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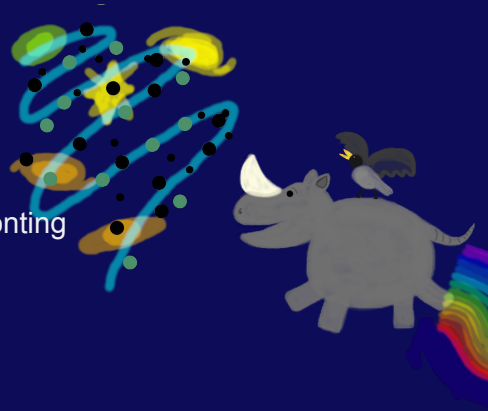
Nathalie Ysard

The Diffuse Galactic Light : Euclid looking through the interstellar veil

LabEx P2IO day
01/12/2022



Goal :

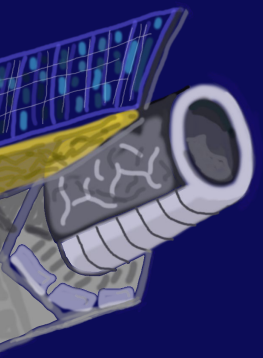
Characterize interstellar big dust grains properties in the diffuse medium by confronting their thermal emission and their ability to scatter light efficiently.

Tools :

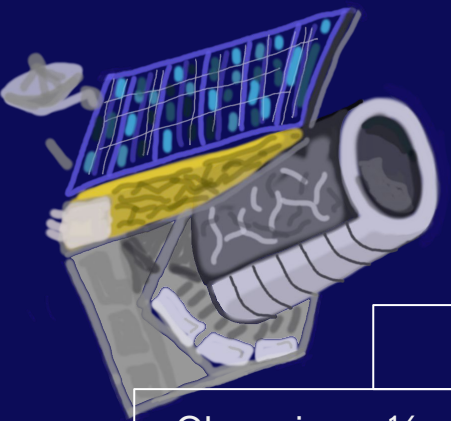
- THEMIS dust model
- DustEM : emission and extinction
- SOC : radiative transfer

Aim :

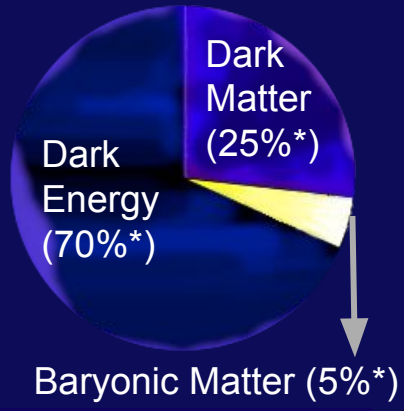
Build a 3D model of an interstellar cloud in order to trace variations of emission, extinction and diffusion properties of the dust. Then use this model to predict diffusion in the visible for Euclid.



A little bit of context… The Euclid Satellite



GOAL :
Better understand dark matter and dark energy by measuring accurately the acceleration of the expansion of the Universe.

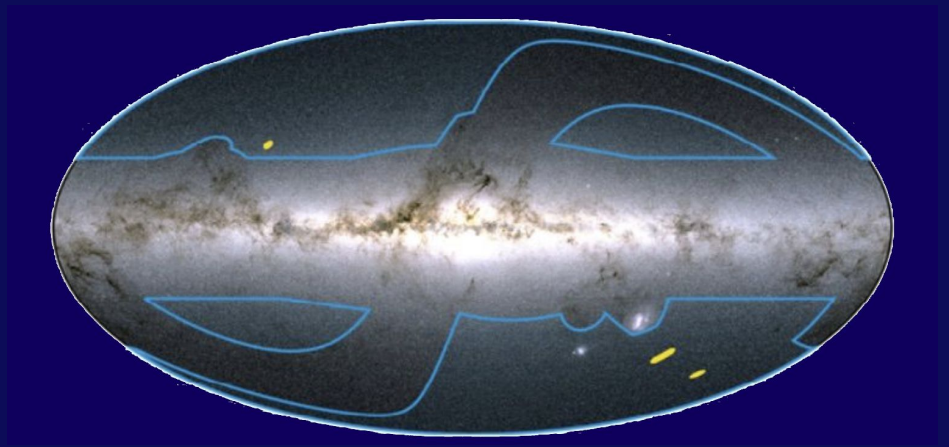


How ?

- Observing > ⅓ of the sky in the visible/NIR at a resolution of 0.1/0.3”.

- Focusing on the darkest regions of the sky in order to avoid dust contamination.

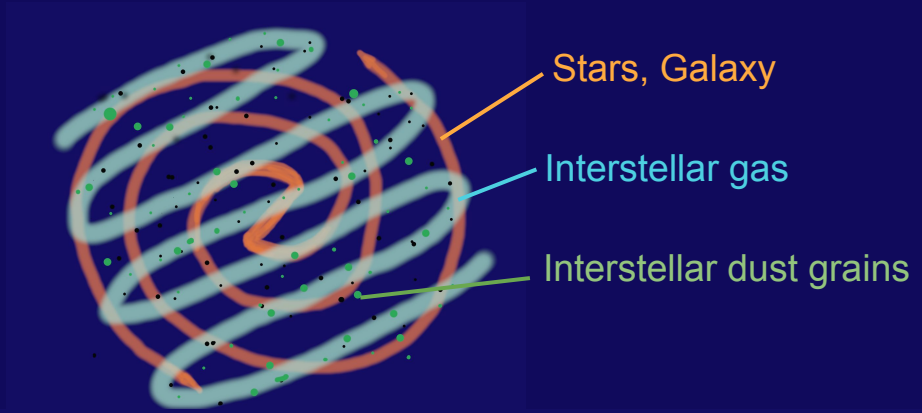
- Using galaxies as probes of the 3D structure of our universe (as a function of cosmic time).

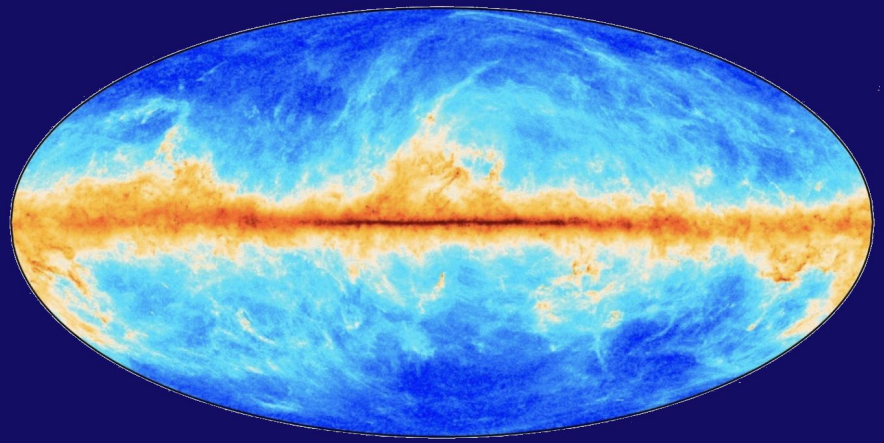


Euclid’s observation regions projected on an all-sky view, by Gaia.

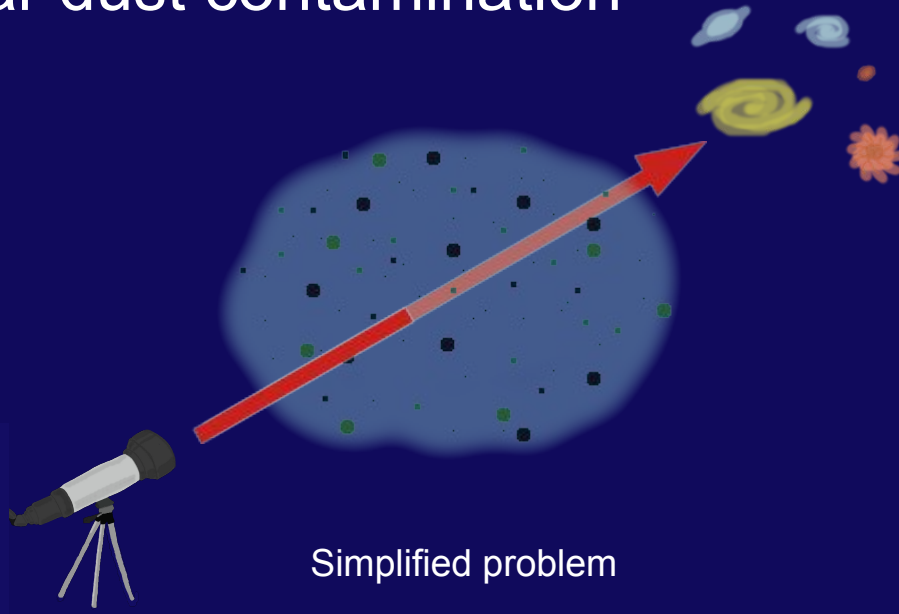
* : Estimated rounded quantities of the matter/energy content of the Universe.

