Deuterium fractionation tracing the evolution of IRDC cores

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Survey Introduction

- A number of great work on **deuteruim fractionation in IRDCs** is done already (e.g. Fontani et al. 2006, 2011, Chen et al. 2011, Miettinen et al. 2011, c.f. Matías Lackington's talk)

- We present a survey of **44 IRDC cores** across **10 clouds**
  - initially from Rathborne et al. (2006)
  - With ammonia temperature from Sakai et al. (2008):
    - **Nearby** (< 4.5 kpc)
    - **Massive** (> 100 $M_{\odot}$)
  - + three clouds from Rygl et. at (2010)
  - builds upon previous work (Chen et al. 2010, 2011)

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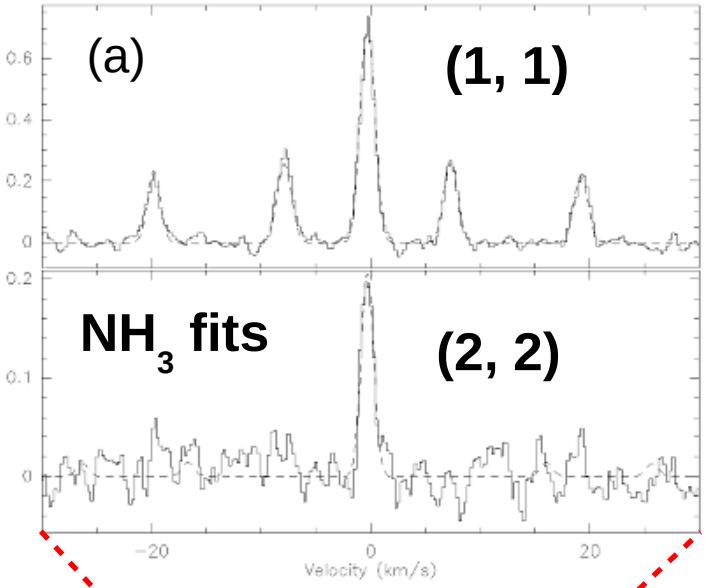
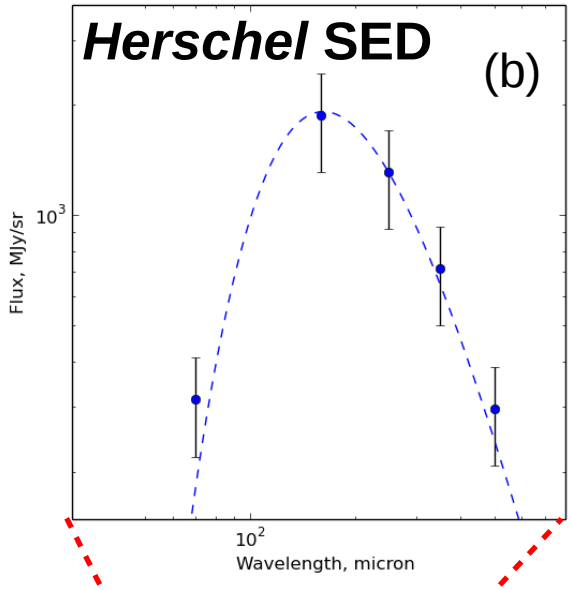
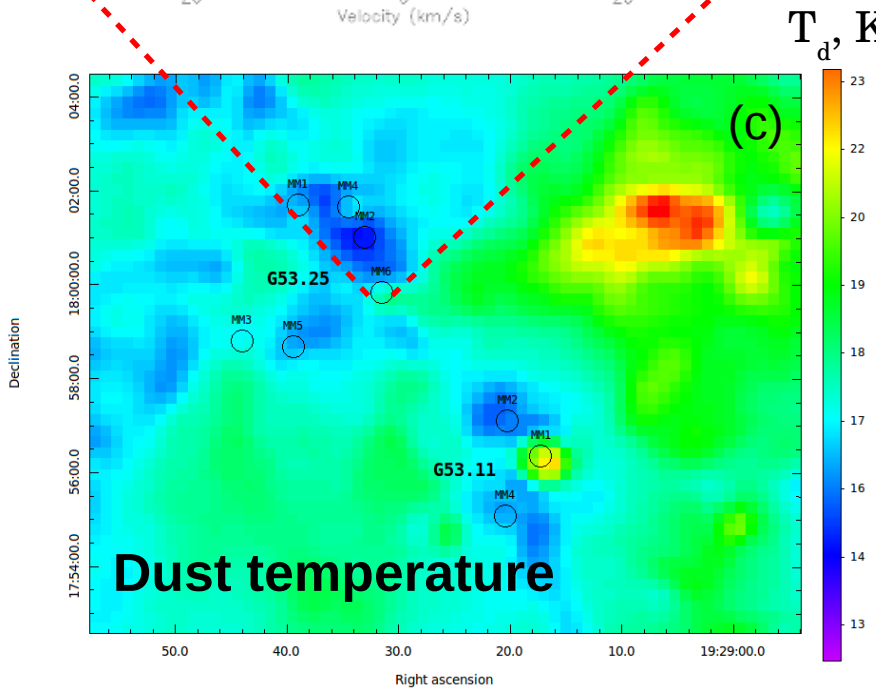
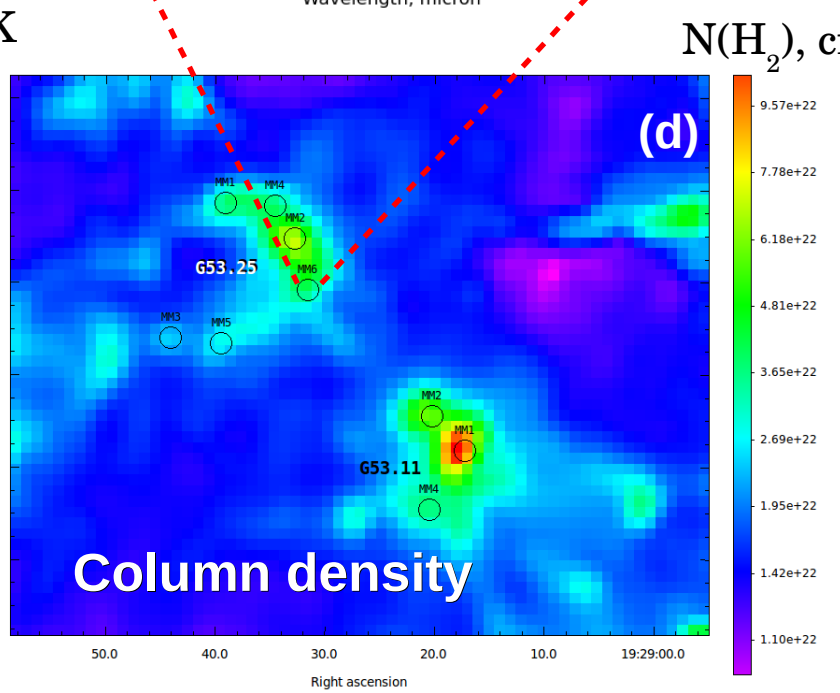
- **Observations** towards the cores:
  - **N_2H^+, N_2D^+**, $C^{18}O$ **(3-2)** with 10m SMT
  - Rygl et al. (2010) clouds with Nobeyama 45m in ammonia
  - *Herschel* archival data

