Cold Structures in the Interstellar Medium

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FAPESP
The LLAMA Workshop
FAPESP, São Paulo, August 8-9, 2011

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Cold Structures in the ISM with LLAMA

Stars, their planets… and possible life within…

originate in the magnificent gaseous clouds of the Interstellar Medium (ISM) – the pillars of life

The pillars of life

What are they?

What is their origin?

How do they evolve downwards to stars and planets?

What are they?

Cold and dense structures that form the ISM

Also known as molecular clouds

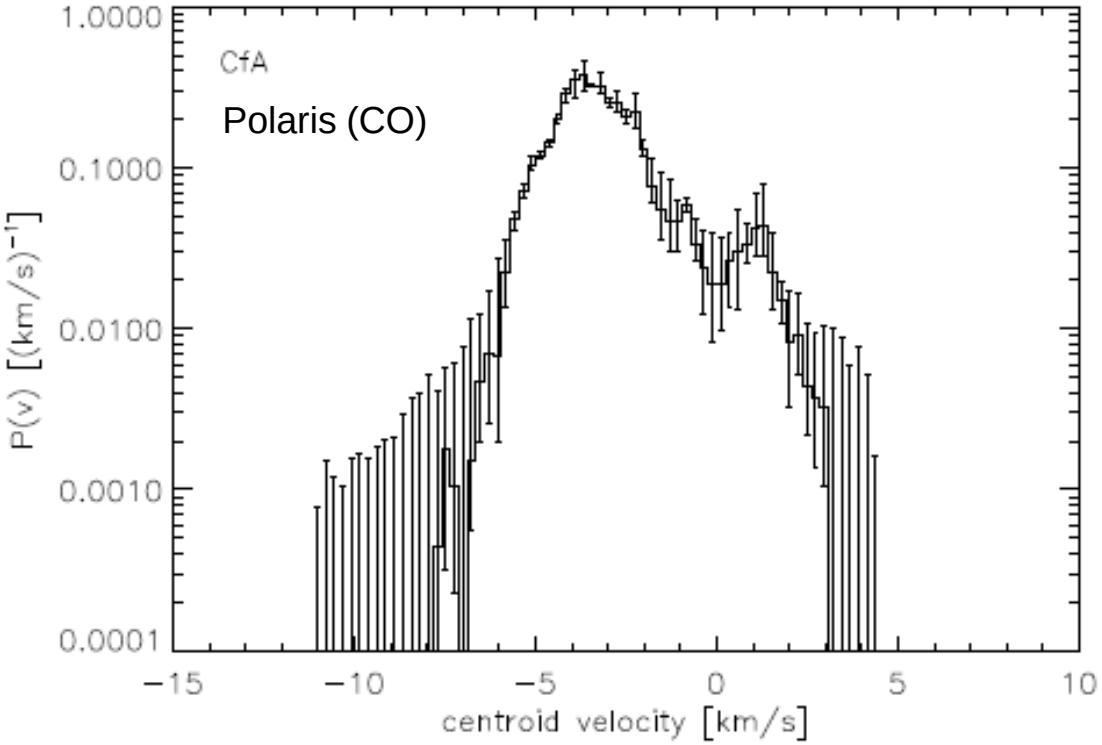
What is their origin and how they evolve?

There are many theories that attempt to answer both questions

It is still not completely clear yet

Though **turbulence** may be the key!

