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Water in the Disks Around Massive Young Stars

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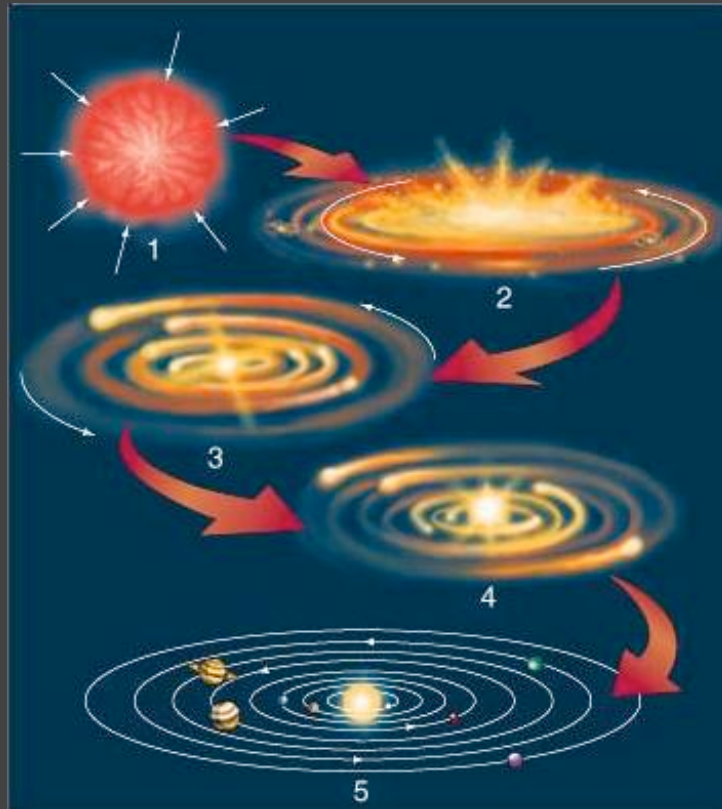
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Water in the disks around massive young stars

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Formation of stars and planets

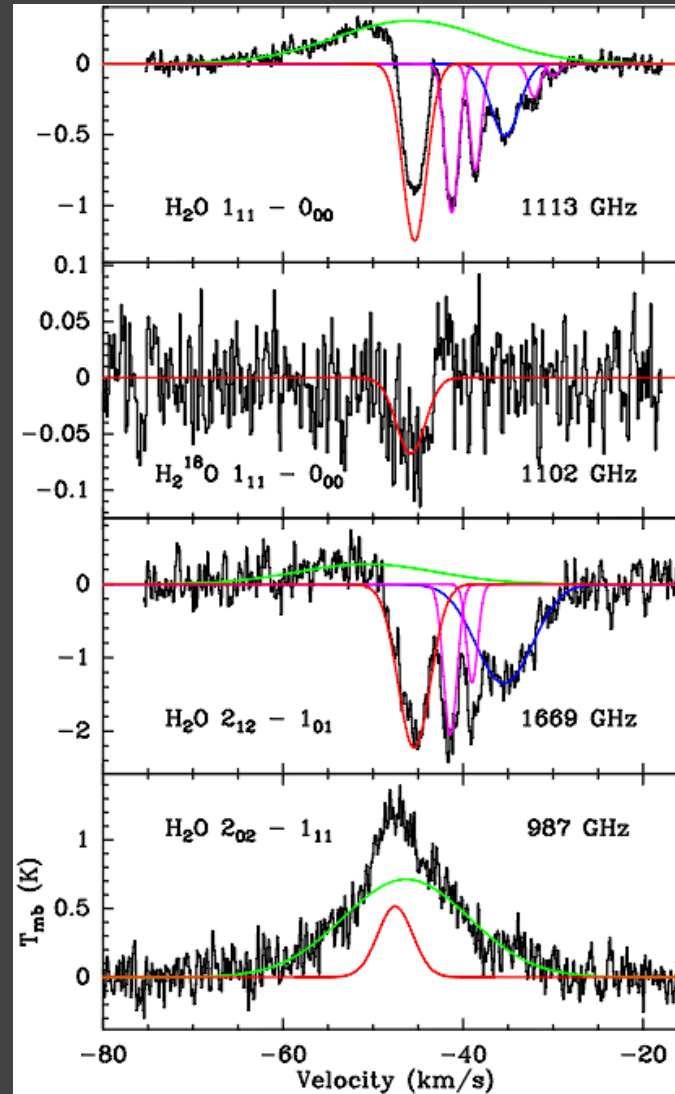
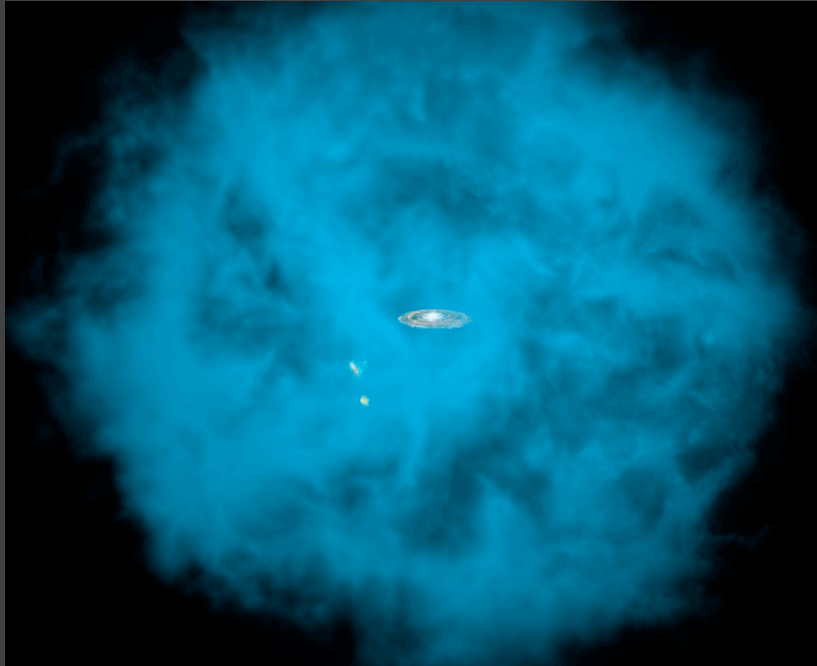


