Jet Propulsion Laboratory
California Institute of Technology

Filaments and Dense Cores in Taurus Probed using the 100m GBT

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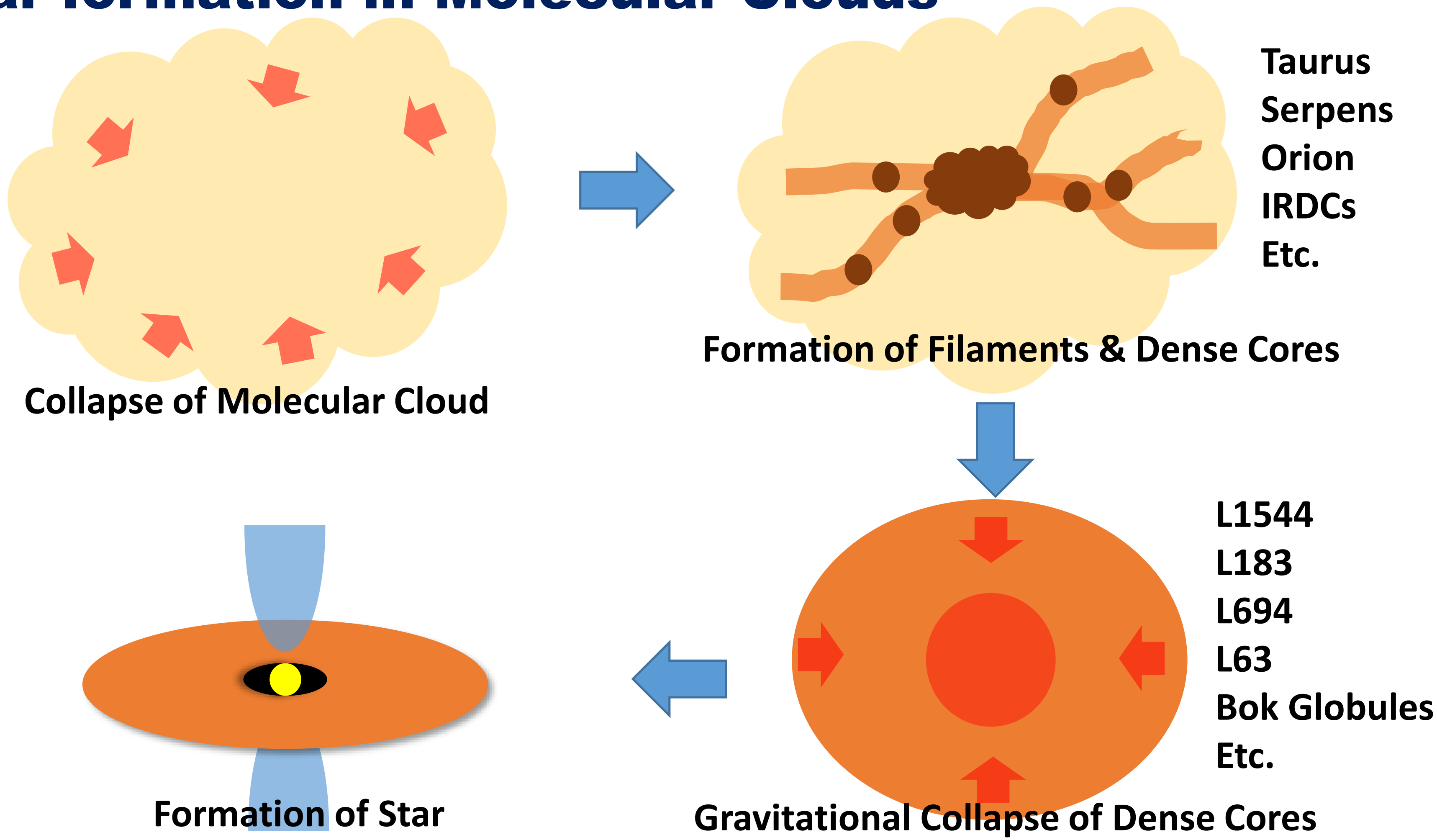
I. INTRODUCTION

Star formation in Molecular Clouds



- **A complete view of star formation processes from a molecular cloud to protostars is required.**

II. OBSERVATIONS

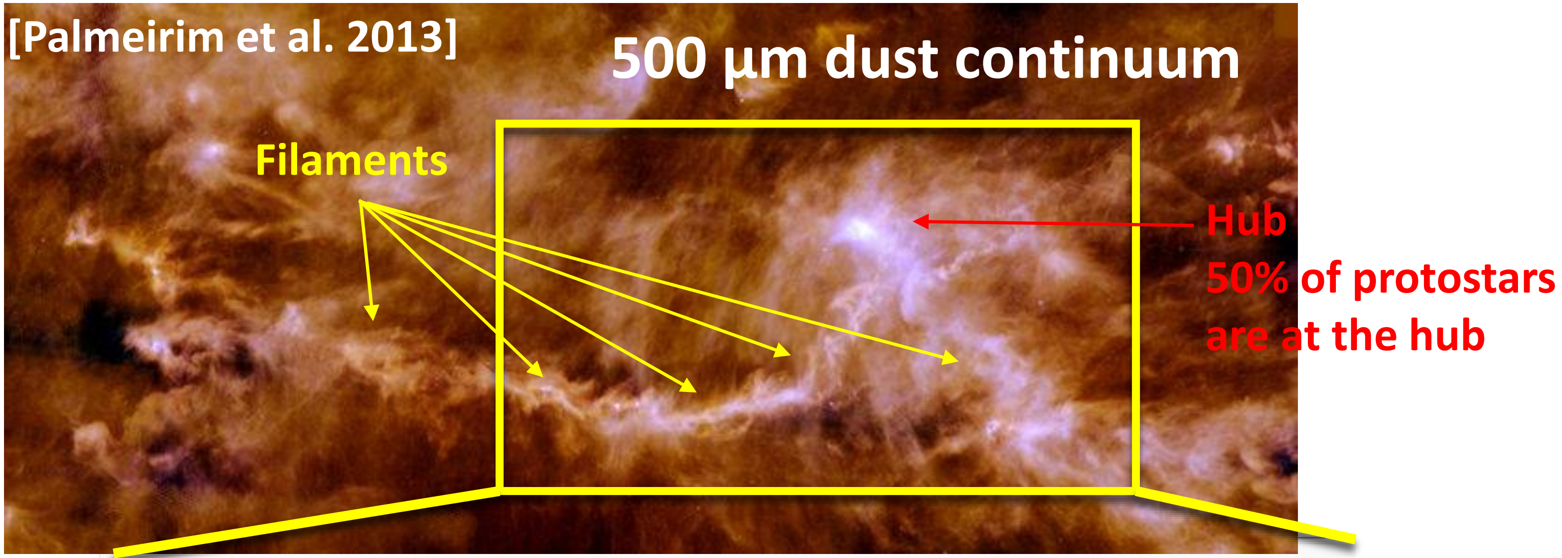
1. Probing Filaments and Dense Cores using KFPA

