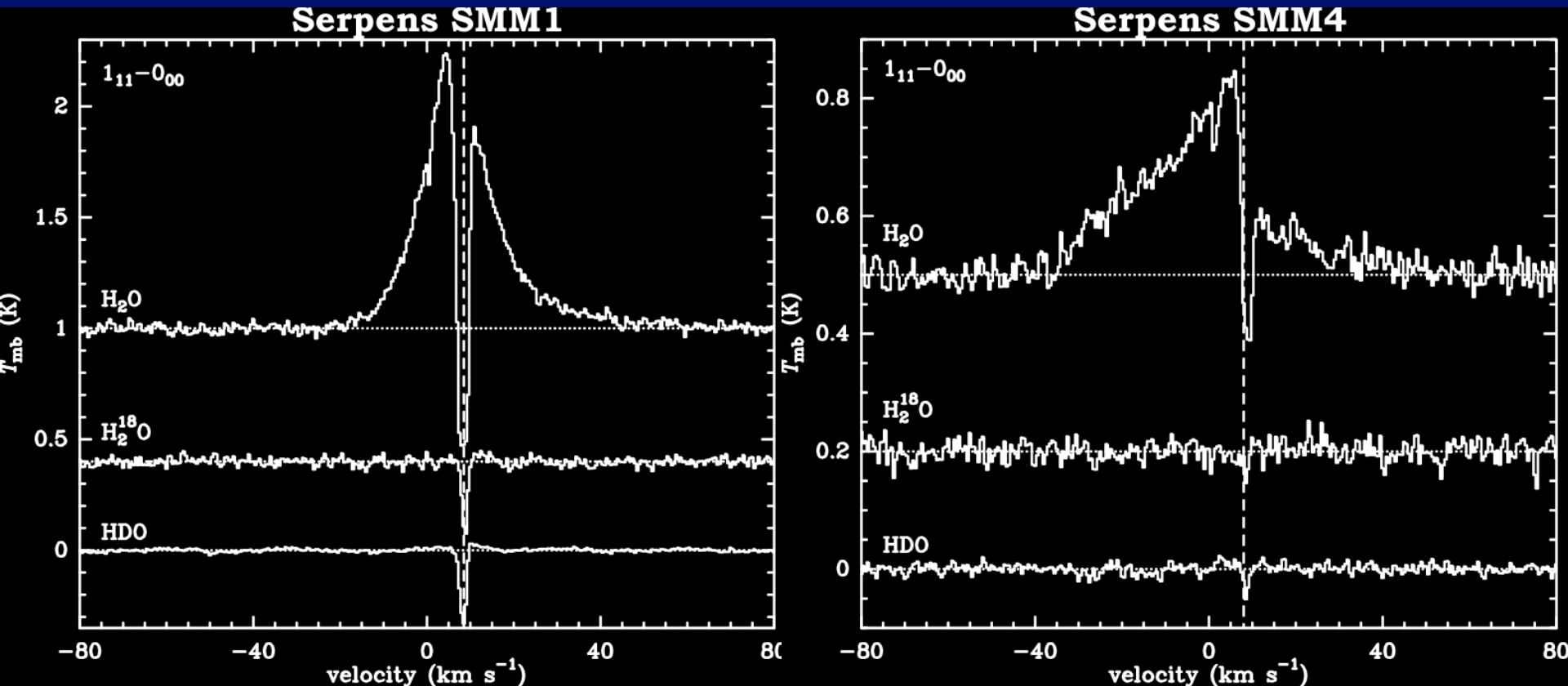


# Serpens SMM1 & SMM4: HDO & H<sub>2</sub>O

**Joseph Mottram**

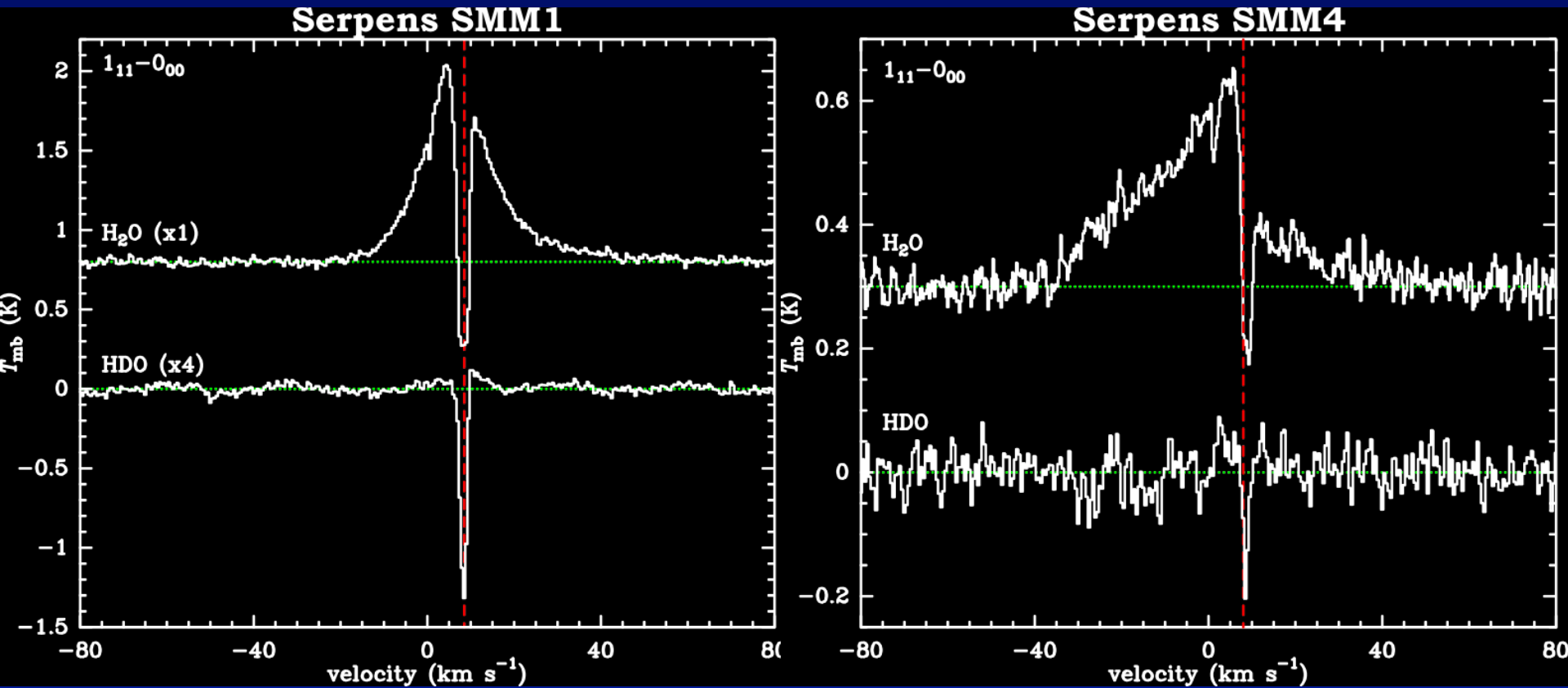
**on behalf of Tobias Albertsson, Ewine van Dishoeck, Lars Kristensen,  
Markus Schmalzl & Ruud Visser**

