

A vertical strip on the left side of the slide shows a bright yellow star with a glowing corona and a ringed planet in the foreground, set against a dark blue space background with distant stars.

The Status of Spectroscopic Data for the EChO Mission

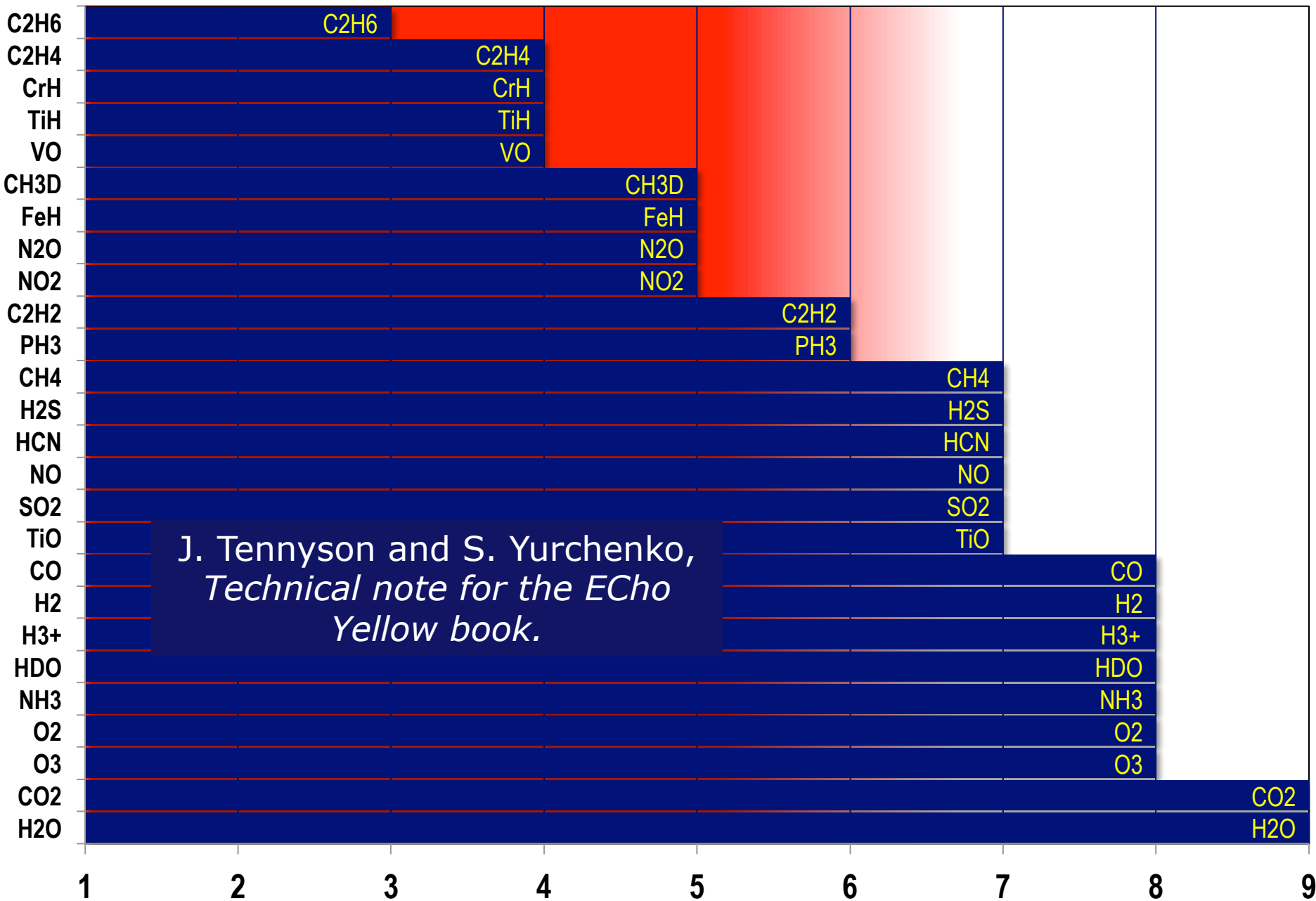
Sergey N. Yurchenko and Jonathan Tennyson

**Physics and Astronomy Department
University College London**

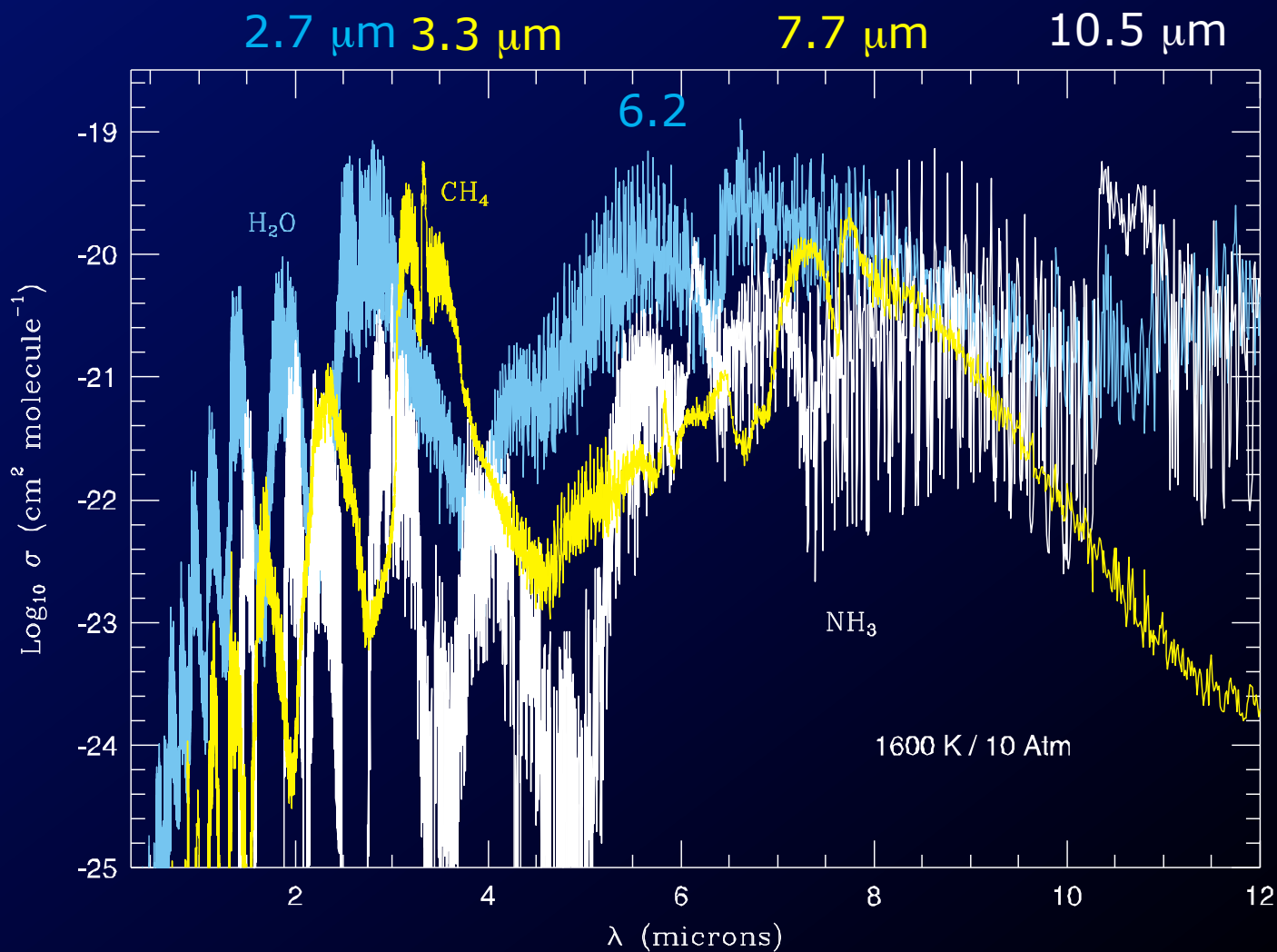
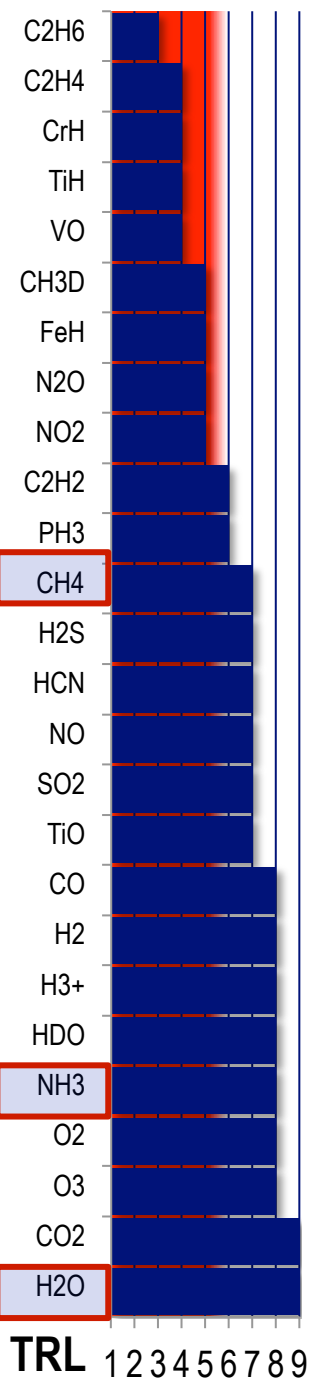
ECho molecules

H ₂ O	CO	H ₃ ⁺	NO ₂	TiO
C ₂ H ₂	CO ₂	HCN	O ₂	VO
C ₂ H ₄	CrH	HDO	O ₃	
C ₂ H ₆	FeH	N ₂ O	PH ₃	
CH ₃ D	H ₂	NH ₃	SO ₂	
CH ₄	H ₂ S	NO	TiH	

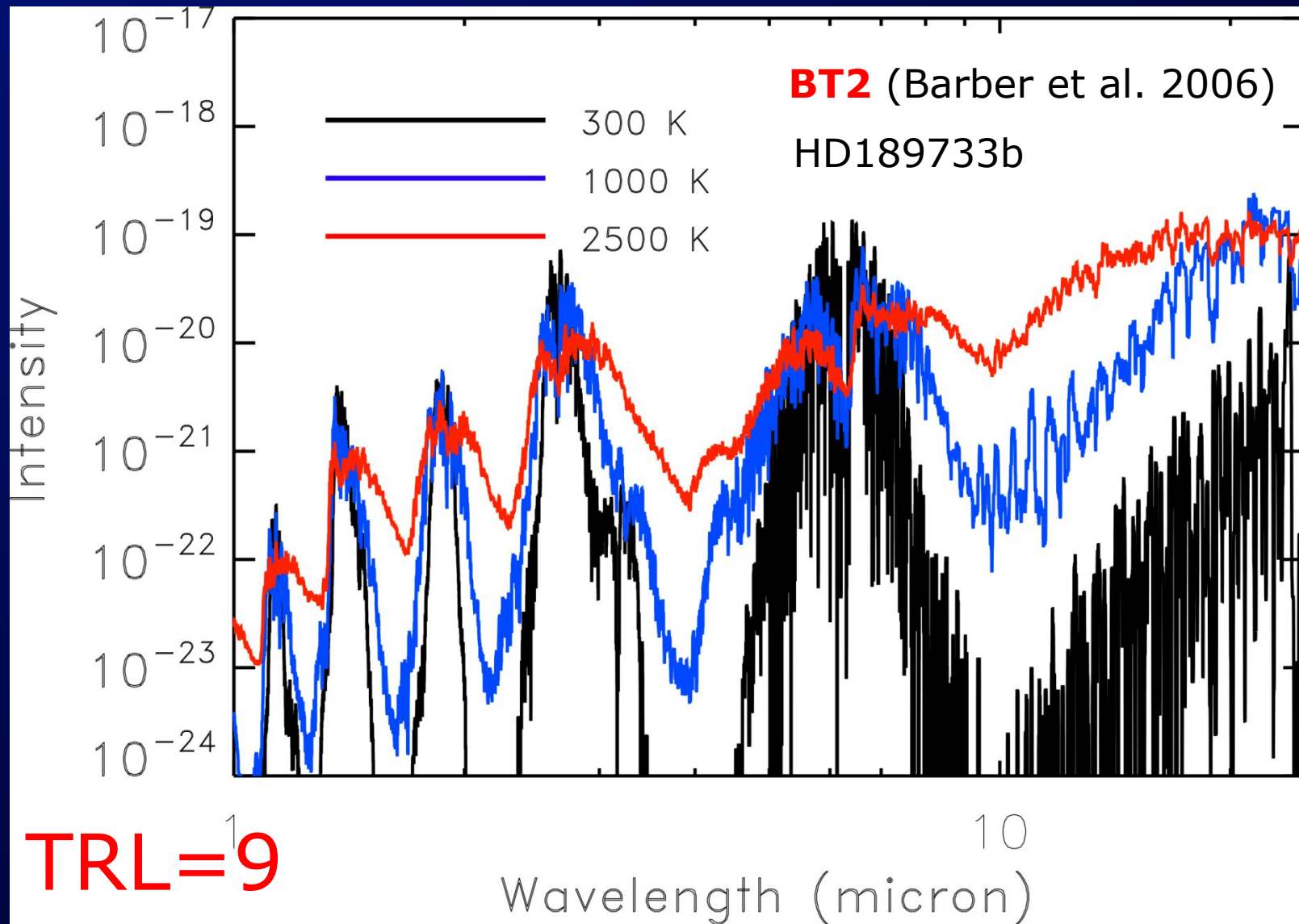
TRL = "Technology Readiness Level"