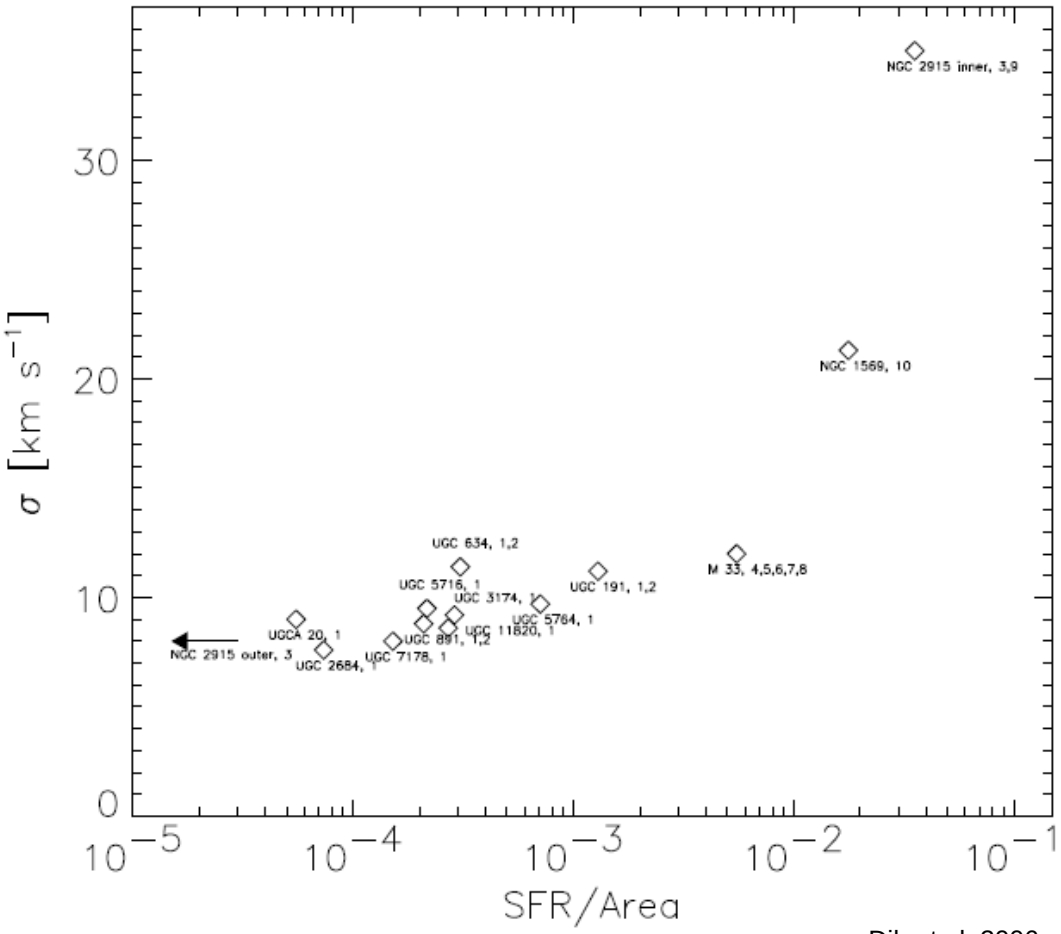
Turbulence in the ISM



$$\sigma_{térm} \cong 0.15 \pm 0.01 \text{ (km/s)}$$

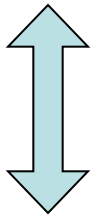
$$\sigma_{turb} \cong 5.0 \pm 0.1 \text{ (km/s)}$$