# The spectra



- Broad emission not seen in HDO &  $\text{H}_2^{18}\text{O}$
- SMM4 shows redshifted absorption

# The spectra

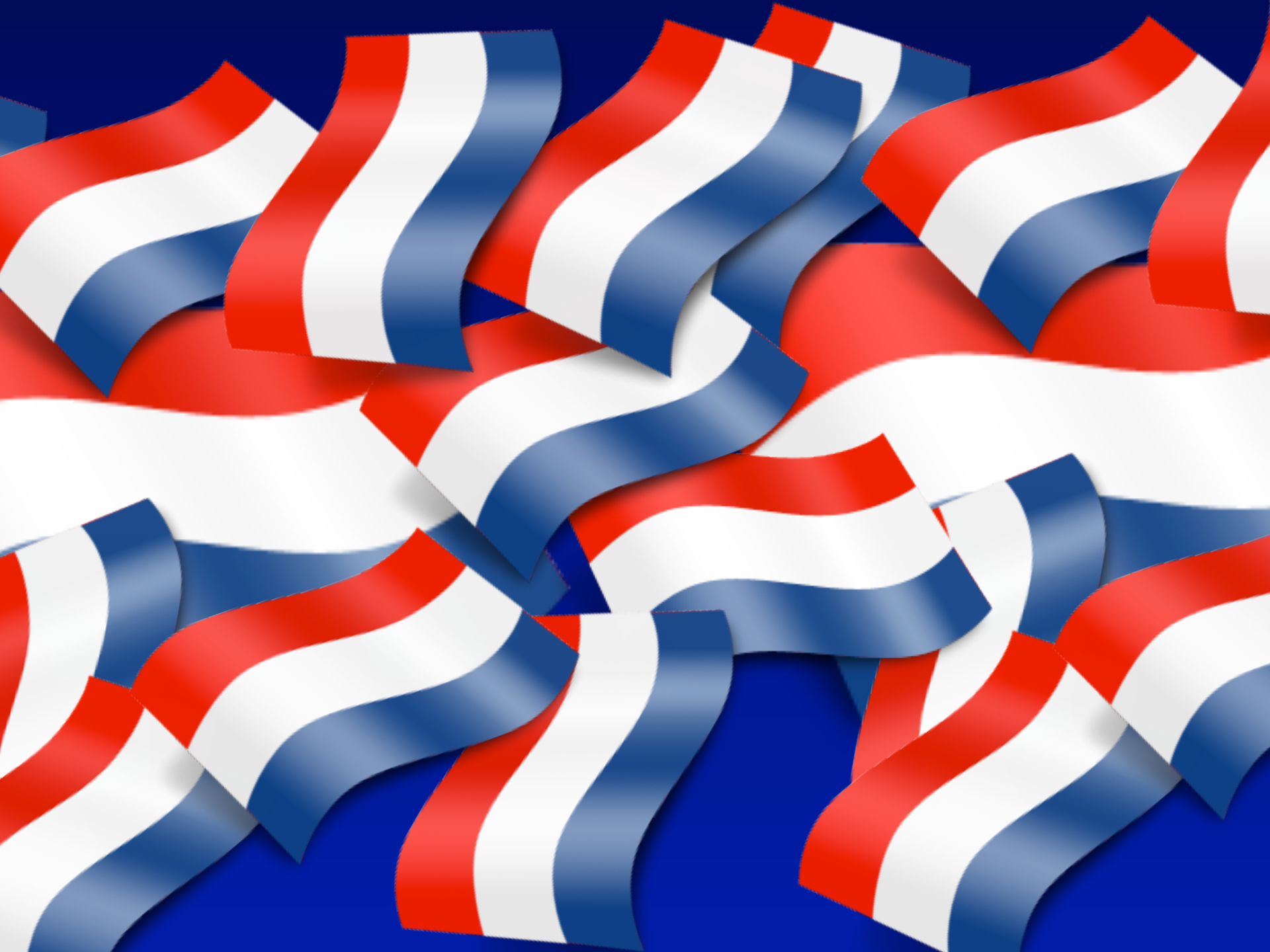


- Broad emission not seen in  $\text{HDO}$  &  $\text{H}_2^{18}\text{O}$
- SMM4 shows redshifted absorption

# Absorbing Column Density

Source	$N(\text{H}_2\text{O})$	$N(\text{HDO})$	HDO/ $\text{H}_2\text{O}$	$N(\text{H}_2)$ ( $10 < T < 100\text{K}$ )
SMM1	$5 \times 10^{15}$	$1 \times 10^{13}$	0.2%	$3.3 \times 10^{23}$
SMM4	$< 1 \times 10^{15}$	$2.5 \times 10^{12}$	$< 0.4\%$	$3.9 \times 10^{23}$

