



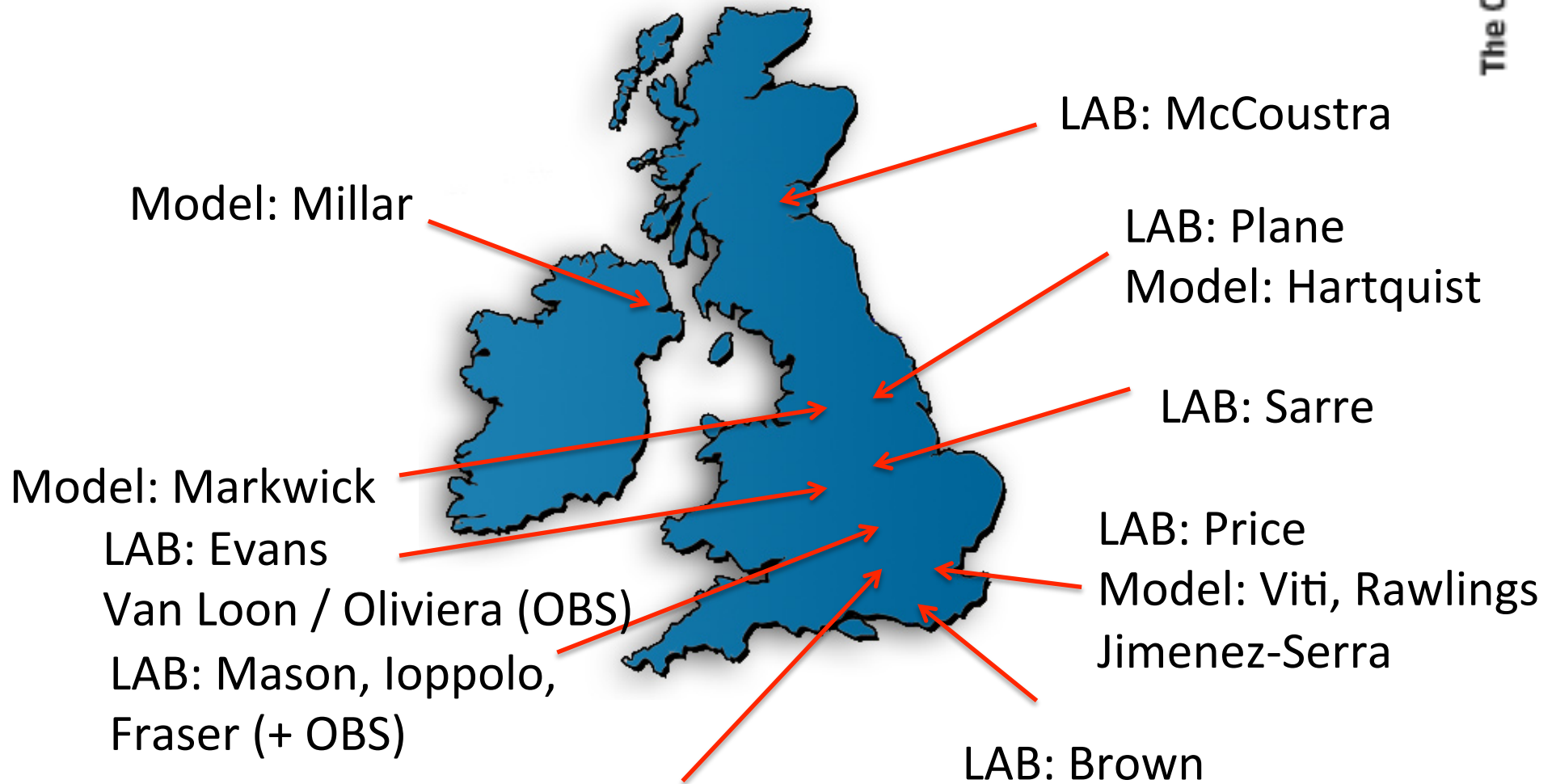
# Bridging the Gap between ice Observations & Modeling: LABORATORY DATA hold the key

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Prof. Serena Viti, Prof. Martin McCoustra,  
Prof. Wendy Brown

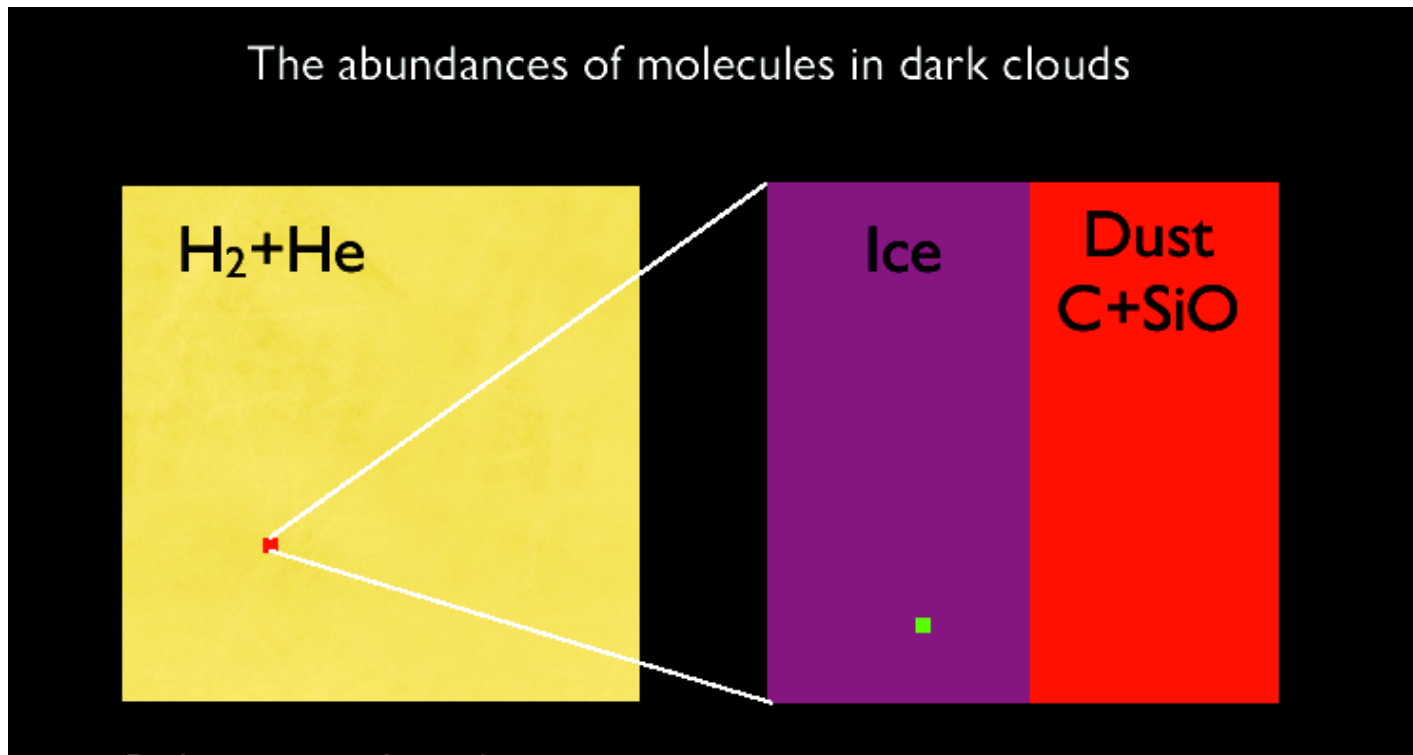
e.g. very little UK Lab involvement  
(except Nigel Mason) in feeding ice  
data INTO databases



DIAMOND/ ISIS/ ESA ELIPS

What we see in gas  $\phi$

- Can originate from solid state
- Can be depleted to solid state
- Can be dependent on historical solid state chemistry

