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Coreshine :

Dust properties inside molecular clouds from coreshine modeling and observations

CHARLÈNE LEFÈVRE
LERMA – OBSERVATOIRE DE PARIS

PSL RESEARCH UNIVERSITY
ACAV
l'Observatoire de Paris
LERMA
Laboratoire d'Étude du Rayonnement et de la Matière en Astrophysique

L. Pagani, Obs. de Paris, France
M. Juvela, Helsinki University, Finland
R. Paladini, IPAC Pasadena, USA
R. Lallement, Obs .de Paris, France
D.J. Marshall, AIM, Paris Saclay, France
the "Hunting Coreshine with Spitzer" consortium

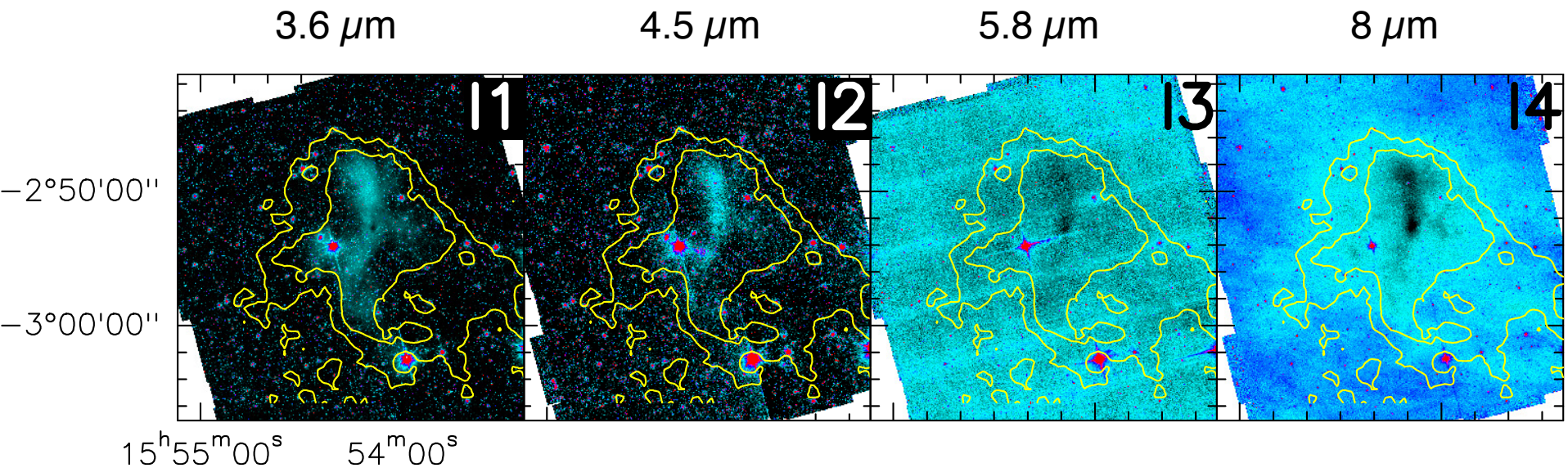
Outline

- Observations :
  - coreshine : what, where, why?
  - coreshine ratio
  - starless vs with embedded sources

- Starless core modeling :
  - Simple cloud model : focus on dust properties
  - Towards multiwavelength modeling
  - Towards a real cloud model L183 : molecular features, NIR extinction

