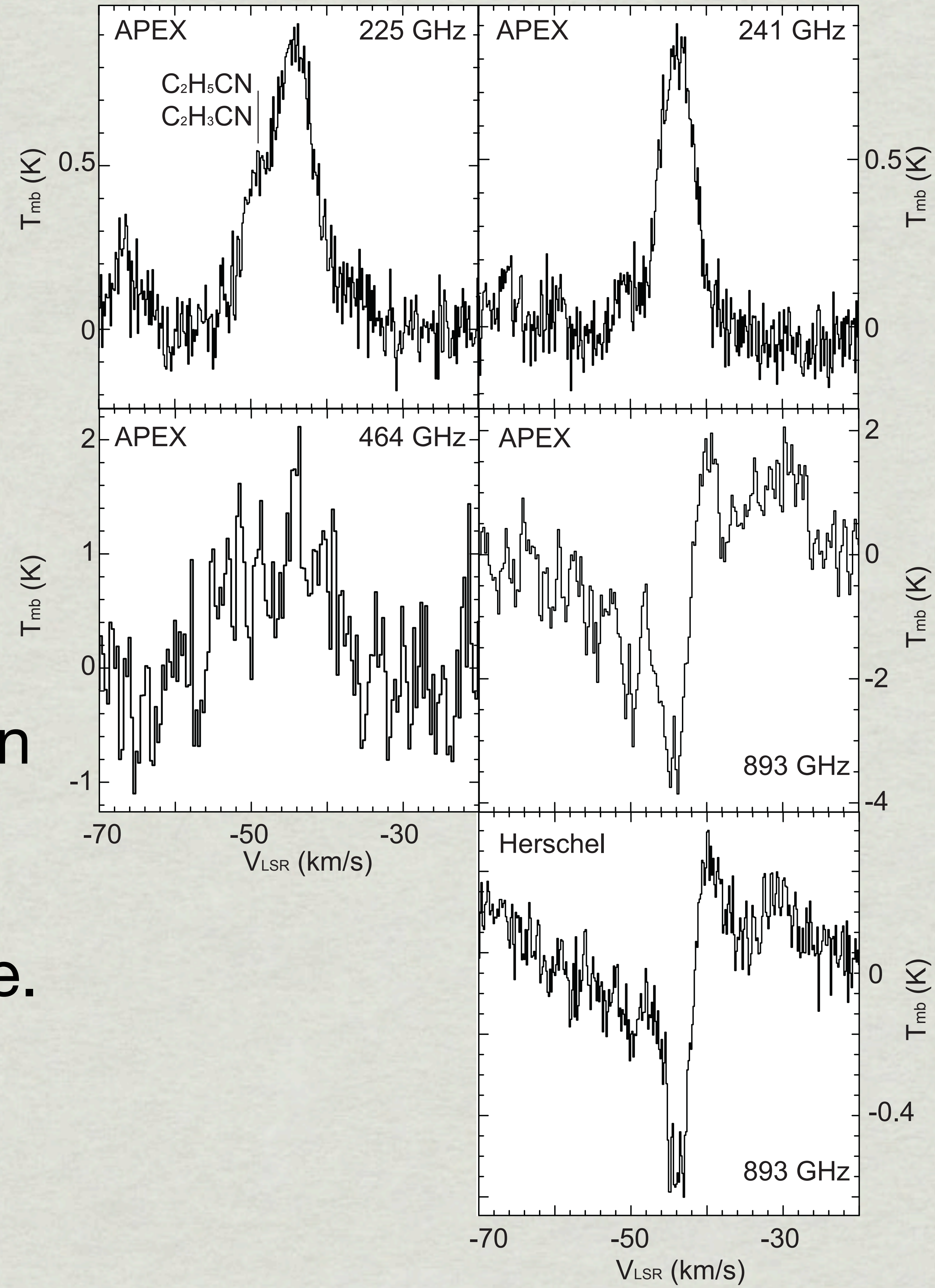
The Projects:

- High-Mass Hot Core:
  G327.3-0.6 & IRAS 16065-5158
- Intermediate Source:
  L1641 S3 MMS1
- Low-Mass Protostar:
  NGC1333 - IRAS 2A

High-mass hot core: G327.3-0.6

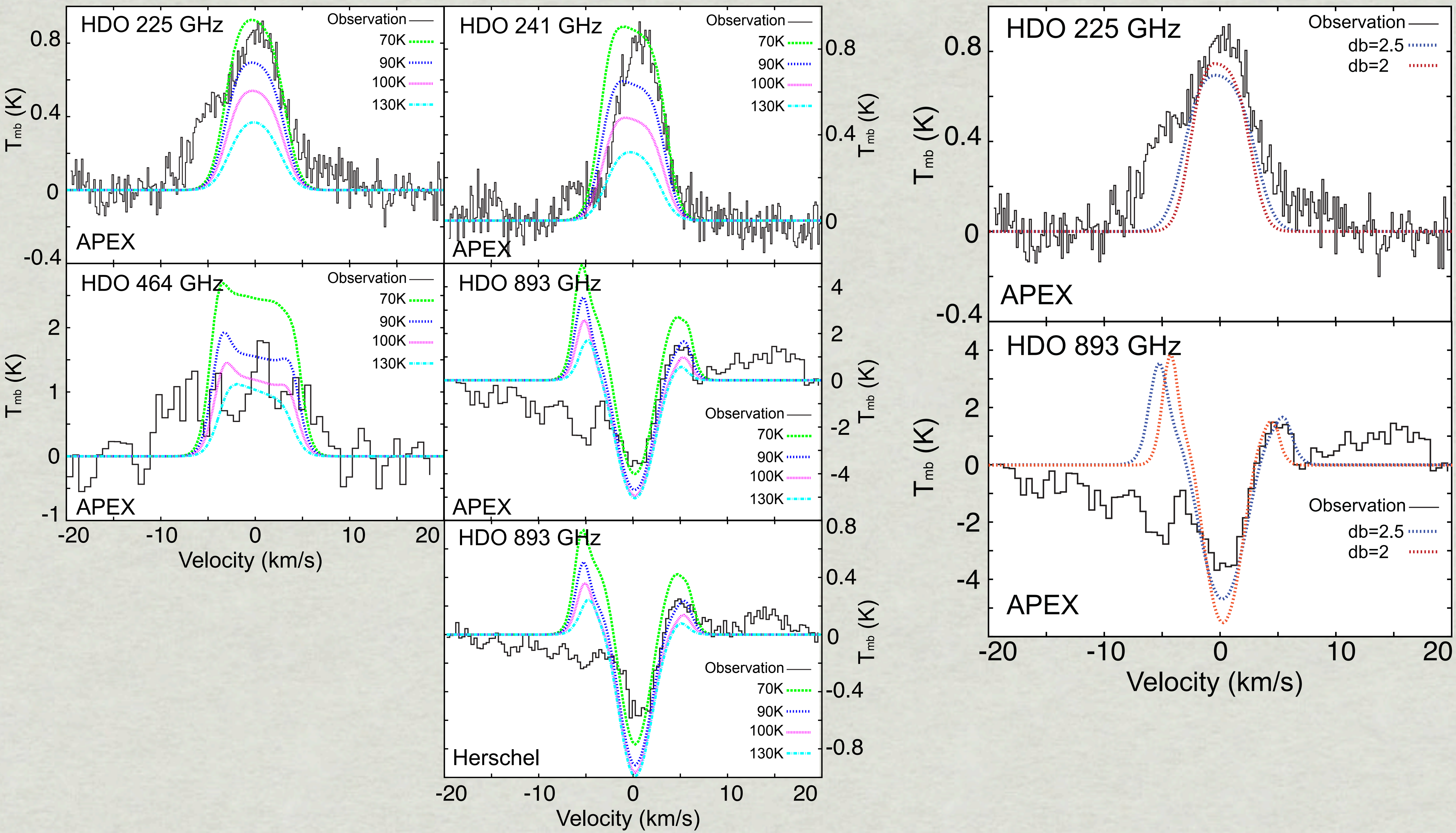
G327.3-0.6
-HDO Data

- Three emission lines are detected.
- The ground-state transition line (893 GHz) observed with different telescopes show the line profile is true.