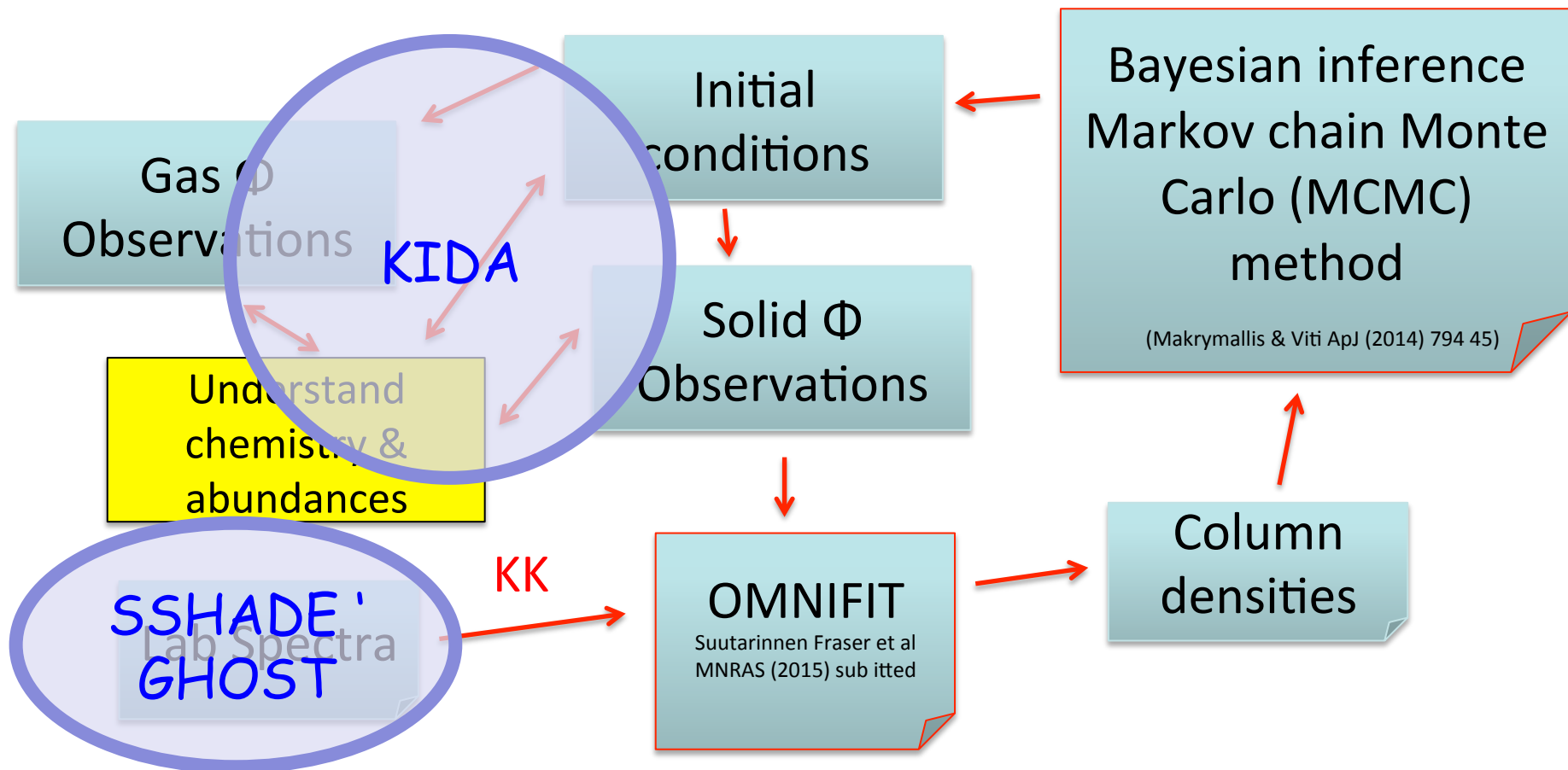


*Image courtesy of K Pontoppidan*

# Project Aims – PRE-STELLAR

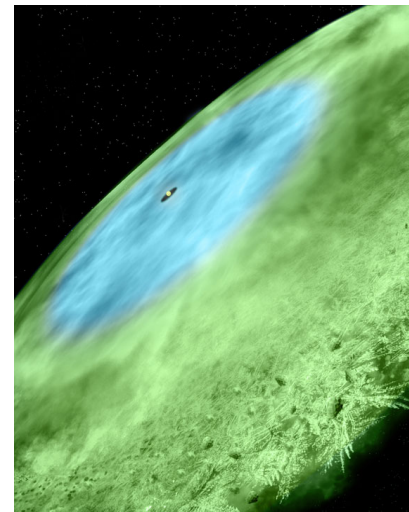
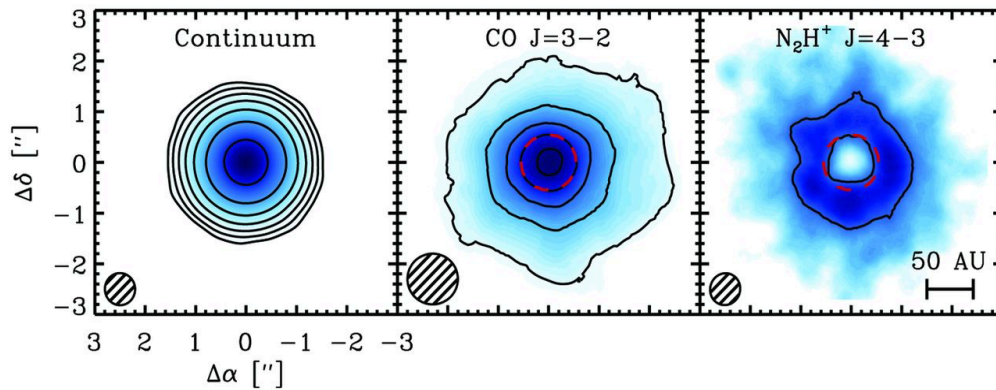
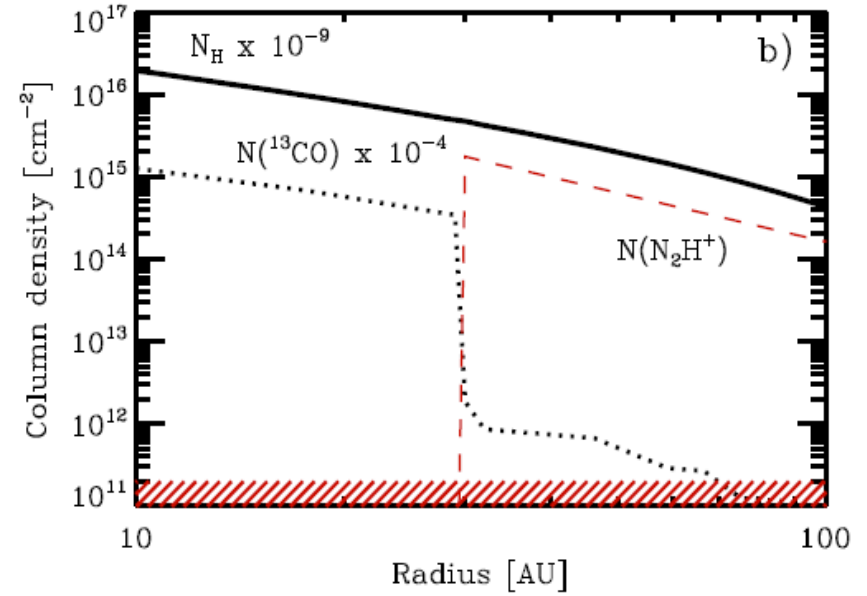
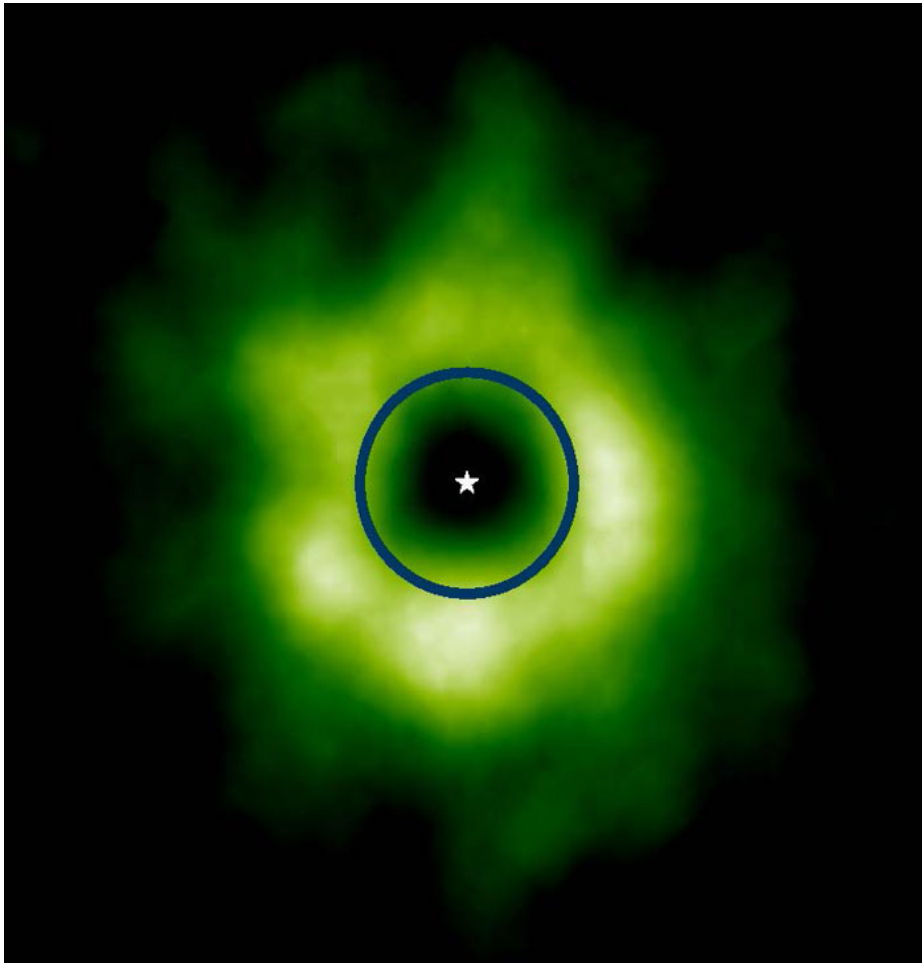