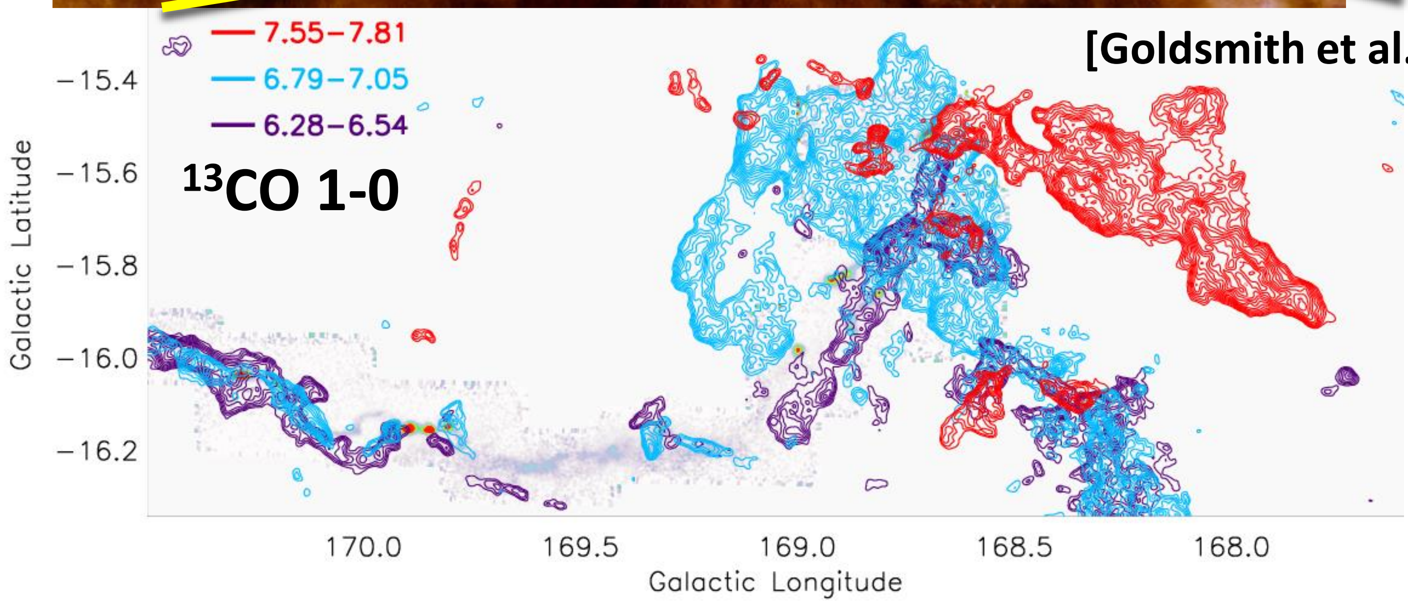
GBT KFPA (2012A, 2013A)
Dense Structure Survey in NH_3, CCS, HC_7N
Observation time: 90 hours
Median rms: 0.1 K
Lowest rms: 0.058 K

2. Probing Collapse & Fragmentation of Dense Cores using Argus

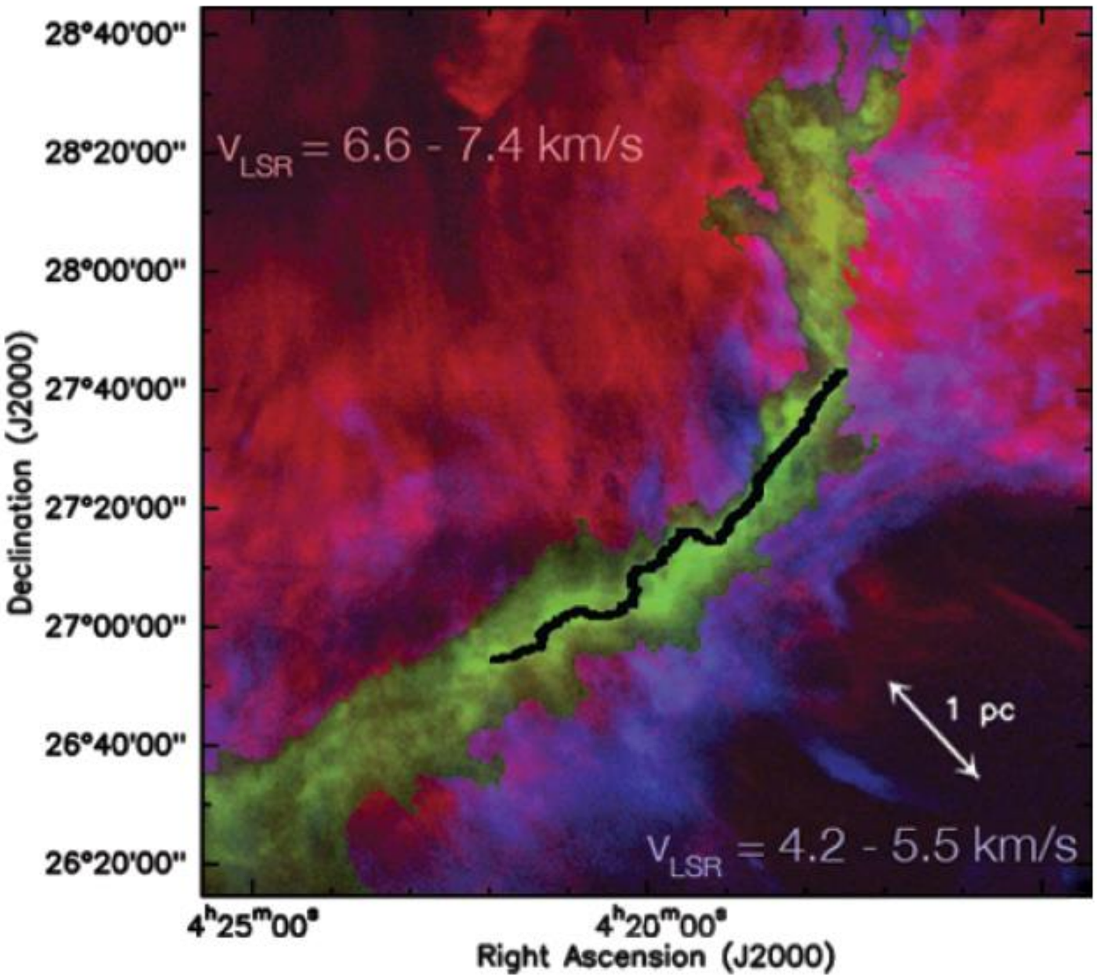
GBT Argus (2016B, 2017B)
Collapse & Fragmentation Survey in HCN & HCO^+ for infall survey, and N_2H^+ & NH_2D for fragmentation survey
Observation time: 10 hours out of 70 hours
Median rms: 0.15 K
Lowest rms: 0.08 K