L183 Spitzer/IRAC images

contours : Av = 5 and 10 mag

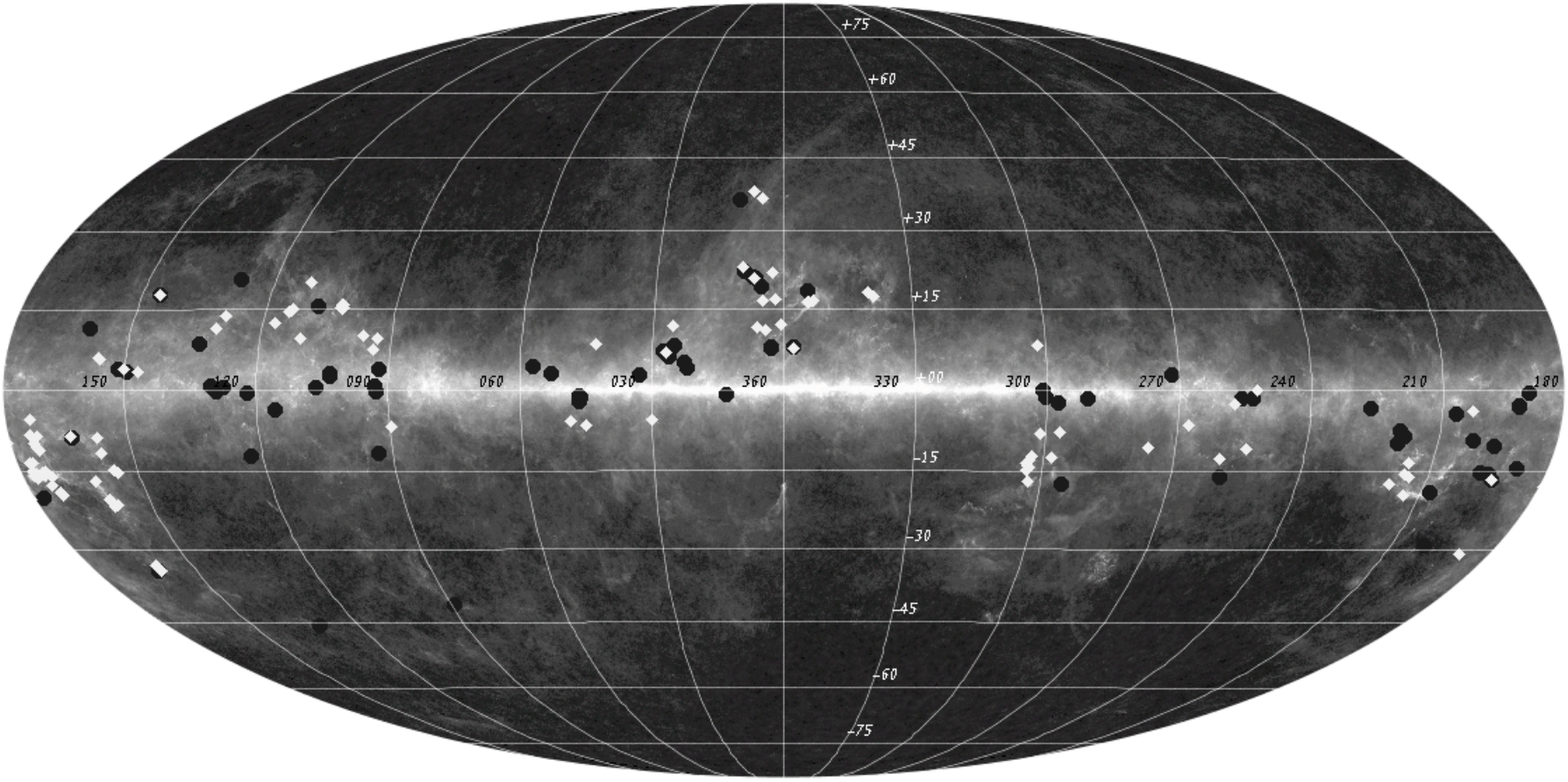


Coreshine : Scattered light seen in MIR

Steinacker et al. 2010
Pagani et al. 2004

A widespread phenomenon

At least 50% of MoC show coreshine

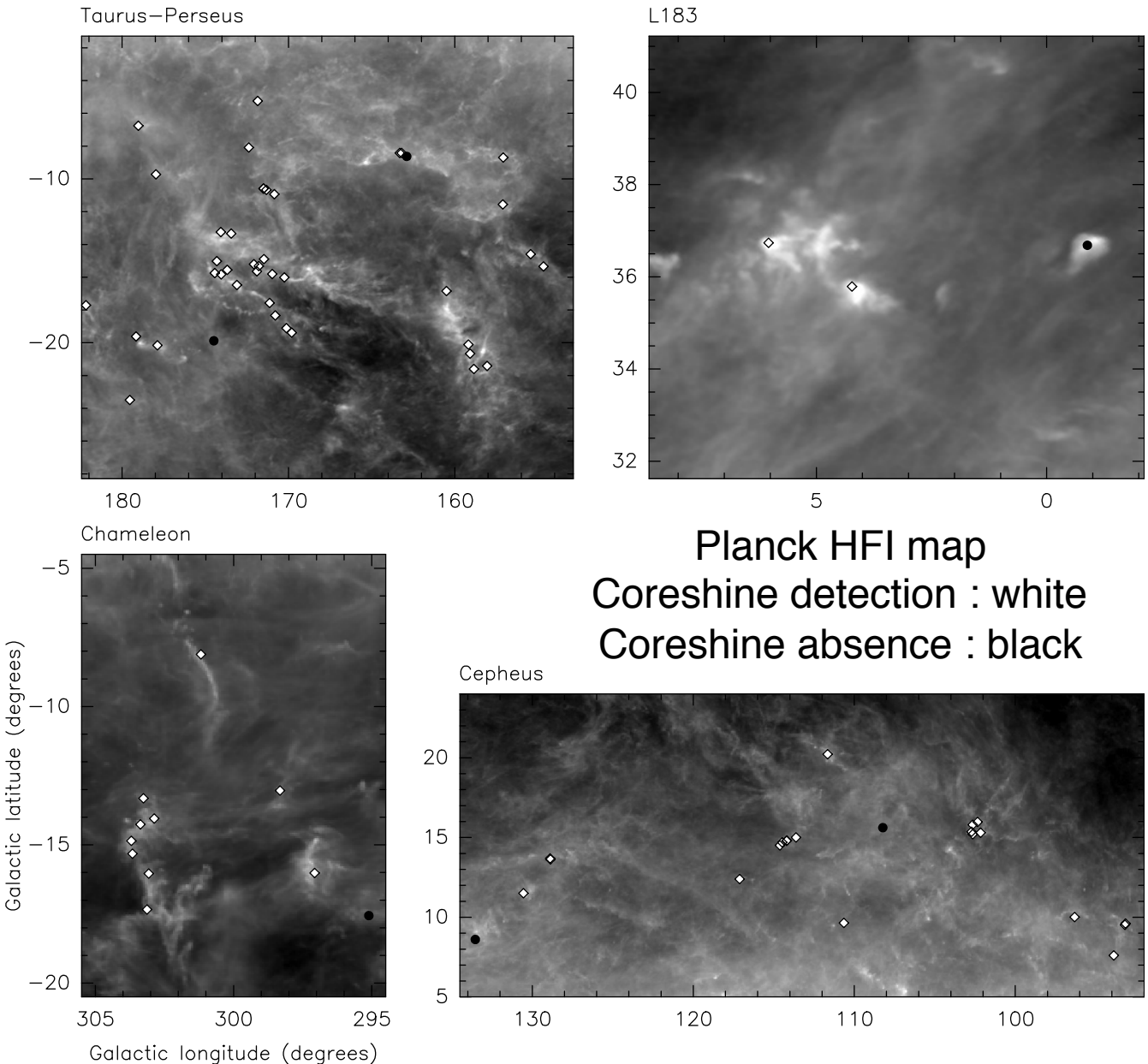


More than 200 sources white = positive detection – **black** no detection

Lefèvre et al. 2014 , Paladini et al. in prep

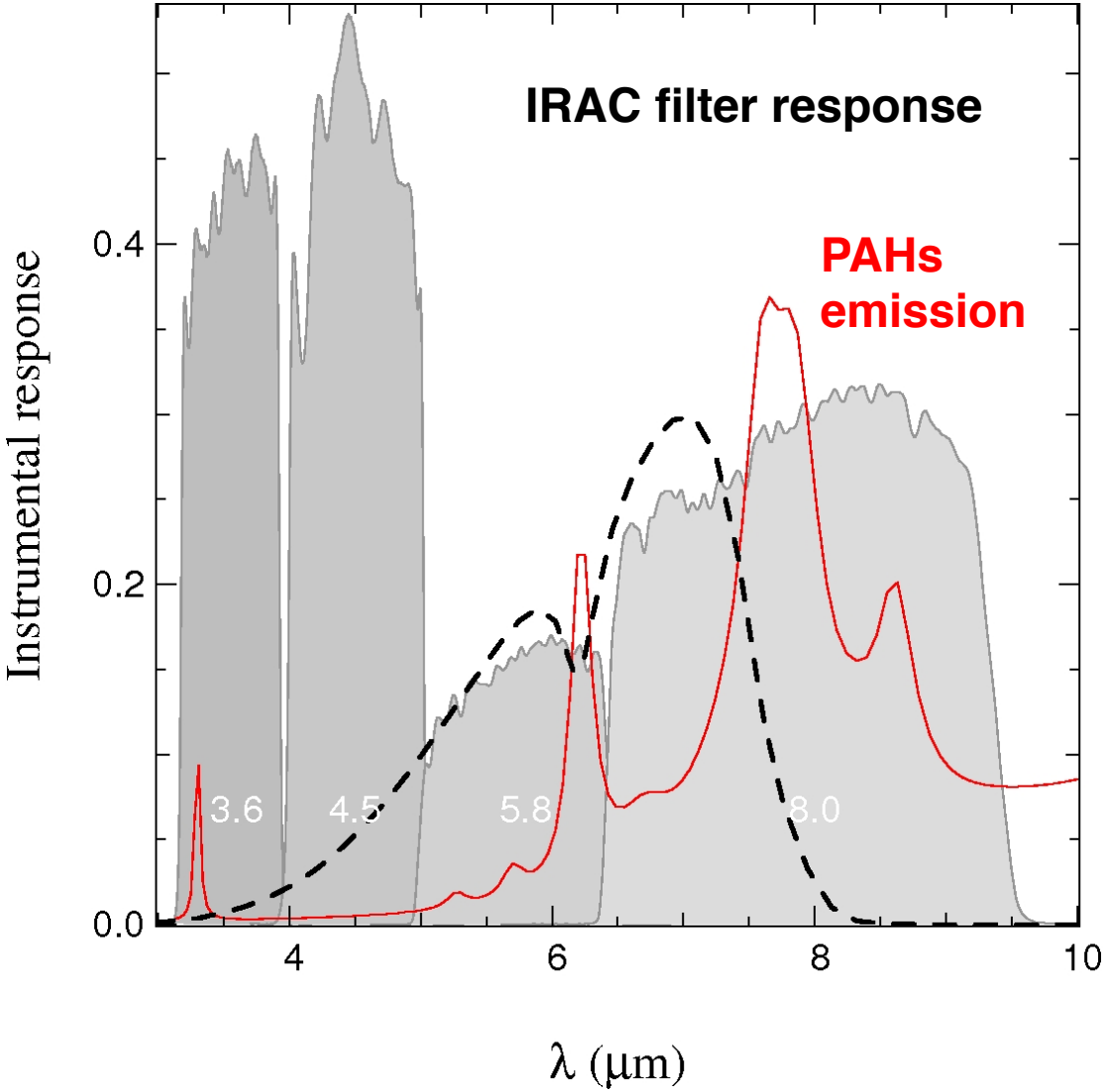
4 regions : 100% positive cases ?

Taurus/Perseus
L183
Chameleon
Cepheus



Planck HFI map
Coreshine detection : white
Coreshine absence : black

Why do we see coreshine ?

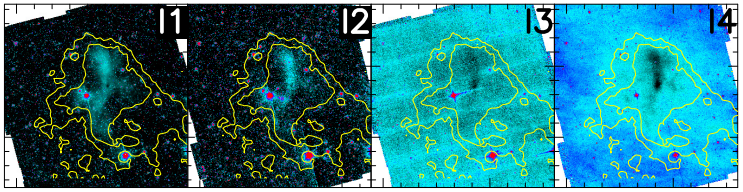


~~Hot grains~~ ?

Need strong ISRF for heating

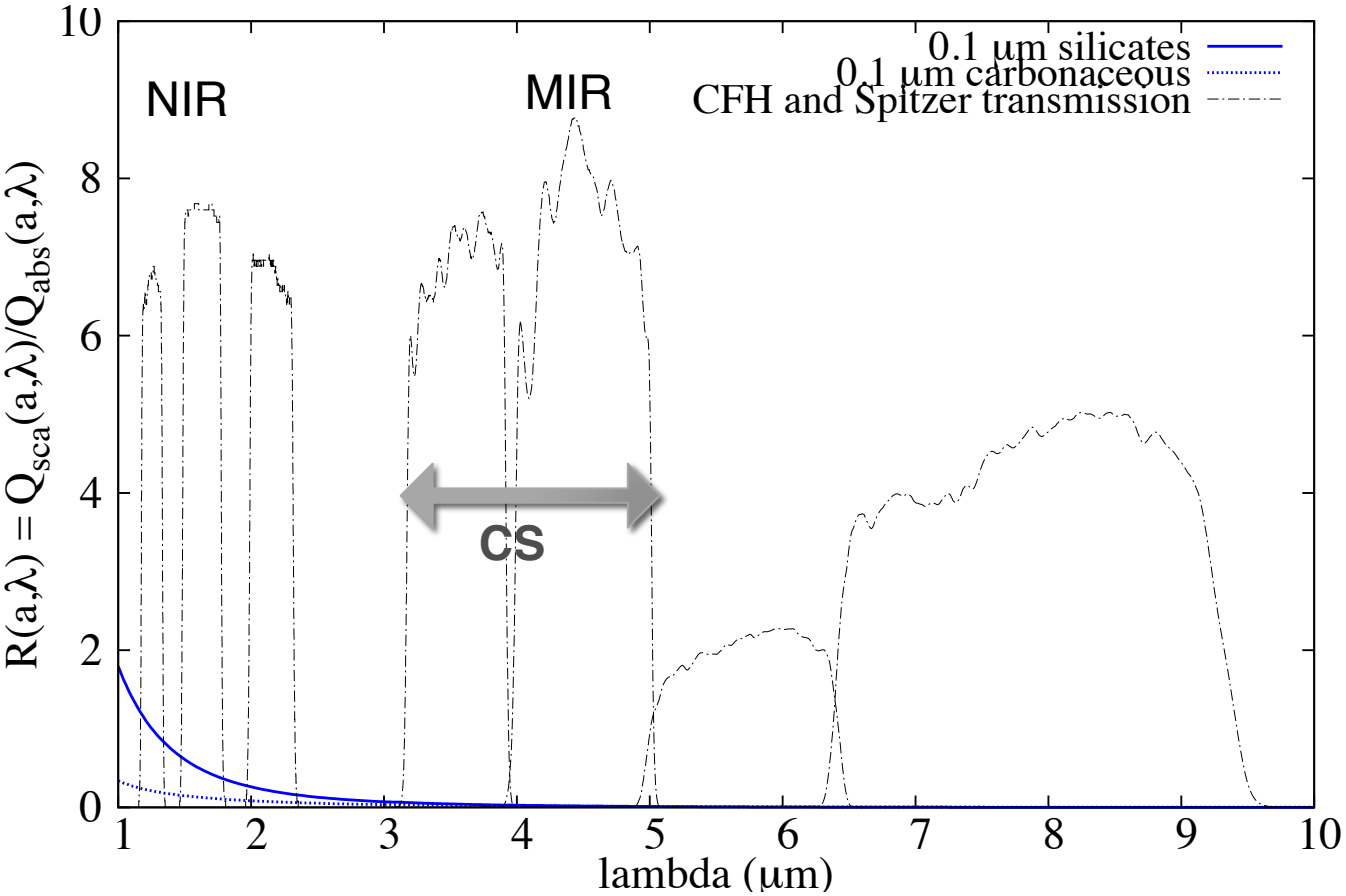
~~PAHs~~ ?