Diversity of stellar masses

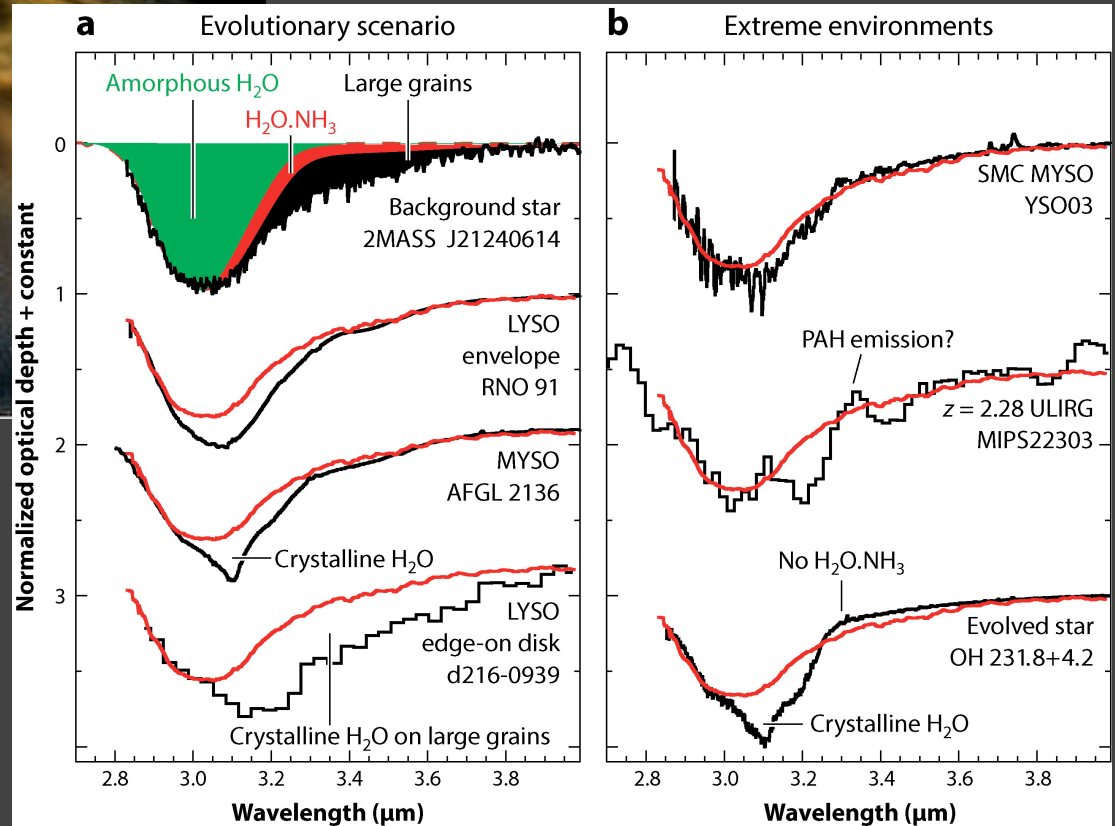
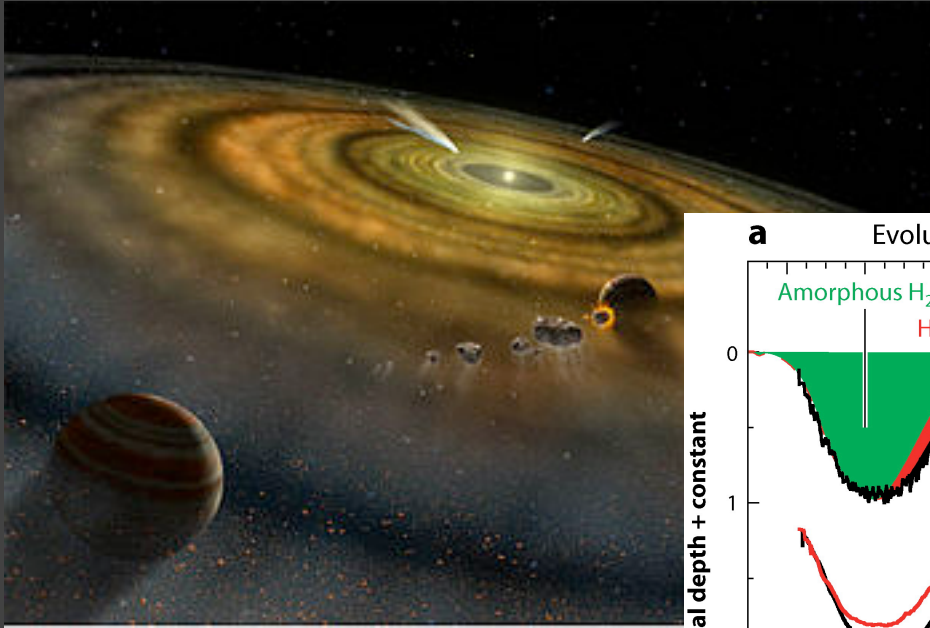
Initial conditions for planet formation

