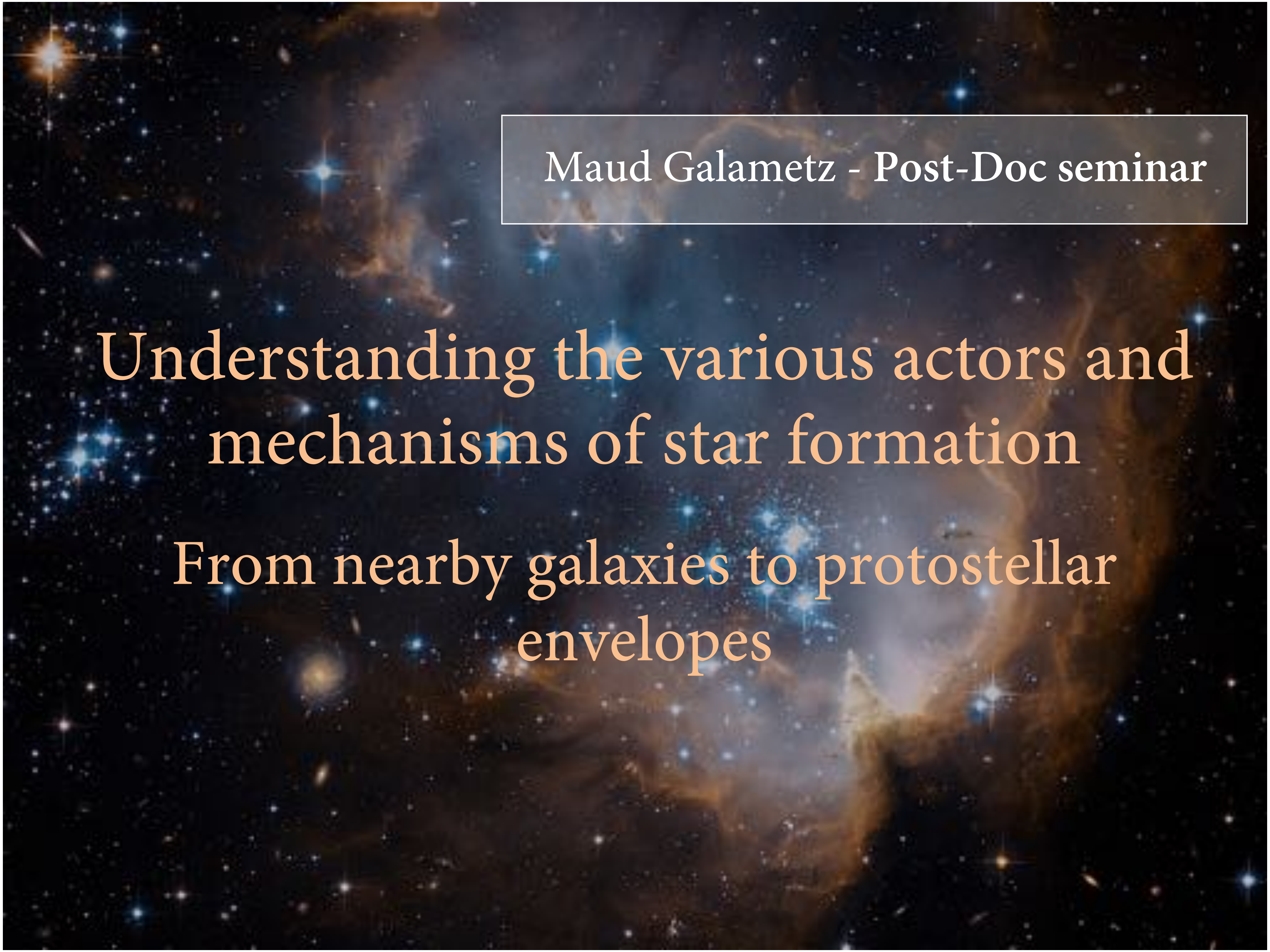
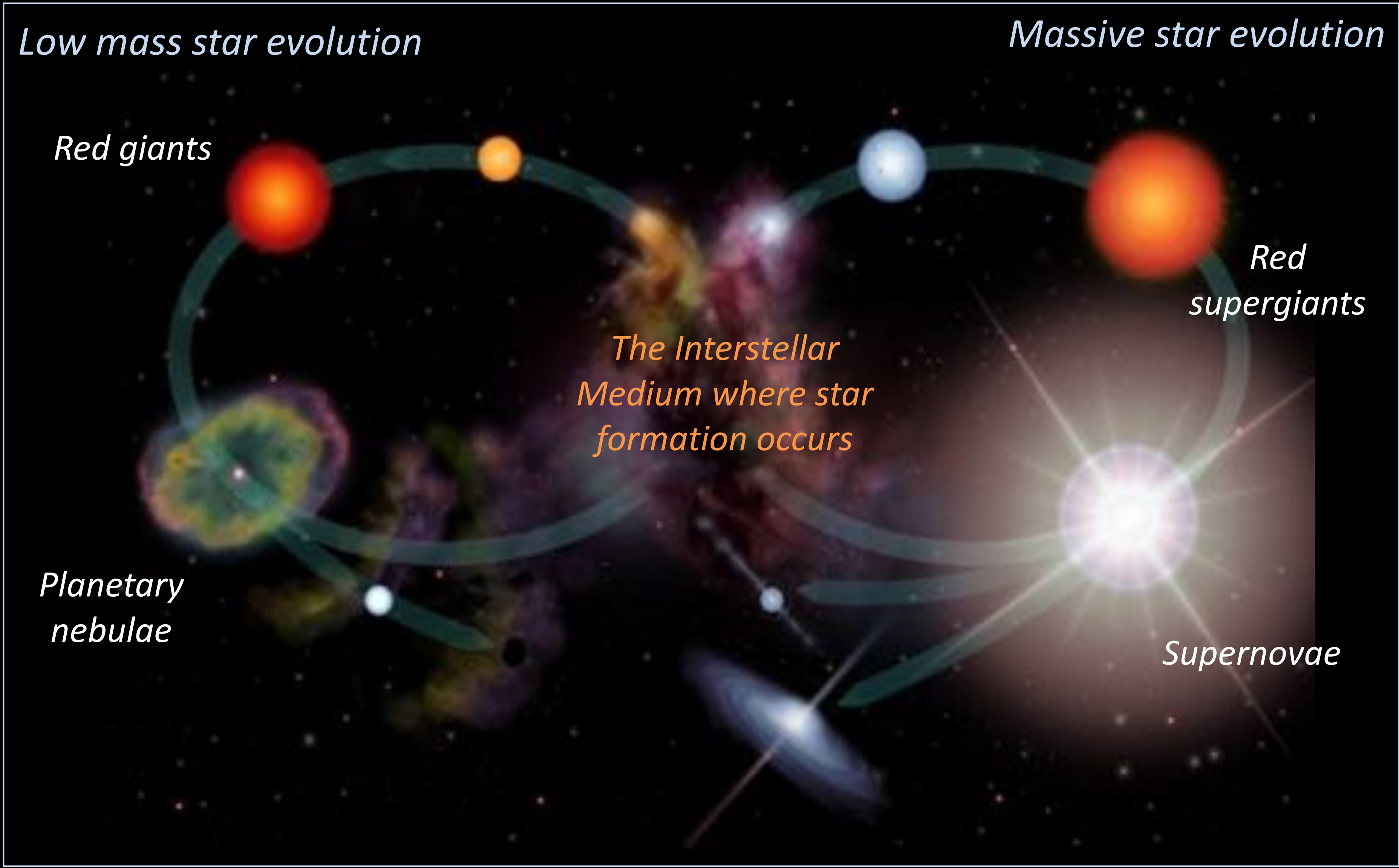

Maud Galametz - Post-Doc seminar
Understanding the various actors and mechanisms of star formation
From nearby galaxies to protostellar envelopes

