

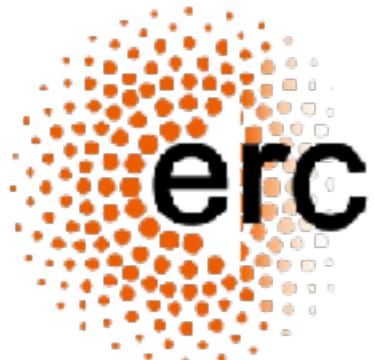
# Magnetic fields and the dynamics of molecular clouds

## from Puget 1991 to Planck and beyond

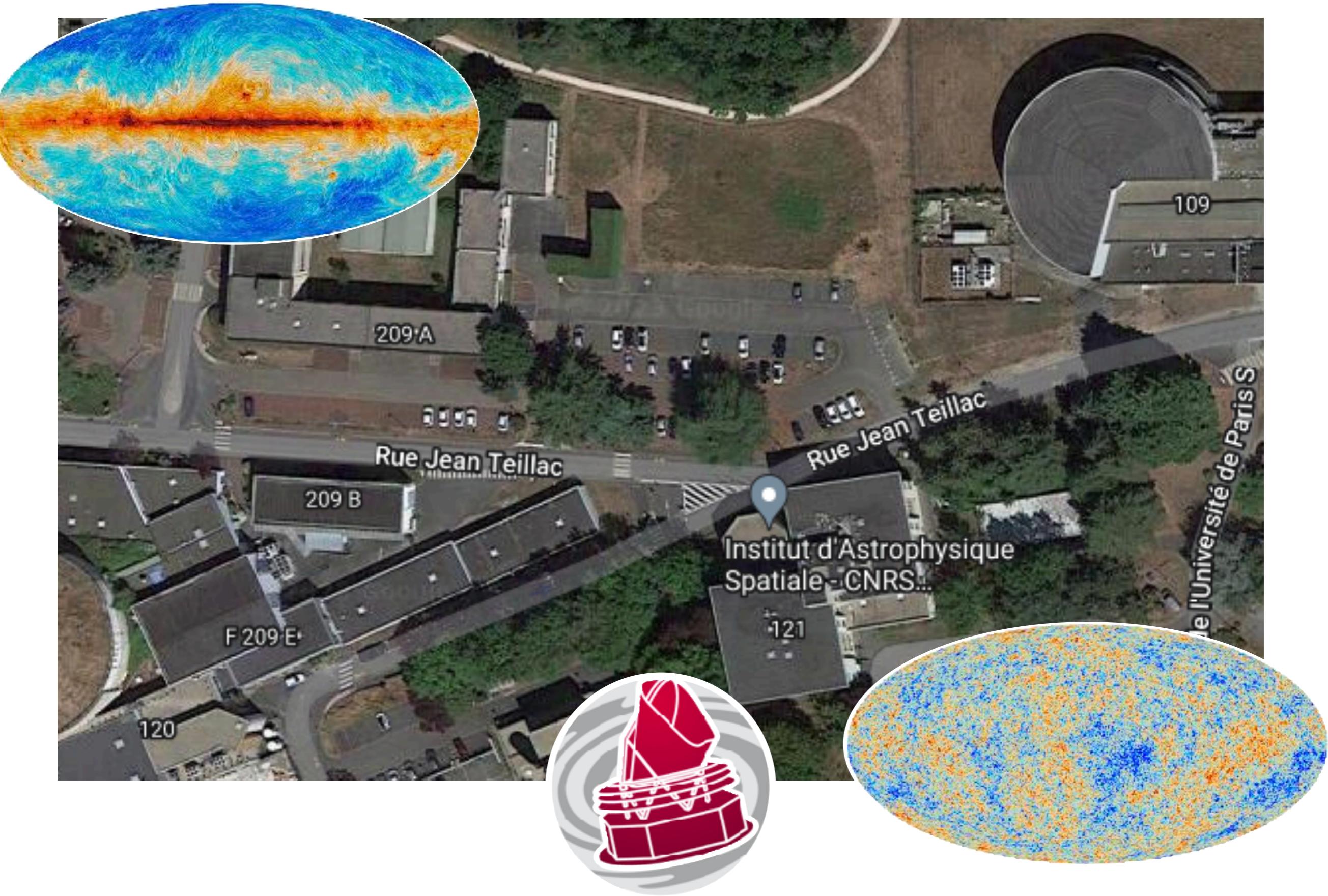
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Juan Diego Soler

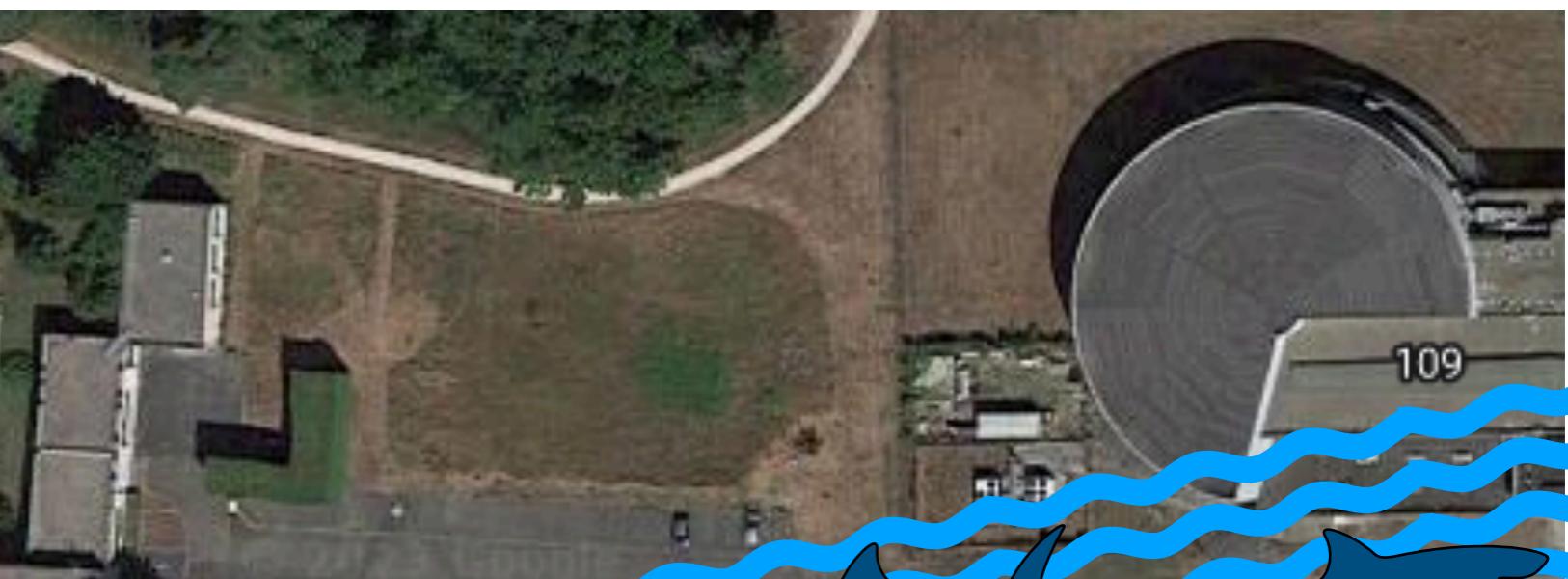
Istituto di Astrofisica e Planetologia Spaziali (Rome, Italy)



# Institute d'Astrophysique Spatiale (Orsay, France)

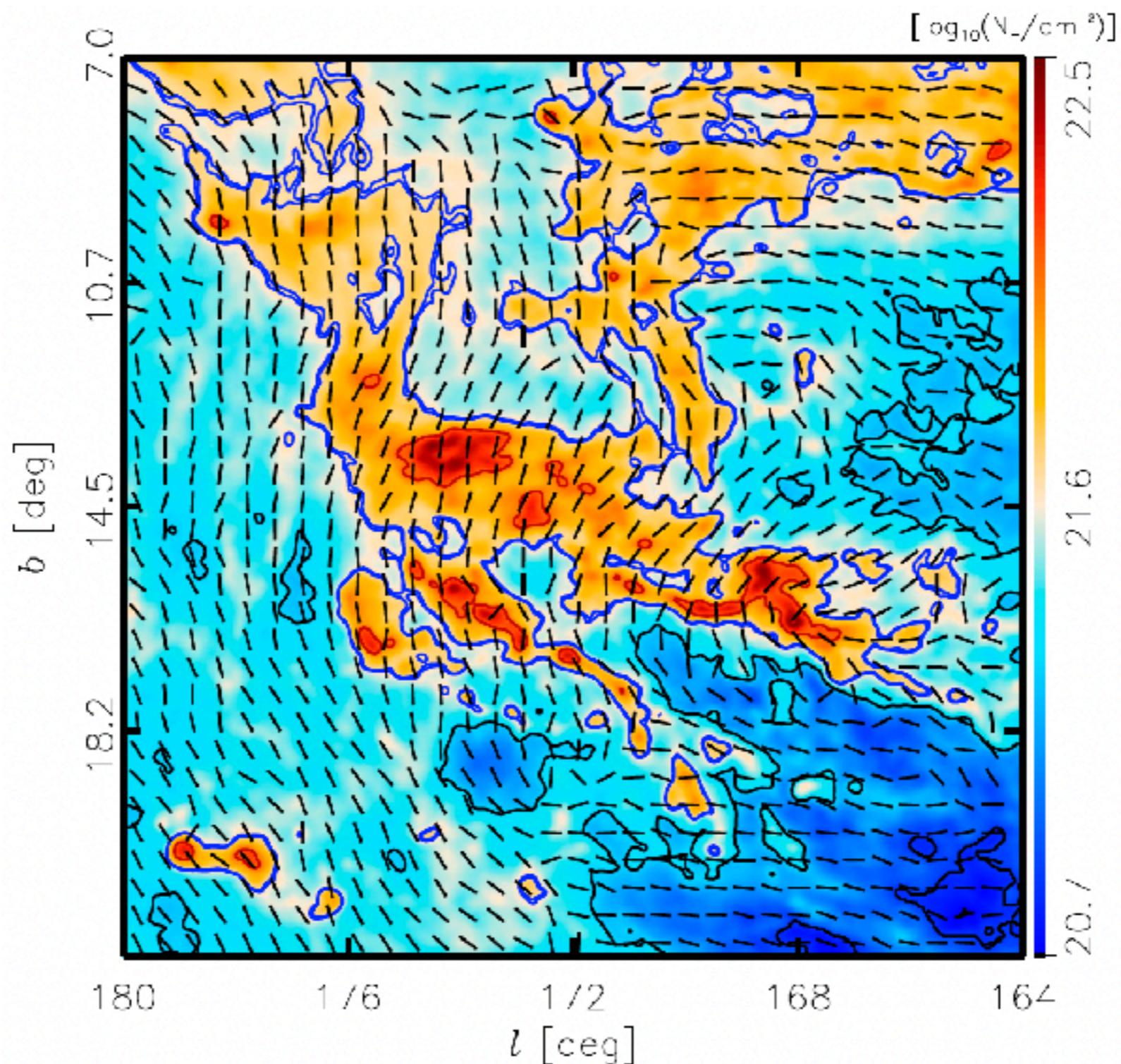


# Institute d'Astrophysique Spatiale (Orsay, France)



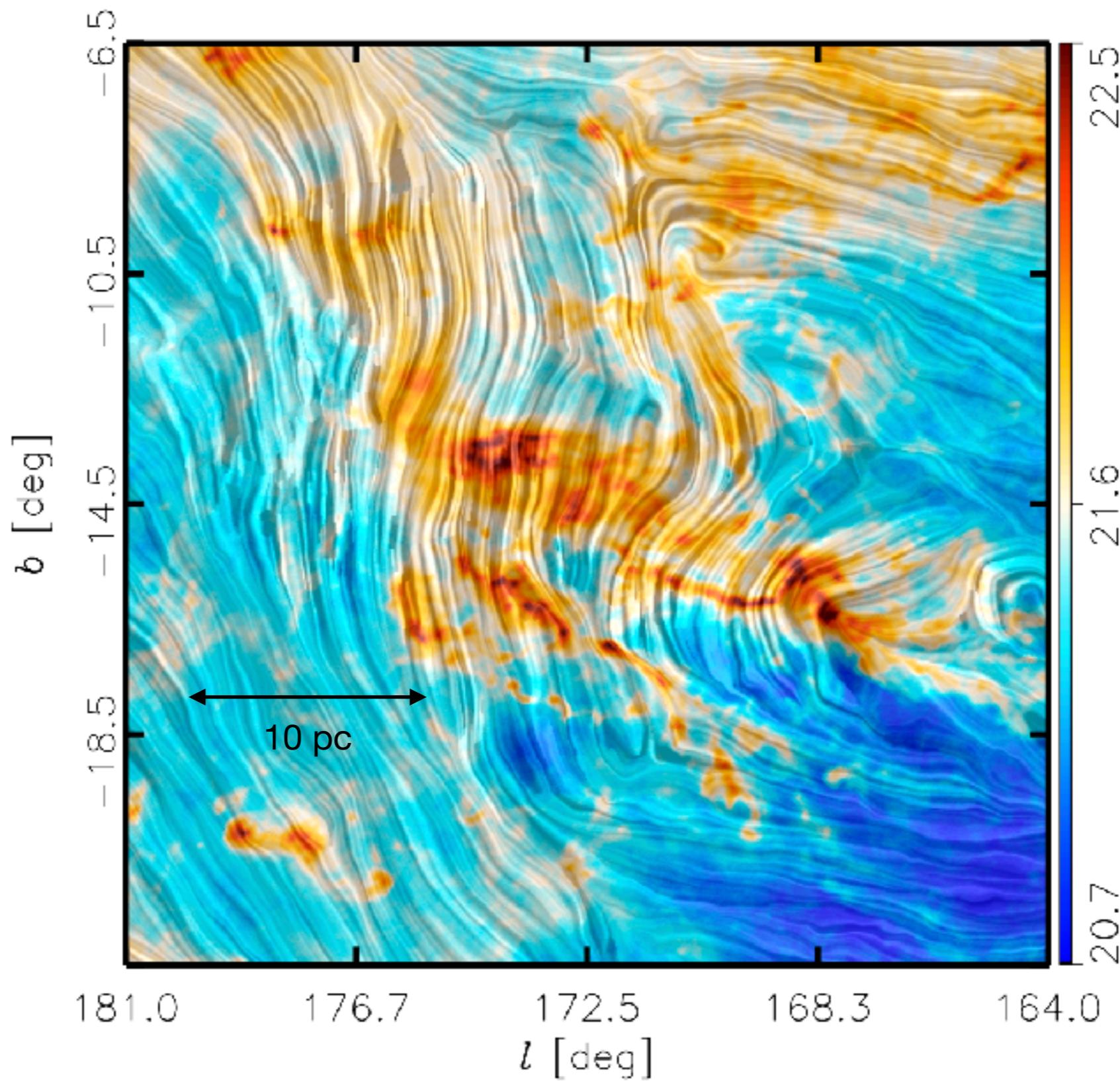
# Taurus MC

Planck XXXV (J.D. Soler et al.) A&A (2016)