ALMA Band 5: use water as tracer for disk structure & chemistry

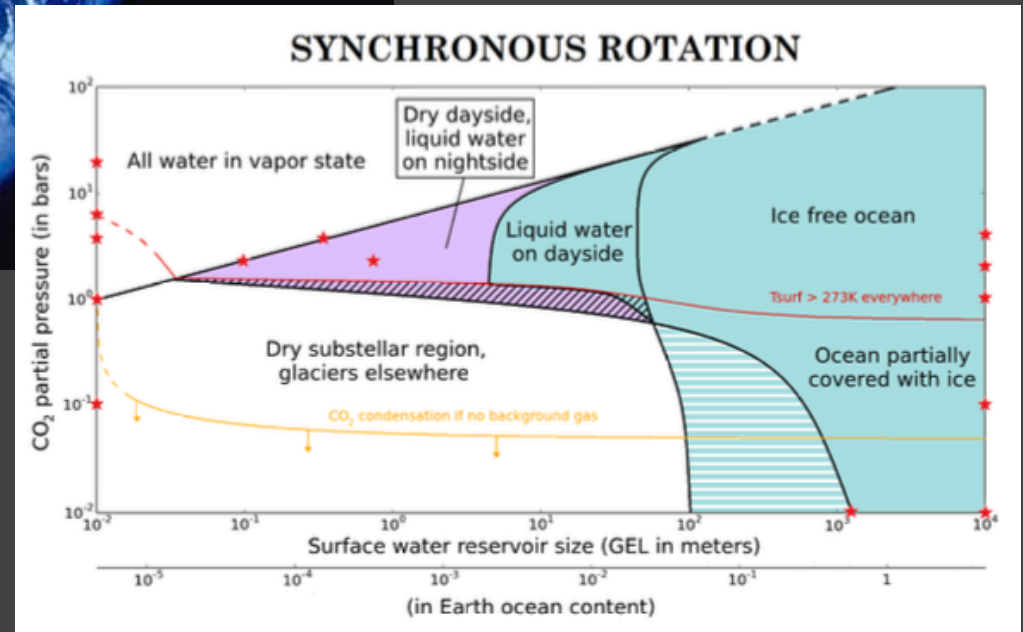
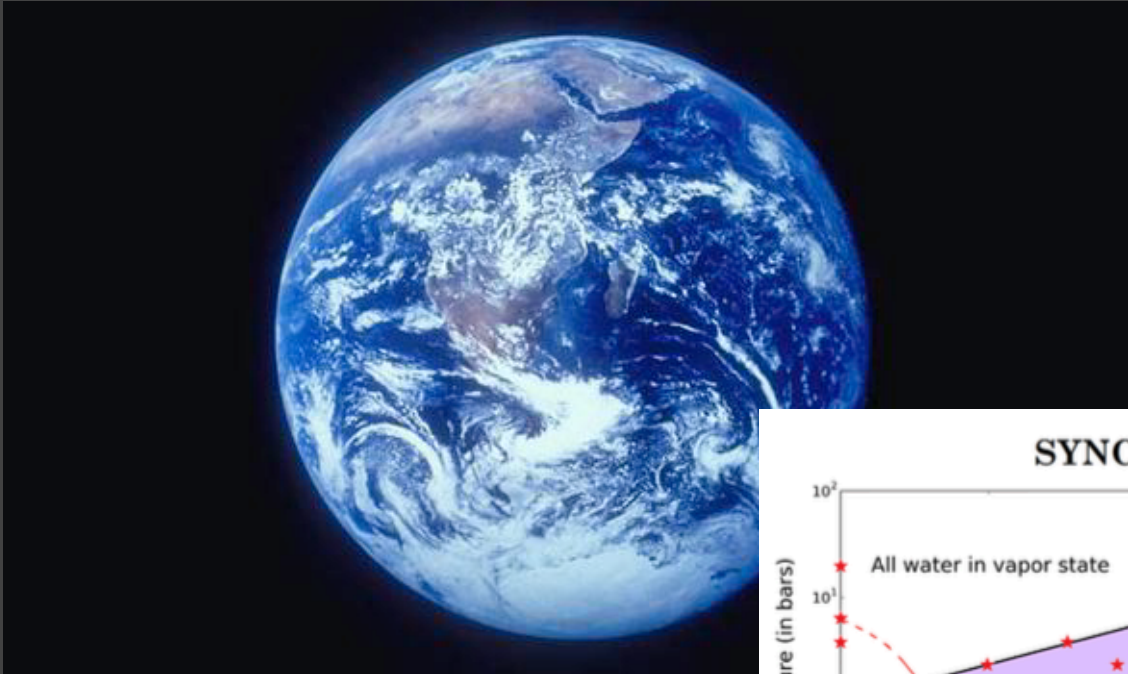
Water vapour: Cooling of collapsing gas clouds