A little bit of context… Interstellar dust contamination





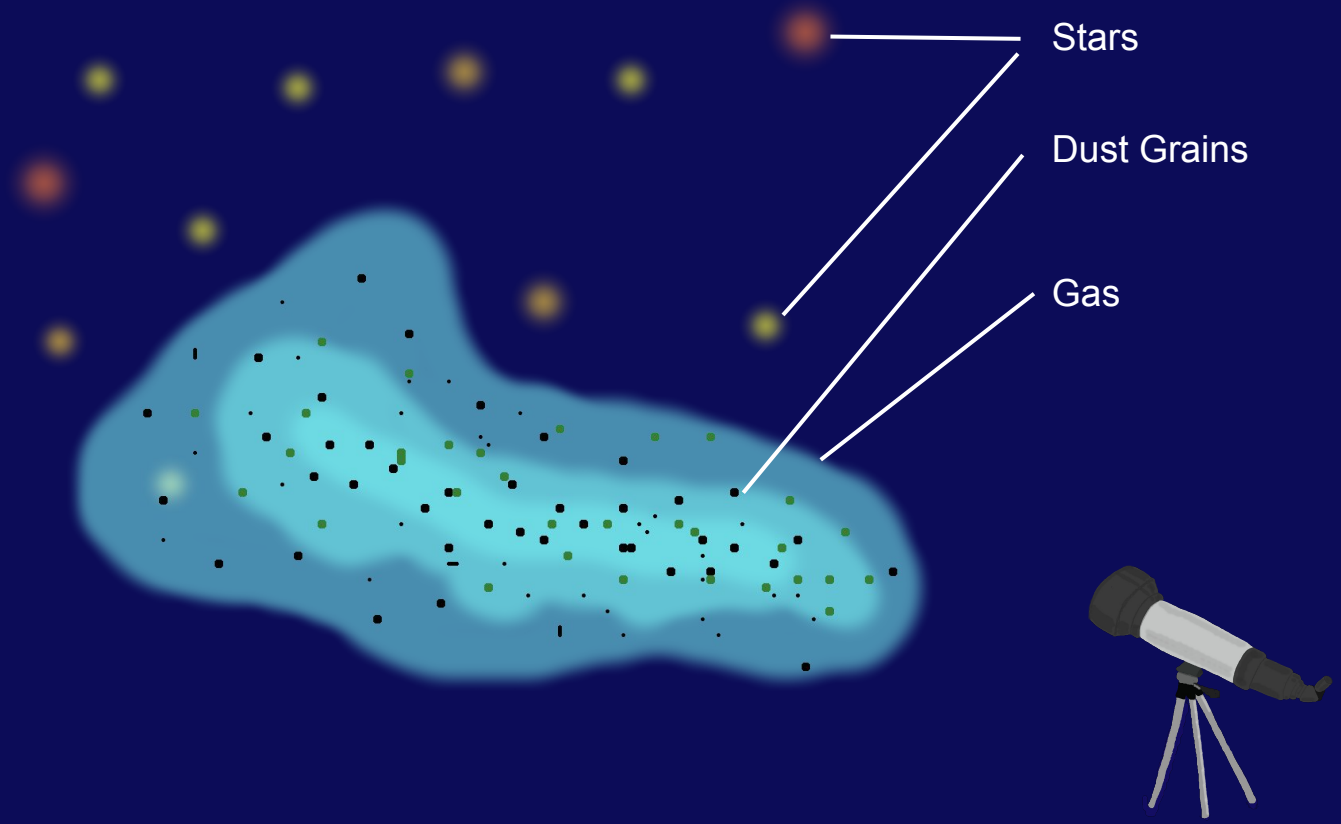
Dust thermal emission all over the sky seen by Planck and IRAS satellites (5')



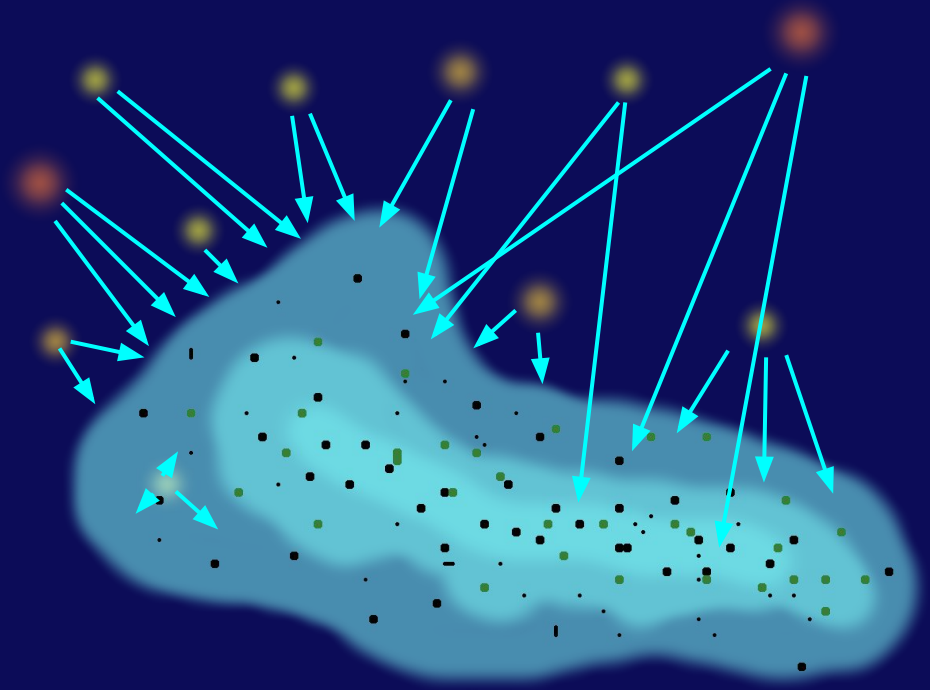
Simplified problem

Milky-way's interstellar medium is ubiquitous over all line of sight, blurring the background and disturbing deep sky observations. We're talking about "Interstellar Veil".

A little bit of context… Contamination mechanisms



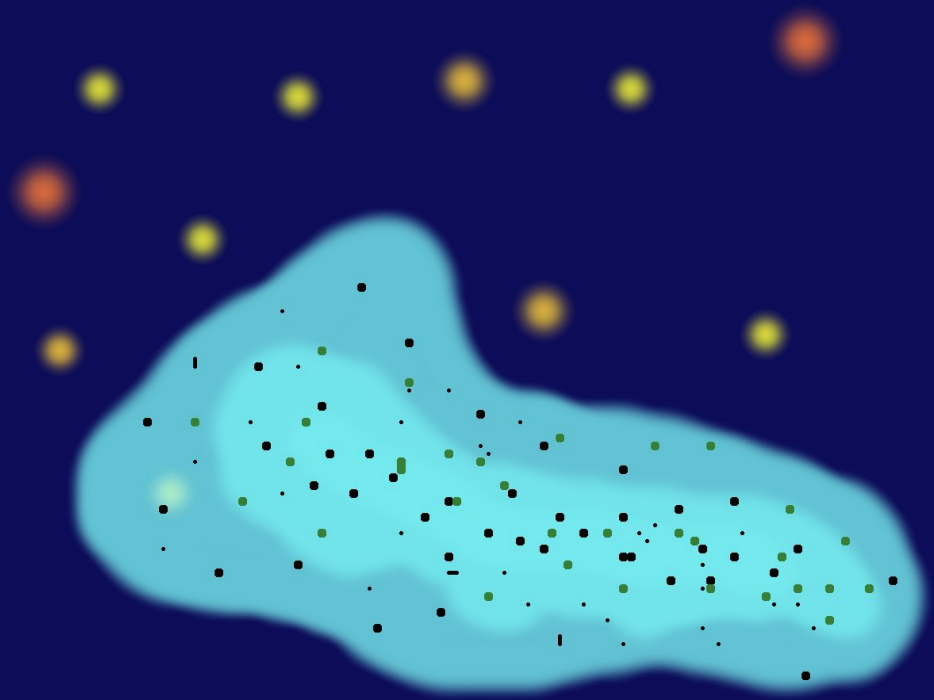
A little bit of context… Contamination mechanisms