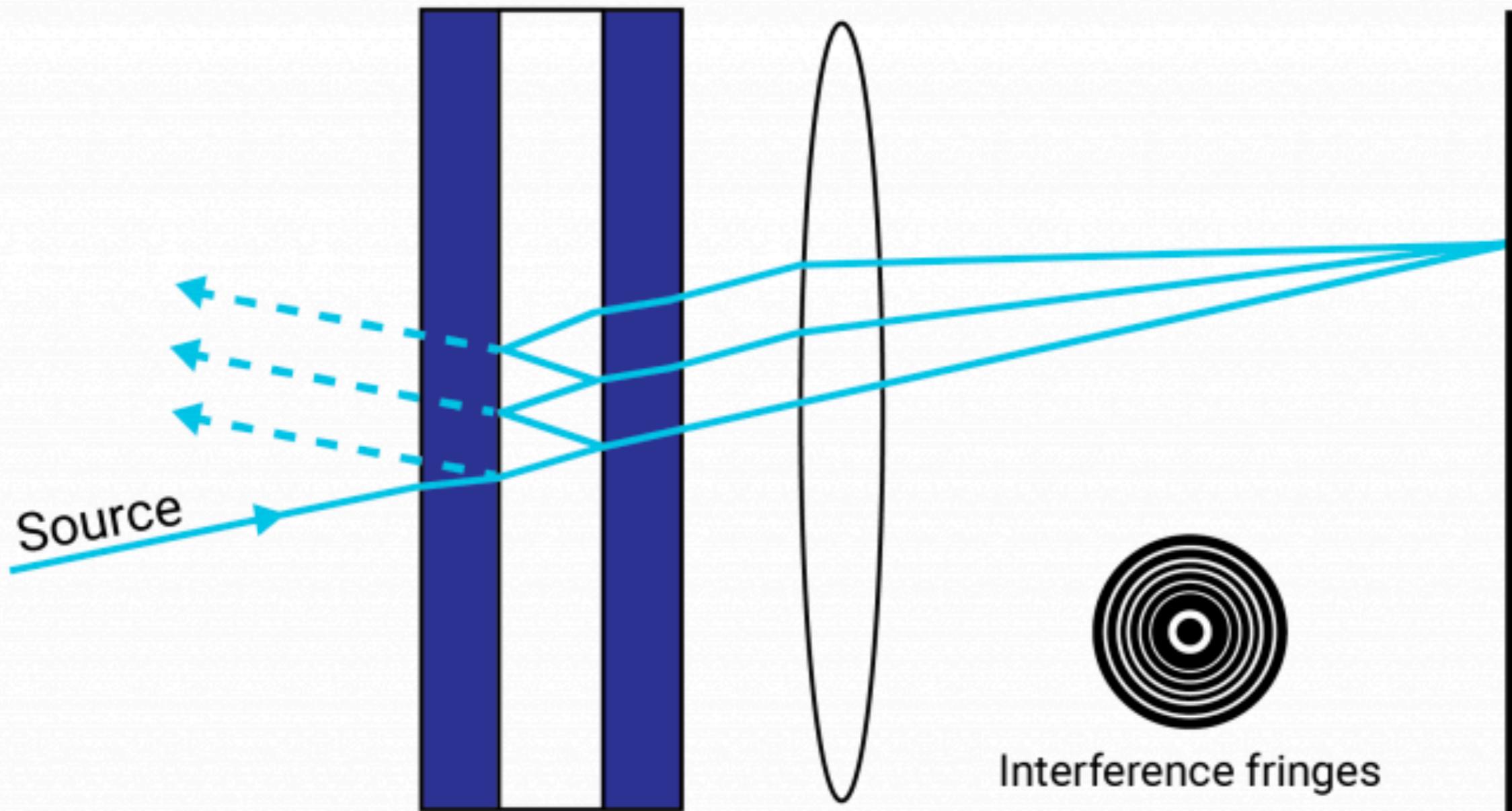
# Taurus MC

Planck XXXV (J.D. Soler et al.) A&A (2016)



# Fabry-Perot interferometer

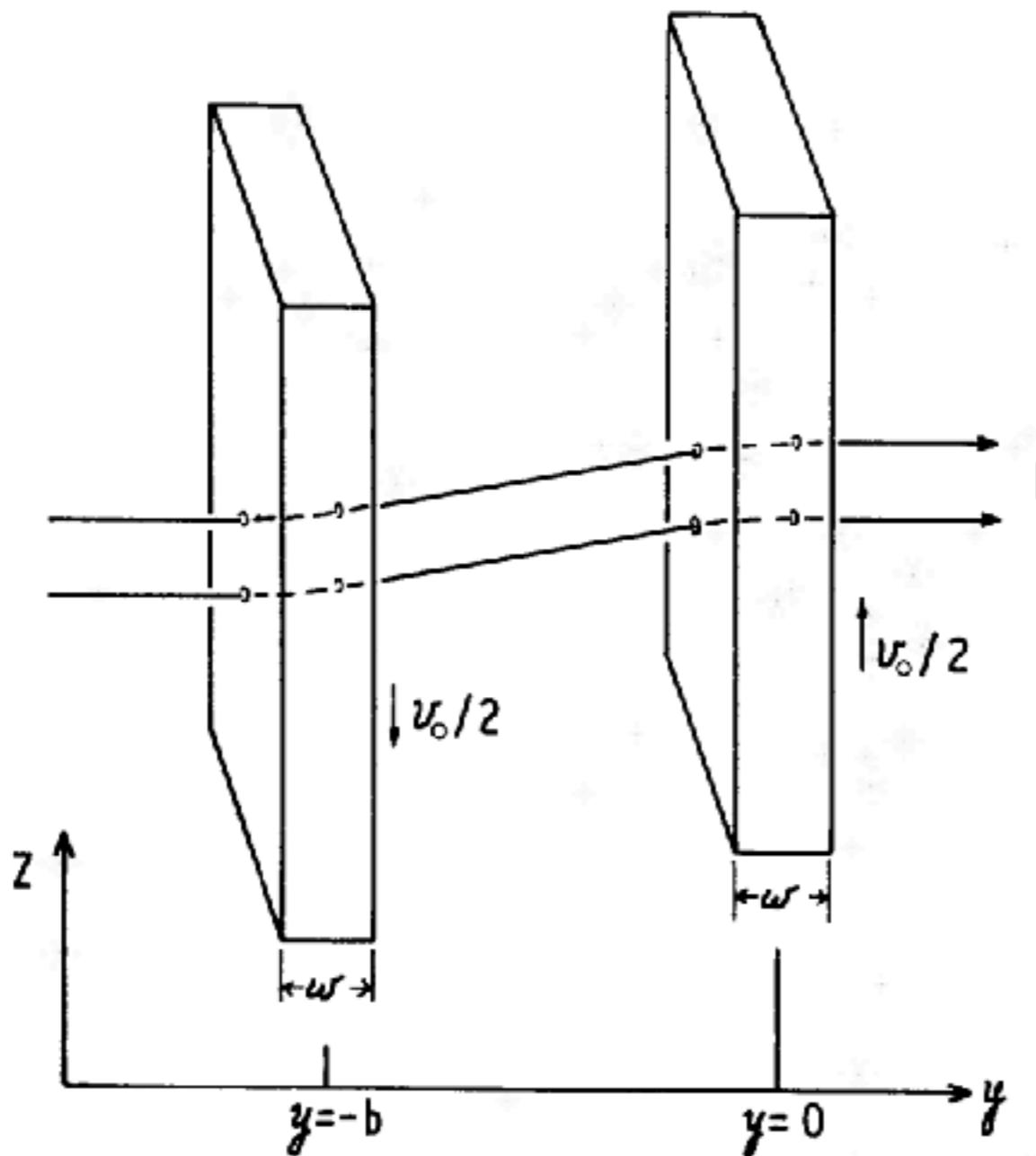
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# MAGNETIC FIELDS AND THE DYNAMICS OF MOLECULAR CLOUDS

J.L. PUGET

**KEYWORDS:** Molecular clouds evolution; Alfvèn Waves; Magnetic field; Filamentary structure; Turbulence .

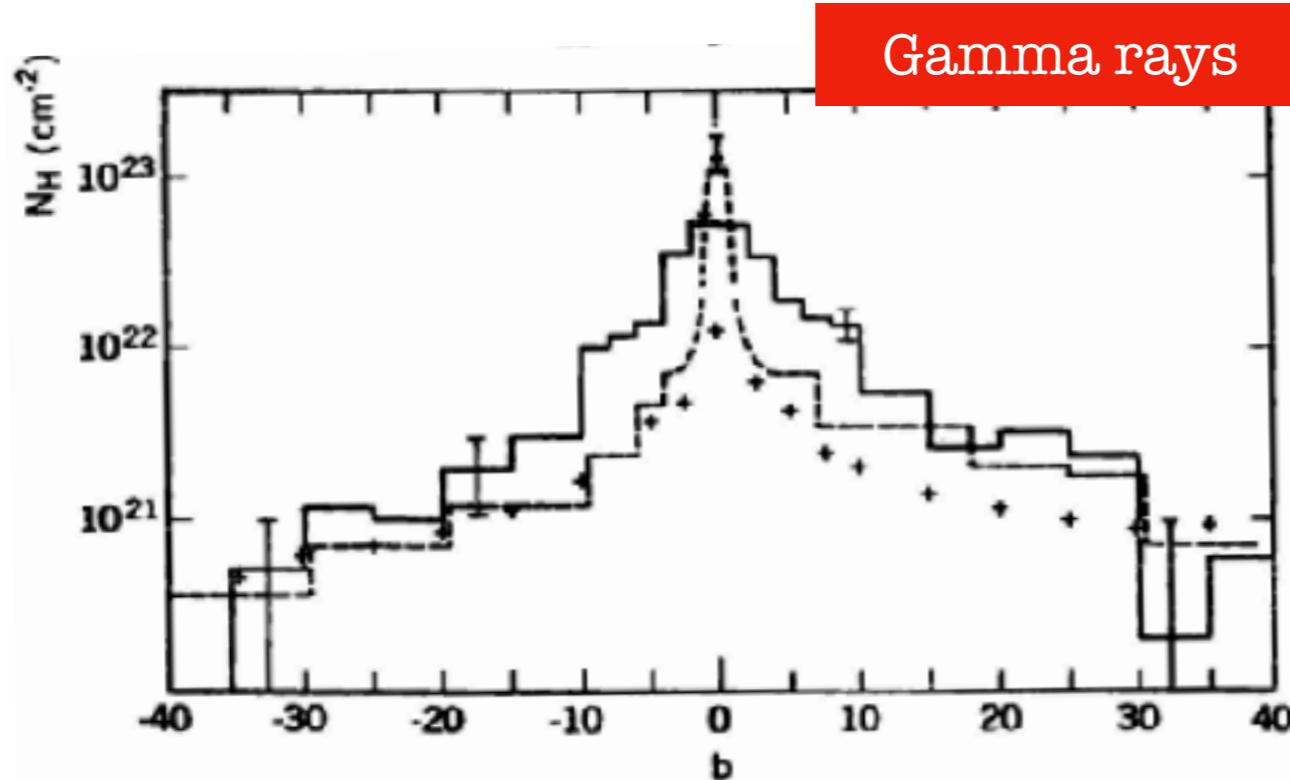


Clifford & Elmegreen. MNRAS (1983)