Data analysis

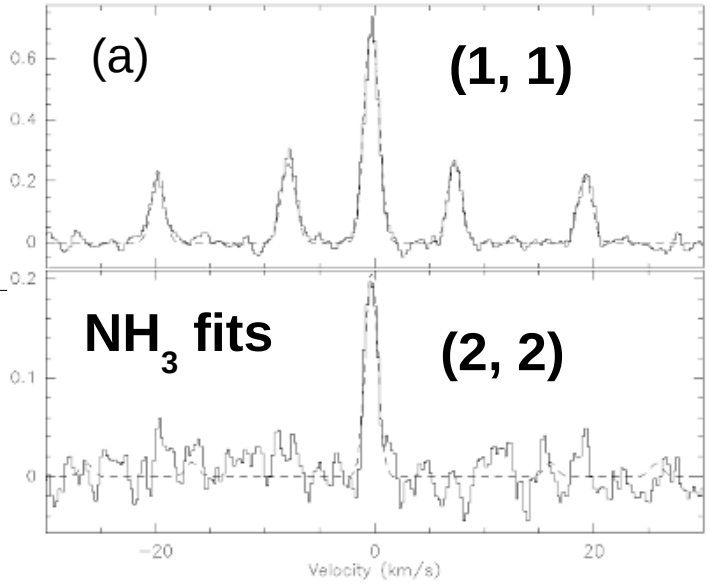


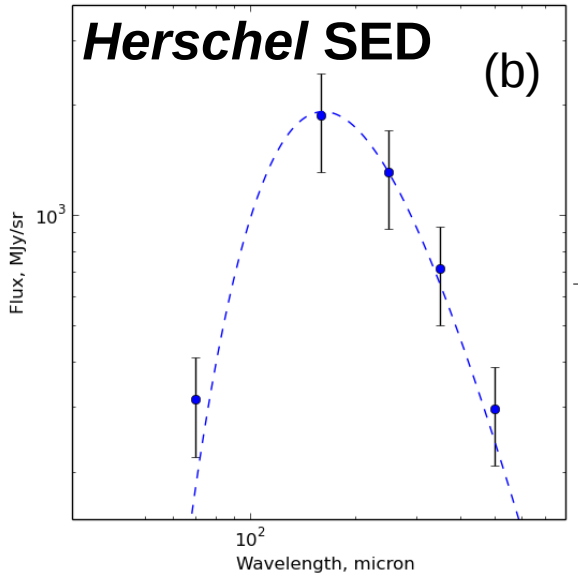






Data analysis (cont.)