- Assuming that  $\text{H}_2\text{O}$  and HDO probe the same column

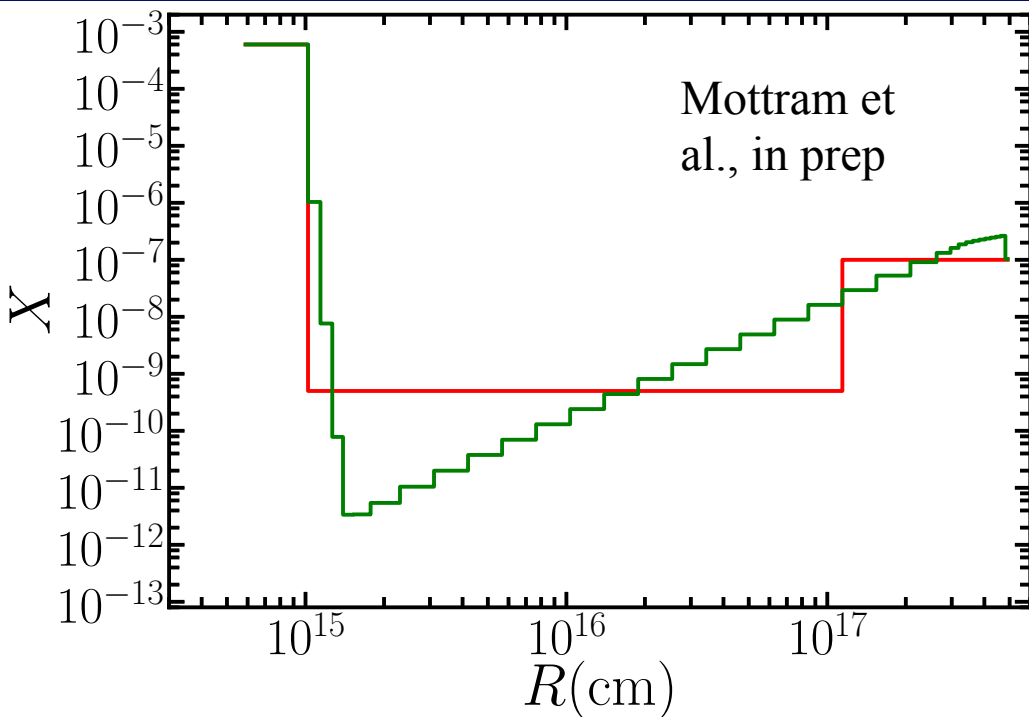


30

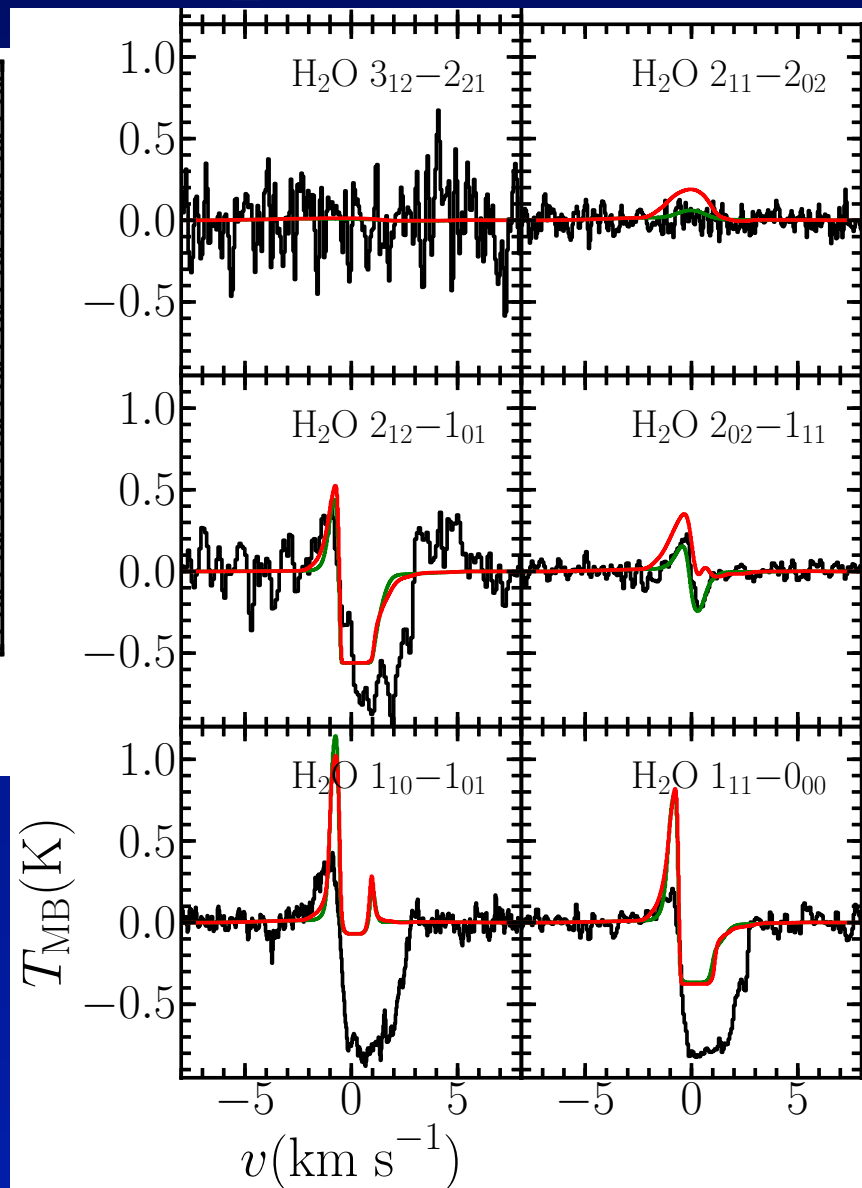


**Got Milk ?**

# Water abundance profile



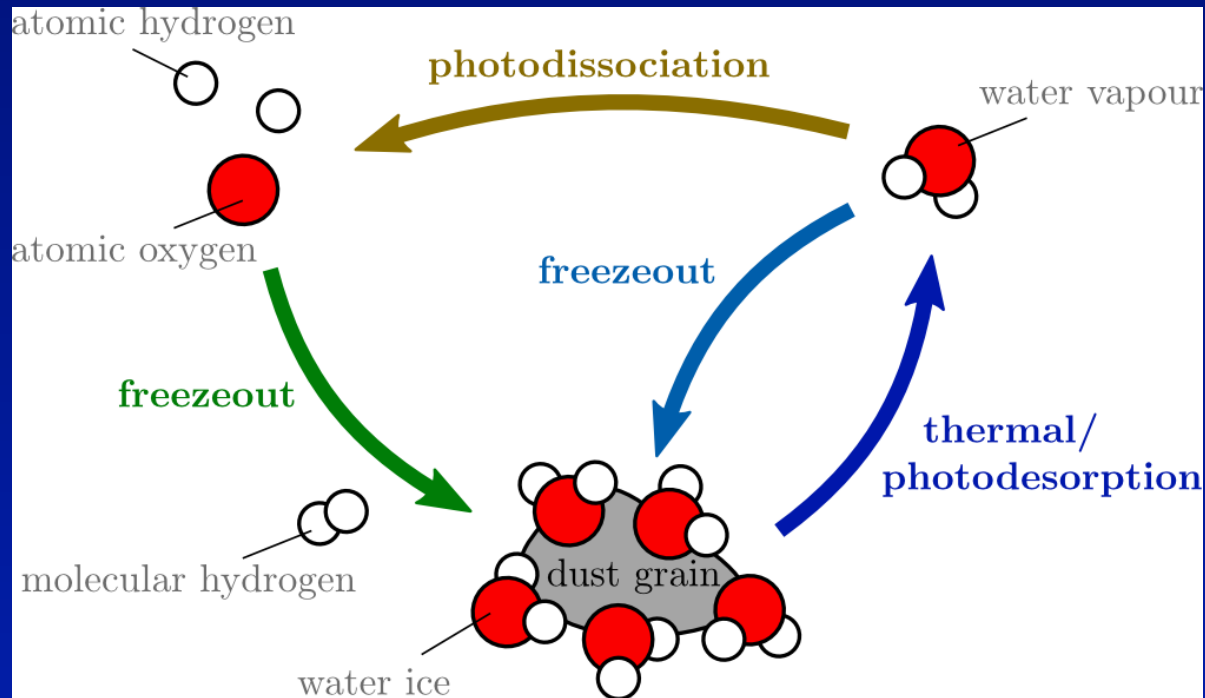
- Simple chemistry provides much better fit to line profiles for NGC1333-IRAS4A





