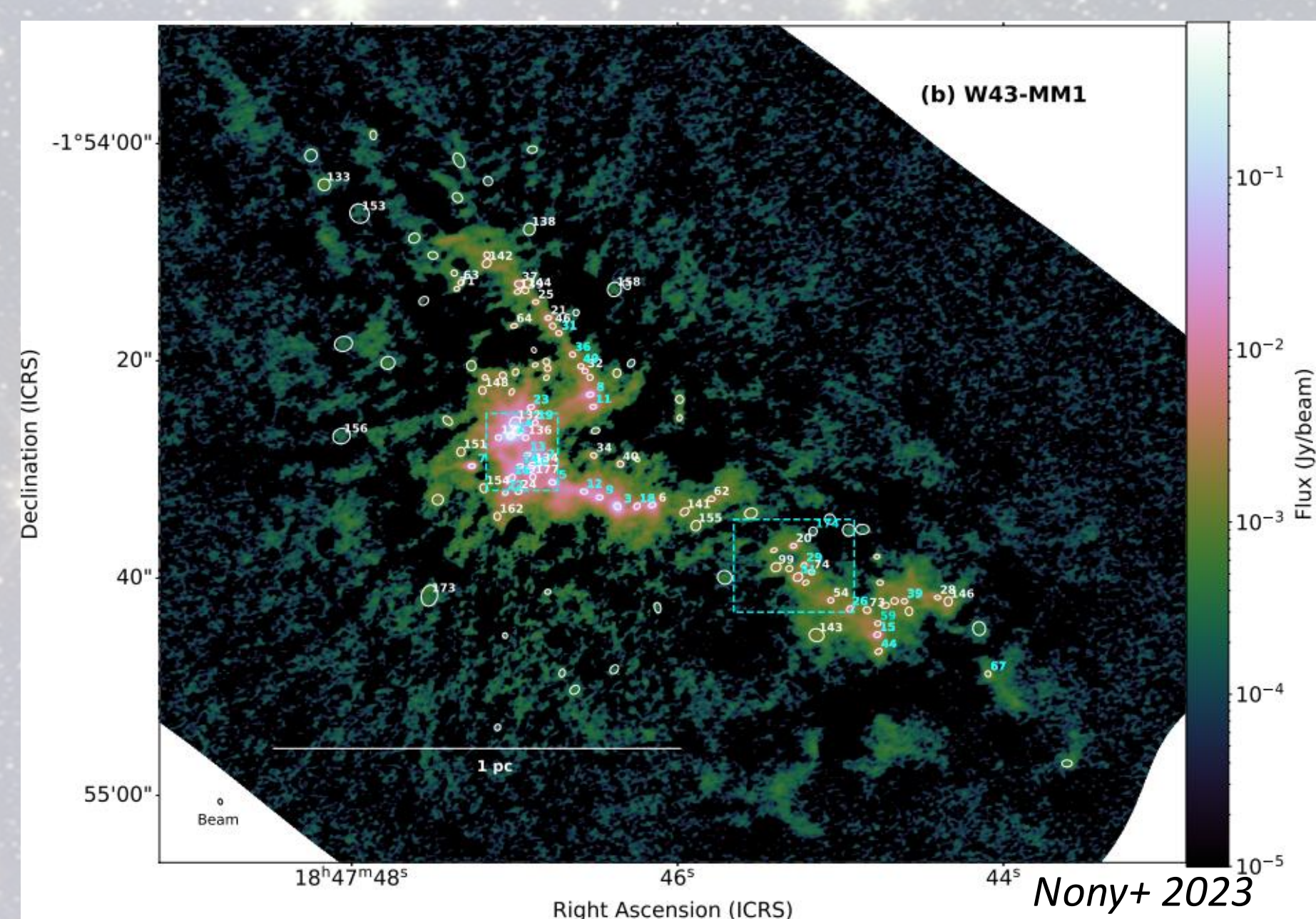
