Hints to planet formation history from the chemistry of disks and natal clouds

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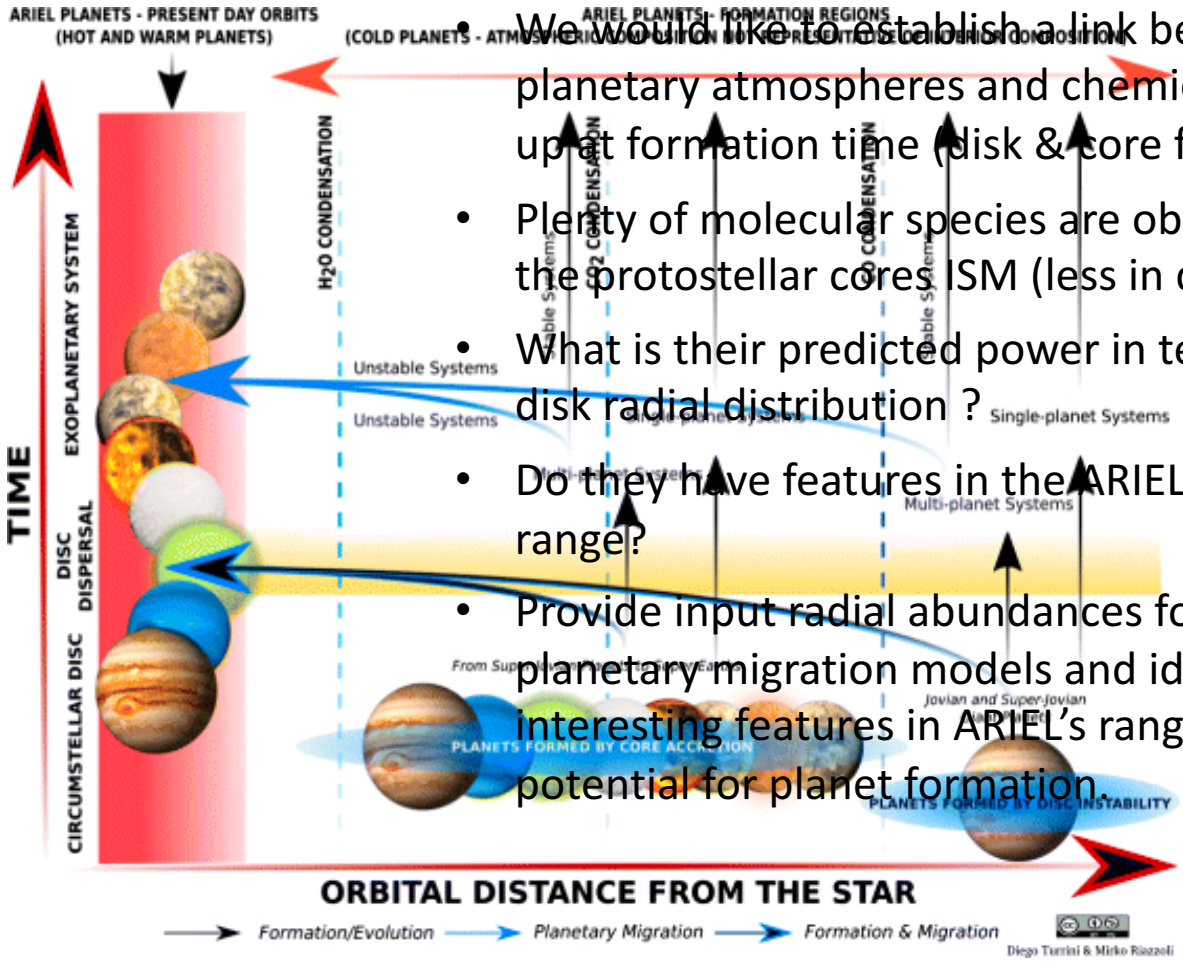
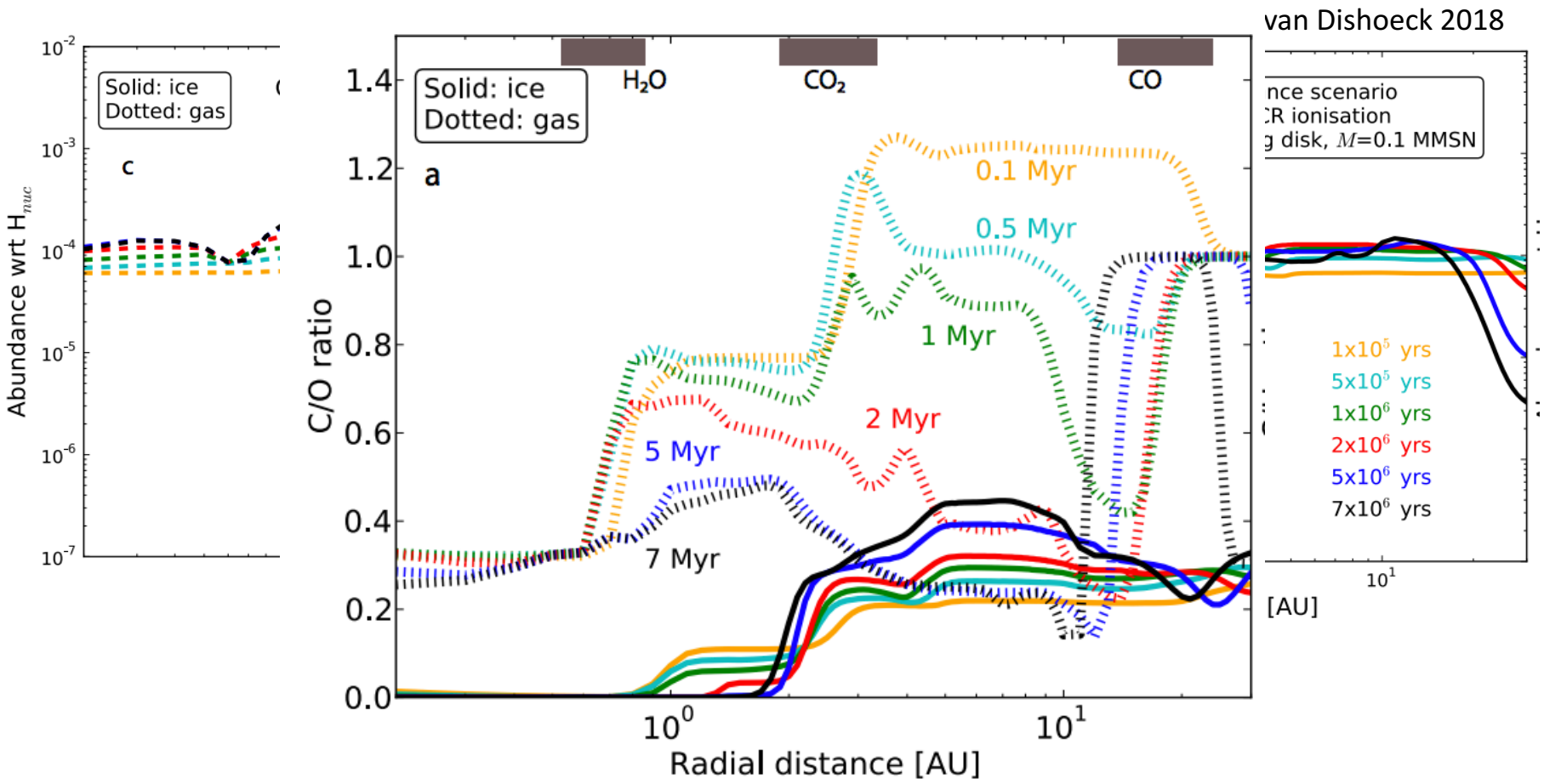
Context