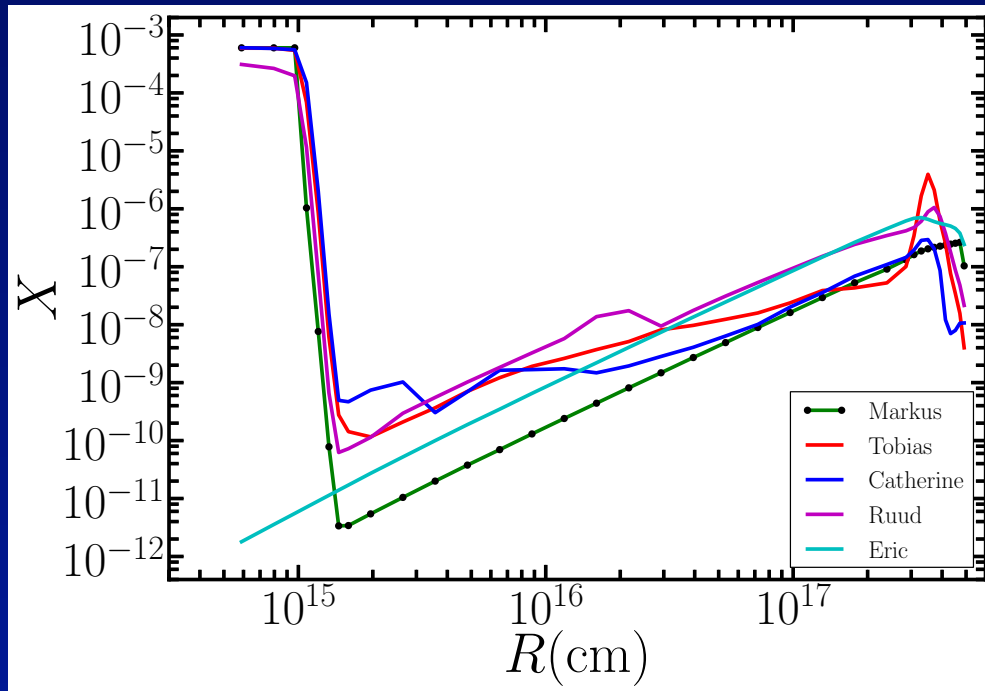
# Simple Water Chemistry

- Scheme considers only oxygen, water vapour & ice similar to Hollenback et al., 2009
- Slope throughout cold ( $<100\text{K}$ ) envelope due to density dependence of freezeout