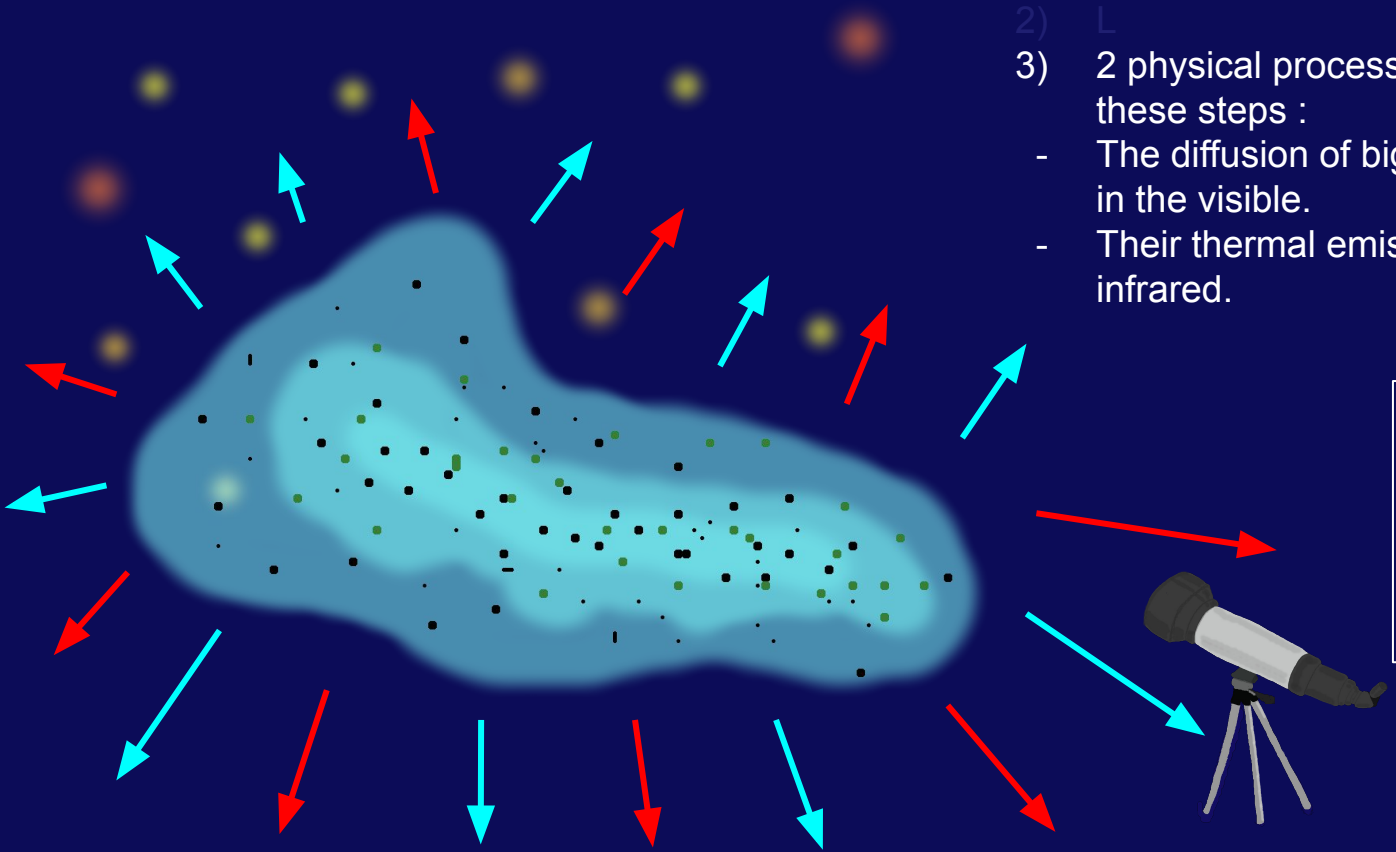
1) Surrounding stars shine over the interstellar medium that will absorb part of its radiation.

A little bit of context… Contamination mechanisms

1) a
2) Dust will then be excited.



A little bit of context… Contamination mechanisms

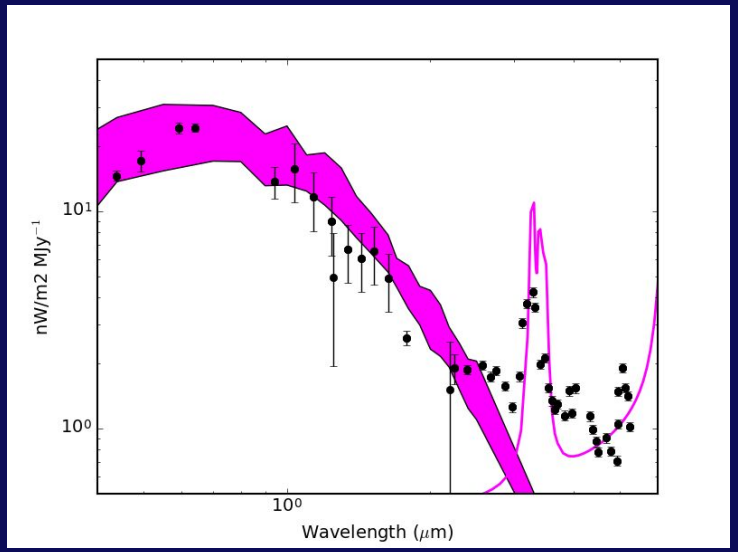


1) a
2) L
3) 2 physical processes follow these steps :
   - The diffusion of big dust grains in the visible.
   - Their thermal emission in the infrared.

We call “Diffuse Galactic Light” (DGL) the star light diffusion by the big dust grains of the interstellar medium.

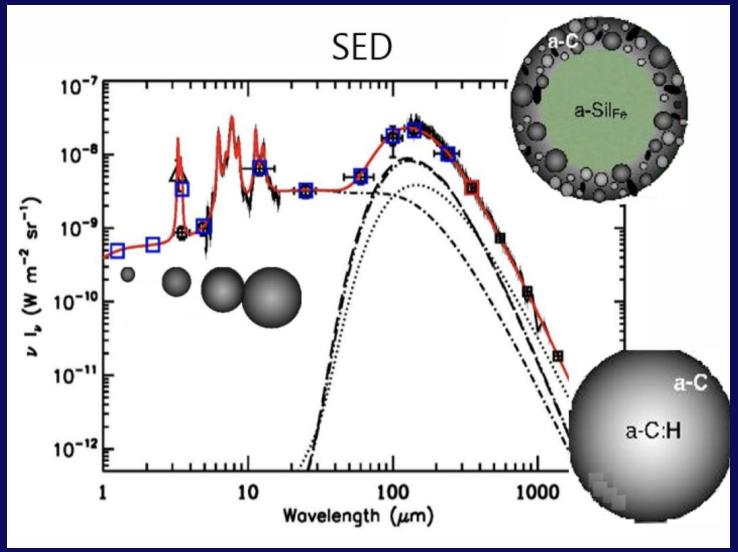
A little bit of context… Modelling

Diffusion in the visible



- Simple radiative transfer model

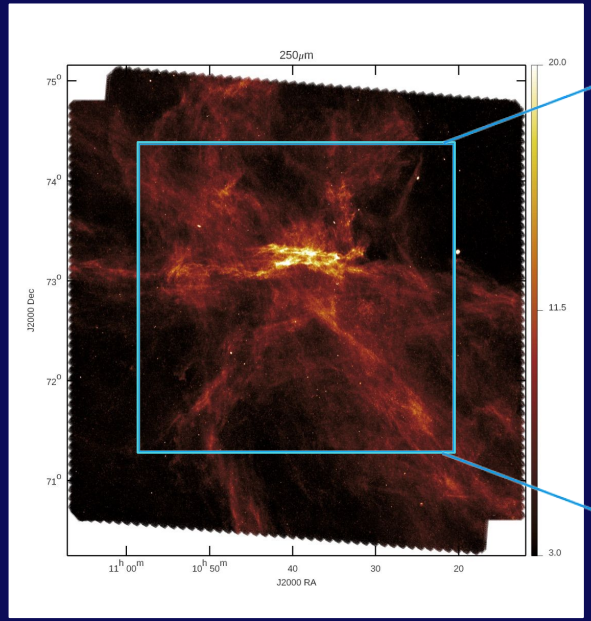
Emission in the infrared



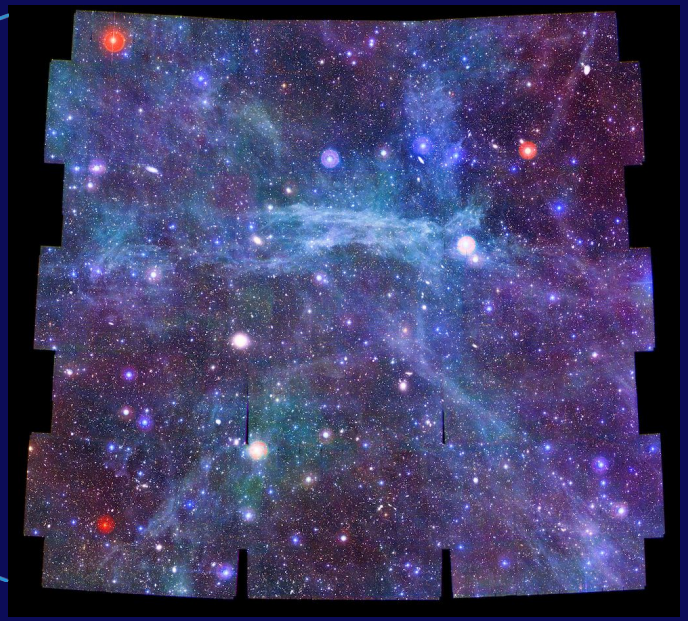
- Emission model based on the evolution of interstellar dust : THEMIS.