Water ice: The glue to coagulate grains in disks



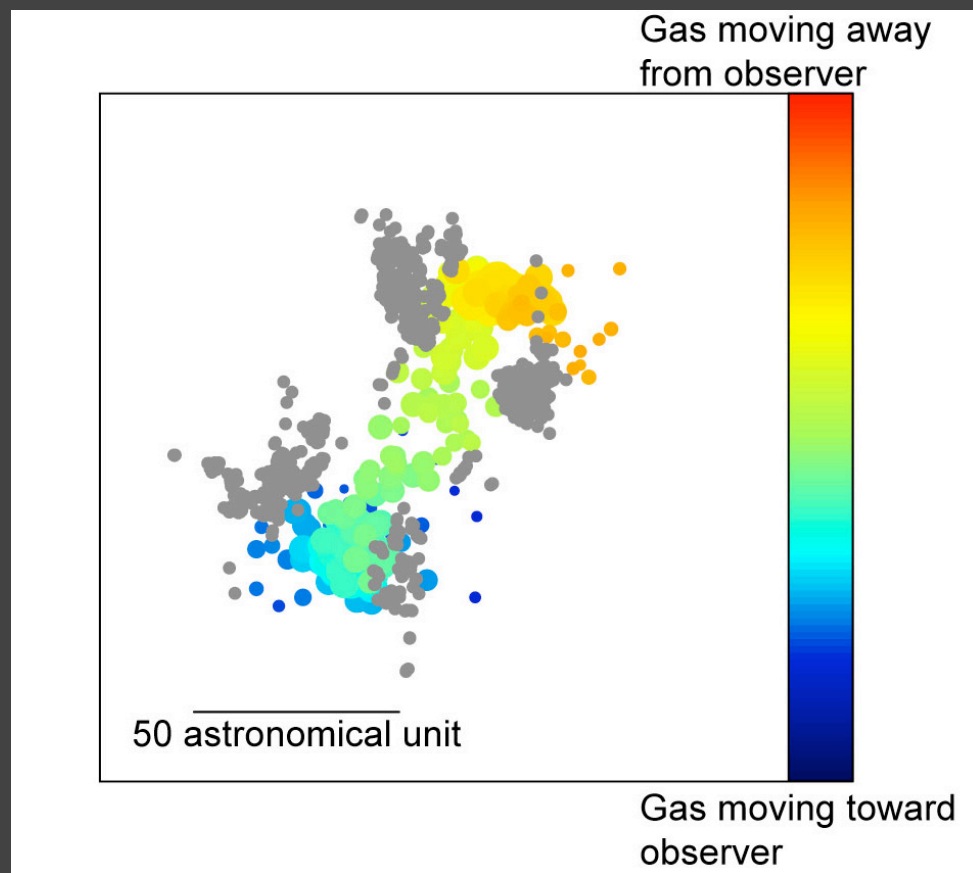
Liquid water: Transports organics on planets