*Those 1980s*

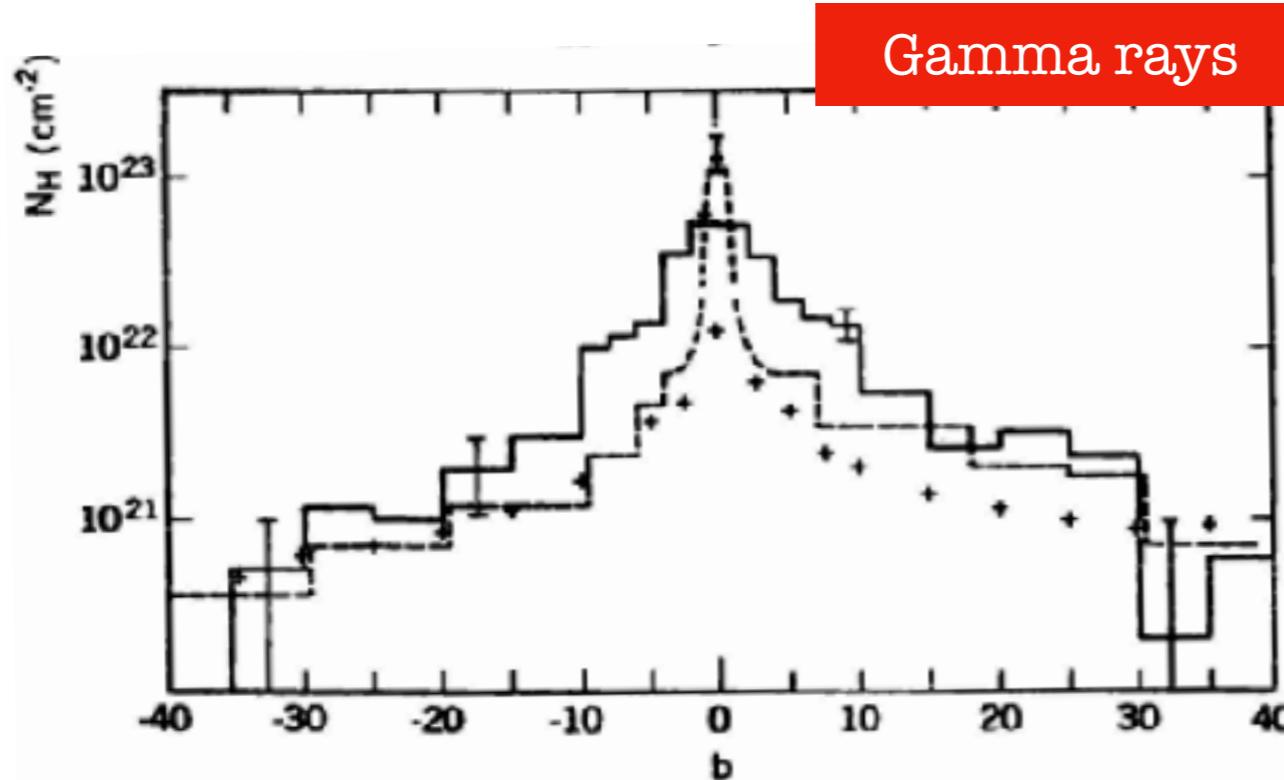
# MOLECULAR CLOUDS

# Constructing the idea of molecular clouds

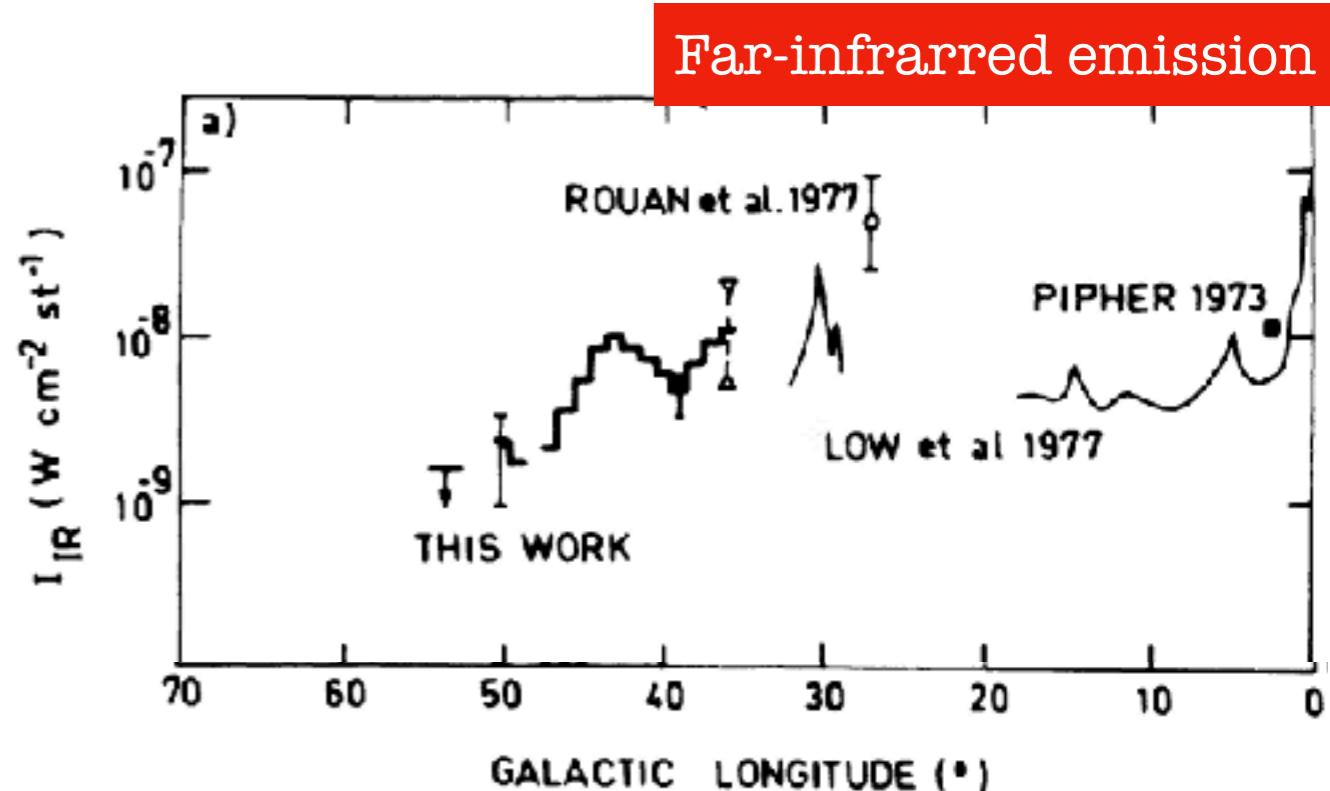


Puget, Ryter, Serra & Bignami, ICRC (1975)

# Constructing the idea of molecular clouds



Puget, Ryter, Serra & Bignami, ICRC (1975)

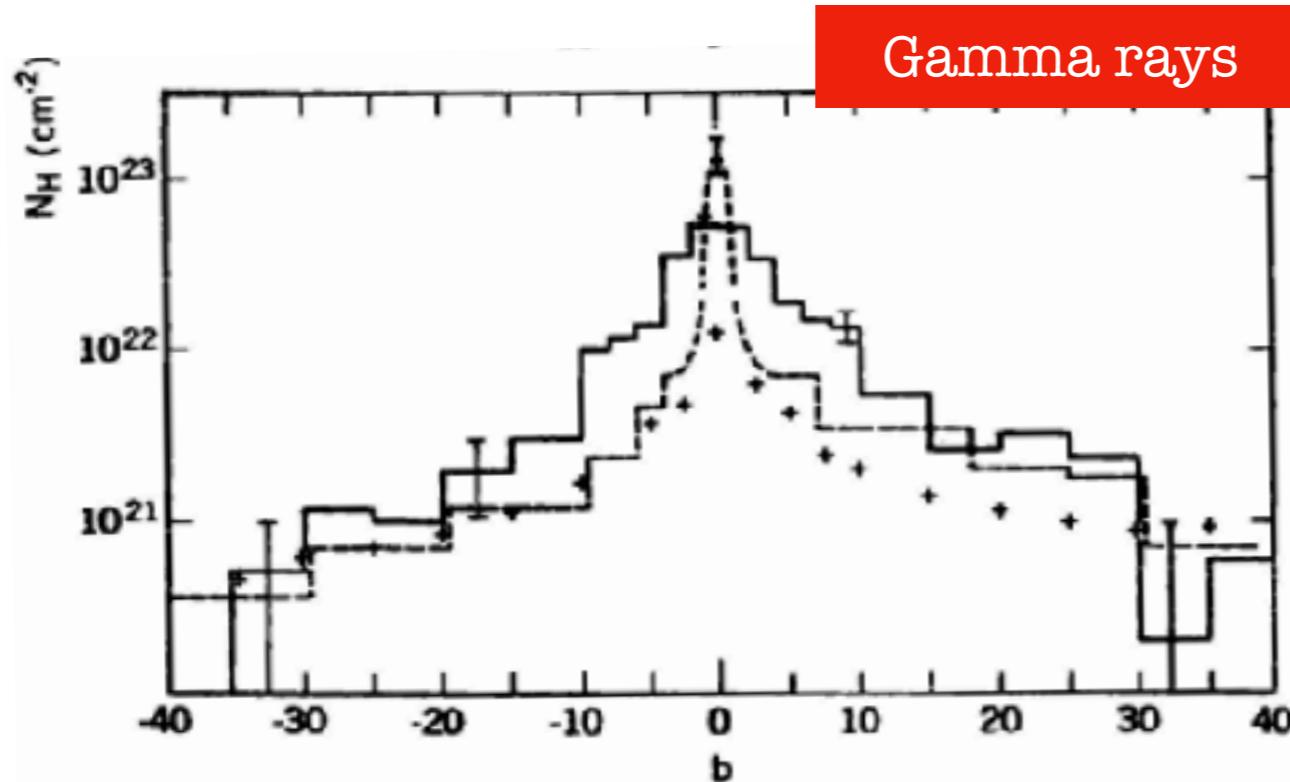


Serra, Puget, Ryter & Wijnbergen (1978)