- Ammonia rotational temperatures
- Deuterium fractionation
- N_2H^+ (3-2) line width

- LoS-averaged dust
- temperatures,
- Column densities,
- Luminosities

Data analysis (cont.)

Caveats

Different beam sizes of single dish data

Herschel analysis caveats:

- no background/foreground subtraction for Herschel maps
- different β in different IRDCs
- warm SED components contamination

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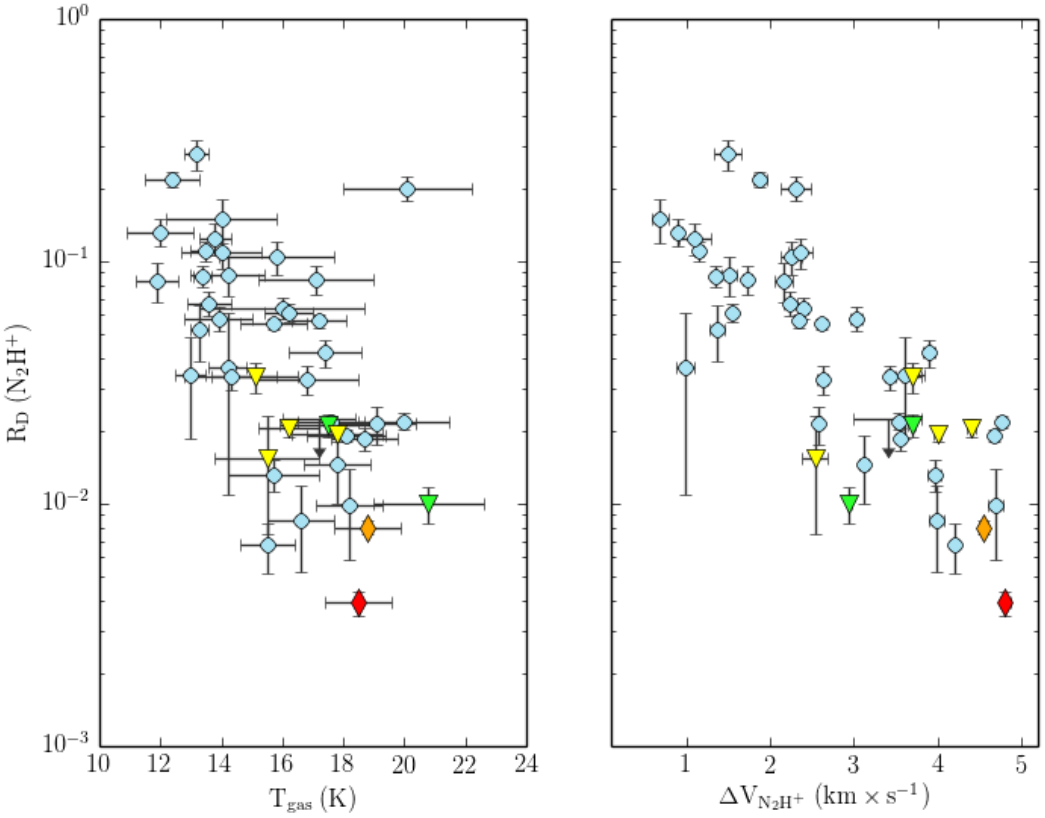
Bringing it all together...

Results

- **Orange**: UC HII region
- **Red**: HMC
- **Green**: HMPOs
- **Yellow**: HMSCs



- Clear decreasing trends in deuterium fractionation against gas temperatures and line widths

