Magnetic fields in the ISM & their effect on star formation

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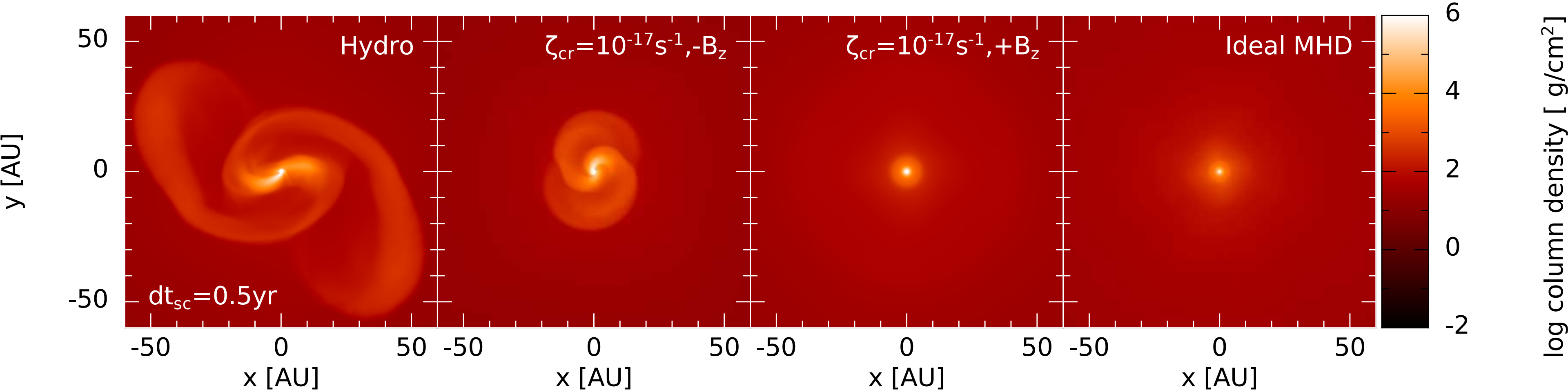
Disc formation: effect of magnetic fields

- Using idealised initial conditions:

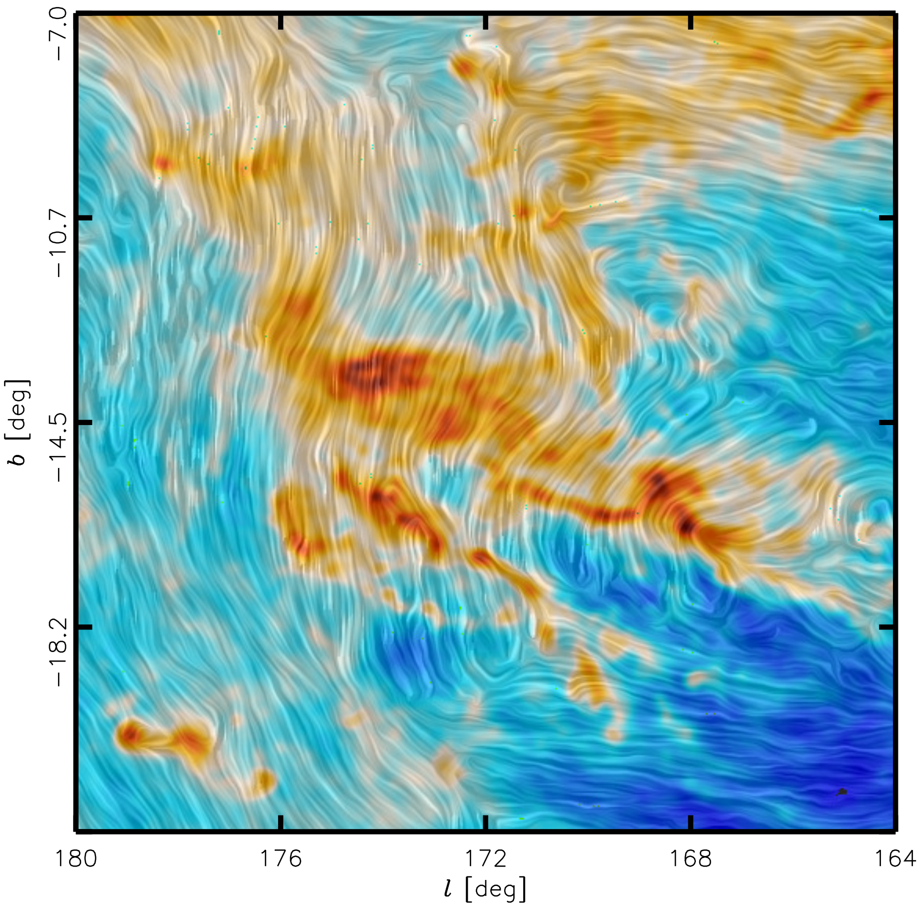


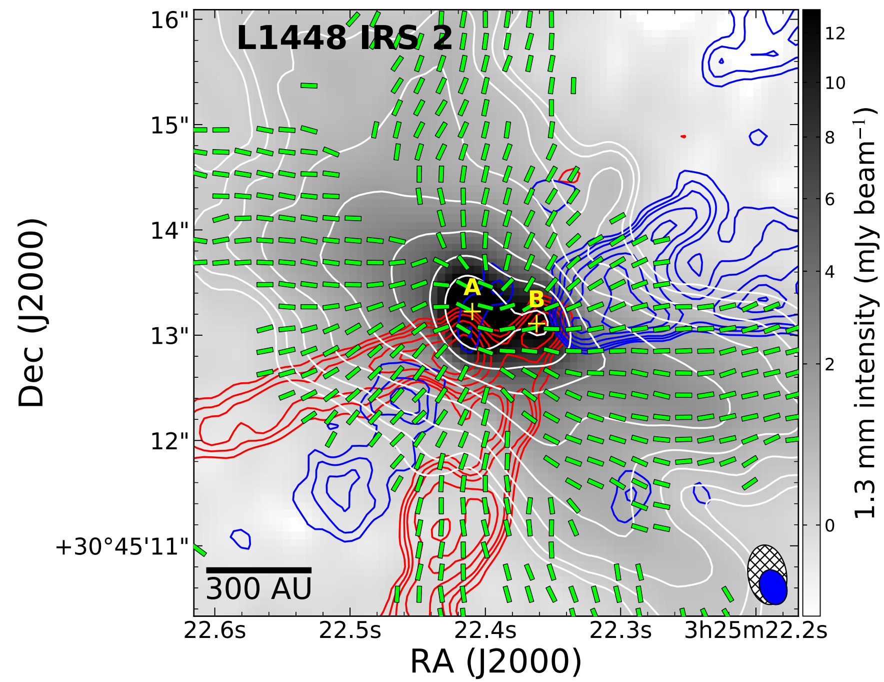
- Hydro:
  forms a 50au disc early during the first hydrostatic core phase
- Non-ideal (Ohmic resistivity, ambipolar diffusion & the Hall effect)
  $-B_z$: forms a 25au disc during the first hydrostatic core phase
  $+B_z$: forms a 1au disc by the stellar core phase
- Ideal:
  never forms a rotationally supported disc
  (the Magnetic Braking Catastrophe; Allen, Li & Shu, 2003)

c.f. Wurster, Price & Bate (2016), Wurster, Bate & Price (2018a,c)

Disc formation:

- ➢ Large-scale magnetic fields are perpendicular to dense structures
- ➢ Large-scale magnetic fields are parallel to low-density structures
- ➢ Small-scale magnetic fields get pinched into dense regions, creating an hour-glass shape