**Aim:** to provide observers and modellers with easy access to laboratory data pertaining to the molecular ices that play a fundamental role in the chemical evolution of star-forming regions





# A CO "snow" line

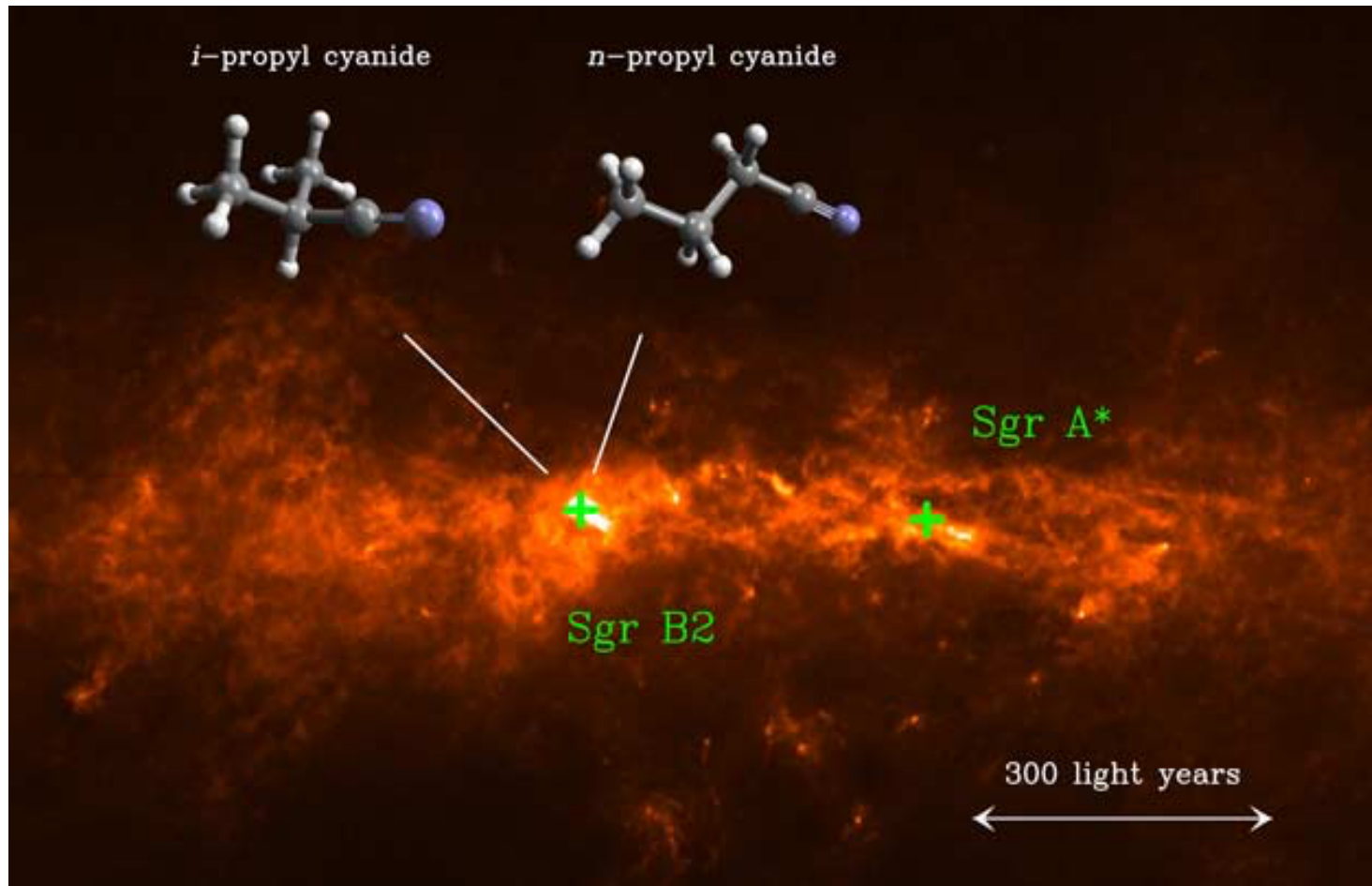


Qi et al Science (2013)



# Complex Molecules as Tracers of Solid-State Radical Chemistry

© Y Beletsky



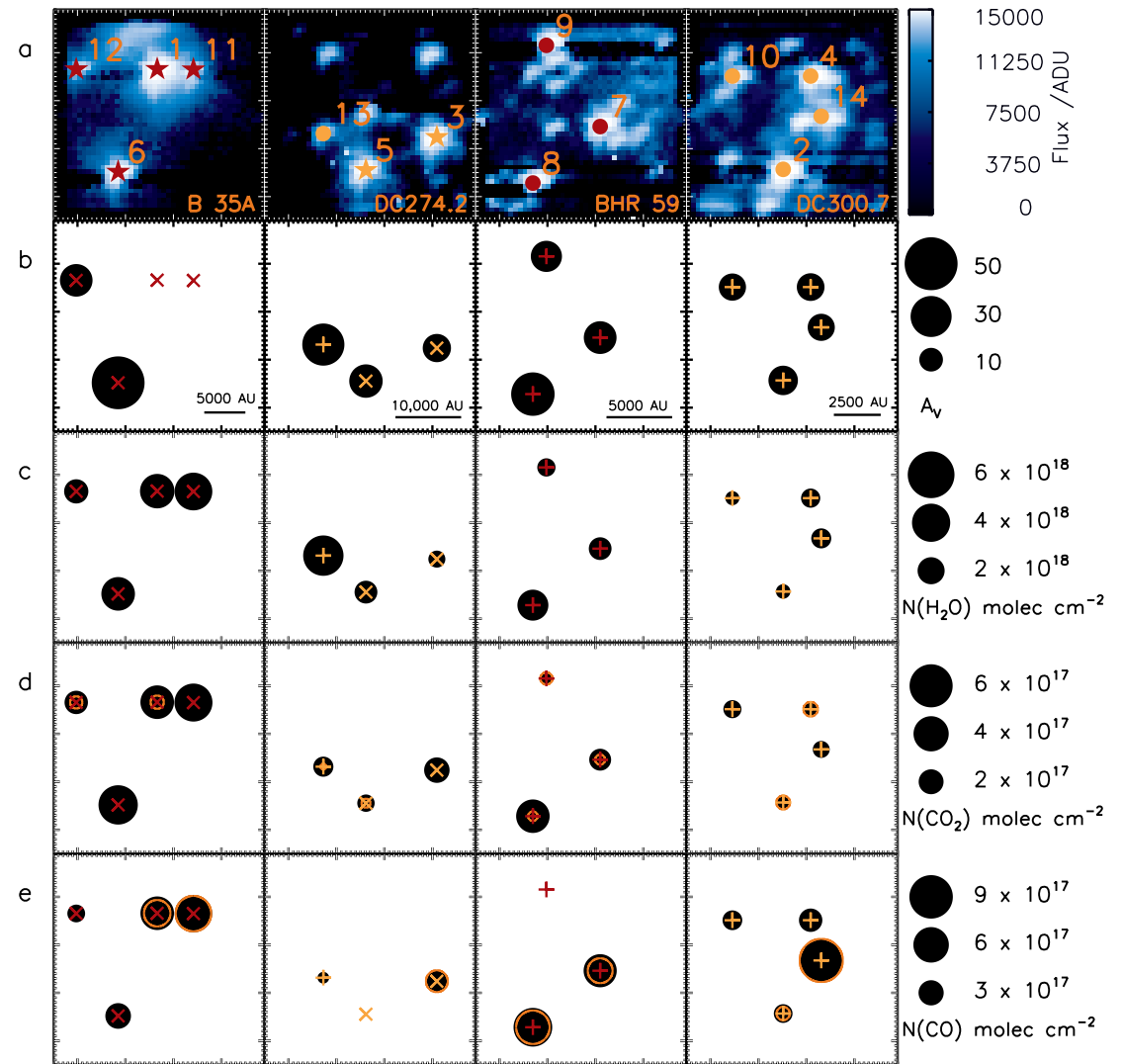
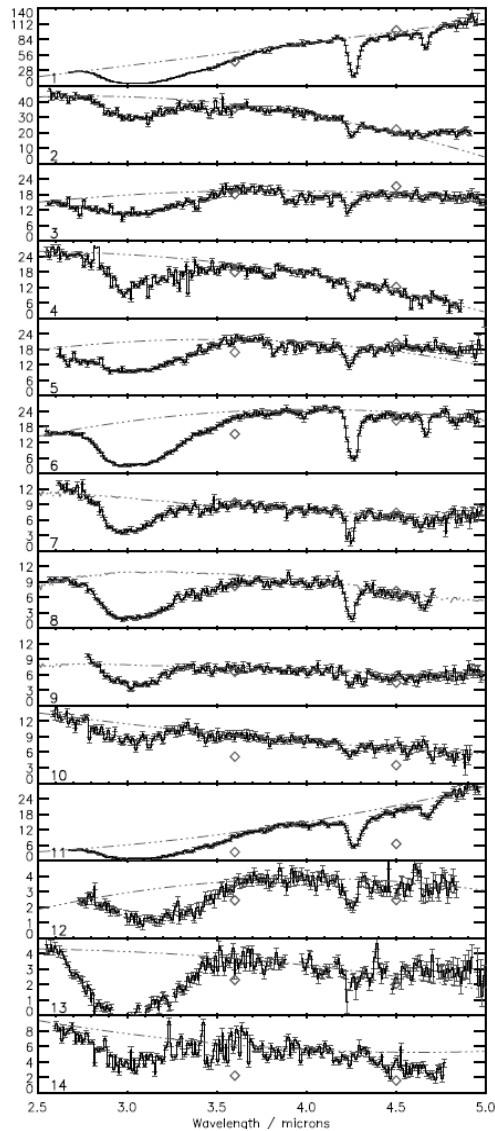
Sagittarius B2, 27,000 light years from Earth, is rich in organic molecules © MPIfR/A. Weiß (background image), University of Cologne/M. Koerber (molecular models), MPIfR/A. Belloche (montage)  
Belloche et al Science (2014) 345 1584