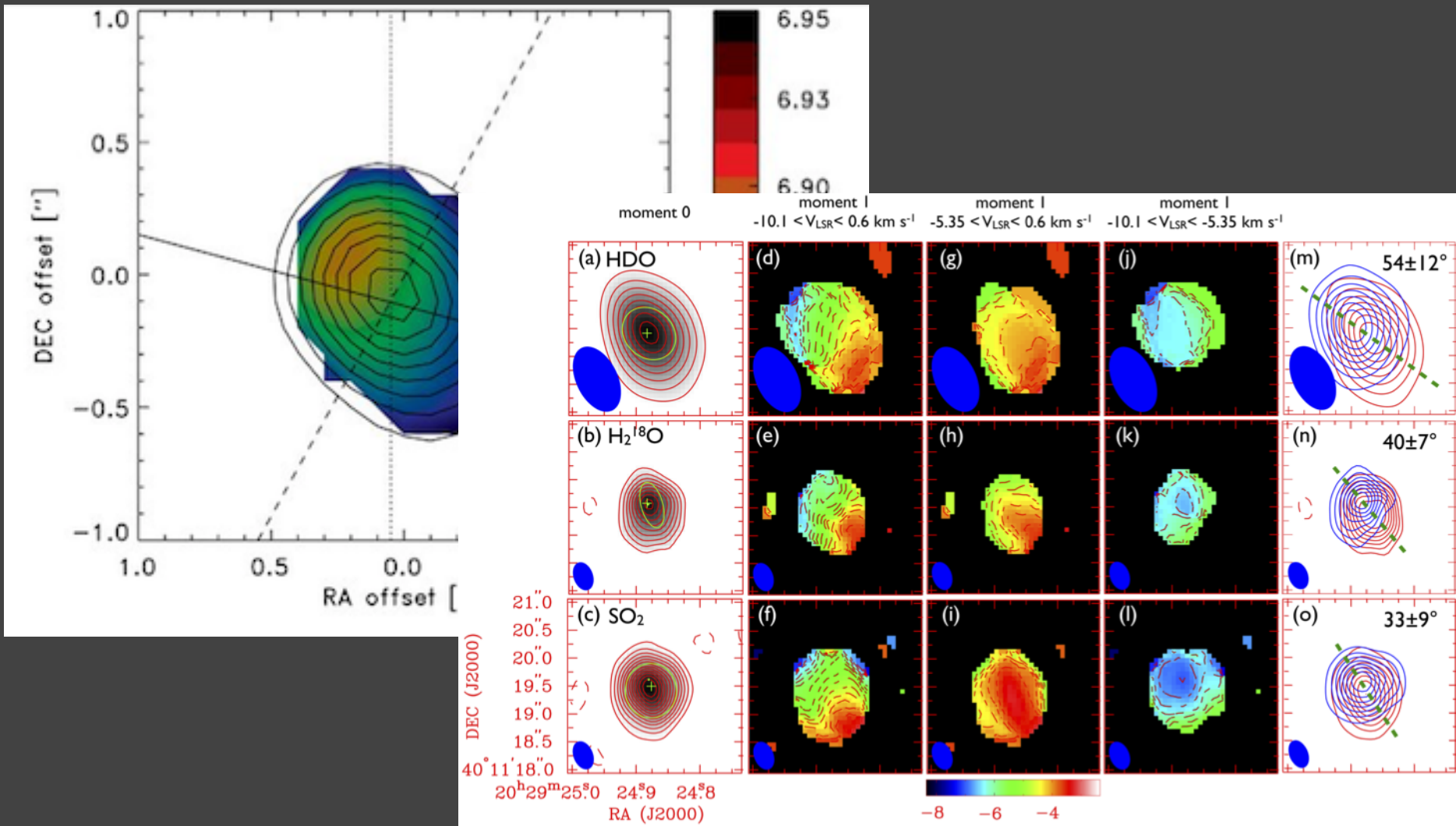
Water from the ground: Nothing new 😊

H₂O 183 GHz line: small scale kinematics