- We would like to establish a link between planetary atmospheres and chemical make-up at formation time (disk & core formation)
- Plenty of molecular species are observed in the protostellar cores ISM (less in disks)
- What is their predicted power in terms of disk radial distribution ?
- Do they have features in the ARIEL spectral range?
- Provide input radial abundances for planetary migration models and identify the interesting features in ARIEL's range with potential for planet formation.

Turrini+ 2018

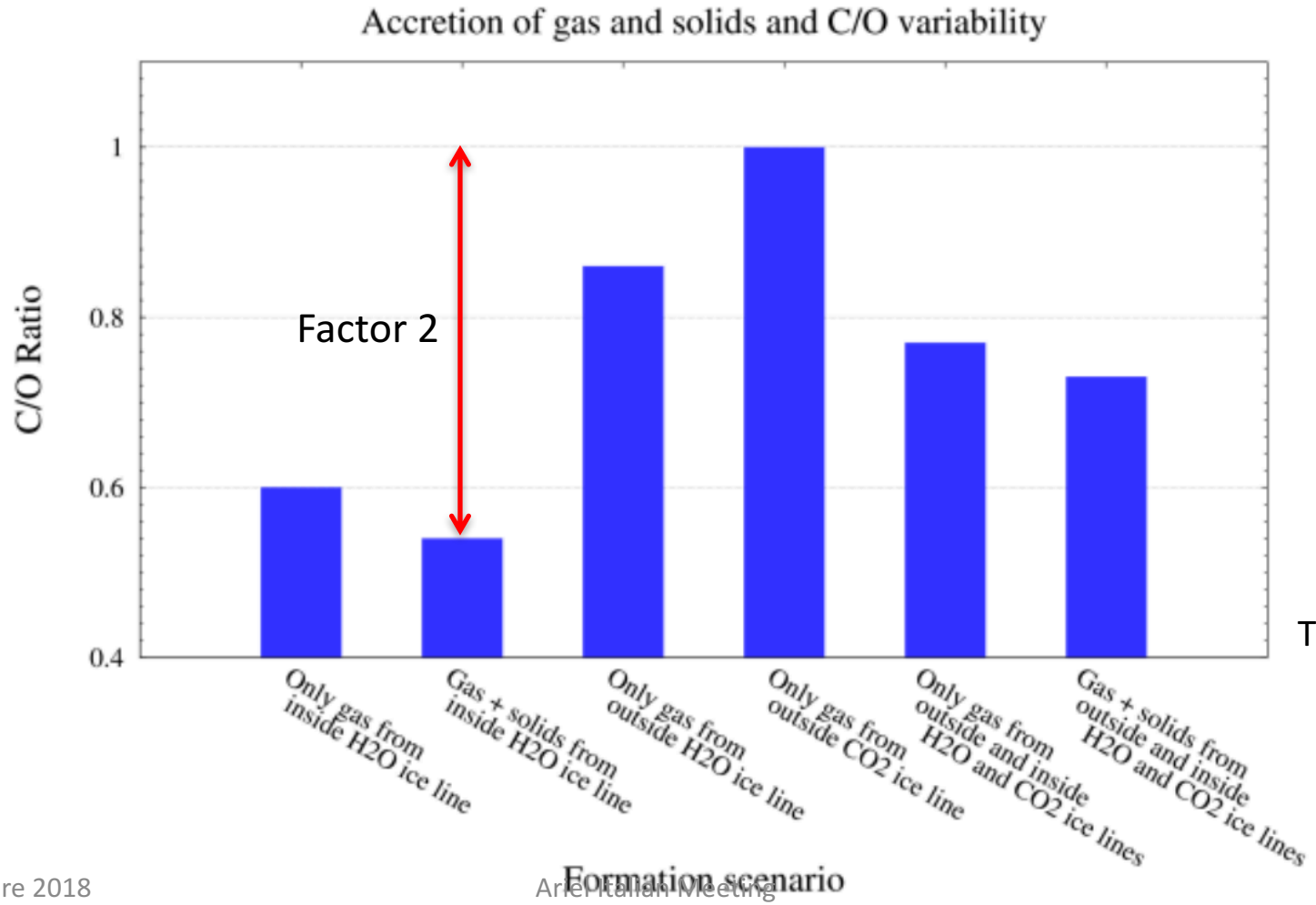
Carbon & Oxygen in disks



Factor of a few at most can be traced in gas (and much less in ices) below 10AU

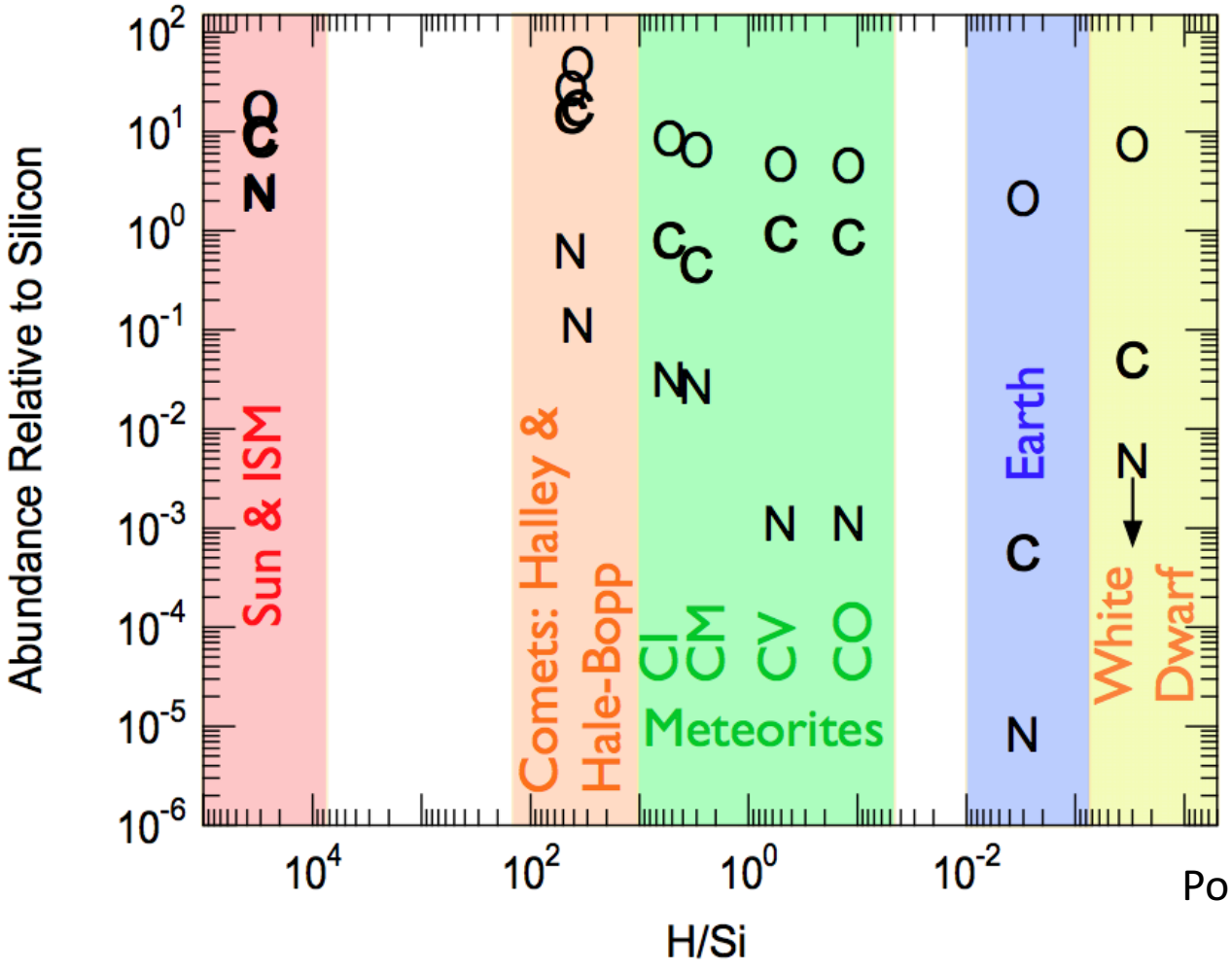
Carbon & Oxygen in planets

Limited dynamical range in C/O ratio to distinguish between radically different scenarios?