Turbulence in the ISM



Dib et al. 2006

Star formation



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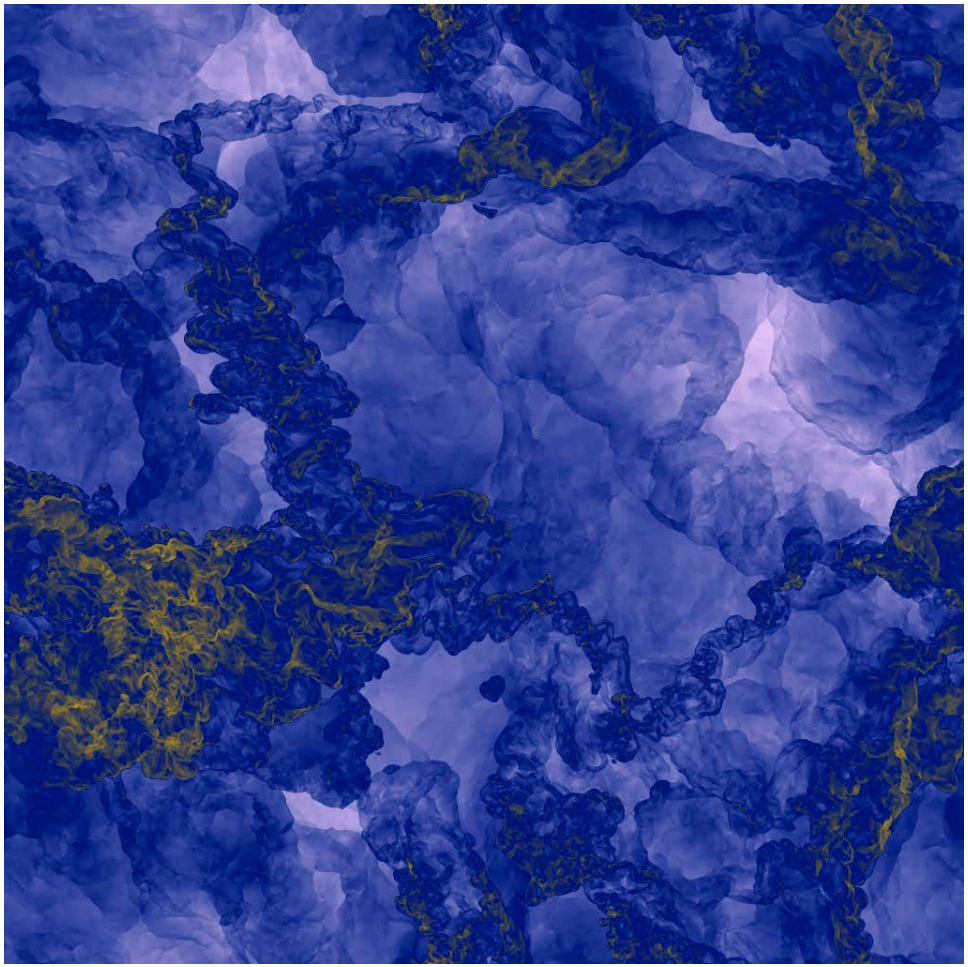
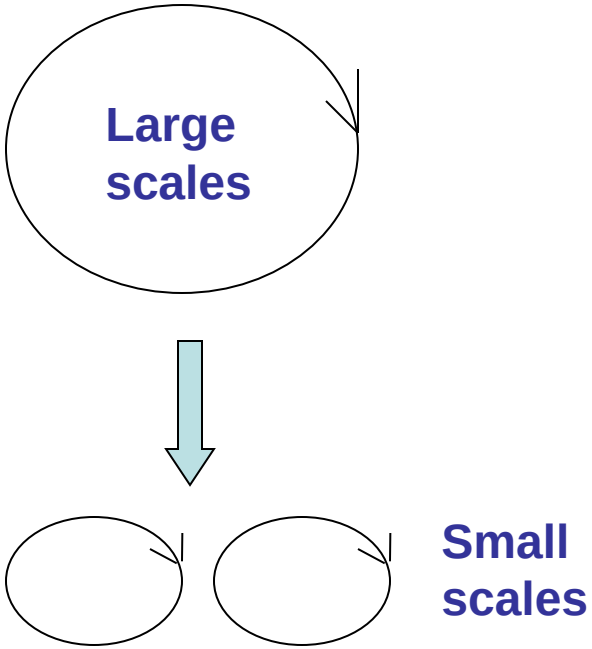
Turbulence