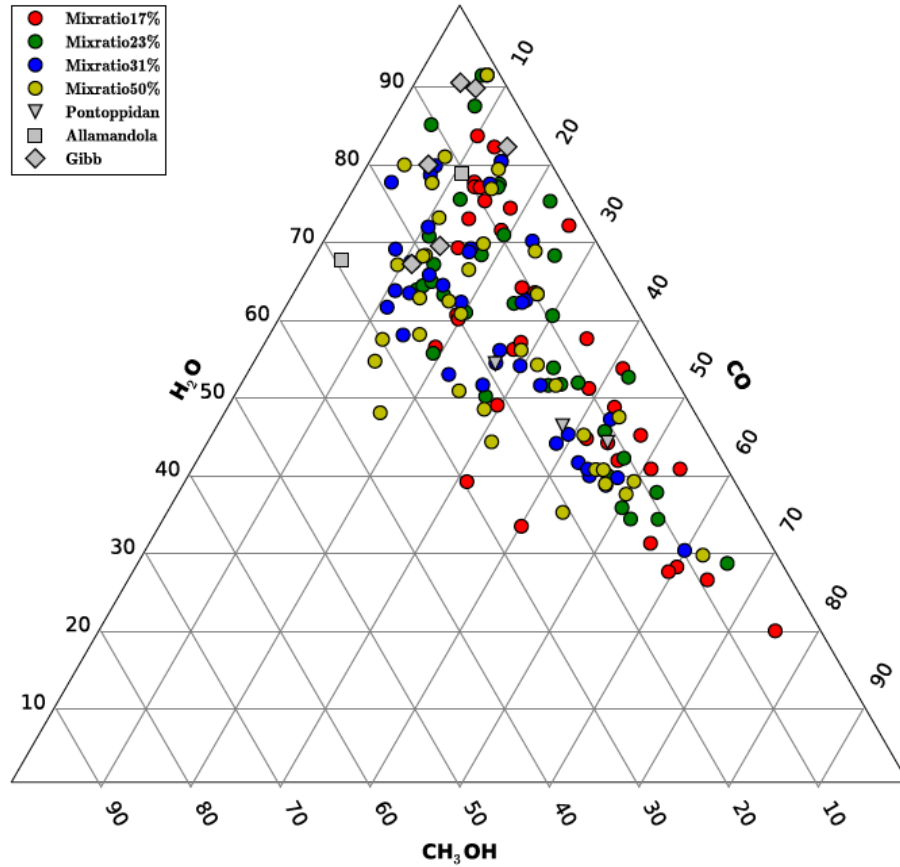
- 1. Column densities of ices in PRE-STELLAR regions**
- 2. Novel Experiments to study COMS production**