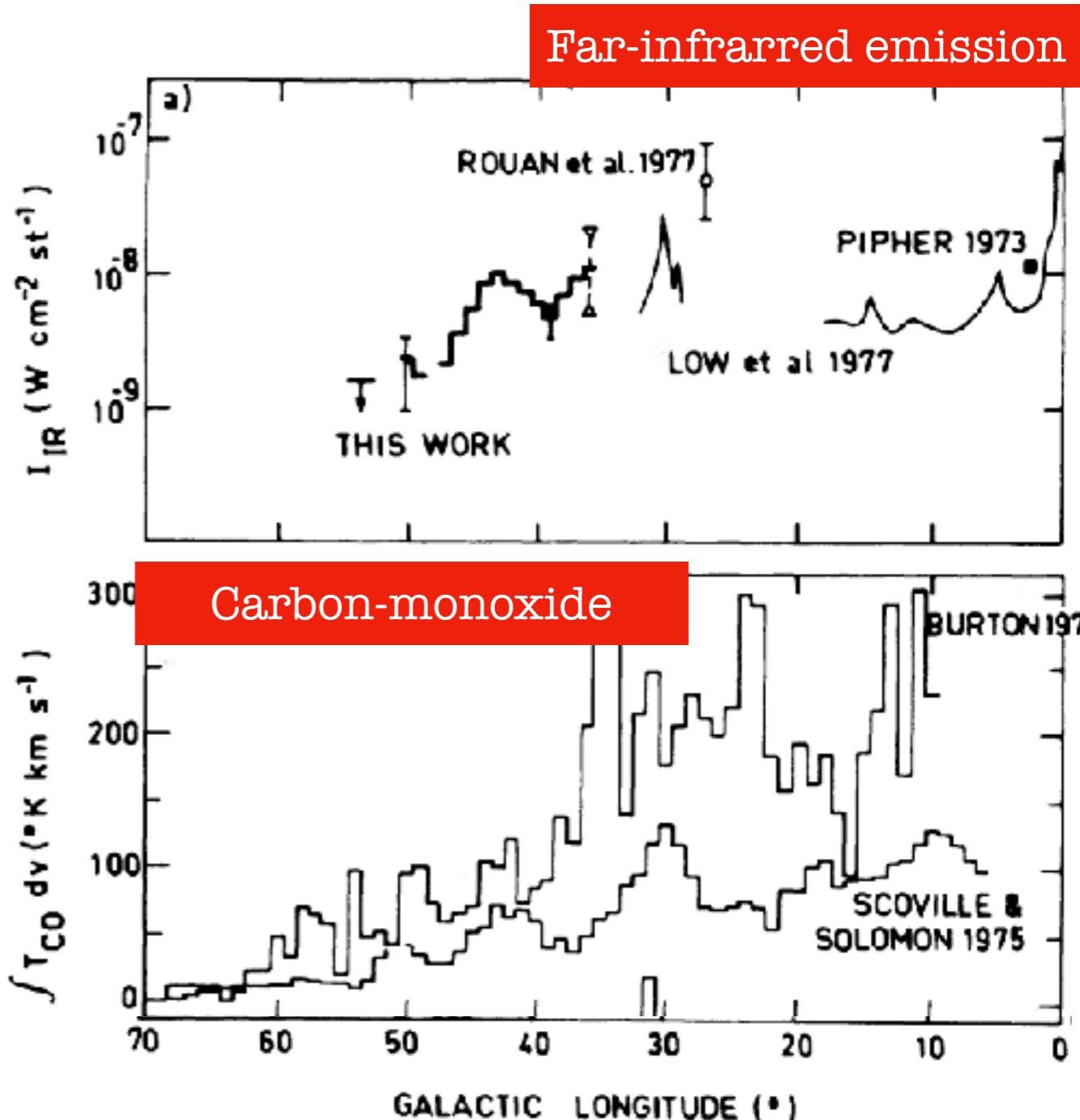


Aire sur l'Adour, France. (1970s) CNES

# Constructing the idea of molecular clouds

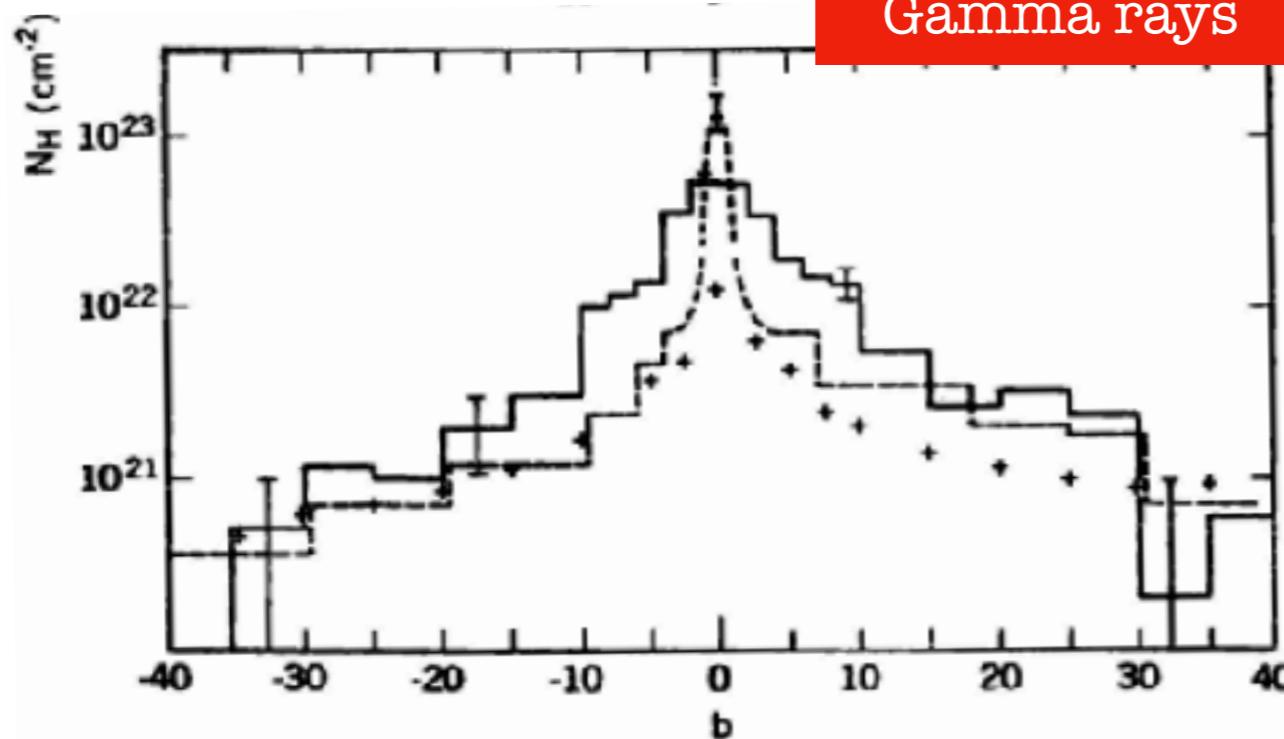


Puget, Ryter, Serra & Bignami, ICRC (1975)



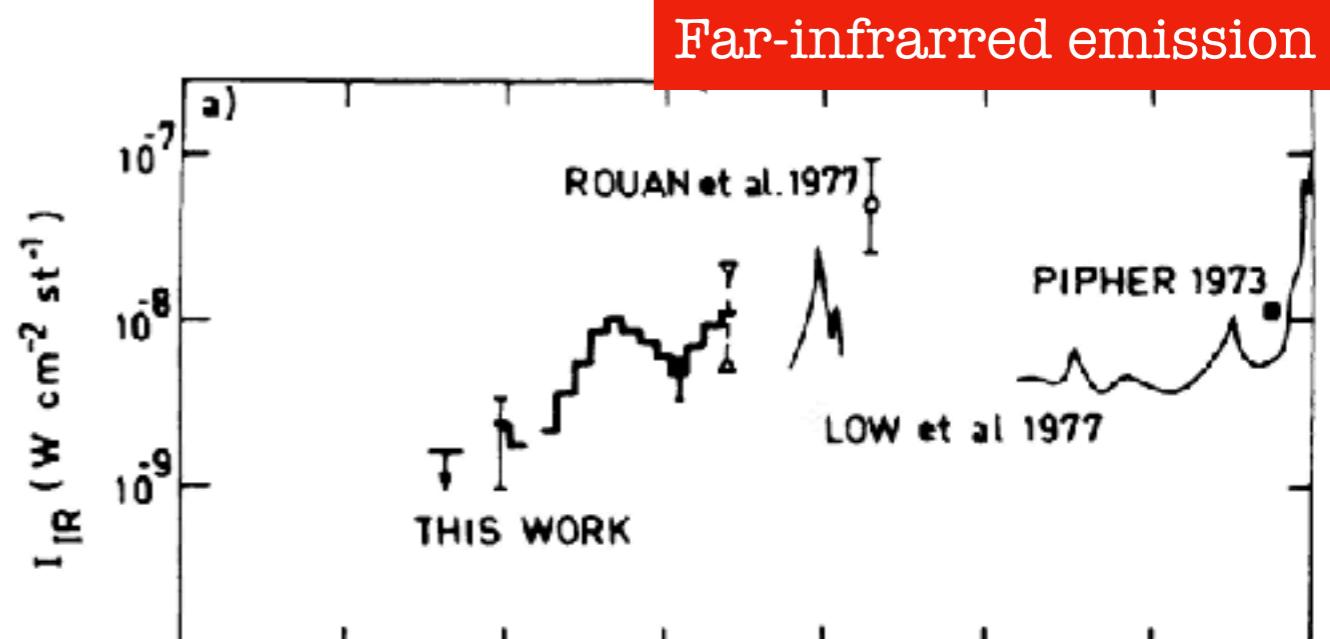
Wilson, Jefferts, Penzias. ApJ (1970)  
Scoville & Solomon. ApJ (1975)  
Péault, Falgarone & Puget. A&A (1985)

# Constructing the idea of molecular clouds

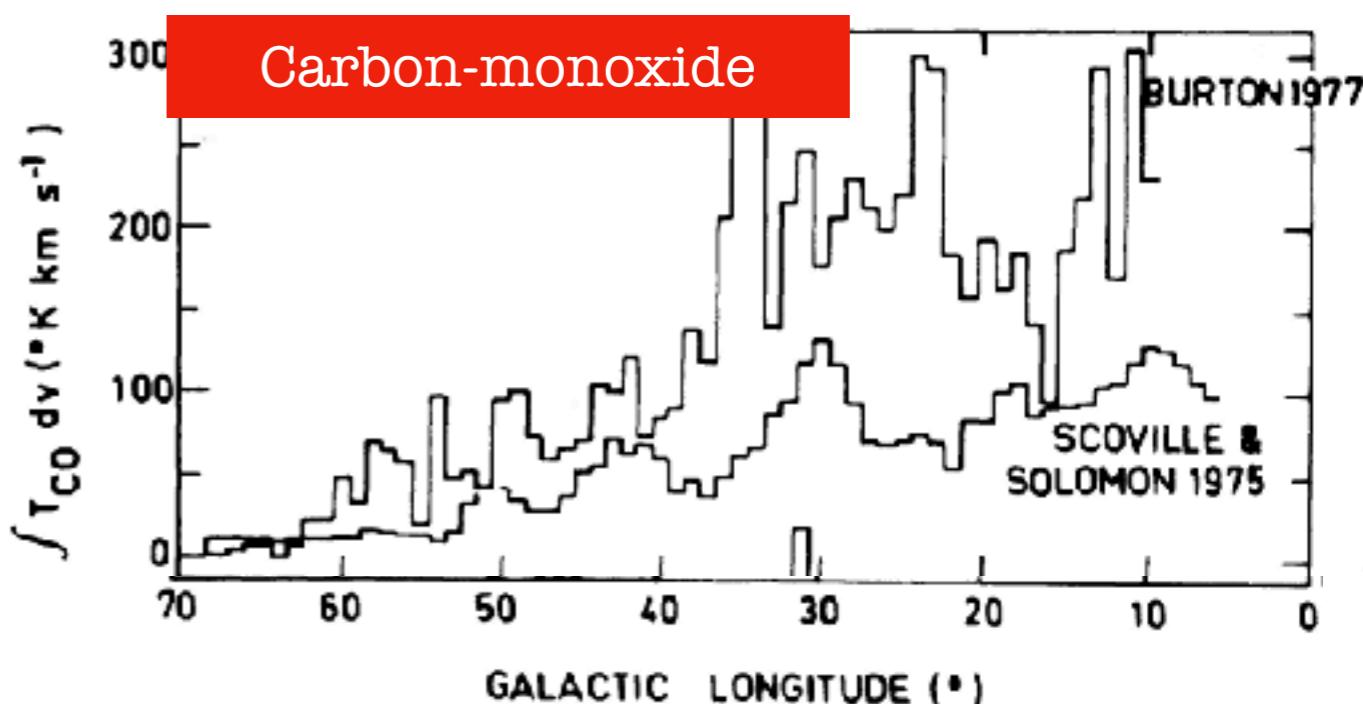


Puget, Ryter, Serra & Bignami, ICRC (1975)

Gamma rays



Far-infrared emission



Carbon-monoxide

Molecular clouds

Supersonic

Gravitationally bound

Multiphase (CNM, WNM, H<sub>2</sub>, CO)

Low filling factor (10%)

Wilson, Jefferts, Penzias. ApJ (1970)

Scoville & Solomon. ApJ (1975)

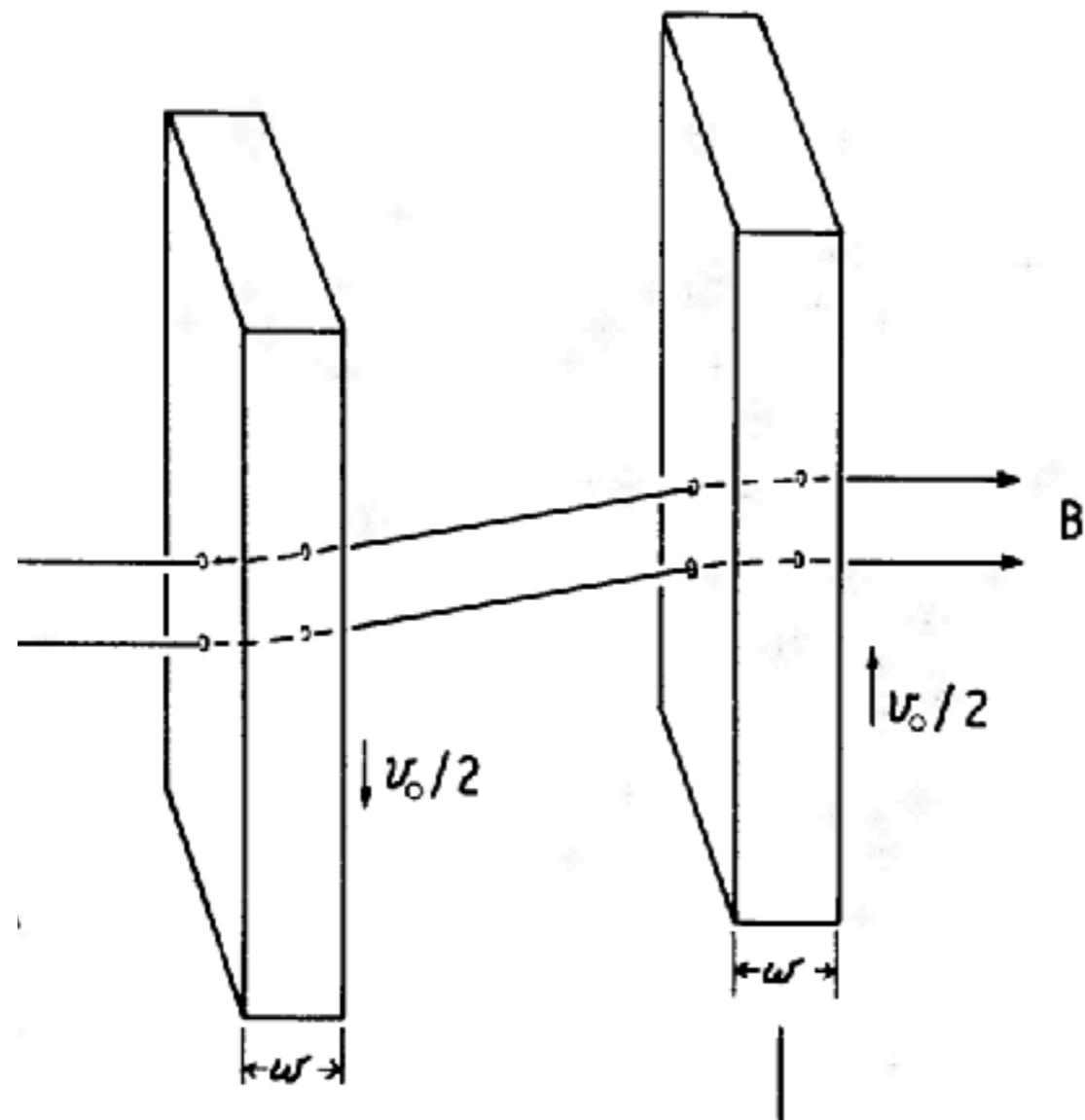
Péault, Falgarone & Puget. A&A (1985)