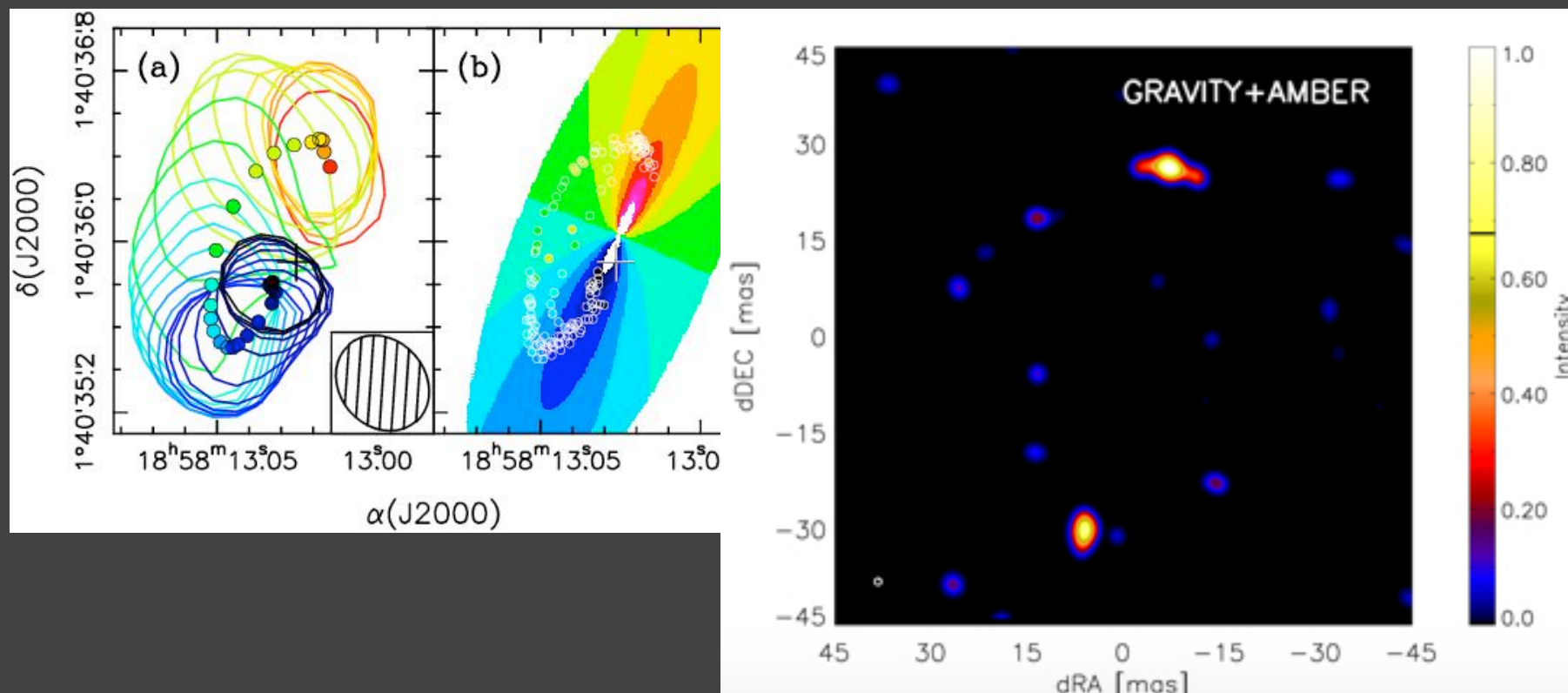
with 336, 321 GHz lines: constrain excitation conditions



