EVOLUTION OF ANGULAR MOMENTUM IN STAR FORMING CORES

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THE PREMISE

Conservation of angular momentum would prevent the formation of stars from the collapse of molecular clouds due to the increasing speed of the star forming core's rotation during collapse which would make it gravitationally unstable. We aim at studying trends in the angular momentum of a population of cores (located in the Perseus Molecular Cloud) with their radius. This helps us track the loss of angular momentum during various stages of core collapse. We gain insight on the interaction between the star forming cores and the environment which plays a crucial role in star formation.

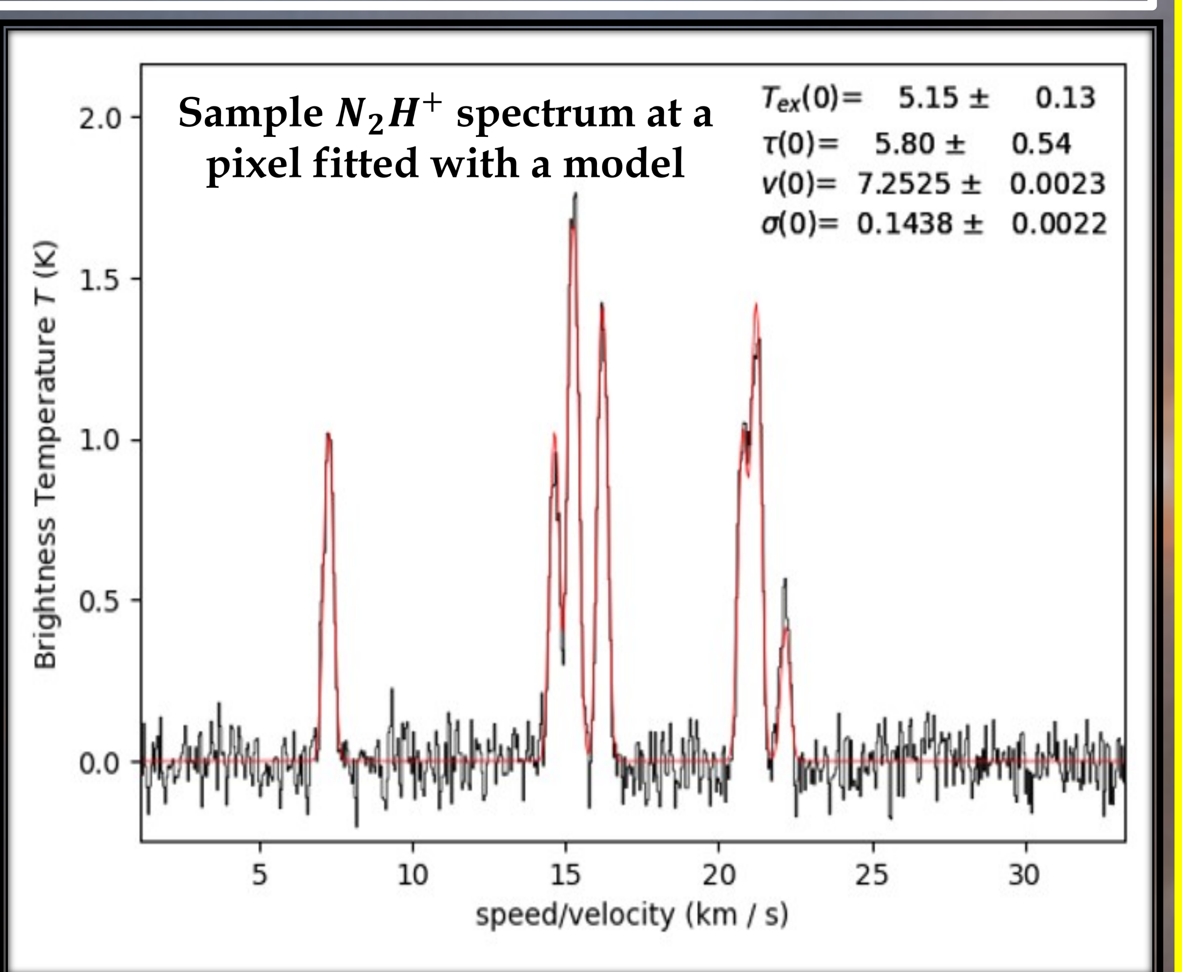
METHODS

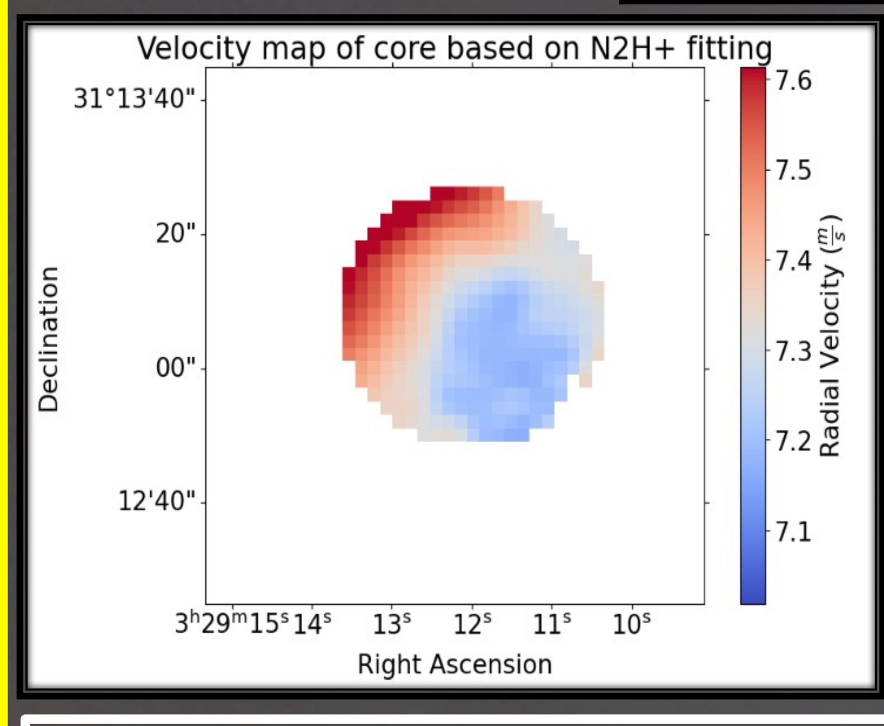
OBSERVATIONS AND DATA:

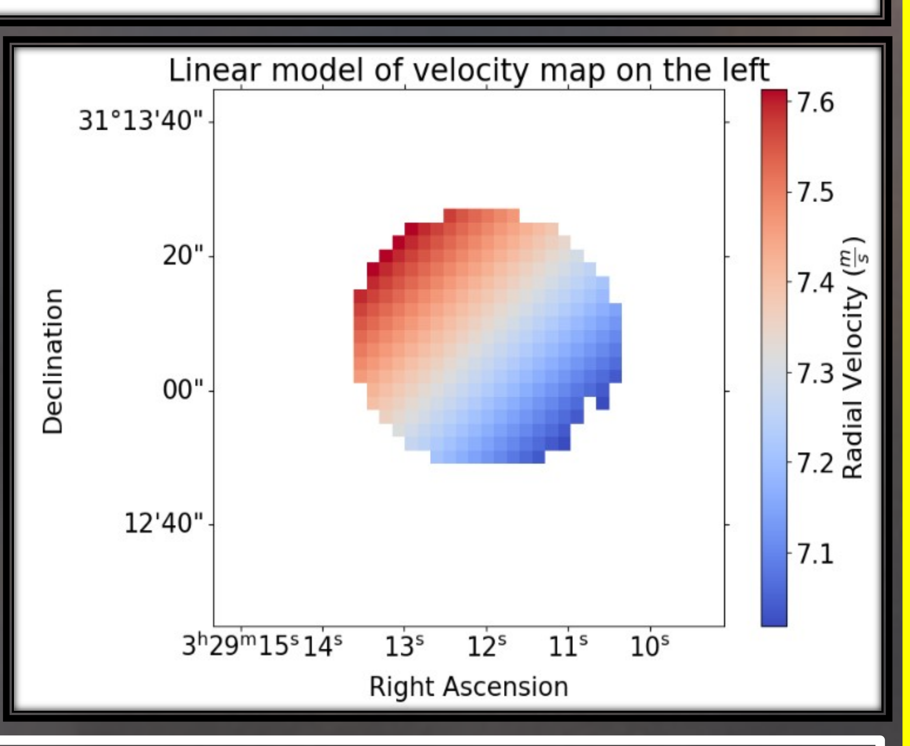
- Target: Perseus Molecular Cloud located 296.5 parsecs away in the Perseus Constellation. Focus on the NGC 1333 region.
- Observations conducted with Green Bank Telescope in West Virginia.
- Measurements were taken of the radio spectrum of the Diazenylium molecule (N_2H^+) which acts as a good tracer for density.
- Cores were identified using the Herschel Gould Belt Survey (HGBS) [a]. The survey lists core dimensions and locations that allowed us to create apertures within which the analysis was focused.