- No 4.5 μm emission
- 5.8 and 8 μm strong emission
- Need UV/Visible light



Grain properties function of their size and of the wavelength

Qsca/Qabs – DustEm – Compiègne 2011 grains



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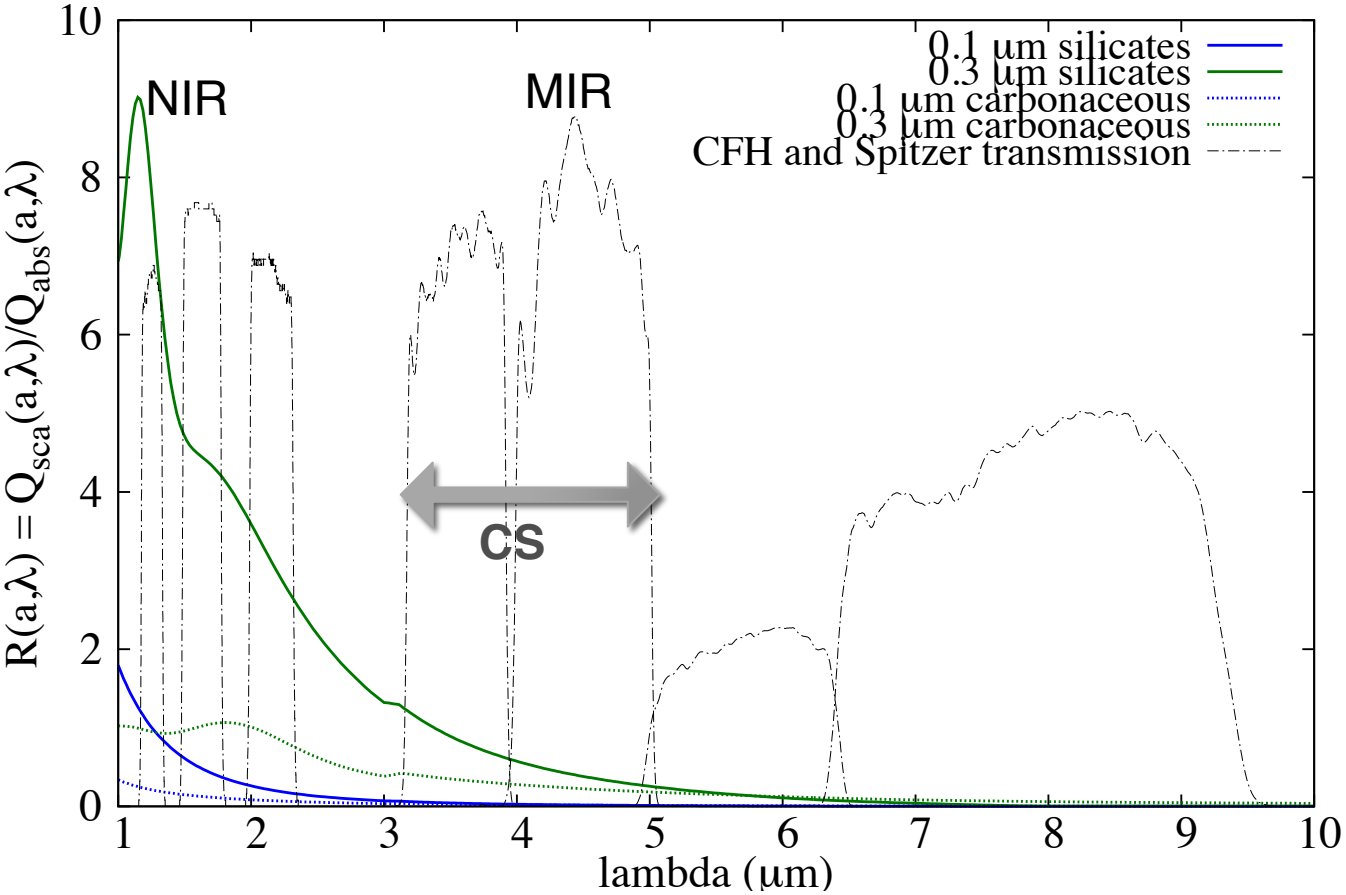

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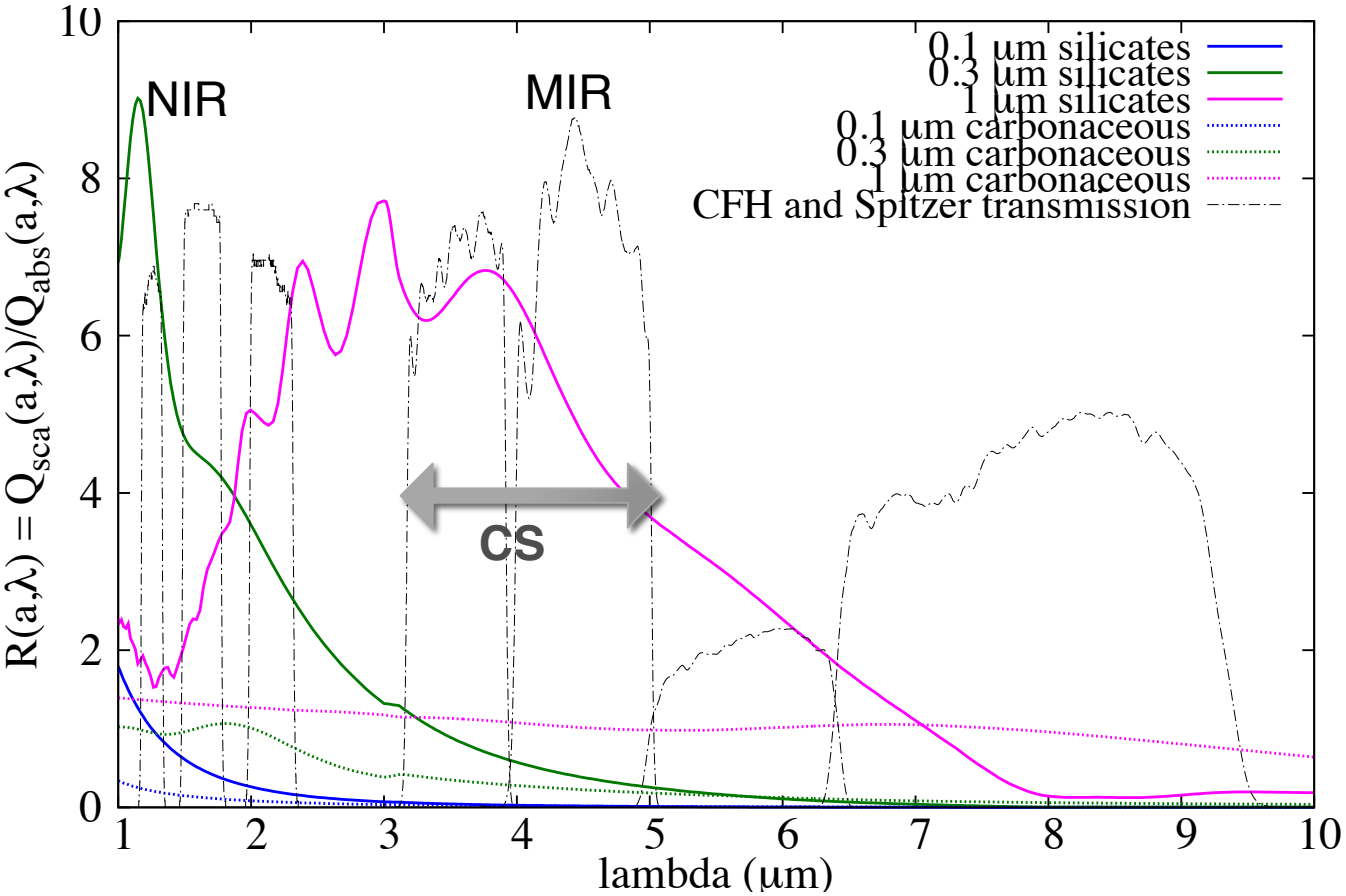
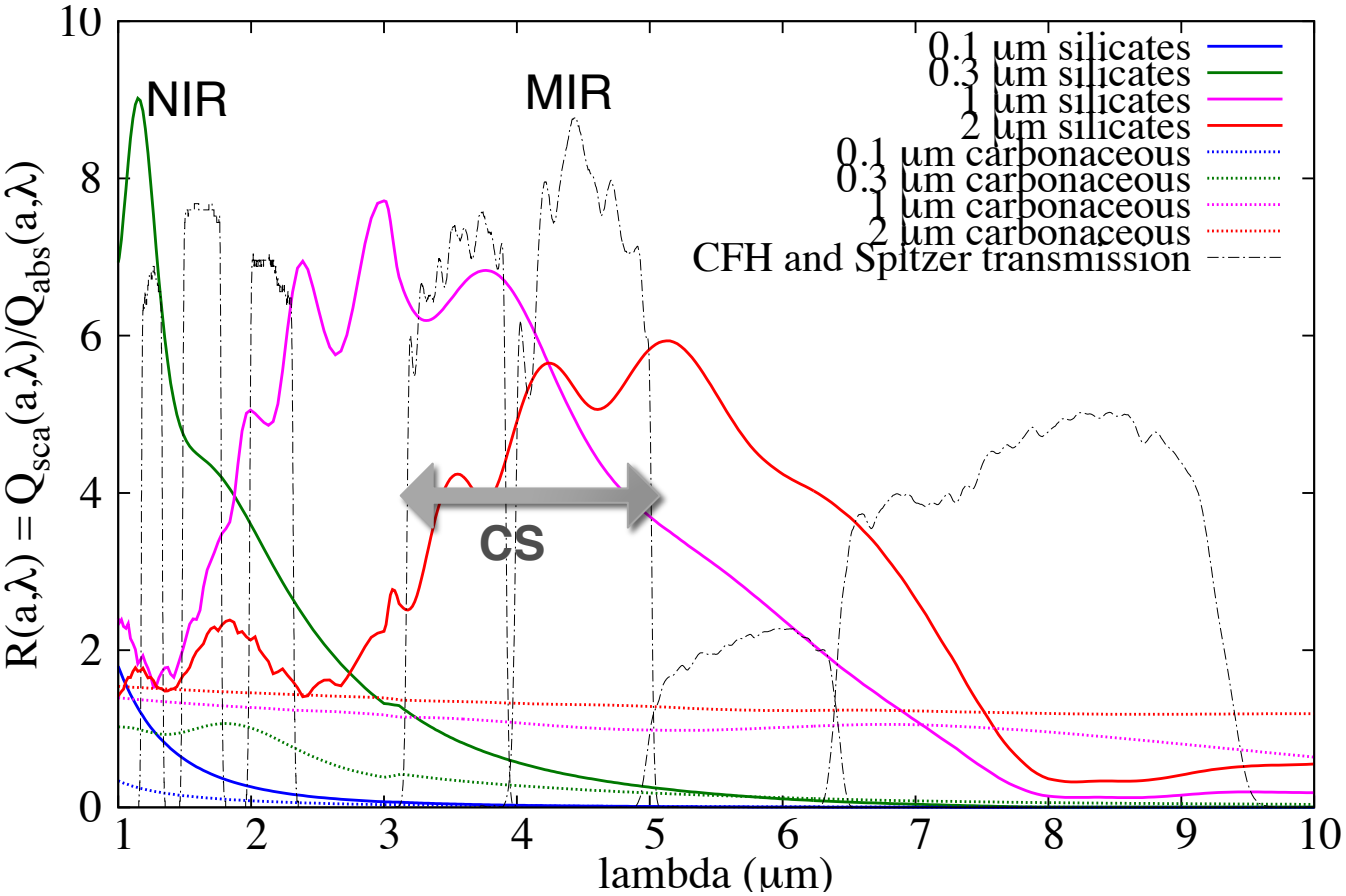


