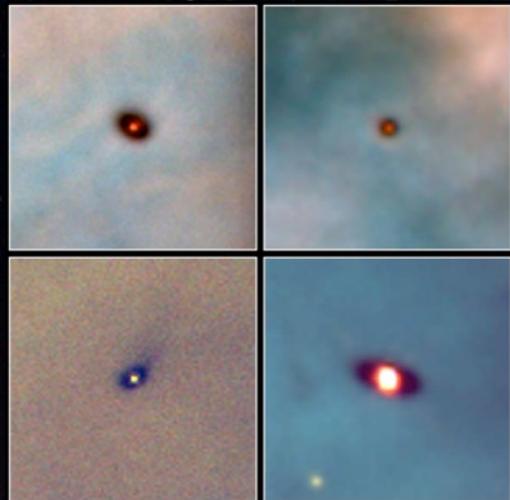


On the role of T Tauri variability in processing the warm molecular gas in young circumstellar disks

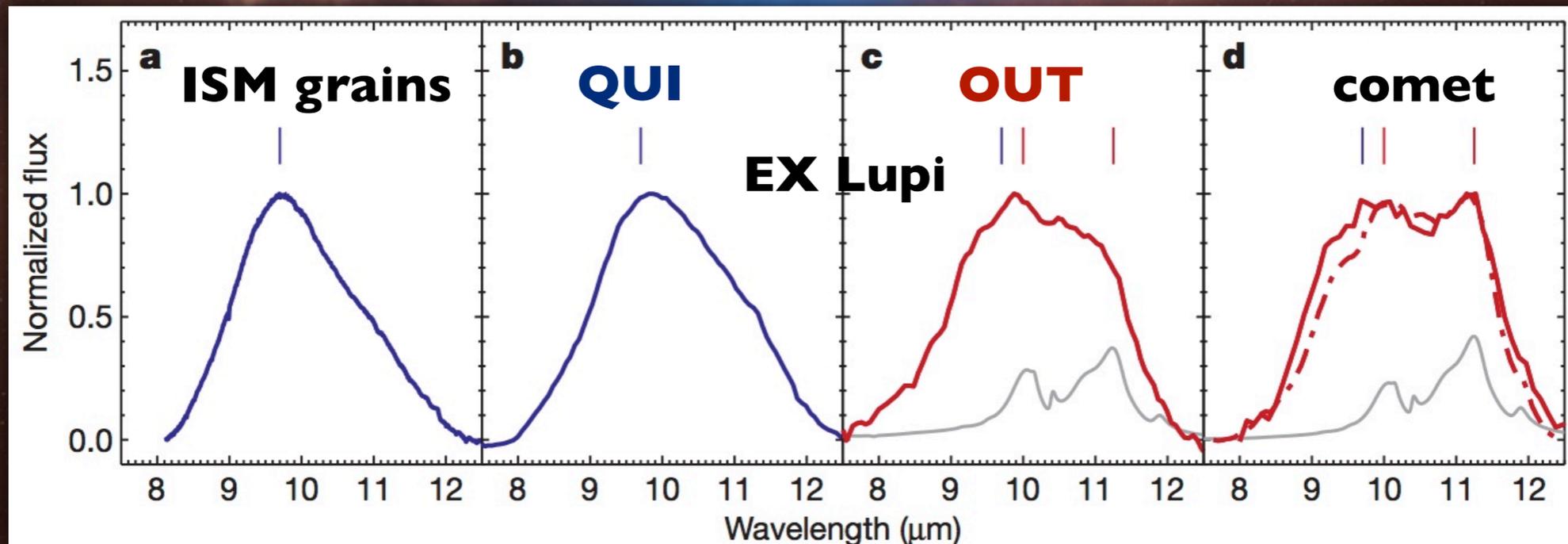
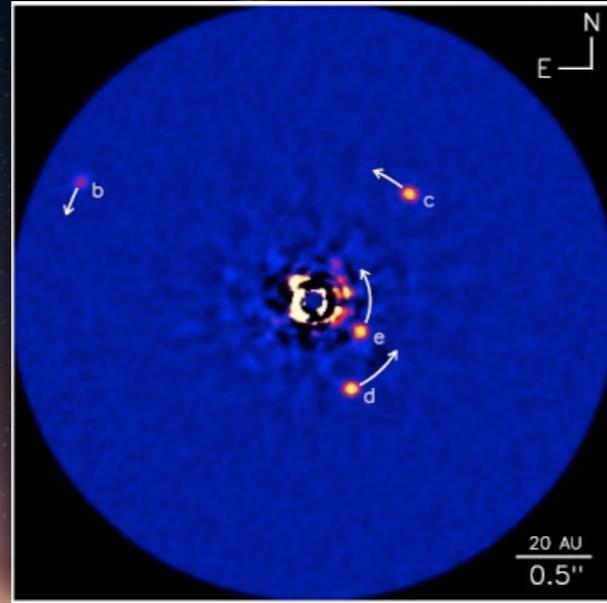
Presenter: A. Banzatti, Institute of Astronomy, ETH Zurich, Switzerland