Star formation drives the evolution of a galaxy



Outline of the talk

Properties of interstellar dust

Dense gas fraction

Role of magnetic field in stellar formation

Outline of the talk

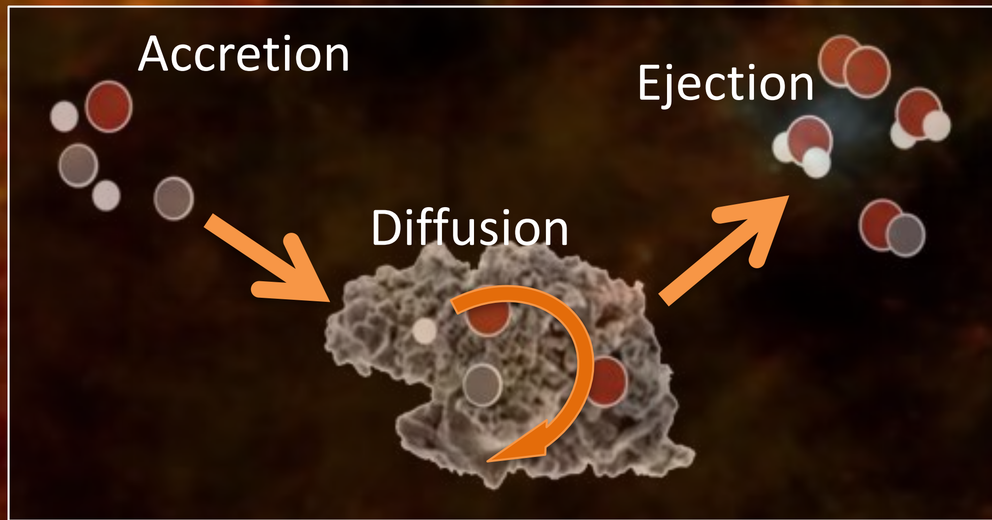
Properties of interstellar dust

Dense gas fraction

Role of magnetic field in stellar formation

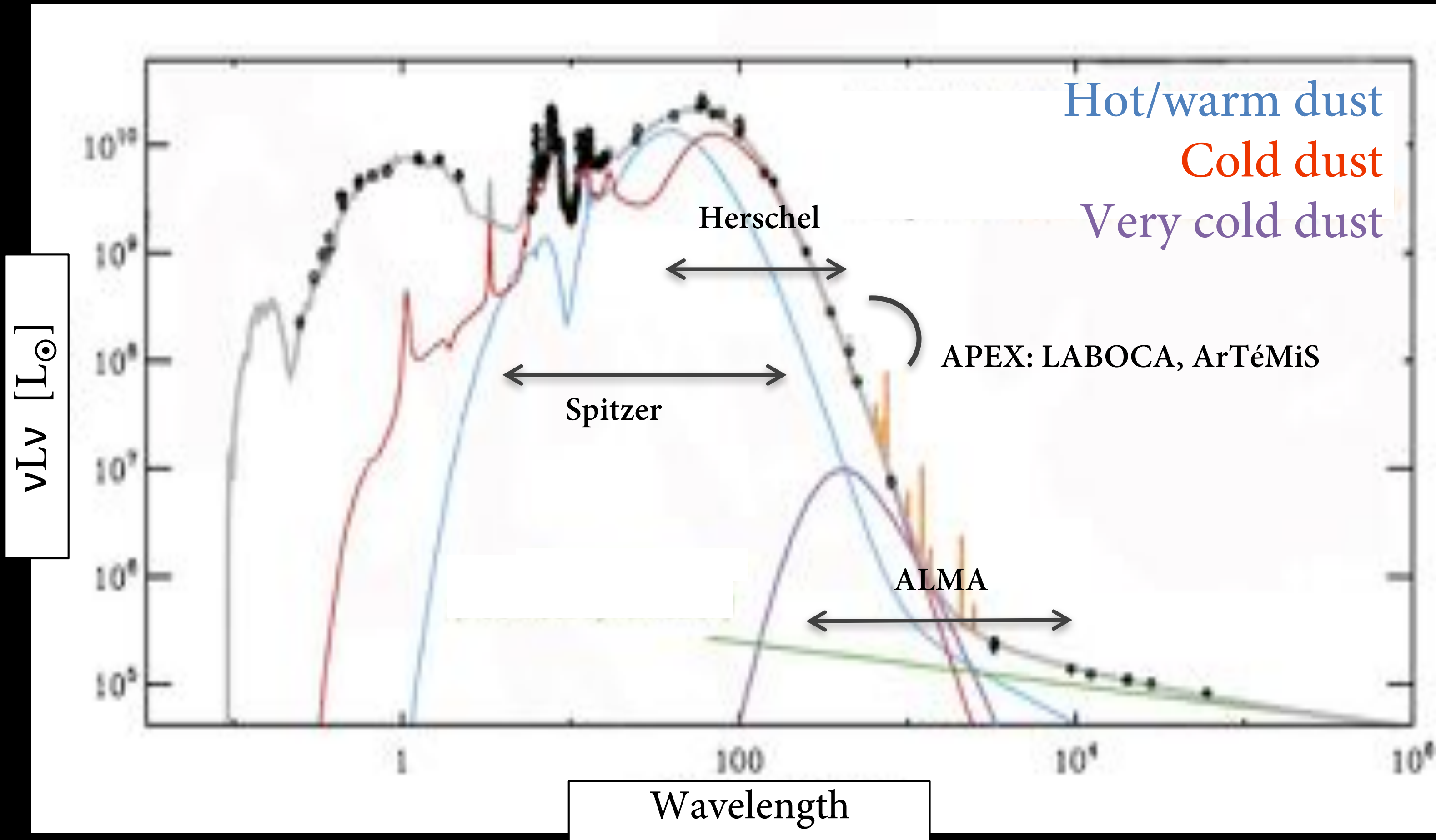
Why do we study dust?

- Indirect tracer of the star formation sites
- Participate in the heating of the ISM (photoionisation of grains by UV photons)
- Interstellar catalyst: H_2 formation



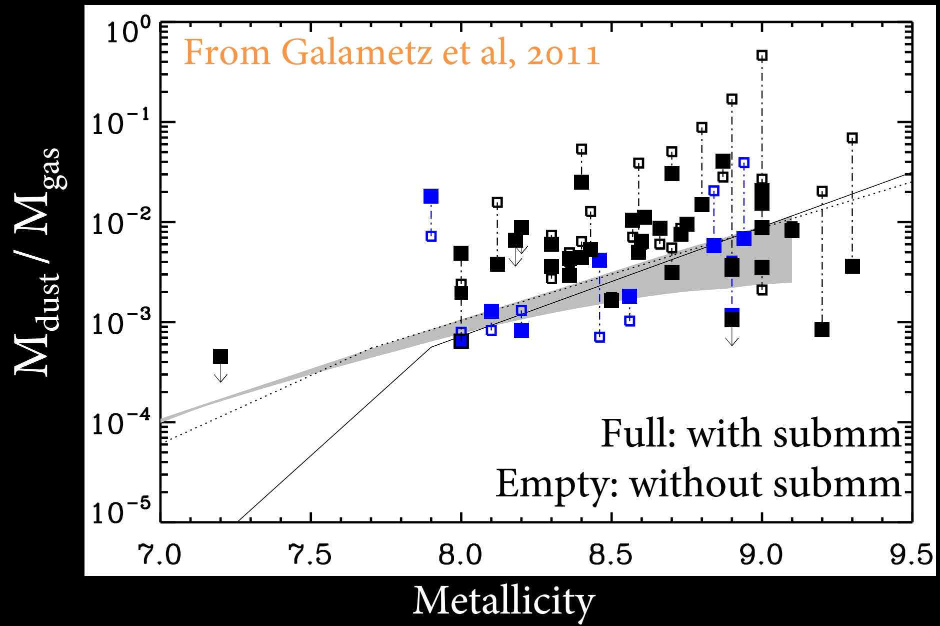
How do we study dust?