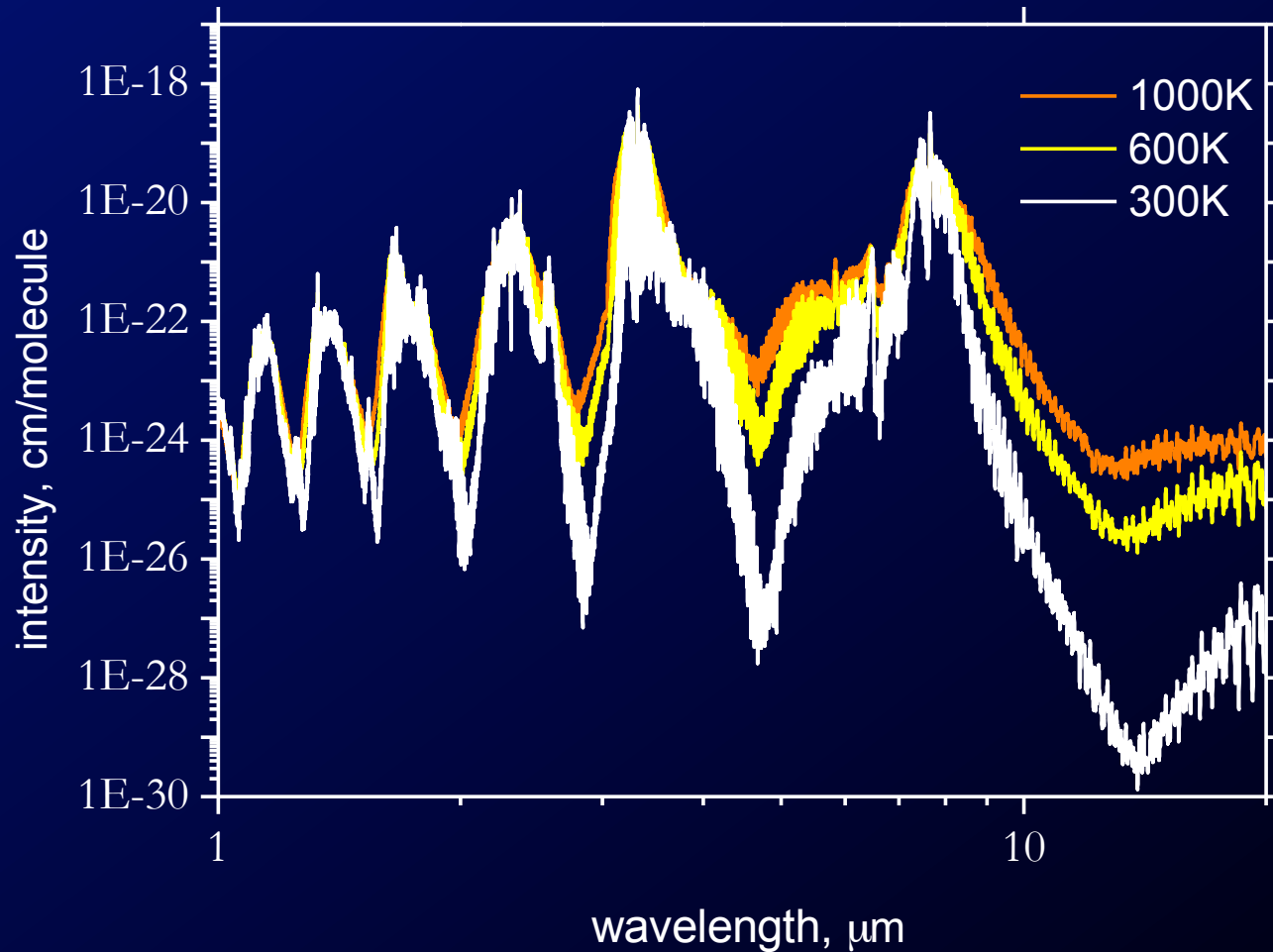
Absorption of molecules (T=1600 K)



Absorption of H₂O: BT2 line list

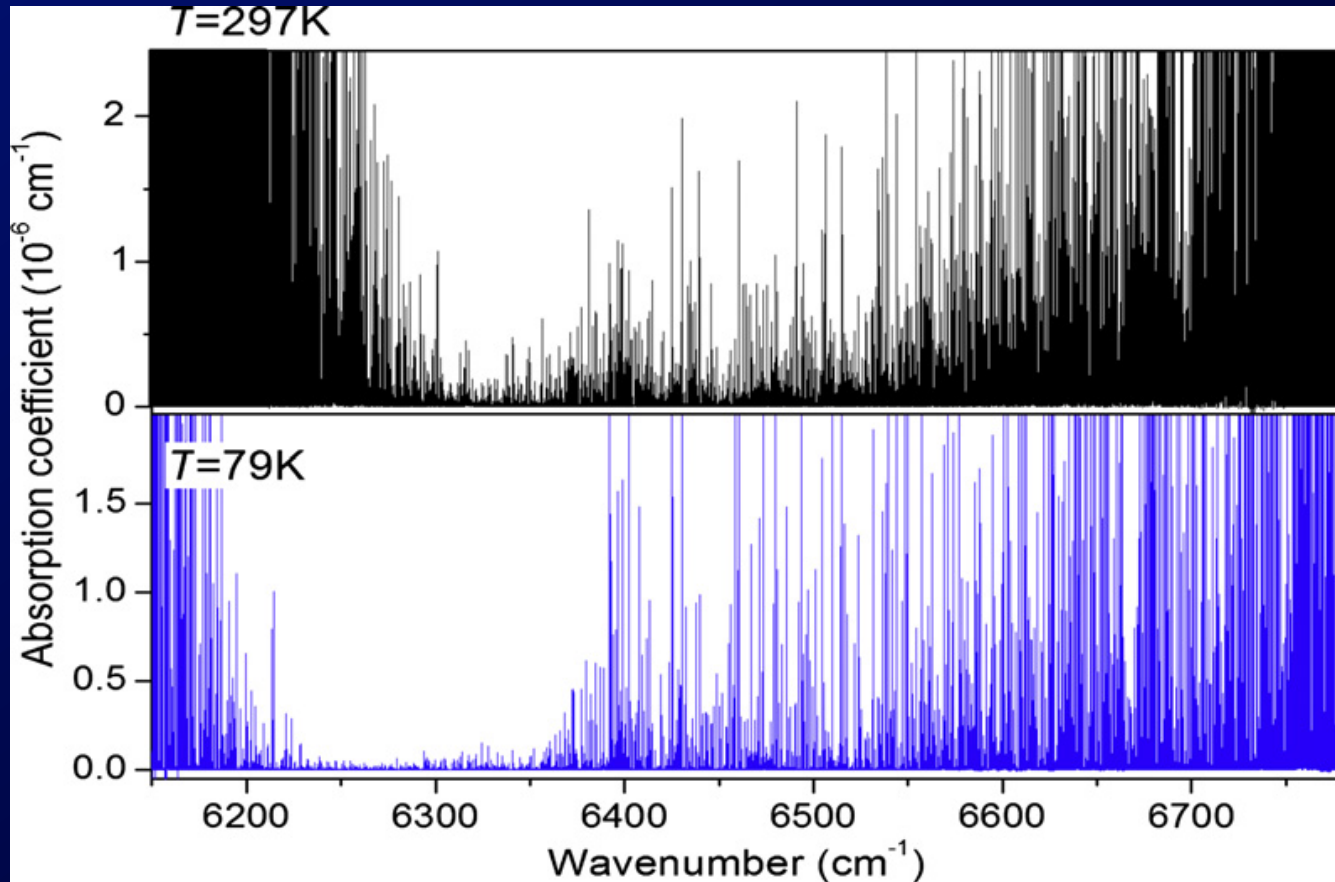


Absorption spectra of CH₄: Temperature effect



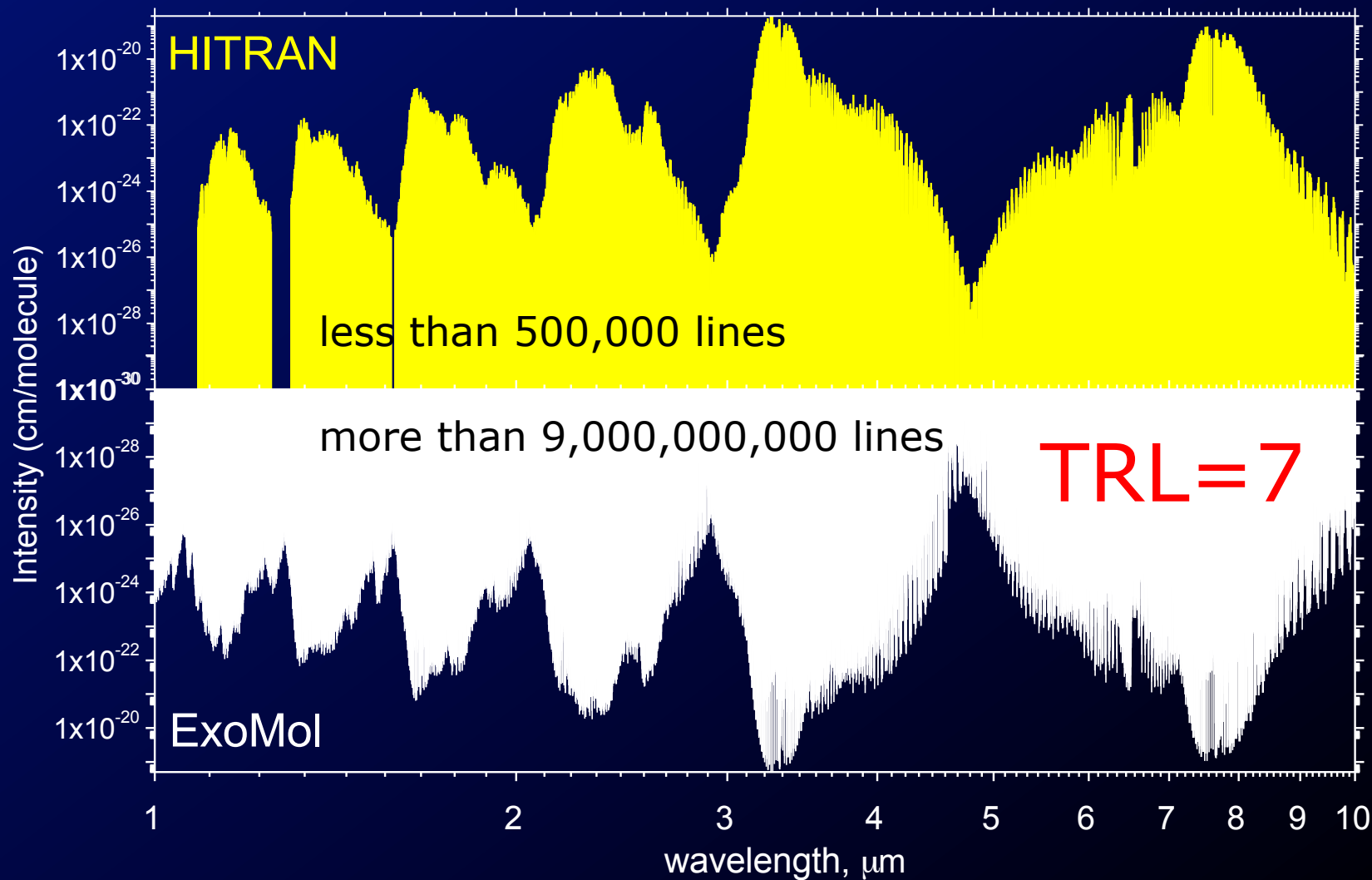
$$I(f \leftarrow i) = S(f \leftarrow i) \frac{e^{-E_i/kT}}{Q(T)} \left[1 - e^{-hc\tilde{\nu}_{if}/kT} \right] \frac{8\pi^3 N_A \tilde{\nu}_{if}}{(4\pi\epsilon_0)3hc}$$

CH₄: Assignment is very difficult!