Diffusion > Absorption

Large grains (0.5 ~ 1 μm) able to explain coreshine

Grain properties function of their size and of the wavelength

Qsca/Qabs – DustEm – Compiègne 2011 grains



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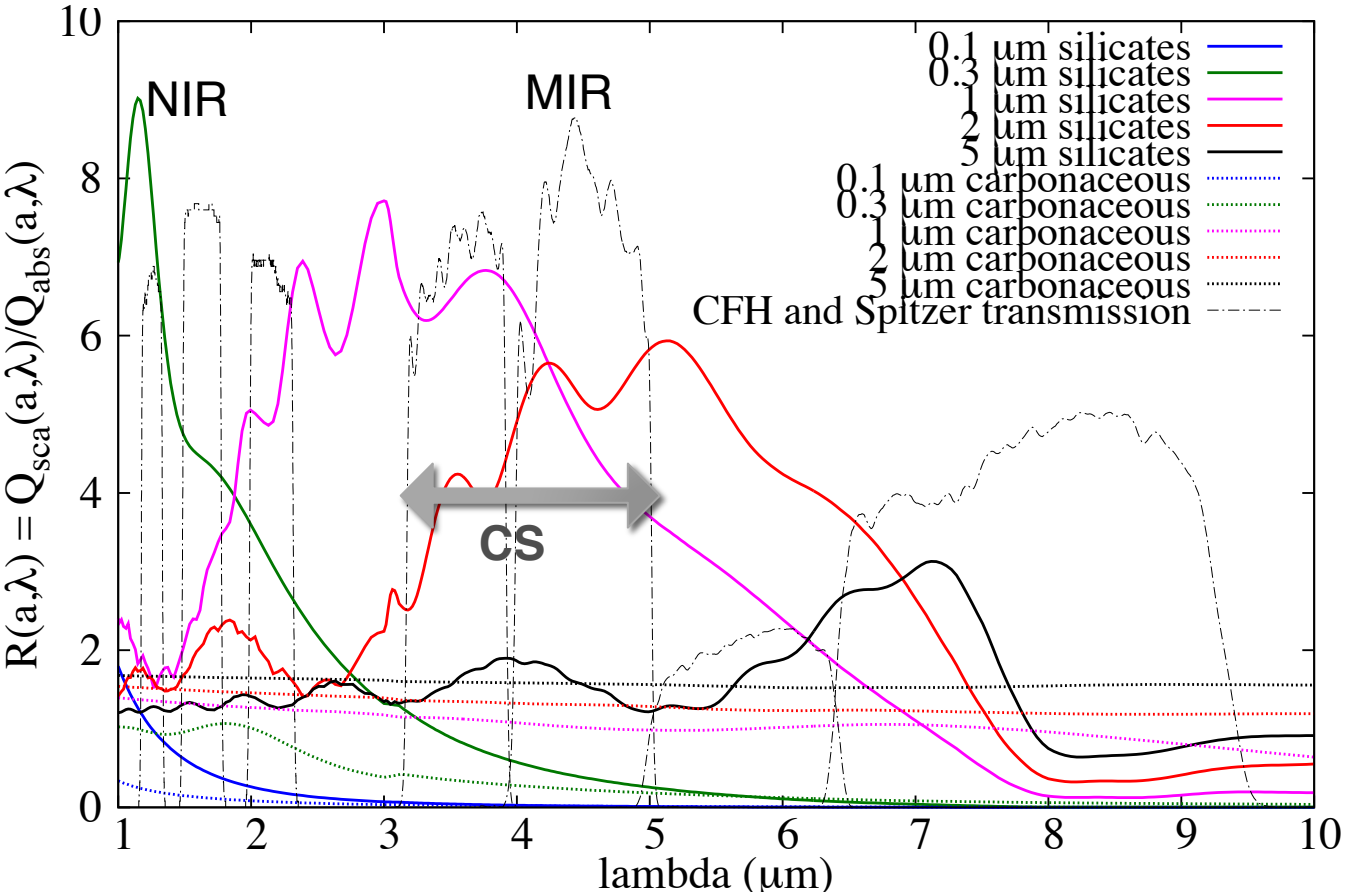

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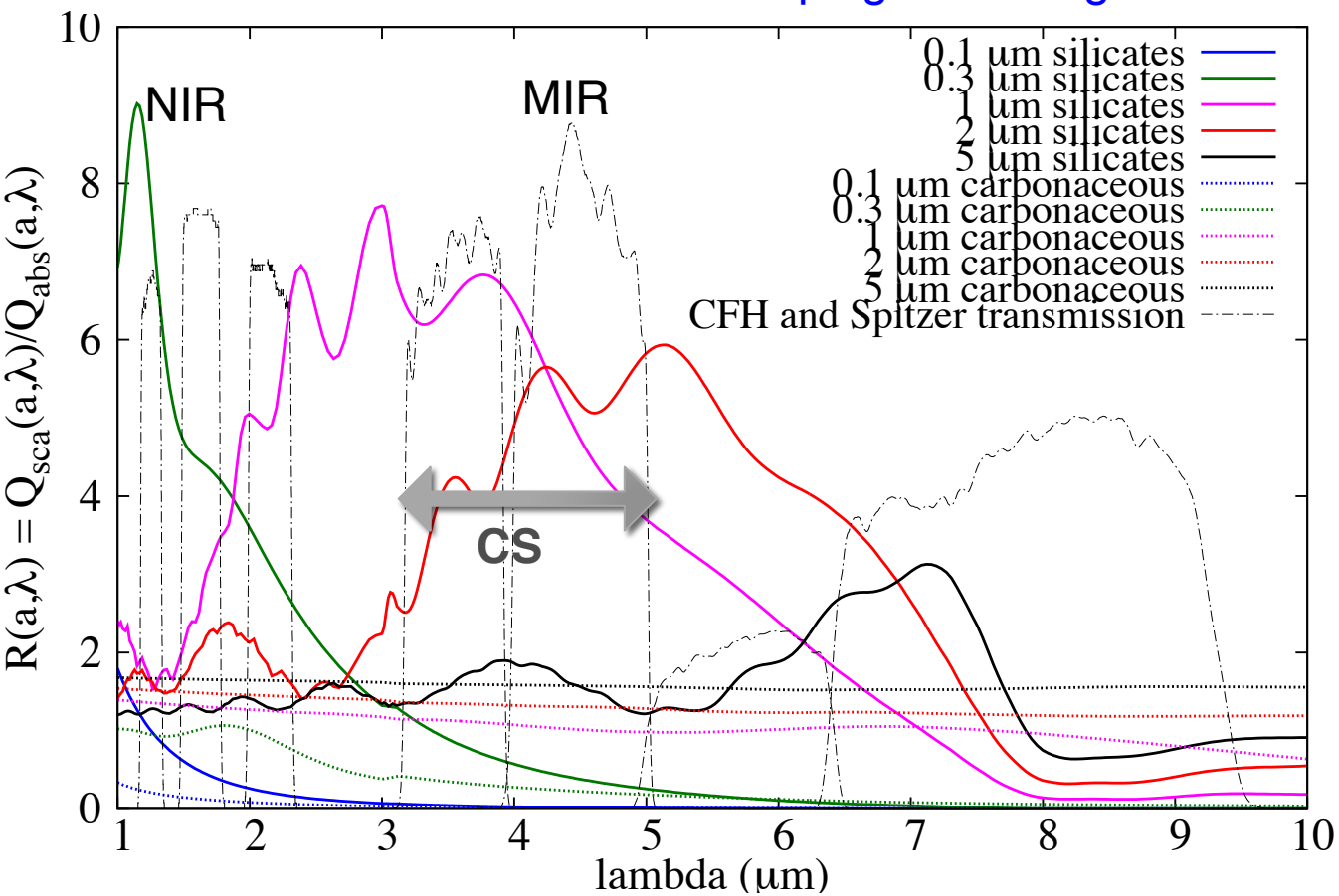