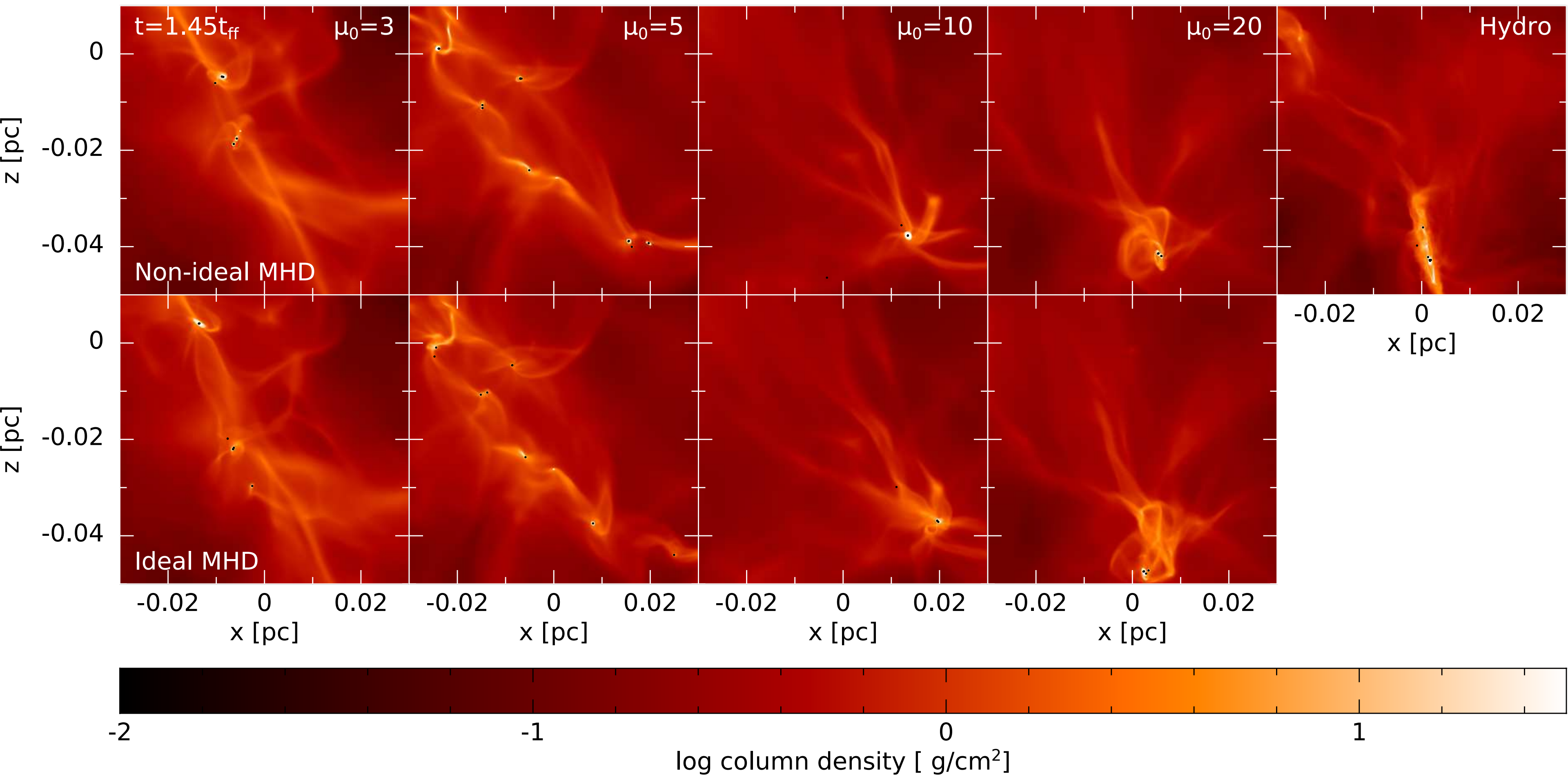


Planck Collaboration (2016)

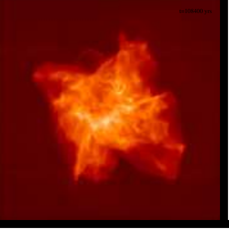
Kwon+ (2019)