# How does ice distribution affect small-scale ice abundances?

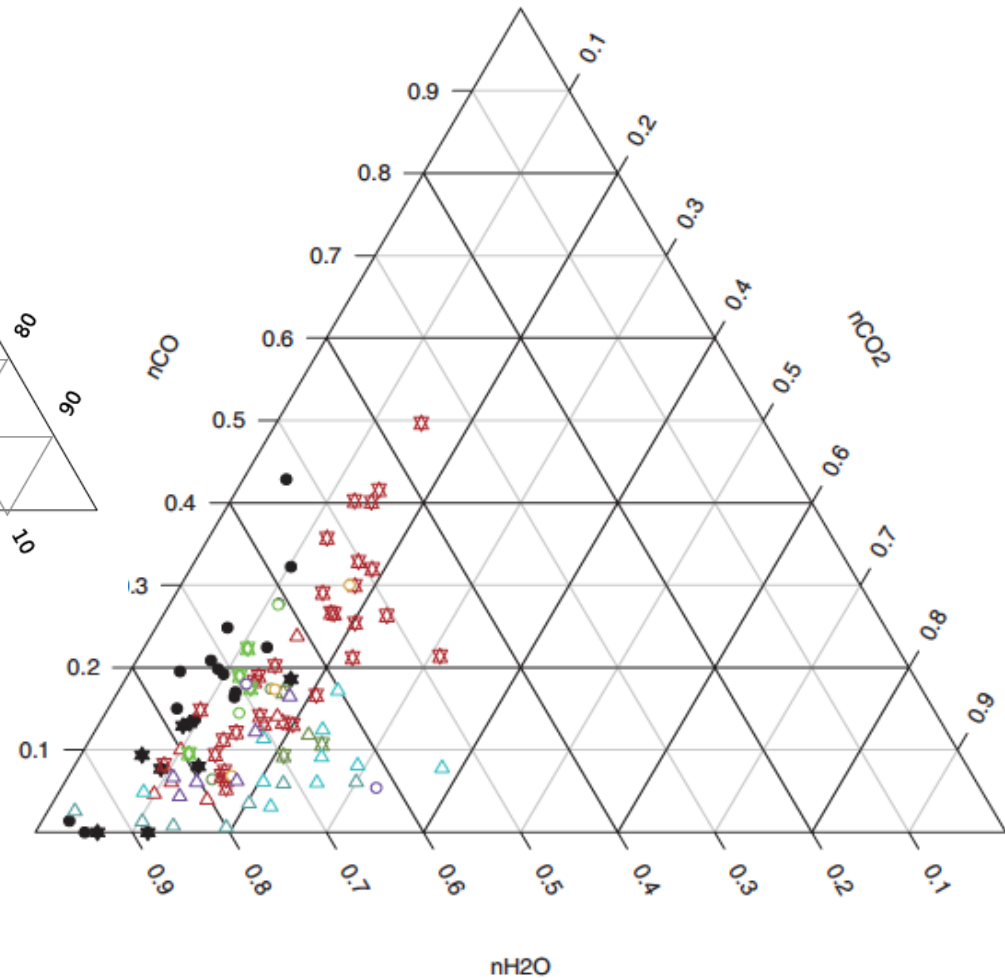


# Ice Column Densities



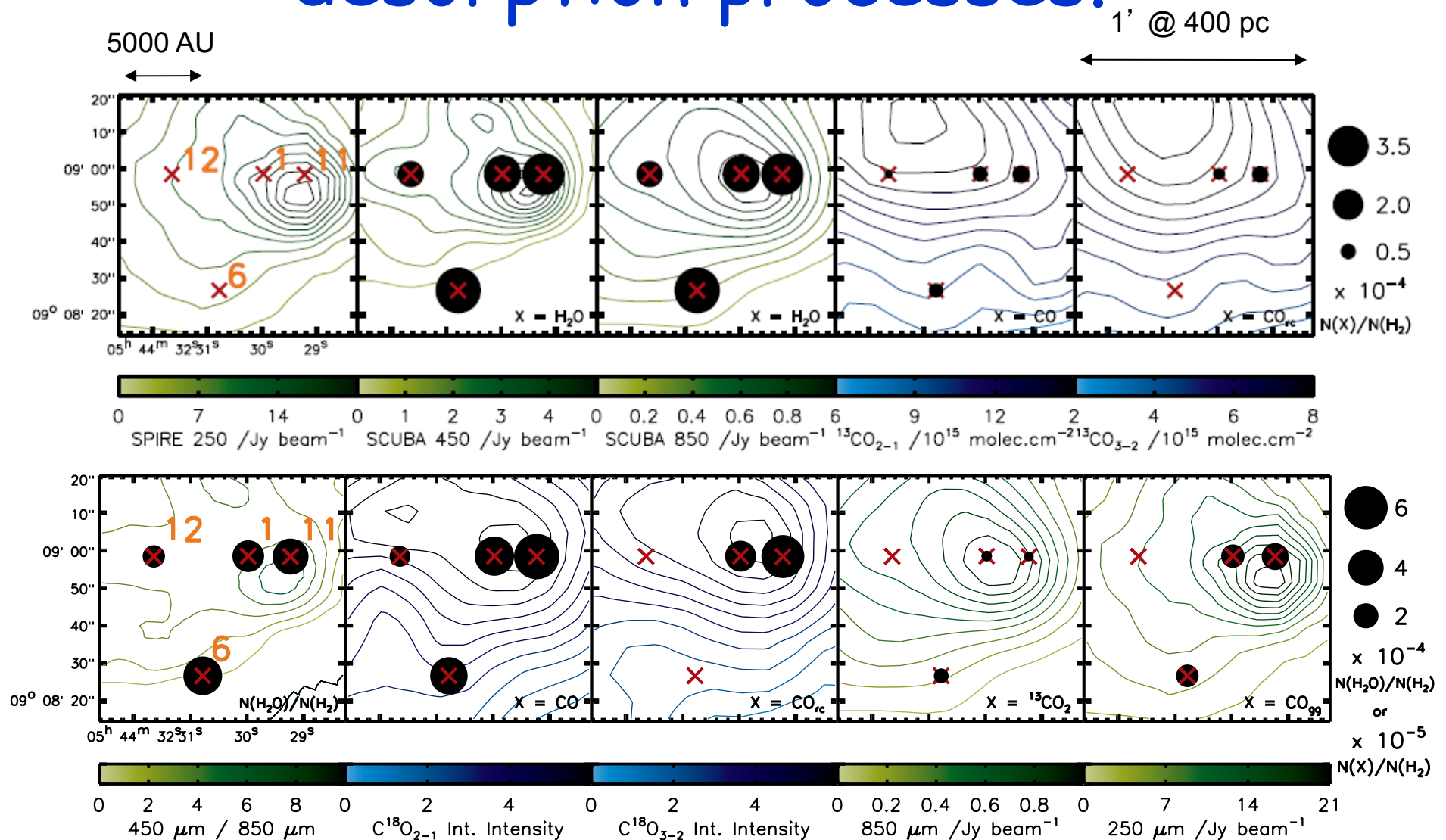
- Mixratio17%
- Mixratio23%
- Mixratio31%
- Mixratio50%
- ▽ Pontoppidan
- Allamandola
- ◇ Gibb