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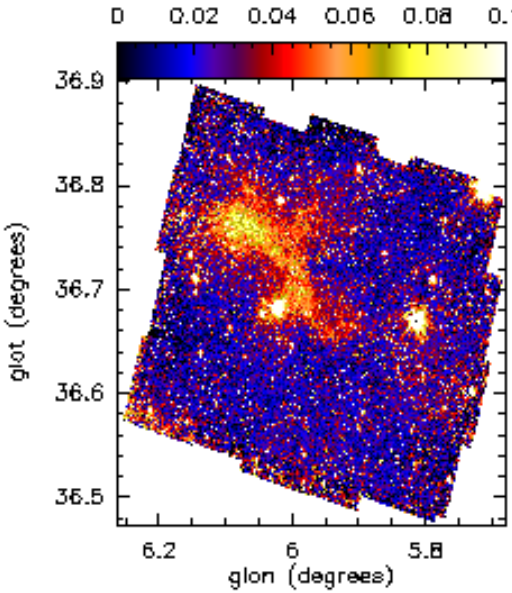
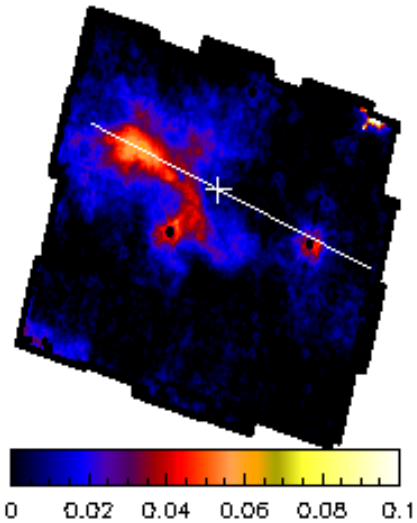
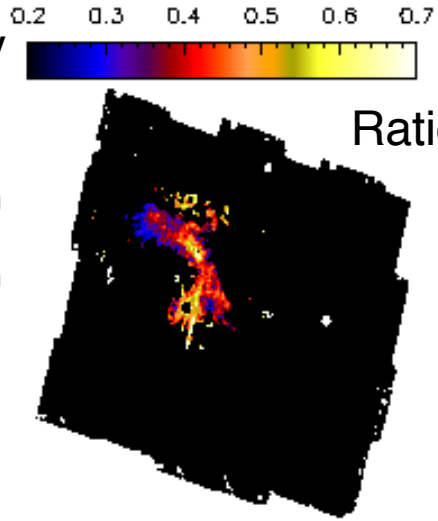
Modeling + Wavelength ratio