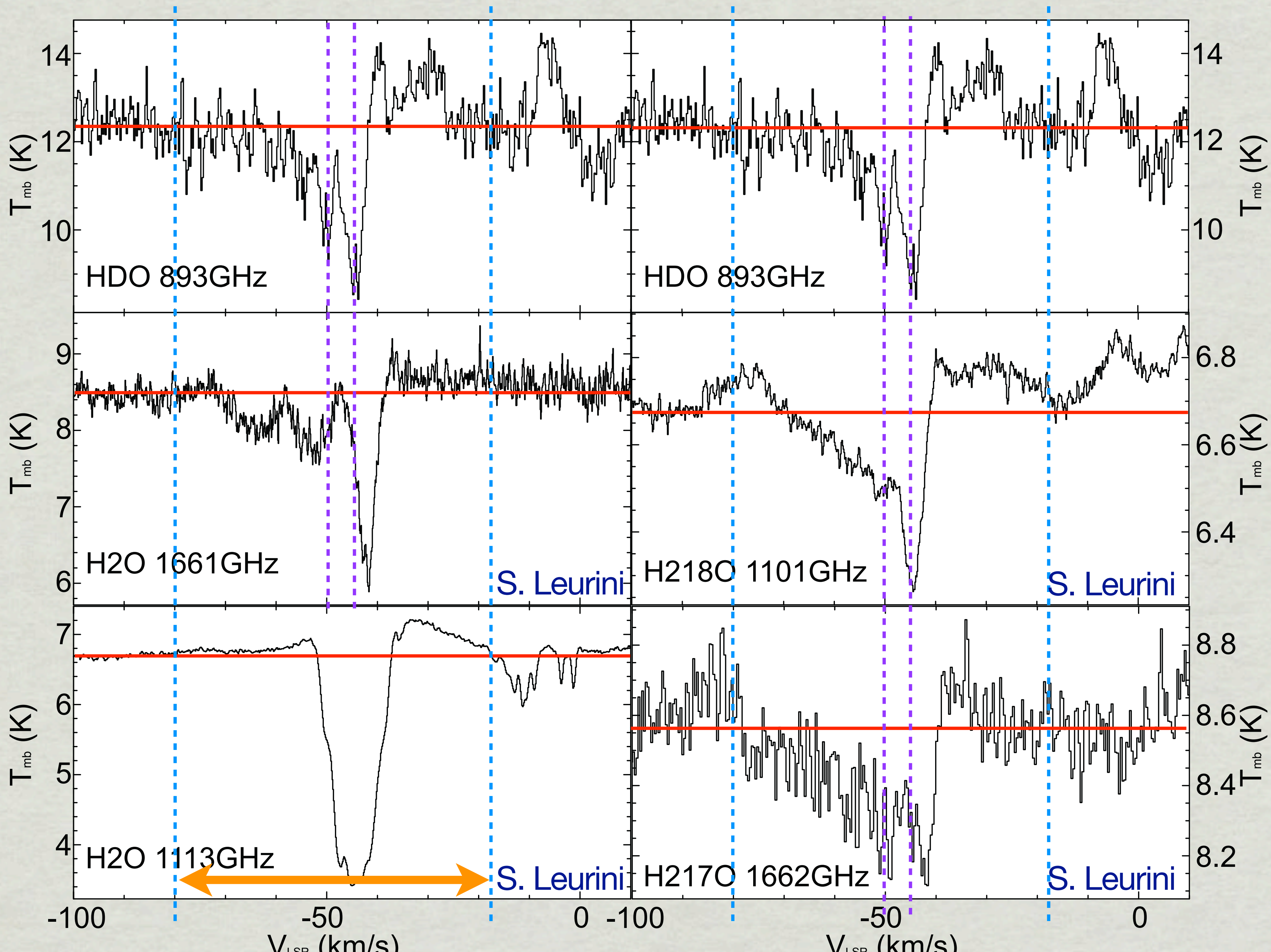
G327.3-0.6

-RATRAN Preliminary Results- Rolffs' model (Rolffs et al. 2011)



- Optically thick in high-excitation lines.

G327.3-0.6
-lines Comparison

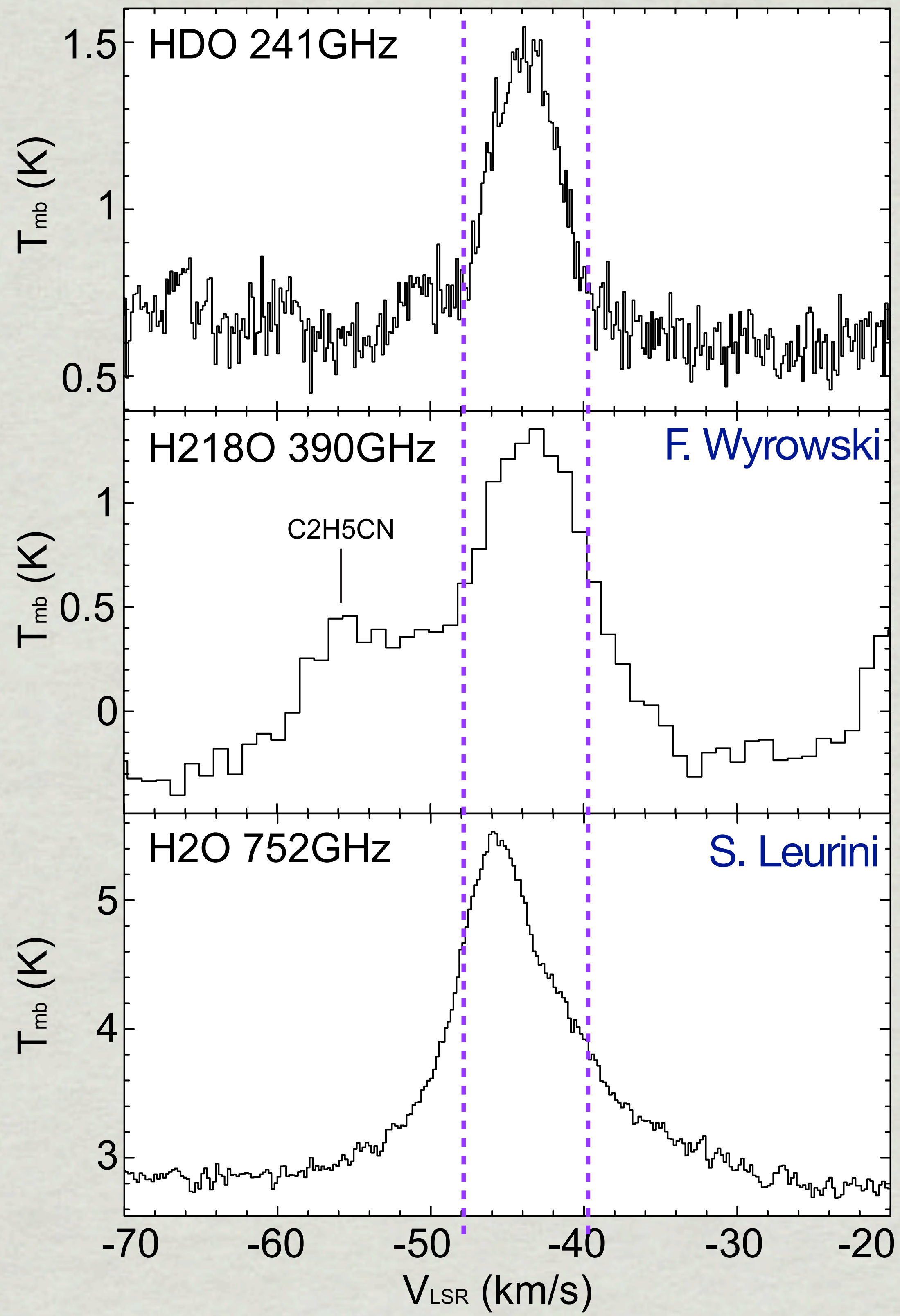


OUTFLOW ABSORPTION LIKE NGC 6334I AND W33A

ONLY HDO TOWARD HOT CORE.

G327.3-0.6
-lines Comparison

- $H_2^{18}O$ and H_2O lines are broader than HDO line.
- H_2O line has different velocity distribution.
  => different position!