Suutarinnen et al (2015) MNRAS submitted



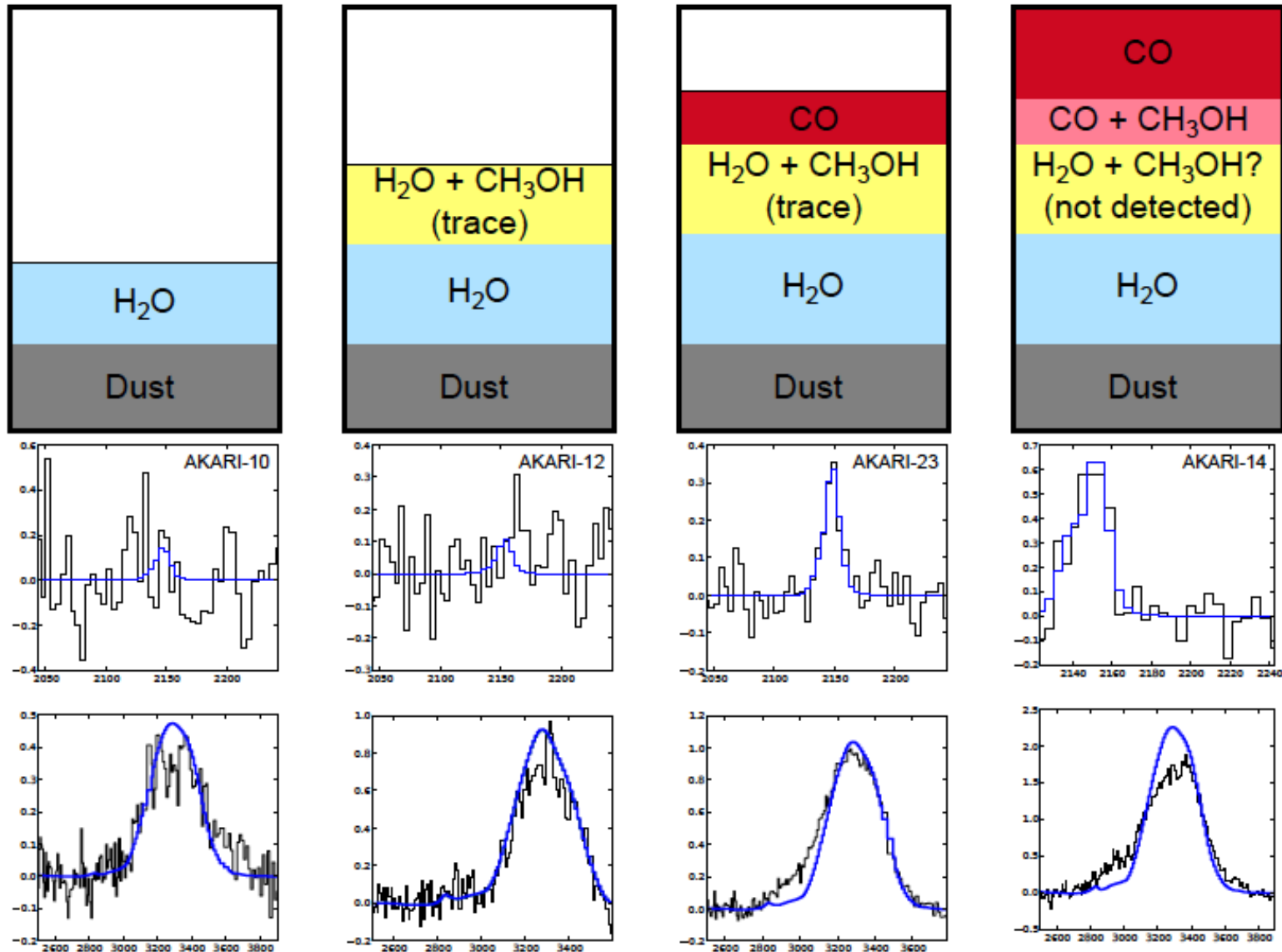
Noble et al (2013) ApJ

# Ice “controls” chemistry and desorption processes.

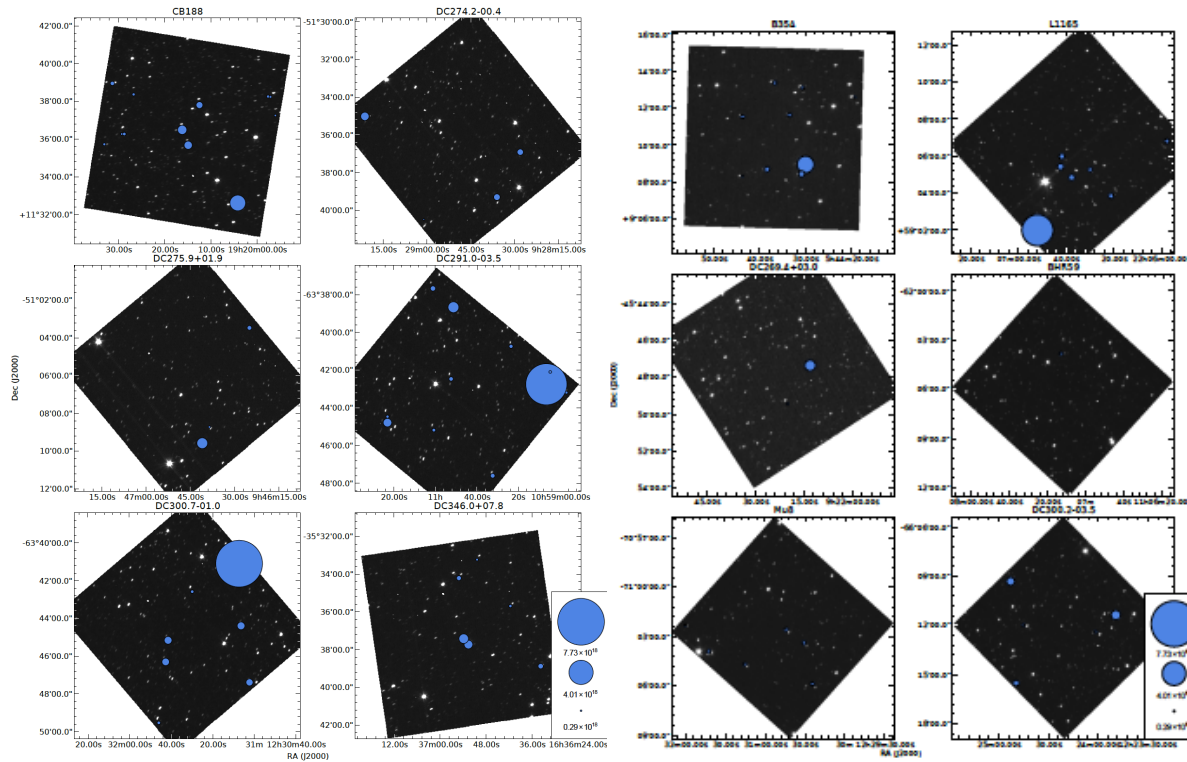


# Linking Spectroscopy to Modeling

Suutarinen et al MNRAS (2015) submitted

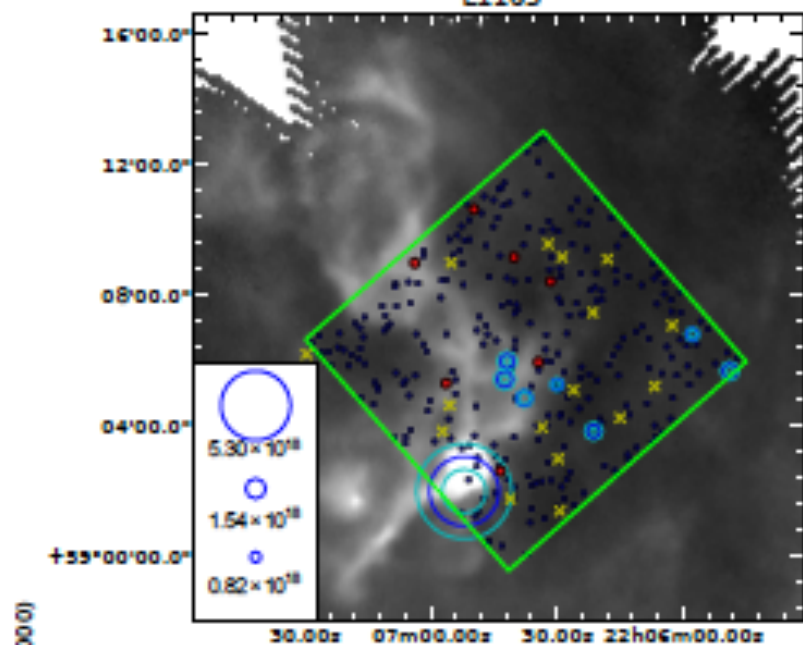
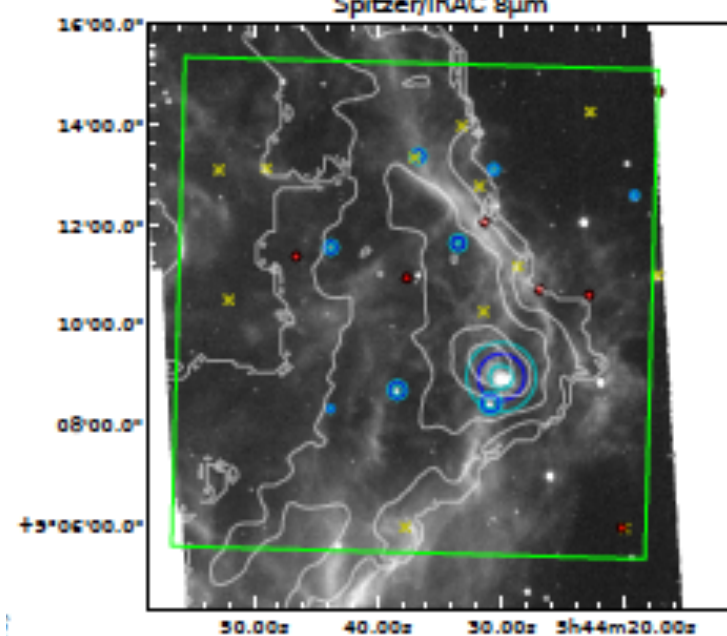


# Ice mapping on larger scales

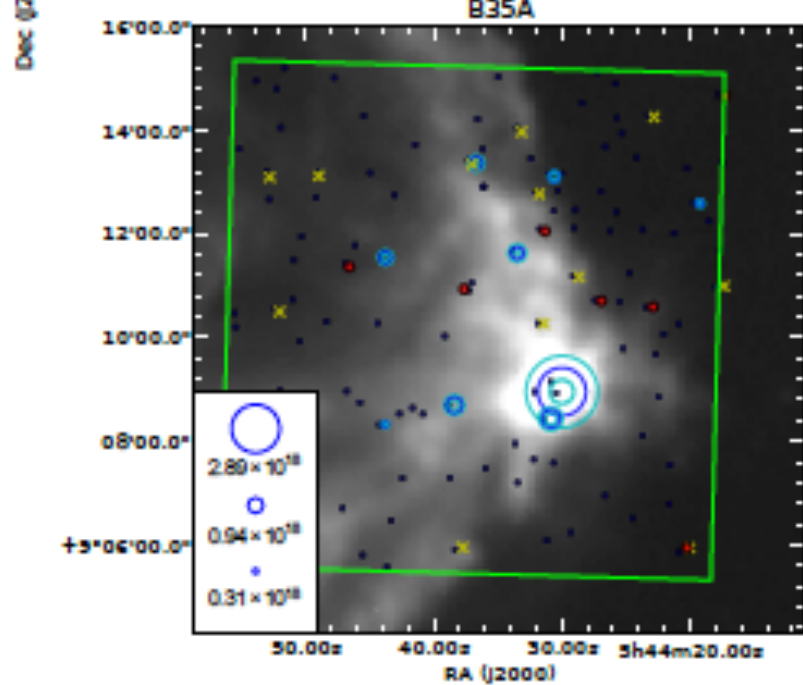
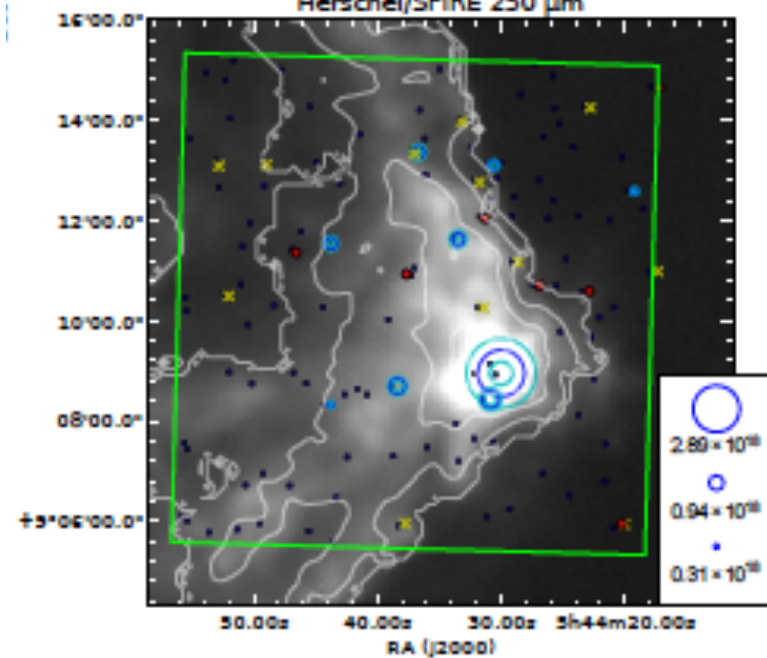


Water ice mapped CONCUURENTLY  
towards 100's of objects  
(258) on 12 LOS to pre-stellar cores