# Magnetic fields and the dynamics of molecular clouds (MCs)

Puget. IAUS (1991)

Falgarone & Puget. A&A (1986)

Falgaron, Puget & Pérault. A&A (1992)



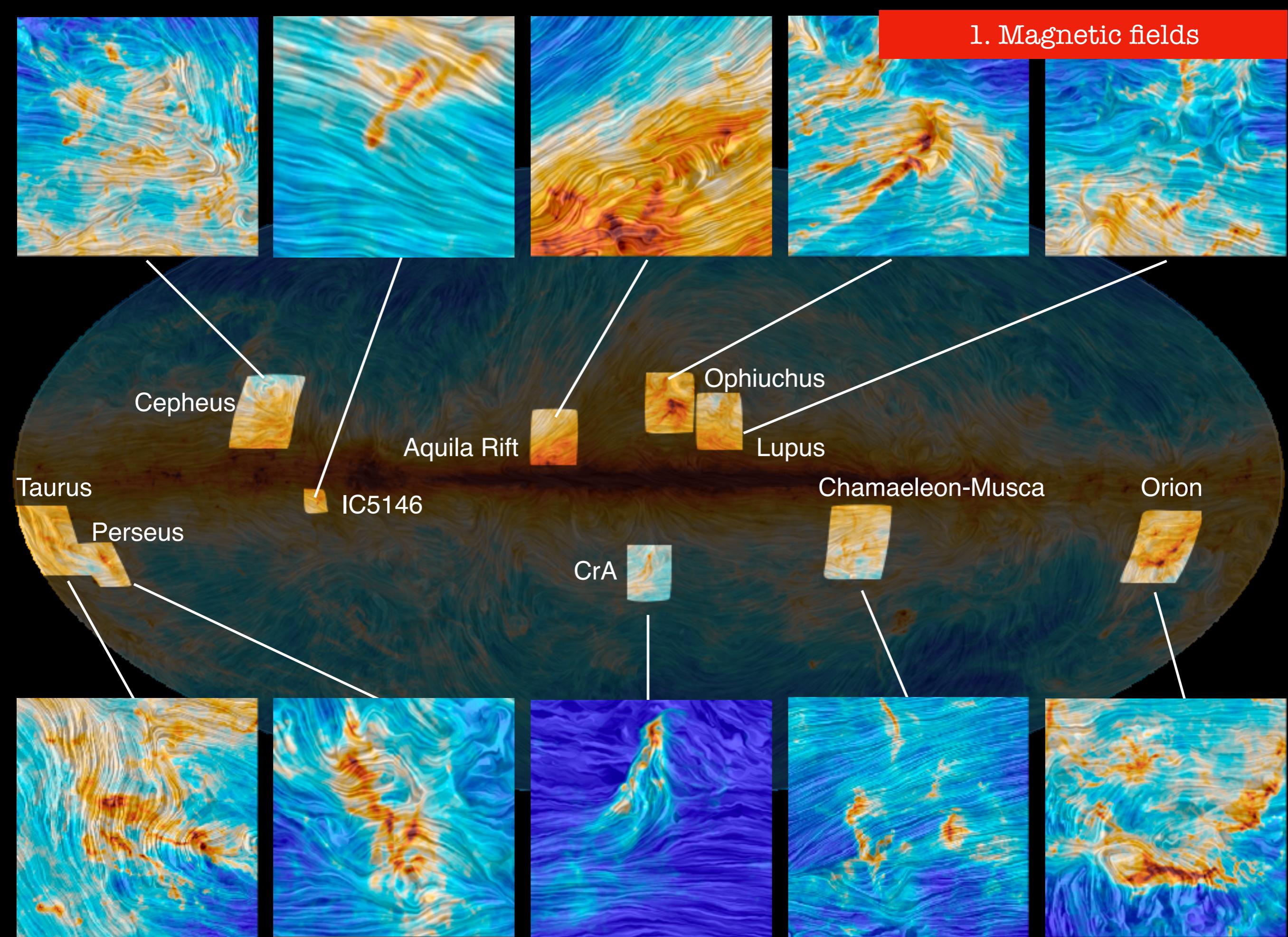
Could explain:

1. How MCs are supported against gravity.
2. How turbulence is fed into MCs.
3. How MCs are structured.

THREE NEW THINGS ABOUT

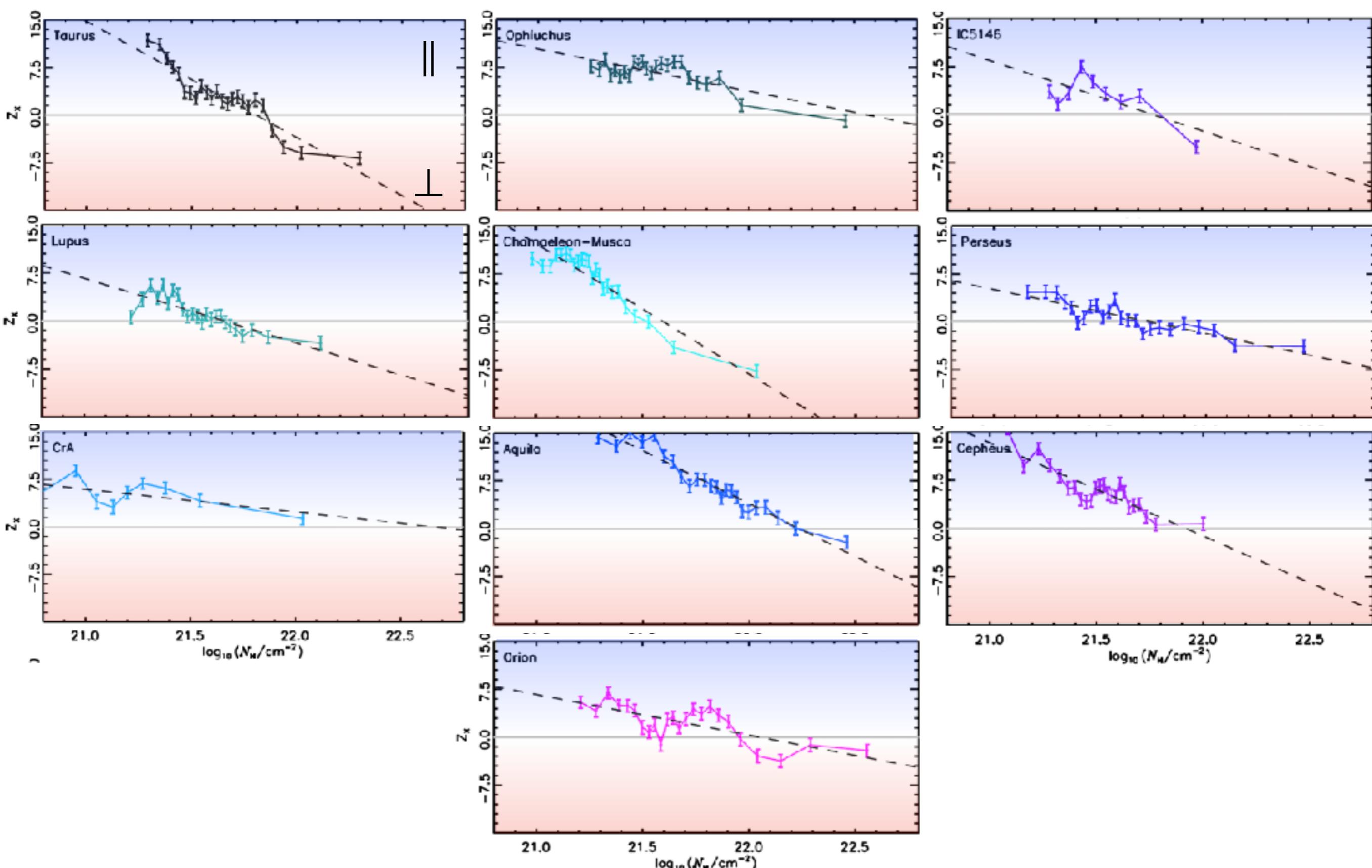
# MOLECULAR CLOUDS

# 1. Magnetic fields



# Magnetic field orientation and $N_{\text{H}}$ distribution

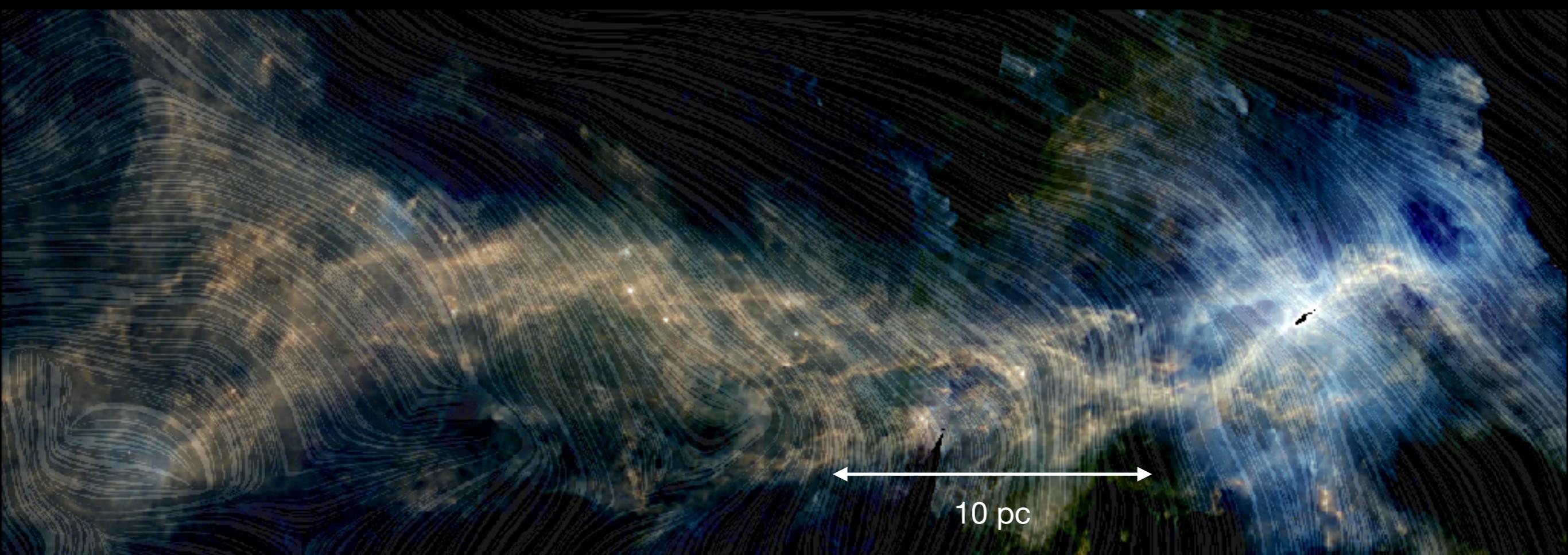
Planck XXXV (J.D. Soler et al.) A&A (2016); Jow et al. MNRAS (2018); Soler (2019)



# Orion A: $N_H$ (Herschel) and $B_{\text{Pos}}$ (Planck)

1. Magnetic fields

Soler. A&A (2019)