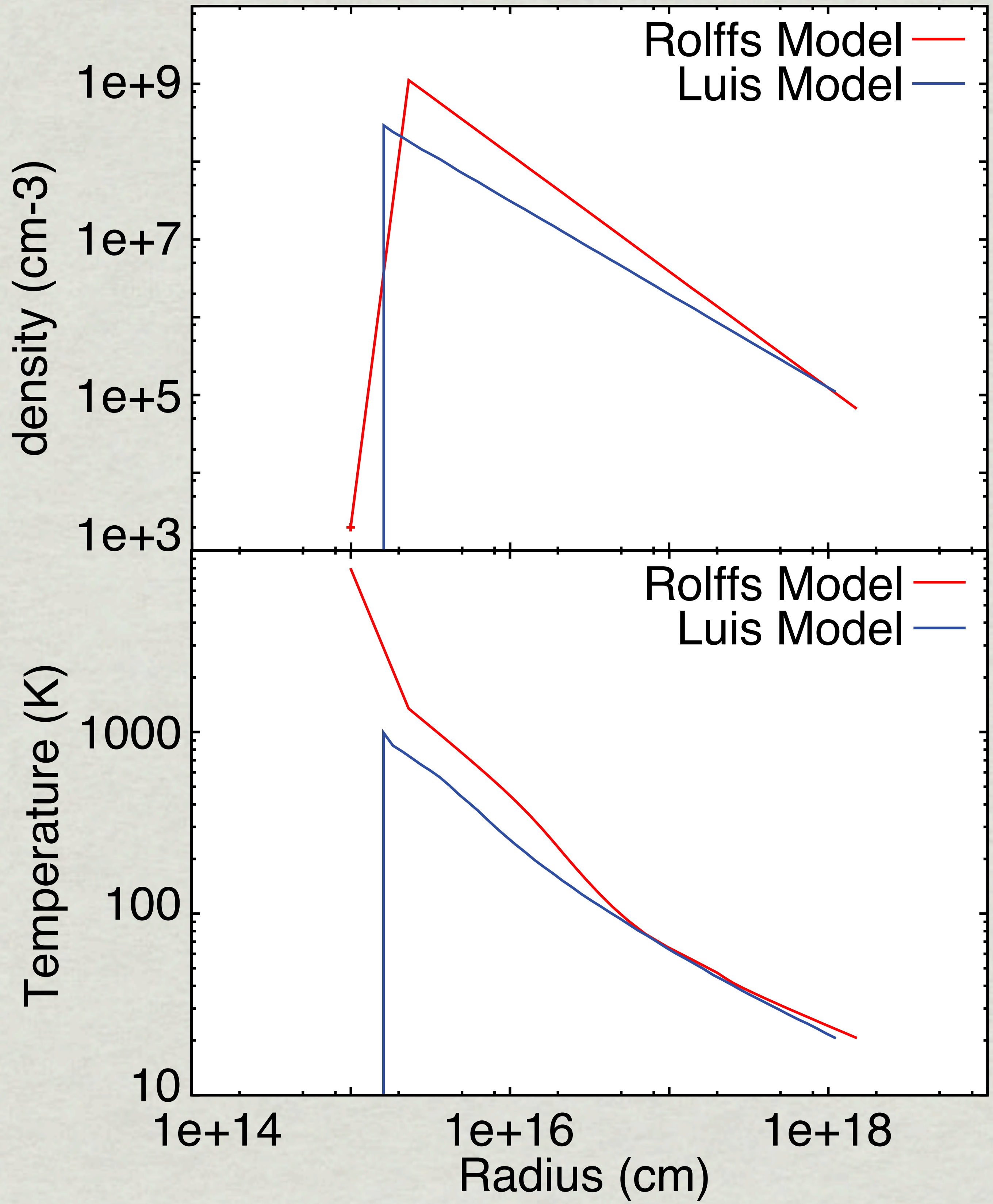


H_2O ARE NOT TOWARD HOT CORE!

G327.3-0.6

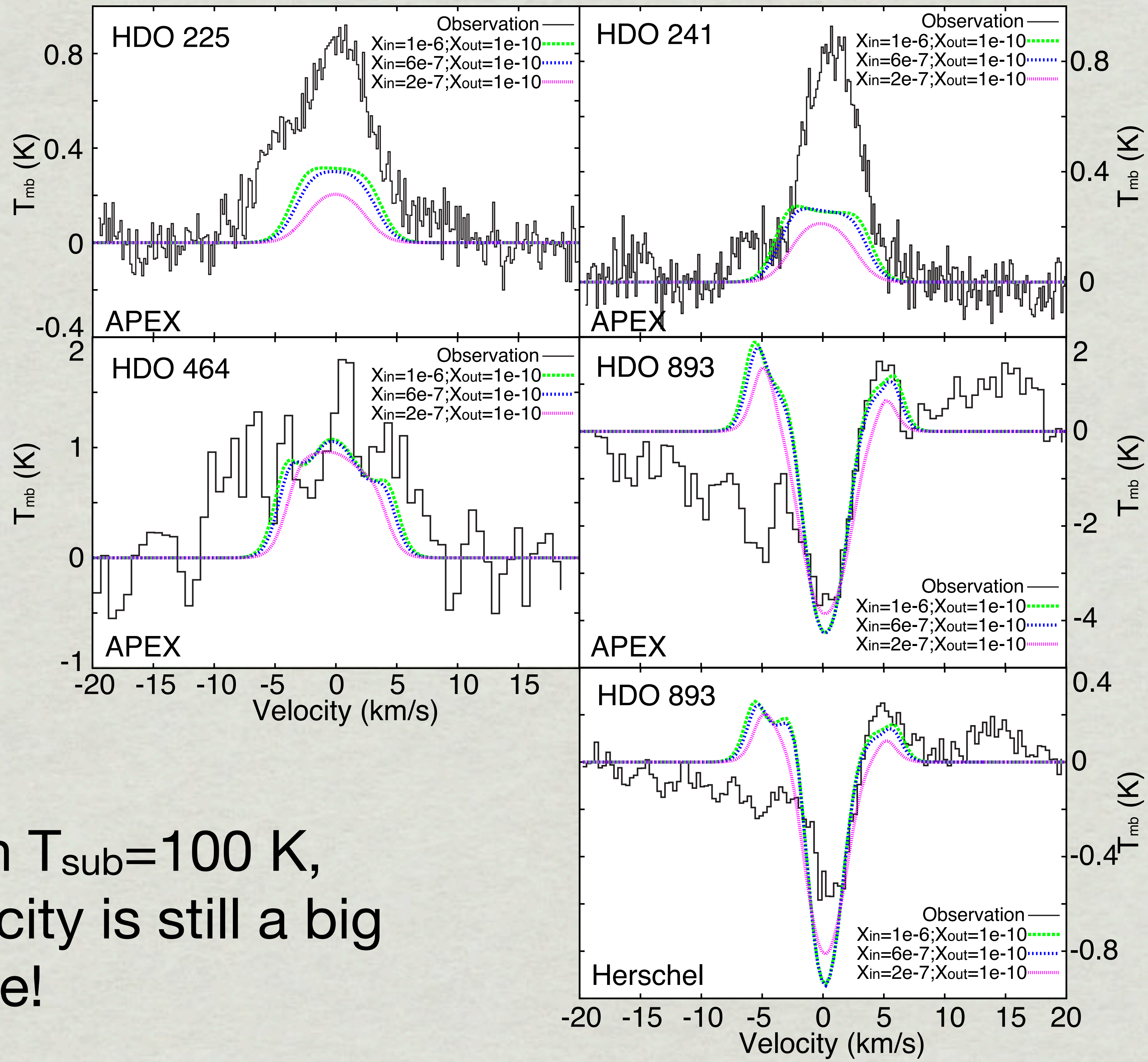
-Rolffs' Model v.s. Luis' Model

- We then adopted the physical profiles from Luis.
- Different constraints and parameters:
  - Rolffs: LABOCA map $\rho=r^{-1.66}$; T:centrally heated cloud with cooling and heating; kappa=jena,bare.e5
  - Luis: 850 μm map & SED $\rho=r^{-1.2}$; kappa=jena,thin.e5.



G327.3-0.6

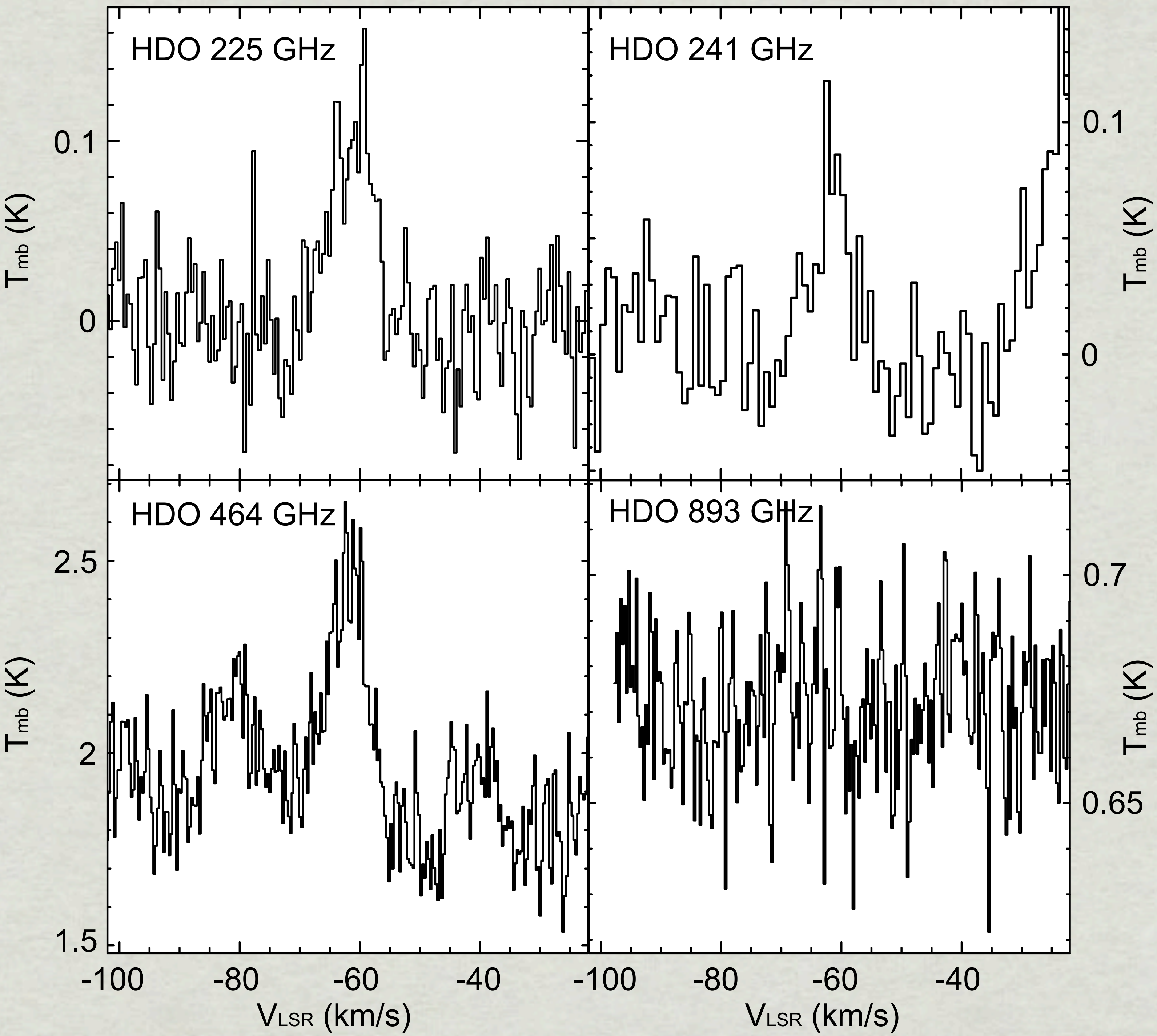
-RATRAN Preliminary Results-luis' model



- With T_{sub}=100 K, opacity is still a big issue!