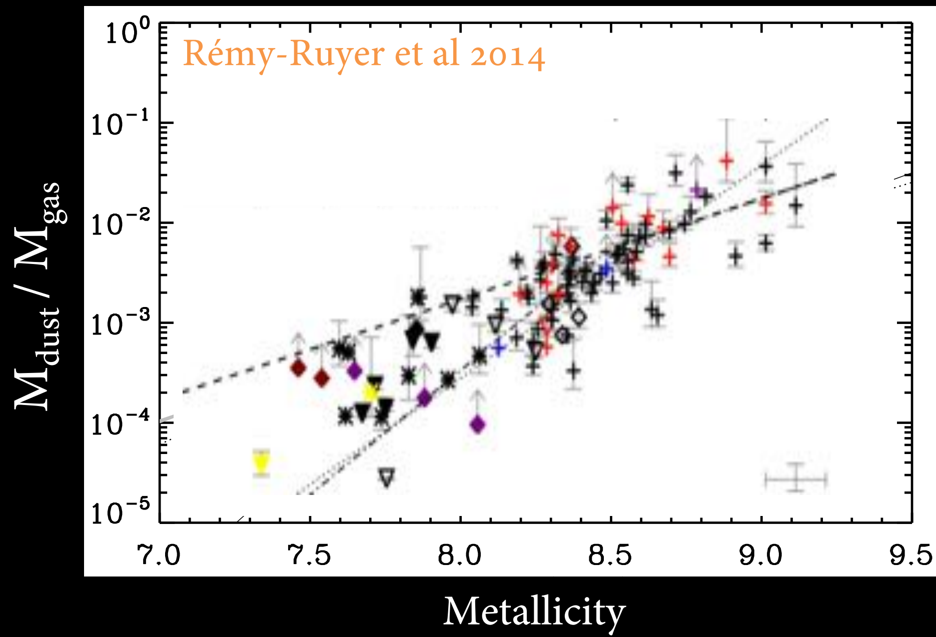
- The IR window to probe the dust emission



The relation between dust and gas

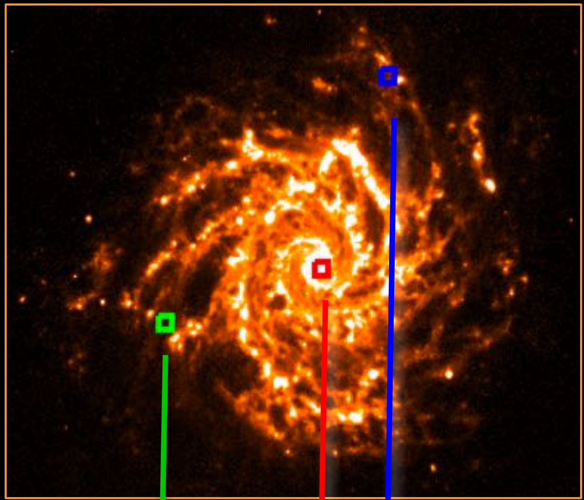
- M_{dust}/M_{gas} relation with metallicity on global scales

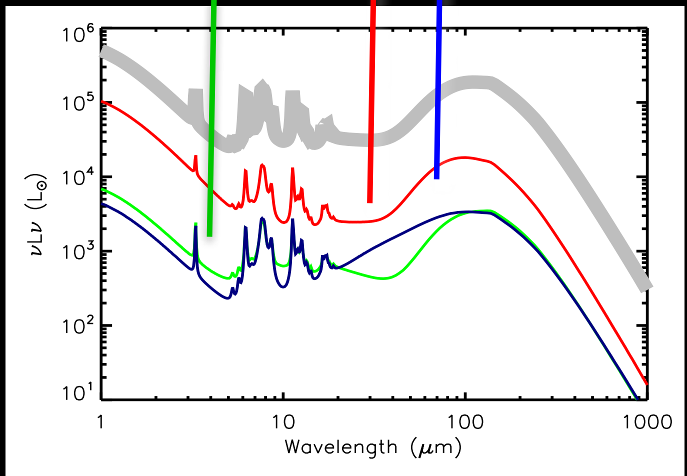




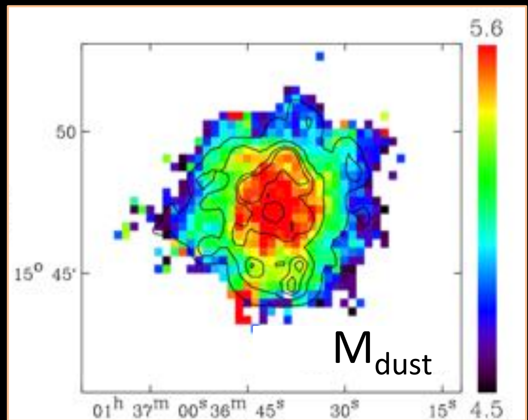
Mapping the dust properties

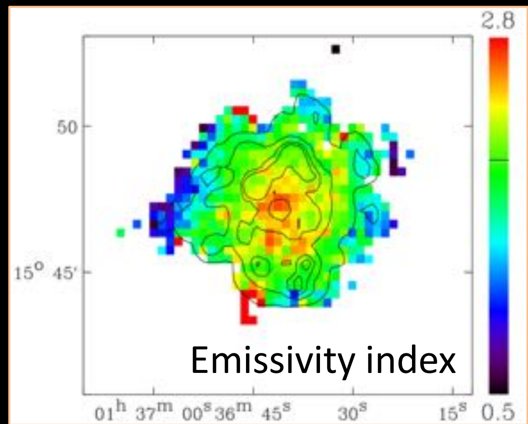
NGC 628





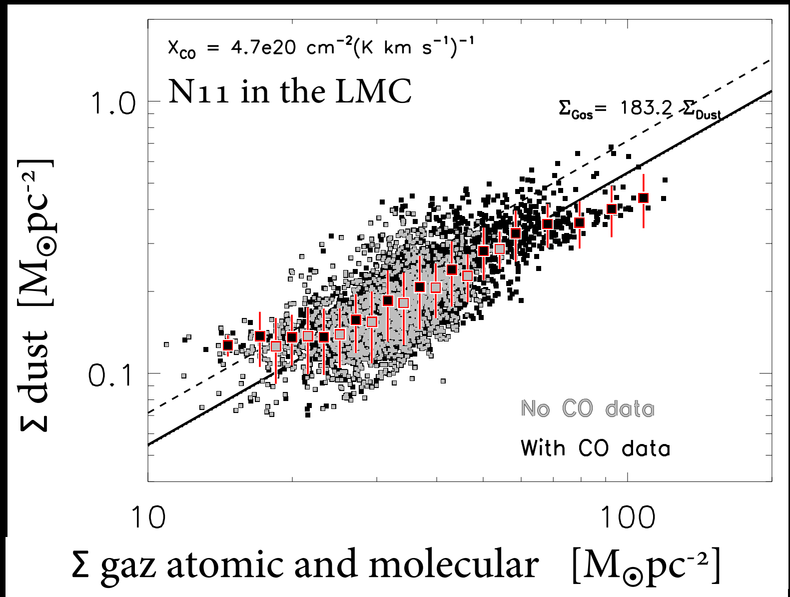
- Derive resolved maps of the temperature
  mass
  emissivity
- Quantify the spatial resolution effects
- Obtain calibrations, derive scaling relations



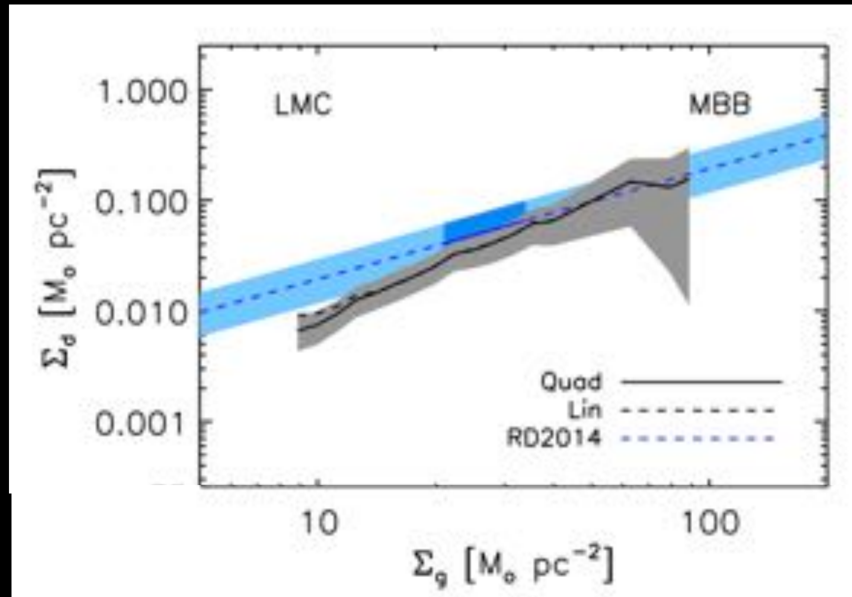


Understanding the scatter with local studies

- LMC: ideal laboratory to study the dust to gas relation on local scales
- Dispersion linked with:
  - X_{CO} conversion factor, dark-gas, dust emissivity variations



Galametz et al, 2015



Roman-Duval et al, 2017

- On-going effort in Saclay: Dustpedia project:

  The THEMIS dust model incorporated into the CEA **HerBIE** SED model.