Anatomy of L1495-B218 Filaments in Taurus





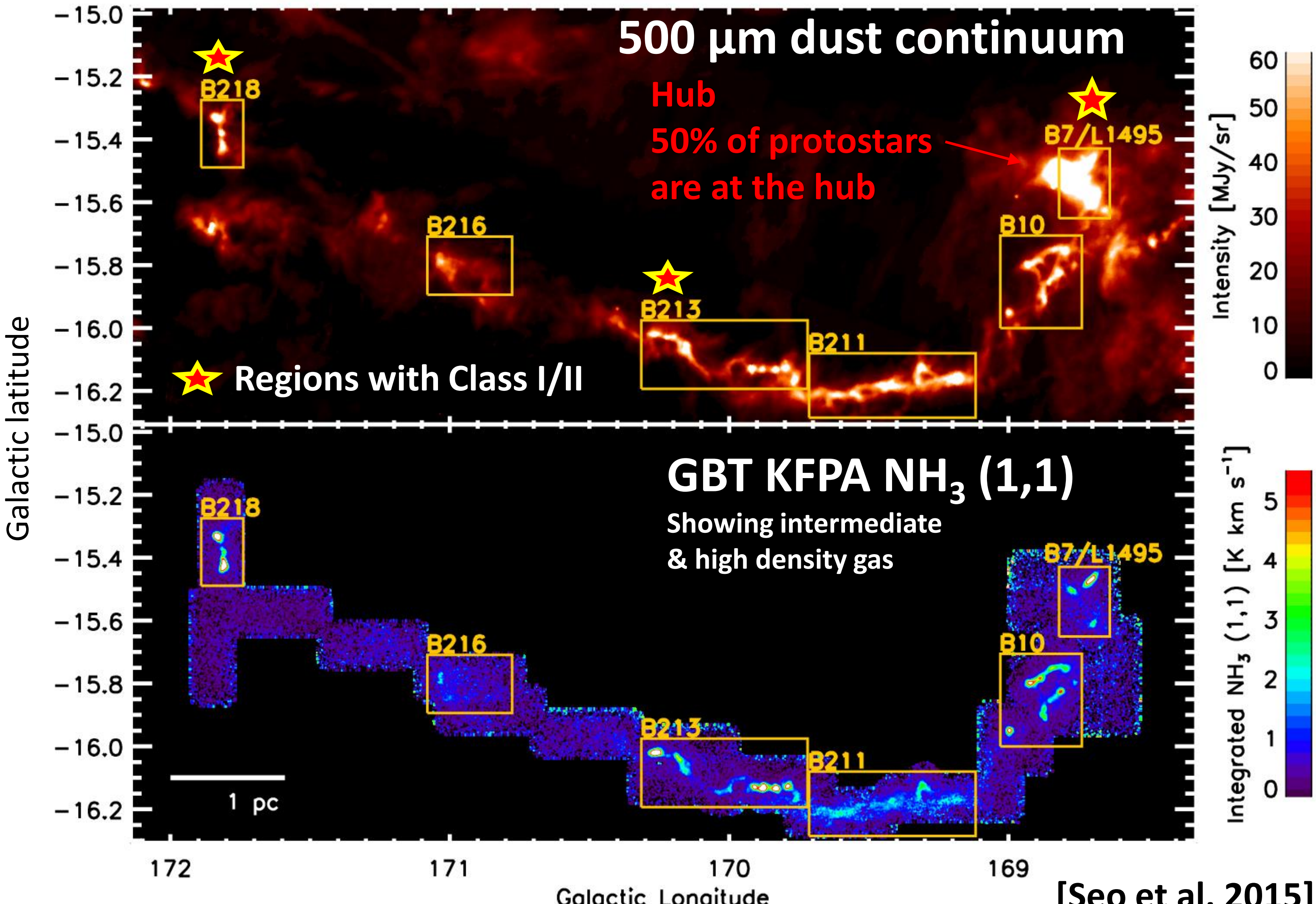
Anatomy of L1495-B218 Filaments in Taurus



Converging or shear flow
[Goldsmith et al. 2008, Narayanan et al. 2008]

III. DENSE STRUCTURES

Probing Filaments & Dense Cores KFPA: NH_3, CCS, HC_7N



[Seo et al. 2015]

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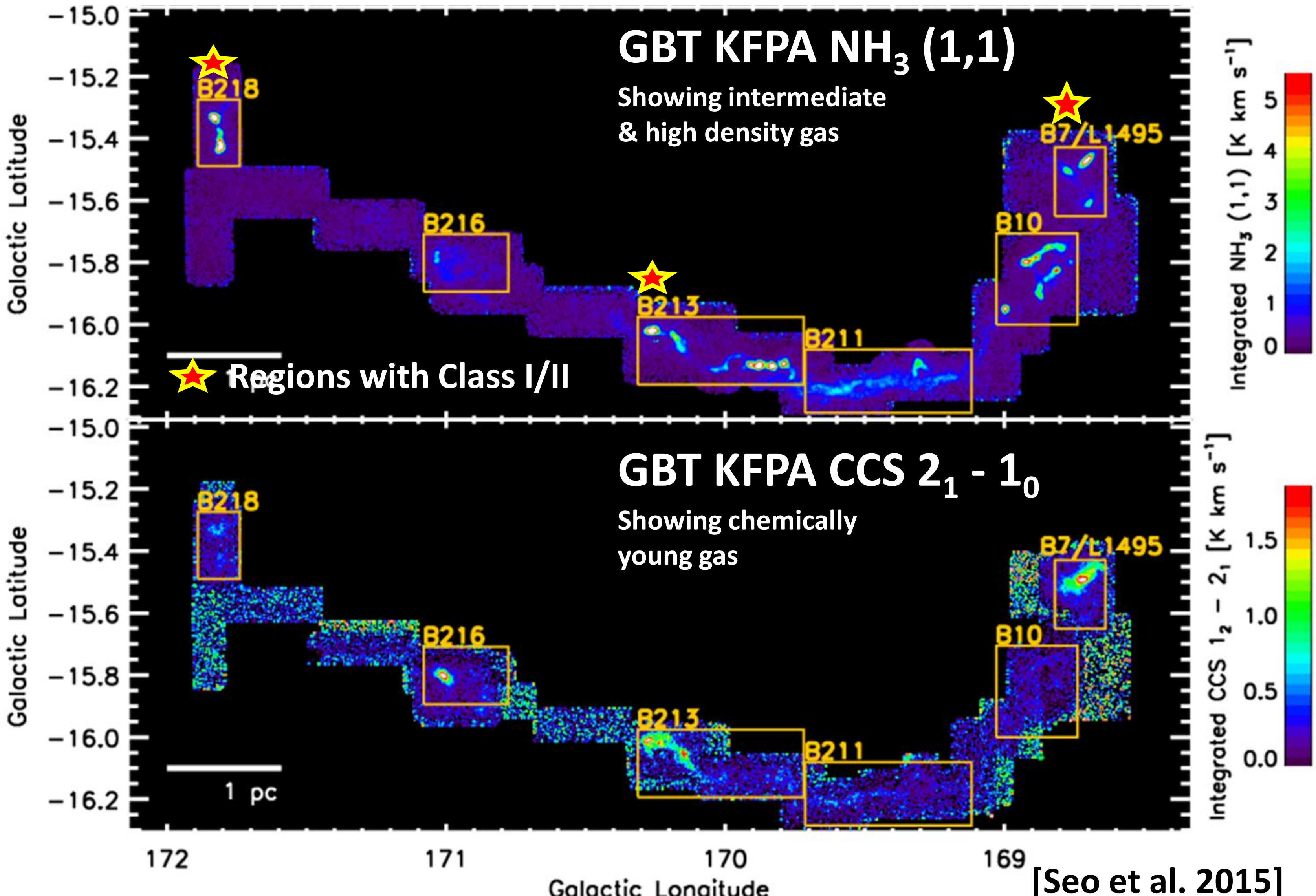
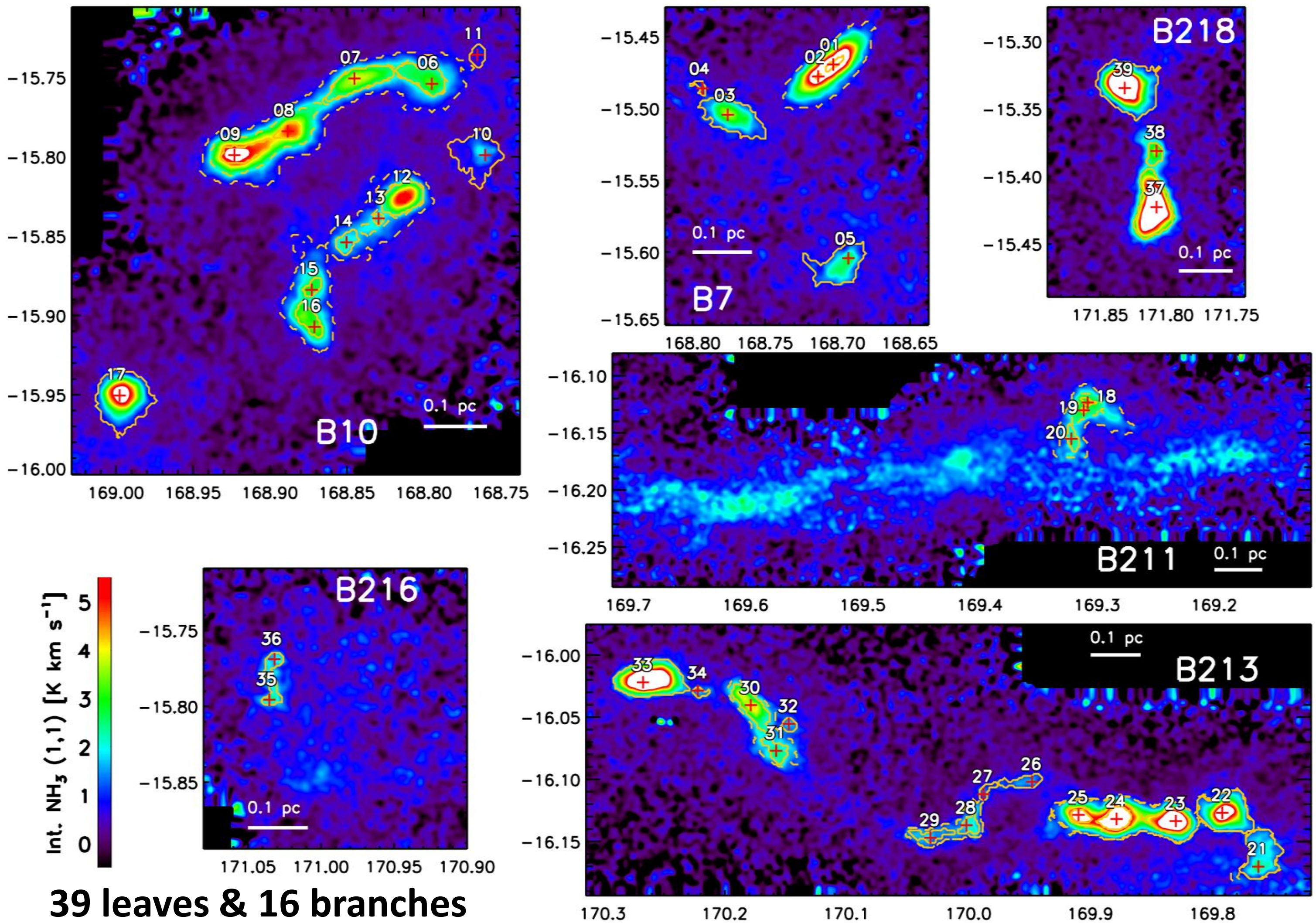
Probing Filaments & Dense Cores KFPA: NH_3, CCS, HC_7N