Turrini+ 2018

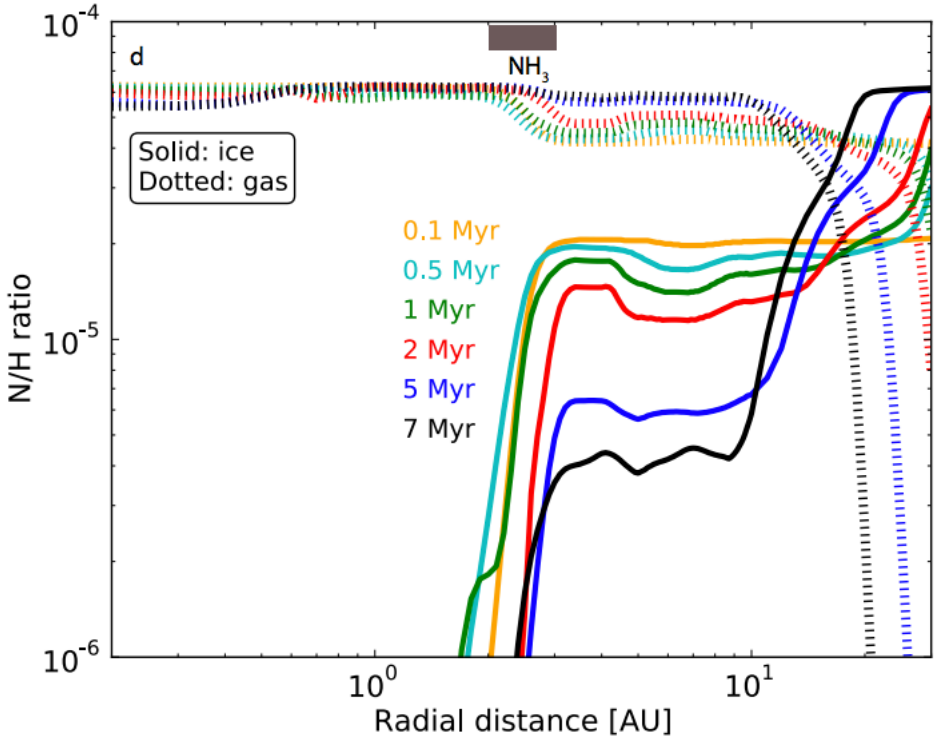
Alternatives

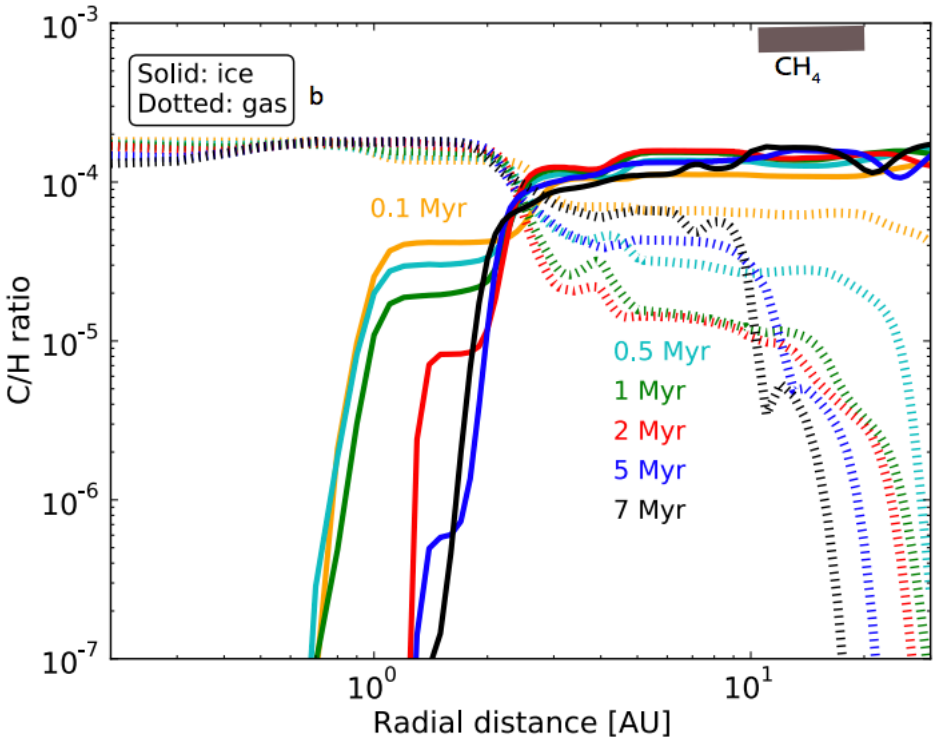


Pontoppidan+ 2014

Nitrogen, Sulphur, ... ?