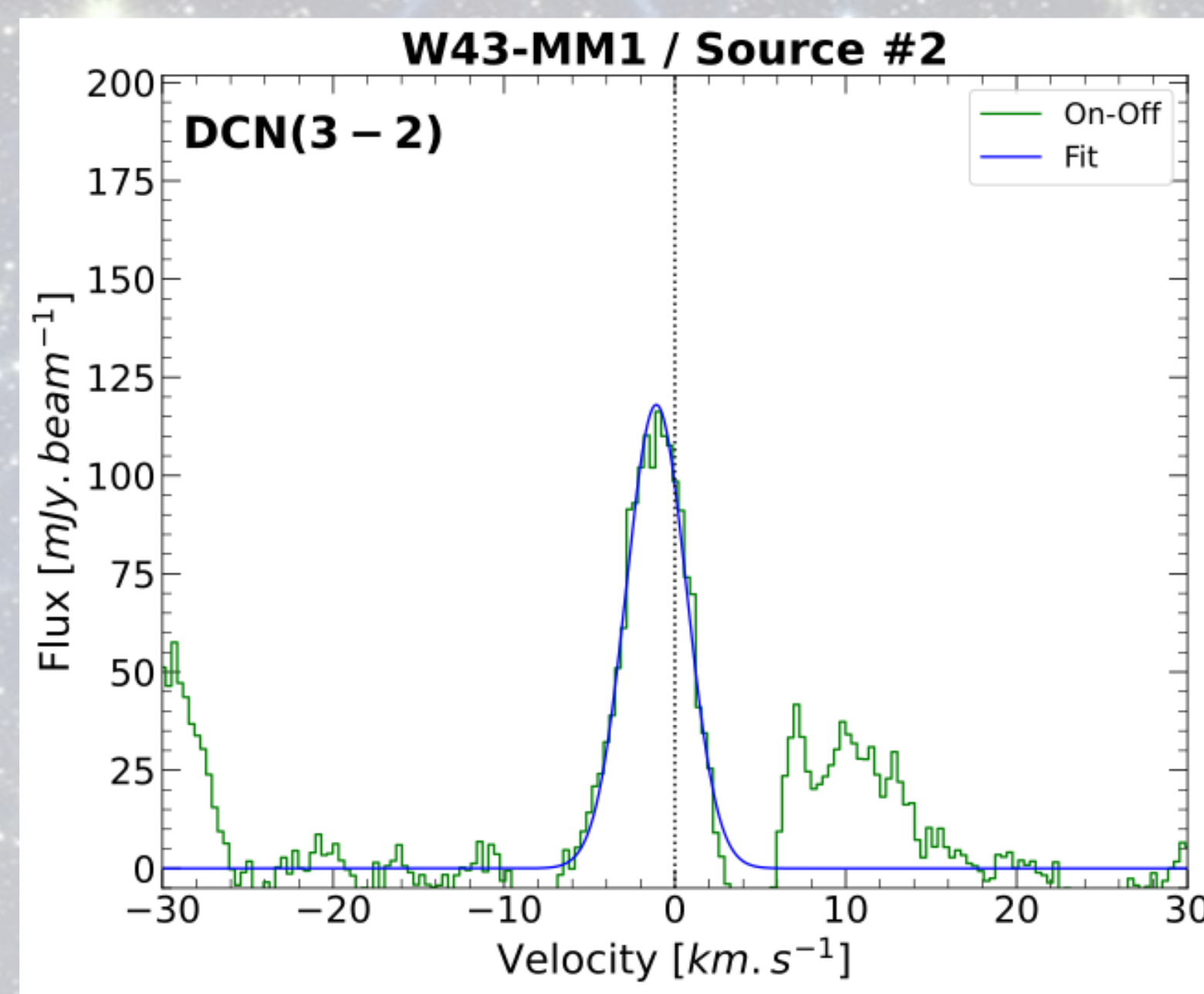