[Seo et al. 2015]

Dense Cores Identification

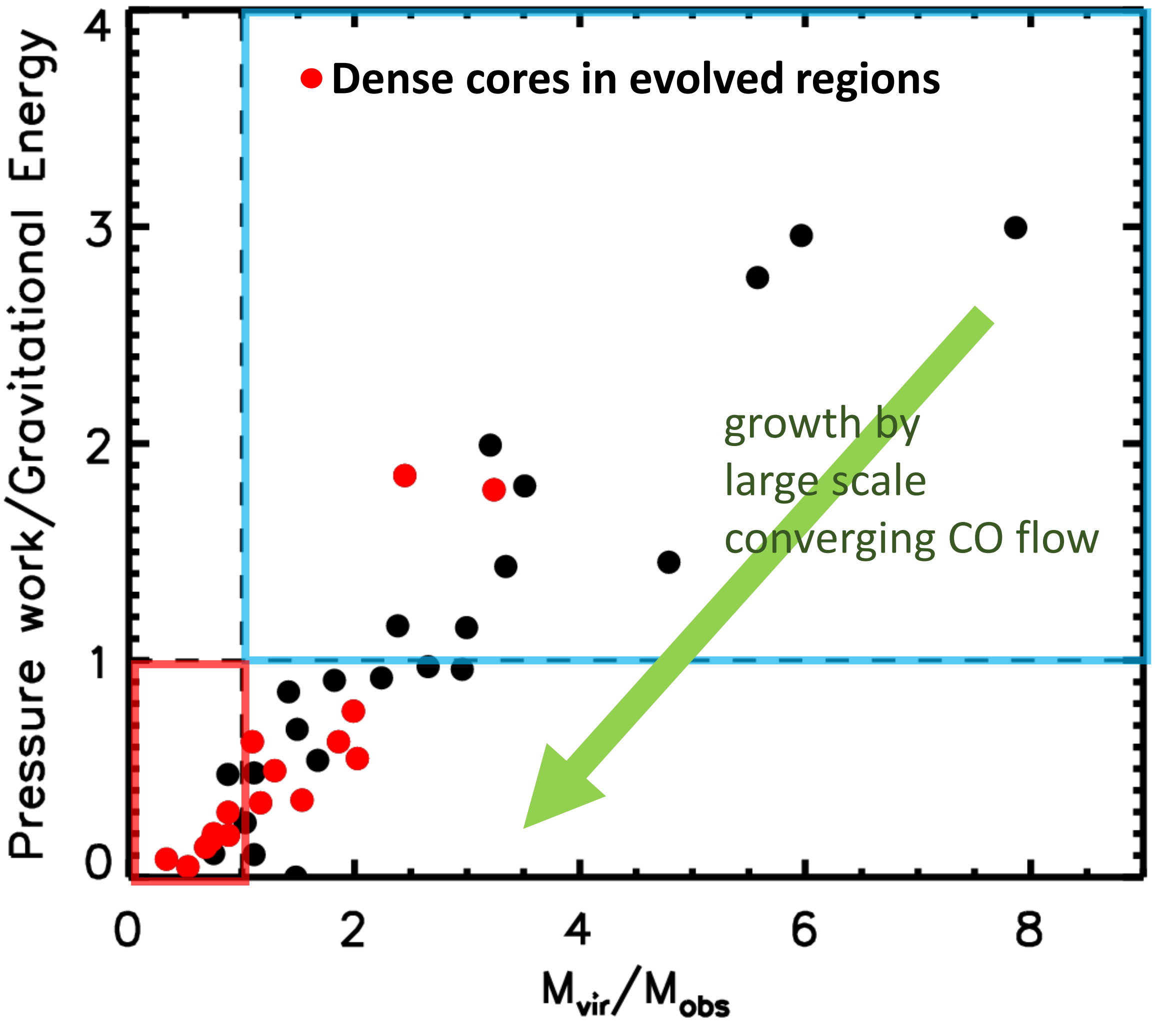
Identifying NH_3 structures using a dendrogram algorithm **[Seo et al. 2015]**