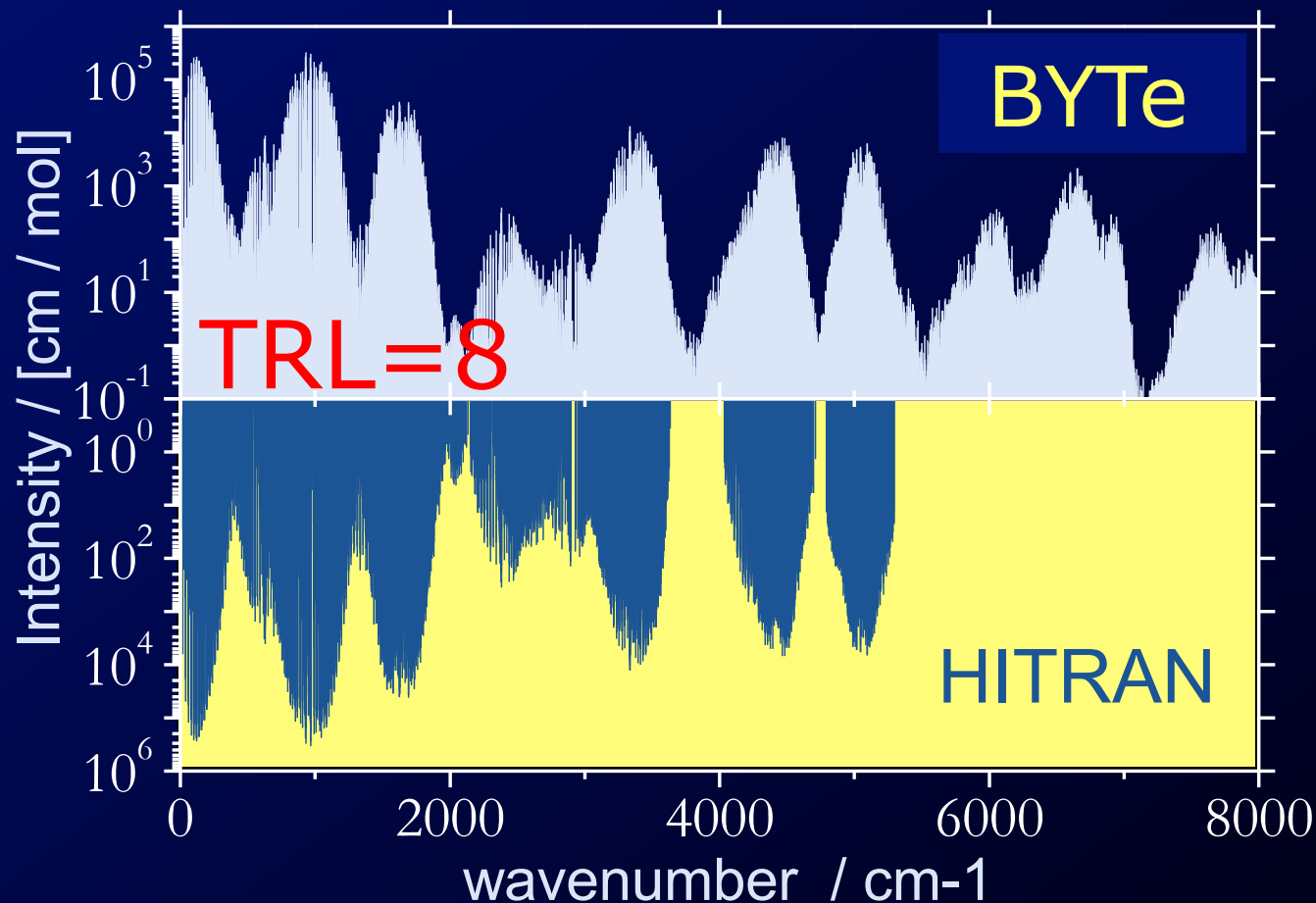


$$I(f \leftarrow i) = S(f \leftarrow i) \frac{e^{-E_i/kT}}{Q(T)} [1 - e^{-hc\tilde{\nu}_{if}/kT}] \frac{8\pi^3 N_A \tilde{\nu}_{if}}{(4\pi\epsilon_0)3hc}$$

Methane (T=300 K): J < 40

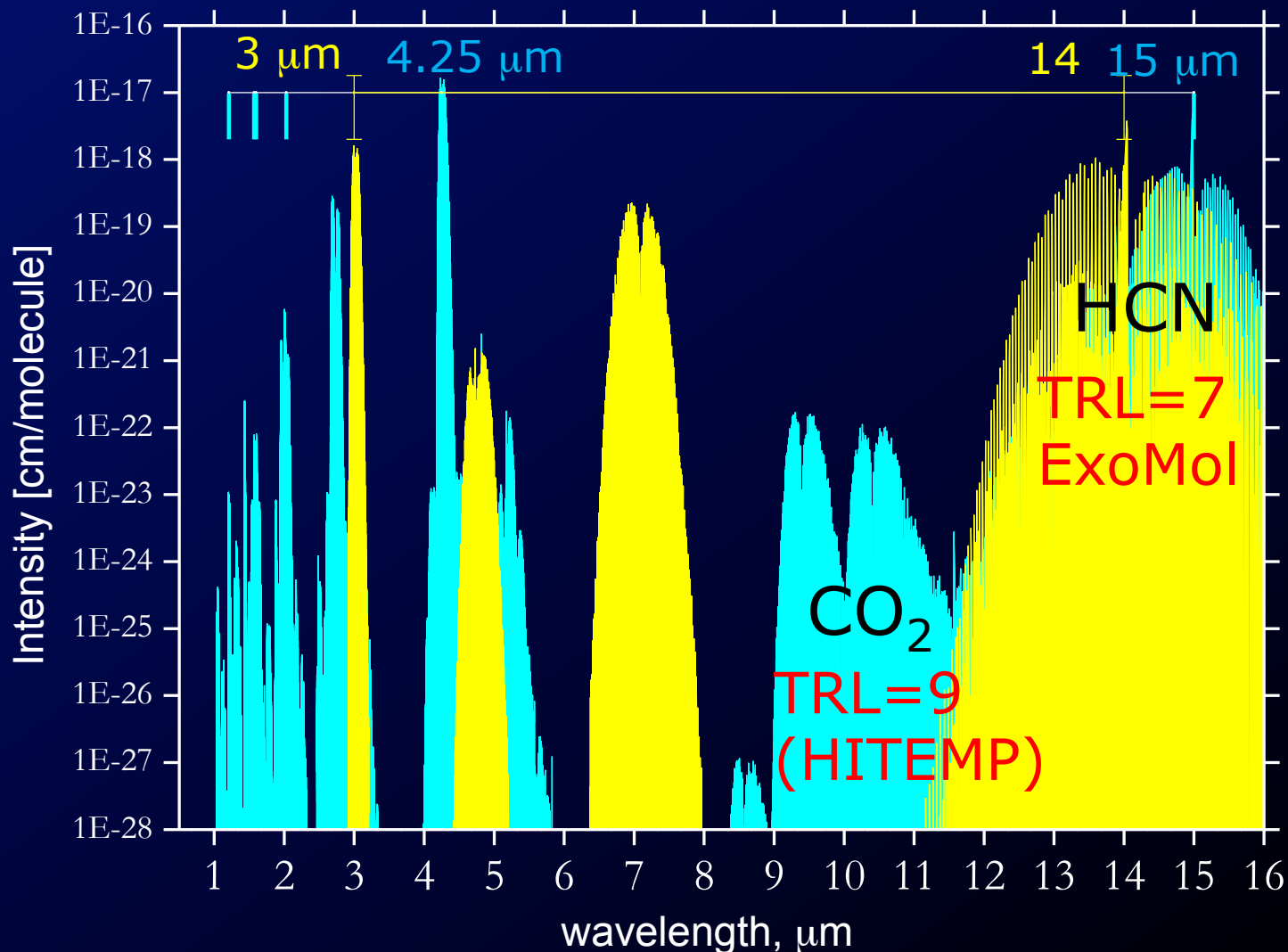
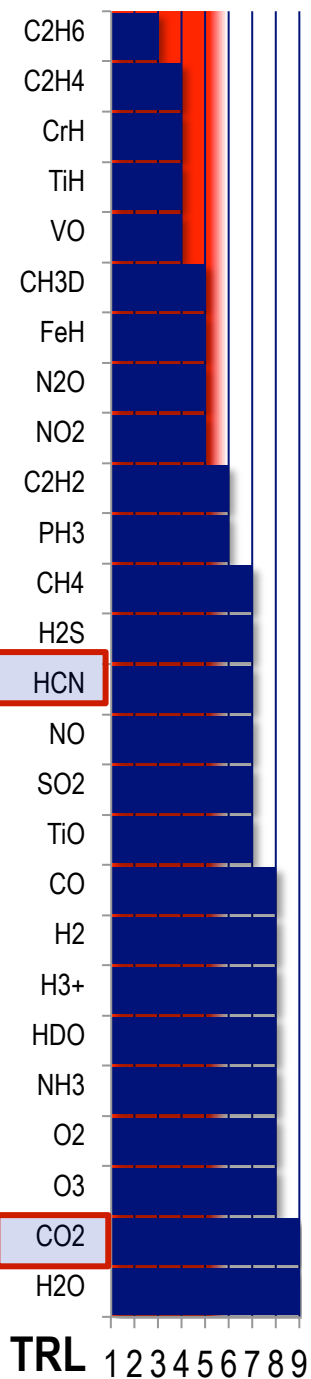


Absorption of ammonia (T=300 K)