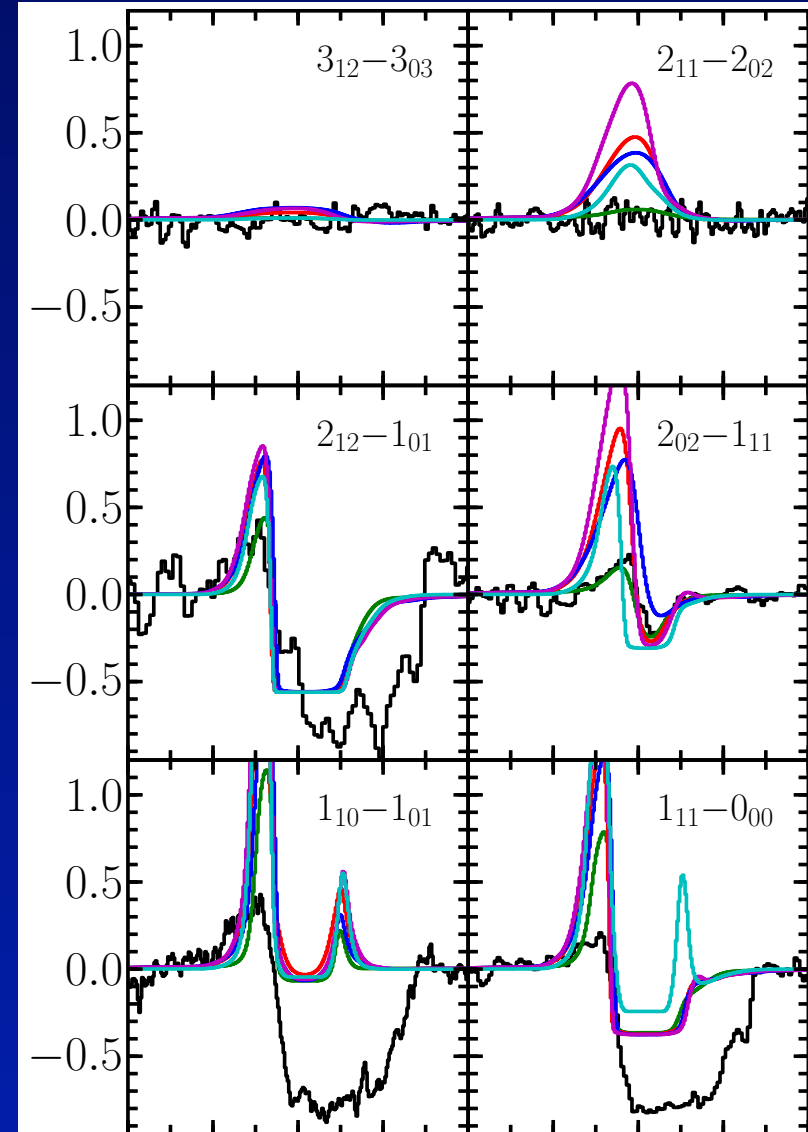


Schmalzl et al., in prep

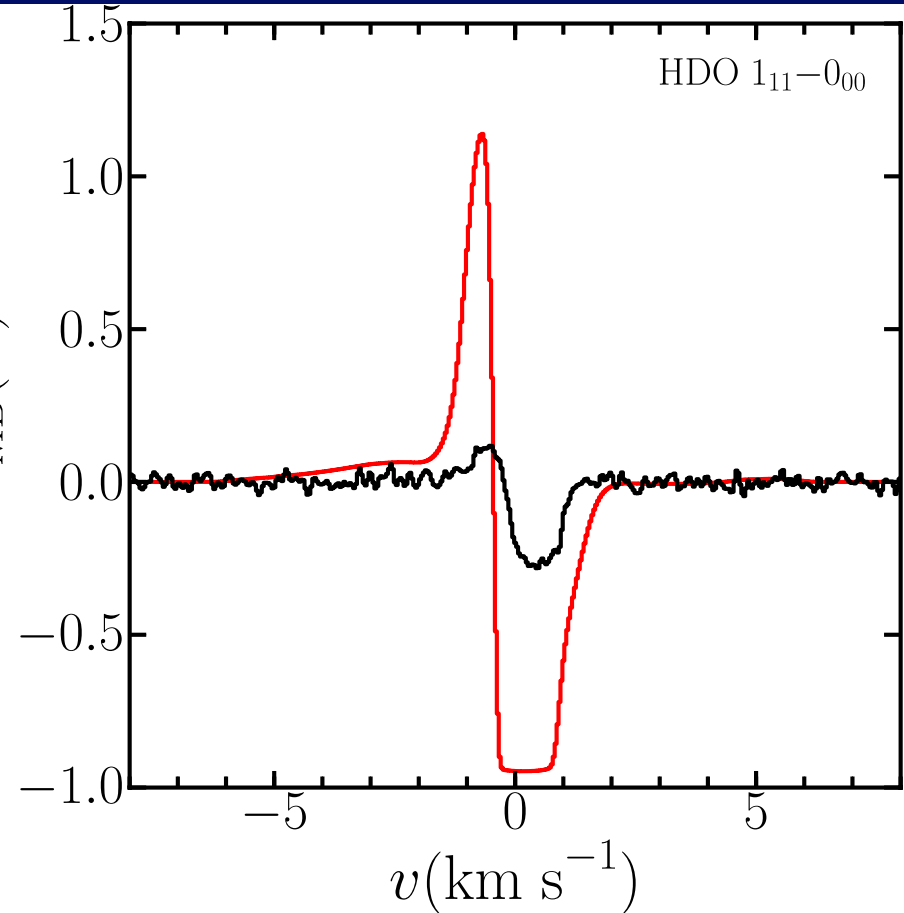
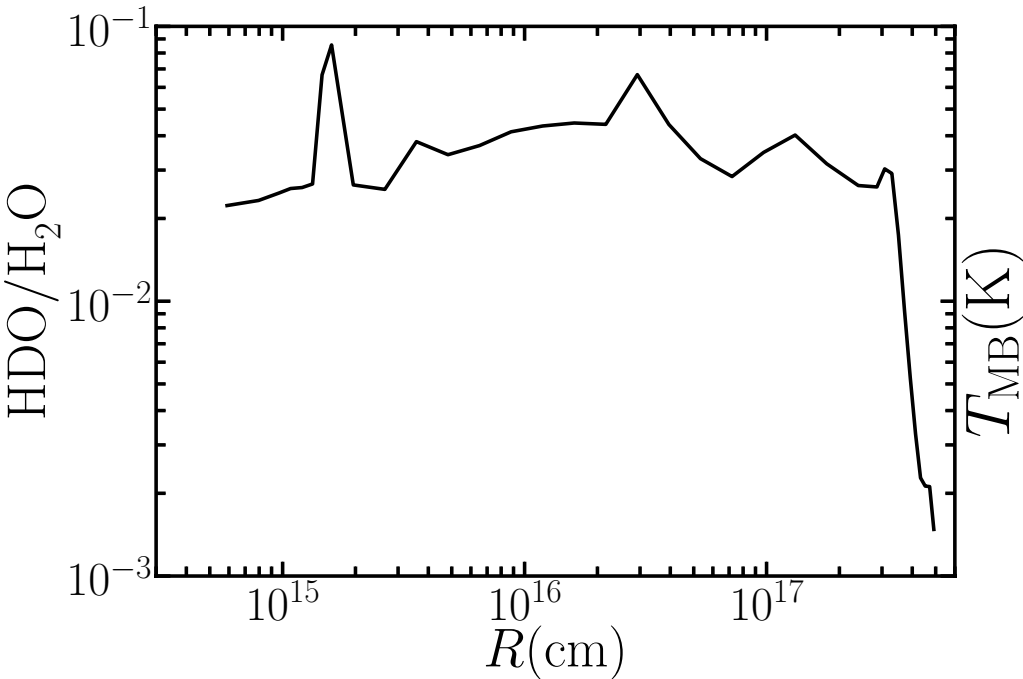
# Comparison with more complex chemical model



- Simple abundance profile has broadly similar shape & currently better agreement with observations