High-mass hot core:
IRAS 16065-5158

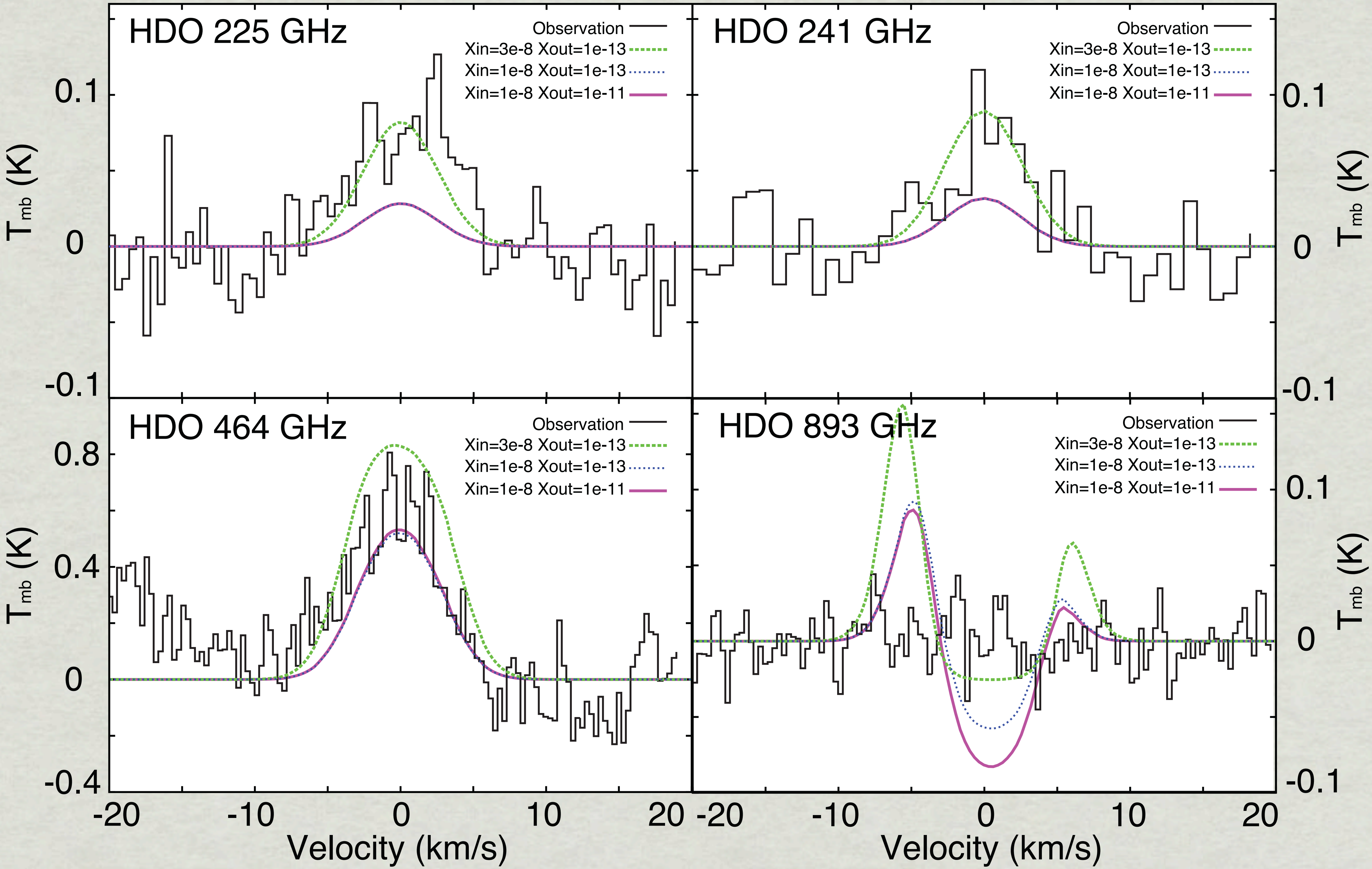
IRAS 16065-5158
-HDO Data



- Three emission lines are detected.
- The HDO line @893 GHz is not detected, even with Herschel telescope.

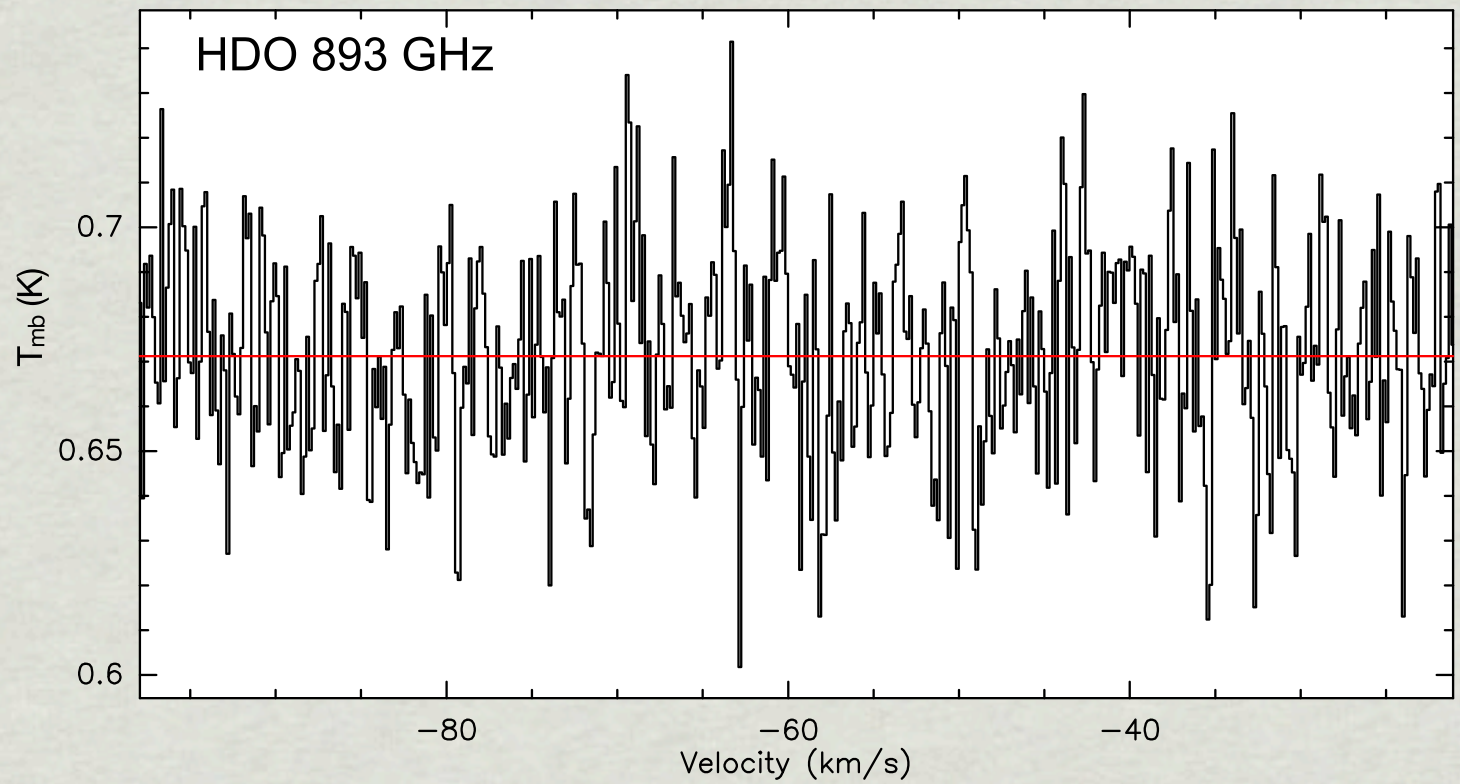
IRAS 16065-5158

-RATRAN Preliminary Results



The HDO fractional abundance in the inner region is around 3e-8.

