"Ices in Star Forming Regions" What about THz?.

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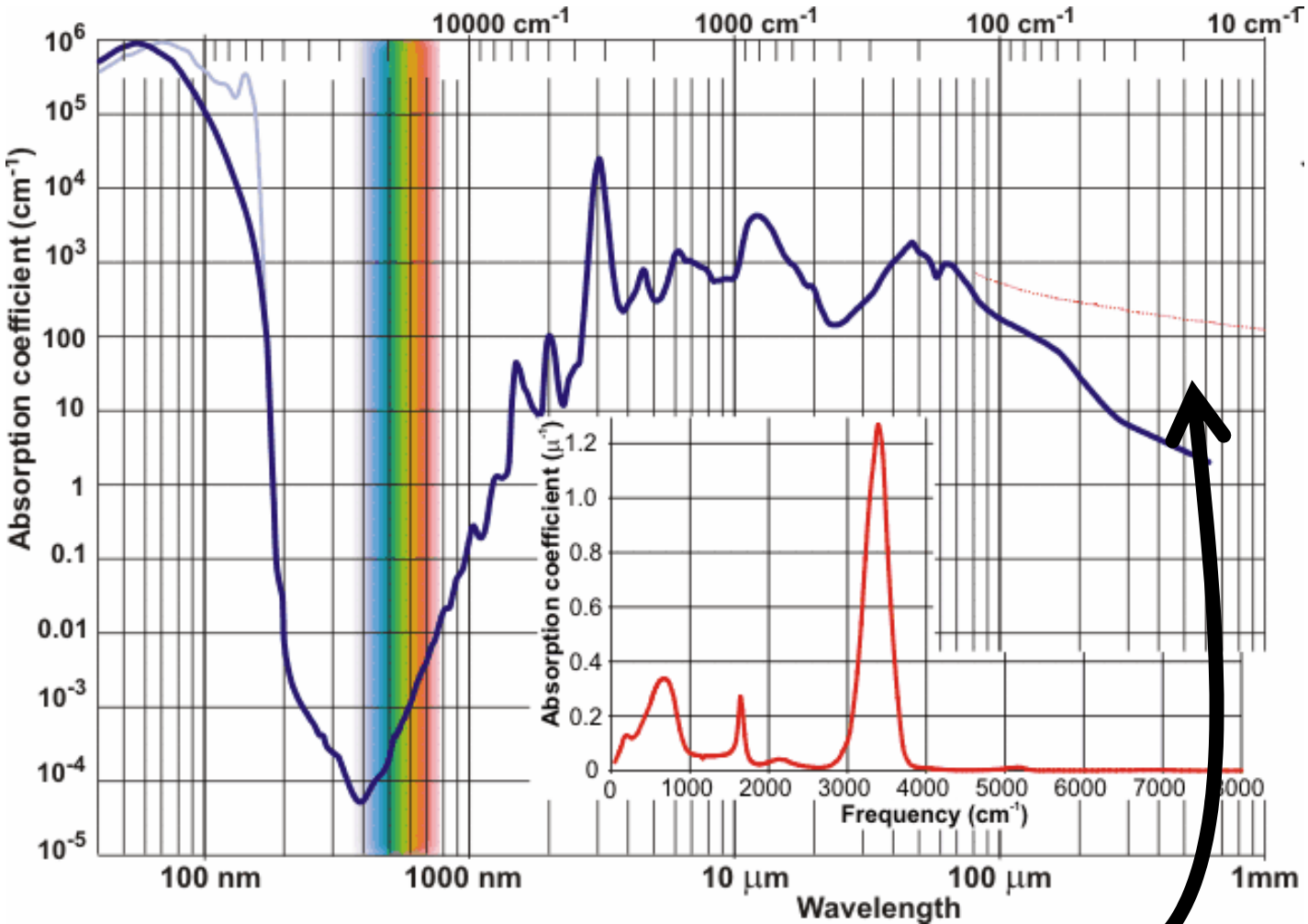
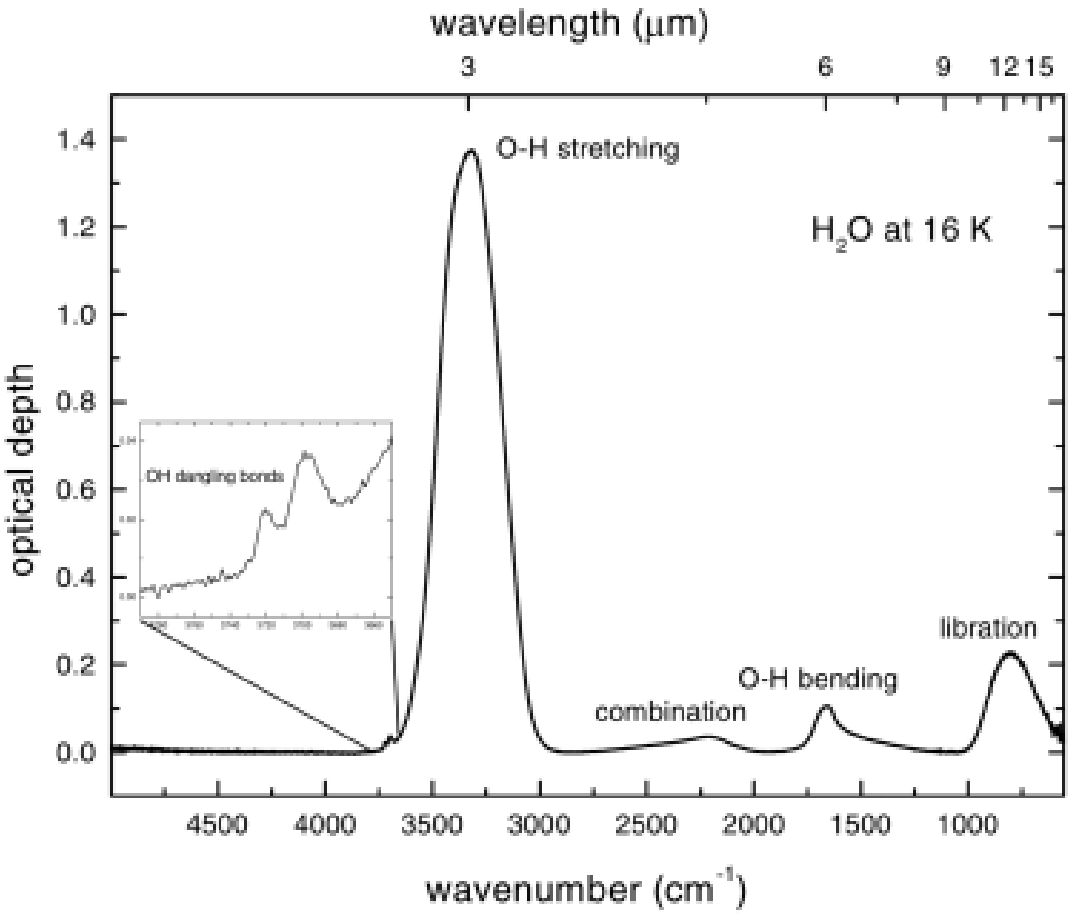
Water Spectra...