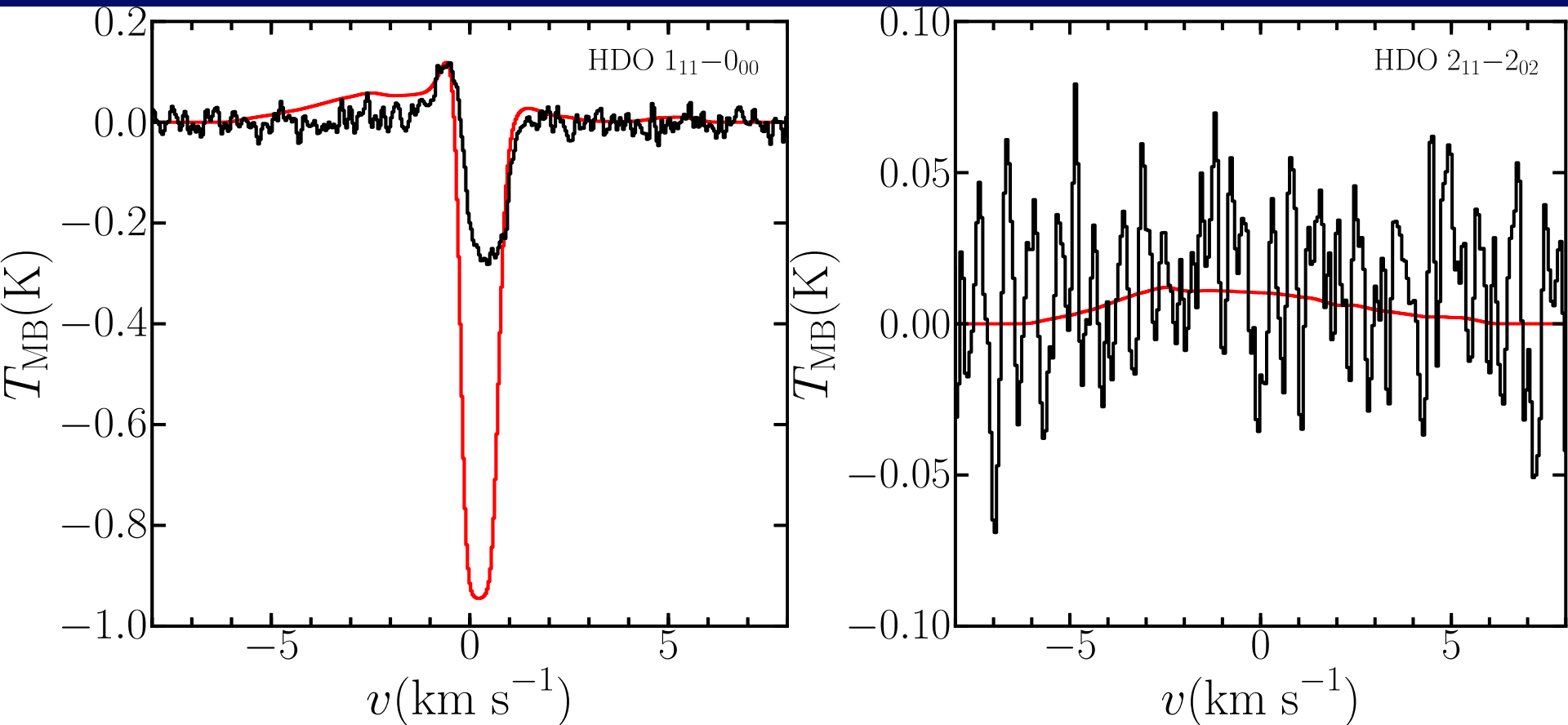


# Model for HDO/H<sub>2</sub>O



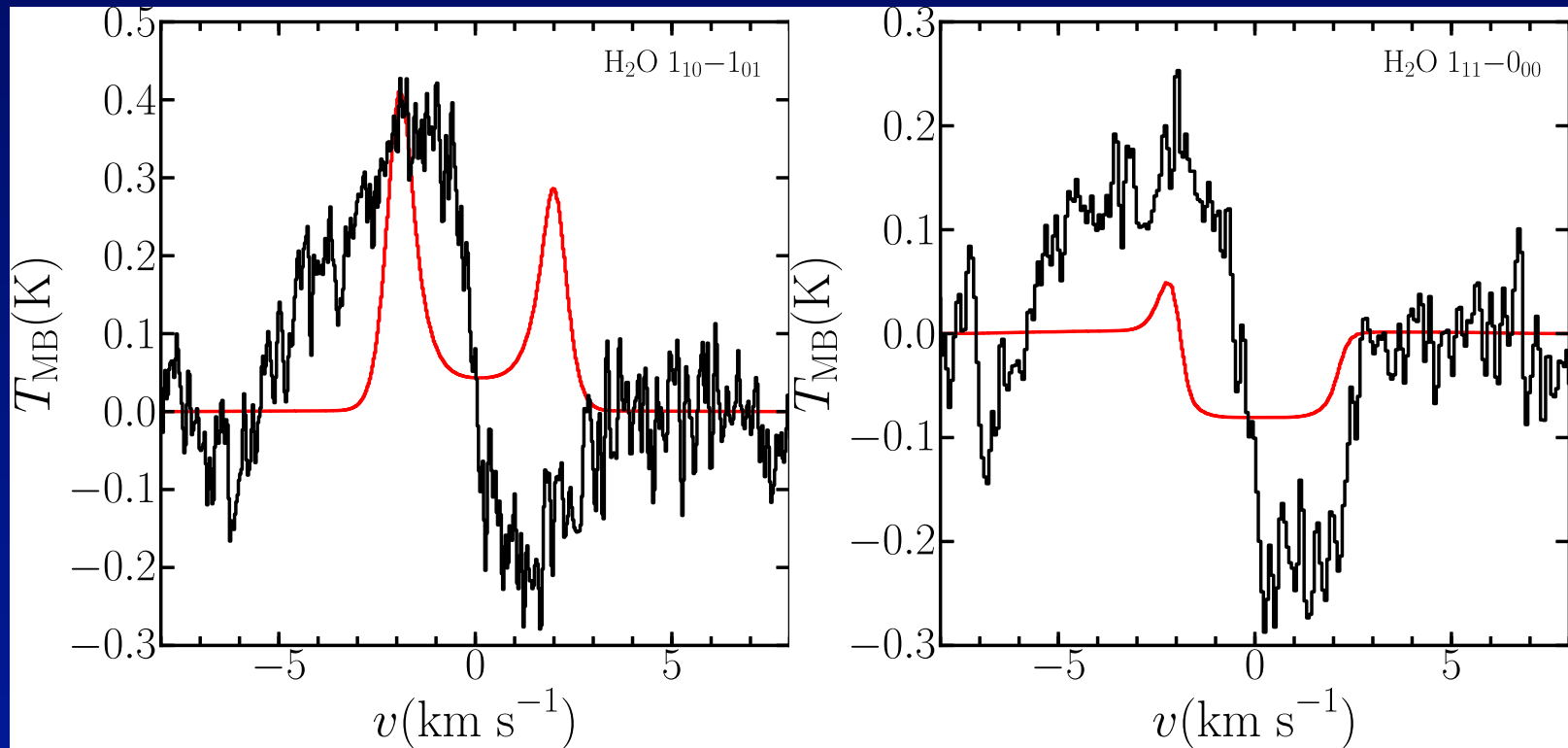
- Emission currently overproduced