Outline of the talk

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Dense gas fraction

Role of magnetic field in stellar formation

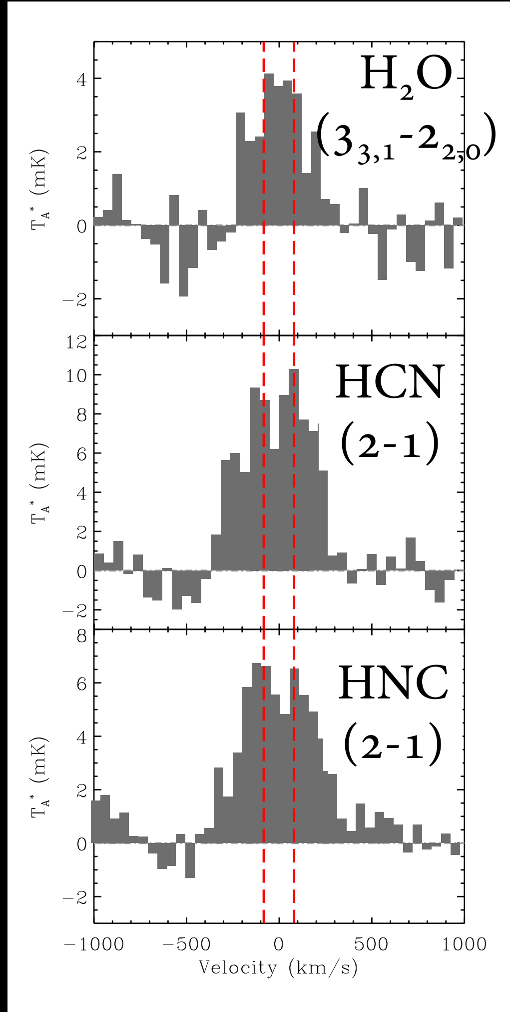
Why and how do we study the dense gas?

- In dense molecular clouds that star formation happens
- Dense gas : poorly constrained by CO observations

→ Use of HCO^+, HCN, HNC, CS …

→ Derive new recipes for high redshift studies

Galametz et al, 2017



- Commissioning of SEPIA Band-5 on the APEX antenna

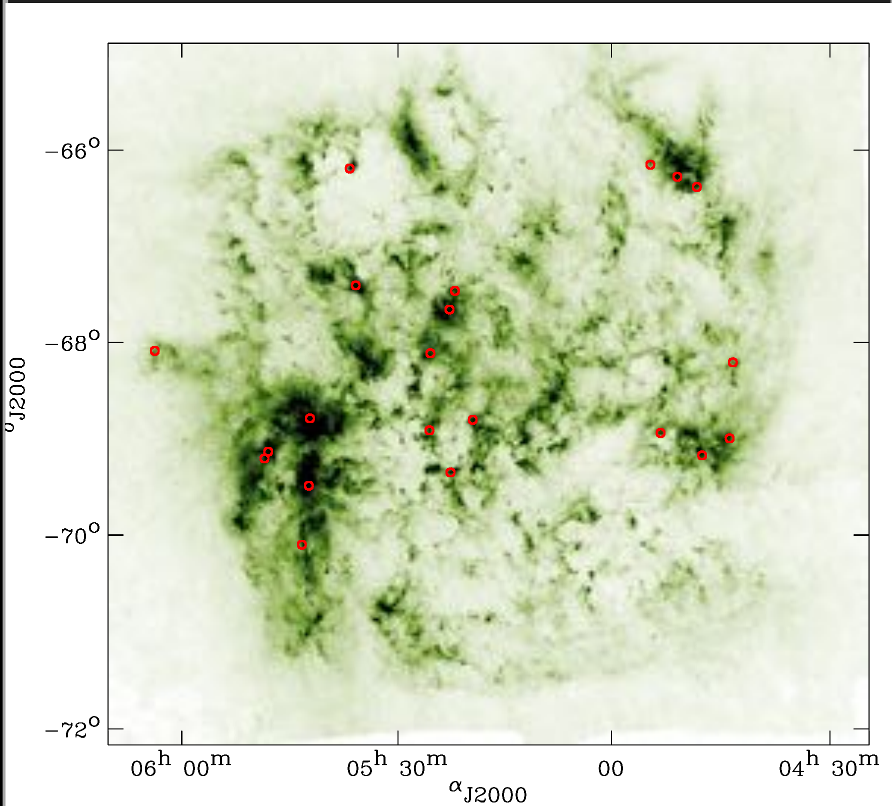
→ SV study on Arp 220

→ Band 5 is now on ALMA

SEPIA: ideal for surveys

DeGaS-MC: A Dense Gas Survey of the MCs

LMC: 21 regions observed in ESO P97

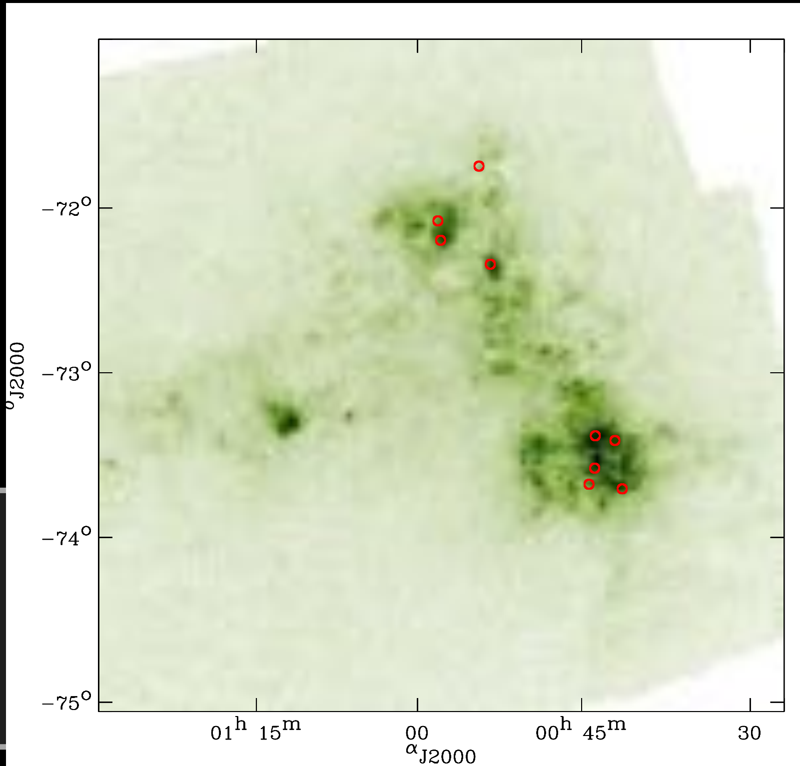


- Single pointing campaign with SEPIA
- Clouds from 2 x 10^4 à 10^6 $M_\odot$
- Traced via HCN and HCO^+ 2-1