Visible/infrared correlation

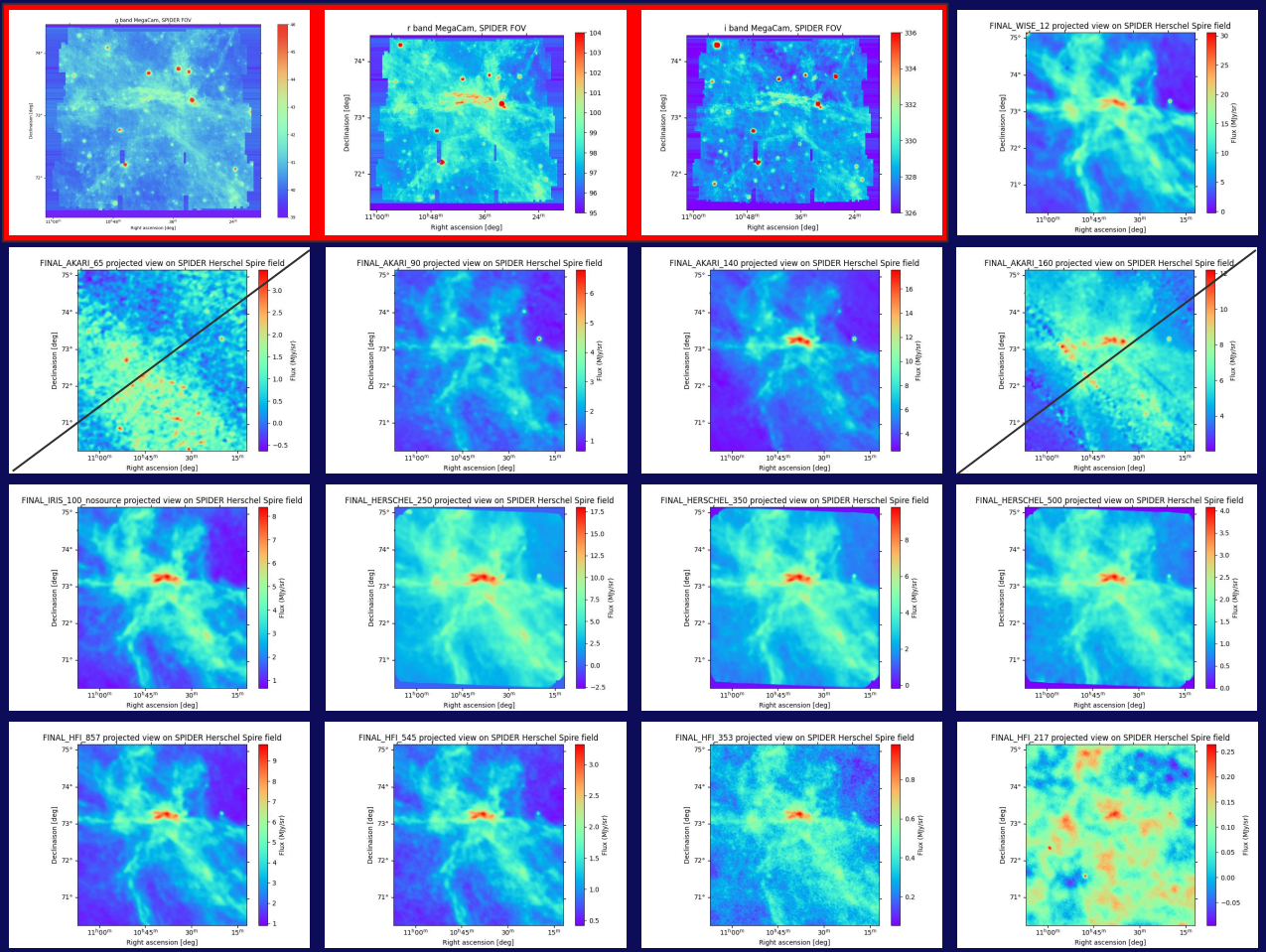
Dust thermal emission
Herschel SPIRE 250 micron



Scattered light
CFHT MegaCam - g,r,i



My work : SPIDER field

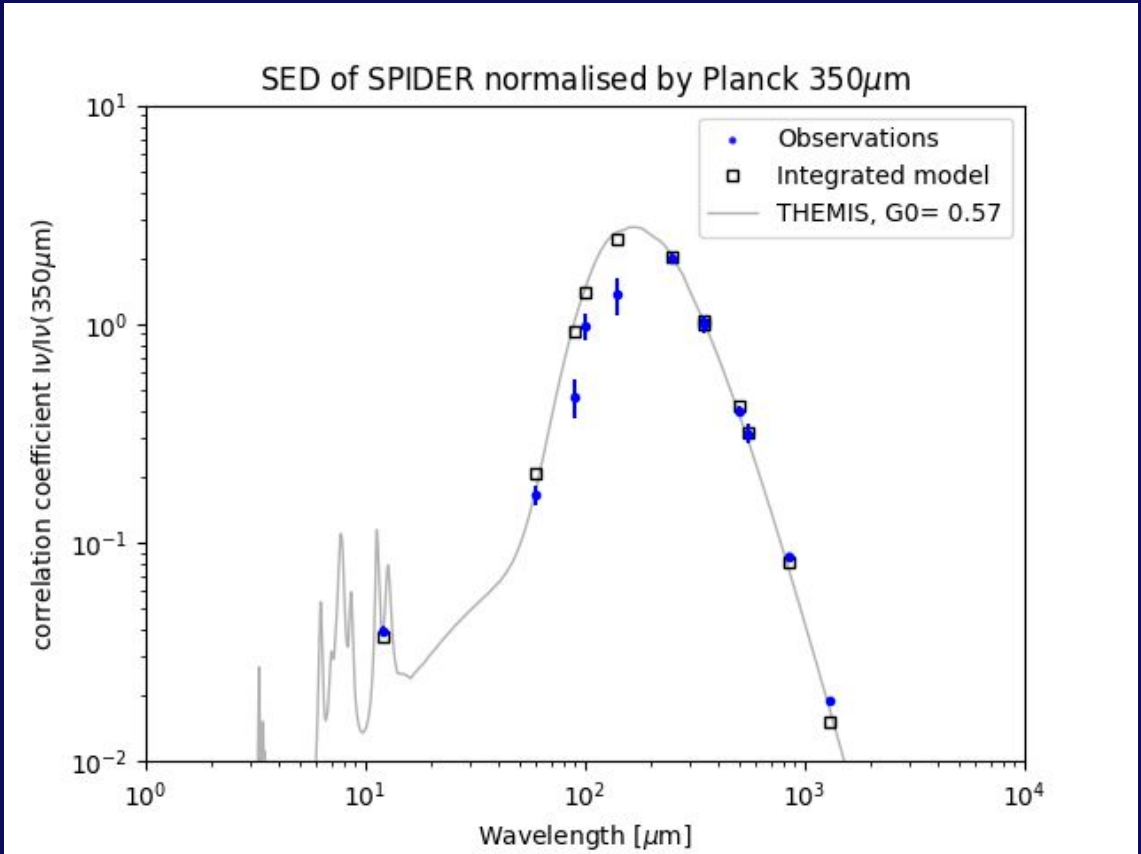


Field : SPIDER 3x3 degrees, loads of observations in the infrared, and a good finish on 3 over the 4 bands of MegaCam (g,r,i).