# Consistent for HDO



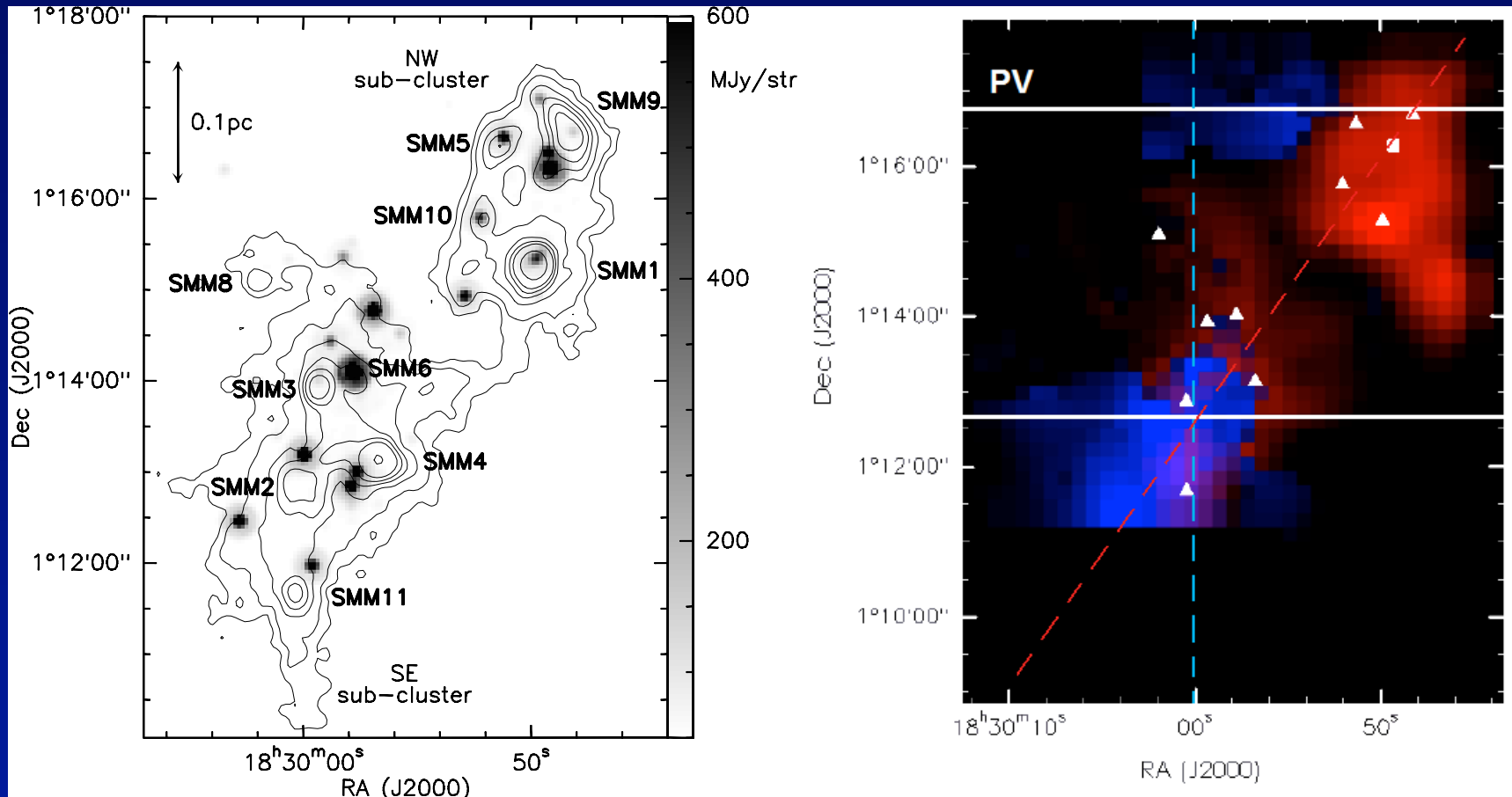
- Constant HDO/ $\text{H}_2\text{O}$  of 0.005 used
- Constrains inner infall radius