Cluster formation: effect of magnetic fields

Decreasing magnetic field strength

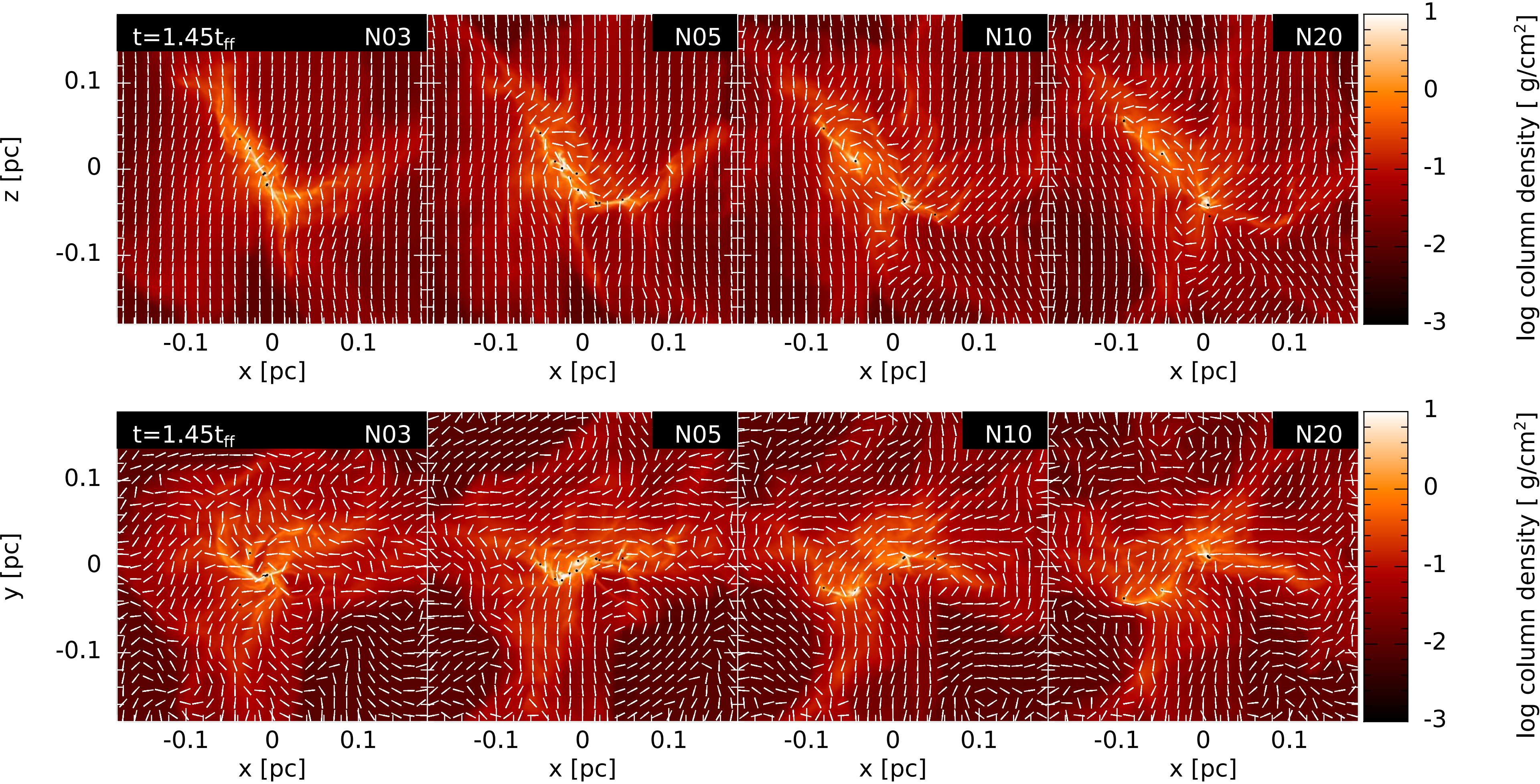


Wurster, Bate & Price (2019)