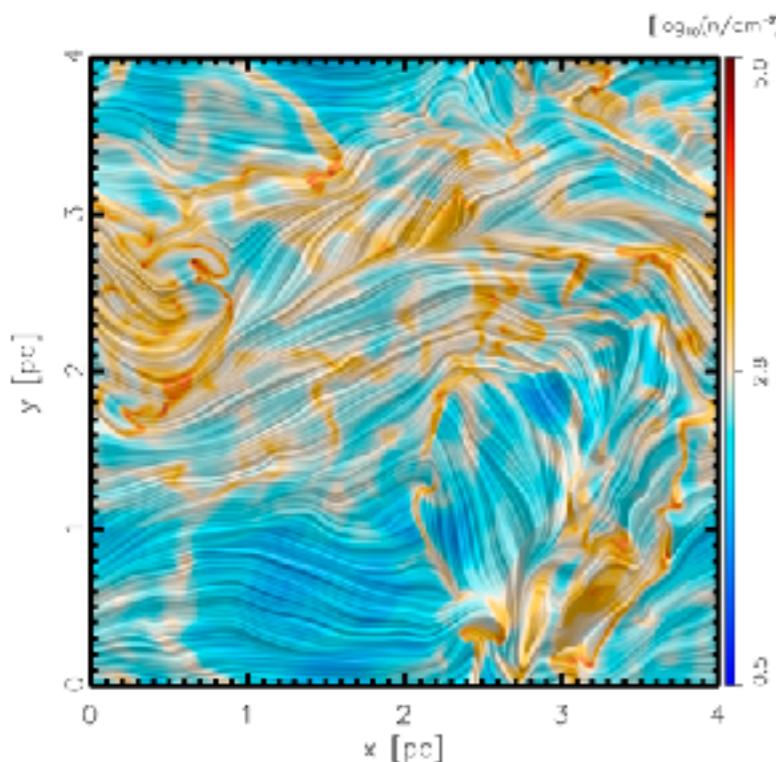


140  $\mu\text{m}$   
350  $\mu\text{m}$   
500  $\mu\text{m}$

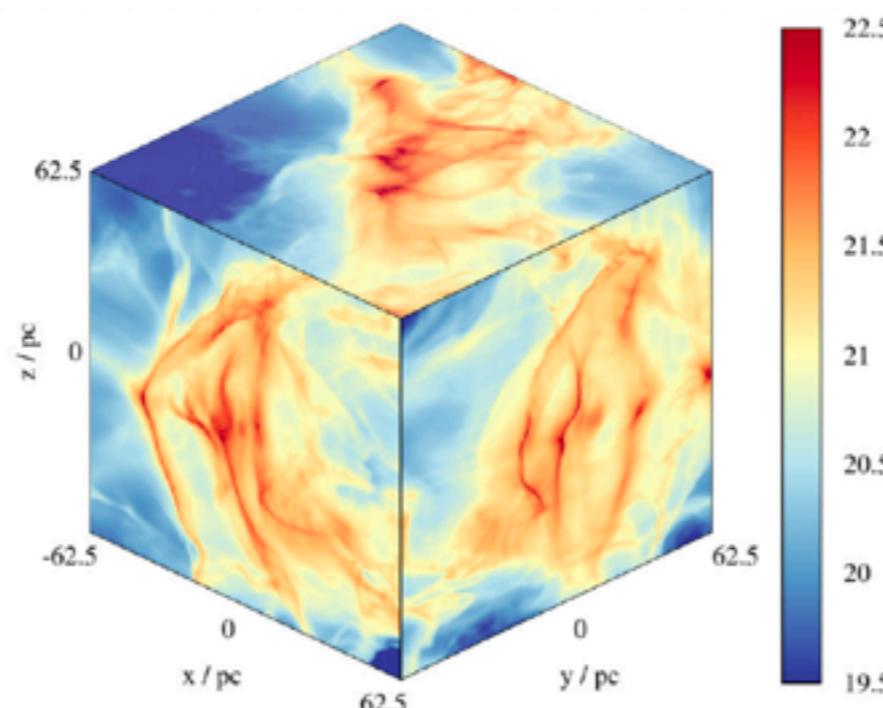
# Magnetohydrodynamic (MHD) sims

## 1. Magnetic fields

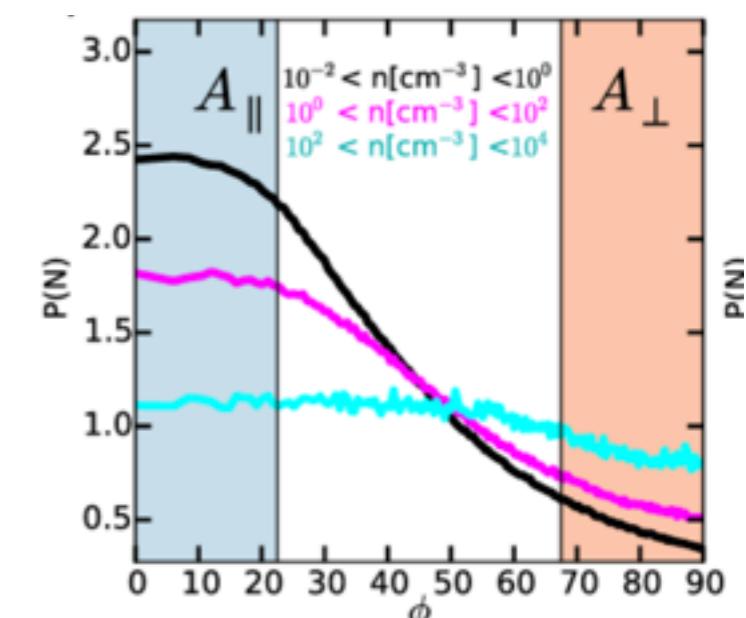
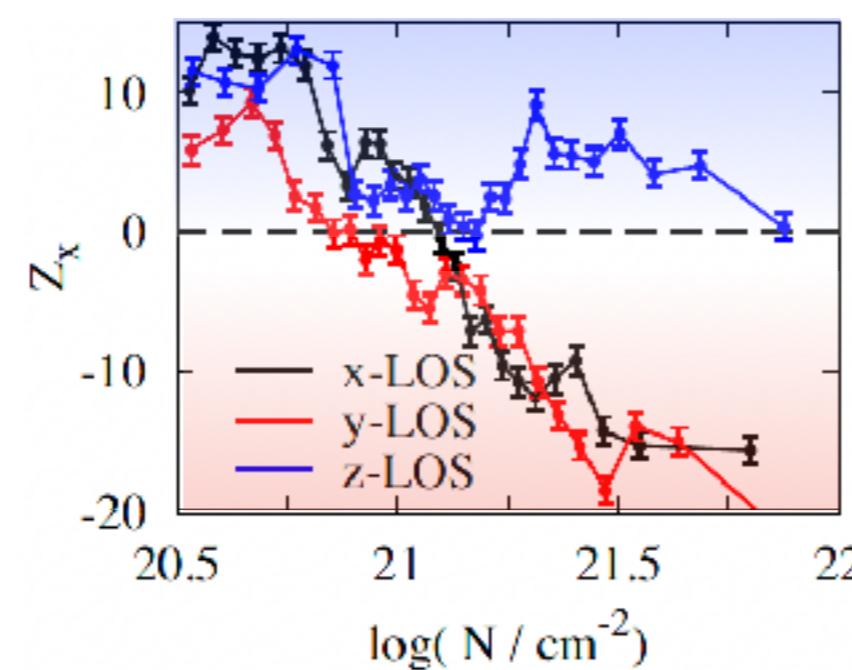
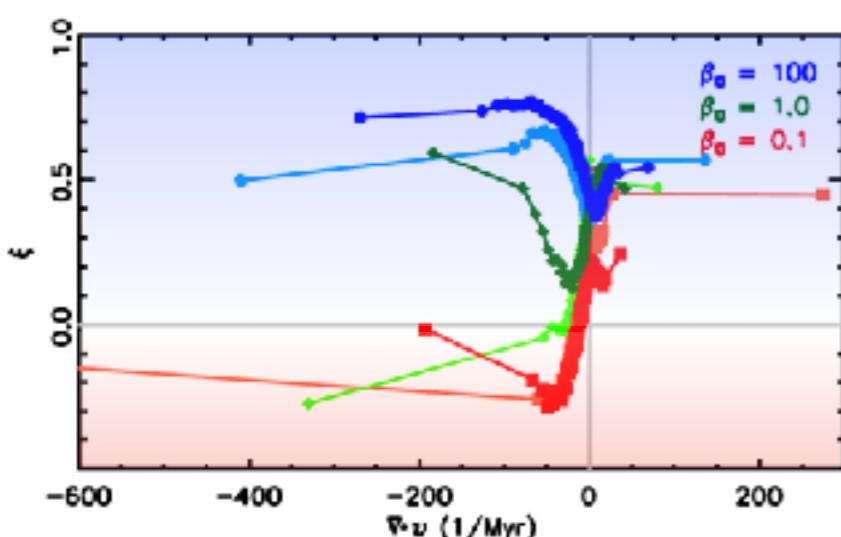
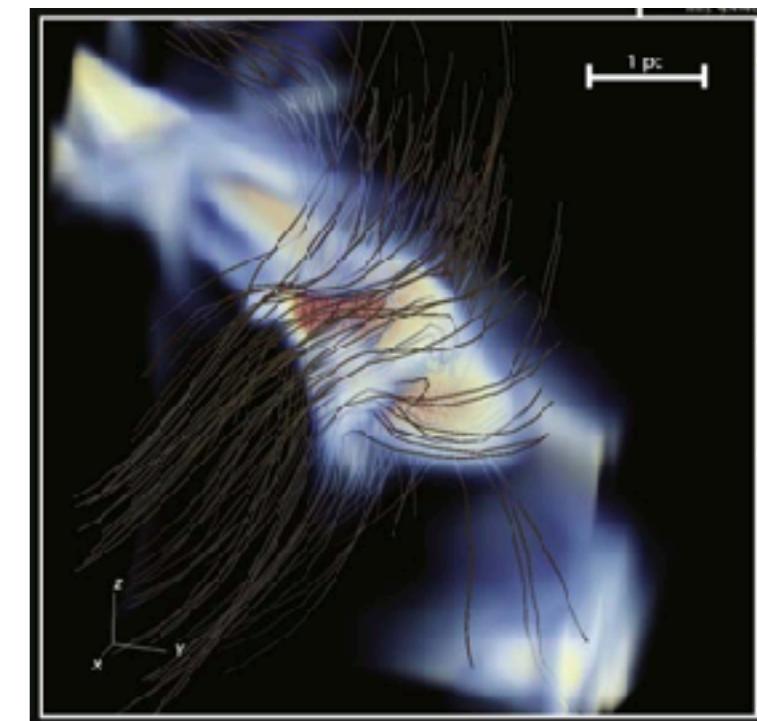
Soler & Hennebelle (2016)



Seifried et al. (2020)



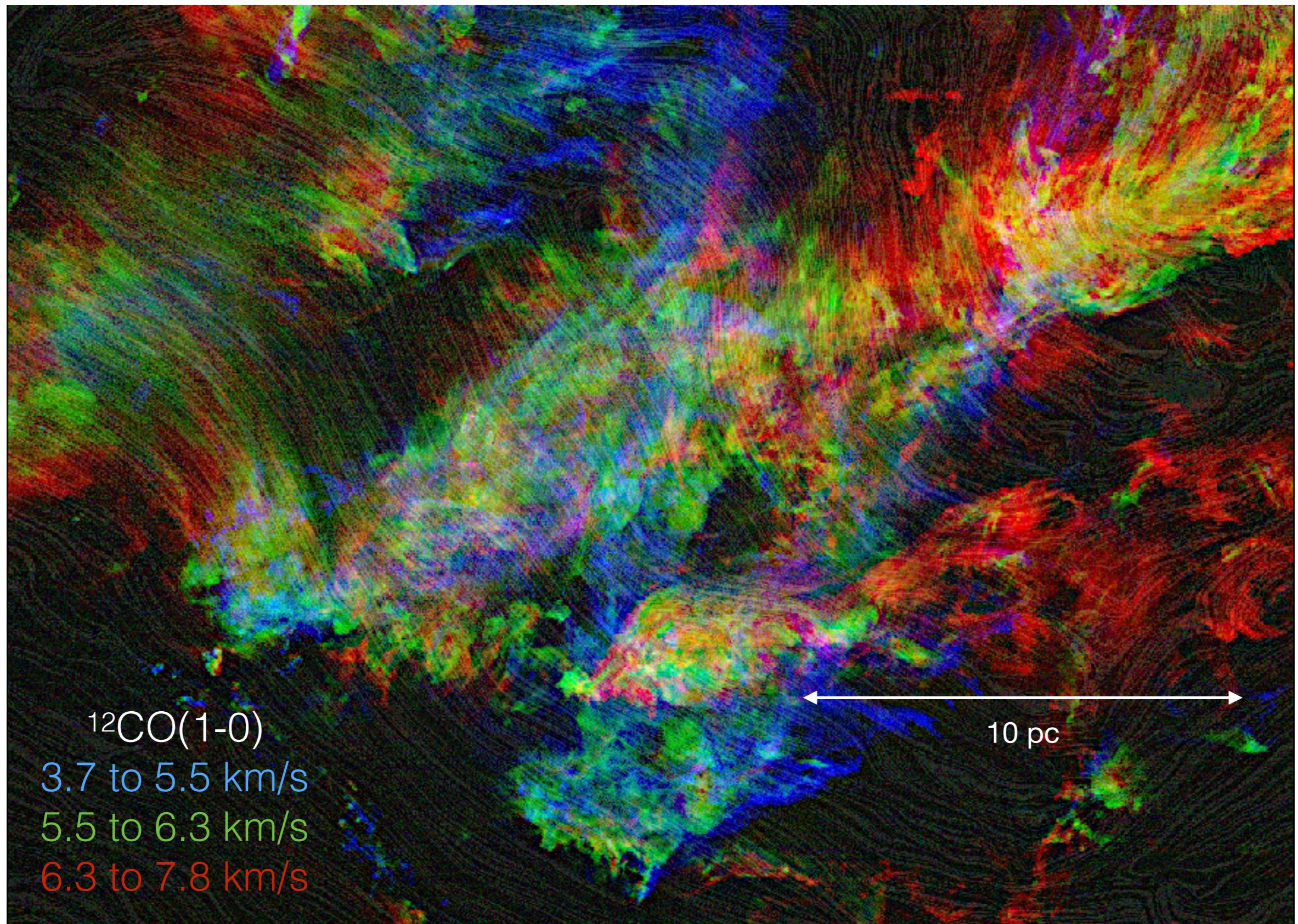
Ibáñez-Mejía, Mac Low & Klessen (2022)