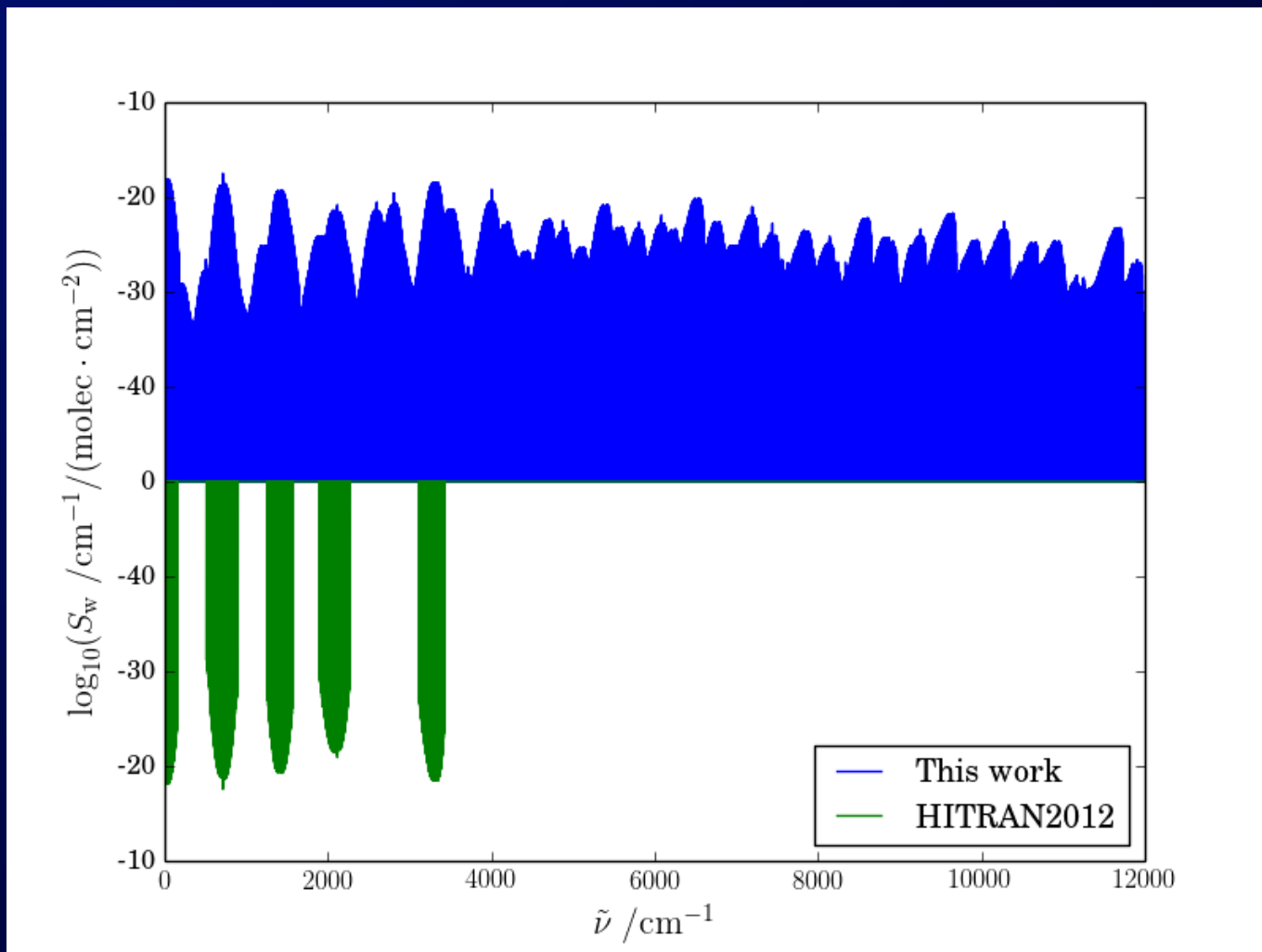
Less than 30,000 NH_3 lines are known experimentally: our list contains 1.1 billion lines, or about 40,000 times as many!

Absorption of CO₂ and HCN (T=300 K)



HCN/HNC: Barber et al , to be submitted.

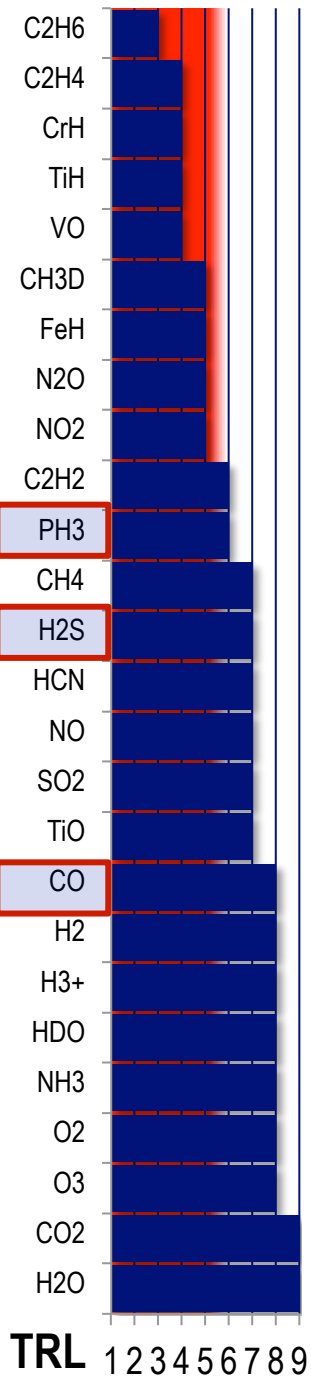
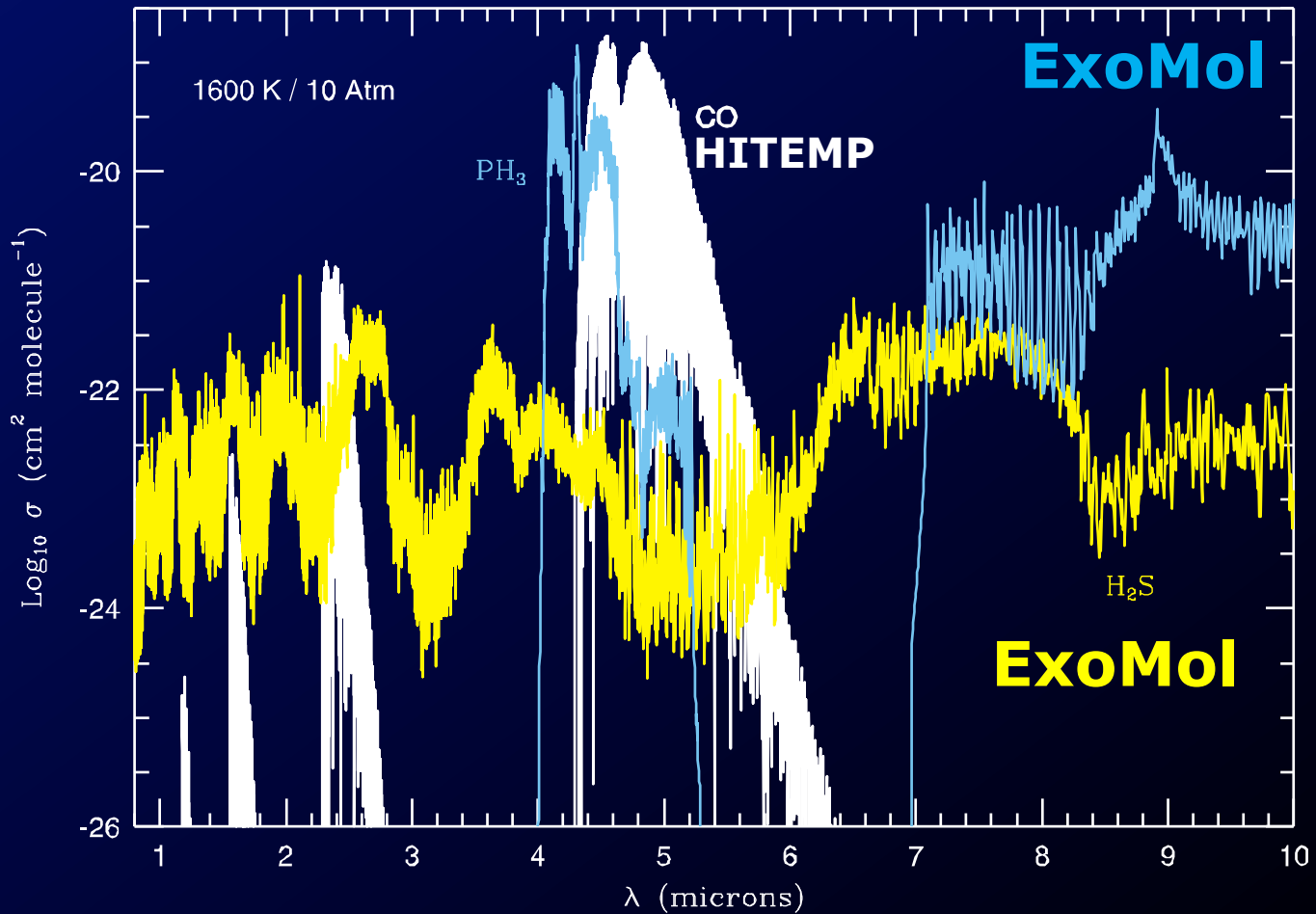
Absorption of HCN (300K)



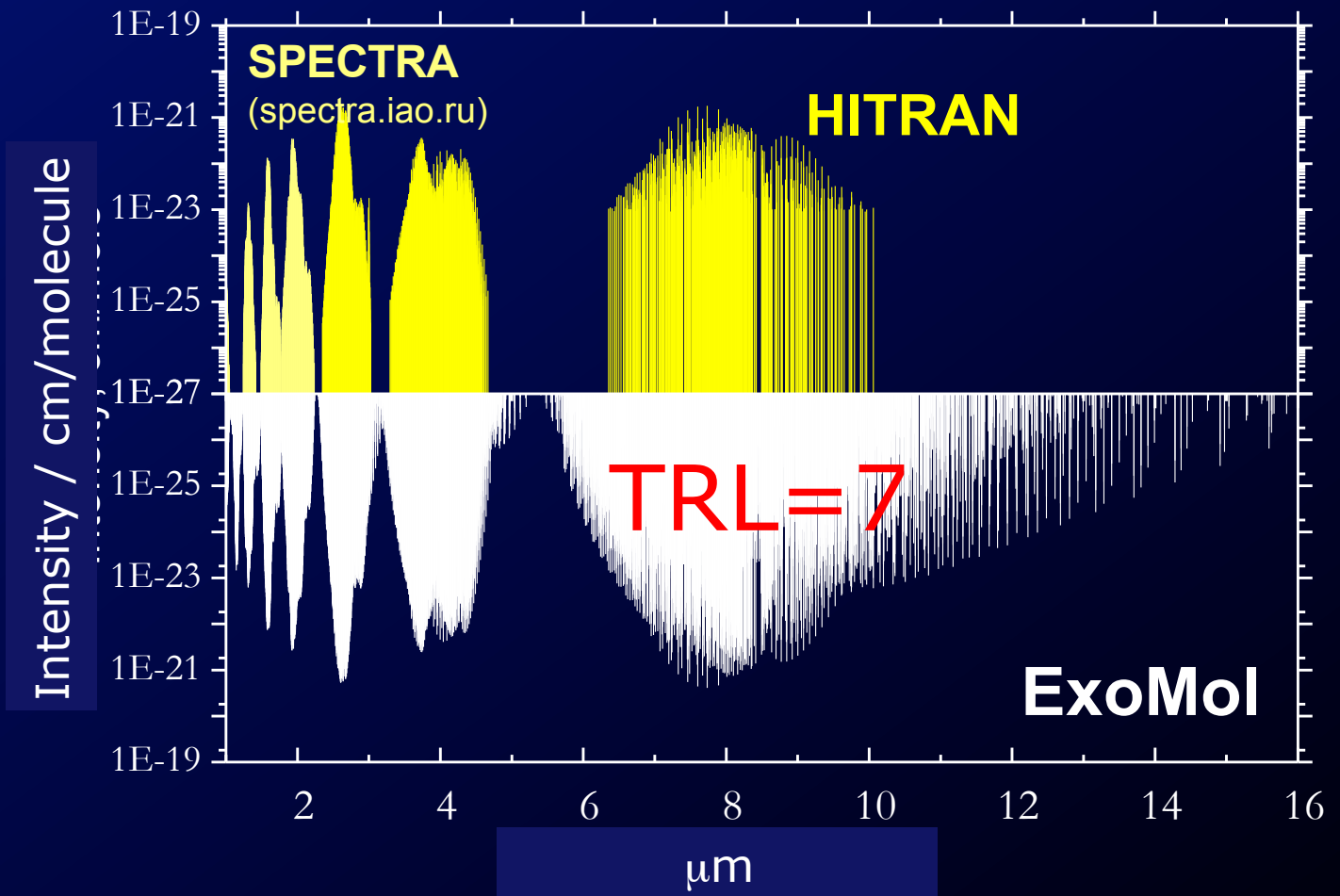
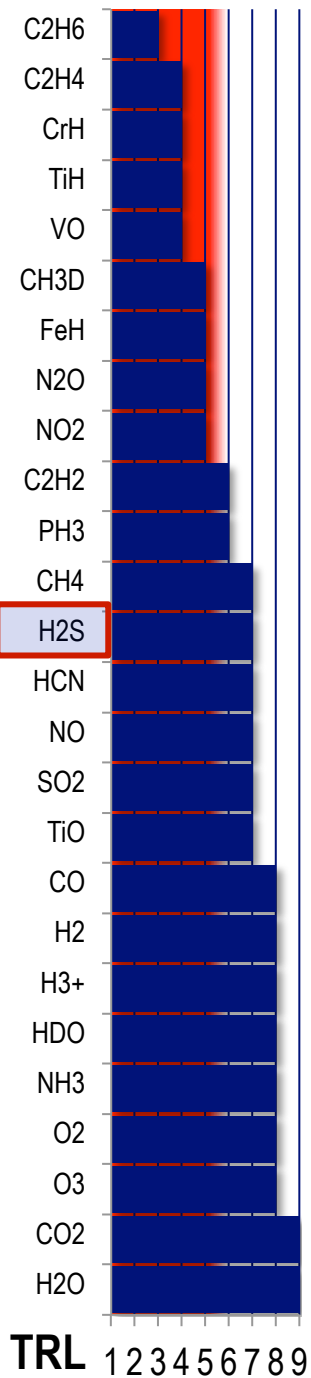
HCN/HNC: Barber et al , to be submitted.