Collaborators: M. Meyer, K. Pontoppidan, S. Bruderer, L. Testi, V. Geers, I. Pascucci

Are disks the places where the fundamental processing of the key ingredients for planets takes place?

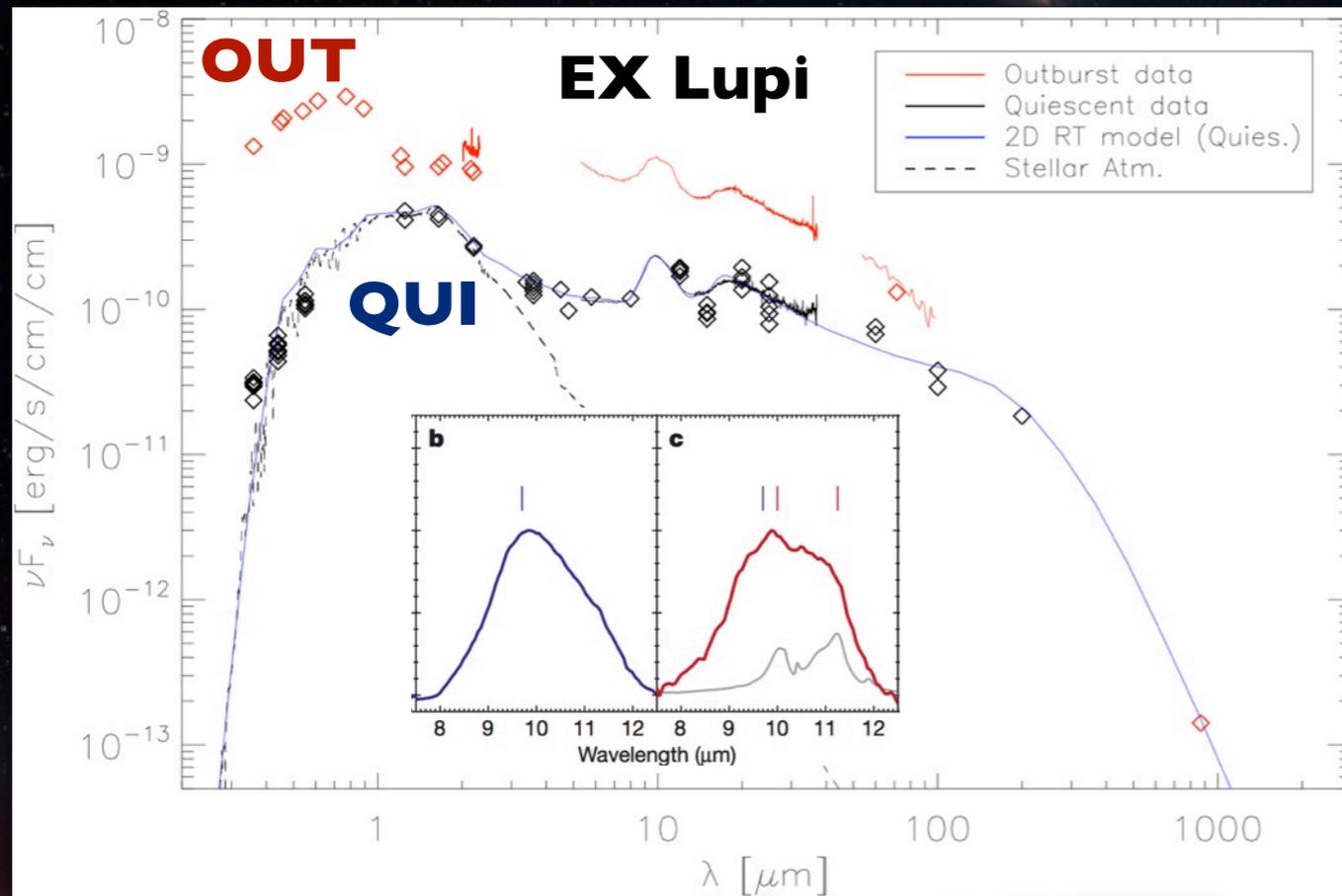


Protoplanetary Disks
Orion Nebula
HST · WFPC2
PRC95-45b · ST ScI OPO · November 20, 1995
M. J. McCaughrean (MPIA), C. R. O'Dell (Rice University), NASA