Turbulence in simulated ISM



Falceta-Goncalves et al. 2008, 2010

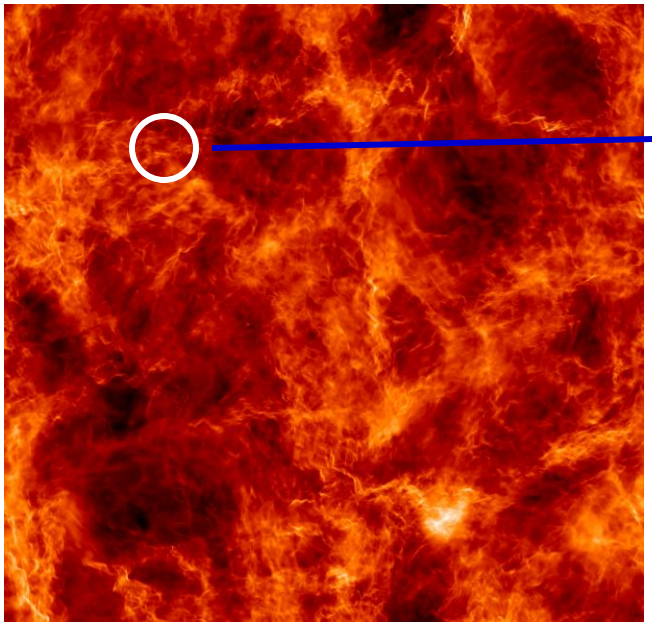


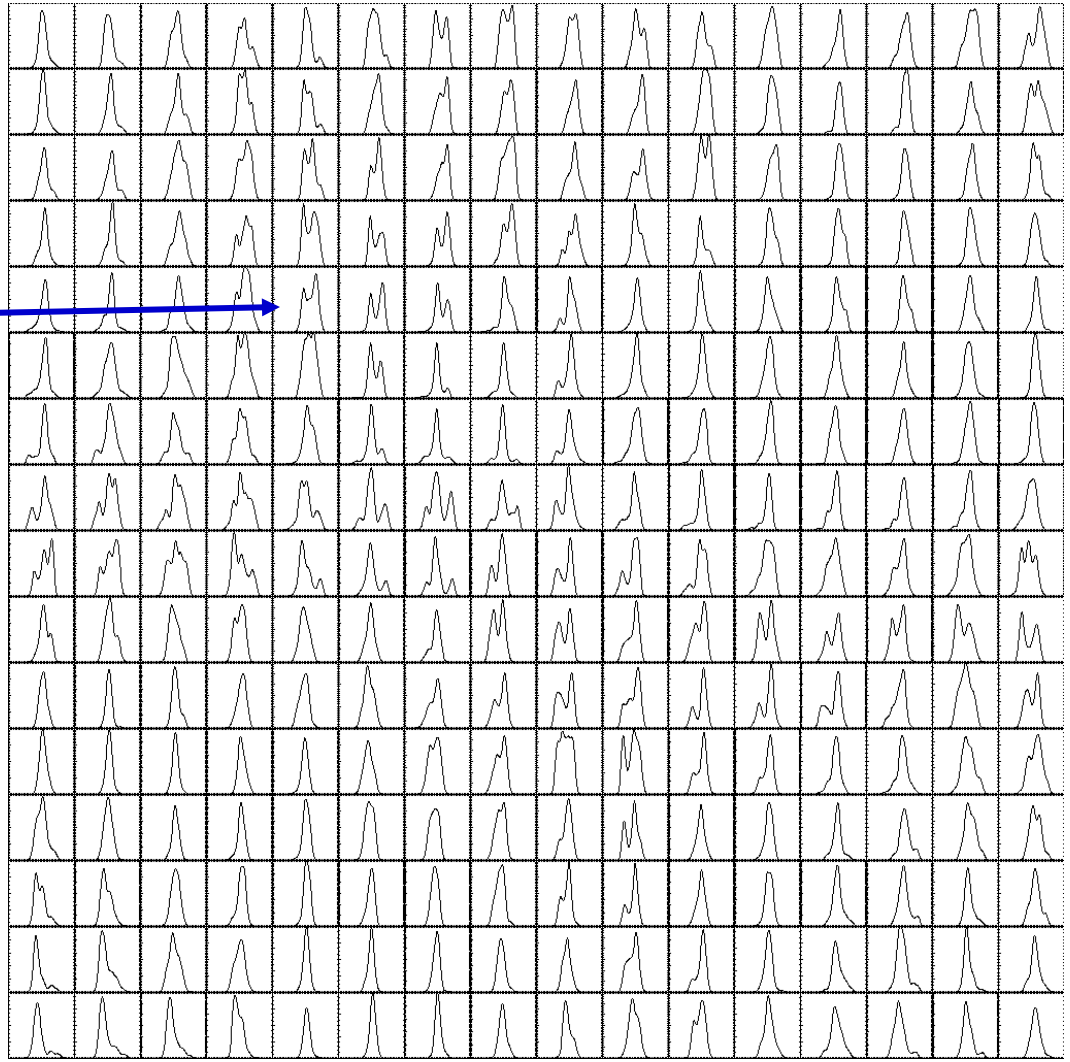
$$P(k) \propto k^{-\alpha}$$

being $k_{max} \sim 1/L_{damp}$

~ 0.01pc !!

The need for high resolution observations





Falceta-Goncalves & Lazarian 2011

Cold structures in the ISM with LLAMA

Basic capabilities at 100GHz

Examples of multiple bright line configurations possible

Band	Species/transition	Frequency
3	HCO^+ 1-0	89.188
	HCN 1-0	88.632
	CH_3OH	101.293
	H_2CO	101.333

Angular resolution for Band 3 $\theta \cong$ **0.006”**

If a cloud is **1kpc** away, the spatial resolution $\cong 10^{-5}$ pc (few AU)

Spectral lines: few hours – 10mJy sensitivity

Δv = 0.1 km/s

Perspectives

- **Thermal and turbulent velocities at A.U. scales!**
- **Statistical distribution of dense cores within the clouds**
  - **sizes**
  - **number**
- **Dynamics of clumps = testing models of star formation efficiency**
- **Combining spectral lines of ionized and neutral molecules, constrain the magnetic field of the molecular clouds**
  - **independently on Zeeman or polarization**
- **… much more**