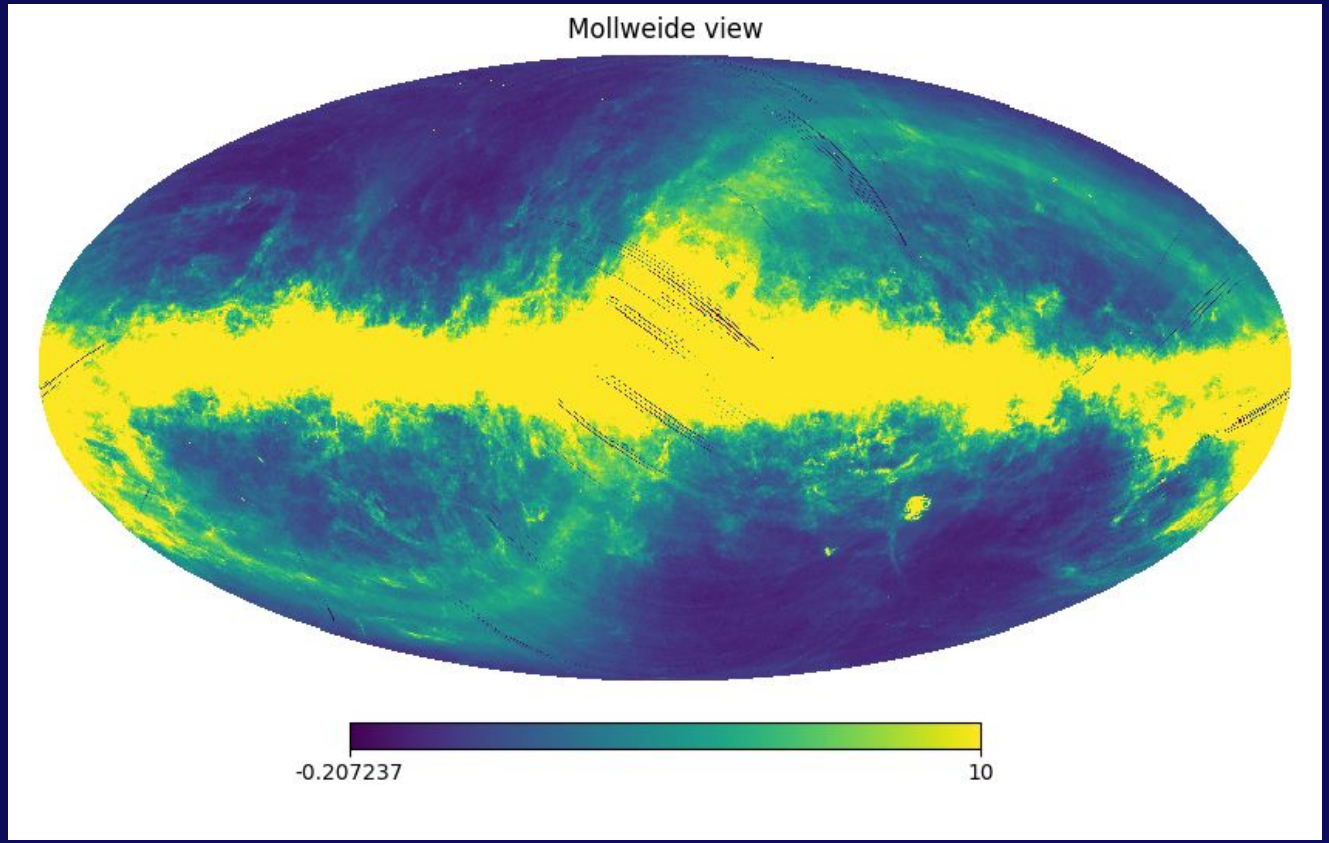
All infrared data have been converted in MJy/sr and convolved at 5.02 arcmin, then projected on the HERSCHEL 250µm field.

MegaCam data are next on the list.

SPIDER spectral energy distribution (infrared)



AKARI FIS re-calibration : 90 microns



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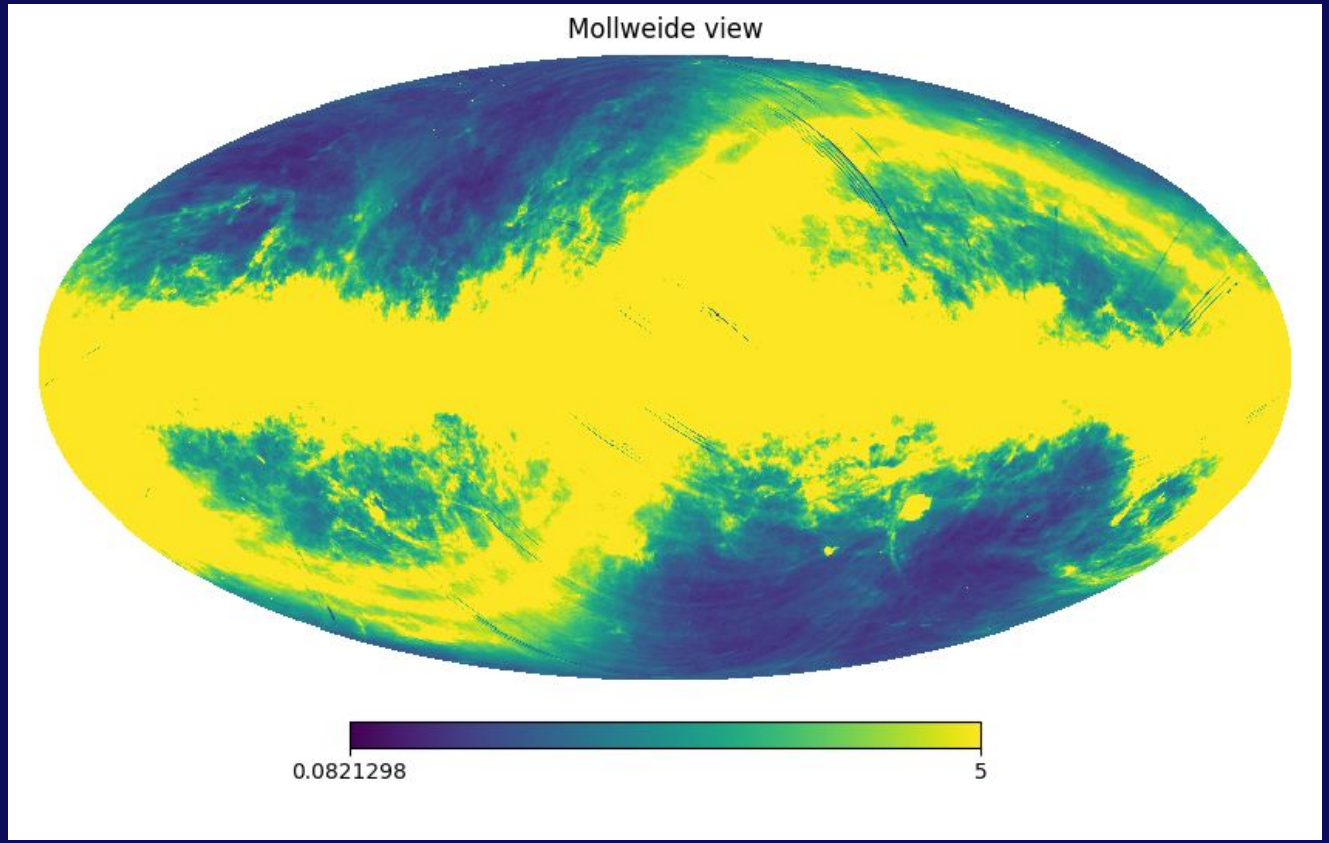