Observations

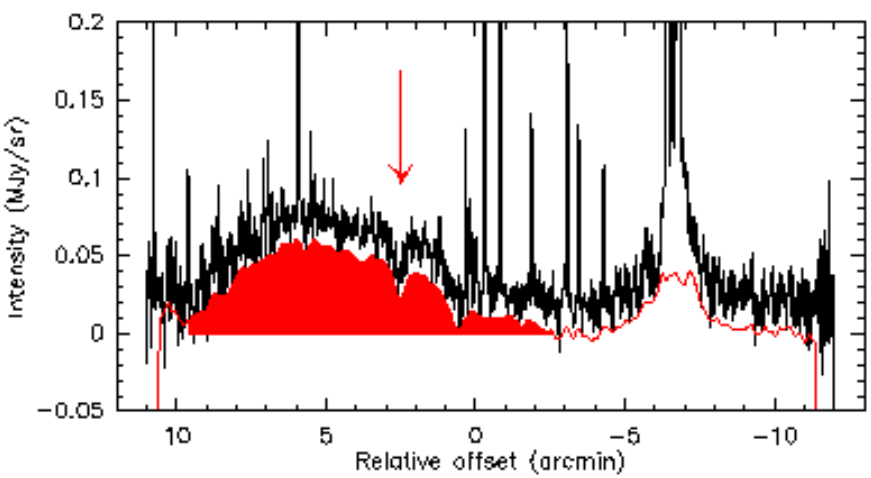


3.6 μm CS intensity

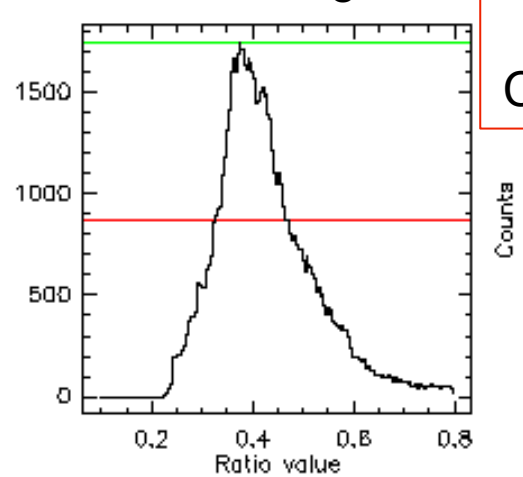




Ratio map = 4.5 μm /3.6 μm



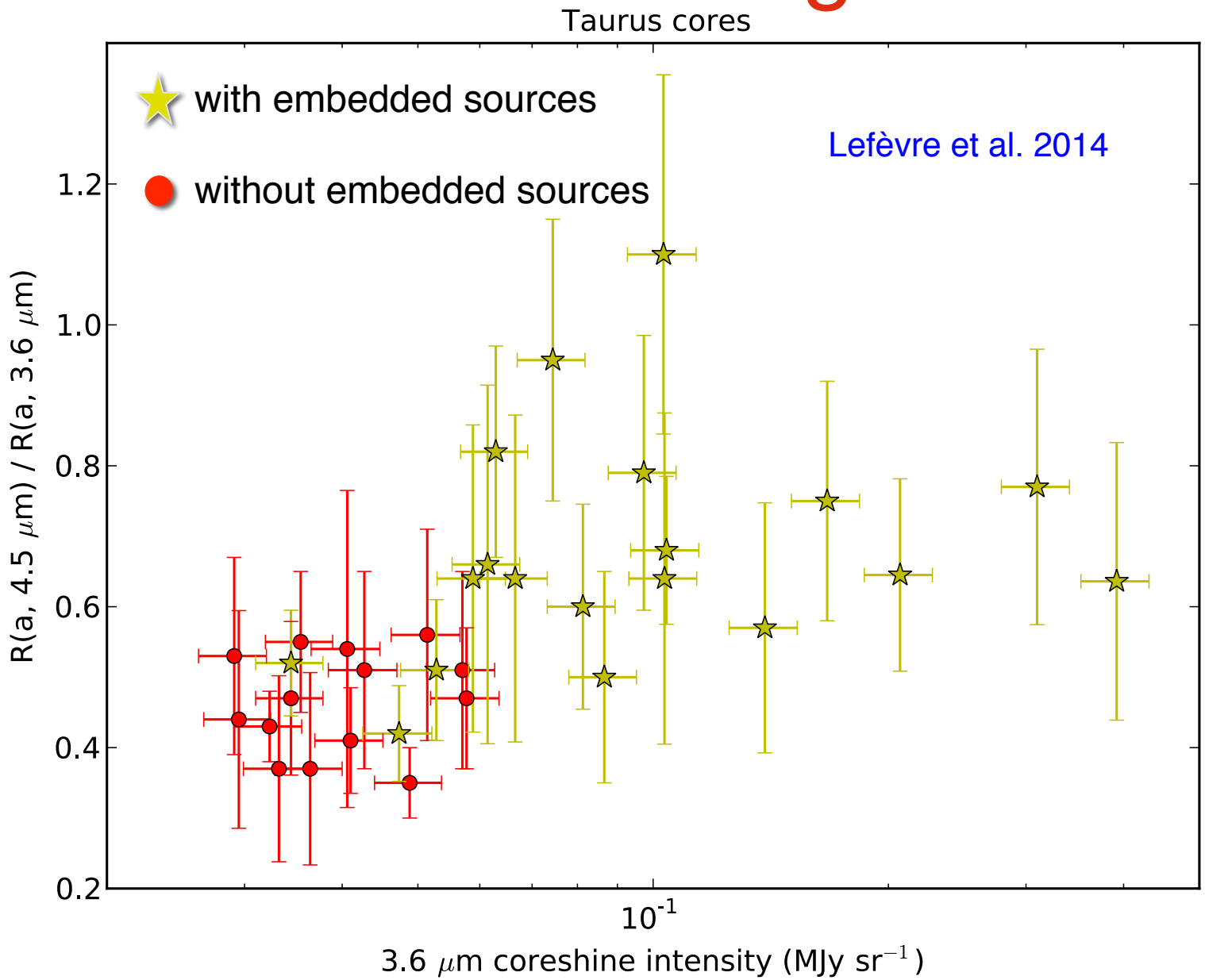
Ratio histogram



L183
CS ratio : 37.5% ± 7 %

Global survey : CS ratio from 0.3 to 1.1

Embedded sources : higher CS ratio



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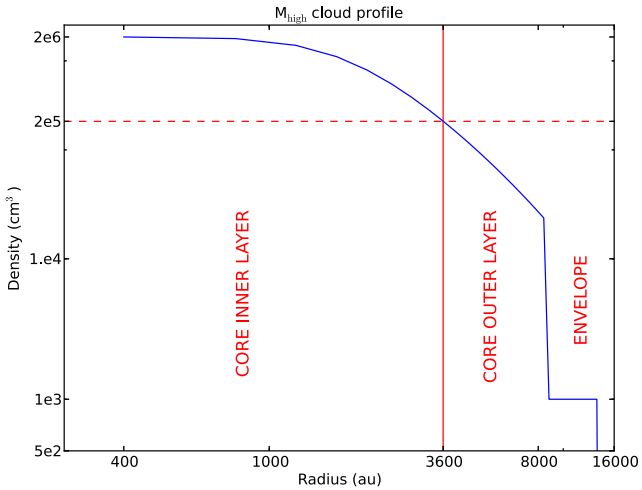
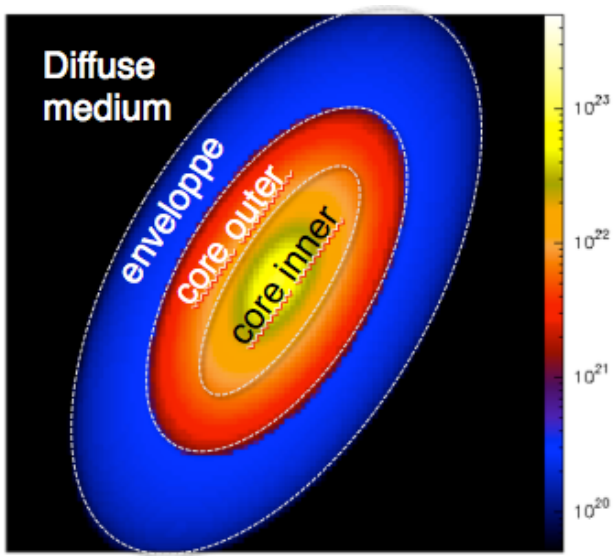
Modeling : Cloud model + ISRF

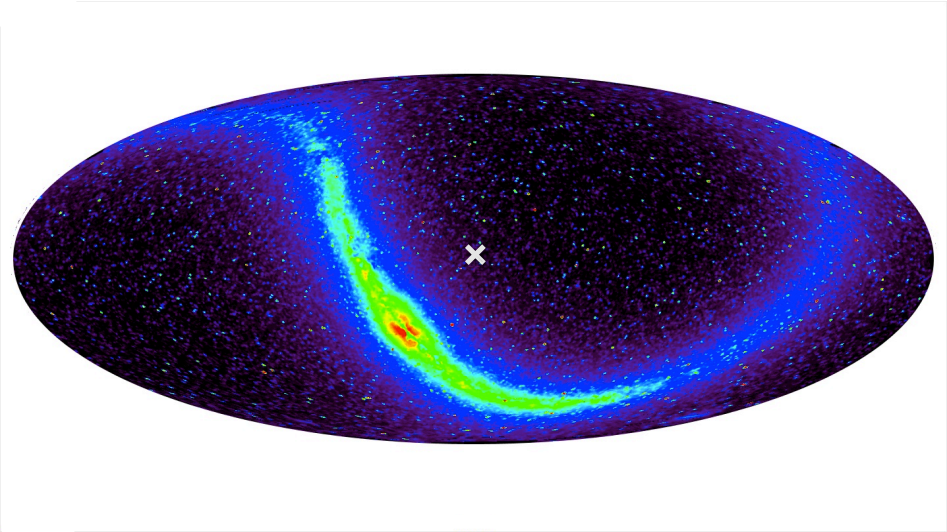
Plummer density profile



Column density map



ISRF intrinsically anisotropic : DIRBE maps



Inputs for the CRT radiative transfer code

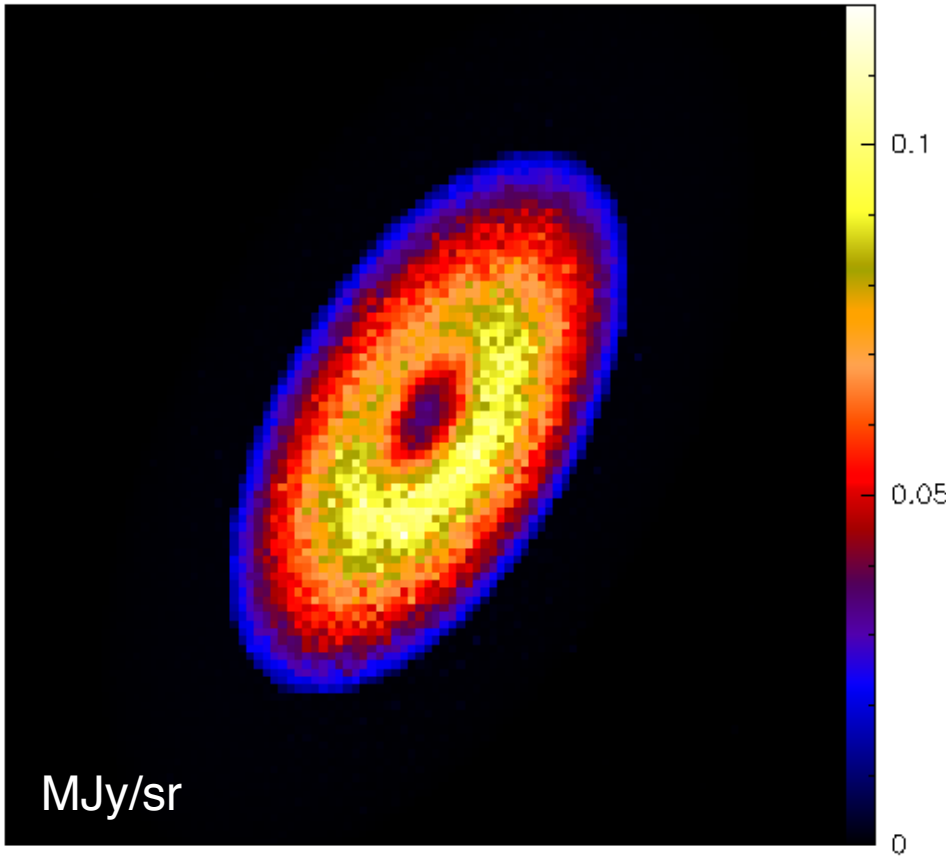
Juvela & Padoan (2005)

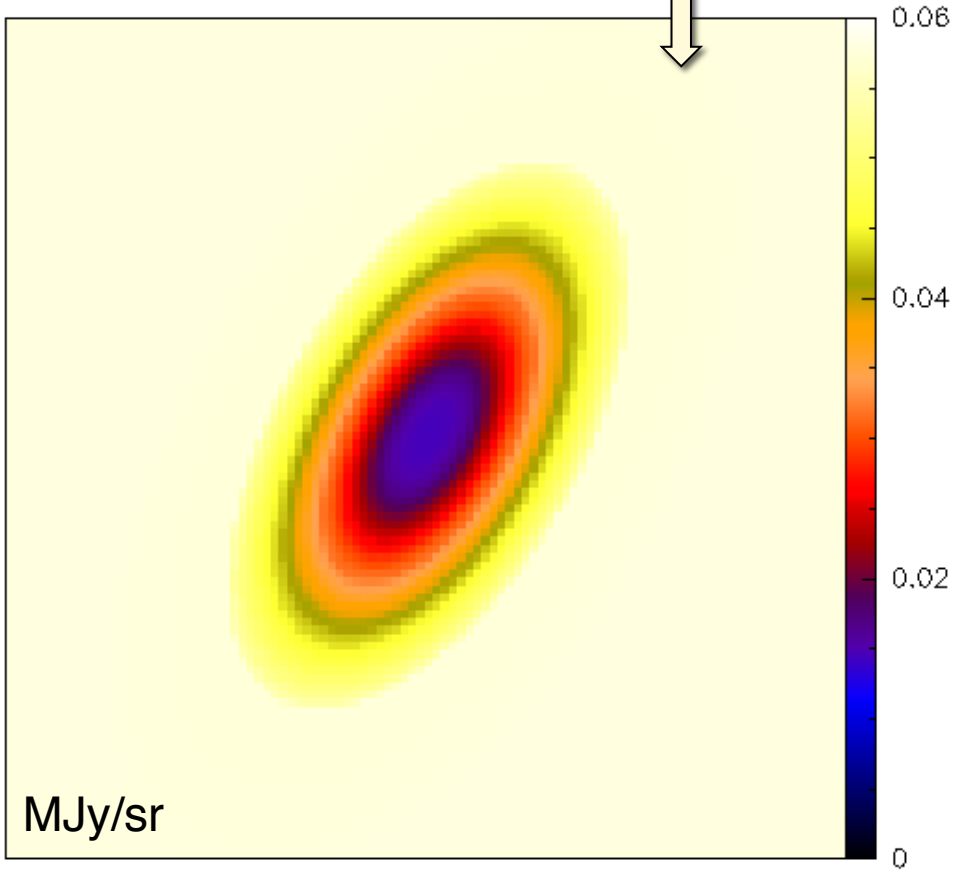
Modeling : Combination scattering/absorption