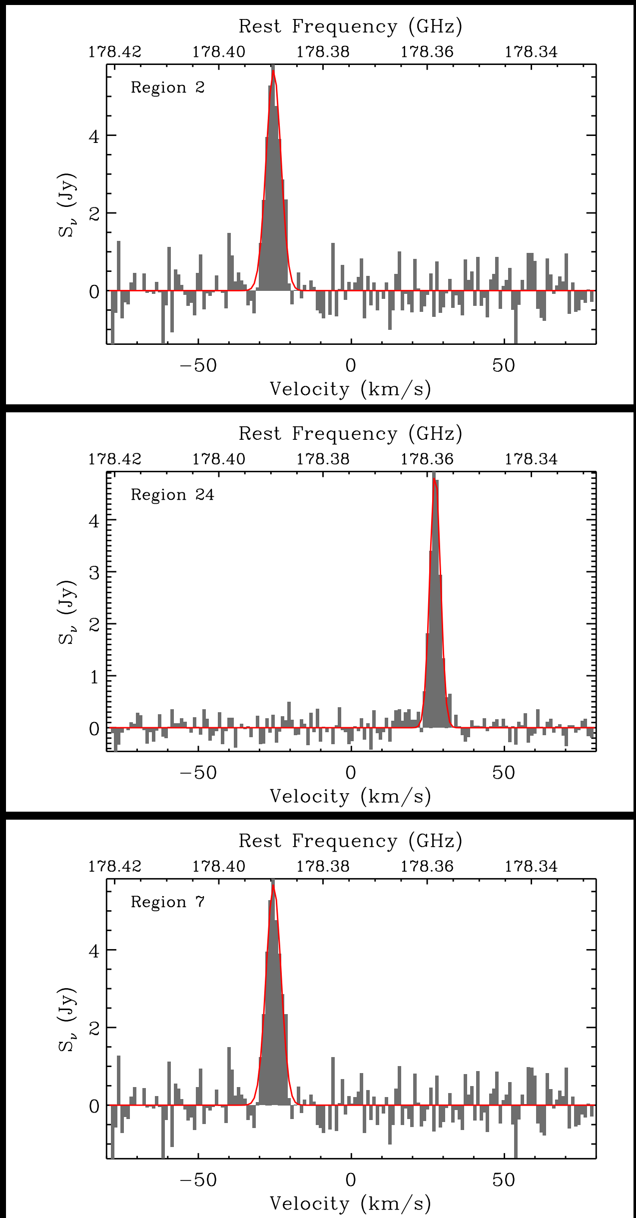
SMC

1 region observed in SV phase

8 regions observed in P97



DeGaS-MC: First conclusions



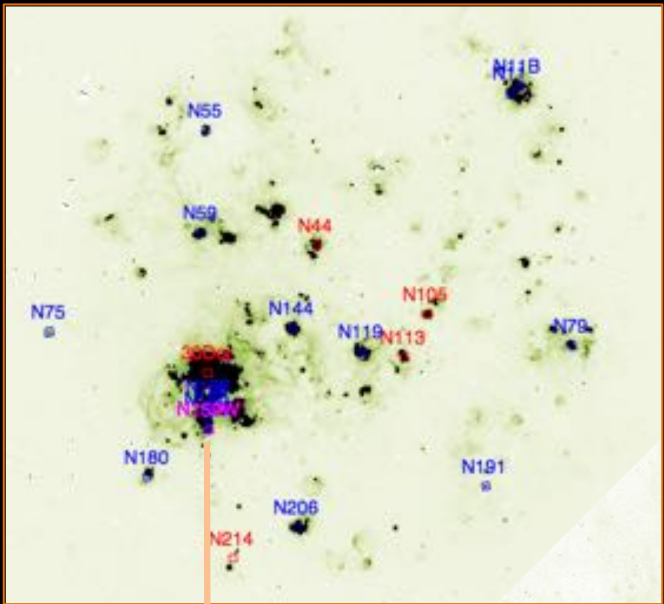
- HCN difficult to detect
  while HCO^+ easily detected (2/3 of the regions)
  → N/O abundance variations ≠ MW
- Larger linewidth in the SMC clouds
  → more turbulence ?
- Variation of the HCO^+/HCN line ratio throughout the LMC
  → no variation observed in previous studies
- Poor correlation between the line intensity and the CO masses
  → CO is a poor tracer of the dense phase

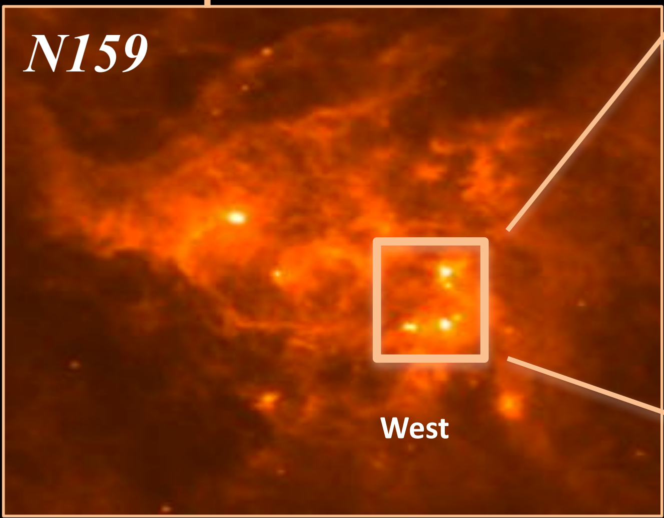
HCO^+ (2-1) detections in the LMC; Galametz et al, in prep

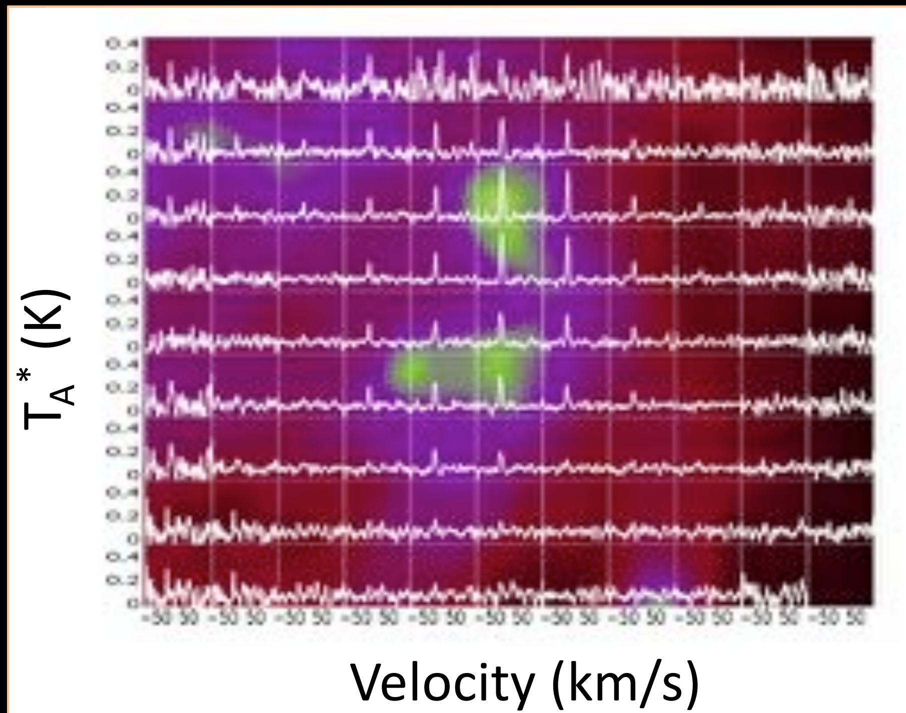
DeGaS-MC: the mapping campaign

- Follow-up mapping campaign
- 65h already observed in MP time + 50h OSO time

… observations & data reduction on-going







HCO⁺ detections overlaid on the Herschel PACS map

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Why do we study Class 0 protostars?

- Formation of parsec-scale filaments from molecular clouds

  → Formation of pre-stellar cores in the densest regions.