ALMA = 2.8 cm $^{-1}$ → 31.6 cm $^{-1}$

Water Ice..



In fact THz features in H_2O (l)
@ 3-5 THz & 7-9 THz
H-bond stretch / bend modes
v. Broad (2 THz bands)
Need full spectral coverage to see!!

Xu et al JCP (2006)

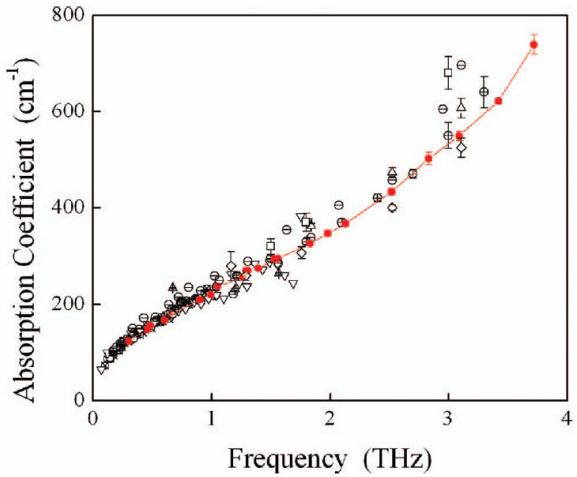


FIG. 2. (Color) Previously published water absorption spectra include measurements using femtosecond time domain transmission[1] (▽) and reflection[2] (⊗) spectroscopies, reflection dispersive Fourier transform spectroscopy[3,4] (○ and ⊕, respectively), optically pumped FIR laser transmission spectroscopy[5–7] (△, ◇, ⊖), and FIR grating spectroscopy[8] (□). Our data are in excellent agreement with the published data below ~1.5 THz. Above this frequency, our measurements provide continuing and perhaps more accurate documentation for water absorption up to 3.72 THz.