Absorption of molecules (T=1600 K)

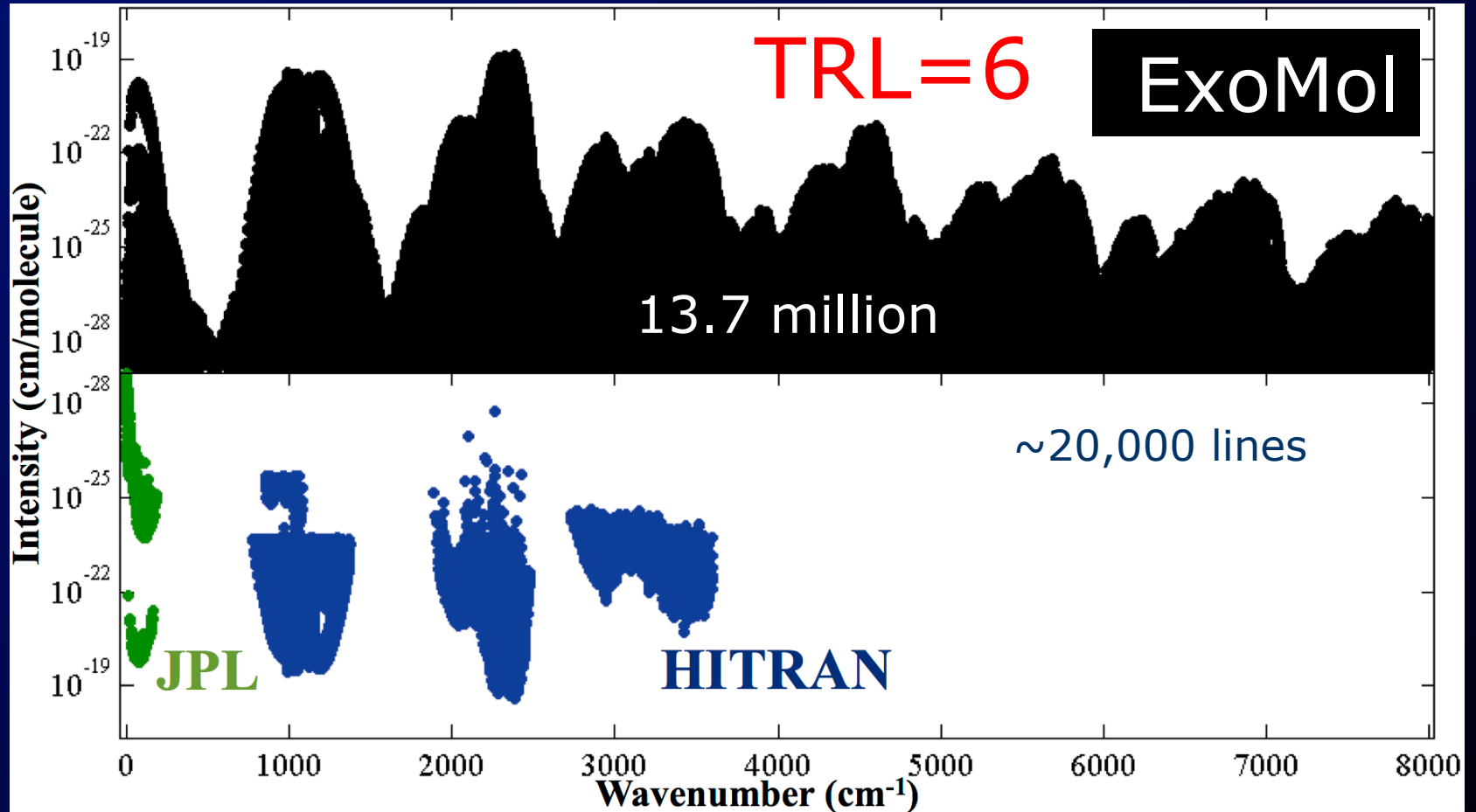
4.67 μm



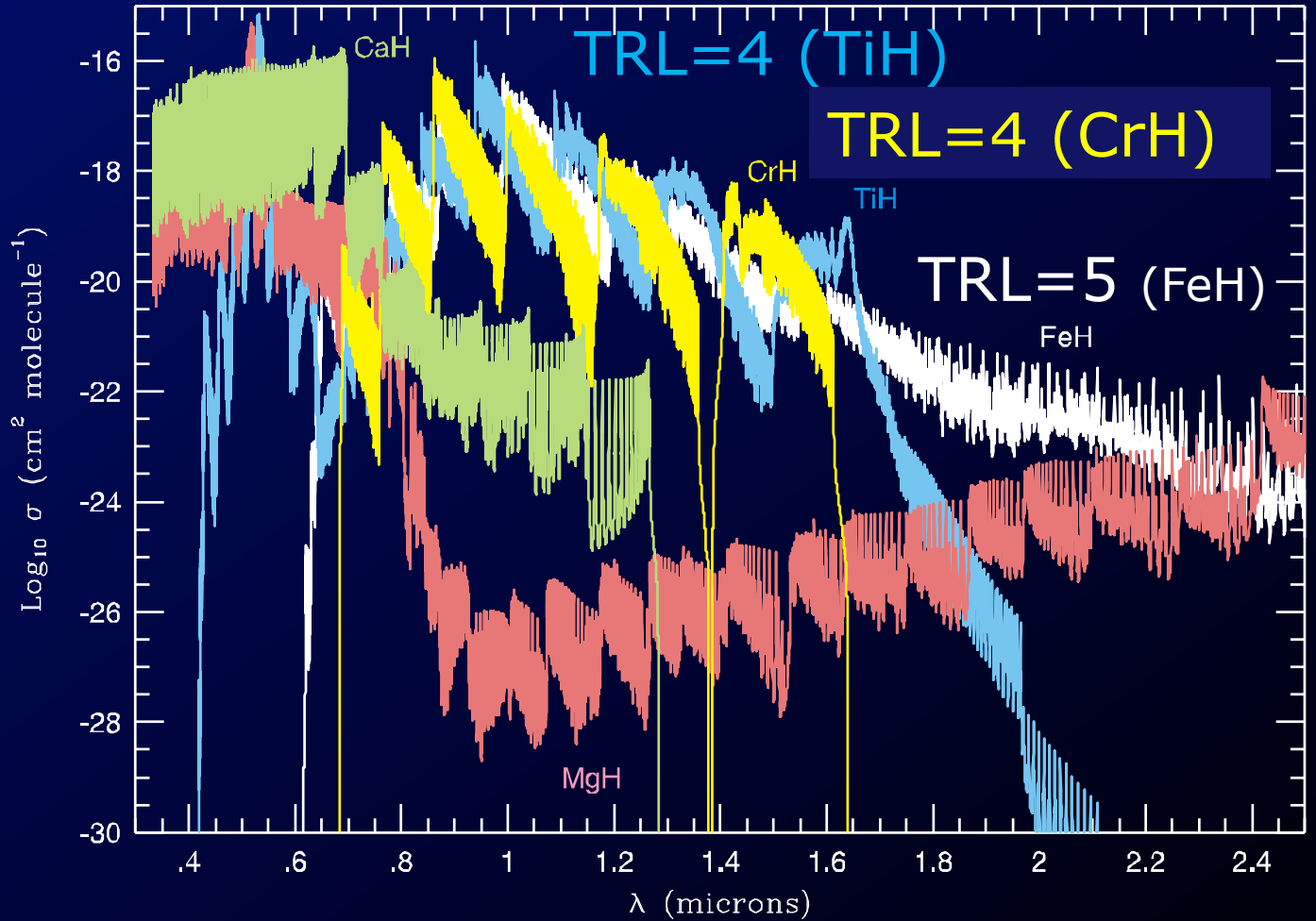
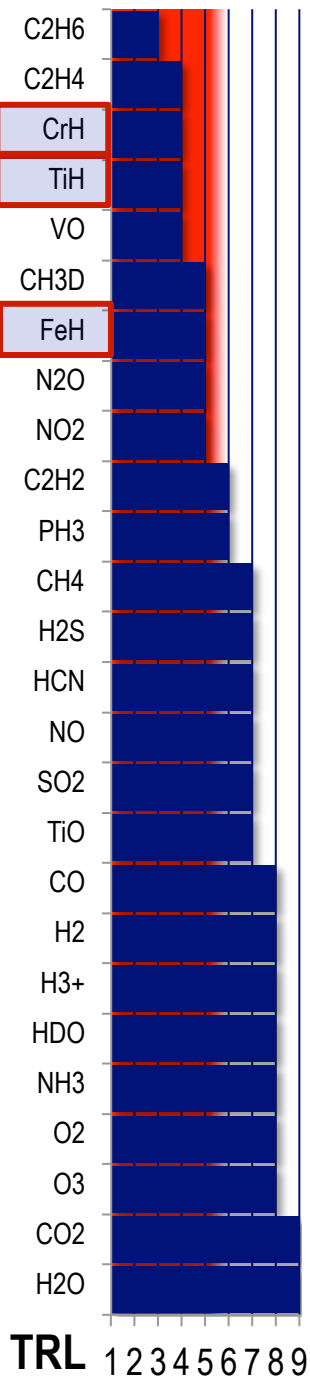
Absorption of H₂S (T=300 K)