  → Collapse to form a protostar

- Class 0 are the very first stage of the protostellar formation process

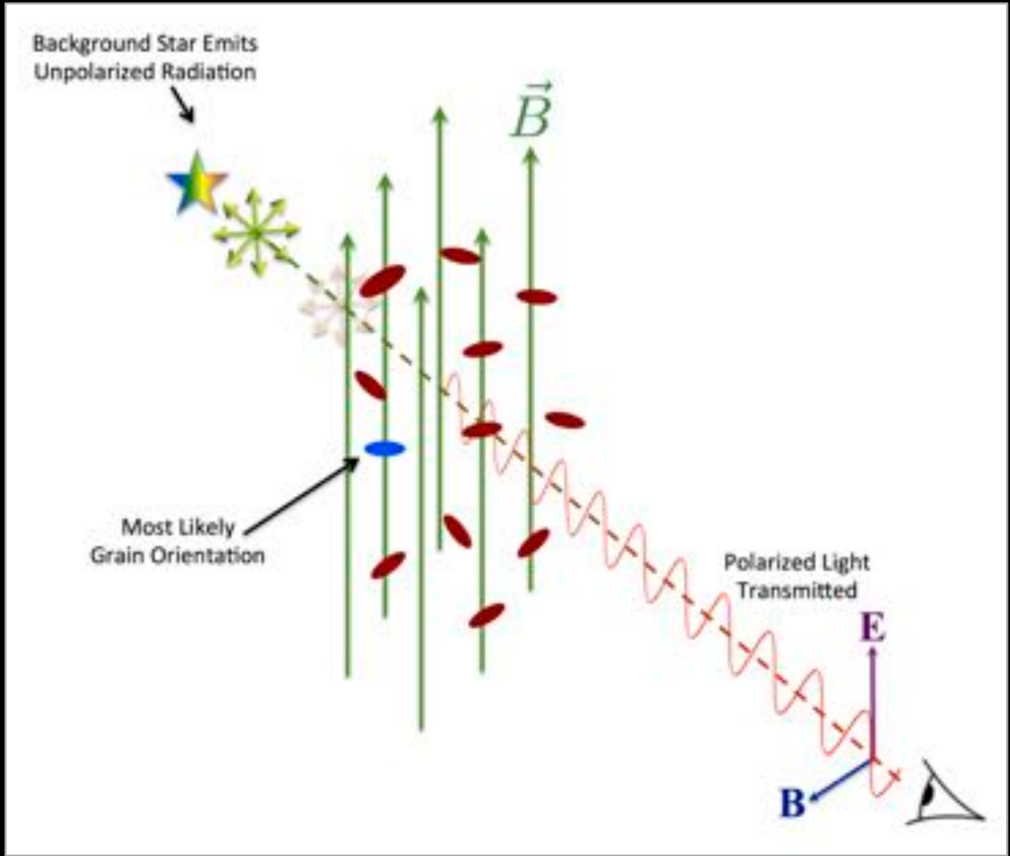
  - age = a few 10^4 yr
  - main accretion phase

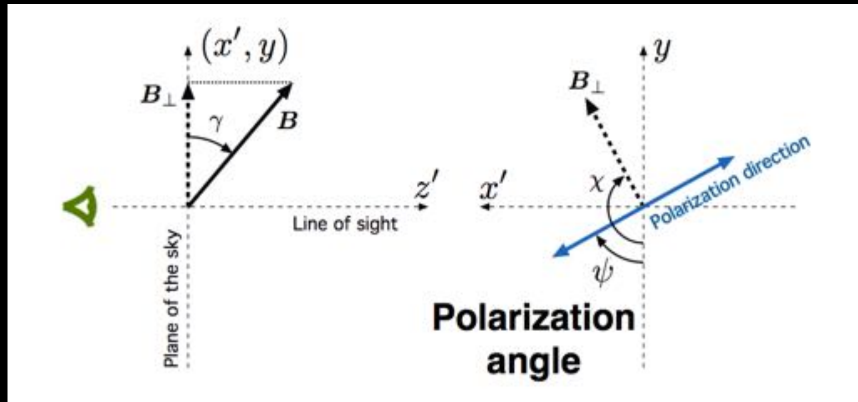
The Angular Momentum Problem:

A star-forming cloud needs to reduce its specific angular momentum by 5 to 10 orders of magnitude to form a typical star.

How can we study the effect of magnetic braking?

- By tracing magnetic fields in the enveloppes using dust polarized emission





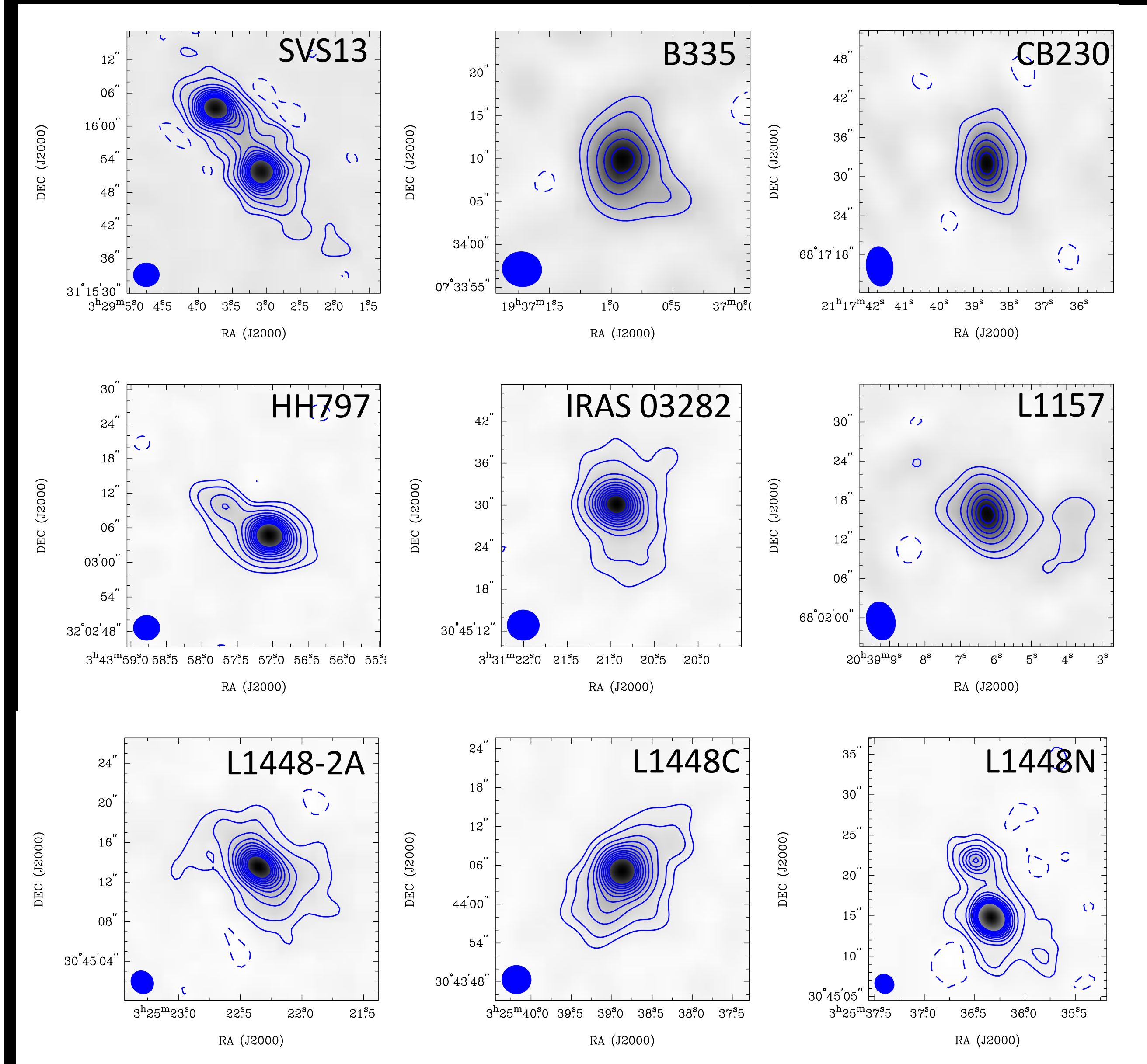
$$Q = \int p_{\max} R \cos(2\psi) \cos^2\gamma \, dI$$

$$U = -\int p_{\max} R \sin(2\psi) \cos^2\gamma \, dI$$

R: Rayleigh reduction factor

$P = (Q^2 + U^2)^{0.5}$		Intensity
$p = P/I$		Fraction
$\psi = 0.5 \arctan(-U, Q)$		Angle