Using line and dust polarization data from ALMA, we try to estimate the kinetic and magnetic support in the cores of the massive protocluster W43-MM1

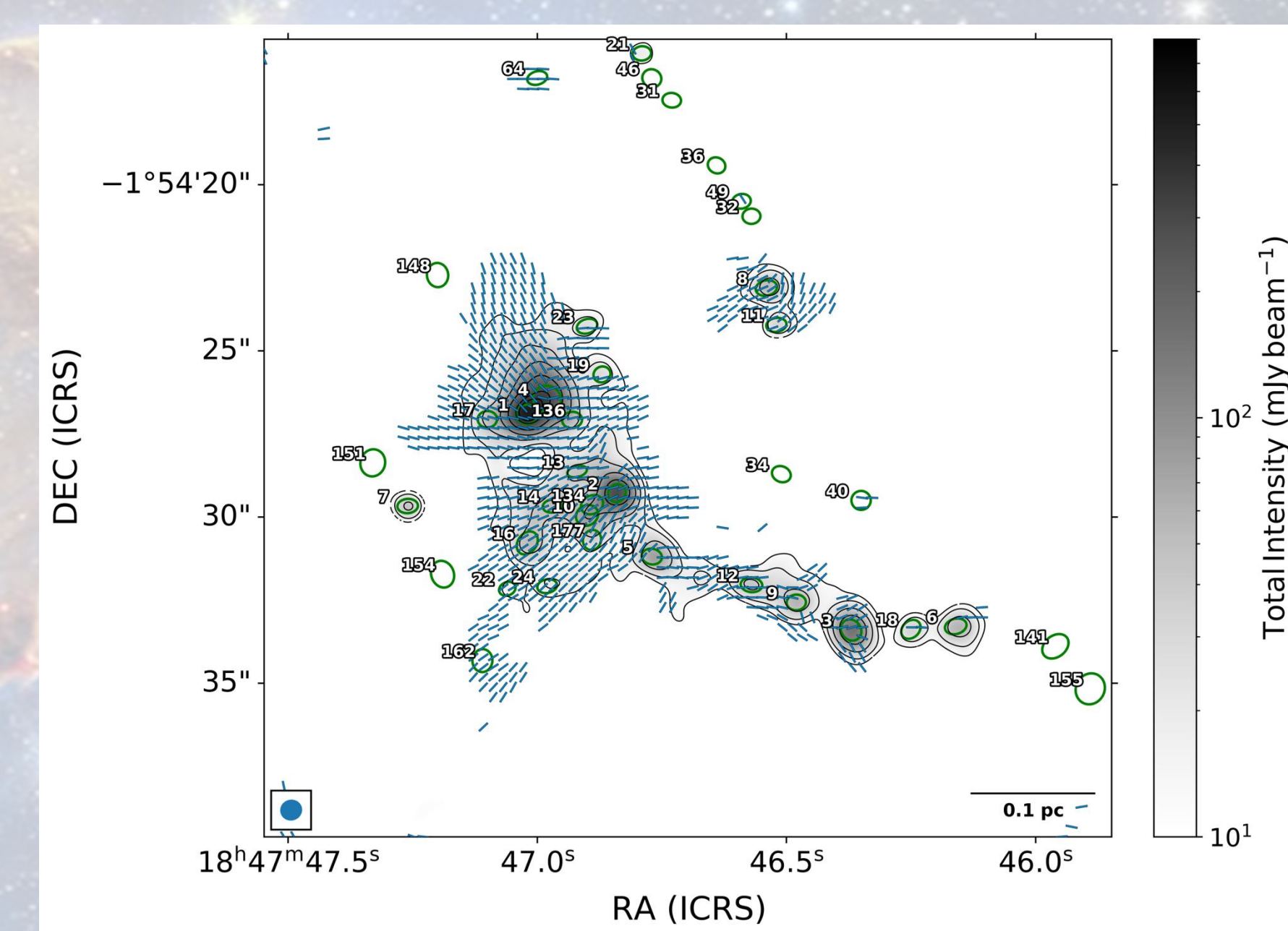
Dataset



Catalog of cores in W43-MM1 at a resolution of ~2500 au



Dense gas tracers from ALMA-IMF large program (Motte+ 2022) to estimate the kinetic supports (DCN(3-2) and ¹³CS(5-4))



