



# **Study of the effect of propagation of the cosmic rays in young protostellar systems**

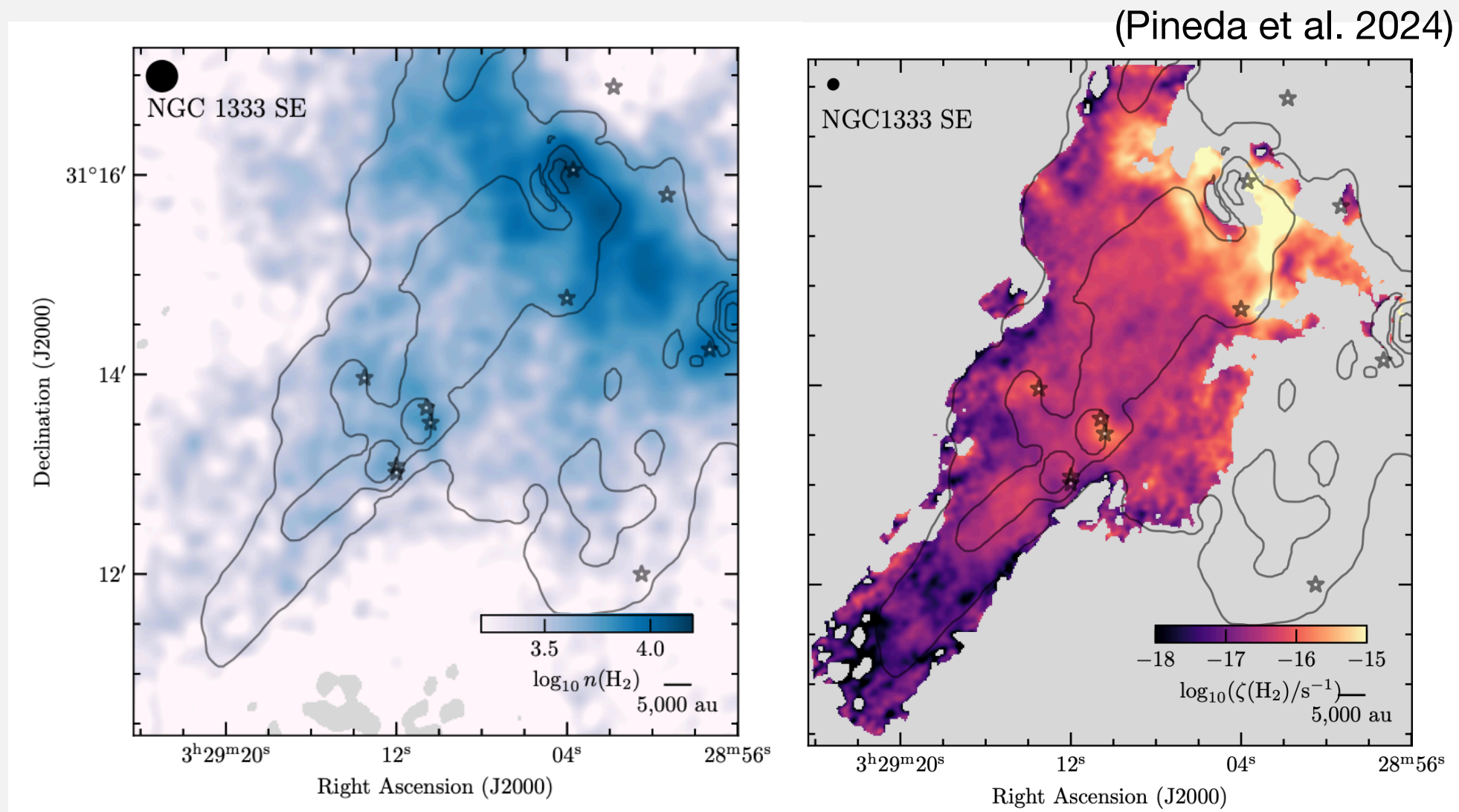
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## Background



## Cosmic rays equations

### Anisotropic diffusion method

$$\frac{\partial E_c}{\partial t} + \nabla \cdot (E_c \mathbf{v}) = -P_c \nabla \cdot \mathbf{v} - \nabla \cdot \mathbf{F}_c$$

(Dubois & Commercon 2016)

### Two-moment method

$$\frac{\partial E_c}{\partial t} + \nabla \cdot \mathbf{F}_c = (\mathbf{v} + \mathbf{v}_s) \cdot (\nabla \cdot P_c) + Q$$

$$\frac{1}{V_m^2} \frac{\partial \mathbf{F}_c}{\partial t} + \nabla \cdot P_c = -\sigma_c \cdot [\mathbf{F}_c - \mathbf{v} \cdot (E_c \mathbf{l} + P_c)]$$

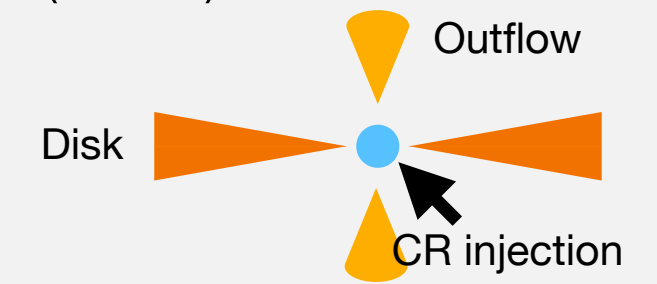
(Jiang & Oh 2018)

## Numerical Simulation

### RAMSES Code

(Teyssier 2002 & Fromang et al. 2006)

- Adaptive-mesh-refinement (AMR) with Jean length ( $\lambda_J$ ) resolved within 30 cells.
- CR energy inject within 2000 years with 1% of sink accretion luminosity.
- 1 solar mass which followed Boss & Bodenheimer (1979).
- MHD and NiMHD  $\frac{\partial \mathbf{B}}{\partial t} = \nabla \times (\mathbf{v} \times \mathbf{B}) - \nabla \times E_{AD}$ .
- Diffusion coefficient:  $10^{24}$ .



## Results