Thermal water emission from protostellar disks



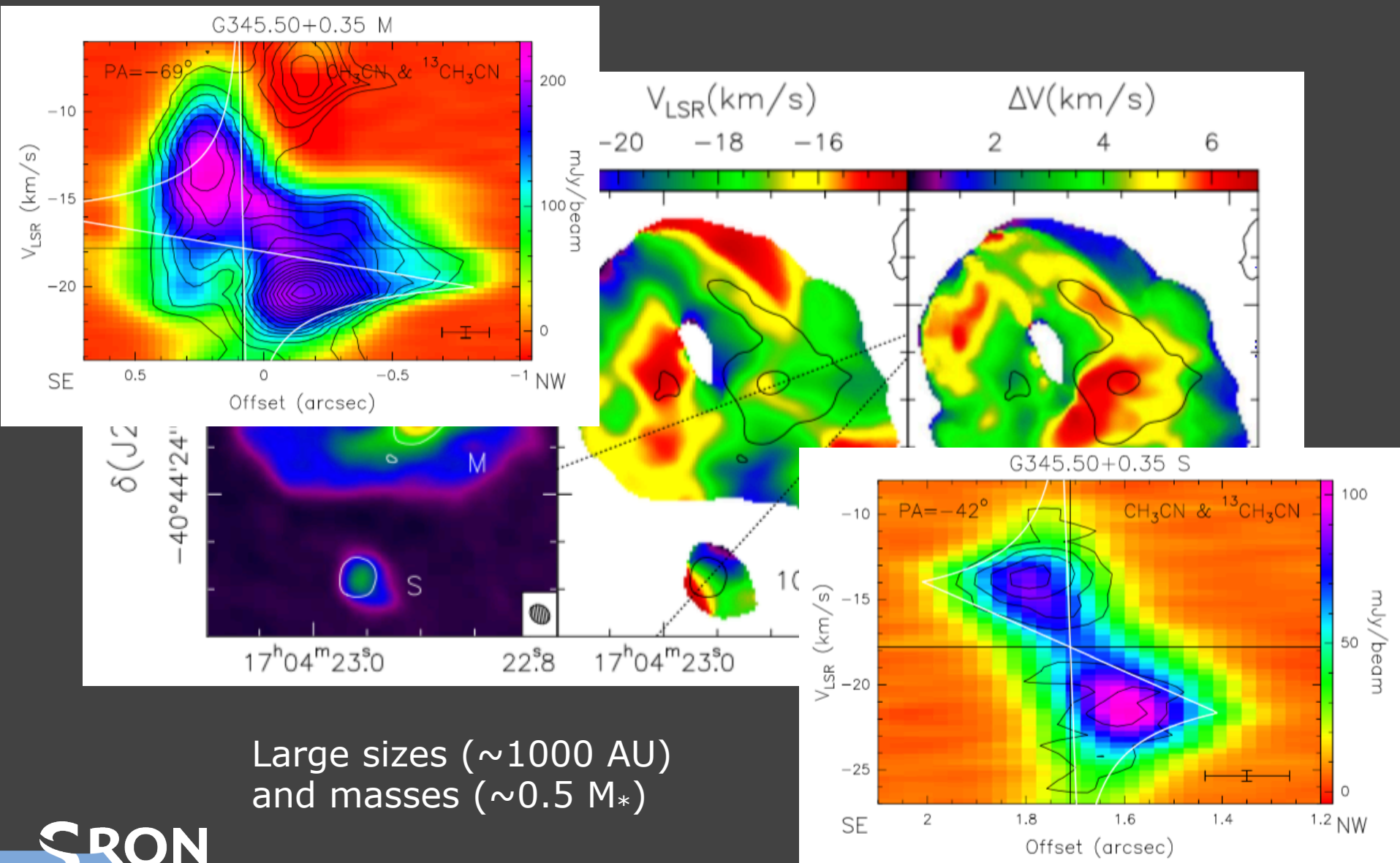
Disks around young high-mass stars



Up to B-type established (de Wit & Beltrán 2016)
First candidate O-type: Johnston et al 2015

Sánchez-Monge et al 2013; Kraus et al 2017

Candidate disks around O-type protostars



Substructure of massive circumstellar disks

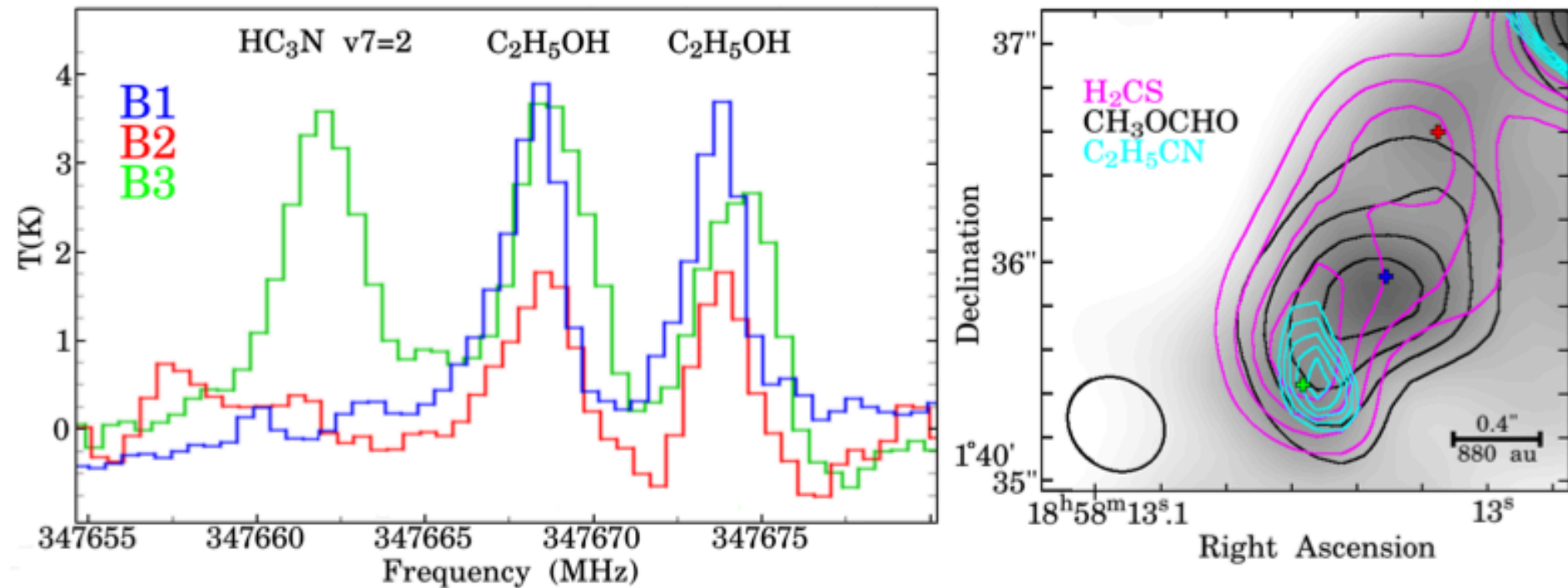
Strong organic emission from high-mass protostars

origin in disk, inner envelope or outflow cavity?