Dust polarization data to study the magnetic field strength in the cores

Goal: Virial analysis of the cores of W43-MM1 at the core scale of ~2500 au

Results

- Velocity dispersions ranging between 0.3 and 4.5 km/s

- Mean of 1.1 km/s

Similar to other ALMA-IMF protoclusters (Cunningham+ 2023) and slightly larger than other high-mass core studies (Saha+ 2022, Li+ 2023)

Vaille-Manet et al, in review

- Magnetic field strengths estimated in the plane-of-the-sky with the DCF method

$$B_{POS} = Q \cdot \sqrt{4\pi\rho} \frac{\sigma_v}{\sigma_\theta}$$

- B_{POS} ranging from 1 to 49 mG

First study with several tens of mG in cores

Virial analysis

Kinetic mass

$$M_{vir} = 3 \left(\frac{5-2n}{3-n} \right) \frac{FWHM_{dec}^2}{G} \sigma_v^2$$

Magnetic mass

$$M_{vir} = \frac{1}{2} \sigma_{alf}^2$$

With $\sigma_{alf} = \frac{B}{\sqrt{\mu_0\rho}}$ and n the density profil index

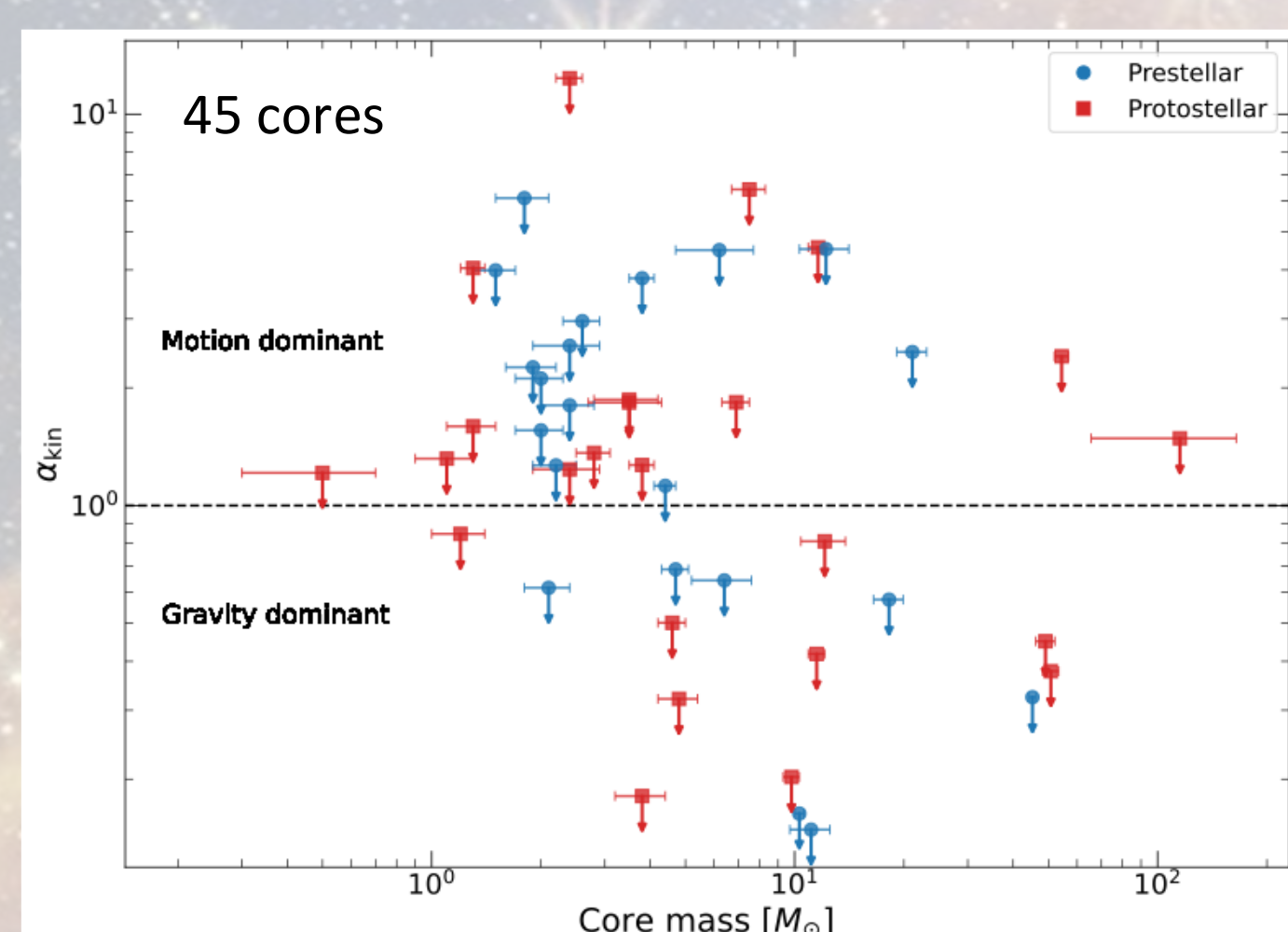
$$\alpha_{vir} = \frac{M_{vir}}{M_{core}} \begin{cases} \alpha < 1: \text{collapsing} \\ 1 < \alpha < 2: \text{Stable} \\ \alpha > 2: \text{unbound} \end{cases}$$