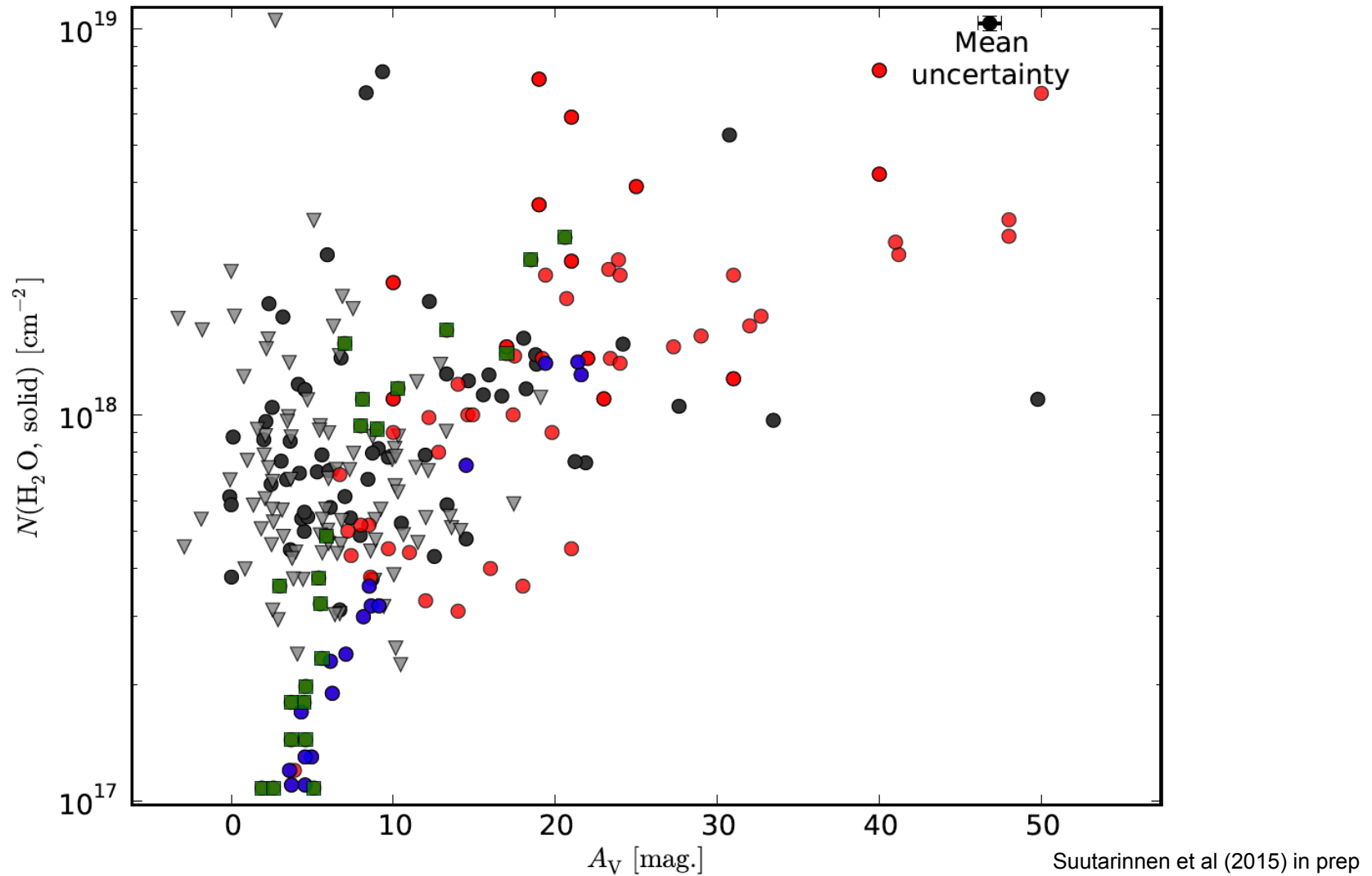
L1165

Spitzer/IRAC 8  $\mu\text{m}$ 

B35A

Herschel/SPIRE 250  $\mu\text{m}$ 

# Is there a critical $A_V$ onset to ice formation?



# Terahertz Desorption Emission Spectroscopy (THz-DES)

(with Brian Ellison (RAL Space)  
& Geoff Blake (Caltech))



The Open University

- 1. Are COMS produced in gas / solid phase?**
- 2. Do radicals / ions desorb from surfaces?**
- 3. Are A/E o/p ratios affected by surface desorption?**



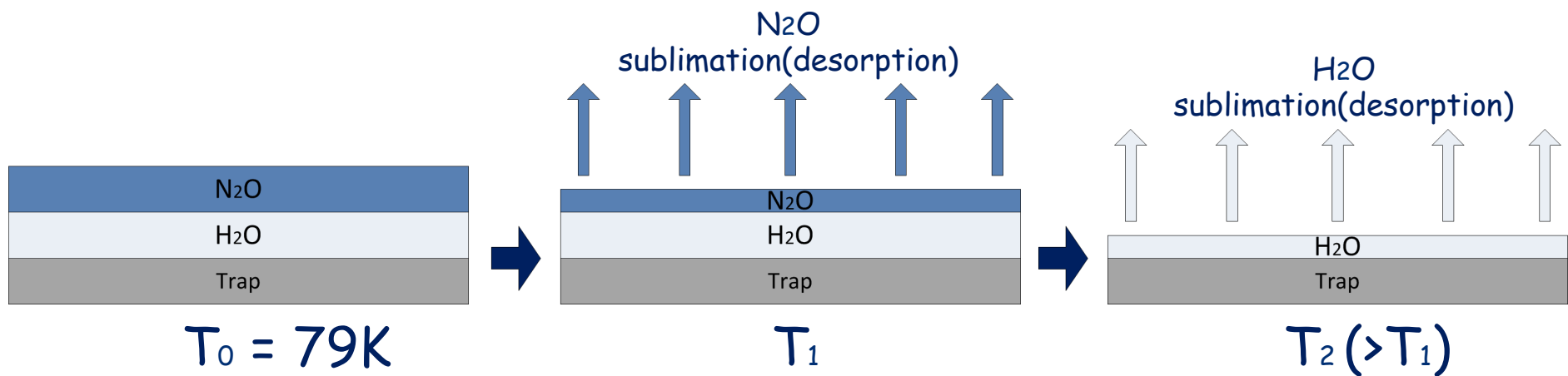
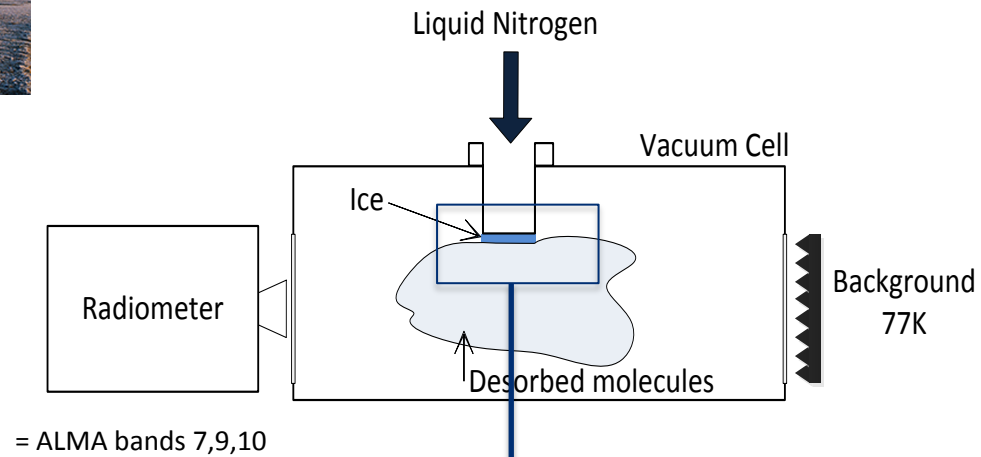


# Proof of Concept: “ALMA” in the lab

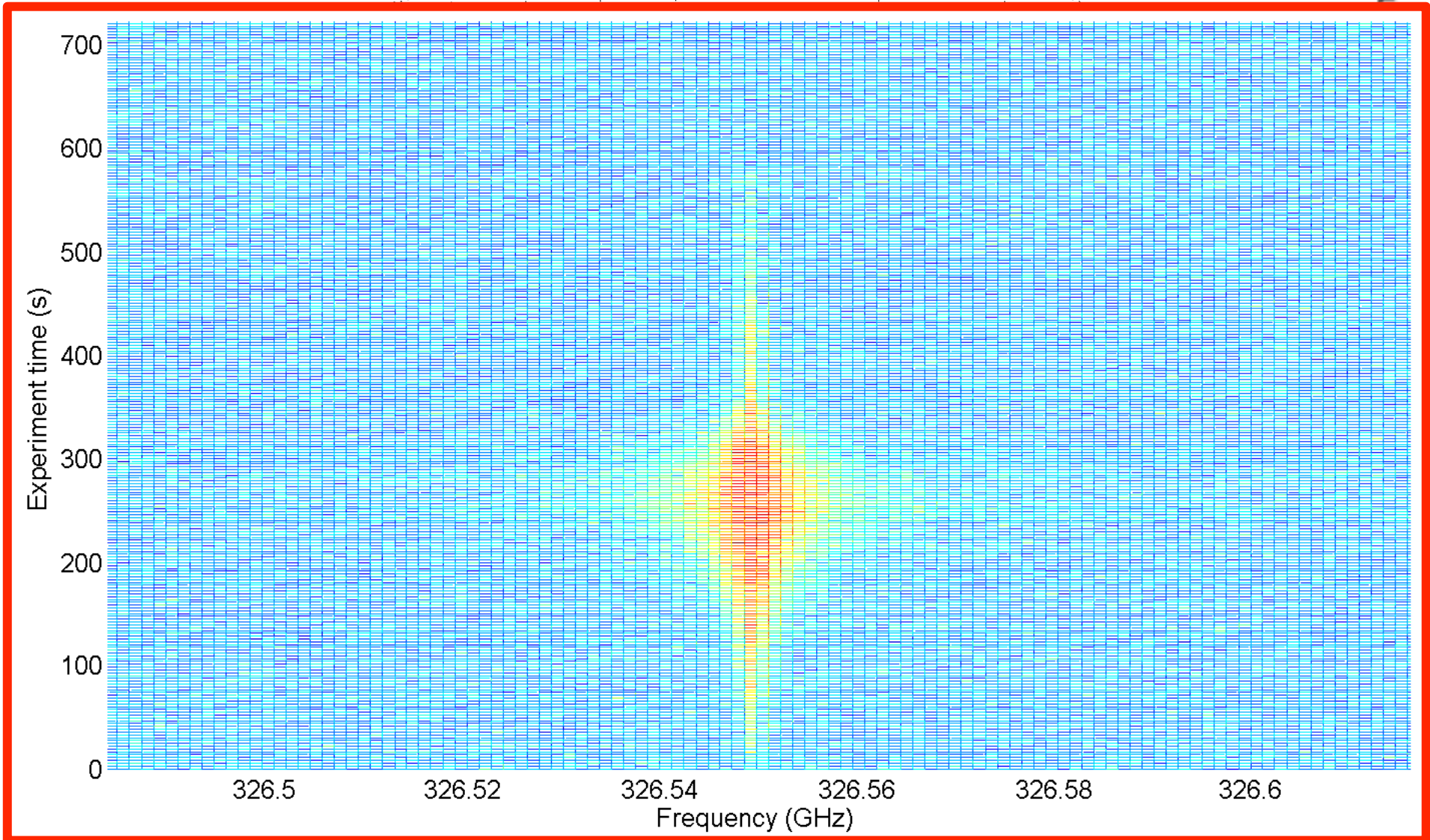


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observe spectra  
of desorbing gas  $\Phi$   
molecules  
IN EMISSION