Abraham et al. 2009

Two "smoking guns" from the infrared

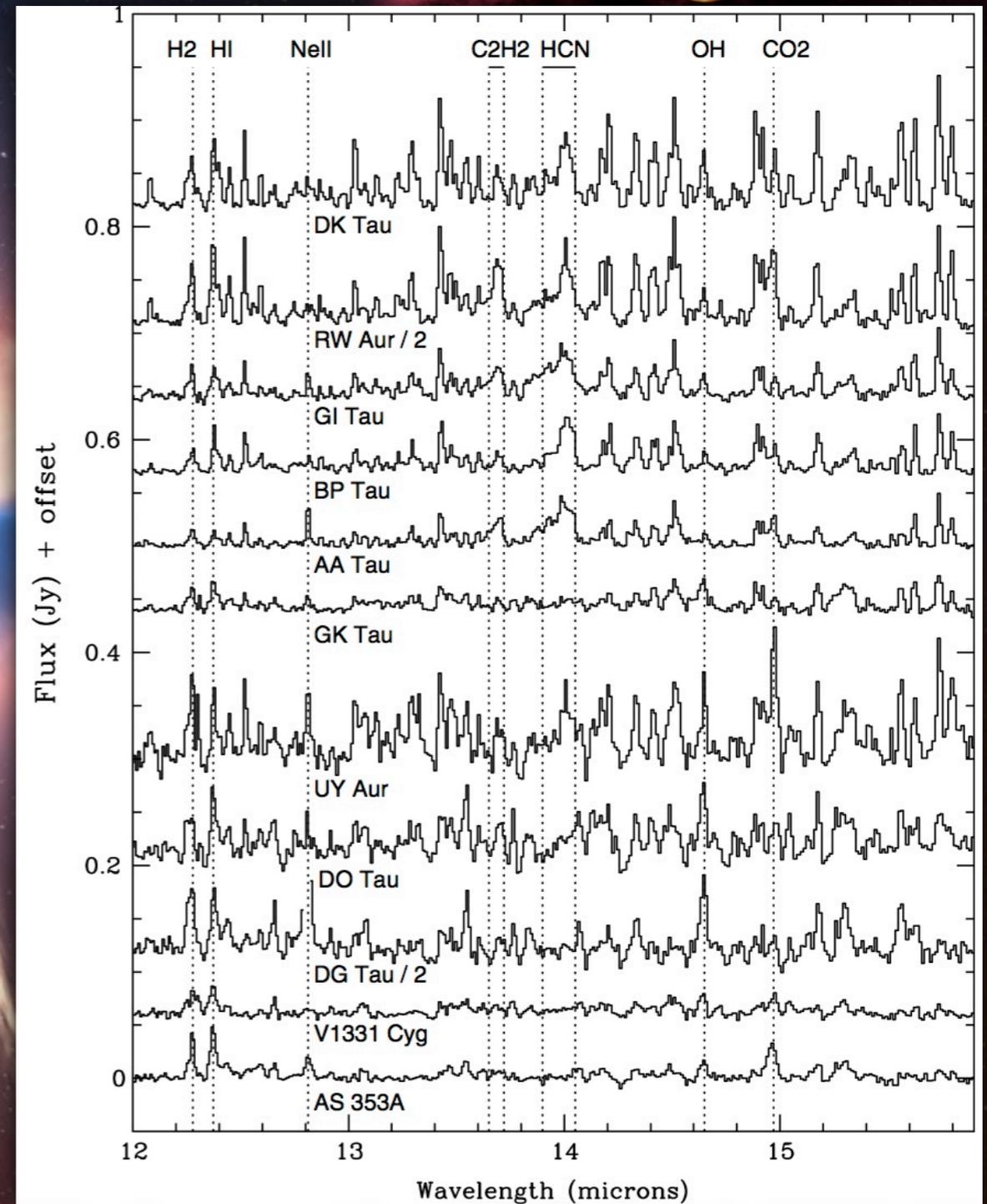


Juhász et al. 2012

+

What is the effect of changes in