IRAS 16065-5158
-RATRAN Preliminary Results

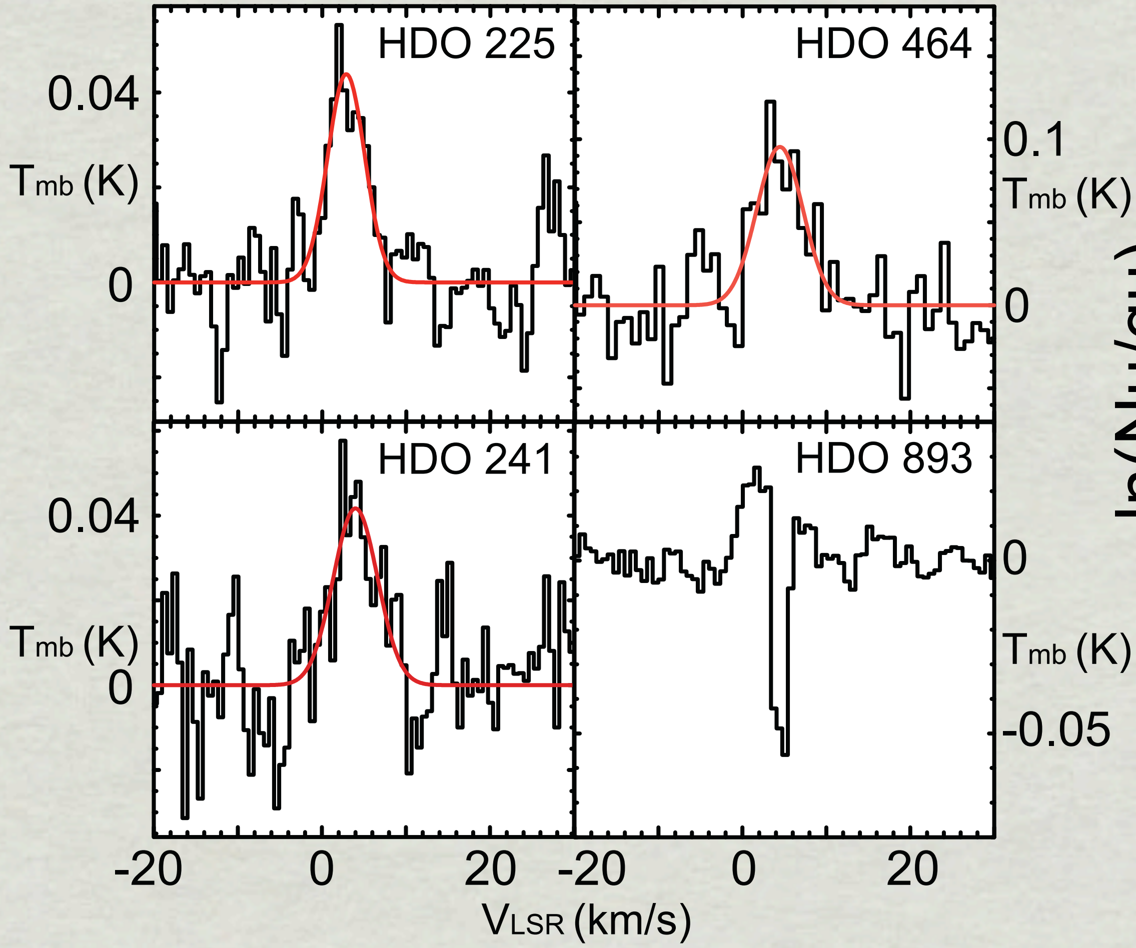


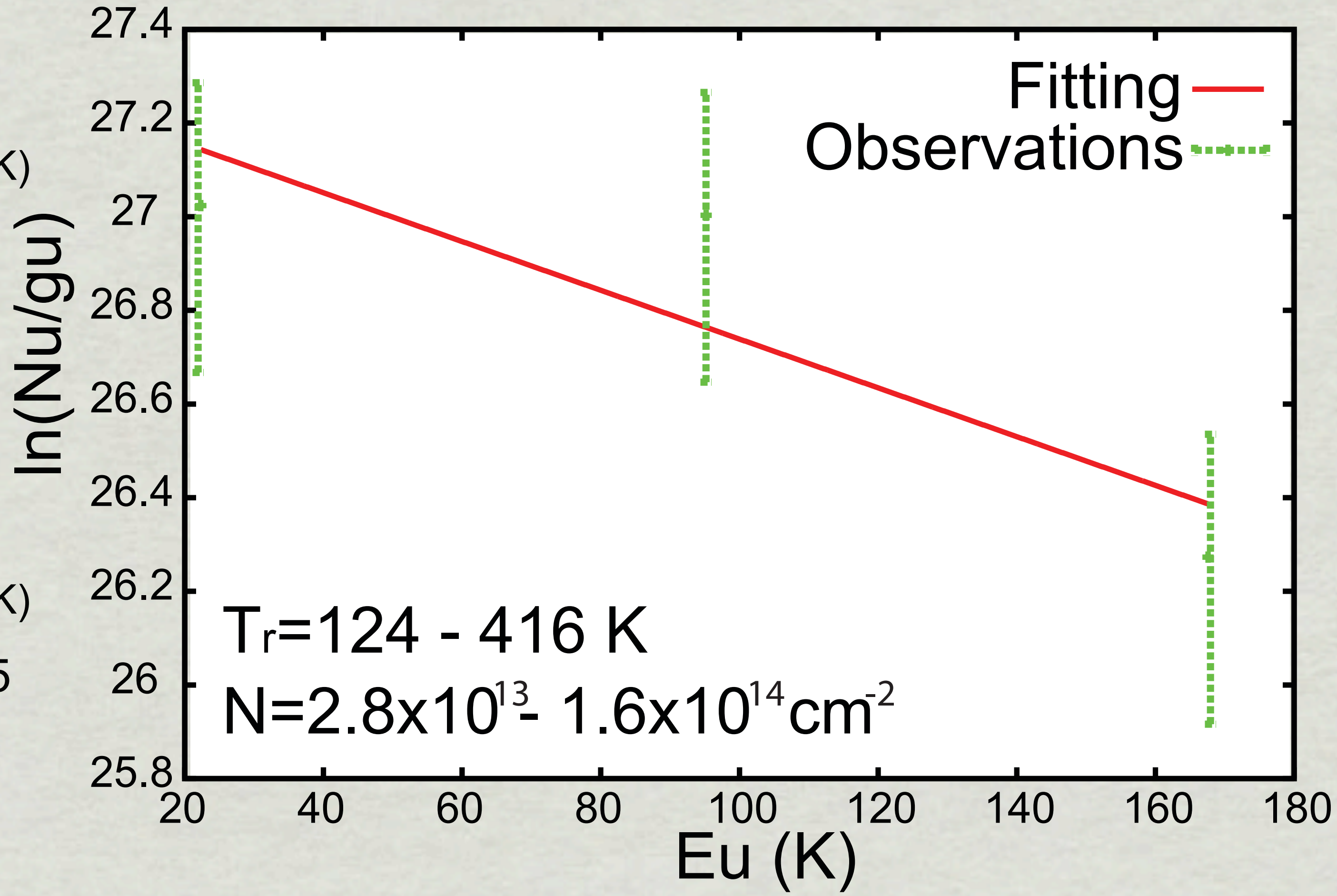
- Observed Continuum
  @ 893 GHz is ~0.67/2=0.335 K
- Modeled Continuum
  @893 GHz is ~1.66 K
- Need to modify the physical profiles.

Intermediate-mass source: L1641 S3MMS1

L1641 S3MMS1
-HDO Data

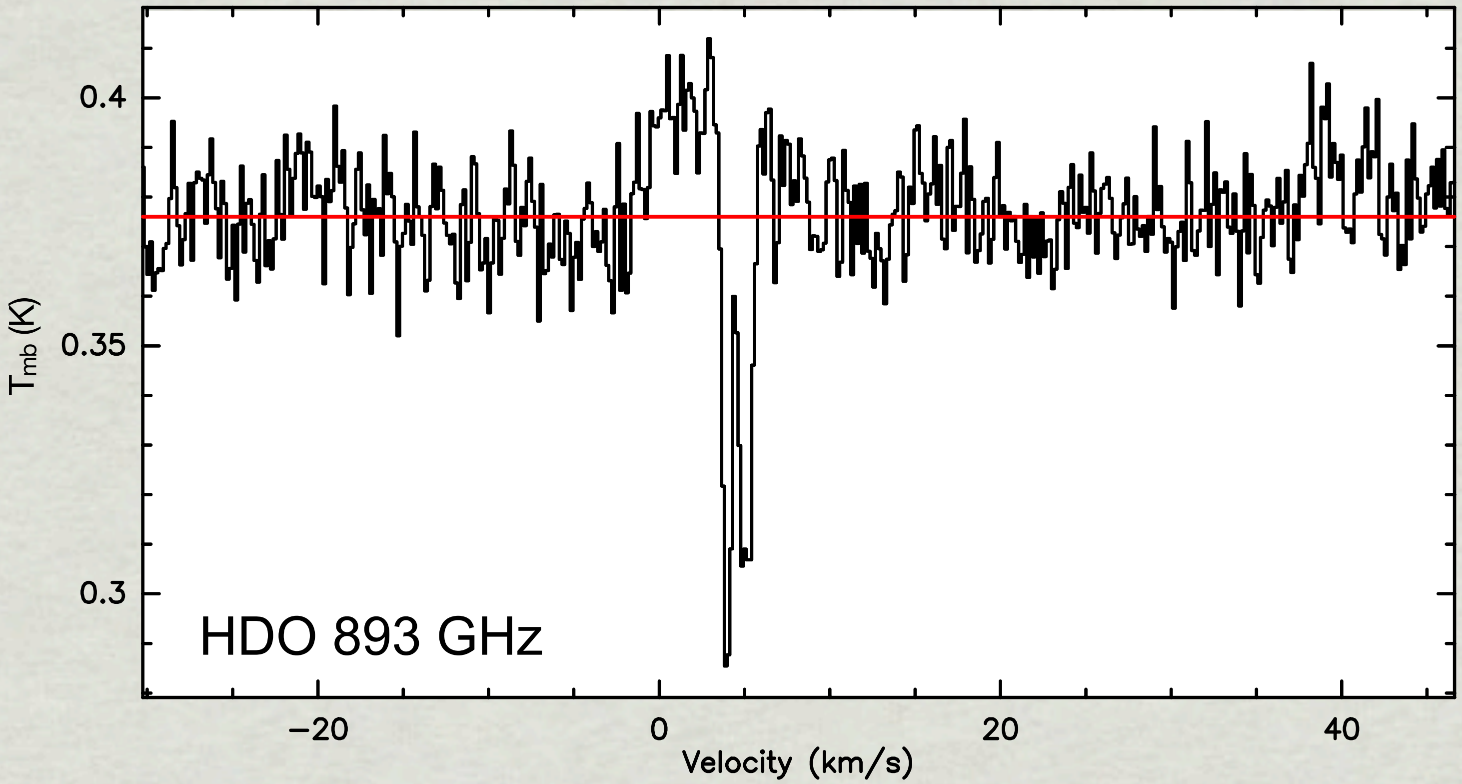
Frequency GHz	Transition	E_{up} K	Beam ″	B_{eff}	rms mK	dv km/s	T^c_{peak} mK	V_{LSR} km/s	Δv km/s	$\int T_{mb}dv$ K km/s
HDO Observations										
225.897	$3_{1,2}$–$2_{2,1}$	167.7	27.85	0.75	8.5	0.65	44	2.9±0.3	5.2±0.7	0.24±0.03
241.561	$2_{1,1}$–$2_{1,2}$	95.3	26.04	0.75	14.8	0.61	42	4.0±0.5	6.2±1.0	0.28±0.04
464.924	$1_{0,1}$–$0_{0,0}$	22.3	13.53	0.53	22.9	0.94	95	4.4±0.5	6.5±1.2	0.66±0.10
893.639	$1_{1,1}$–$0_{0,0}$	42.9	24.14	0.60	4.0	0.67	...	...	...	...
D_2O Observations										
316.800	$1_{1,0}$–$1_{0,1}$	15.2	19.86	0.67	5.8	1.16	24.1	8.34±0.81	10.04±1.84	0.26±0.04