FITTING THE N_2H^+ SPECTRUM:

- Package: Pyspeckit [b] (Python)
- Parameters obtained:
  - Excitation temperature (T_{ex})
  - Opacity (τ)
  - Radial velocity (v)
  - Line width (σ)
- Perform fit at every pixel to obtain radial velocity maps in each core.

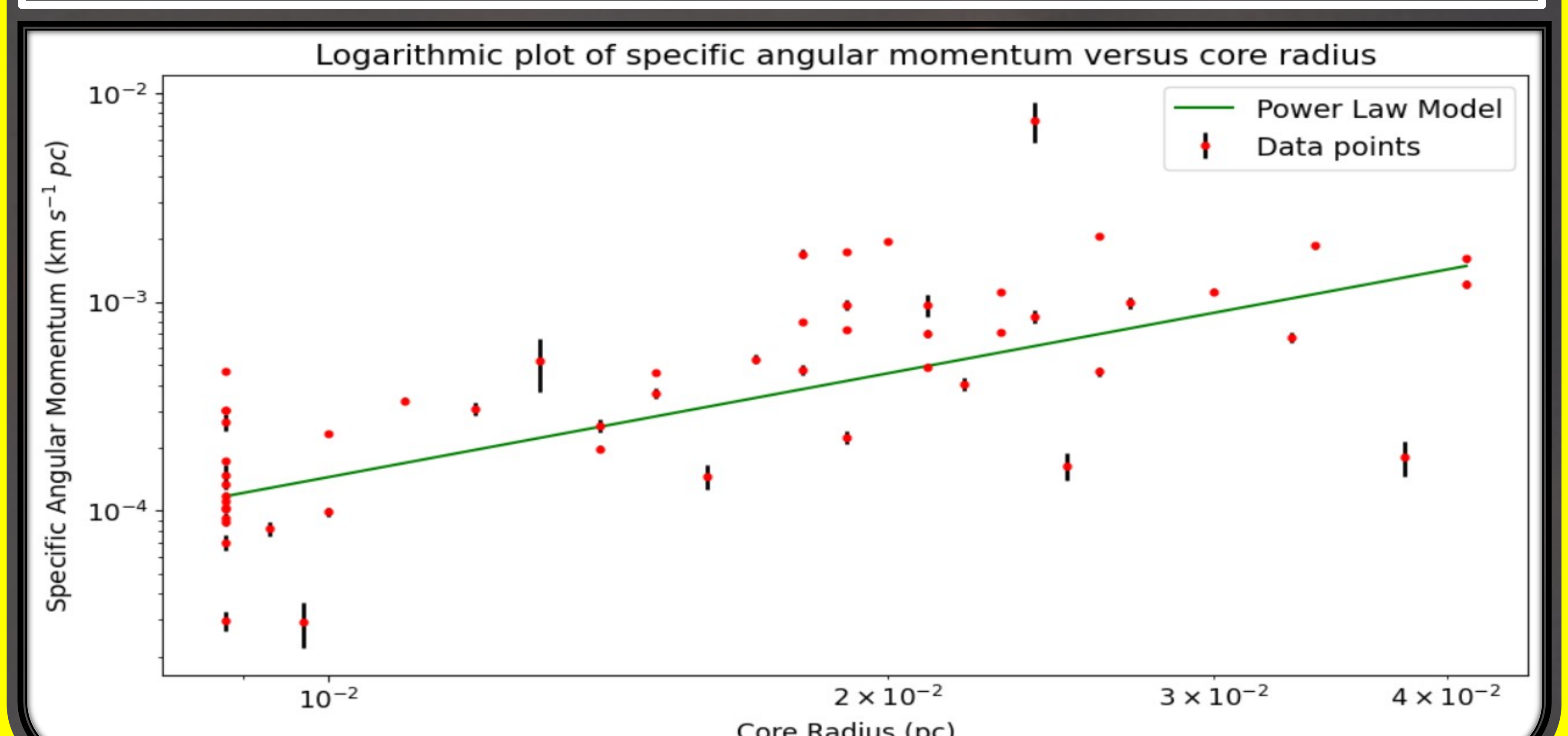






THE SPECIFIC ANGULAR MOMENTUM:

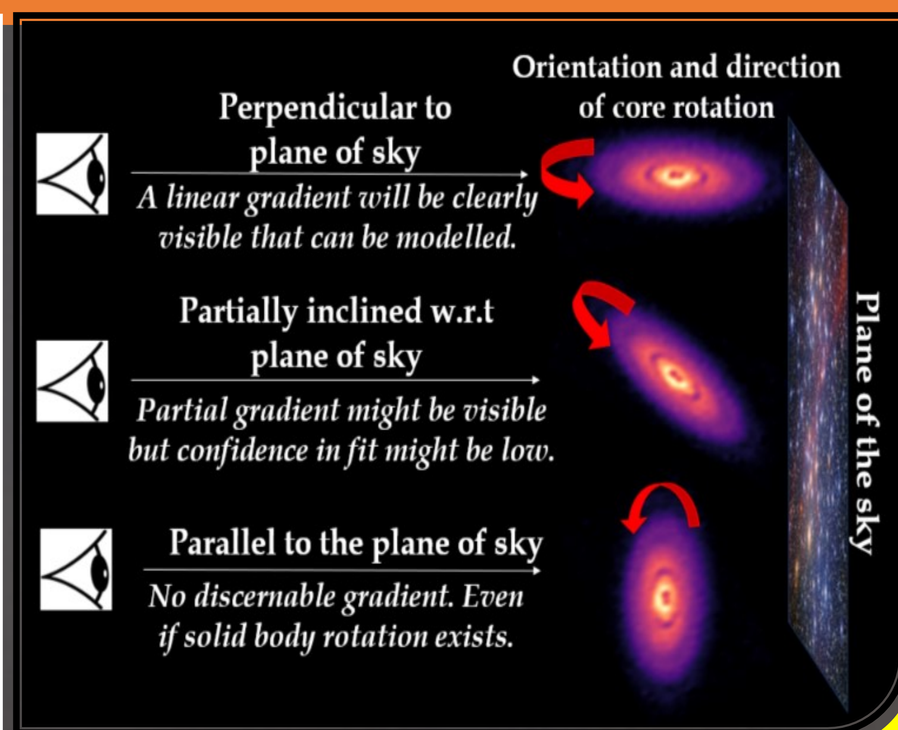
- Fit the radial velocity map with a 2D linear model and calculate velocity gradient in every core.
- Use the gradient to calculate the specific angular momentum and determine the trend with core radius.
- Model the trend with a power law.



LIMITATIONS

ORIENTATION OF CORES:

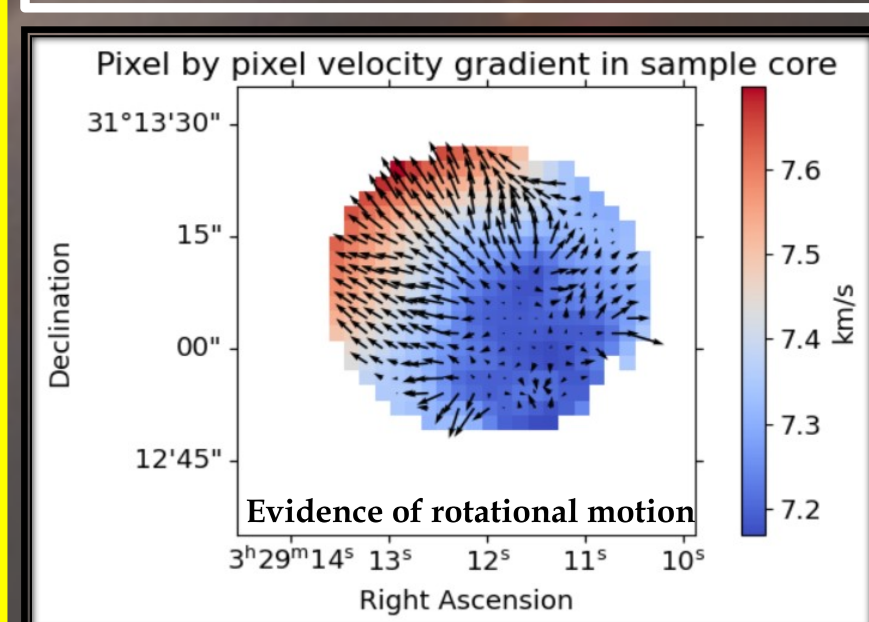
- Not all cores rotate perpendicular to the plane of sky.
- Only cores with discs oriented perpendicular to sky will give us accurate results.
- Analysing a large population of cores minimises errors induced due to core orientation.

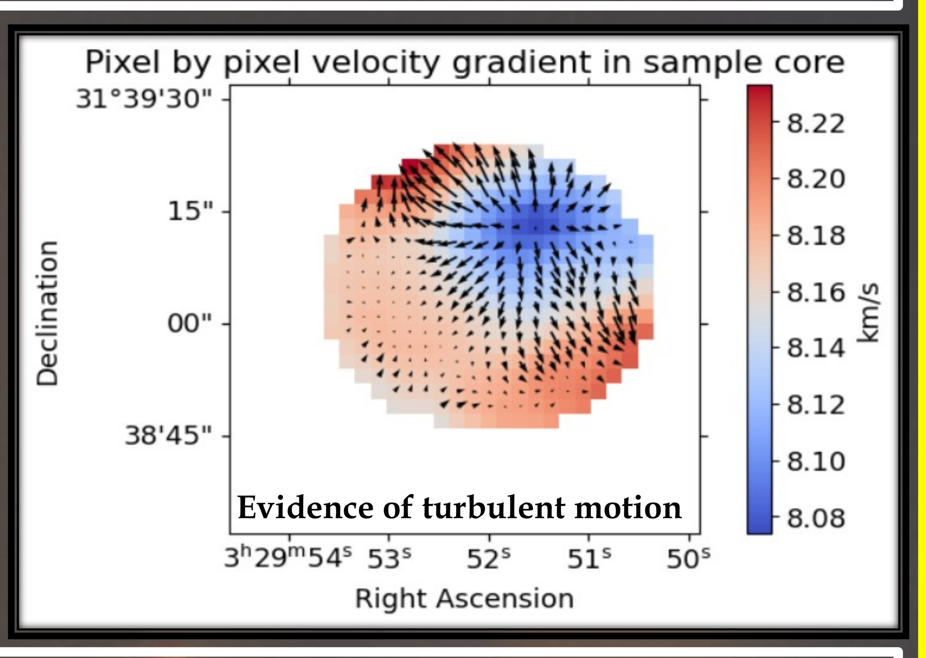


CONCLUSIONS AND FUTURE RESEARCH

CONCLUSIONS:

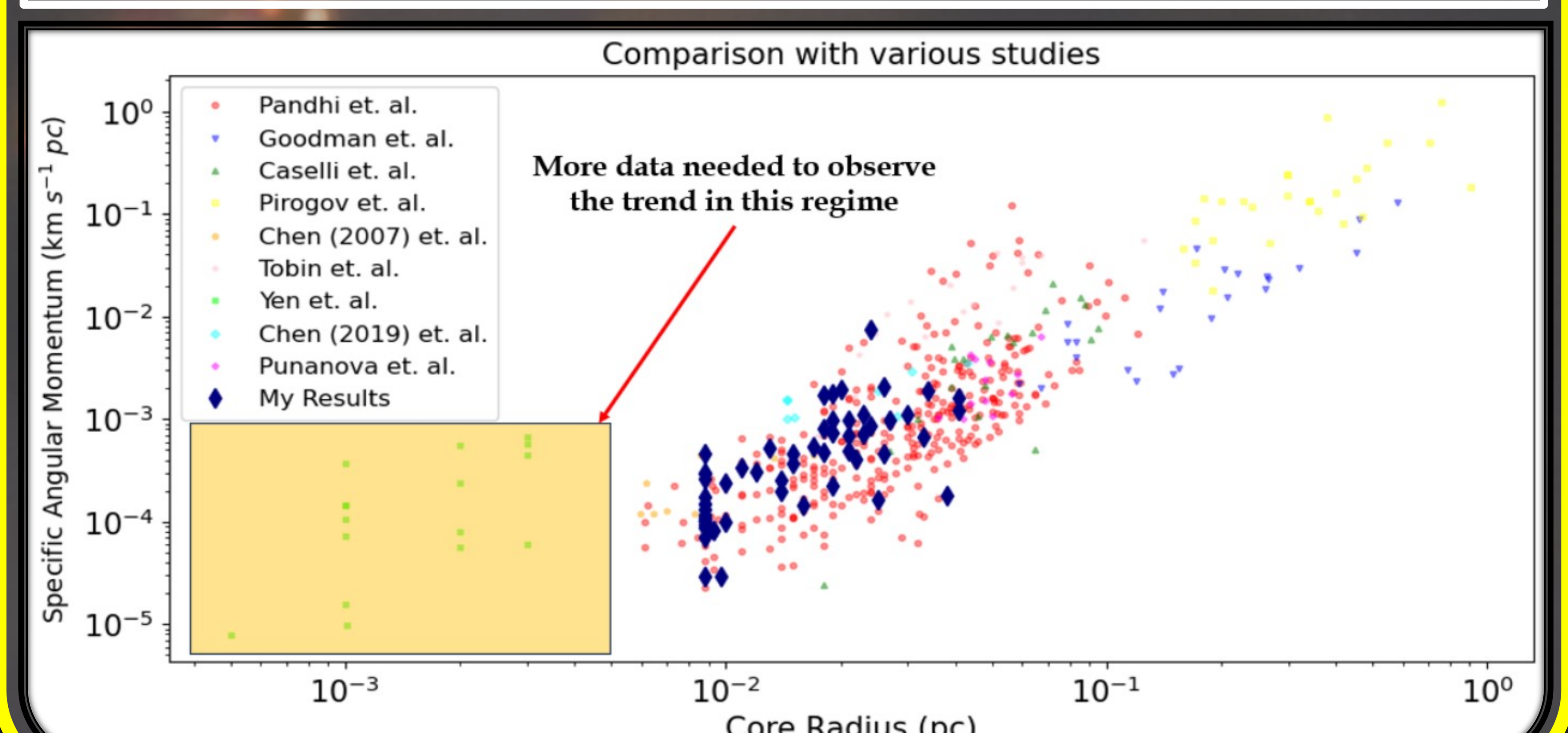
- We found that several cores show turbulent motion which cannot be modelled with a linear function. Turbulence persists down to core scales of 0.01 parsecs.
- The specific angular momentum of cores follow a trend with the core radius that can be modelled as a power law $R^{1.651 \pm 0.168}$. This is in good agreement with other studies [c].





WHAT NEXT?:

- Increased resolution compared to previous studies.
- Allows us to track the change in angular momentum with respect to core radius for individual cores.
- Can refine core radii values obtained from HGBS catalog which are an overestimate due to poorer resolution.
- Refined values will allow us to bridge the gap to very low core radii and verify an evident flattening in trend for specific angular momentum.



References: [a] Sadavoy, S. I., Di Francesco, J., André, Ph., et al. (2014),ApJ, 787, L18. [b] Ginsburg, Adam, Sokolov, Vlas, de Val-Borro, et al. (2022), AJ, 163, 291. [c] Goodman, A. A., Benson, P. J., Fuller, G. A., & Myers, P. C. 1993,ApJ, 406, 528.

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