39 leaves & 16 branches

III. DENSE STRUCTURES

Physical Properties of Dense Cores



Only 9 out of 39 leaves are gravitationally bound

7 out of 9 gravitationally bound leaves are active

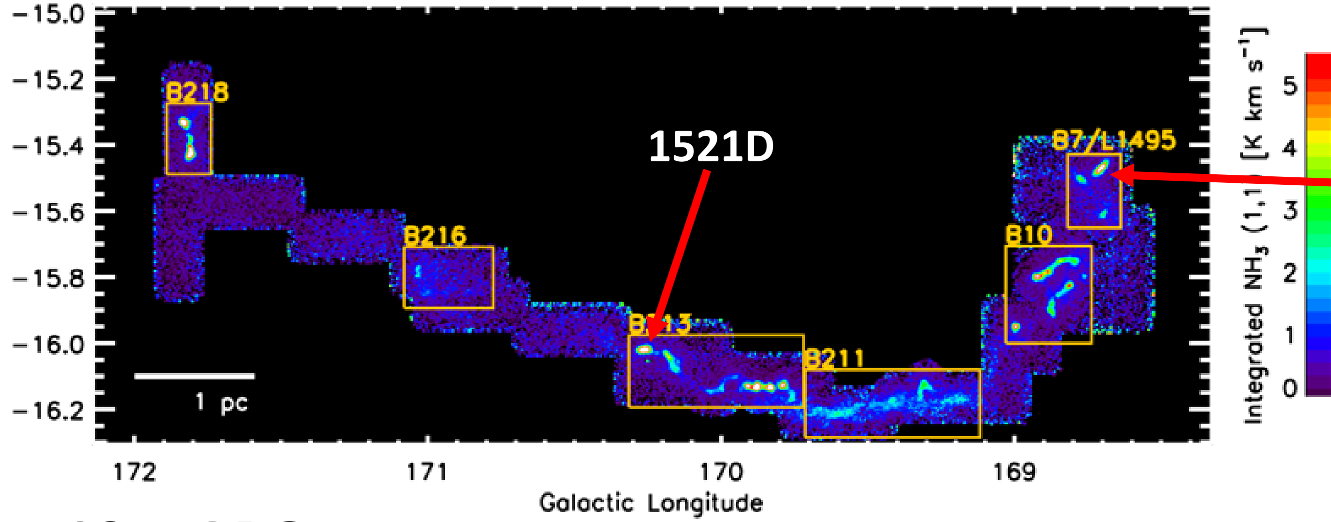
Pressure-confined

Gravitationally unstable

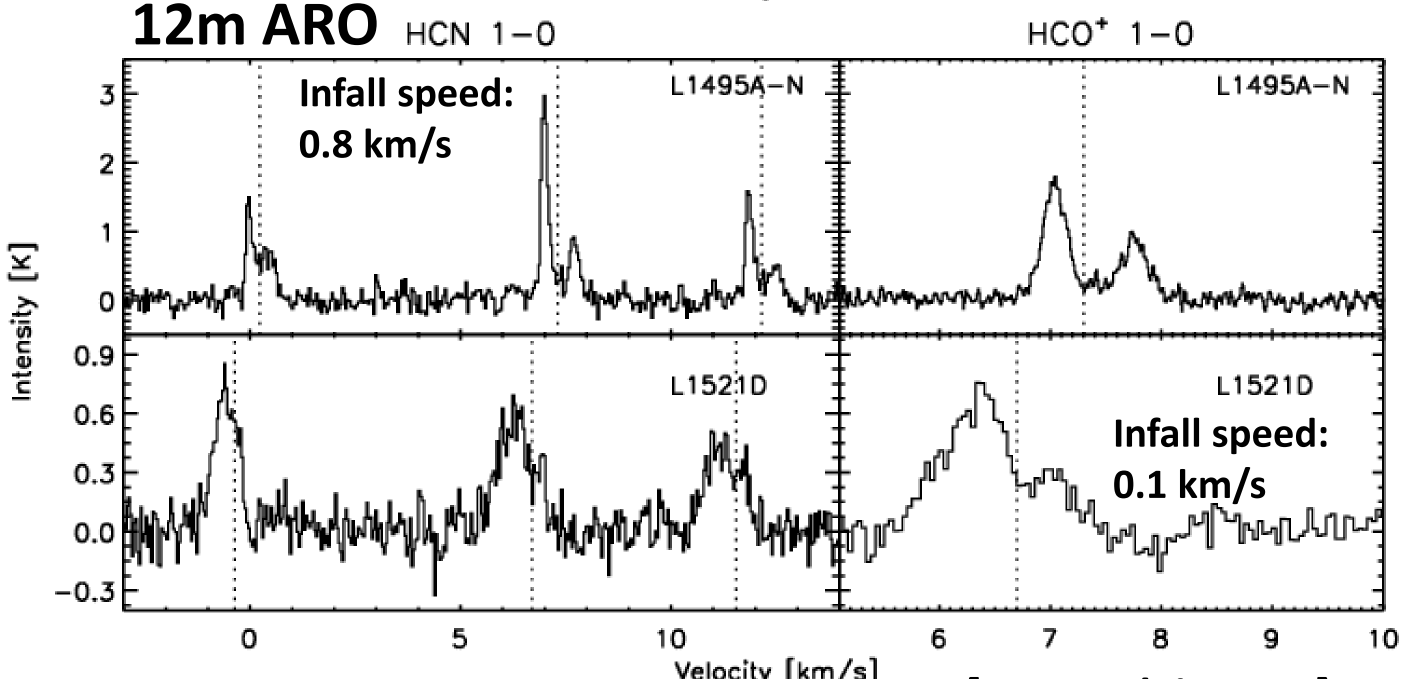
- Pressure confined structures: No gravitational fragmentation

- <u>Pressure-confined structure → gravitationally bound structure → Star formation</u>

IV. COLLAPSE & FRAGMENTATION



12m ARO

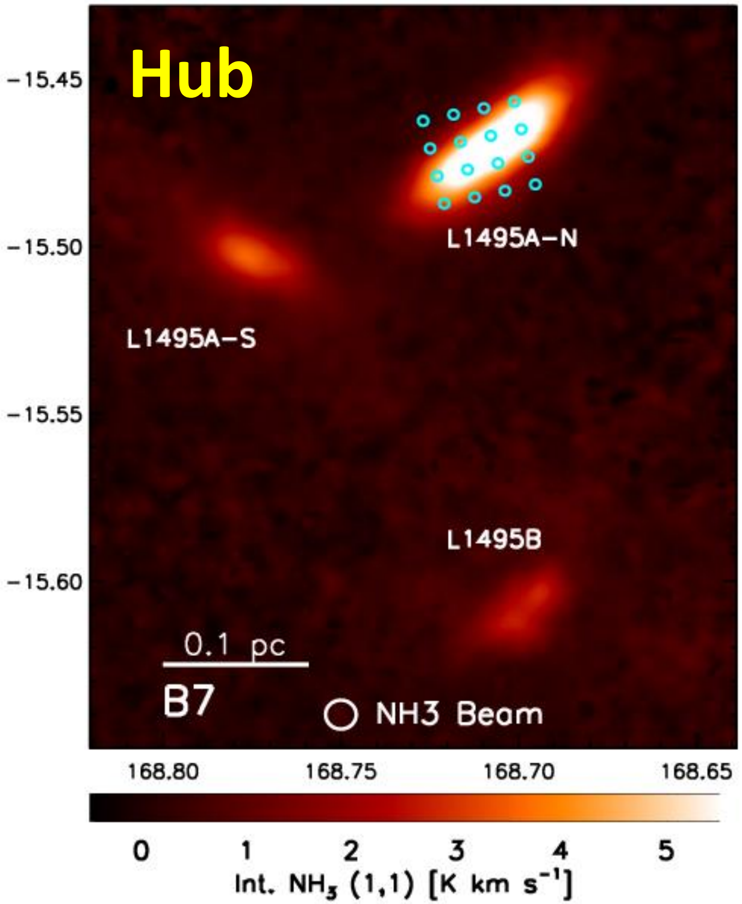


[Seo et al. in prep]