Chemical segregation seen on ~ 1000 AU scales

especially in N- and D-bearing species (model with C. Walsh)

Variation in temperature, density, ...?



Band 5: A chemical goldmine

Thermal H_2^{18}O emission:

location snowline
thermal structure

CH_3OCH_3 lines:

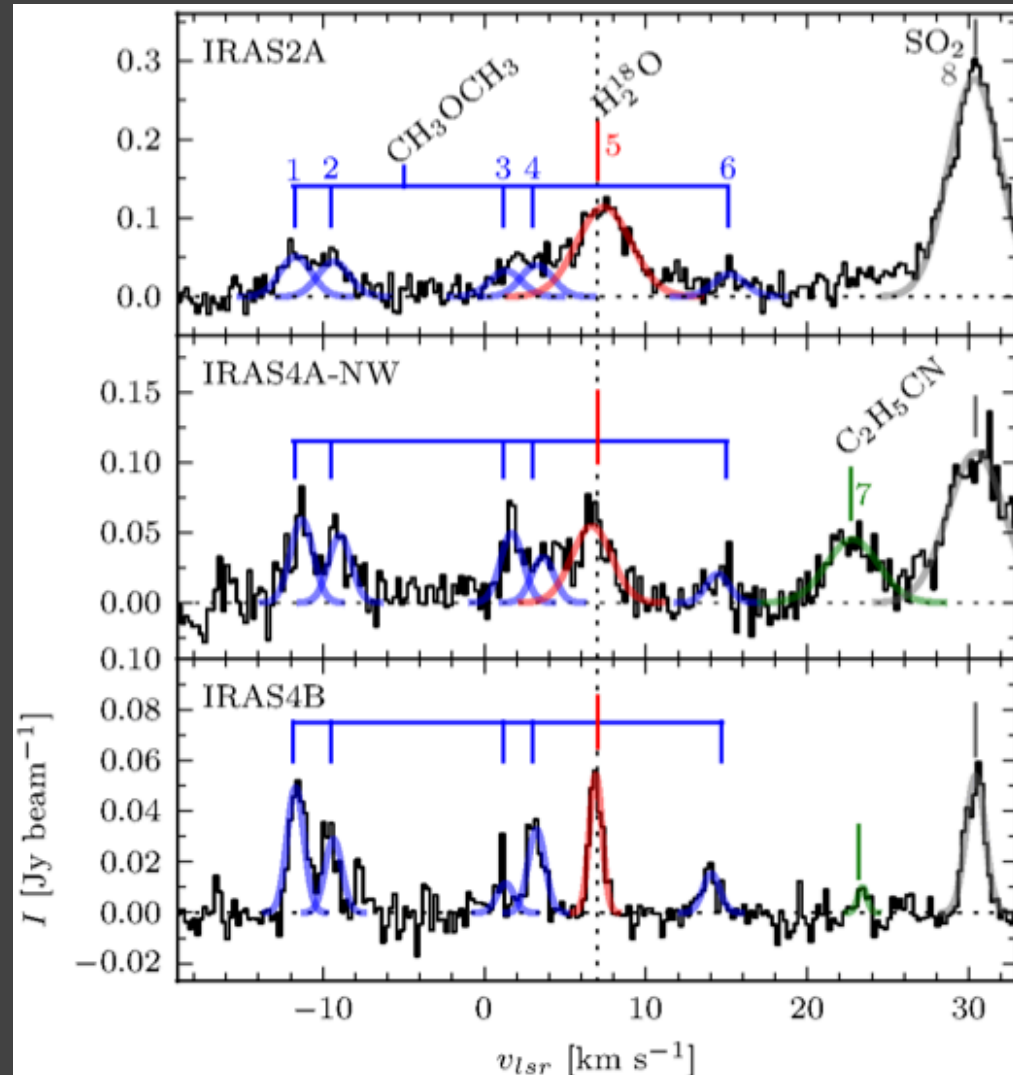
grain surface chemistry
also $\text{C}_2\text{H}_5\text{CN}$

SO_2 line:

shock chemistry
system geometry

Band 5 resolution $0.3''$

= 600 AU at 2 kpc
= well within snowline
(~ 1000 AU for $10^4 L_0$)



Conclusion: Band 5 is cool!

whether you like chemistry or not ...