Tracing the dust polarisation with the SMA



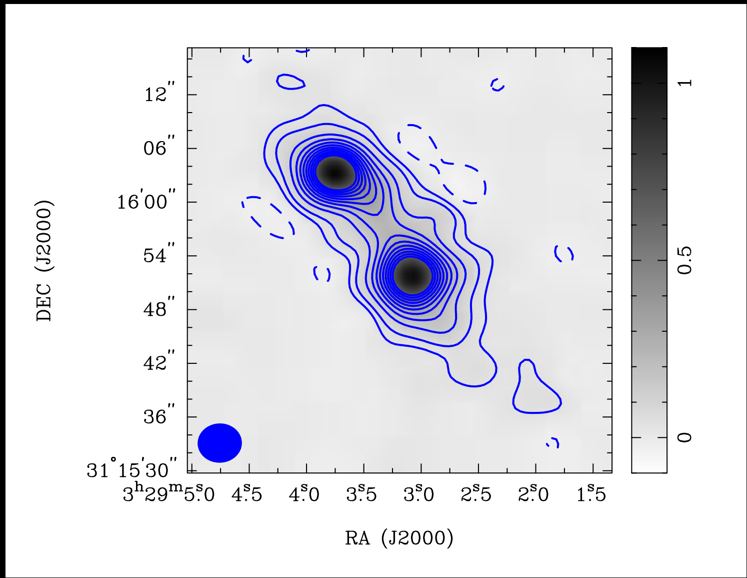
- Sample of 9 Class 0/I
- Sources with multiplicity
- Synthesized beam: 4-5”

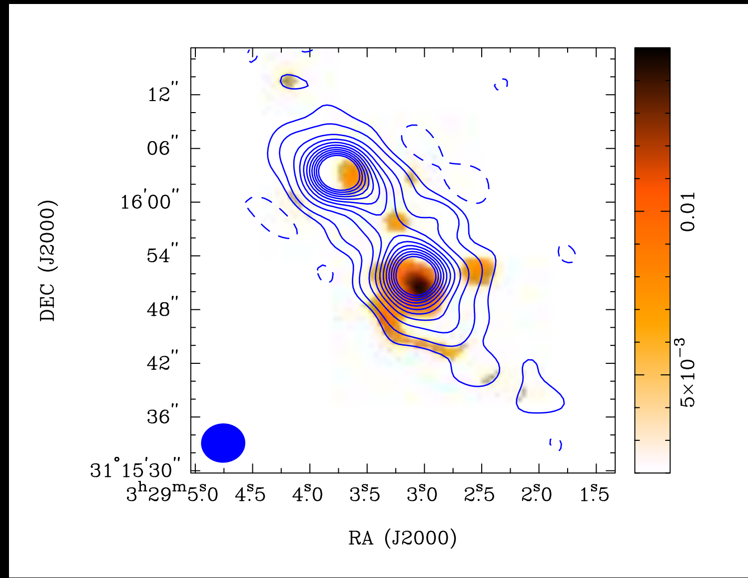
Dust continuum observed at 850μm with the SMA