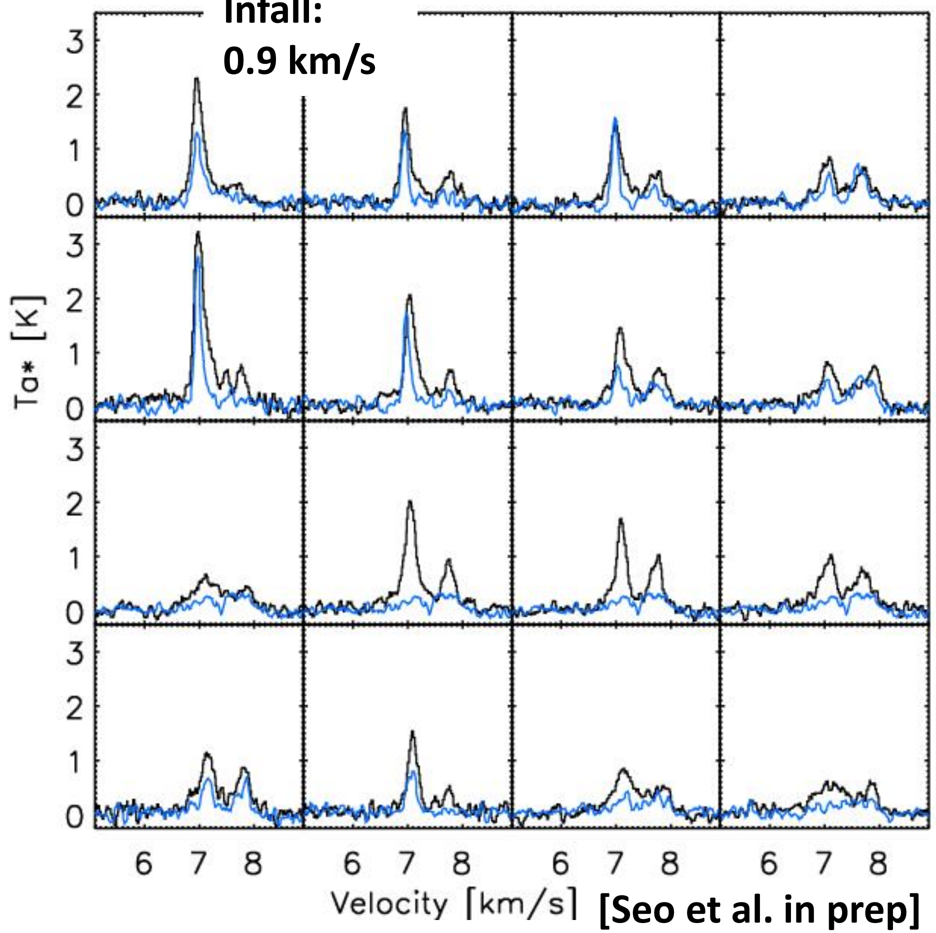
IV. COLLAPSE & FRAGMENTATION

Probing Filaments & Dense Cores using Argus

GBT Argus, HCN 1-0 and HCO^+ 1-0



Blue: HCN, Black: HCO+



[Seo et al. in prep]

- Highly asymmetric infall motion in L1495A-N from Argus mapping
- Unusually strong infall motion in L1495A-N

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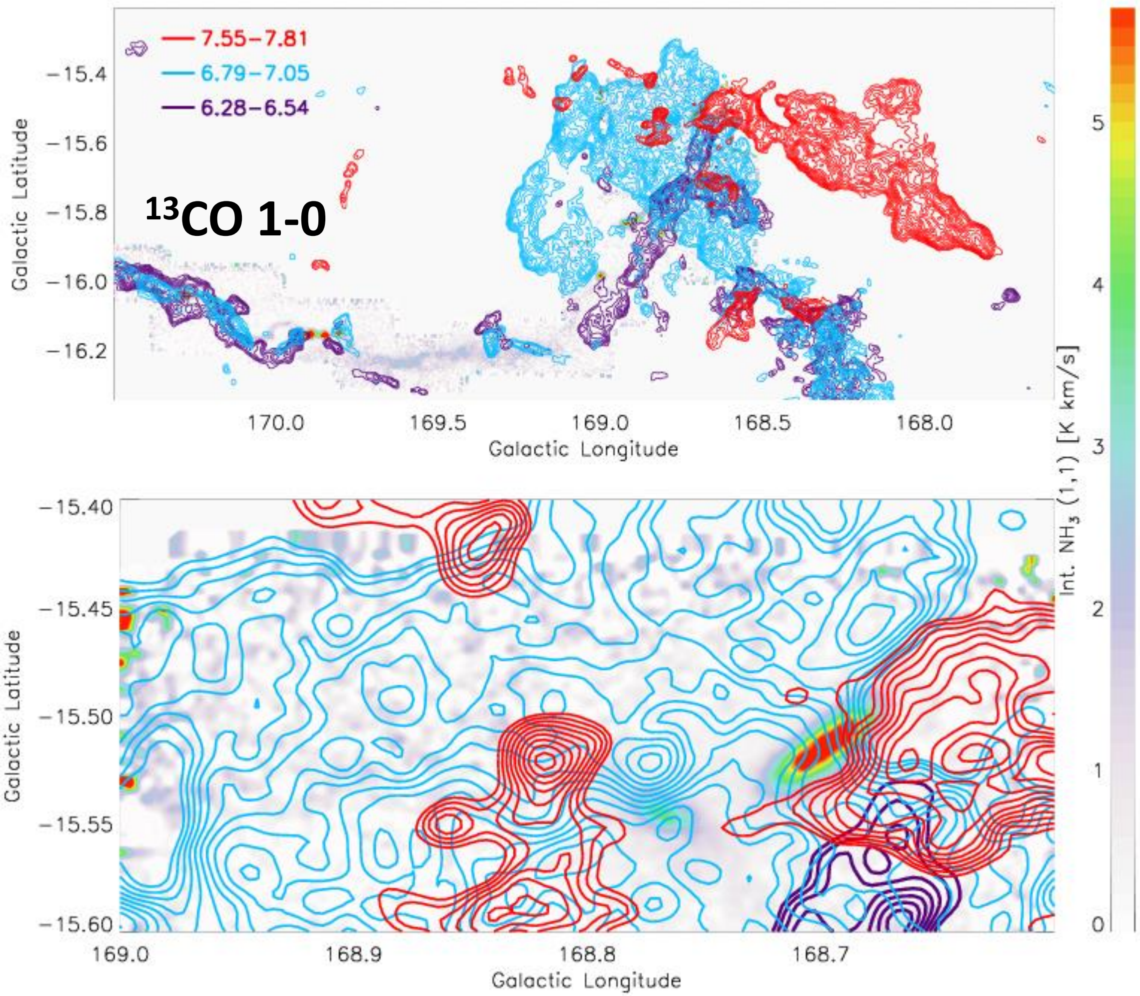


- Peak infall motion: >Mach 4

- The collapse predicted by similarity solutions: Mach 3.3 [Larson 1969, Penston 1969]

- Similar to shock-induced collapse [Gong & Ostriker 2009]