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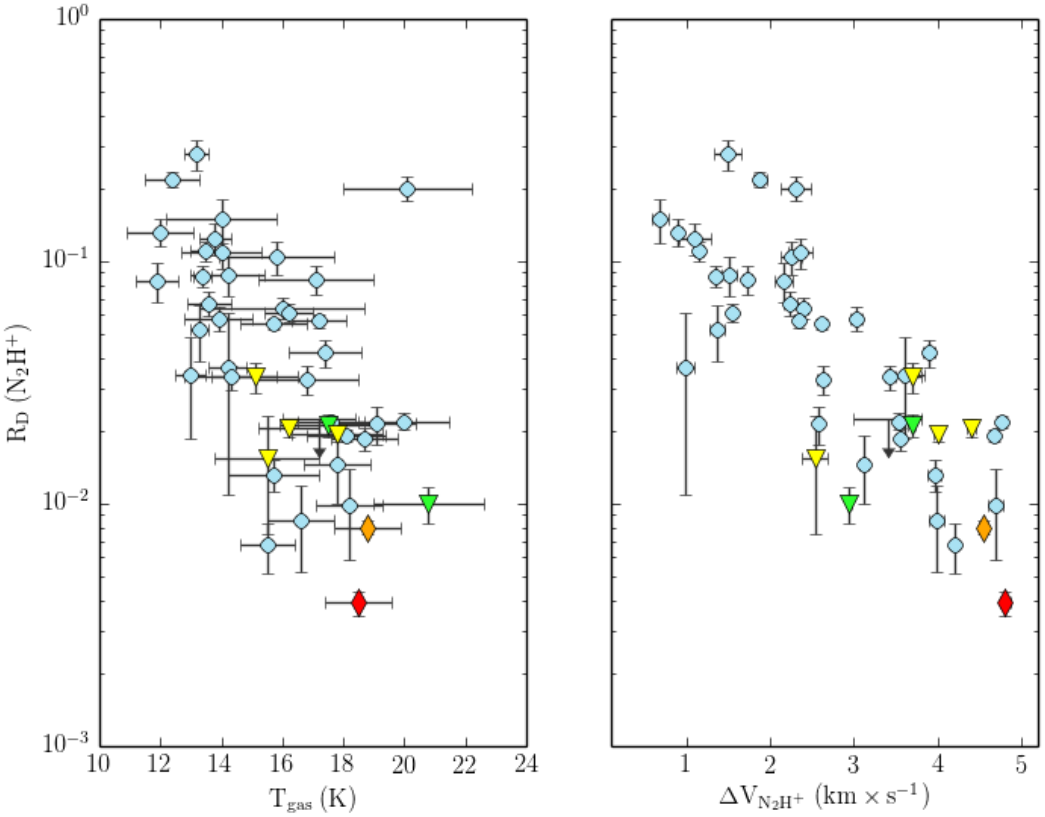

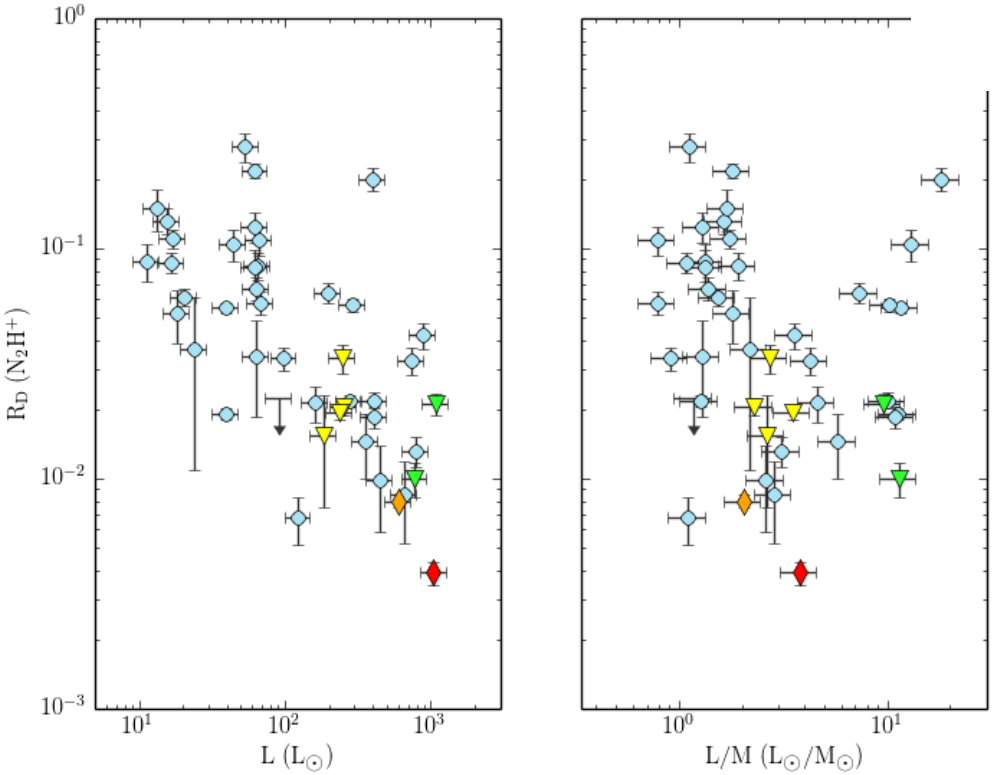

- Clear decreasing trends in deuterium fractionation against gas temperatures and line widths
- R_D traces an evolutionary sequence, as revealed by the *Herschel* data comparison
- Better insight in pinpointing the early IRDC core evolution