# An infalling envelope model for SMM4



- Envelope model struggles to reproduce shape and width of observations

# So what is happening?

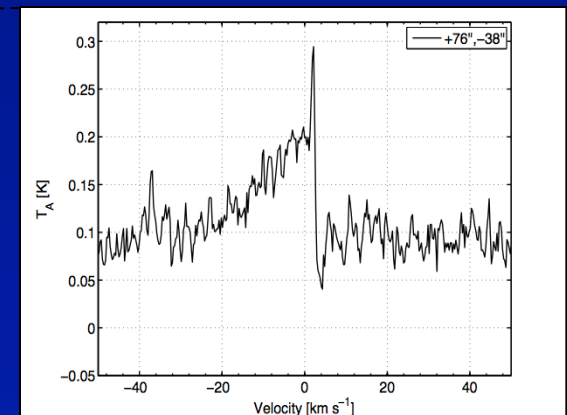
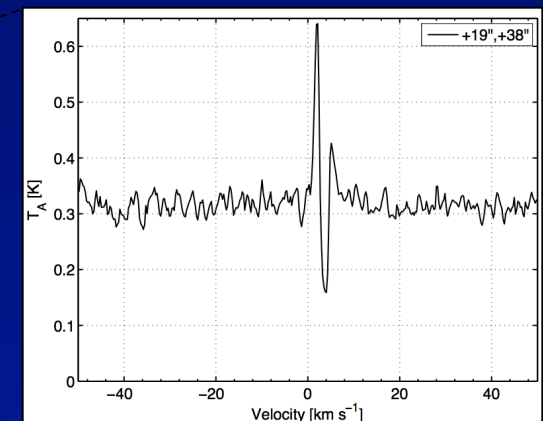
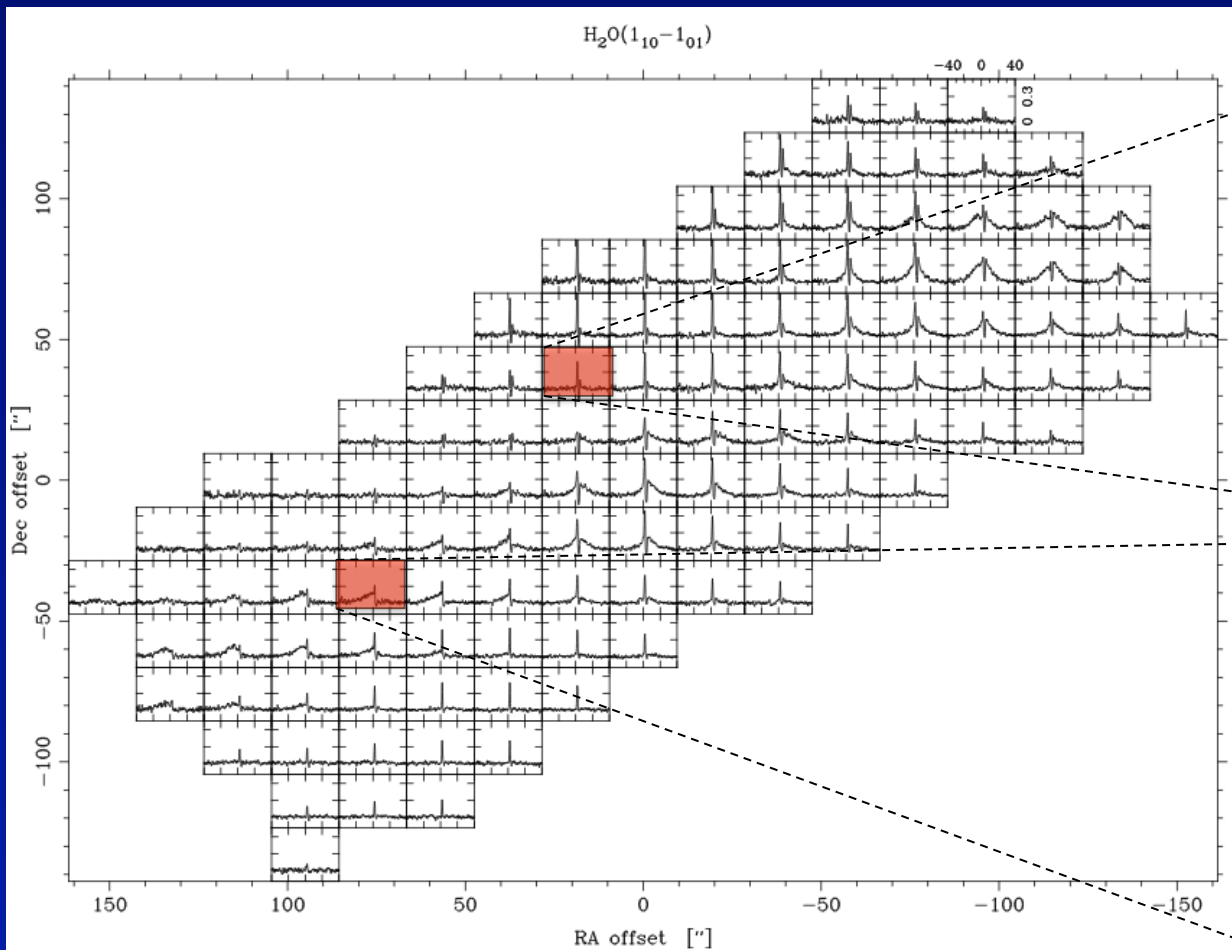


- Duarte-Cabral et al., (2011) suggest Serpens Main is actually two colliding clouds

# Similar effect seen towards VLA1623

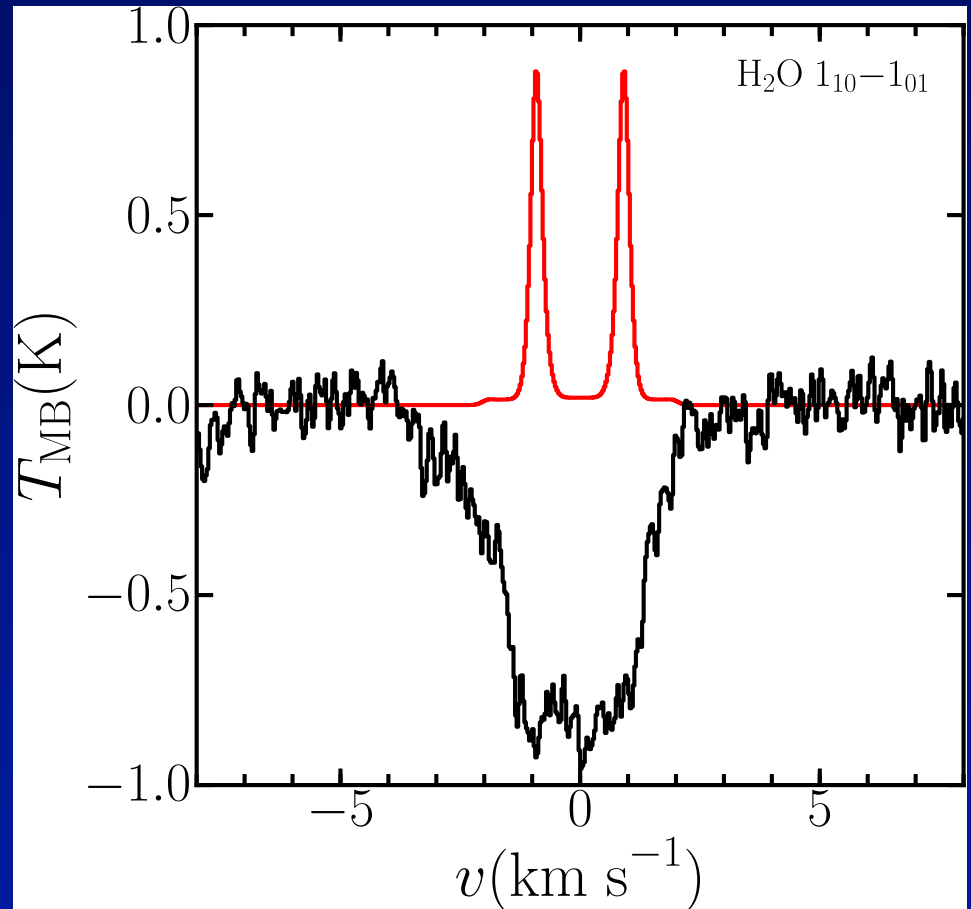
- Bjerkeli et al., 2012 see IPCs across whole

## H<sub>2</sub>O Map



# Similar for SMM1?

- Yet to implement absorption against the outflow
- Otherwise absorption must be at lower densities than consistent with envelope model





Any Questions?