IRAS 16065-5158

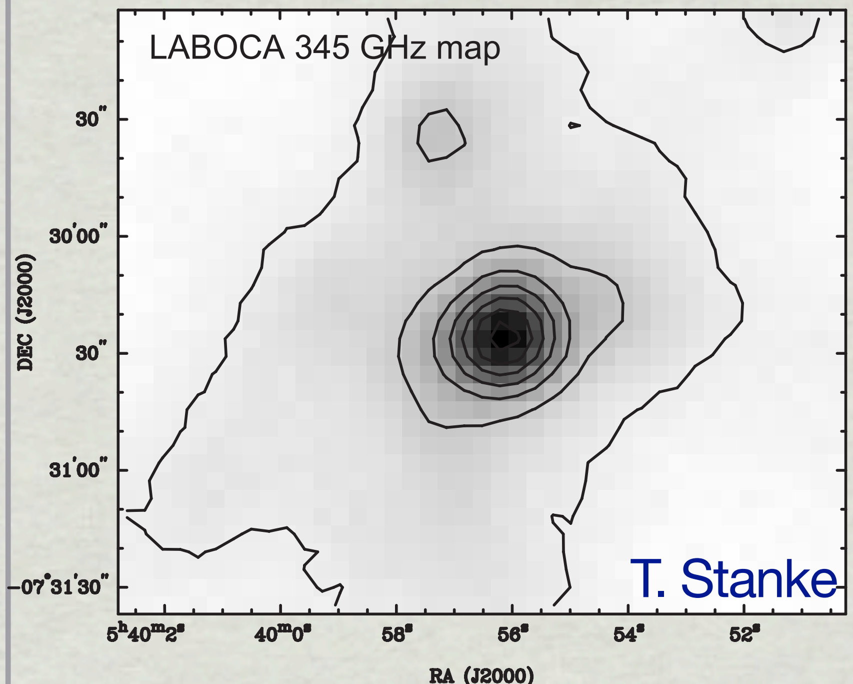
-Continuum issue

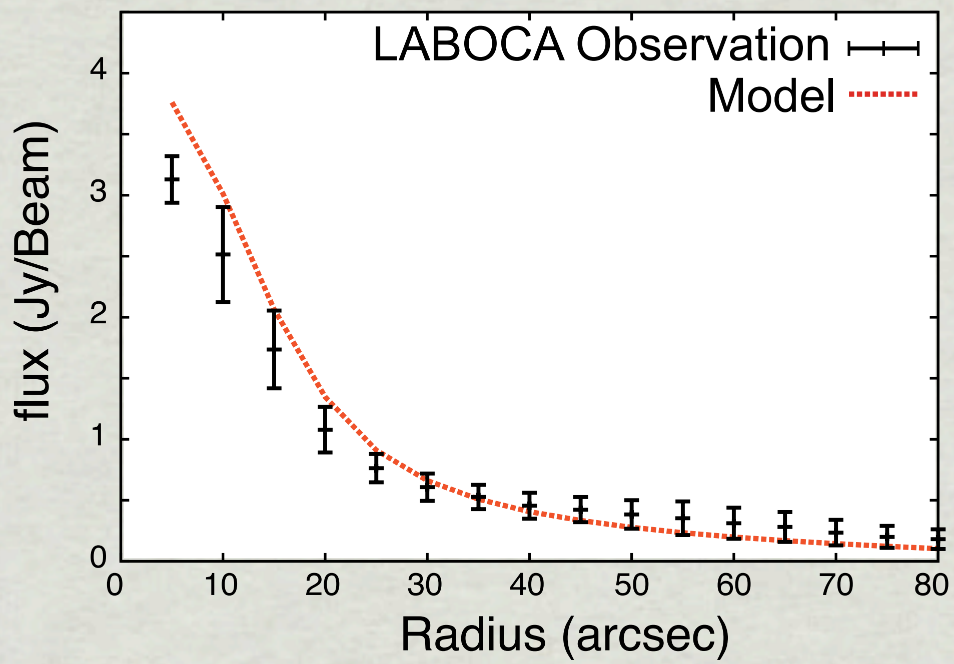


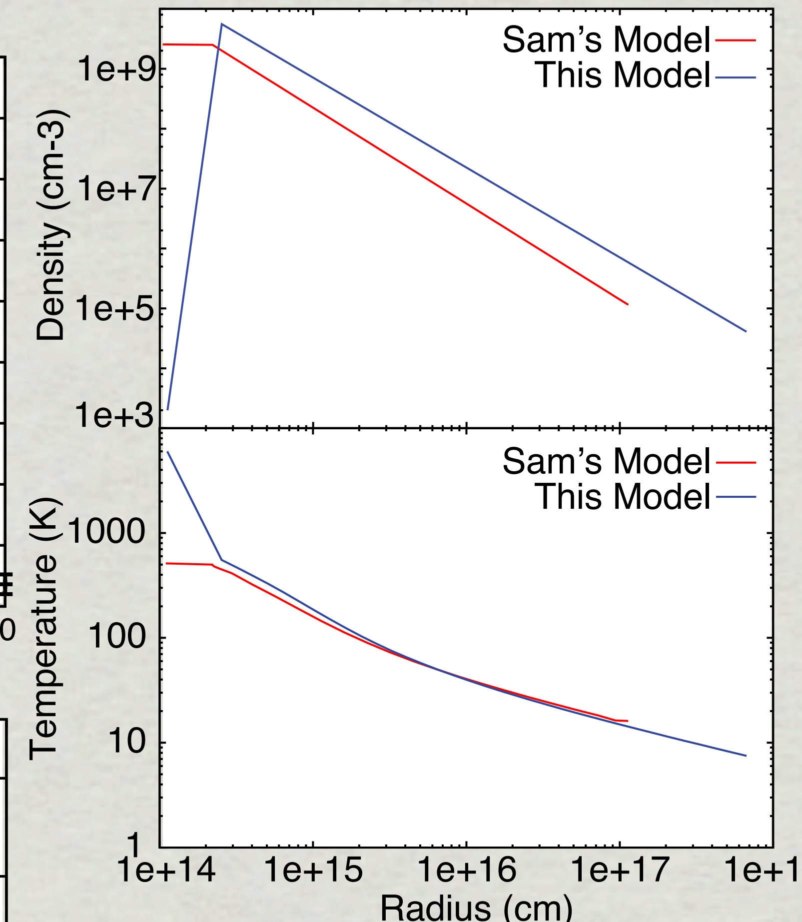
- Observed Continuum
  @ 893 GHz is ~0.376/2=0.188 K
- Modeled Continuum
  =>constraint: 1.3 mm map and SED.
  @893 GHz is ~0.118 K
  37% difference