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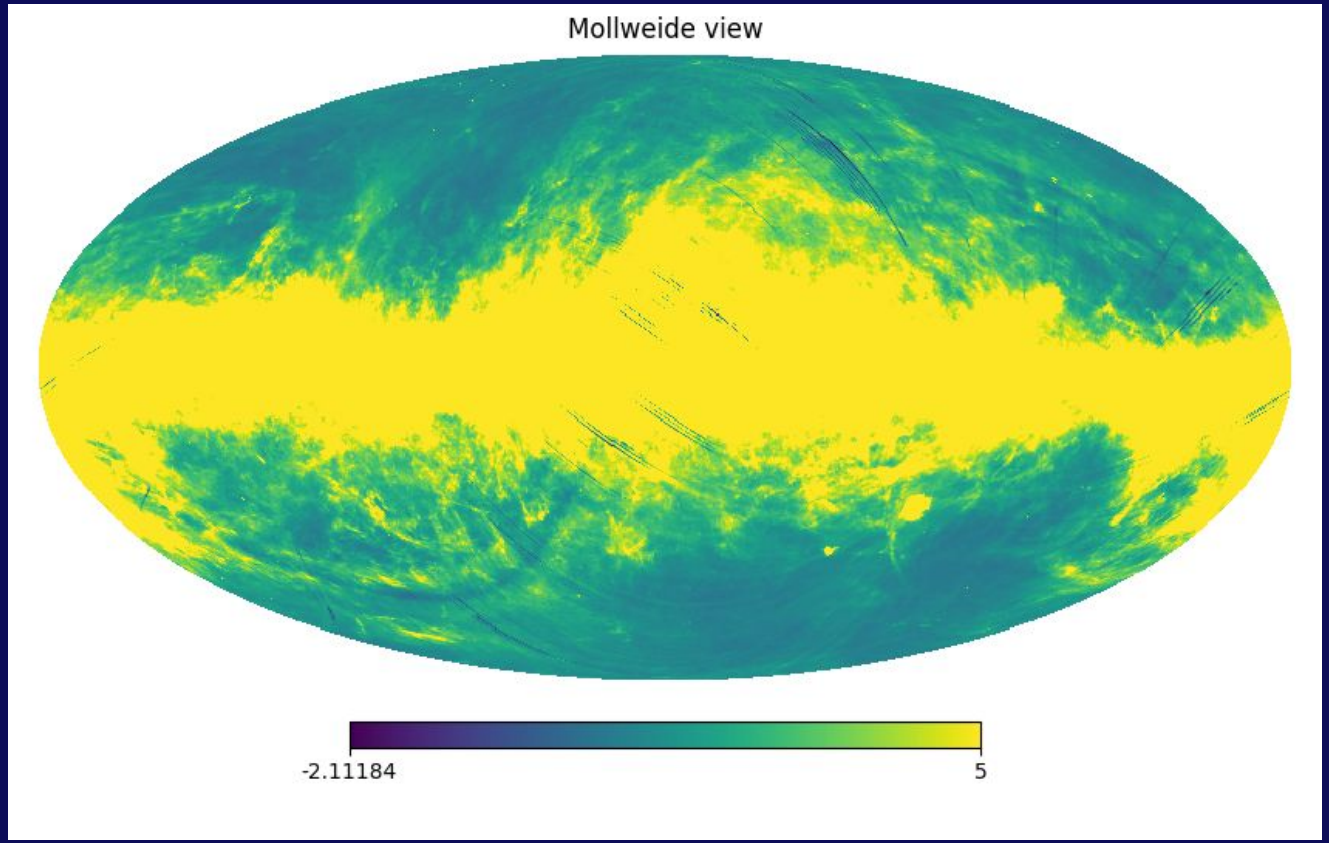
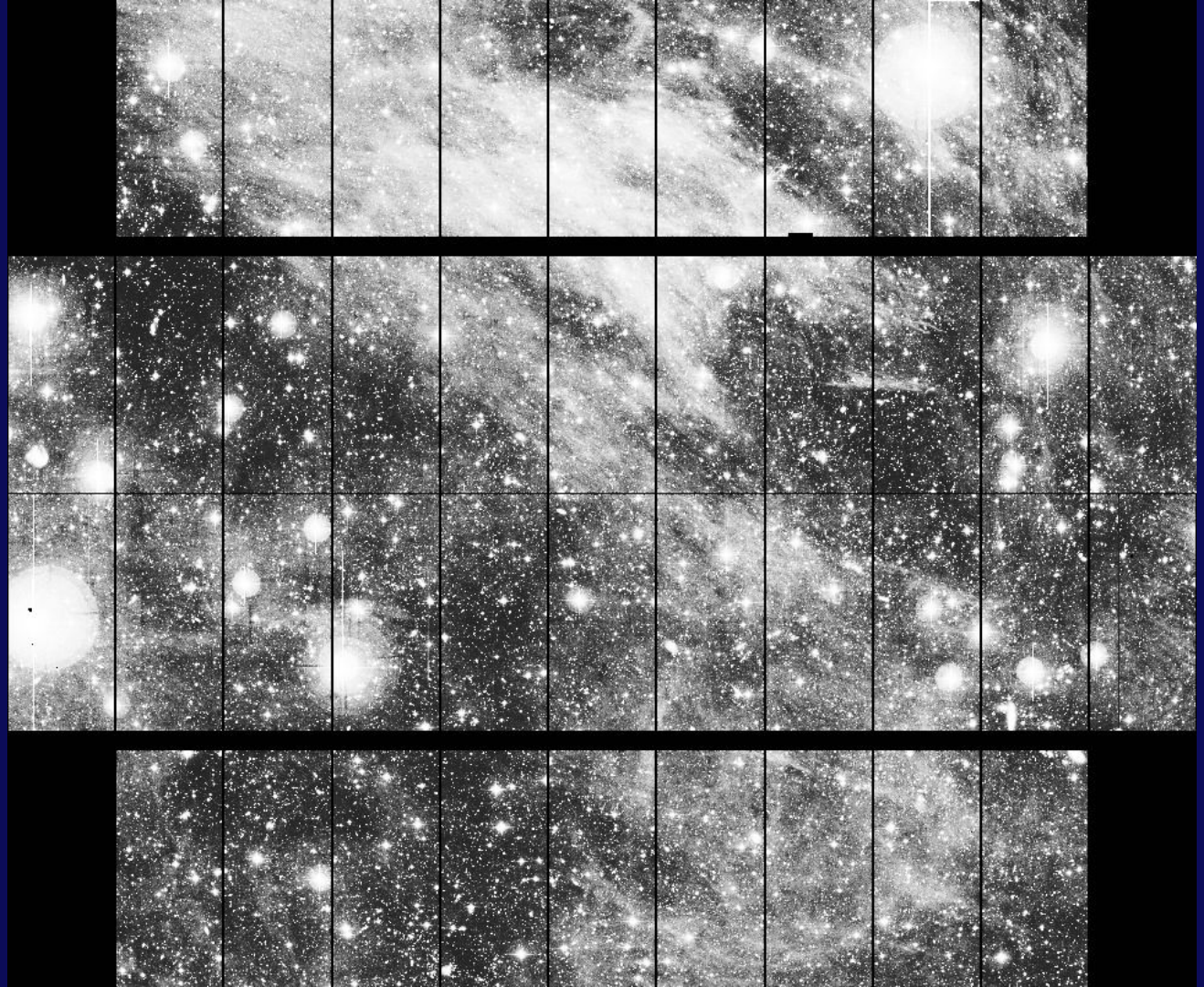
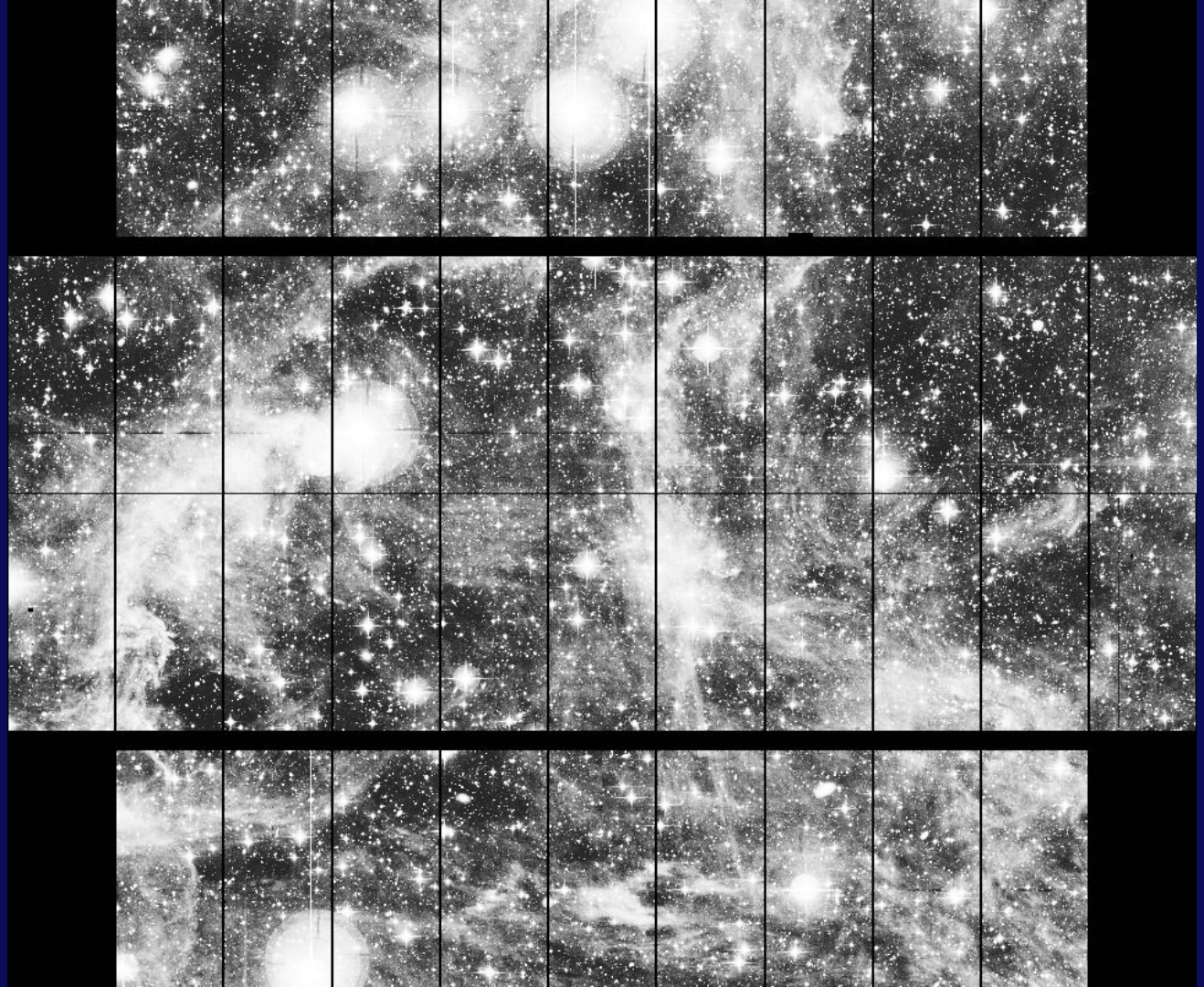
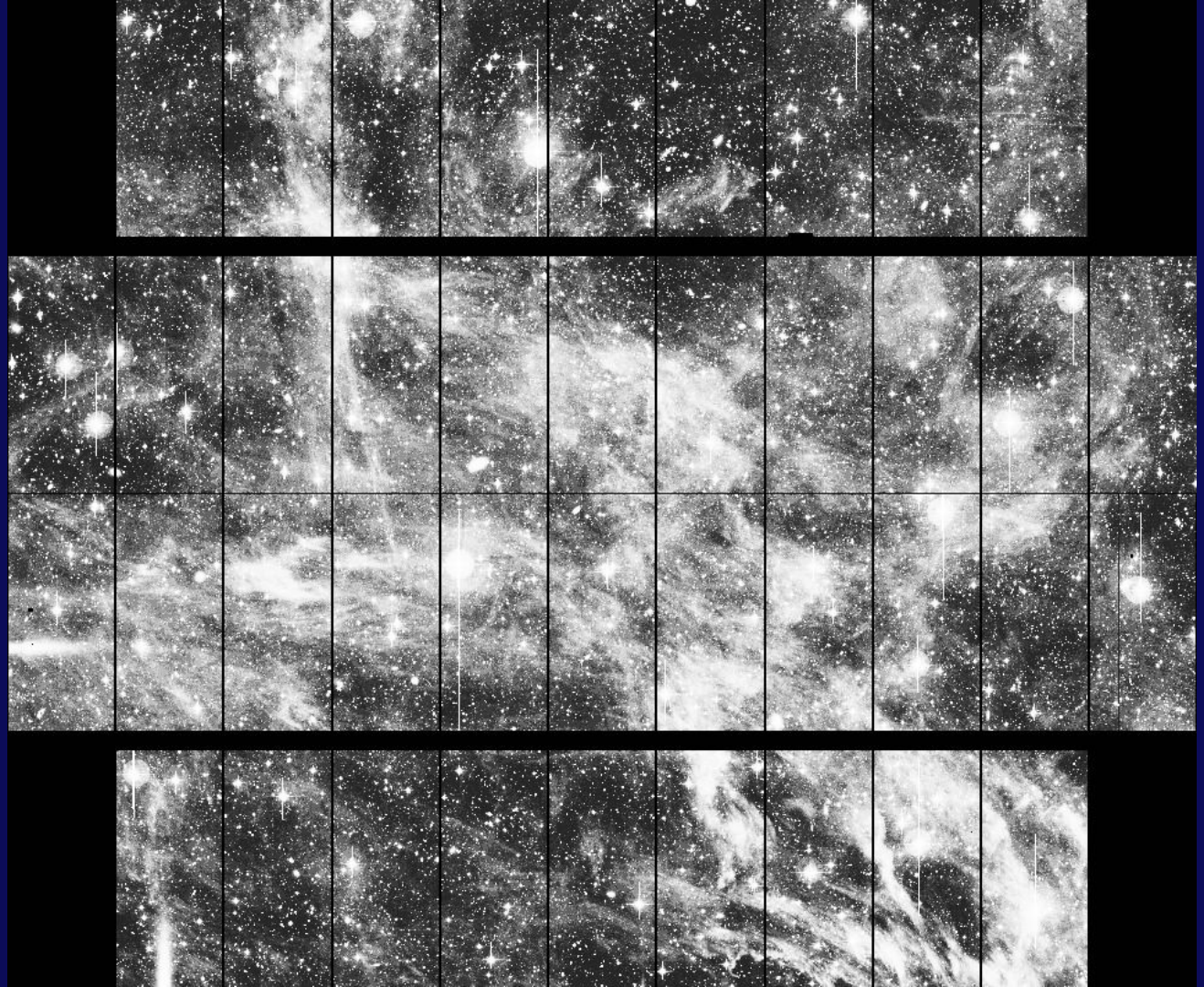