CORESHINE INTENSITY = Scattering + bg*Iback*exp(-tau) - Iback

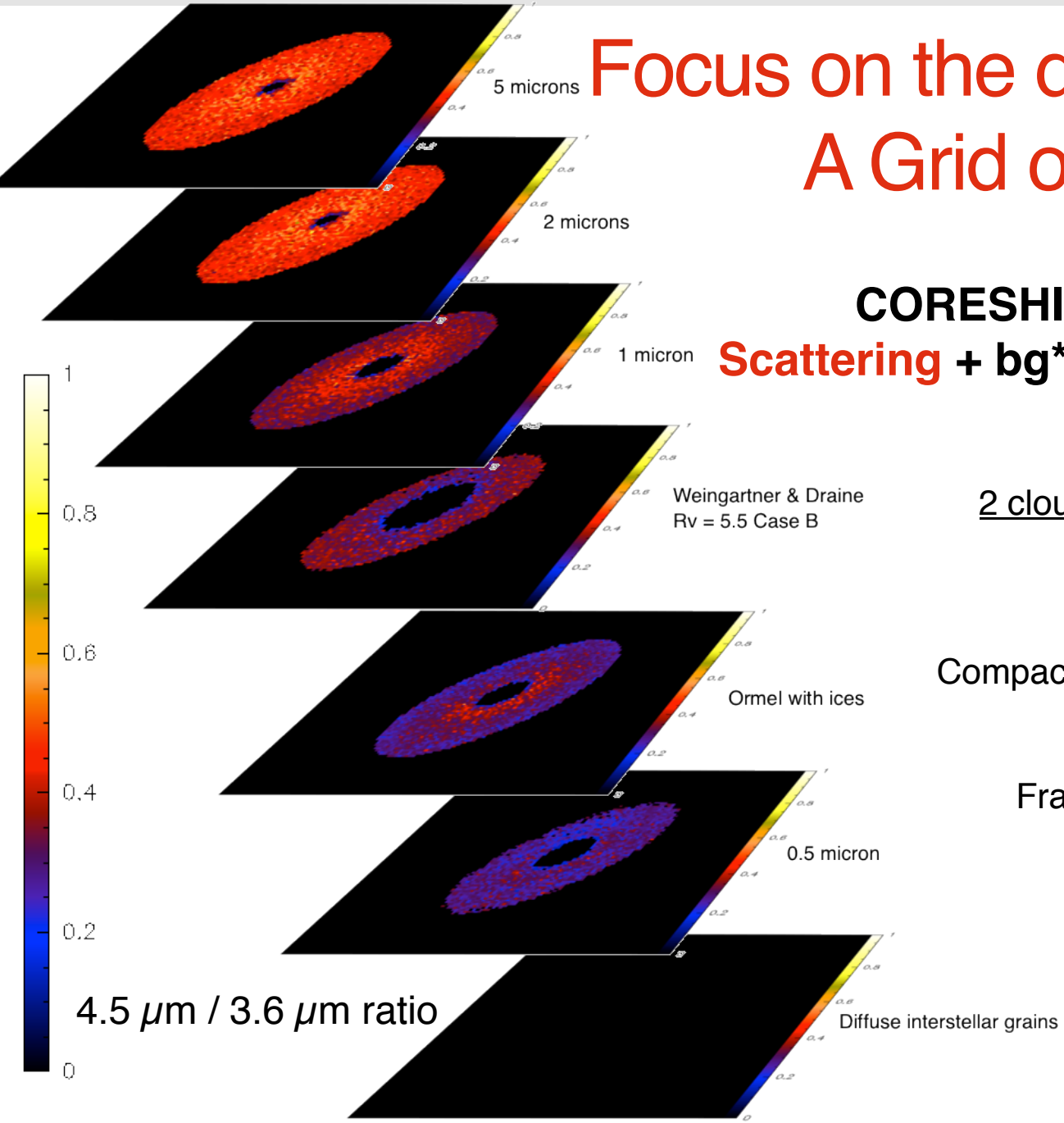
Scattering map

Cloud background field attenuation





Focus on the dust properties : A Grid of models



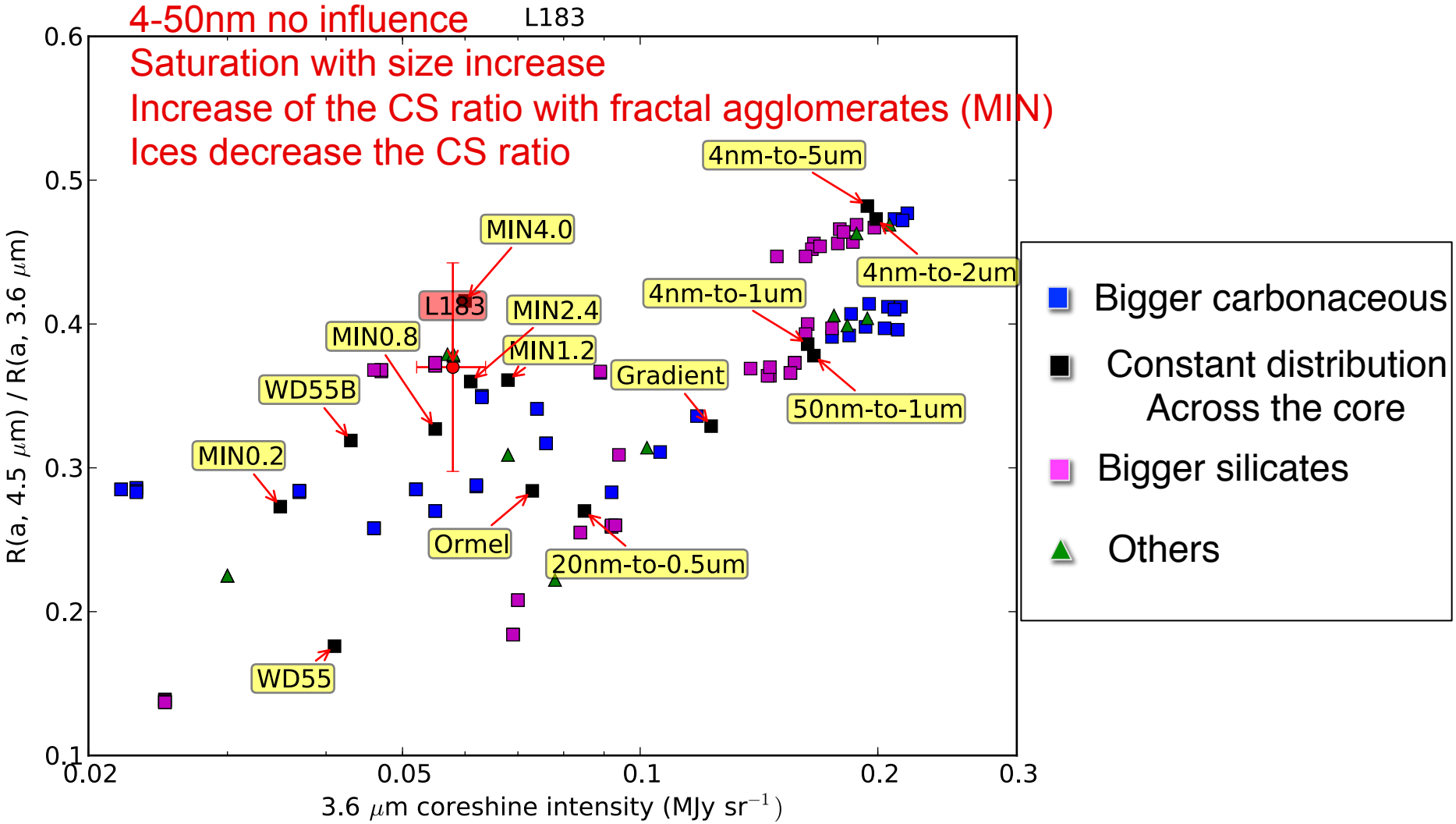
CORESHINE INTENSITY =
Scattering + bg*Iback*exp(-tau) - Iback

2 cloud central densities

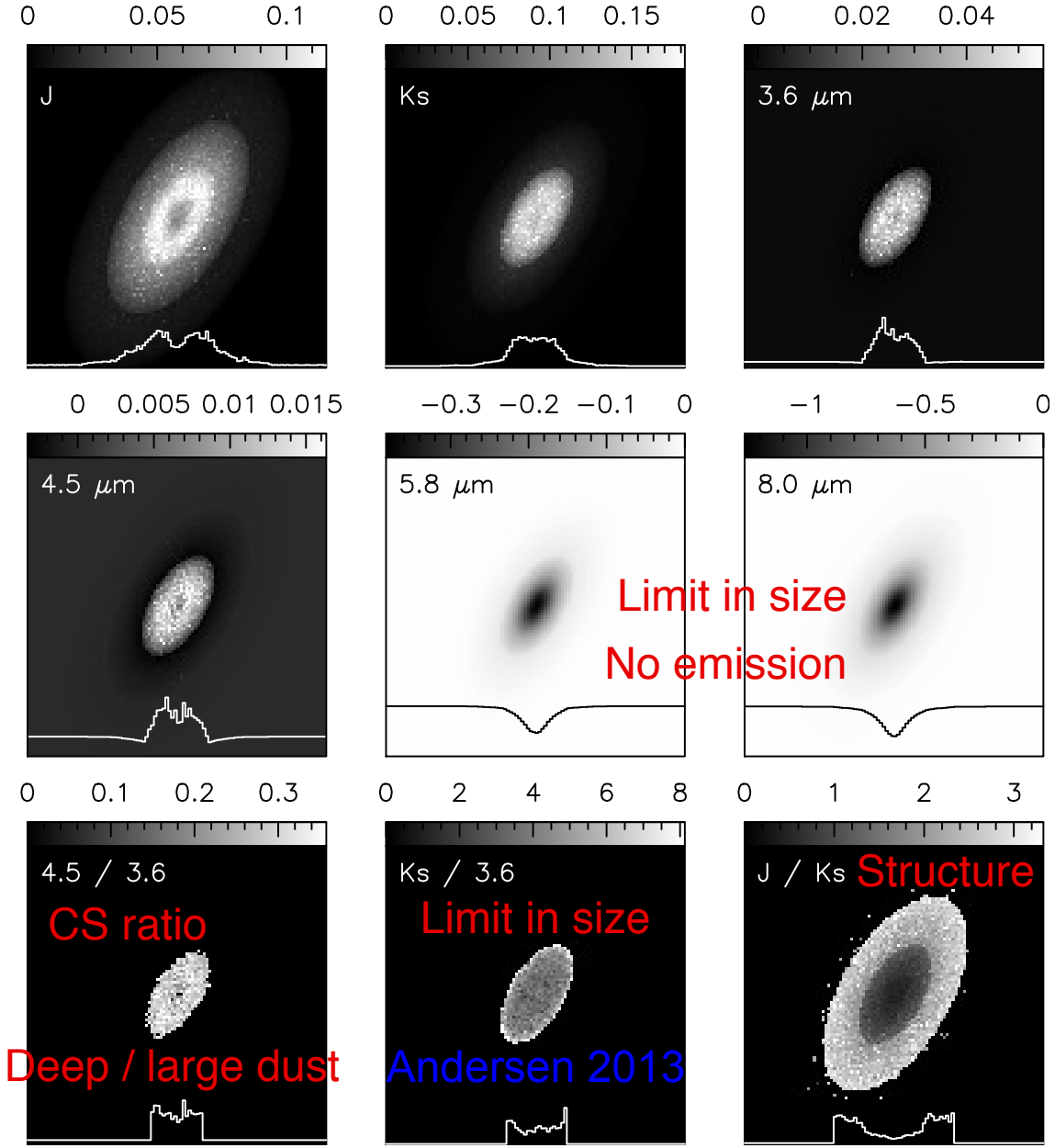
Grain types :
Compact spherical (Compiègne 2011)
Ice mantles (Ormel 2009)
Porosity (Ysard 2013)
Fractal aggregates (Min in prep.)