# B<sub>PO</sub>s and CO emission

## 1. Magnetic fields

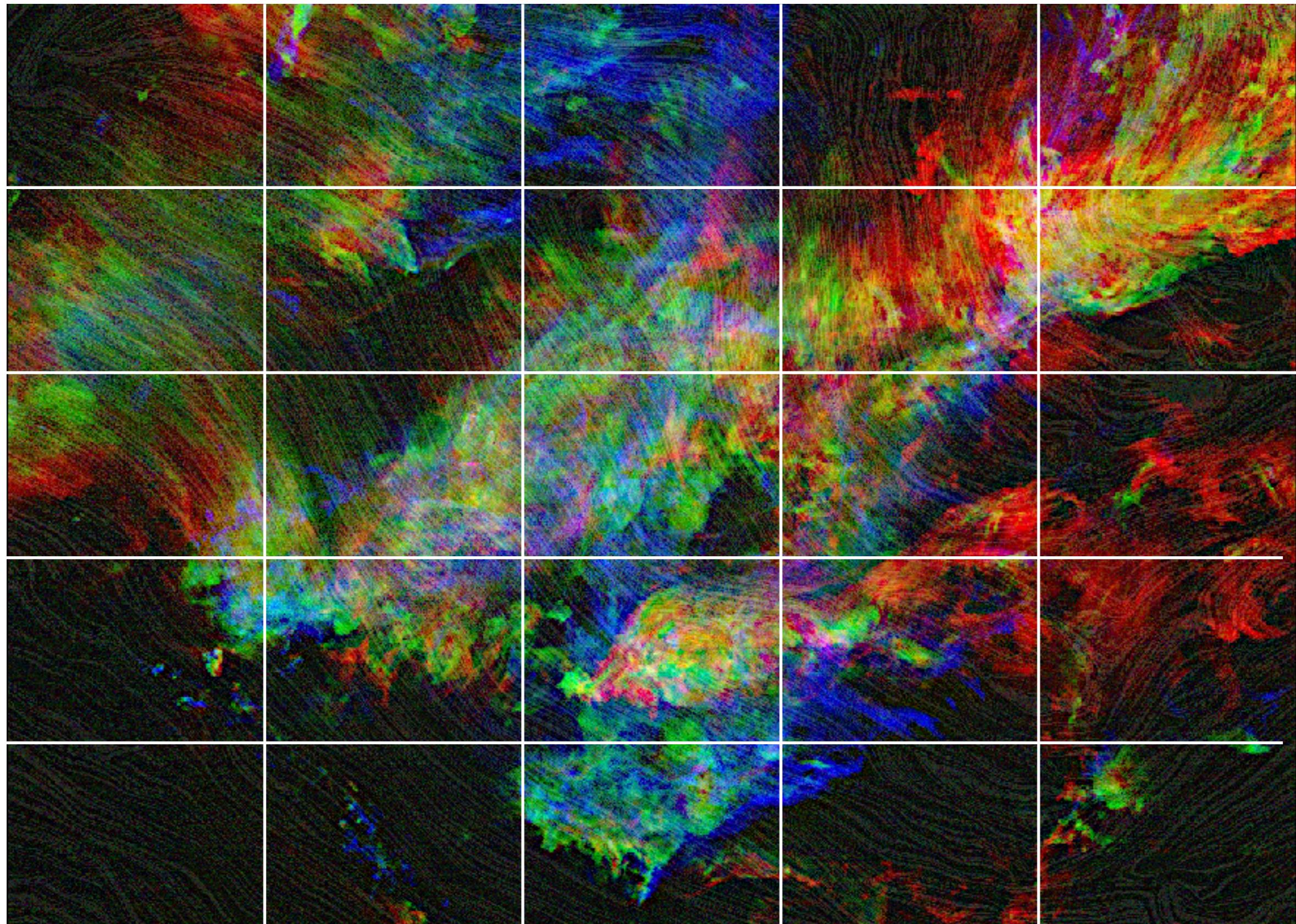
Heyer, Soler & Burkhart. MNRAS (2020)



# B<sub>PO</sub>s and CO emission

## 1. Magnetic fields

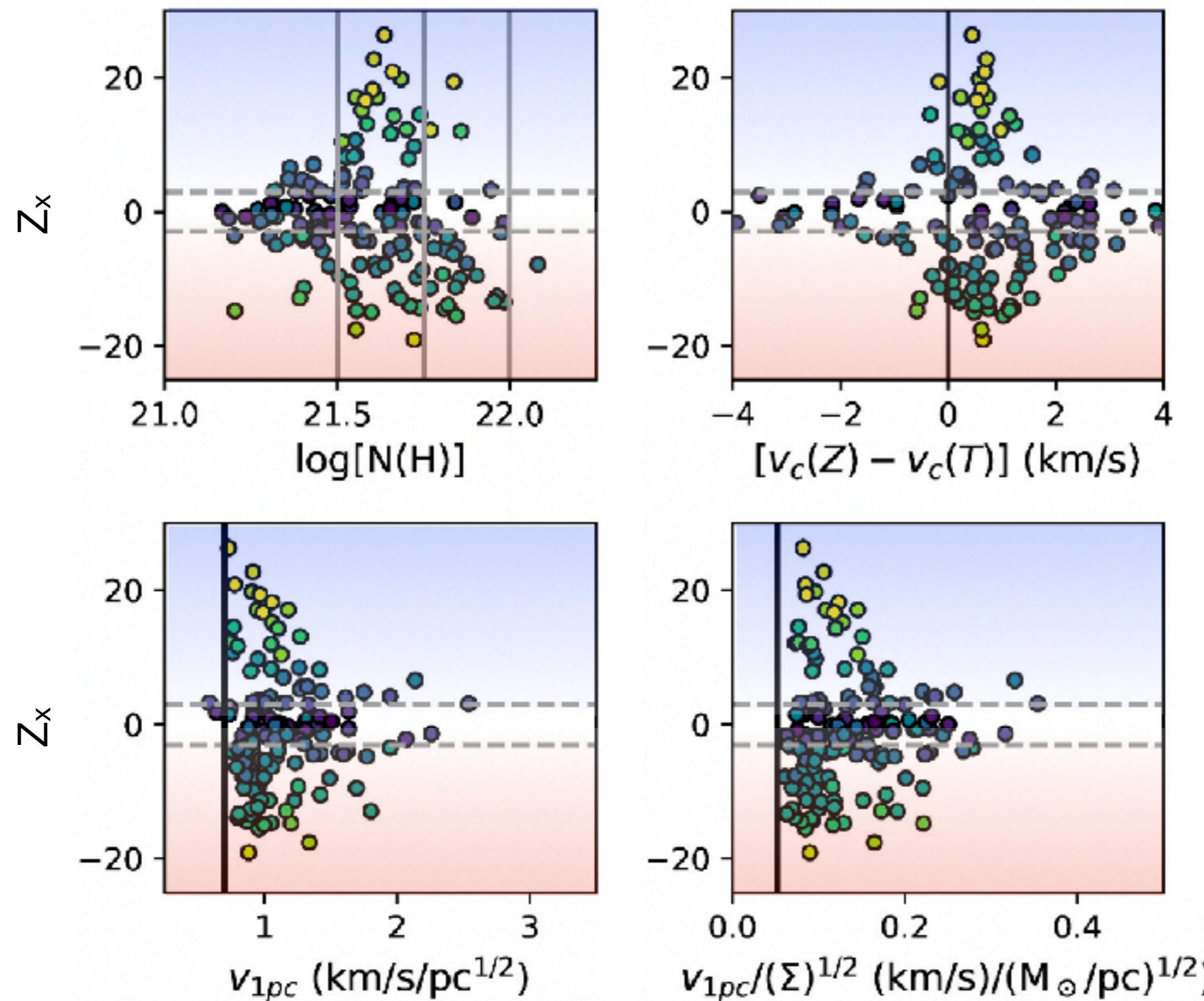
Heyer, Soler & Burkhart. MNRAS (2020)



# BPos and CO emission

## 1. Magnetic fields

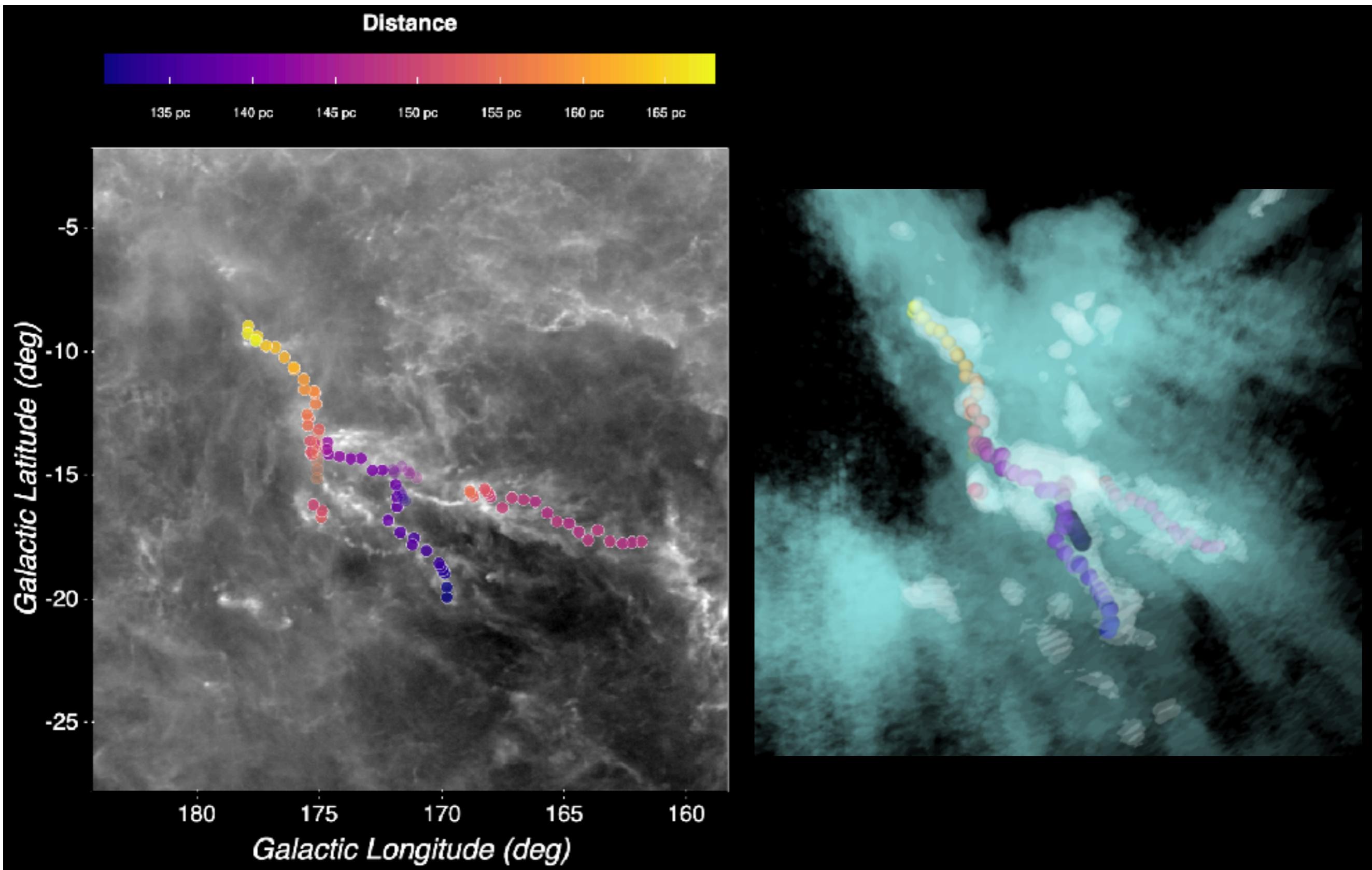
Heyer, Soler & Burkhart. MNRAS (2020)



# The dynamics of the Taurus MC

3. Dust in 3D

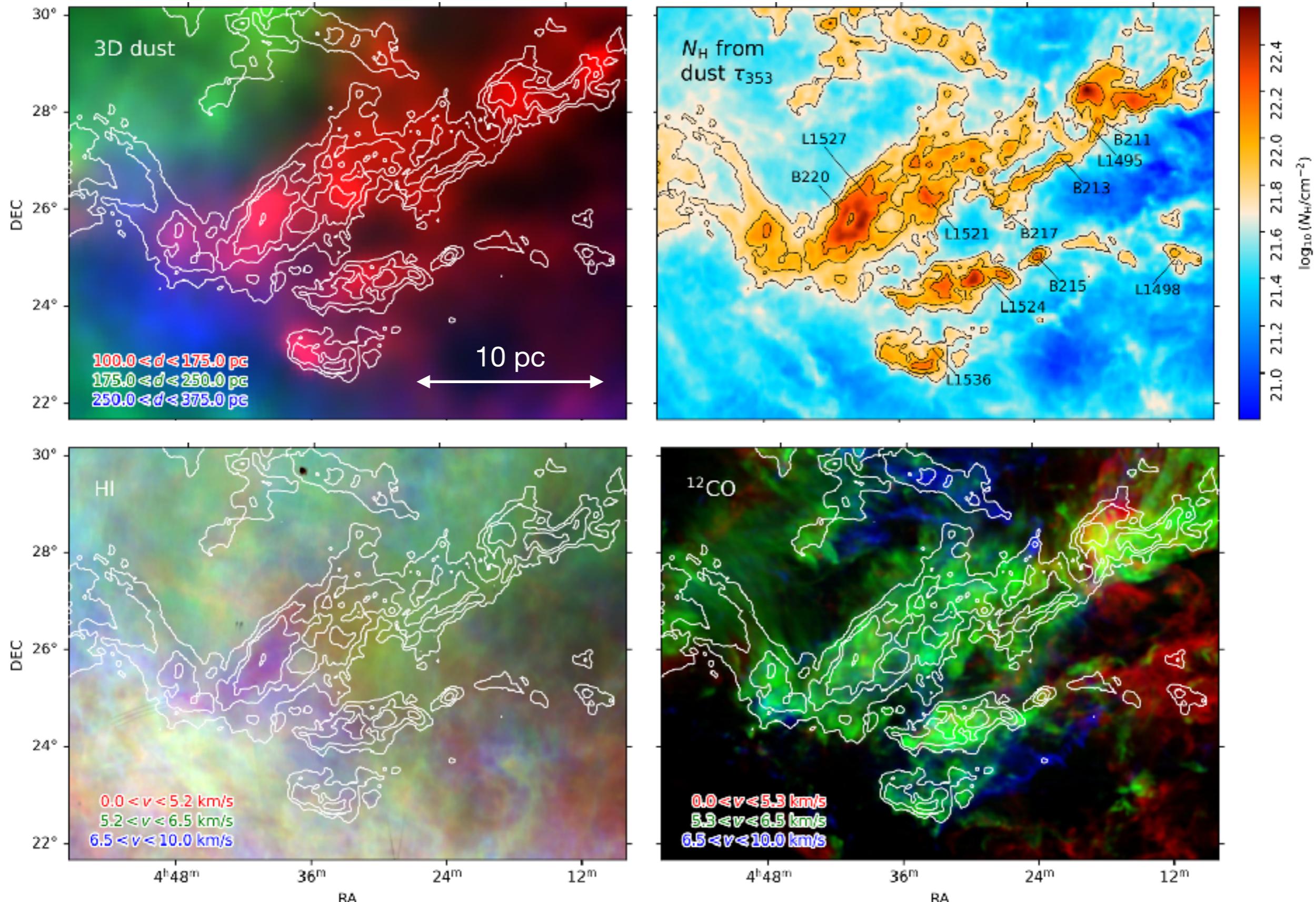
Zucker et al. ApJ (2019/2020/2022); Leike & Enßlin. A&A (2019/2020)