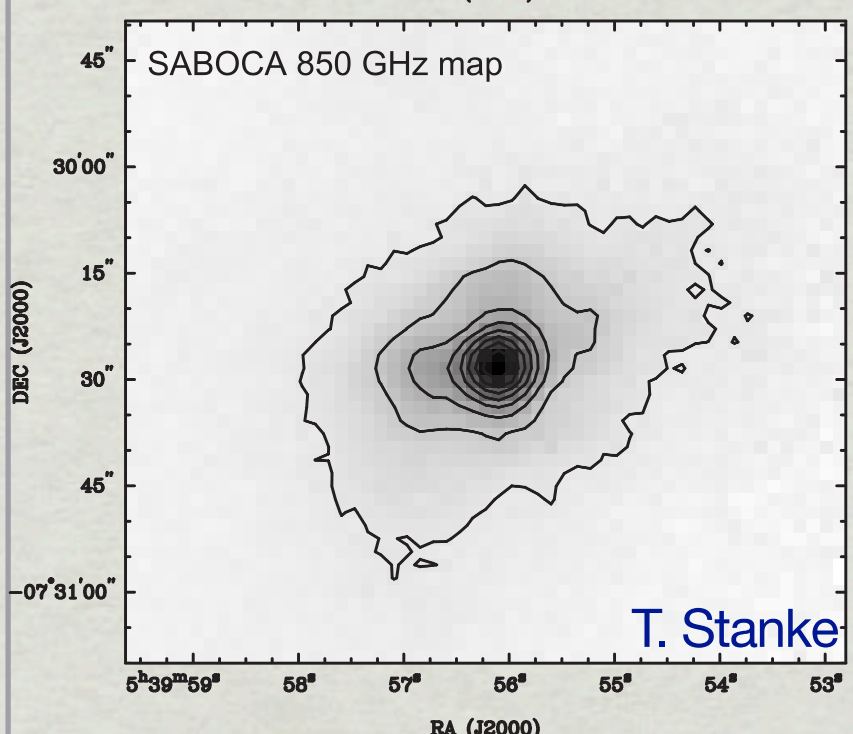
L1641 S3MMS1

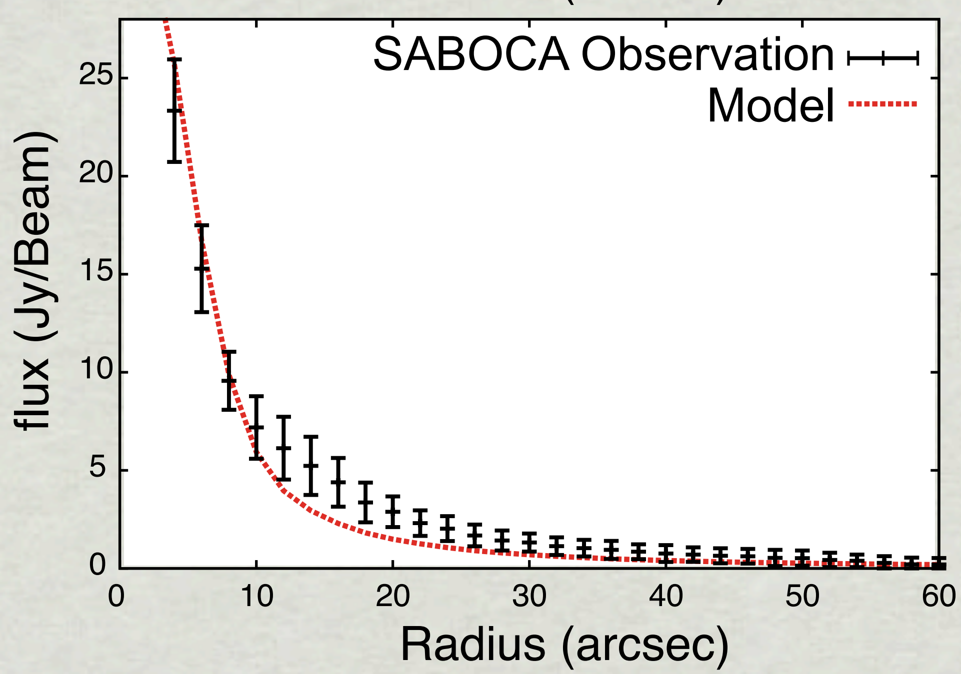
-RADMC3D Preliminary Results







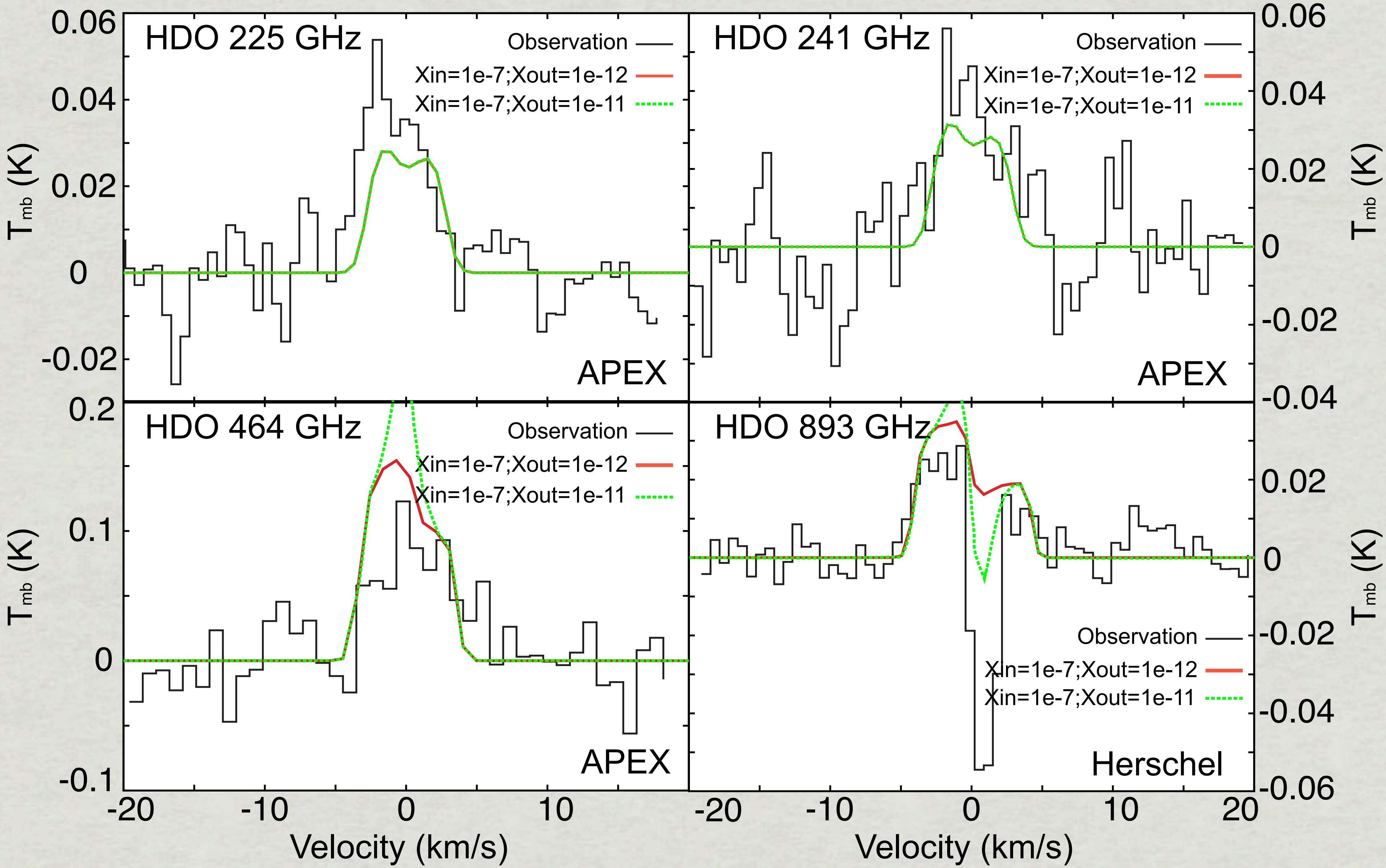




Modeled continuum flux @ 893 GHz =0.188 K

L1641 S3MMS1

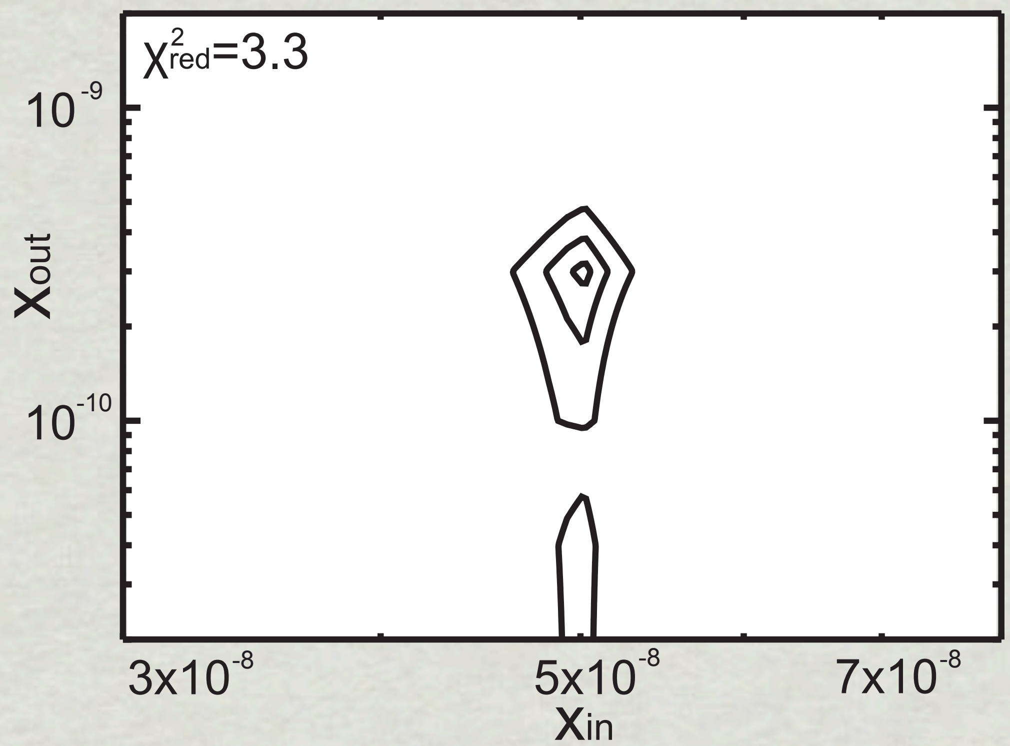
-RATRAN Preliminary Results

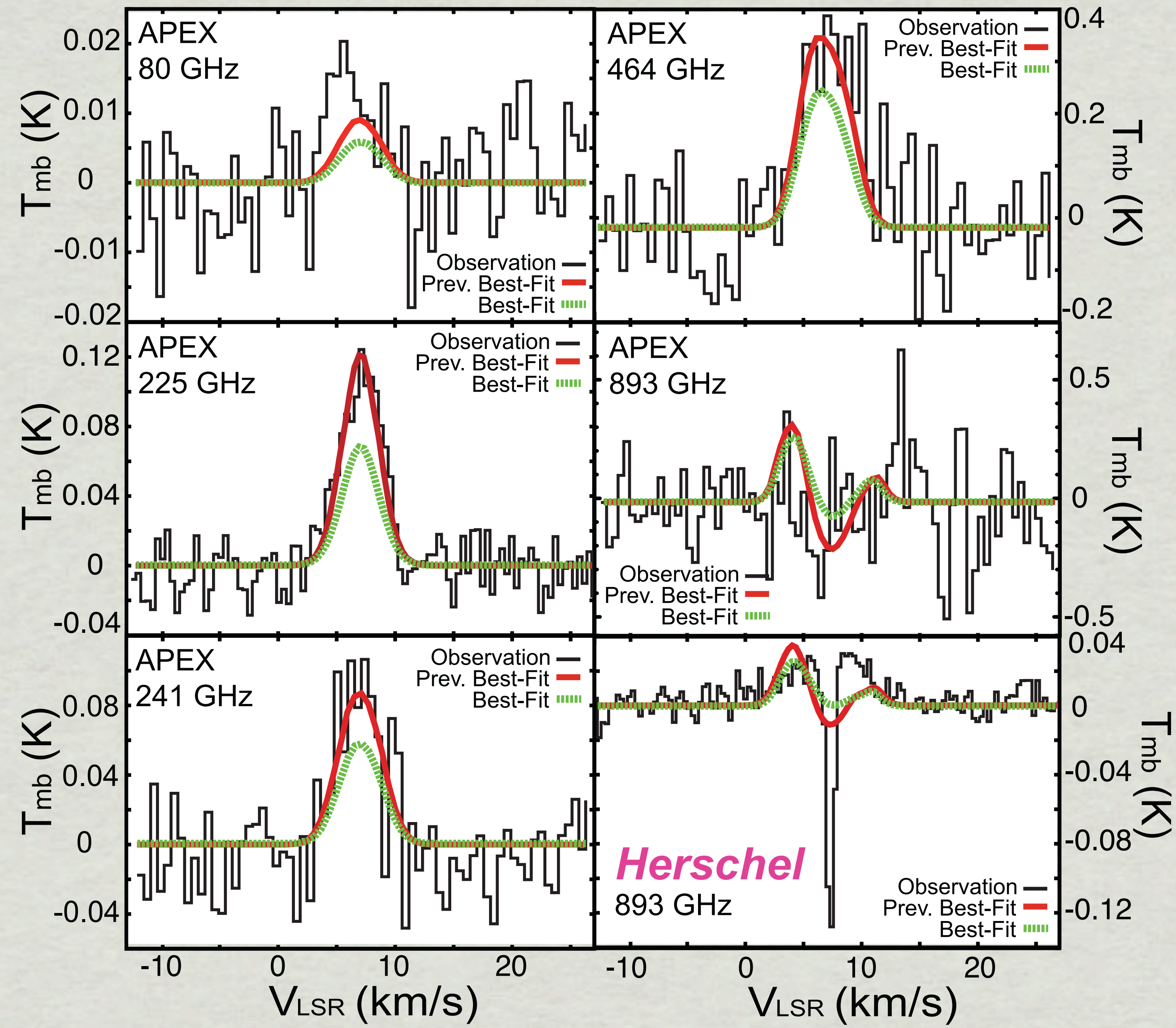


The HDO fractional abundance in the inner region is around 1e-7.
We need to add one more thin layer to reproduce the absorption.

Low-mass source: NGC1333 IRAS2A

NGC1333 IRAS2A
-RATRAN Preliminary Results



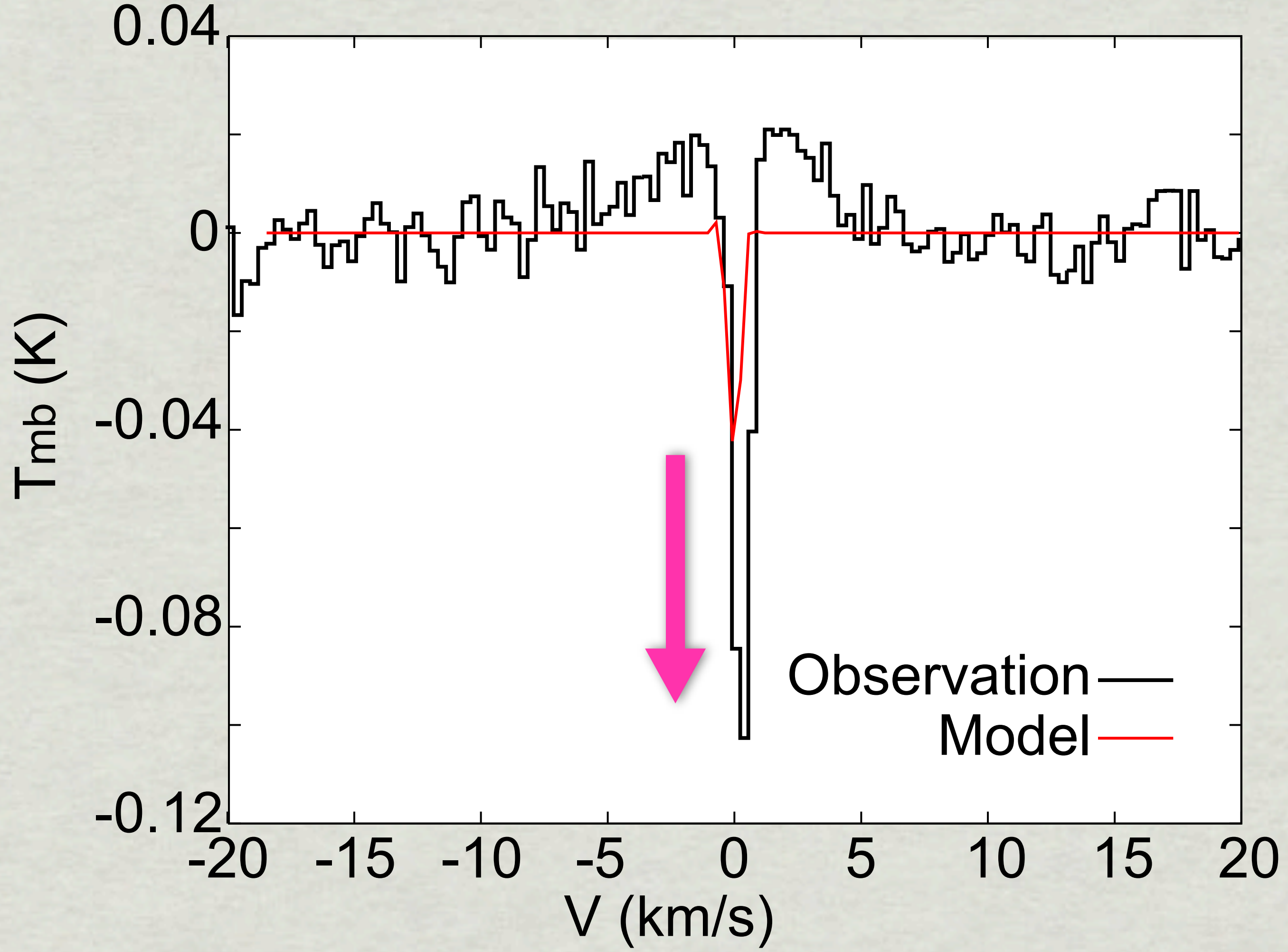


- The fractional abundance in the inner region is needed to be decreased.
- The absorption line is much narrower (~0.58 km/s) than other lines (~4 km/s).

Prev. best-fit: $x_{in}=8x10^{-8}$; $x_{out}=7x10^{-10}$ $\chi^2=4.2$

Best-fit: $x_{in}=5x10^{-8}$; $x_{out}=3x10^{-10}$ $\chi^2=3.3$

NGC1333 IRAS2A
-RATRAN Preliminary Results



- The flux of the continuum 0.17(obs) vs. 0.06(model)

- To reproduce this narrow absorption, we need to reproduce the continuum first.

Thank you very much for your attention!

Summary

- In the case of G327.3, we need to solve the opacity problem. The very similar profiles of different lines can tell us the kinematic structures.
- In the case of IRAS 16065-5158 and IRAS 2A, we probably can well fit the spectra if we can reproduce real continuum emission at 893 GHz.
- In the case of L1641 S3 MMS1, we need to add one photo-disorption layer to reproduce the thin absorption at 893 GHz like the case in IRAS 16293-2422.