Sizes : From 5nm to 5μm

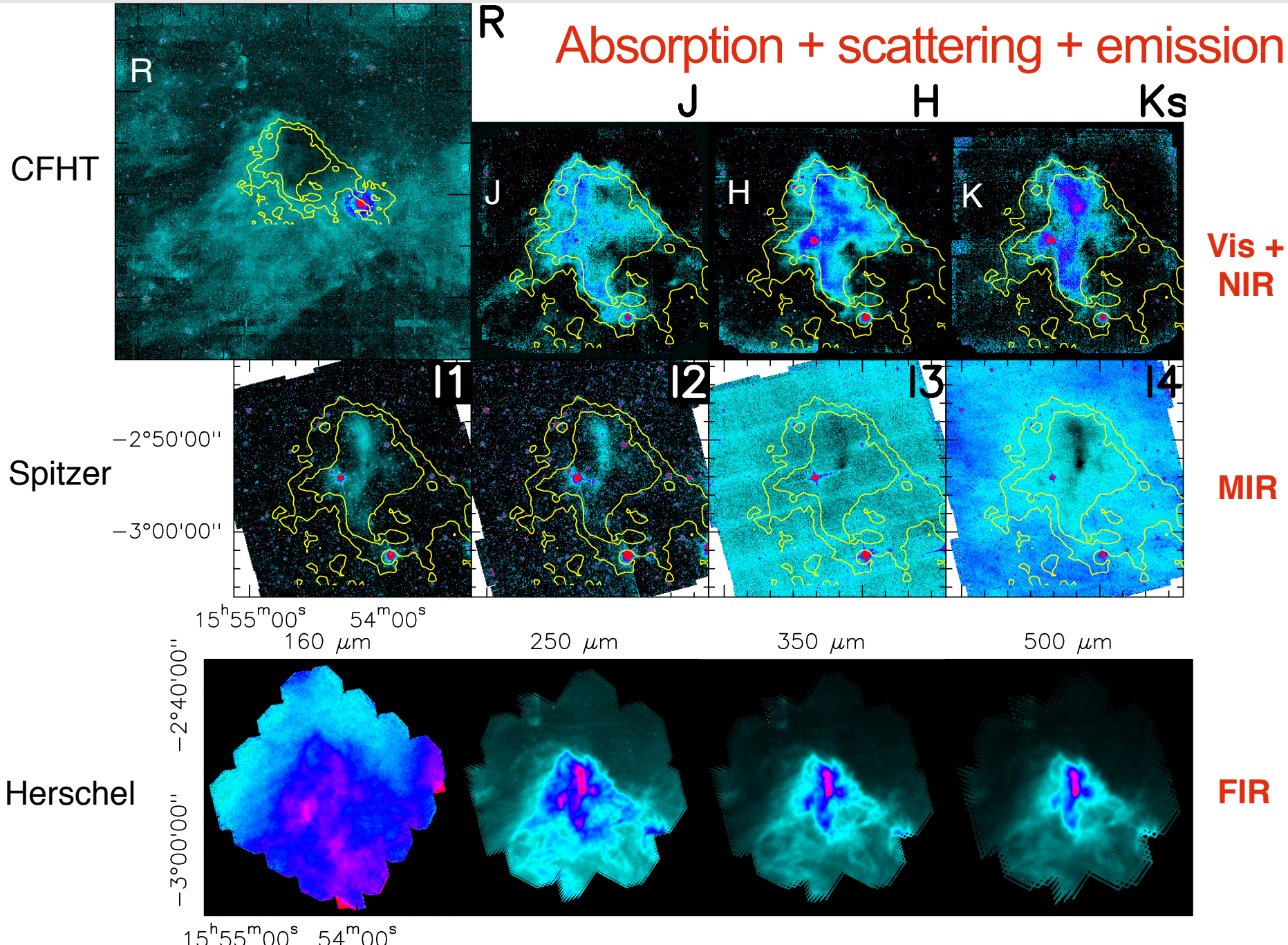
CS ratio sorts the dust models for starless cores



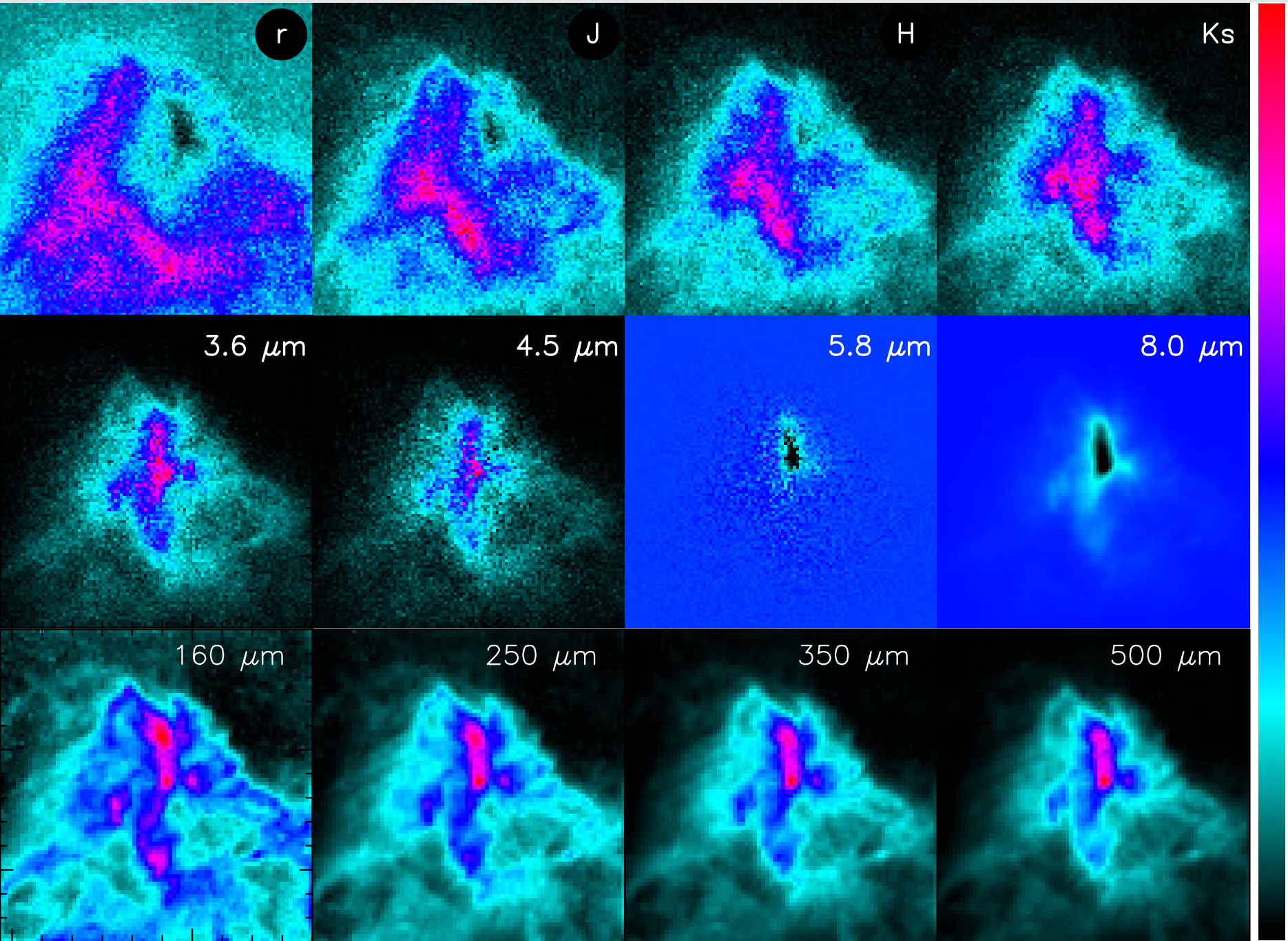
Towards a multiwavelength modeling



Absorption + scattering + emission



One very preliminary tentative model of L183



Conclusions and perspectives

- Coreshine is a widespread phenomenon outside of the Galactic Plane.
- Emergence of coreshine is a contrast issue depending on the cloud background field strength, and scattering is crucial to reproduce NIR/MIR.
- Small grains have no influence to investigate the CS ratio.
- Coreshine implies big grains but the coreshine ratio saturates with increasing size and no emission at 5.8 μm put constraints → limit in size.
- CS ratio more sensitive to dust properties whereas NIR (J especially) is more structure dependent → disentangle between dust properties and cloud structure in 3D thanks to multiwavelength approach.
- Molecular features (SiO_2, H_2O) combined with extinction

Thank you for your attention ! Further details in Lefèvre et al. 2014