Galametz et al, in prep

Tracing the dust polarisation with the SMA

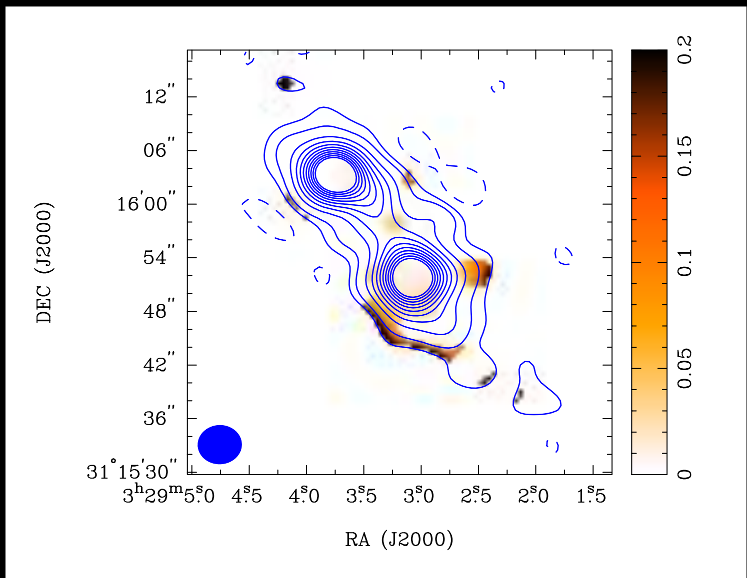
Dust continuum

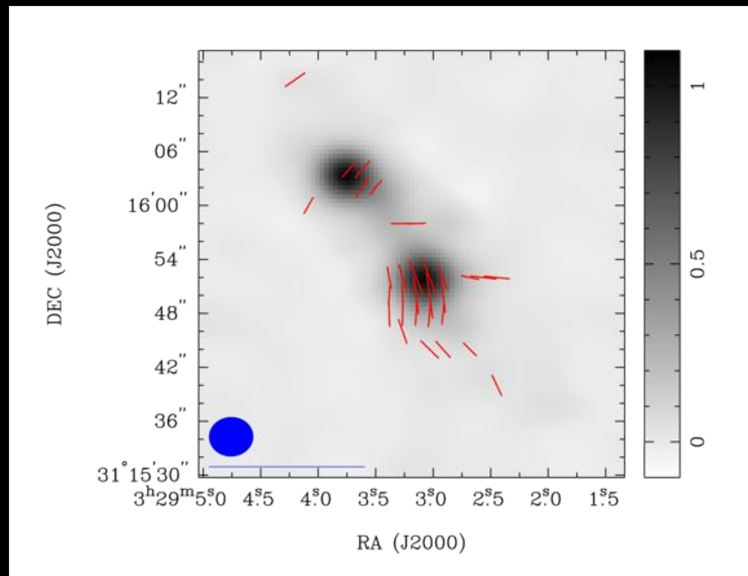




Pola. intensity

Pola. fraction



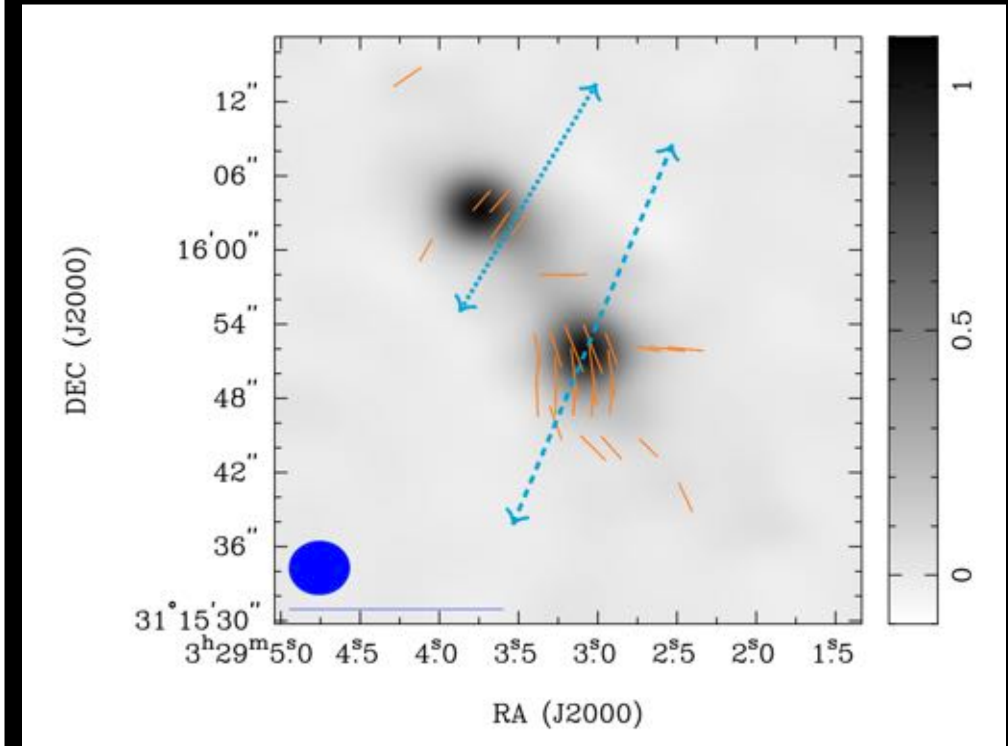


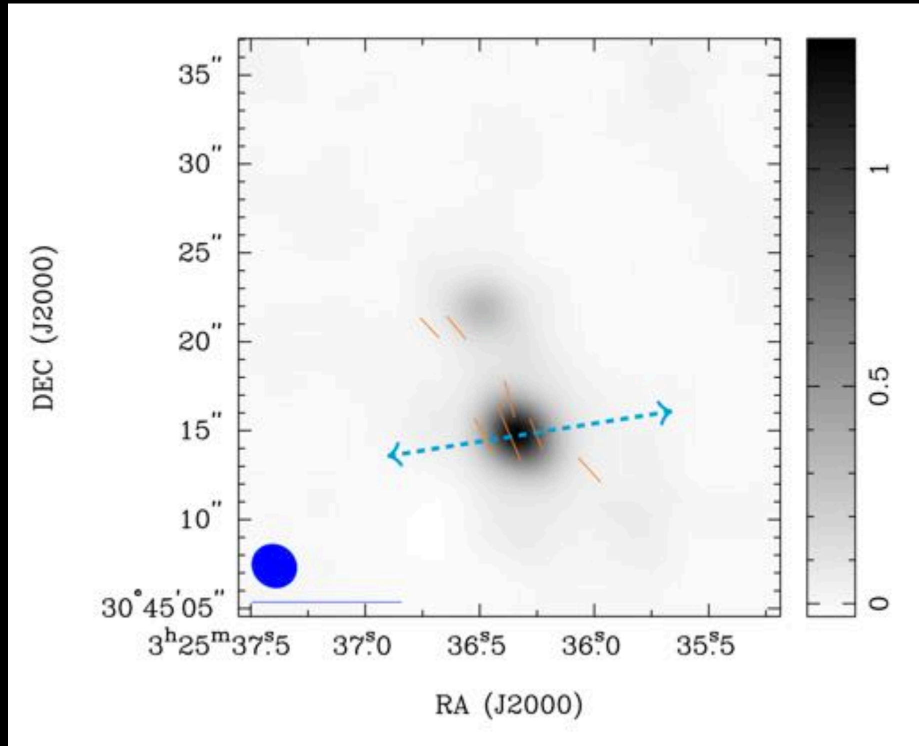
B-field orientation

Alignement with the outflow direction

- For most of the cases, the magnetic field lines tends to align with the outflow direction

… but not always?





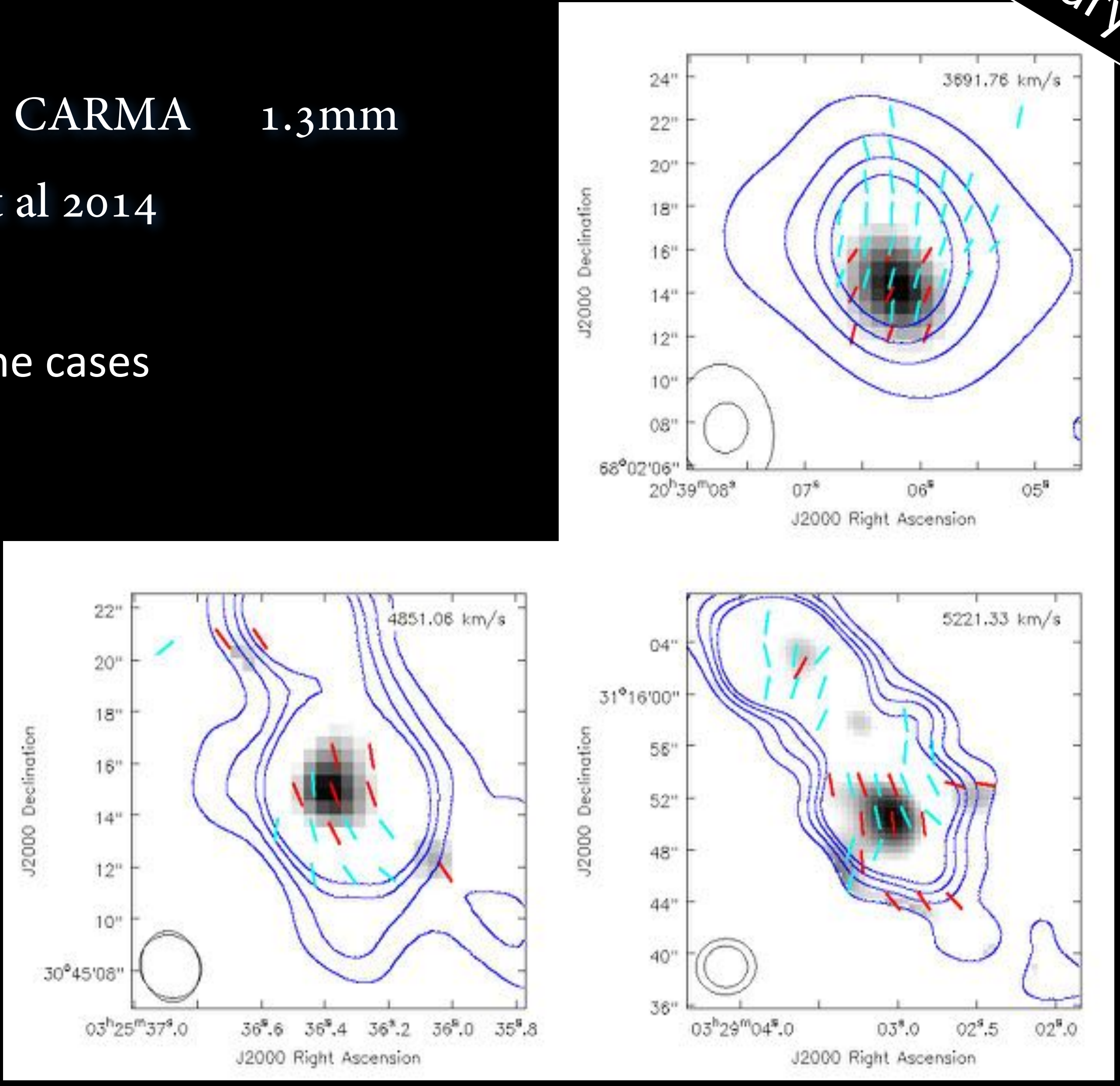
B-field orientation versus Outflow direction

Variations of B orientation with wavelength

Preliminary

- Comparison with CARMA 1.3mm observations by Hull et al 2014

  → Aligned in most of the cases



SMA @ 850 µm
CARMA @ 1.3 mm

Summary

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Dense gas fraction

Role of magnetic fields in stellar formation

Summary

Properties of interstellar dust

New formalism to model dust : - implications on the quantification of dust mass
- impact of dust growth in galaxy evolution model

Dense gas fraction

Investigation on new tracers to - quantify the gas mass involved in star formation
- explore the robustness of new calibrations

Role of magnetic fields in stellar formation

Constrain the role of magnetic fields in the redistribution of the angular mom.

Characterizing magnetic fields → next frontier in many fields of astrophysics

Thanks for your attention

Website: soon

DeGaS-MC

http://irfu.cea.fr/Pisp/maud.galametz/DeGaS-MC/

DustPedia

http://dustpedia.com