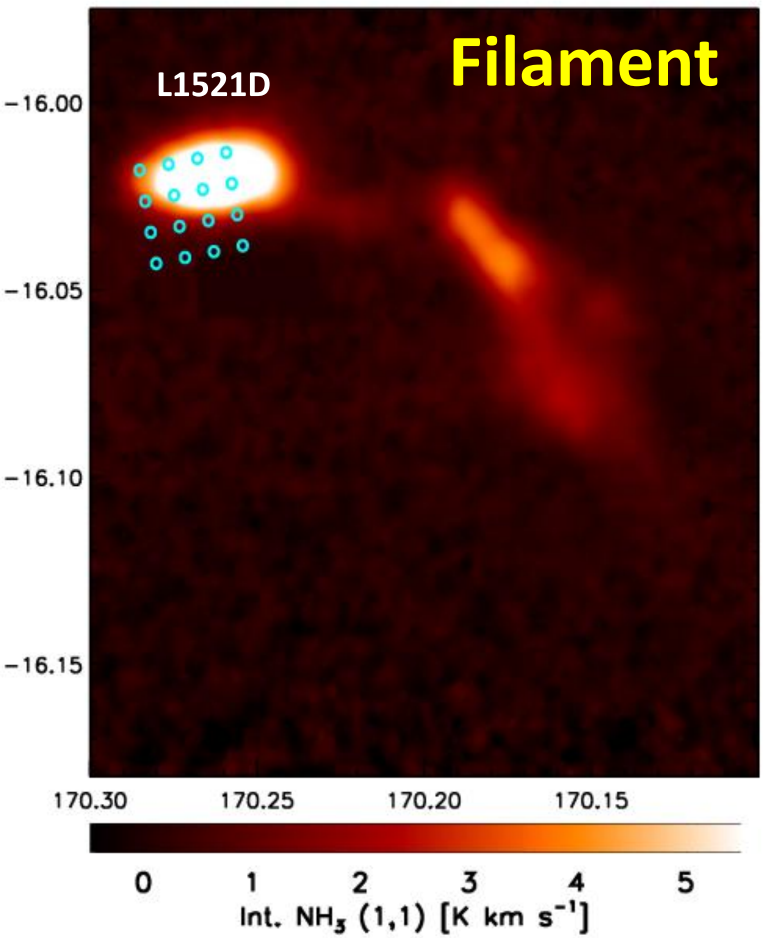
- L1495A-N may form and collapse by colliding flow.

- Collapse time expected to be significantly short (<0.5 Myr)

IV. COLLAPSE & FRAGMENTATION

Probing Filaments & Dense Cores using Argus

GBT Argus, HCN 1-0 and HCO^+ 1-0



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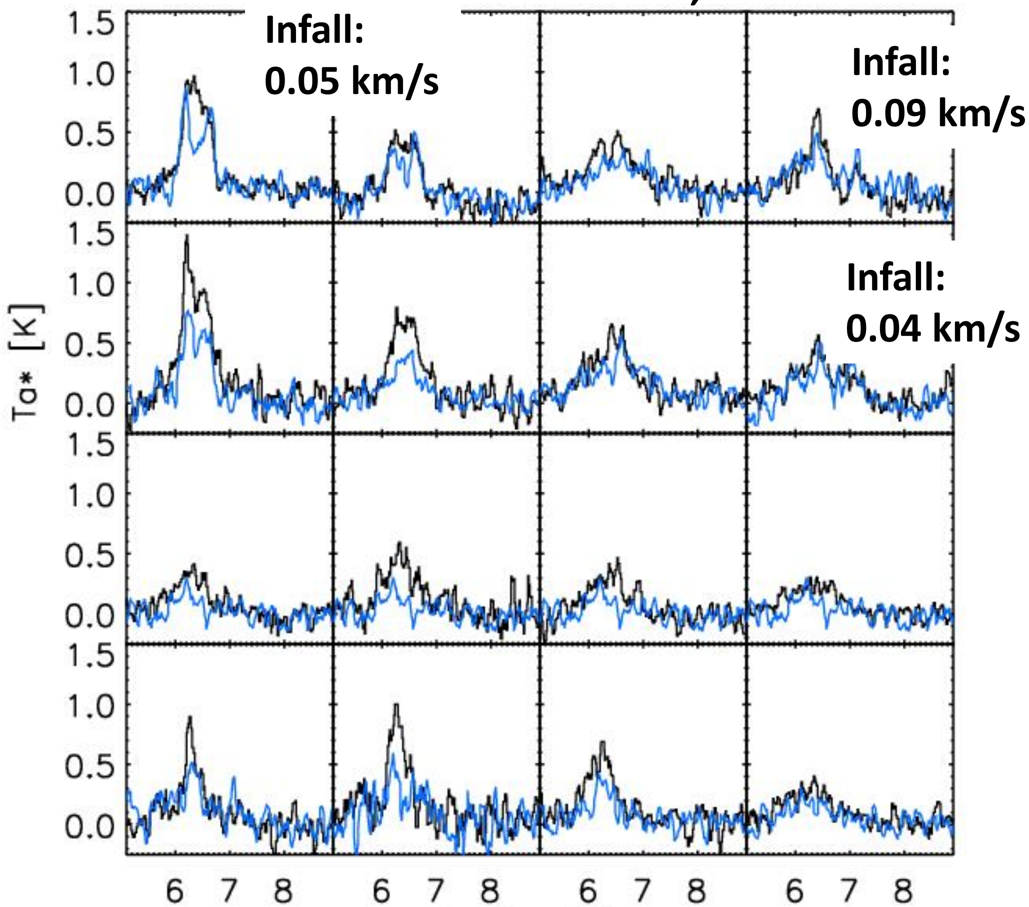


[Seo et al. in prep]

- L1521D is slowly collapsing at half the sound speed.

V. DISCUSSION & CONCLUSIONS

Two Modes of Star Formation

Overall: Pressure-confined structure → gravitationally bound structure → Star formation

In detail: two modes, Fast and Slow

[Seo et al. in prep]

Within filament(L1521D)

Slow star formation

by quasi-static gravitational collapse

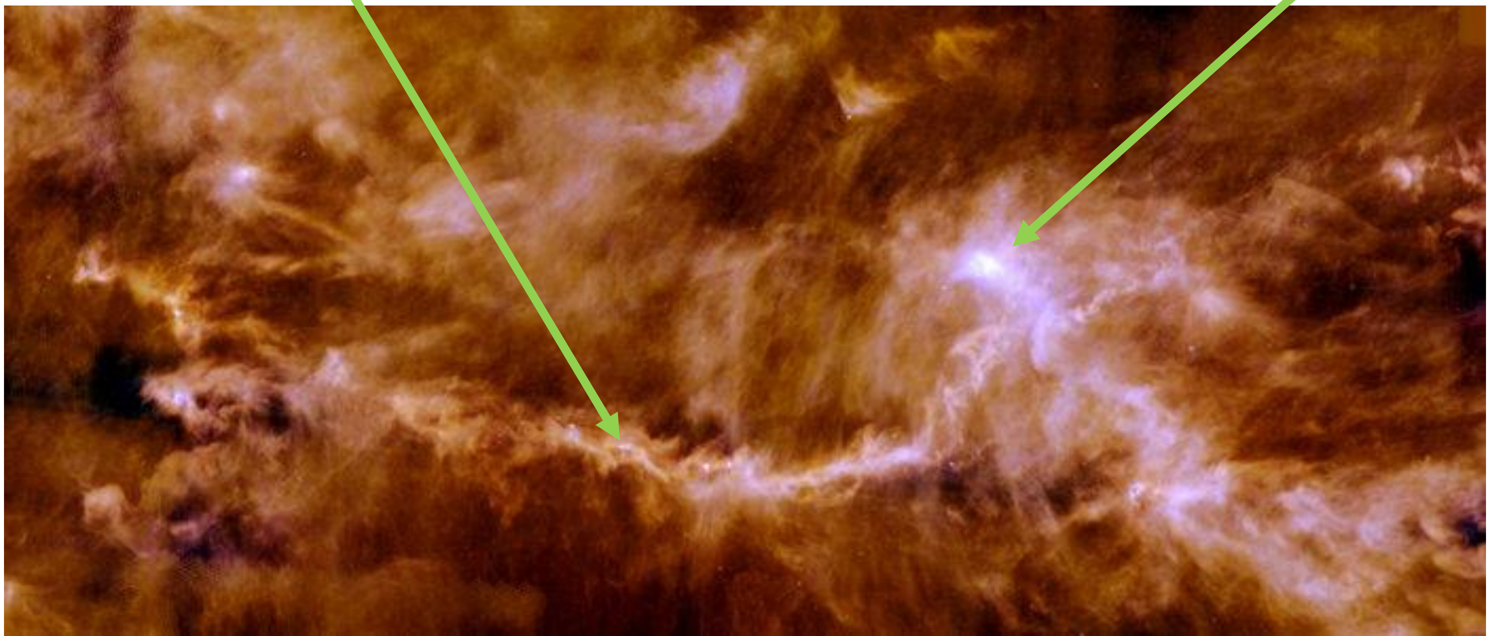
Isolated star formation

At the hub(L1495A-N)