the SED of young stars on the molecular gas in the disk?

+



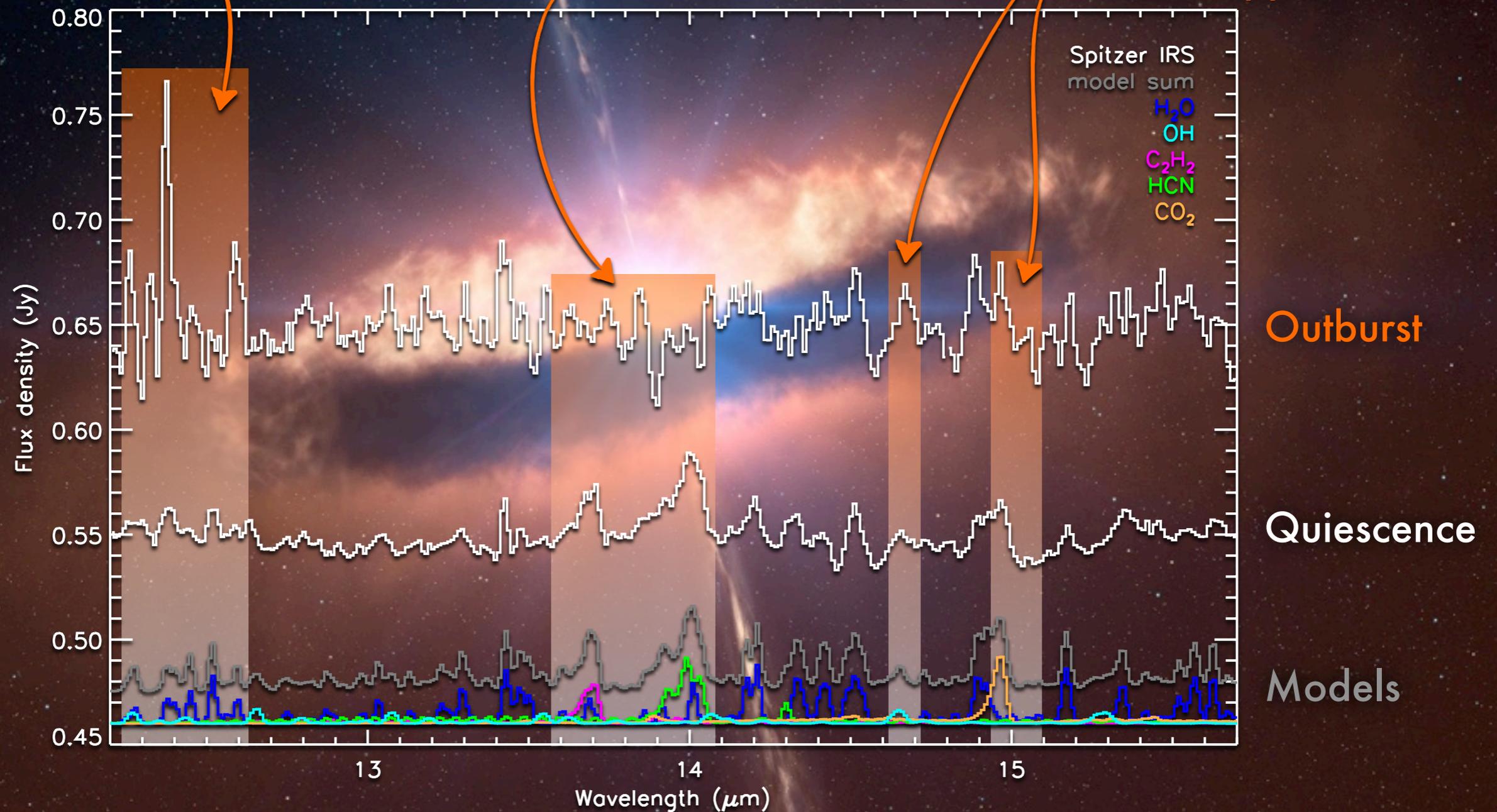
Carr&Najita 2008,2011; Pontoppidan 2010, Salyk 2008,2011