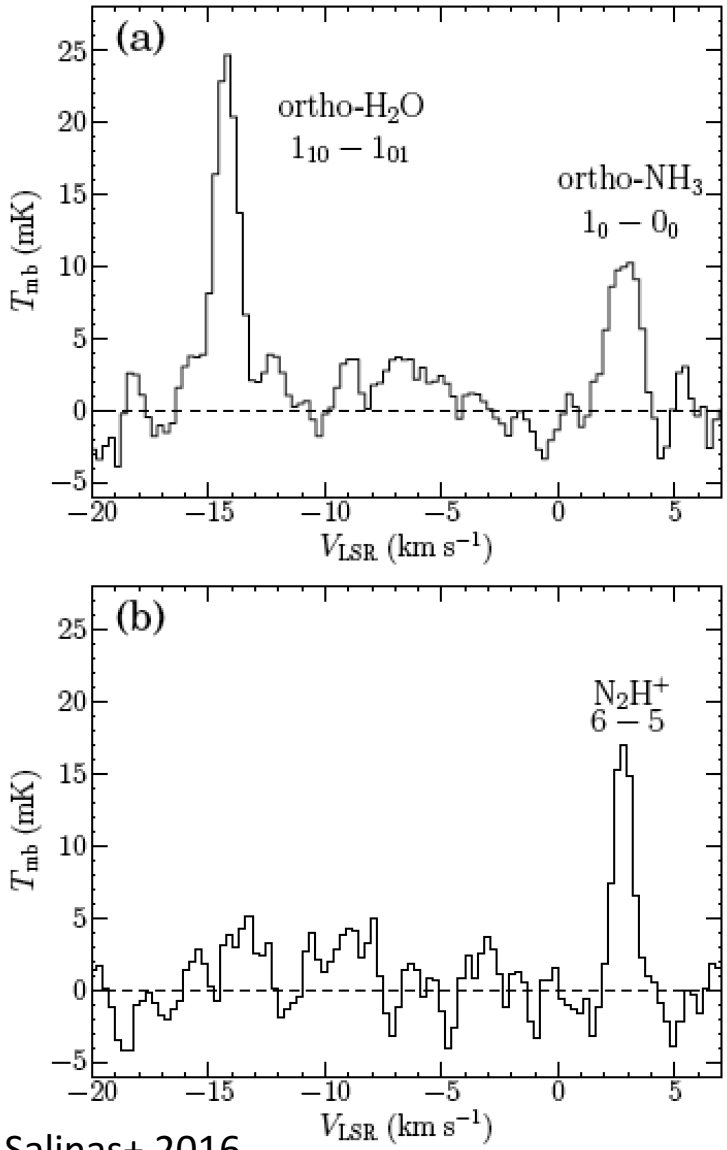
Nitrogen





Large dynamical range in C/N ratio both in gas and ices can be traced to tens of AUs as a function of time

N-bearing tracers



Salinas+ 2016

NH_3, N_2H^+, HCN, CN are routinely observed in protostellar cores

AND also in protostellar disks: TW Hydrae with Herschel/HIFI (Far-IR)

N-bearing species detection in the radio toward protoplanetary disks is a driving requirement for the