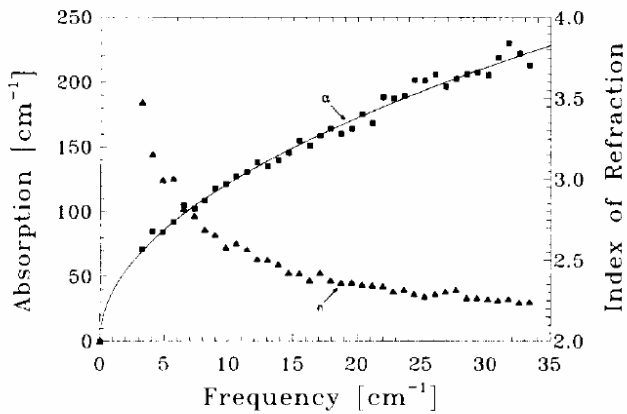
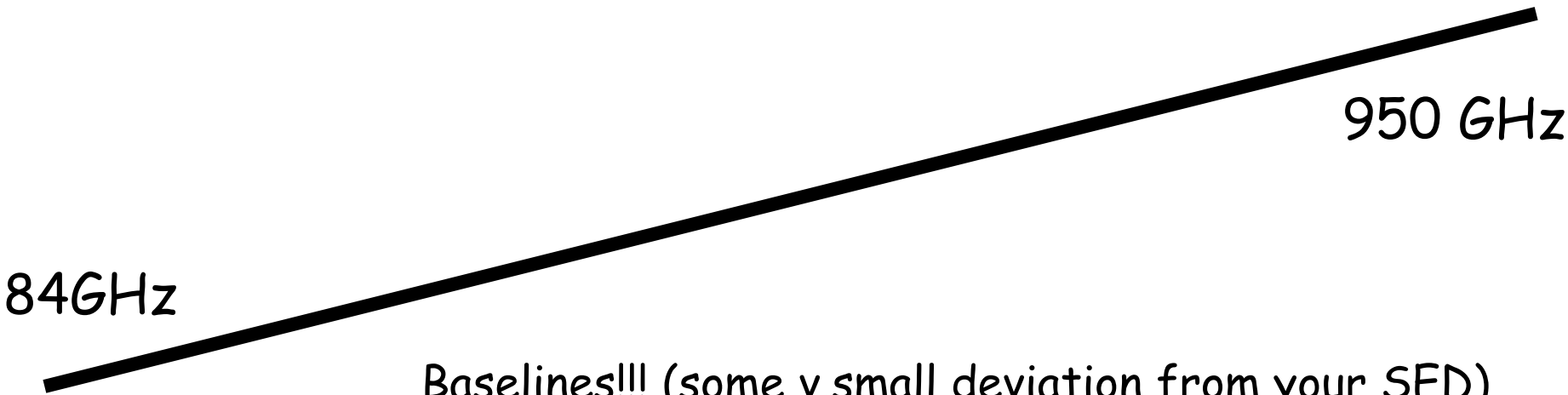


Fig. 2. Absorption coefficient (■) and index of refraction (▲) for liquid water. The solid line is proportional to $\nu^{1/2}$. The water sample was three times distilled and kept at a temperature of 292 K.

Thrane et al CPL (1995)

What will ALMA see from ice?



Baselines!!! (some v.small deviation from your SED)
or even your baseline!!

Not useful for studying ices per se

What can we and can't we do?

- Infer ice presence by large molec
  desorption?