EX Lupi: episodic accretion *does affect* the molecular gas at planet-forming radii in the disk

strong HI, H₂
appear

organics disappear

OH increases, new
lines appear



(Banzatti et al. 2012)

EX Lupi: interpretation ?

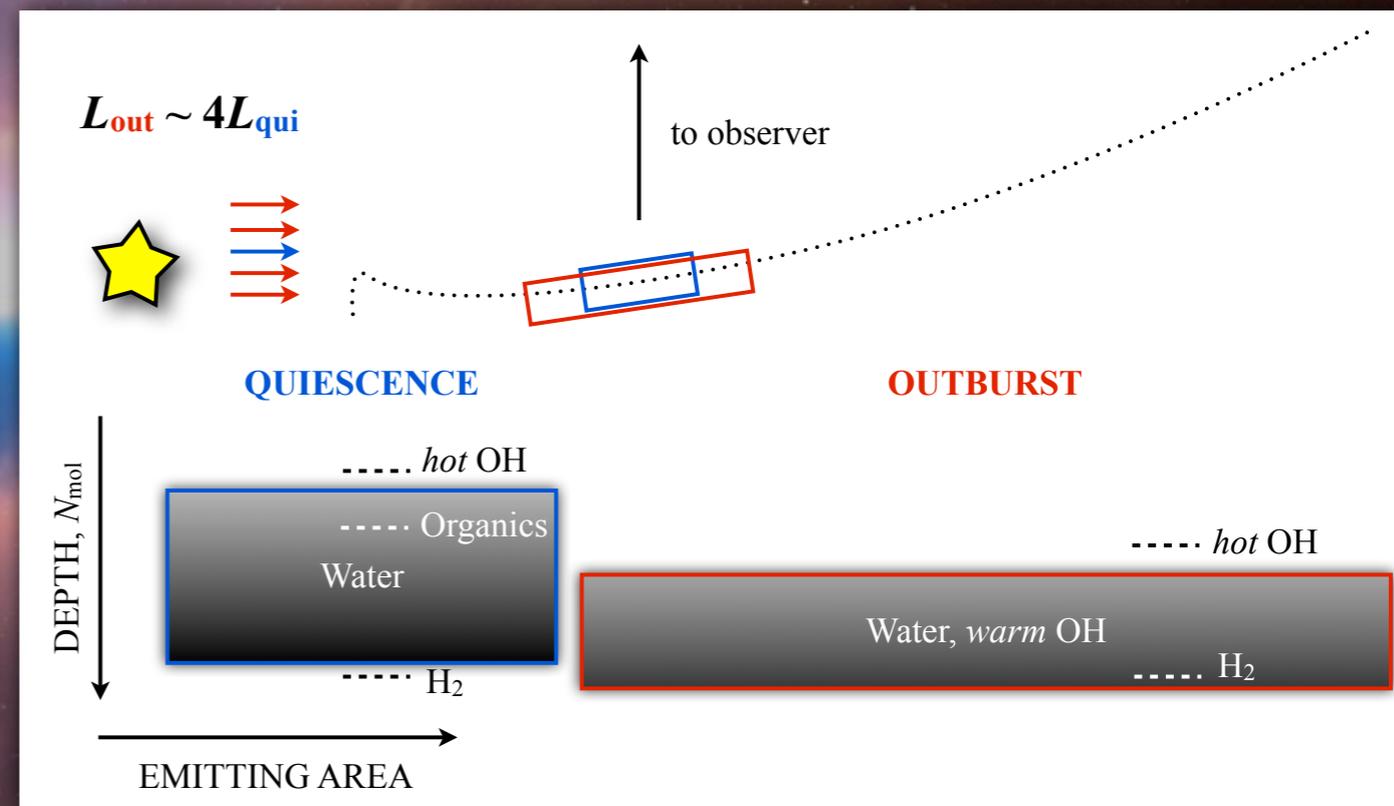
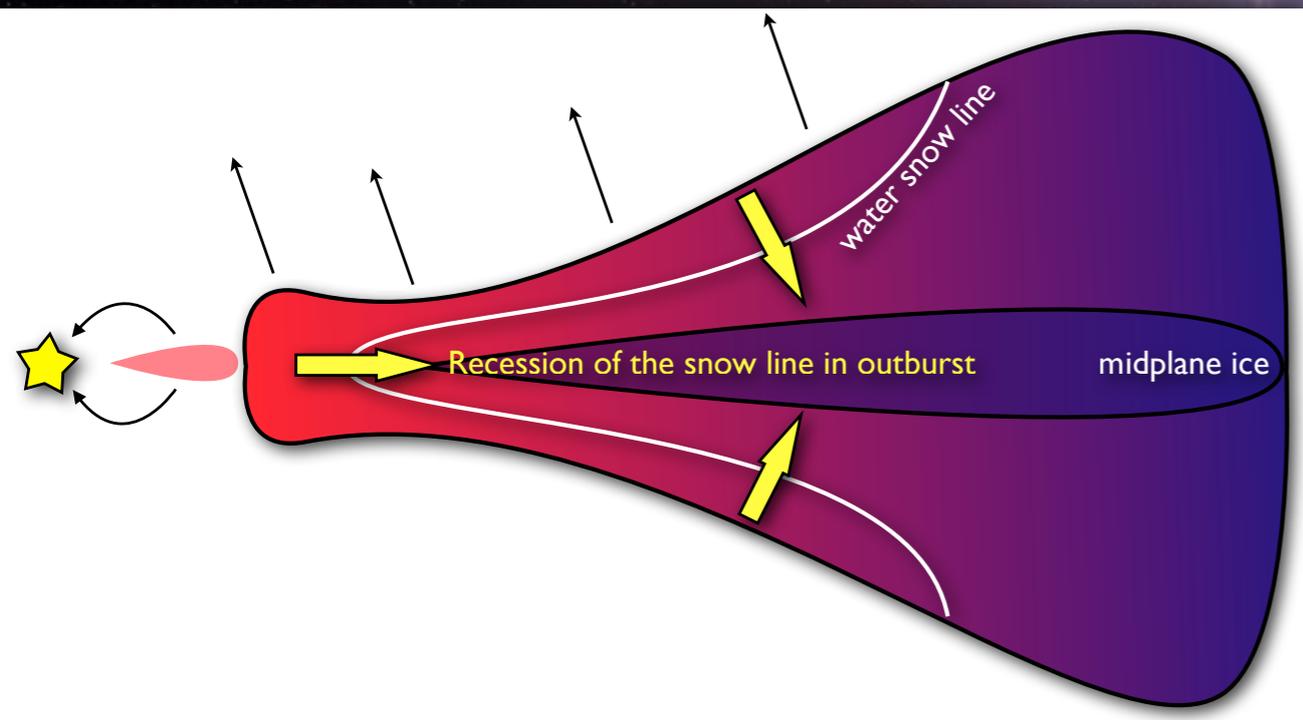
OUTBURST (single slab LTE model):

- more water, same temperature \rightarrow water is produced? \rightarrow How?

(Ciesla&Cuzzi 2006; Bethell&Bergin 2009; Glassgold+ 2009)

- more OH, "two" components (only one in quiescence) \rightarrow UV photodissociation of water?

(Tappe+ 2008, Najita+ 2010)



1. do we see the same effect in other TT stars?
2. is it due to accretion luminosity variability?
3. where is water vapor produced in the disk?
4. what's the long-term effect on disk chemistry?