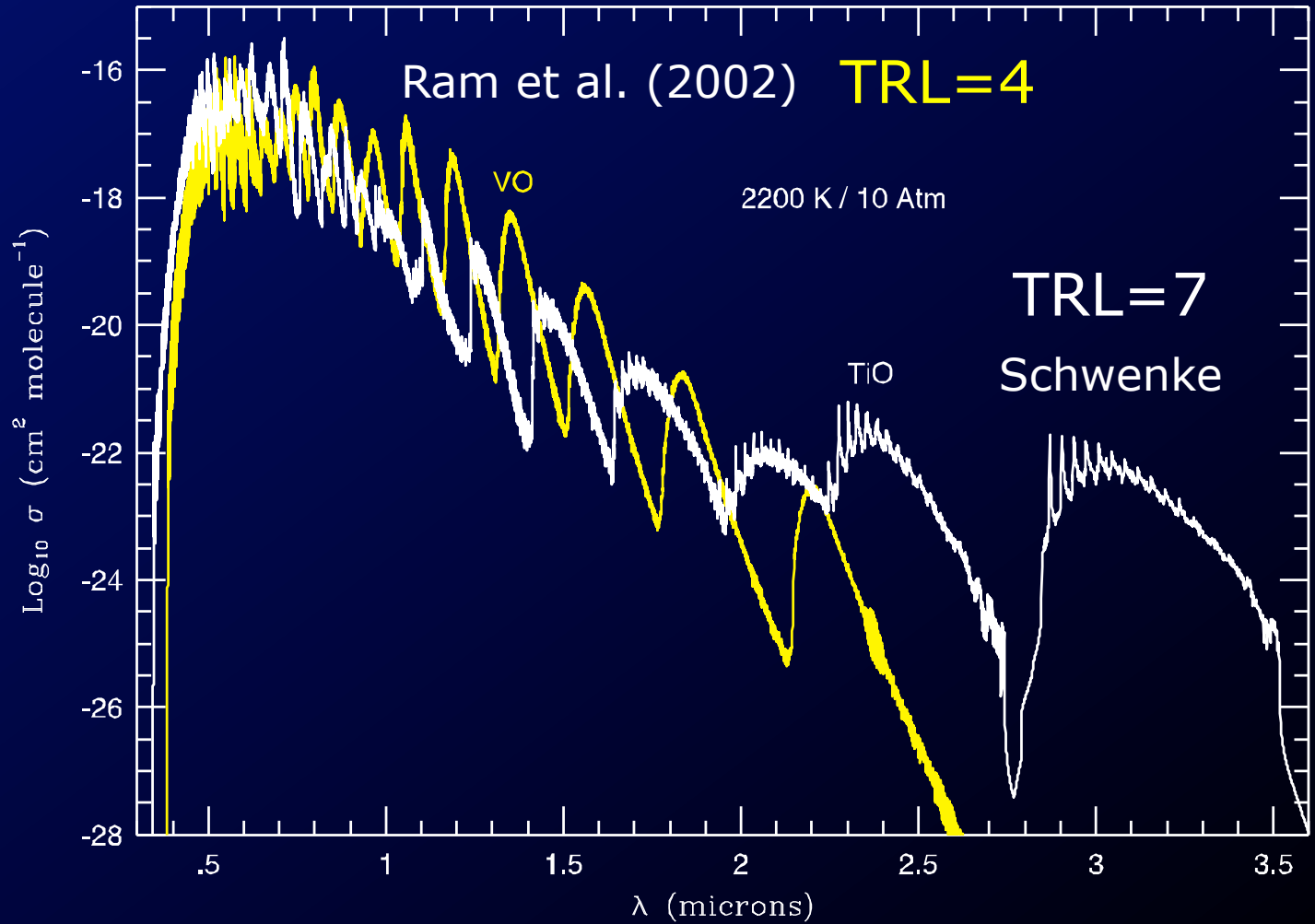
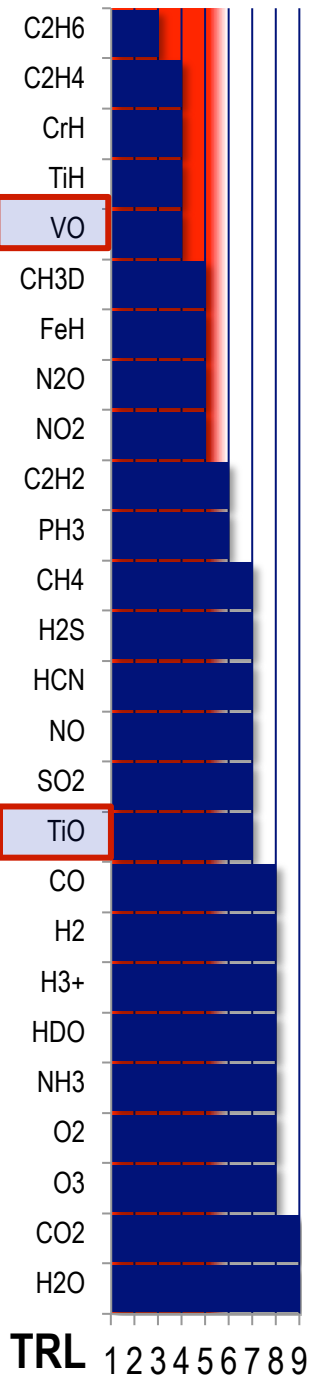
Absorption of phosphine (T=300 K)



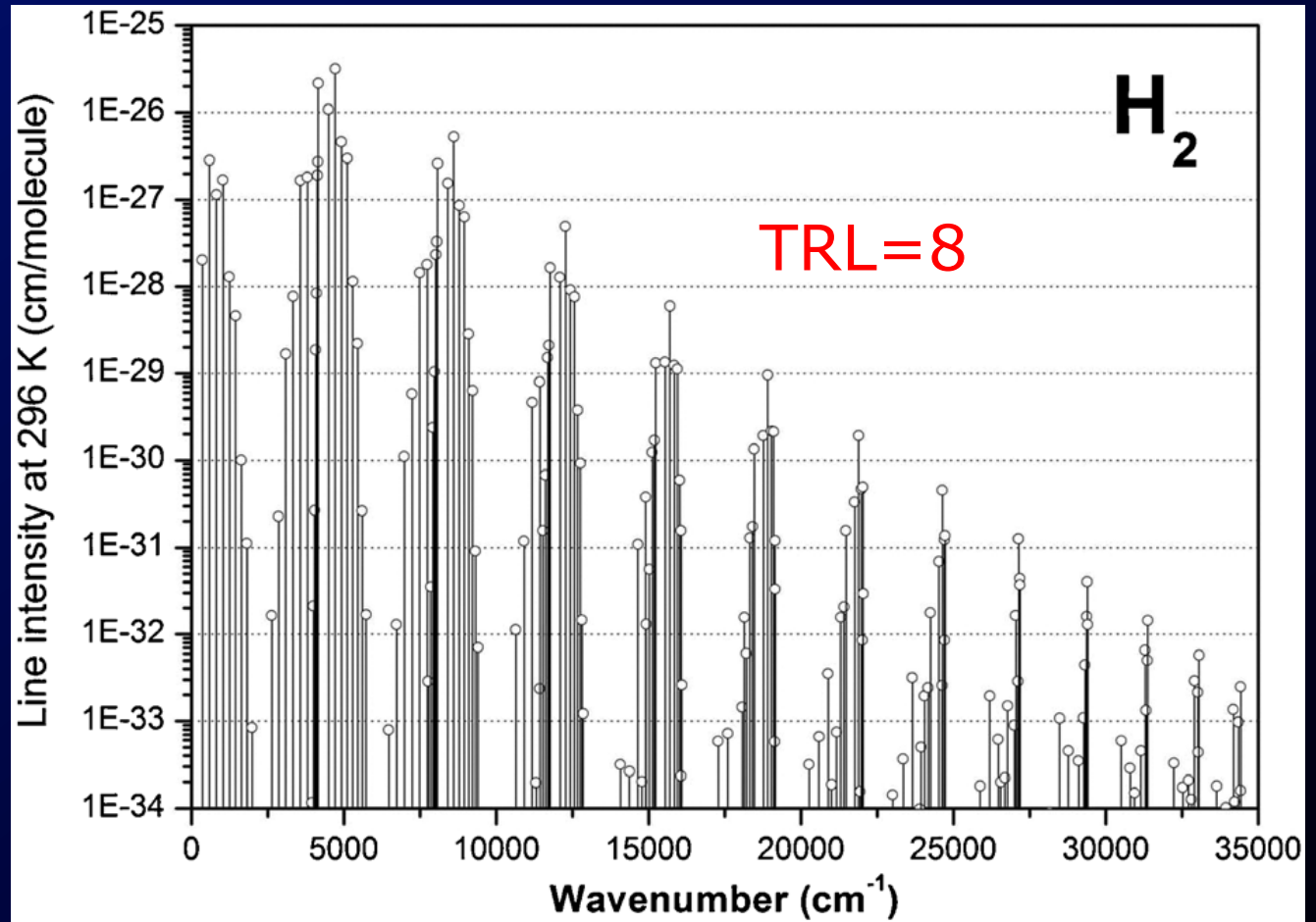
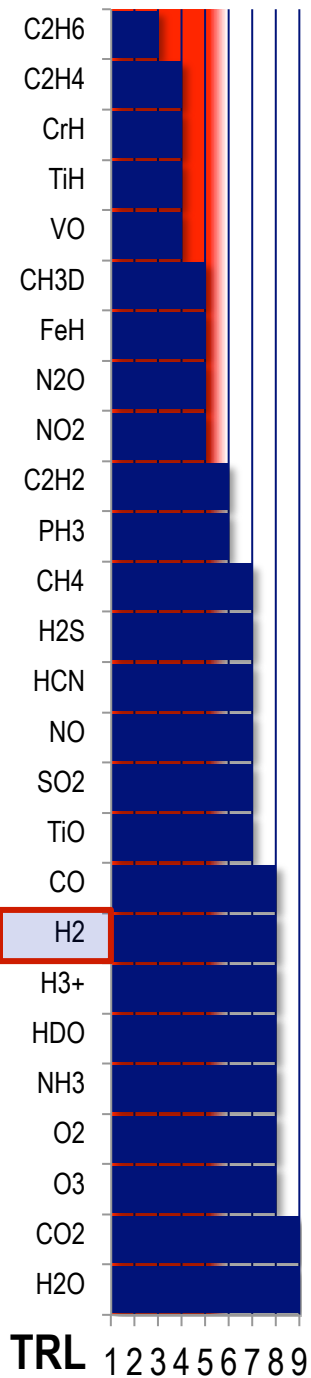
Absorption: CrH, TiH, FeH