New core dust temperatures to compute core masses (Motte+ 2025)

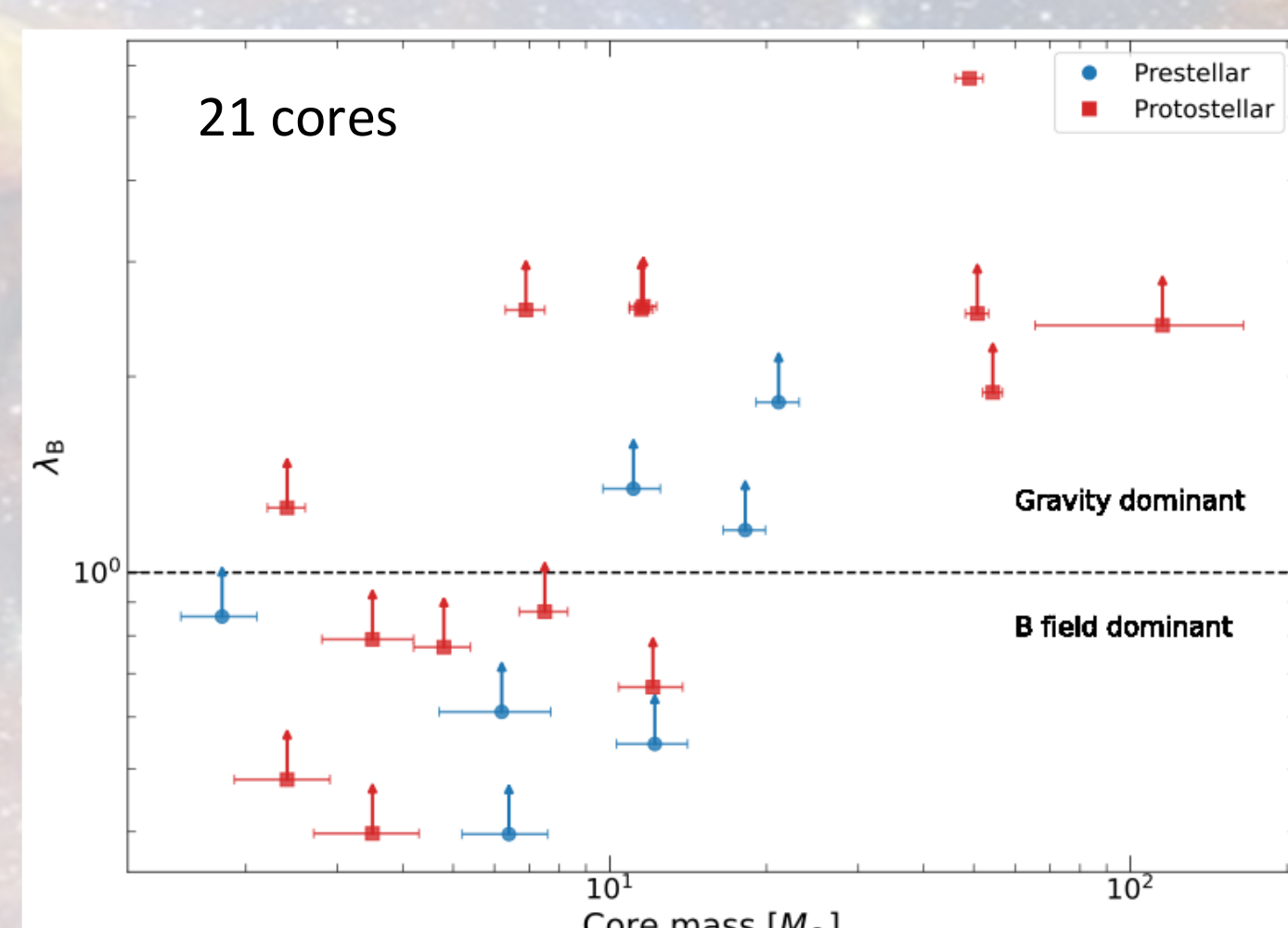
$\lambda_B = \frac{M/\phi_B}{(M/\phi_B)_{crit}}$: Mass-to-flux ratio to compare magnetic over gravitational support