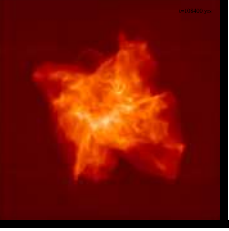


Cluster Formation: Magnetic field lines

Decreasing magnetic field strength

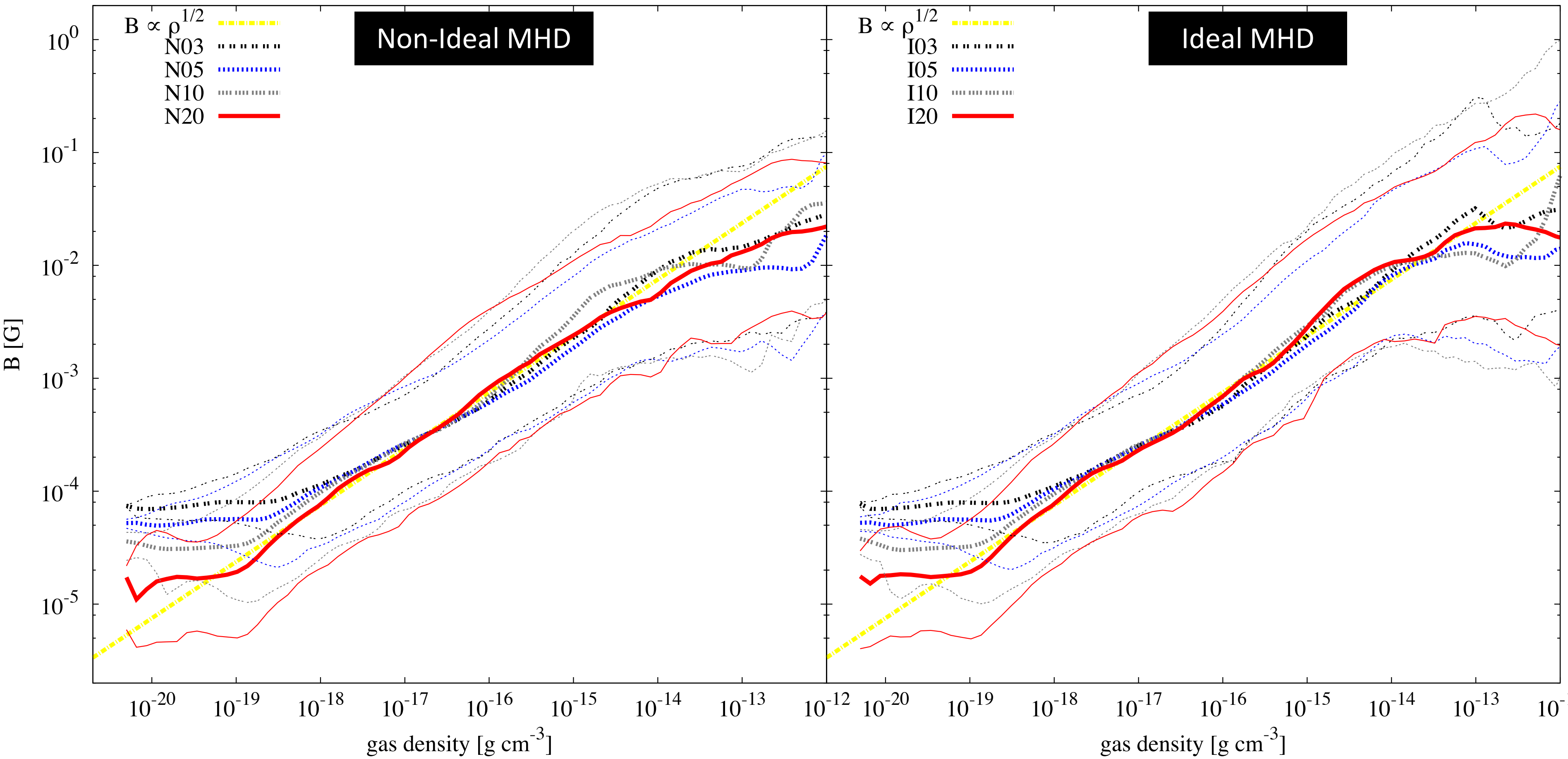


Wurster, Bate & Price (2019)

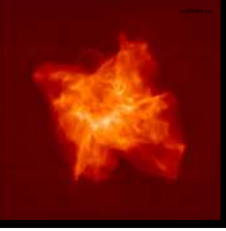


Cluster Formation: Star forming regions

- Star forming regions have a wide range of initial magnetic field strengths, that are approximately independent of the global environment