# The dynamics of the Taurus MC

3. 3D dust

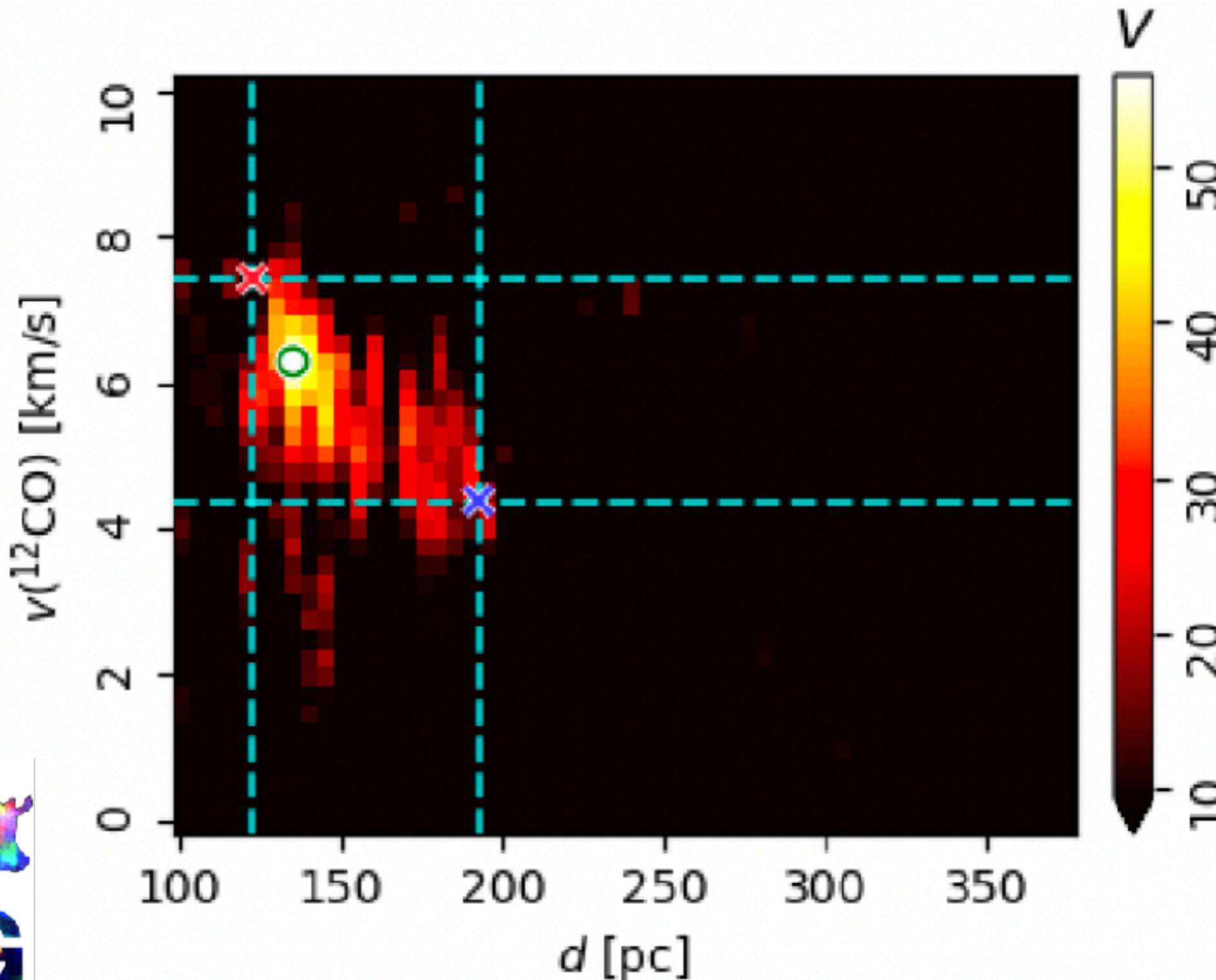
Soler, Zucker, et al. A&A (2023)



# The dynamics of the Taurus MC

3. 3D dust

Soler, Zucker, et al. A&A (2023); Soler et al. A&A (2019)

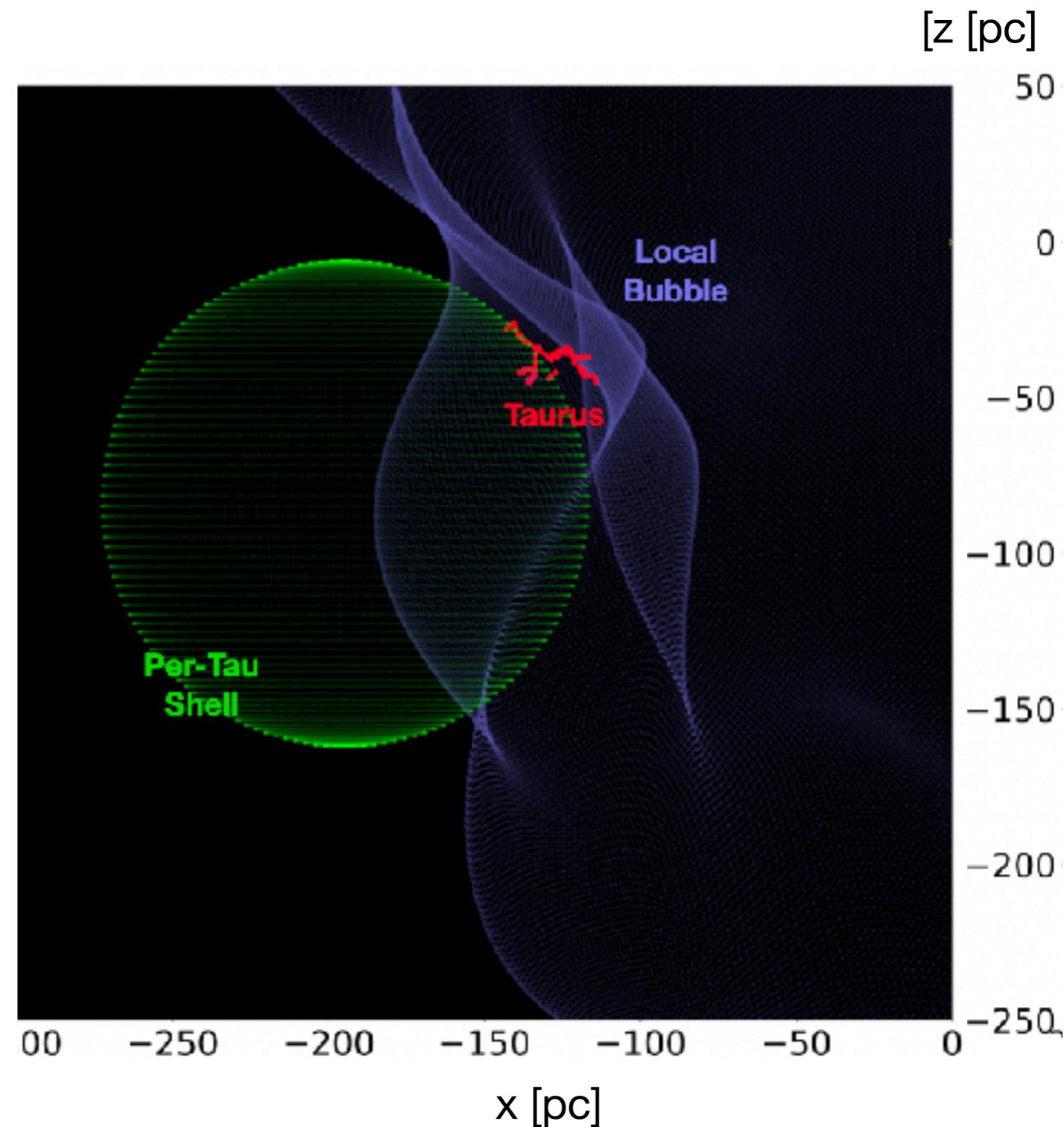
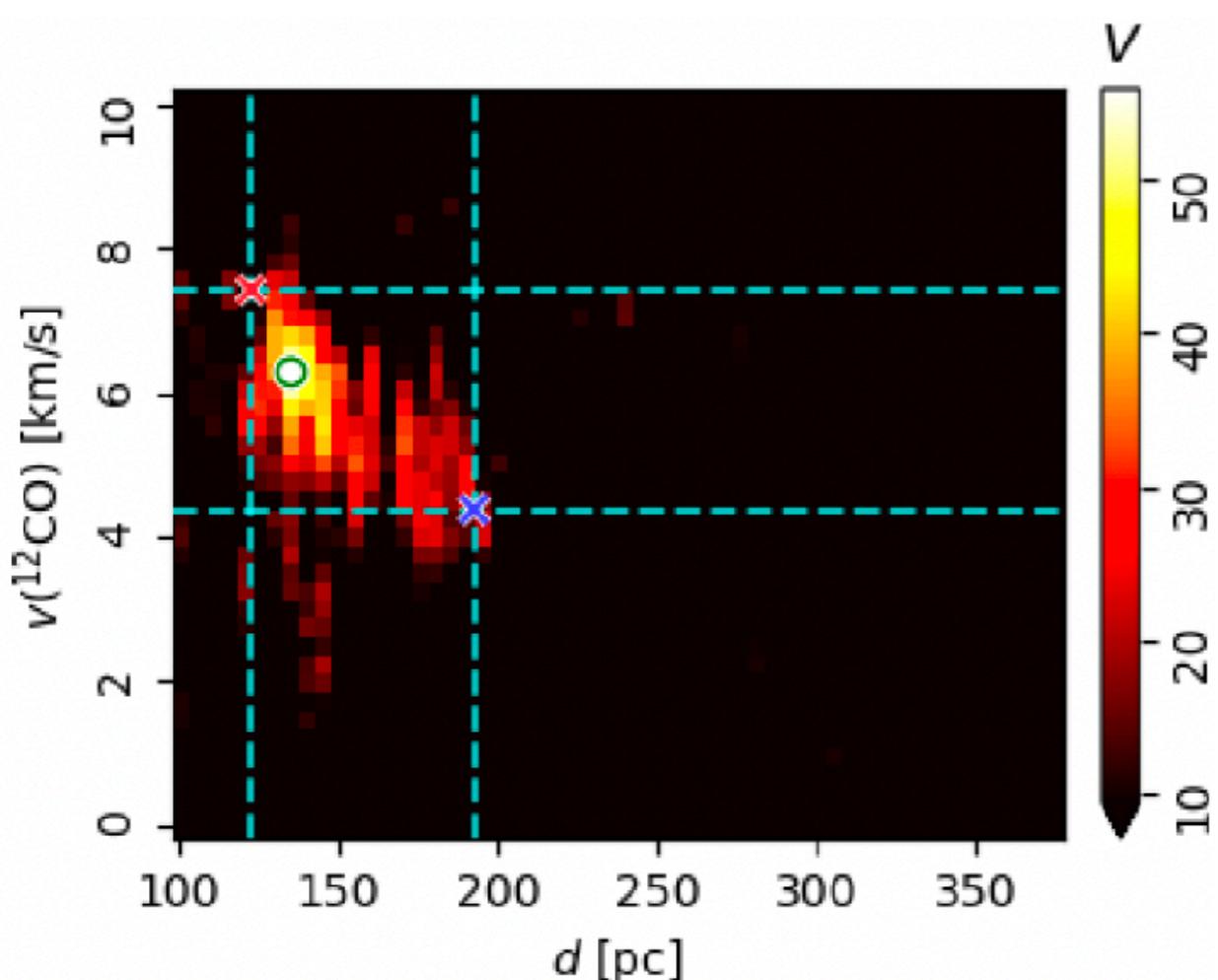


Soler et al. A&A (2019)

# The dynamics of the Taurus MC

3. 3D dust

Soler, Zucker, et al. A&A (2023); Soler et al. A&A (2019)



# Magnetic fields and the dynamics of MCs

from Puget 1991 to Planck and beyond