Quantifying the support

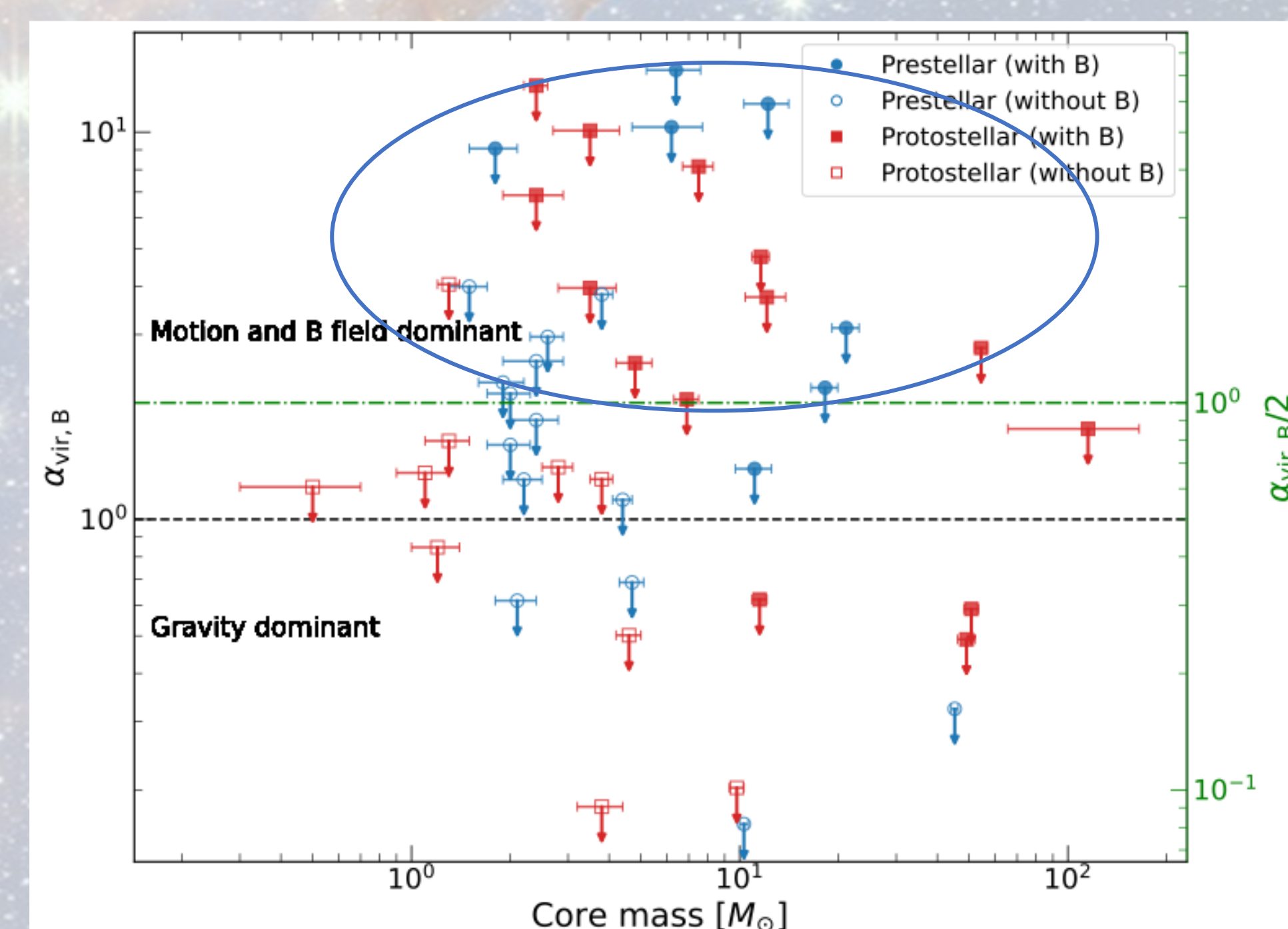
Vaille-Manet et al, in review



Kinetic support alone



Magnetic support alone



Combined supports

Overestimation of the non-thermal support

1 - Contamination of large scale flows (infall, streamers, rotation?) in the velocity dispersions? (Traficante+ 2018, Mouri+ 2025)

Infall velocities between 1 to 3 km/s needed to be subtracted to put the supported protostellar cores of W43-MM1 in a state of gravitational collapse

- Agreement with infall/convergent flows velocities observed in high-mass star forming regions (Csengeri+ 2011, Peretto+ 2013, Beuther+ 2025b)

- Expected in a dynamical region like the « Galactic mini-starburst » W43-MM1

- A purely collapsing core could be misinterpreted as being supported as infall motions would broaden the linewidths (Ballesteros-Paredes+ 2018)

2- Lack of surface terms in the observational virial theorem

- We can only access volume terms observationally, while surface terms can reduce the support

- Shadmehri+ 2002, Dib+ 2007 and Chevalier+ in prep show that surface terms can be between half and the same order of magnitude

Many protostellar cores appear to be kinematically dominated, while they display protostellar outflows → in a state of collapse (should have $\alpha < 1$)

Are we really tracing the turbulence with our velocity dispersion estimates?

Conclusion / What's next?

- Important level of support in cores with B_{POS} ranging from 1 to 49 mG

- It suggests an overestimation of the non-thermal support which appears in agreement with contamination of flows/infall in the velocity dispersions and with the omission of surface terms in the virial theorem

- Larger turbulence and magnetic fields strength than in low-mass studies (subsonic velocity dispersions and tens to hundreds of μG , Pineda+2010, Pattle+2017)

- These results highlight the intrinsic difficulty of reliably measuring individual support terms in cores embedded in a highly dynamical region such as W43-MM1