Fast star formation

by converging large-scale flows

Stellar group/cluster formation



VI. FUTURE

Star Formation & Argus+

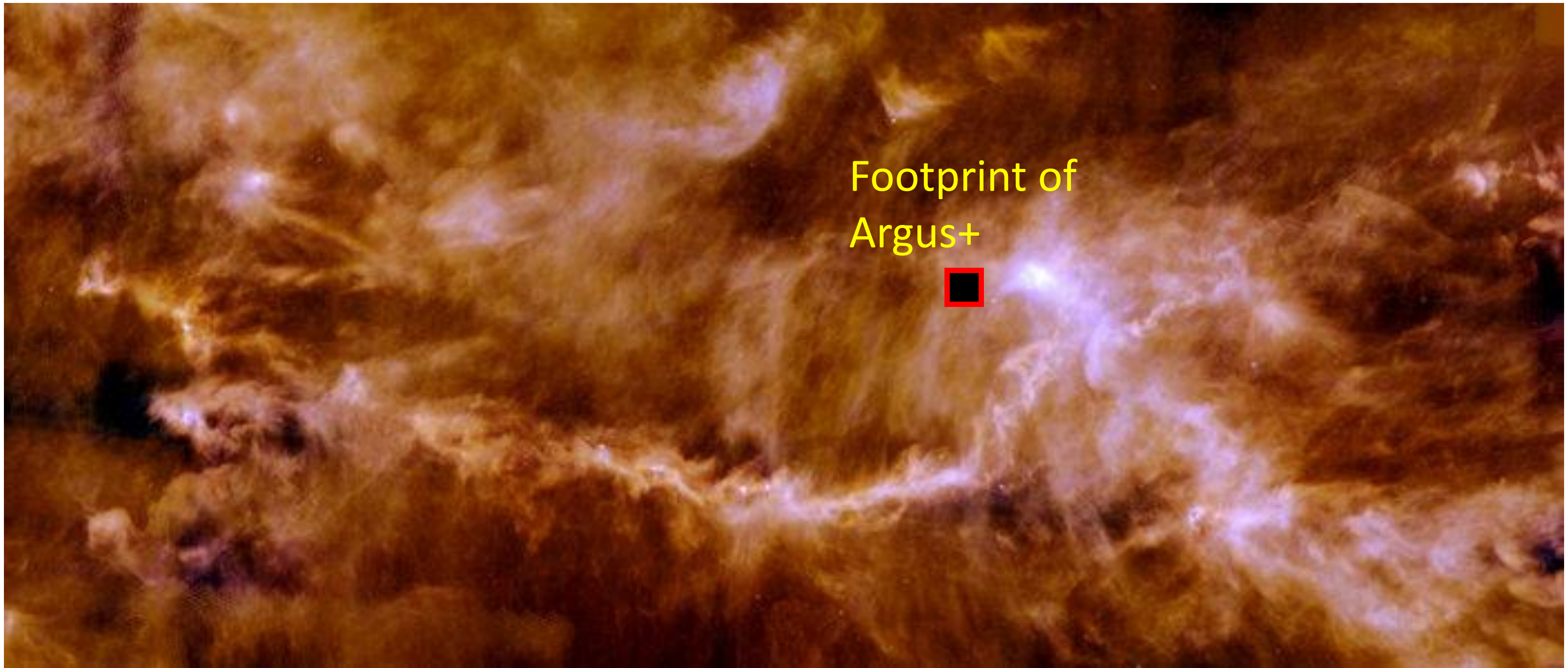
Getting a complete view of star formation processes in molecular clouds

General star formation processes within a molecular cloud (Large maps)

+

Individual star formation (High spatial and spectral resolution)

- **Connecting dynamics of a molecular cloud and individual star formation**
- **Comparison of star formation processes between molecular clouds (Argus+ Gould Belt survey, IRDC survey)**



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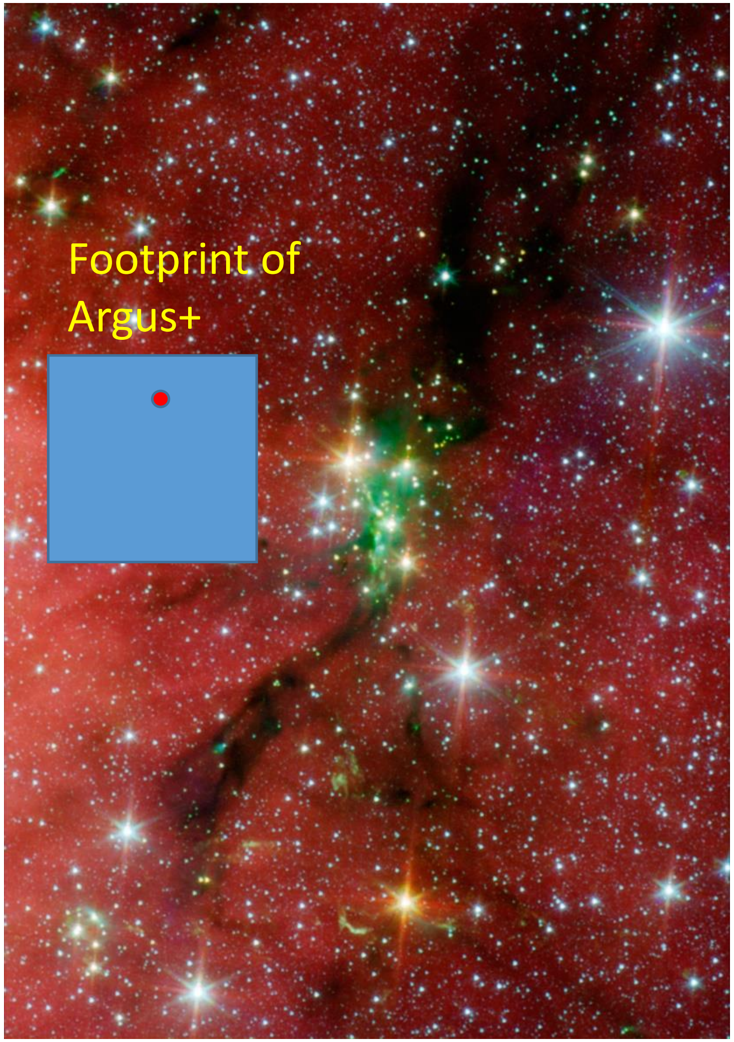

- Serpens South (~440pc)
- Connecting dynamics of a molecular cloud and individual star formation
- Comparison of star formation processes between molecular clouds
  (Argus+ Gould Belt survey, IRDC survey)