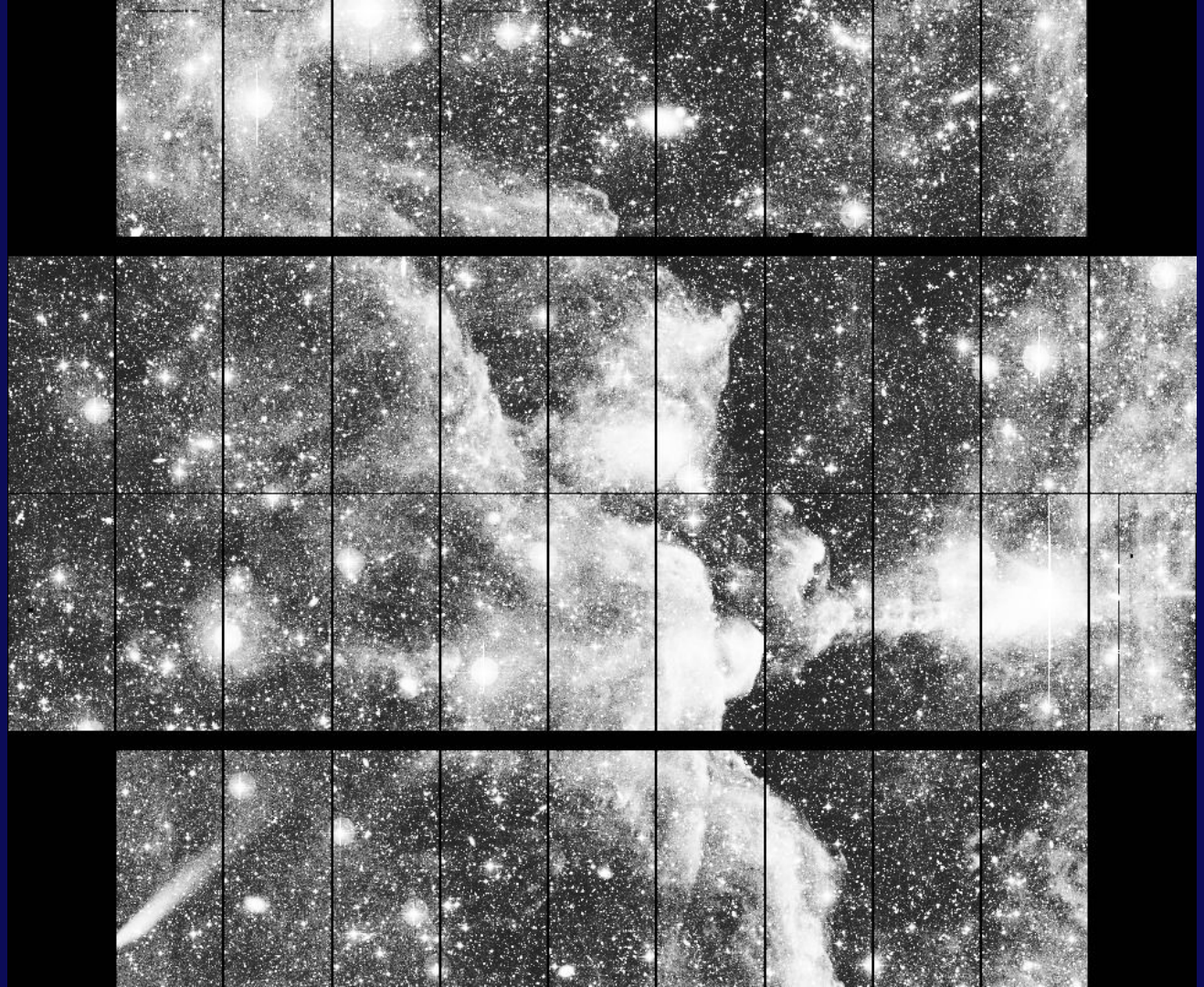
What’s next ?