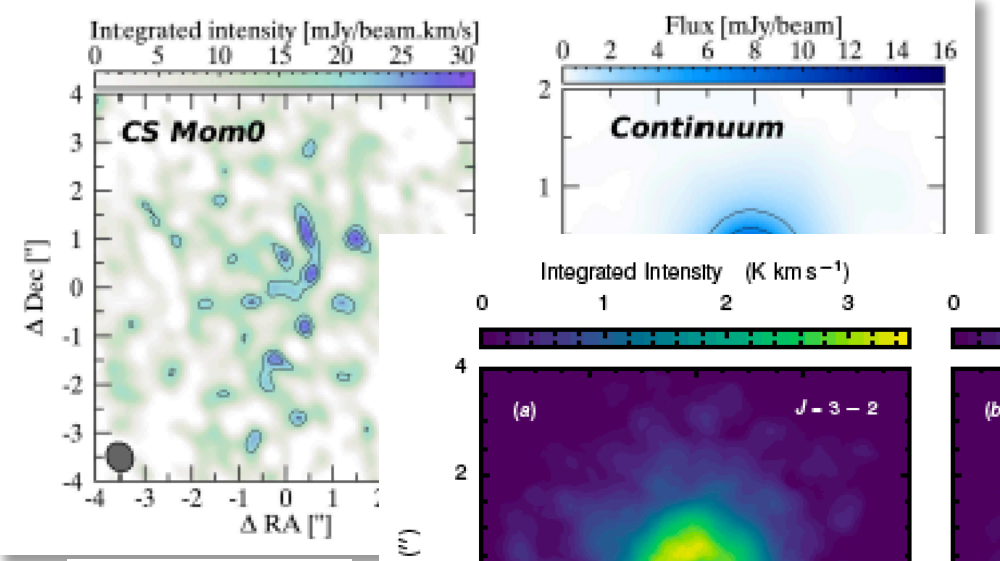
ngVLA

(early science 2028)

Any chance for S-bearing ?

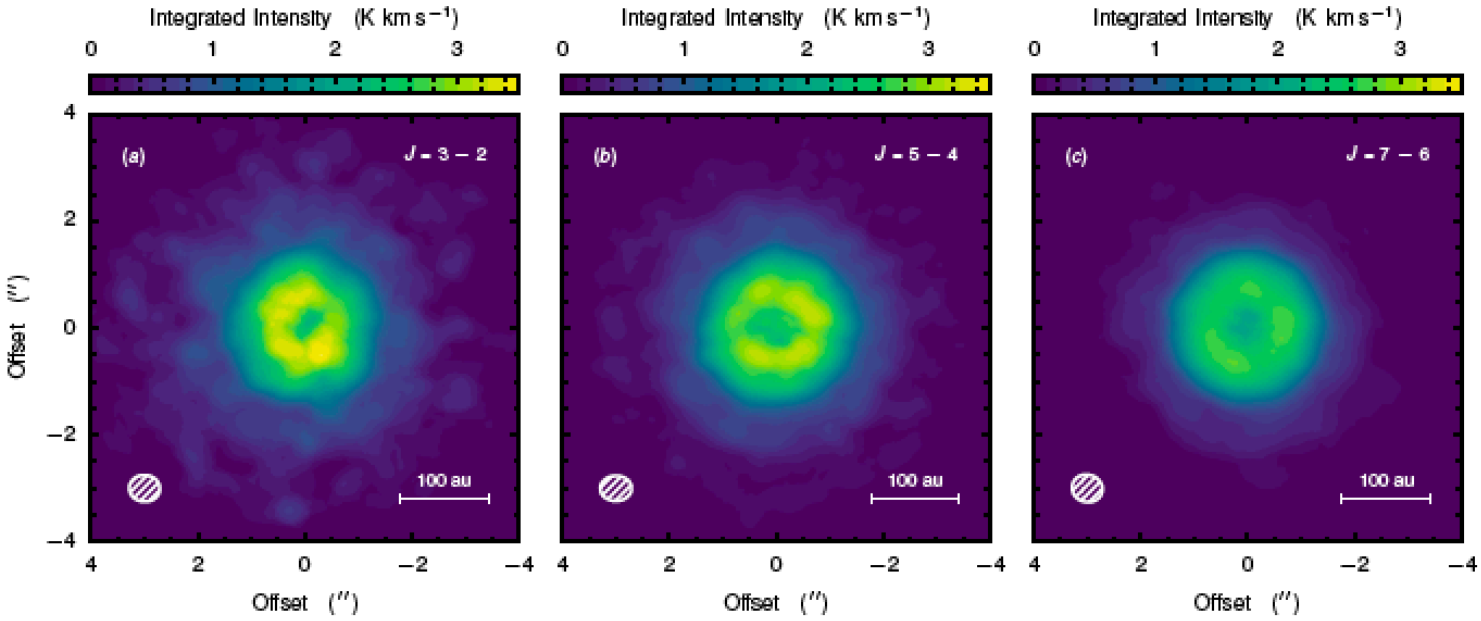
CS is routinely observed in protostellar cores, and now also in disks with ALMA!