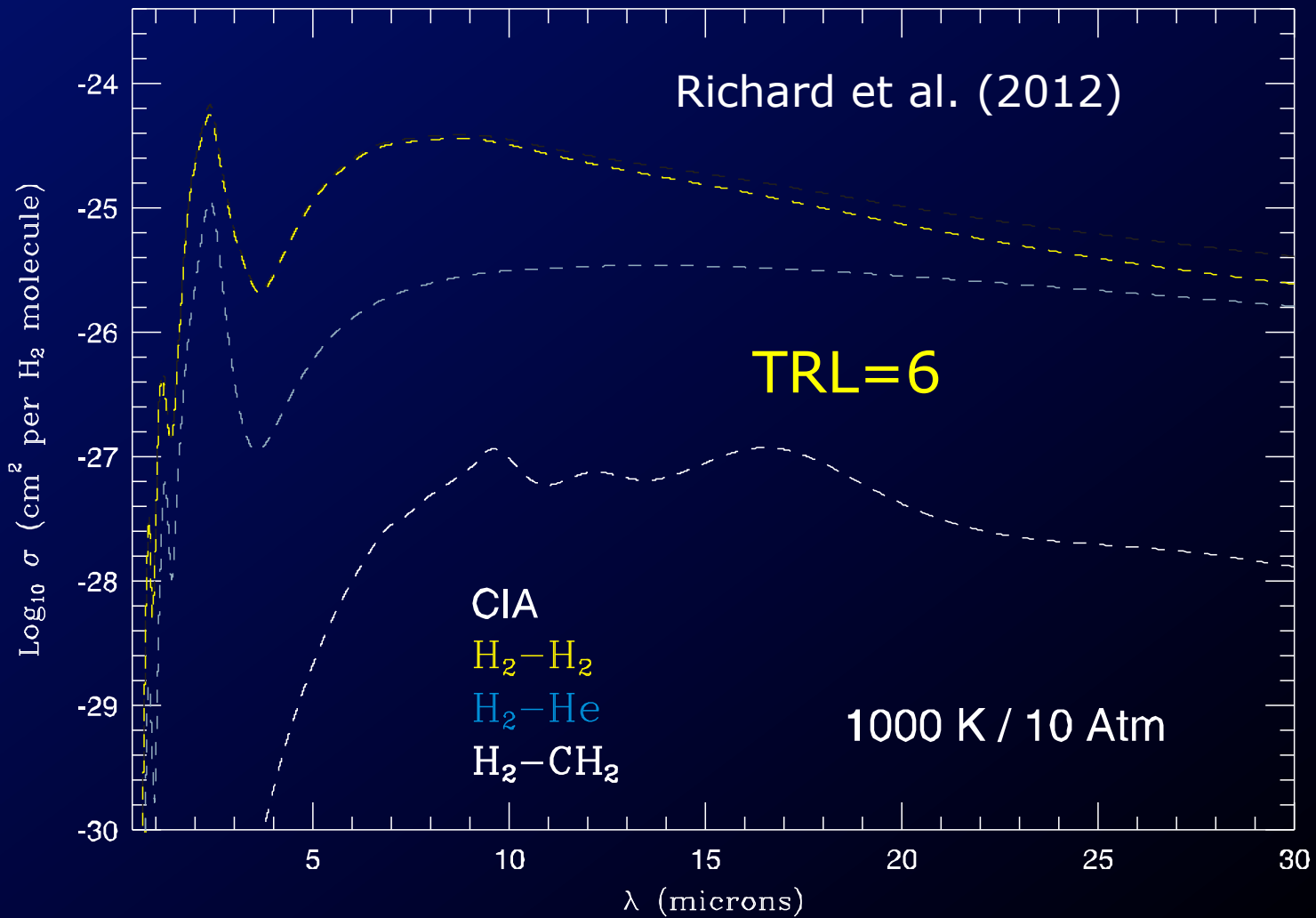
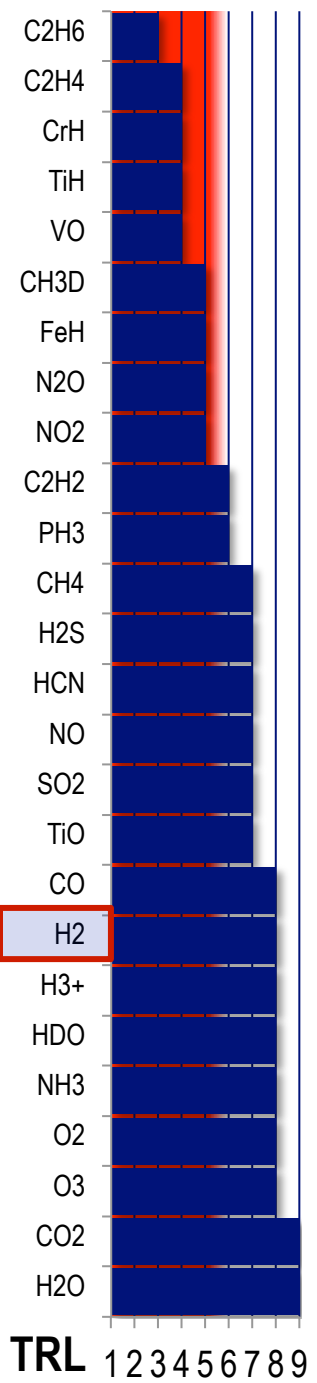
Absorption of VO and TiO



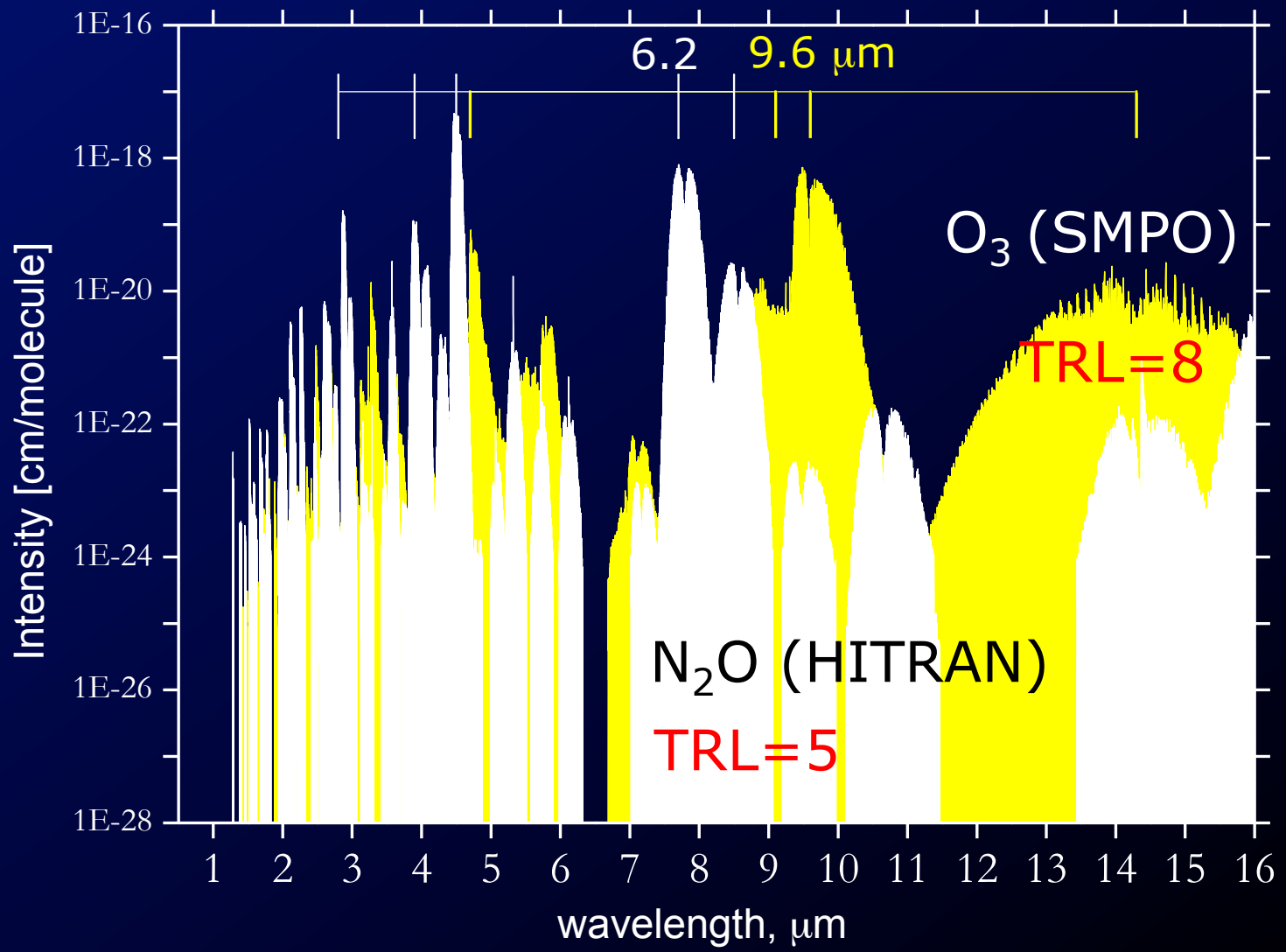
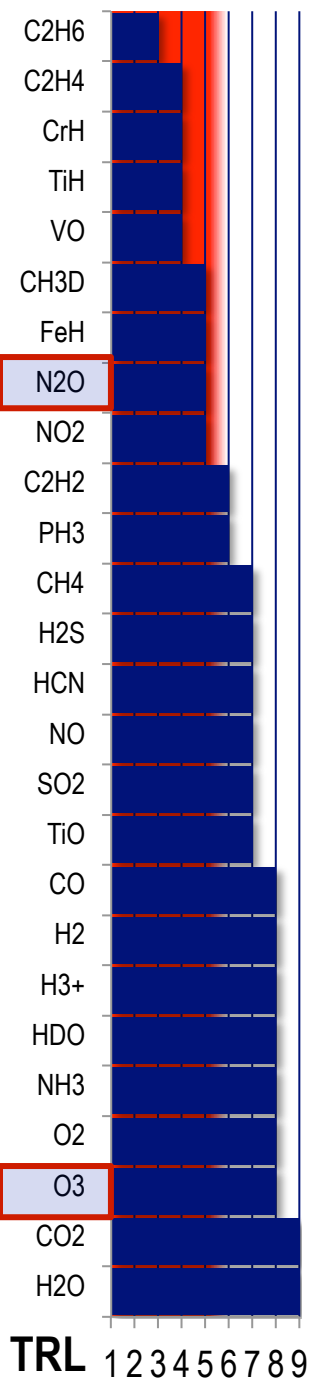
Absorption of H₂ (T=296 K)



Collision-induced absorption (CIA)

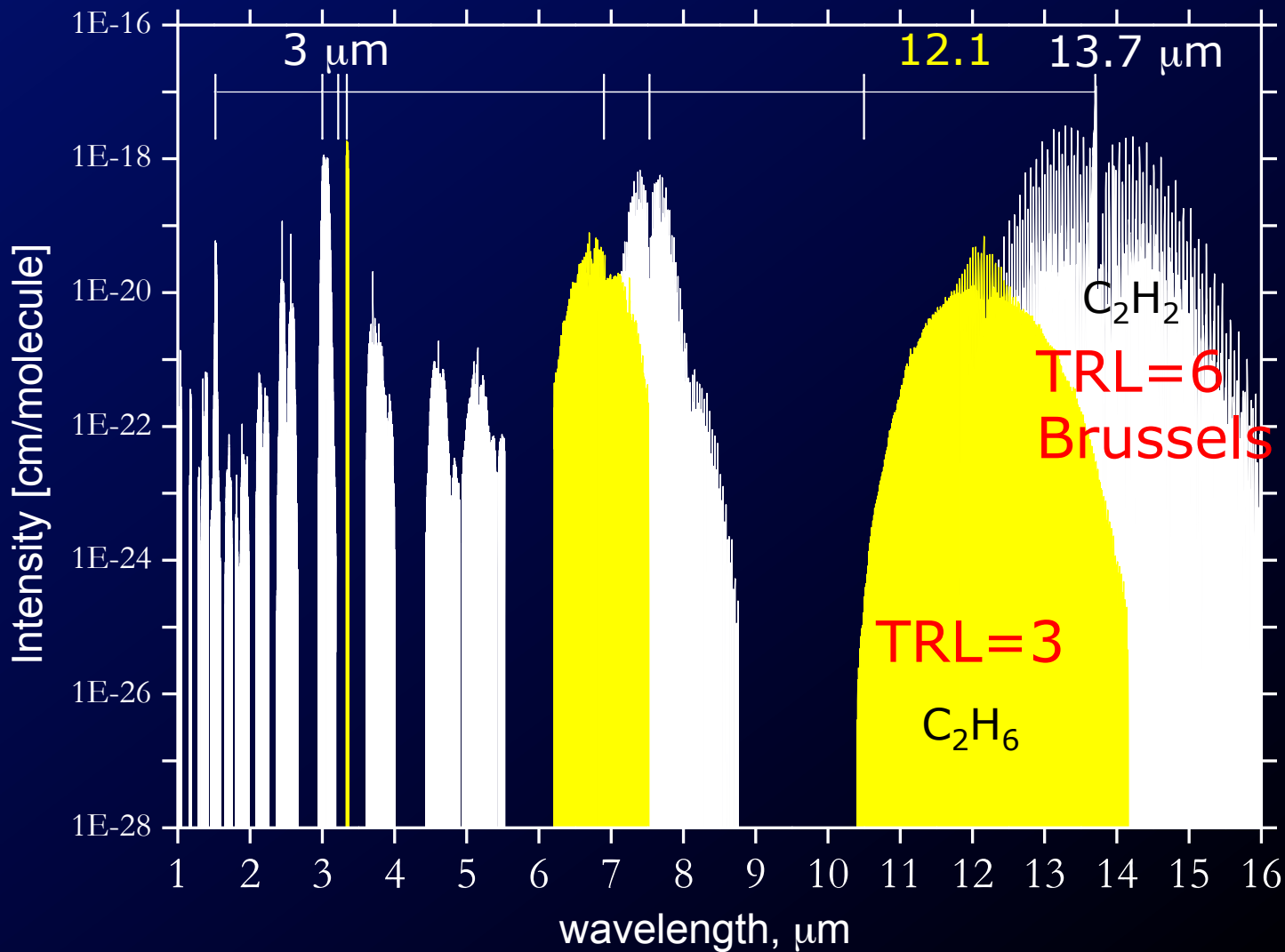
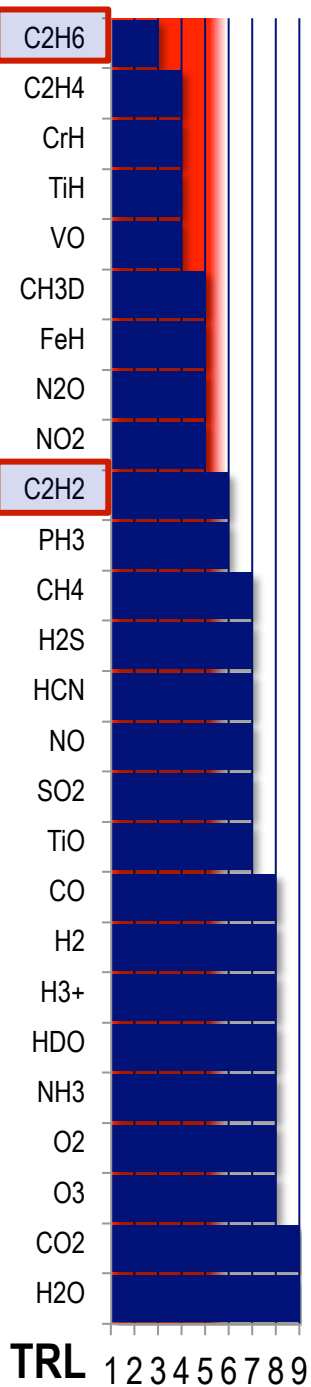