Water vapor : gas-phase formation or evaporation from icy solids?

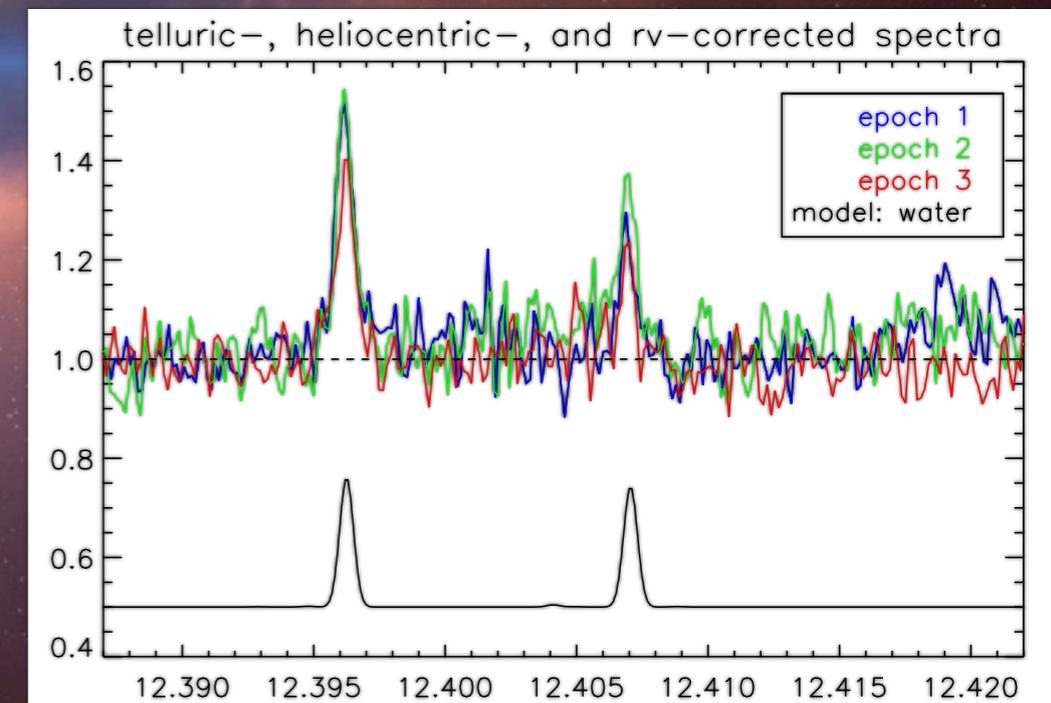
Setting up a new experiment : DR Tau

1. do we see the same effect in other TT stars?
2. is it due to accretion luminosity variability?
3. where is water vapor produced in the disk?
4. what's the long-term effect on disk chemistry?



Preliminary results:

- the effect seen in EX Lupi might be common in other TTauri systems: what are the implications on the molecular gas in the disk at planet-forming radii?
- some “flickering” of the water emission is observed with VISIR, and we need to check for correlations with the accretion variability with XSHOOTER



Banzatti, Meyer, Pontoppidan, Testi, in prep.

VISIR 2.0 Large Program

“Protoplanetary disks as chemical factories”

PI: Pontoppidan

Cols: Pascucci, Banzatti,
Flaccomio, Salyk, Carmona,
Blake, Meeus, Sterzik, Kaufi,
Meyer, Sacco, Alexander,
Kamp, Dullemond



24 nights over 2 years
55 disks (including EX Lupi and DR Tau)
water, OH, [NeII], H₂, organics – spectrally resolved

+

Finding more constraints on water vapor formation

1. consider large samples of rotational levels at once
2. better constraints on the water abundance
3. clarify origin and connection to disk structure

Banzatti, Pontoppidan,
Bruderer, Meyer, in prep.

Some concluding remarks ...

- Episodic/variable accretion may have an important role in the story of young disk evolution and planet formation; (see also talks by Wasson and by Tieloff)
- molecular emission changes: not only timescales of gas in disks but also ongoing chemistry for planets; (see also poster by Lahuis)
- just scratching the surface, exciting and promising times to come!

Thanks!