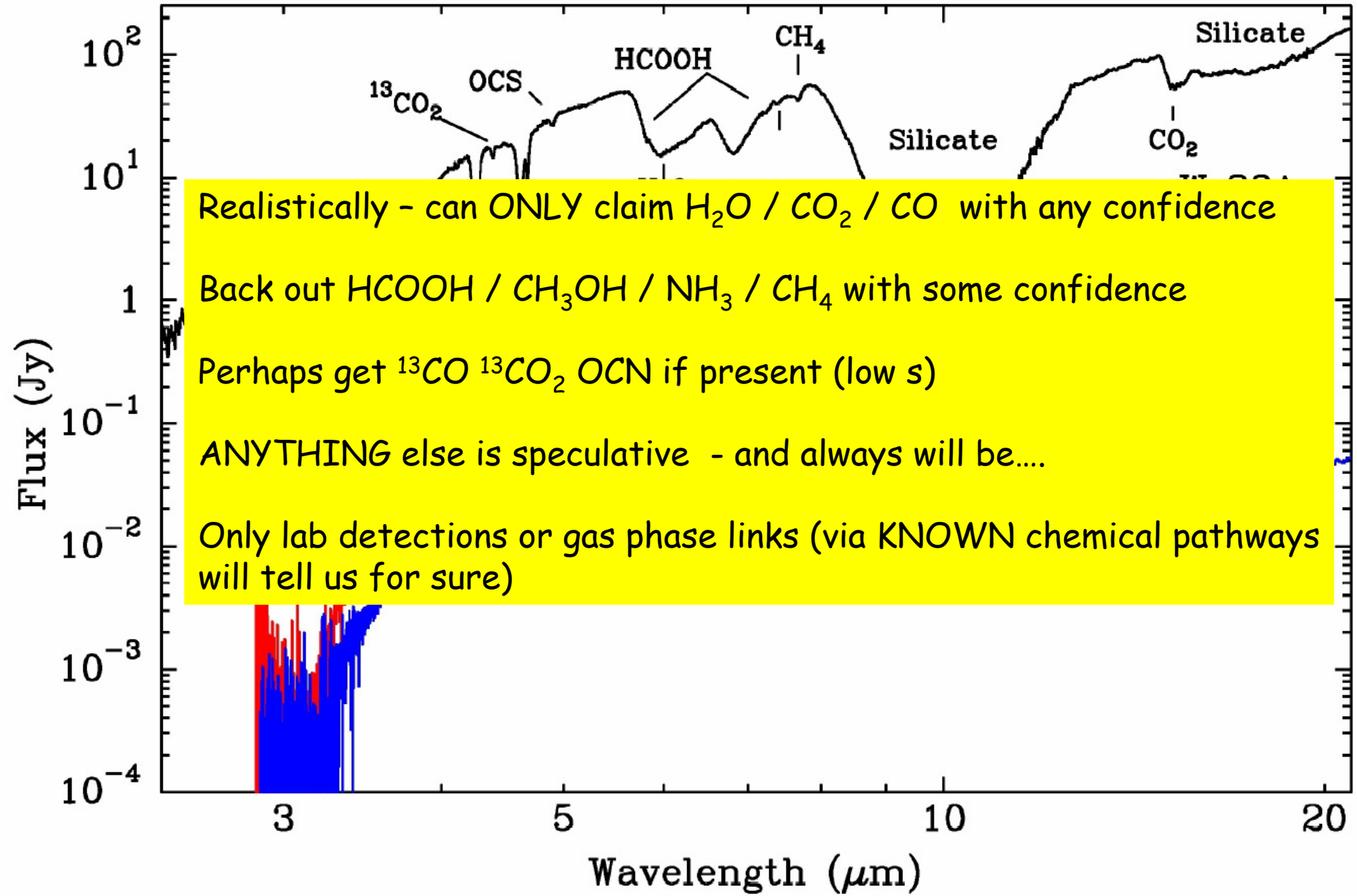
Warning 1: what is linked to what?

- Infer ice presenc known ice species in
  gas phase?

Warning 1: can ONLY be done with same species?

PLEA: No generic lists - bring us clear shopping lists!!!

TH need excellent desorption data &
understanding of chemistry



Realistically – can ONLY claim H_2O / CO_2 / CO with any confidence

Back out $HCOOH$ / CH_3OH / NH_3 / CH_4 with some confidence

Perhaps get ^{13}CO $^{13}CO_2$ OCN if present (low s)

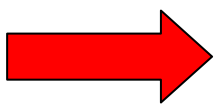
ANYTHING else is speculative - and always will be….

Only lab detections or gas phase links (via KNOWN chemical pathways will tell us for sure)

van Dishoeck et al., Pacific-Chem Proceedings (2006)

Ice in Space

ALMA data needs are INDIRECT



2 e.g.s

Deuteration – lab work

Multi λ approach (ice mapping) - observations

Conclusions

- multi λ observing is key

  – even when looking on small scales the 'bigger environment' is vital to understanding the astronomy

- ice is interesting – but for astronomers to benefit most;

We need a shopping list – not saying non thermal desorption / binding energies / etc etc etc

BUT specifics – molecules / specific constants etc..

e.g. extragalactic… NO? ….others?

Galactic sources??? BE REALISTIC and careful what we can do in lab & how it translates…

Funding = always an issue… NSF-EPSRC funding in chemistry (need good links etc)..even letters of support help!!