DM Tau



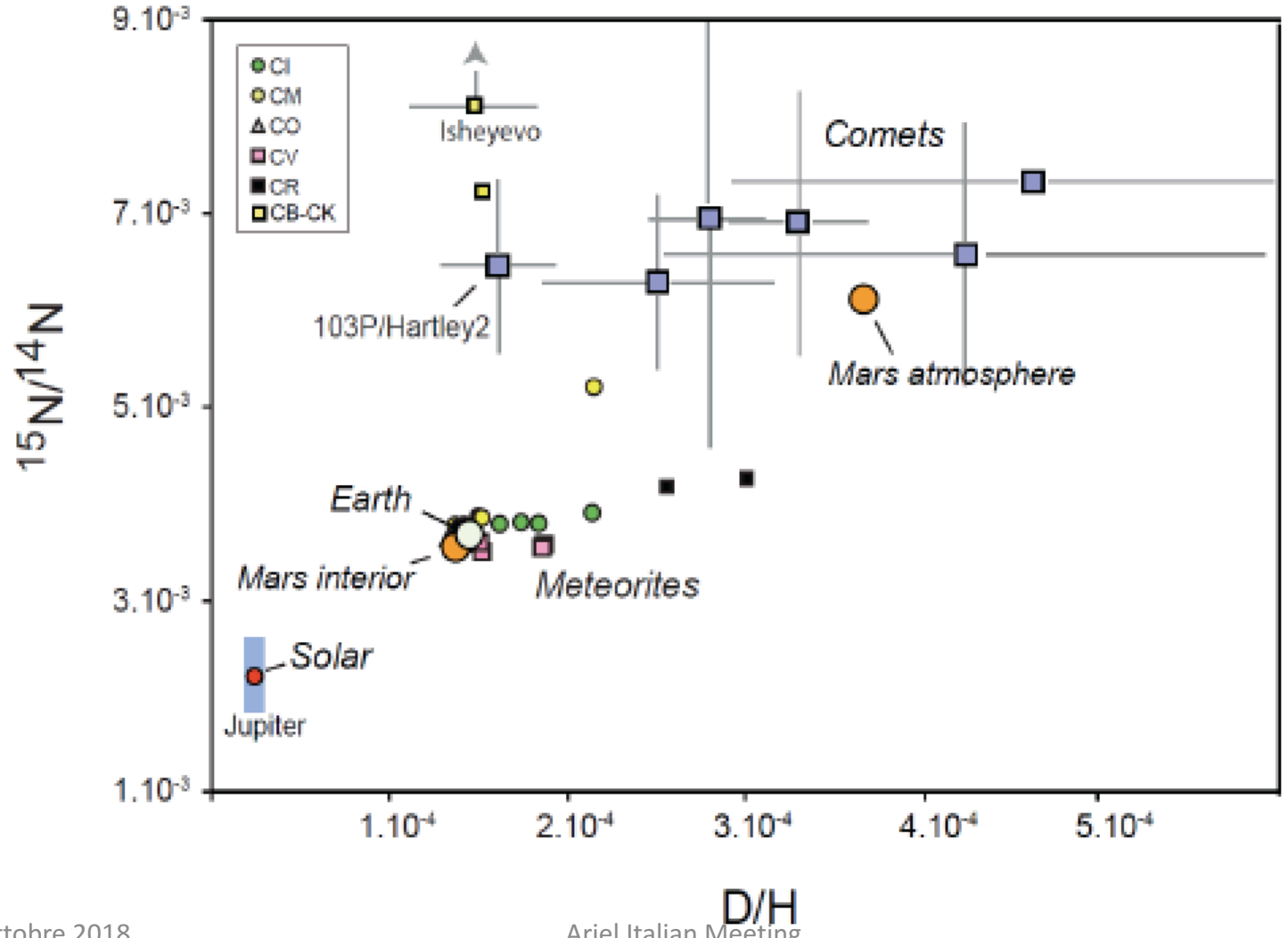
Semenov+ 2018

TW Hydrae



Teague+ 2018

Isotope ratios: a long shot ?



Short term plan (phase B1)

- Inventory of species detected till now toward protoplanetary disks
- Inventory of chemistry models with evolving disks to identify promising species with predictive power X/H=f(r, t) → extension to **N**, **S** and others
- Search for corresponding features in ARIEL's range
- Define possible input conditions for planetary formation models and run migration models to predict what we could see with ARIEL
- Help define science requirements for the mission