Absorption of O₃ and N₂O (T=300 K)



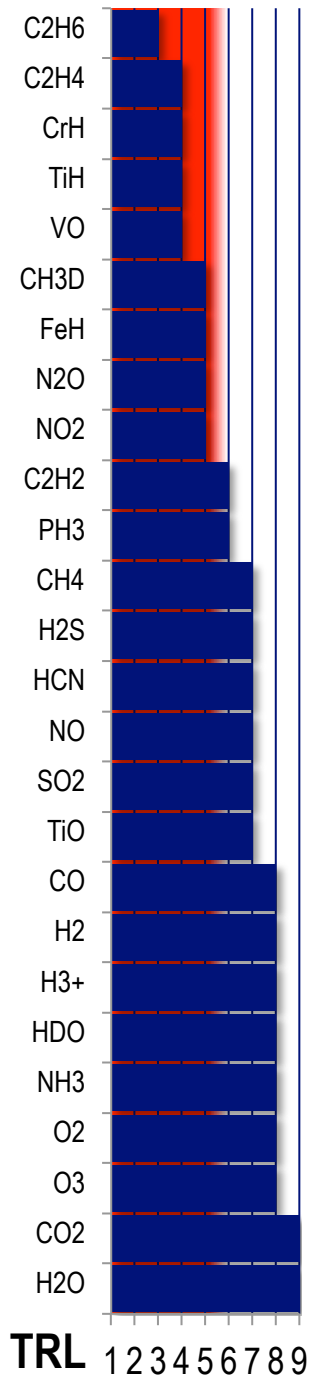
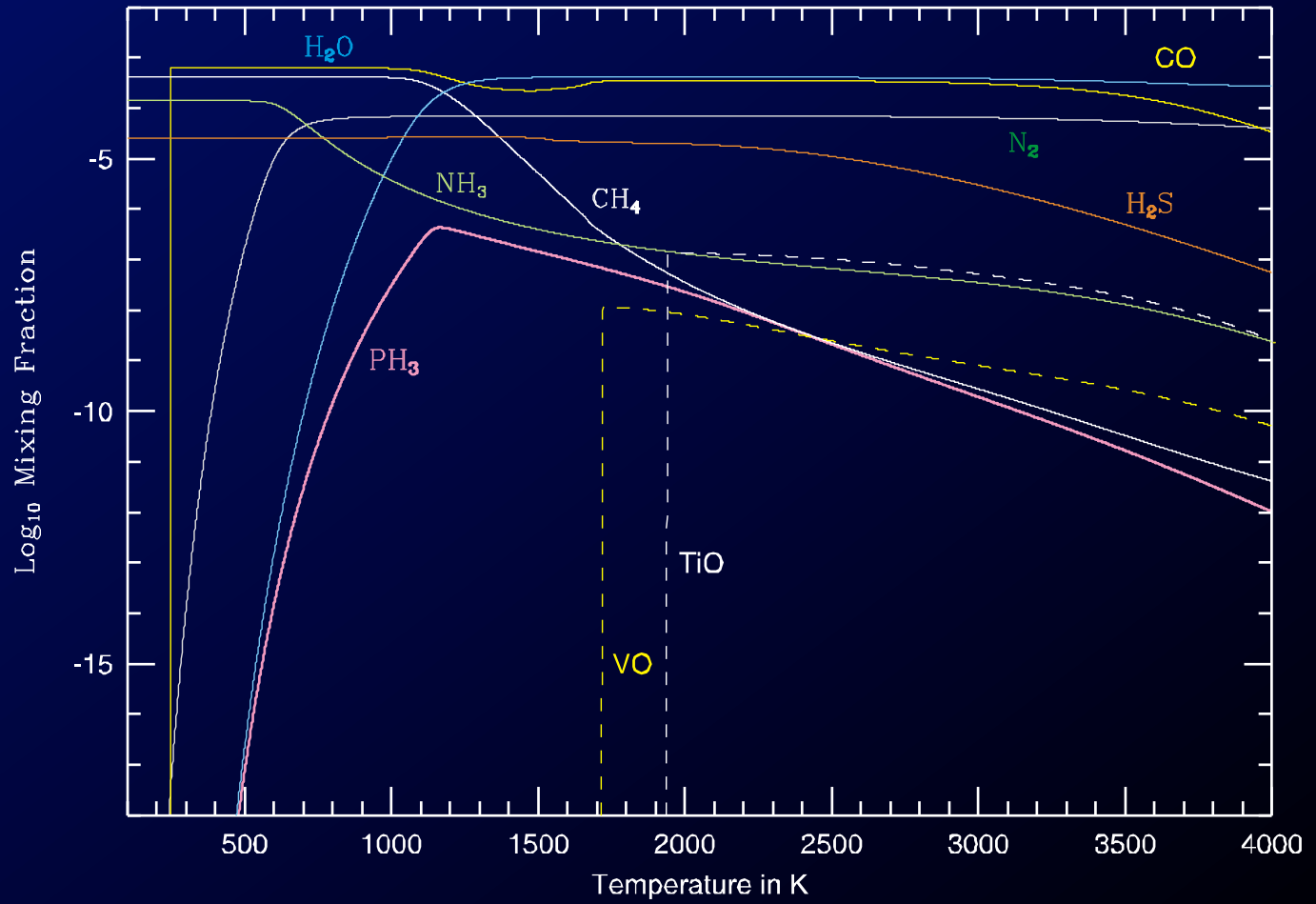
SMPO = Spectroscopy & Molecular Properties of Ozone

Absorption of C_2H_2 and C_2H_6 ($T=300$ K)



Abundances

Mixing fractions (P=1 atm)



Other Contributions

Atomic species

TRL=9

- NIST
- VALD (Alkali)
- Kurucz

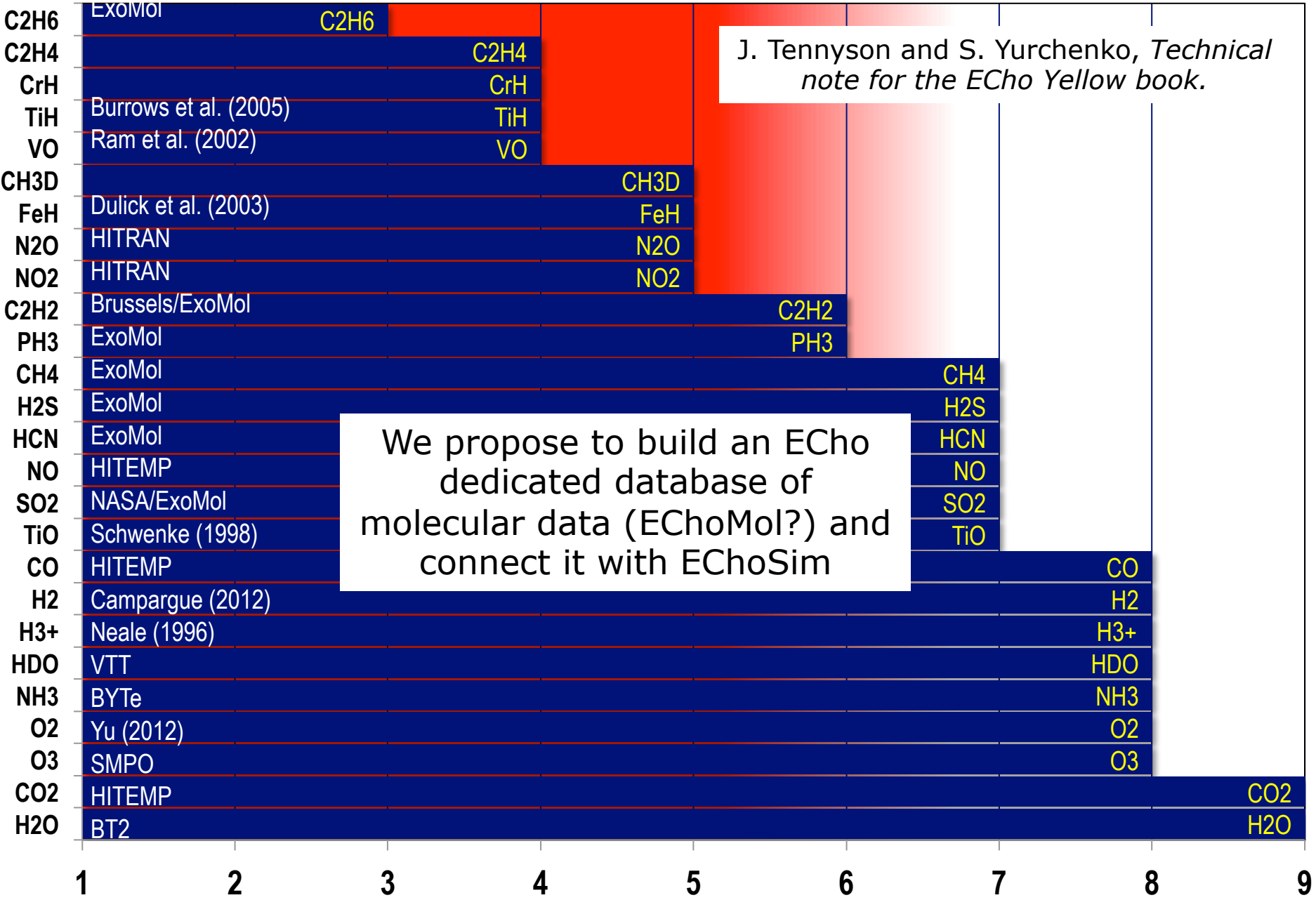
Rayleigh

TRL=9

TRL = "Technology Readiness Level"

J. Tennyson and S. Yurchenko, *Technical note for the ECho Yellow book.*

We propose to build an ECho dedicated database of molecular data (EChoMol?) and connect it with EChoSim





H_2CO

NiH UP TOWN

C_2H_4

AlO

CrH

MgH

C_3

H_2S

YO

CH_4

HNO_3

$HOQH$

SO_3

PH_3