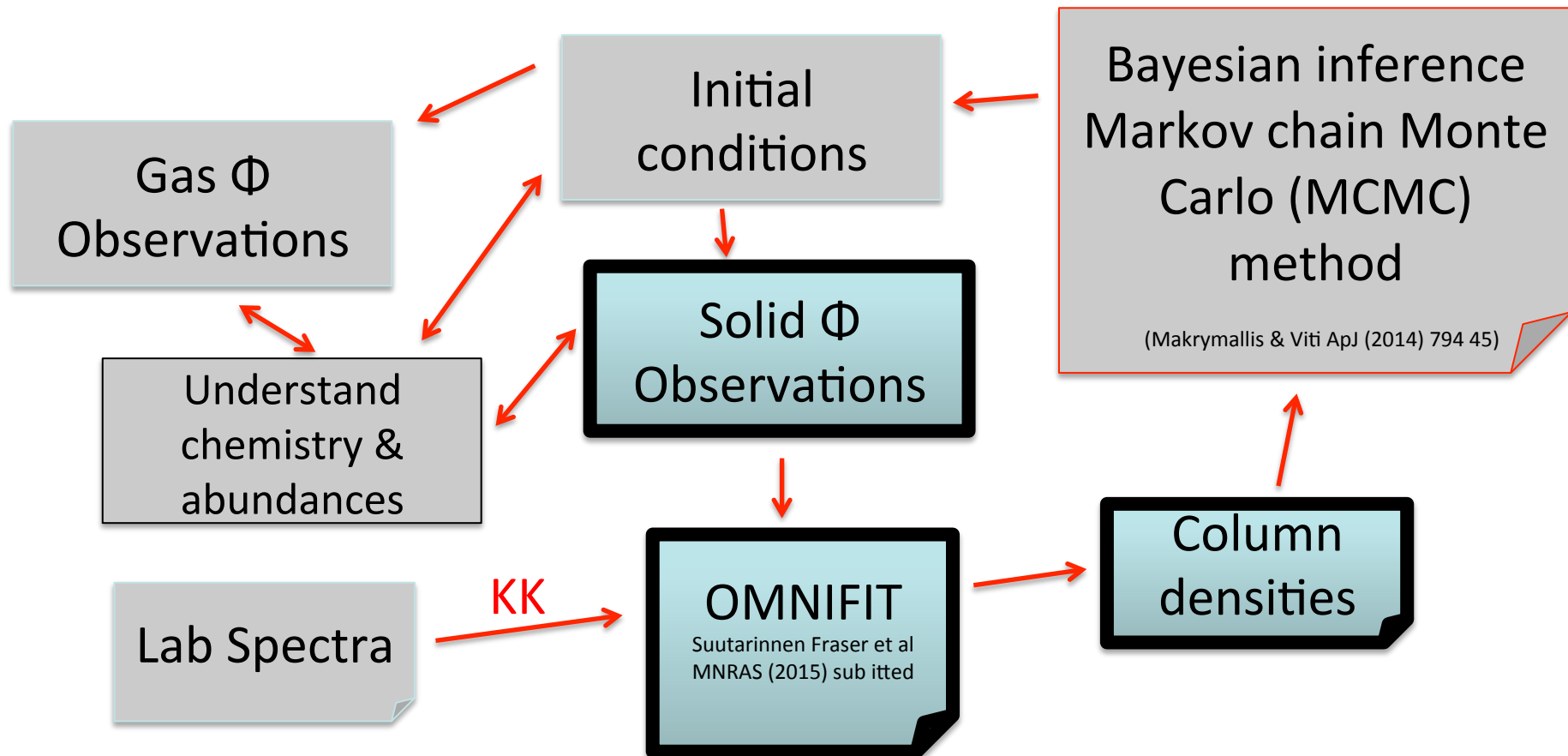
# H<sub>2</sub>O and N<sub>2</sub>O desorption



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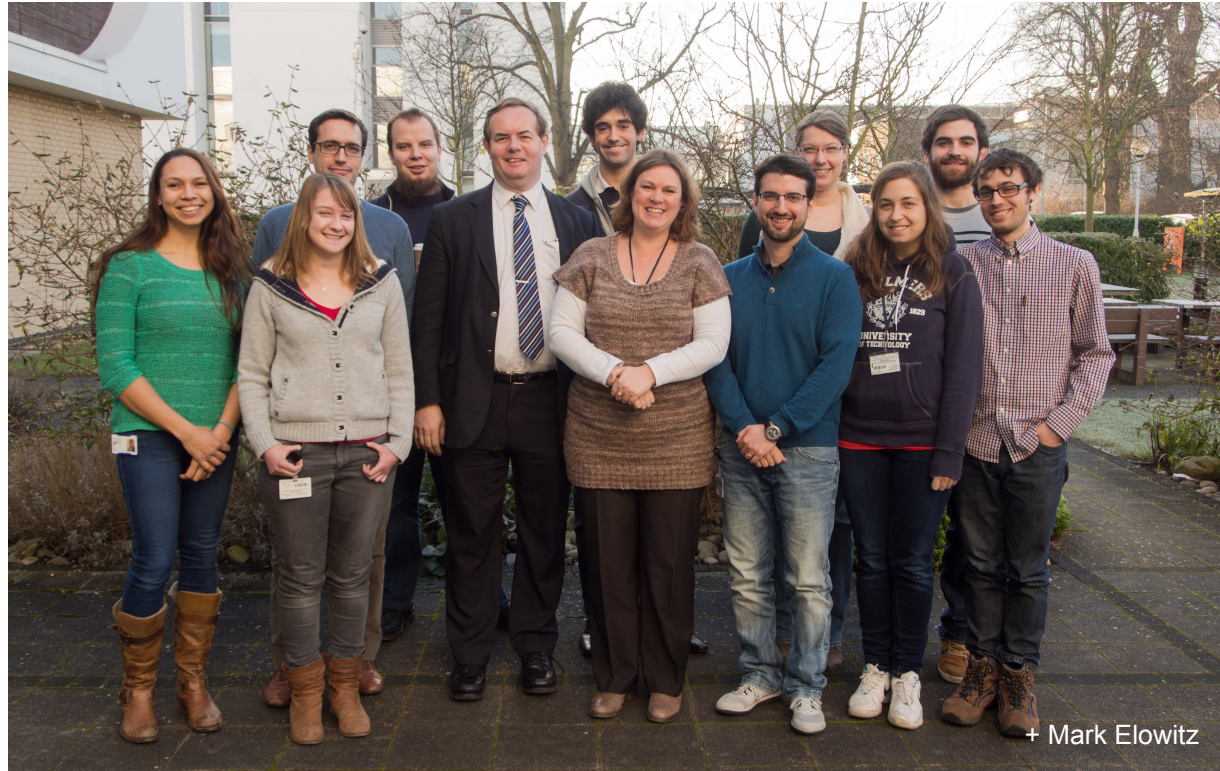
**Aim:** to provide observers and modellers with easy access to laboratory data pertaining to the molecular ices that play a fundamental role in the chemical evolution of star-forming regions



# The OU Astrochemistry Group



The Open University



££/ €



# Unashamed Advertising



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C.B.5 Laboratory Astrophysics*

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European network action

CM1401 “Our Astrochemical History”

**Short Term Scientific Missions**

**1<sup>st</sup> Meeting – Prague**

**May 26<sup>th</sup> – 29<sup>th</sup> 2015**



[http://www.cost.eu/COST\\_Actions/cmst/Actions/CM1401](http://www.cost.eu/COST_Actions/cmst/Actions/CM1401)



**For this community:-**

Workshop II (July 13<sup>th</sup>) UK Links to SSHADE & KIDA

Workshop III (Oct 2015)

*Watch your inbox for invites – save the date(s)*