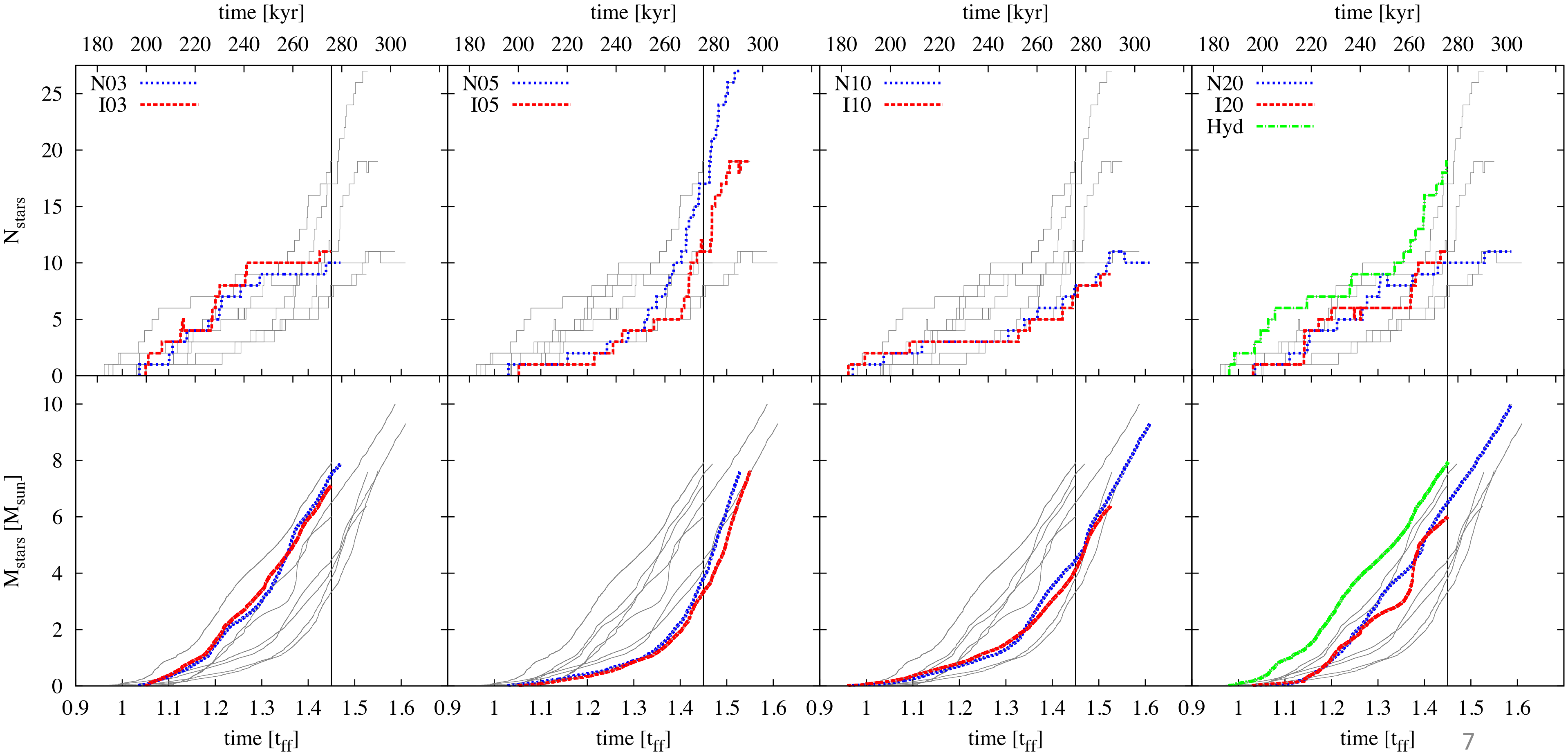
Wurster, Bate & Price (2019)



Cluster Formation: Stellar Mass

- No trend when stars form
- Excluding N03 & I03, there is more mass in stars with weaker initial magnetic field strengths

Decreasing magnetic field strength



Wurster, Bate & Price (2019)

Conclusions

- Isolated stars:
  - Magnetic fields play an important role in determining formation of the star and its discs
  - Non-ideal MHD is instrumental in disc formation

- Star cluster formation:
  - Ideal MHD affects large-scale structures,
    while non-ideal MHD affects small-scale structures
  - No trend between magnetic fields strength and number of stars
  - Loose trend between magnetic field strength and total mass of stars

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