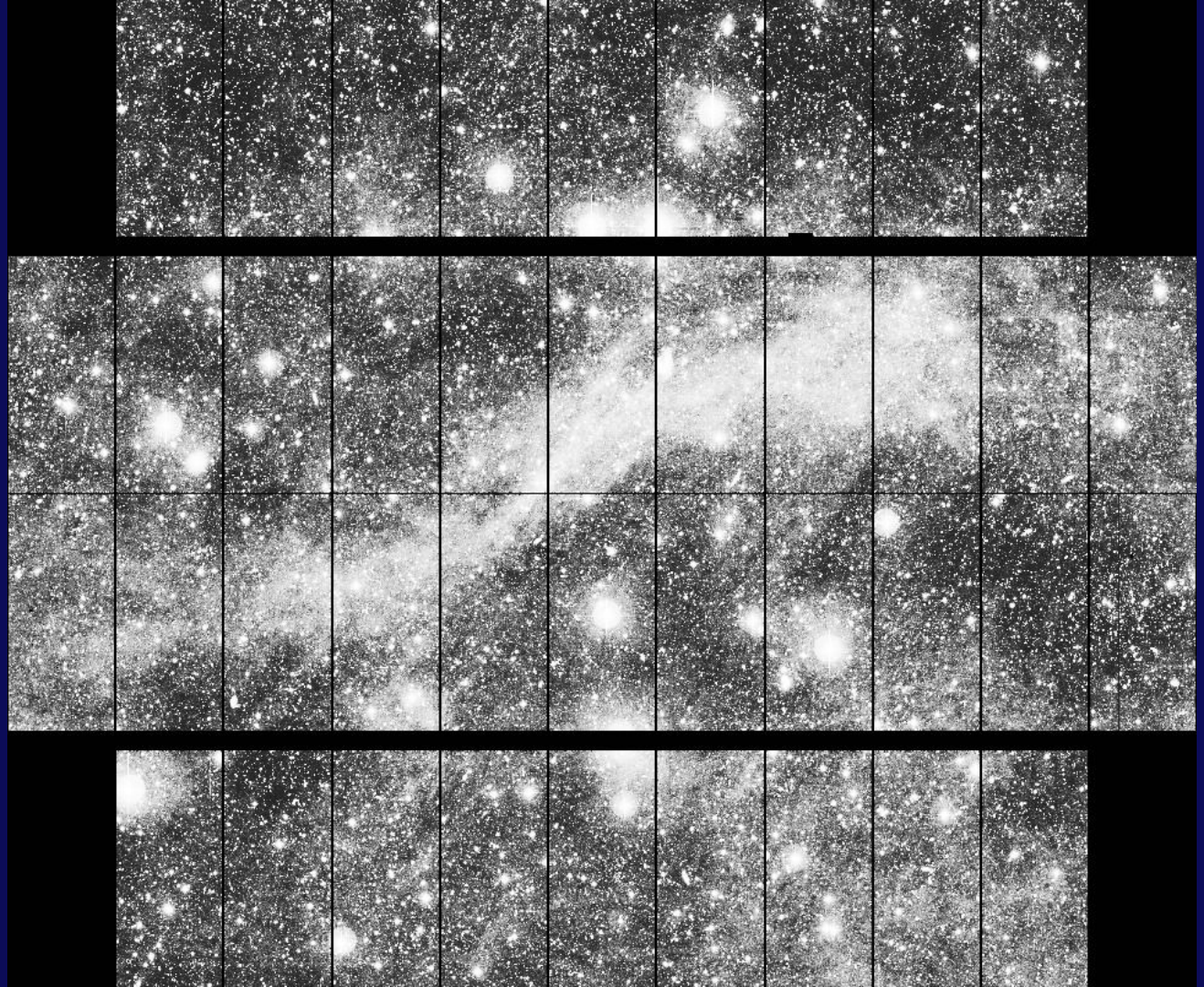
- Finishing AKARI FIS calibration
- Including MecaCam data in the SED
- Trying THEMIS 2 on the fit (already concluent)
- Modelling the diffusion
- Extend the work on other regions of the sky

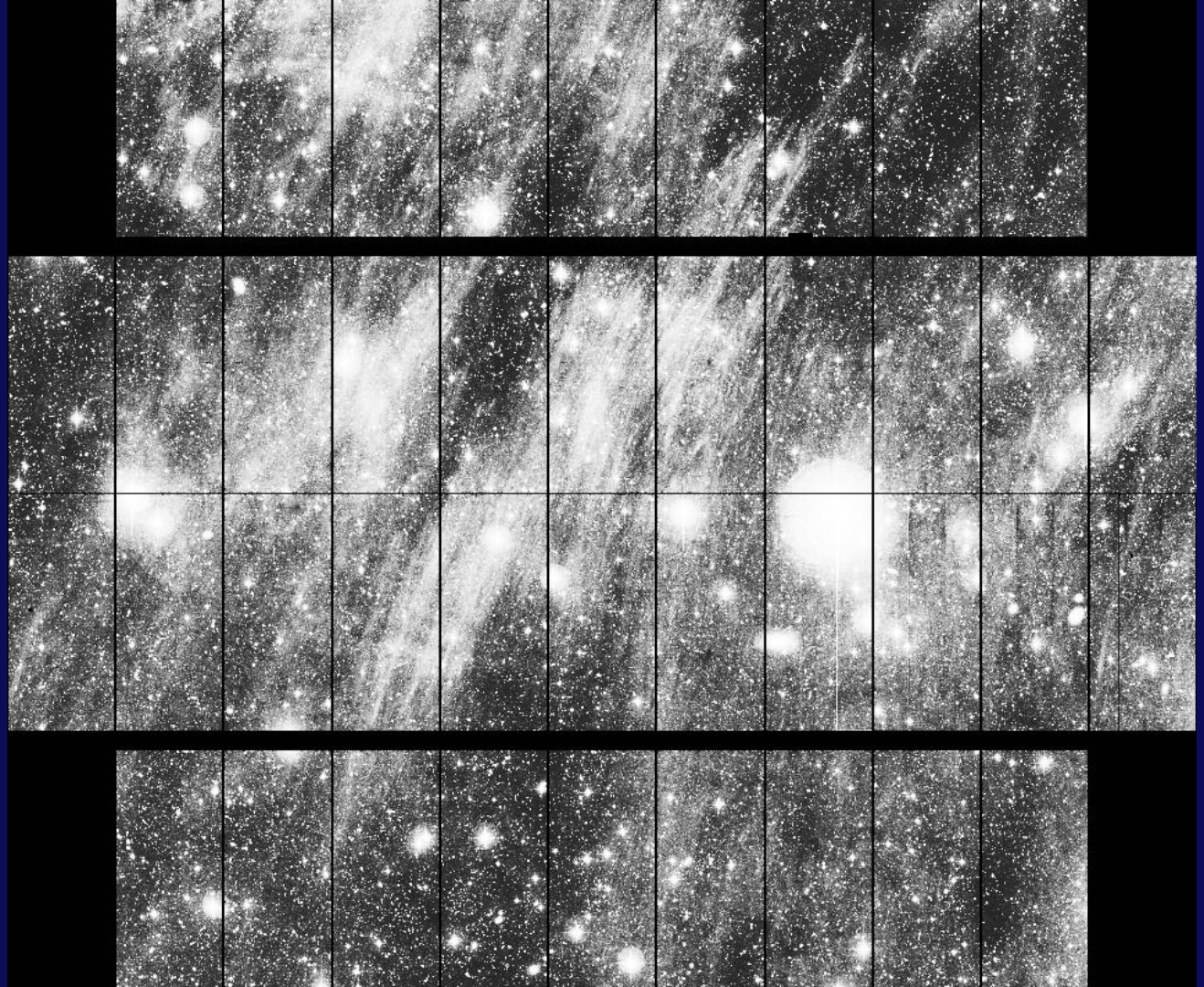






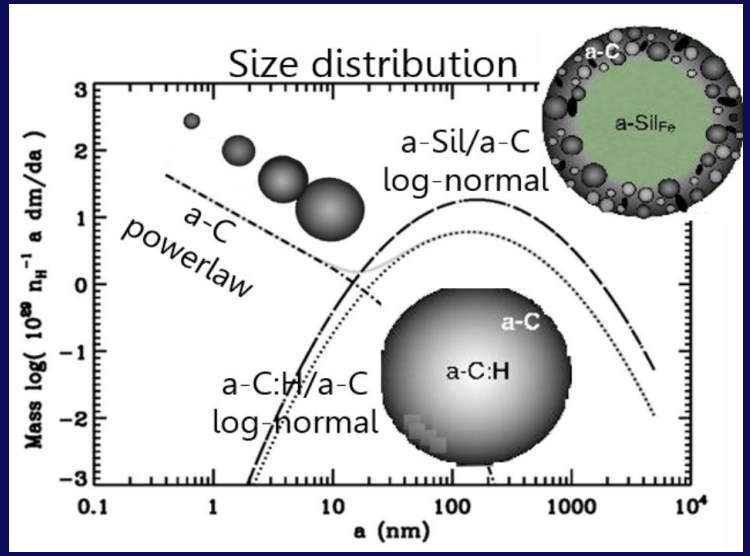


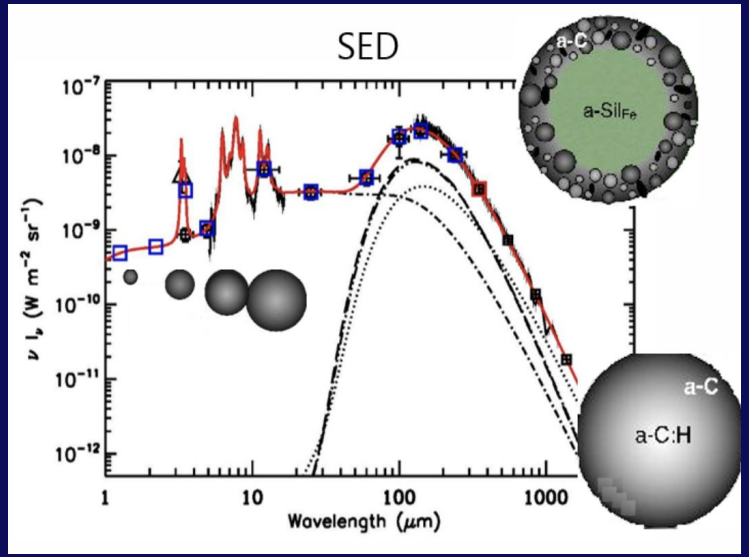




Thank you

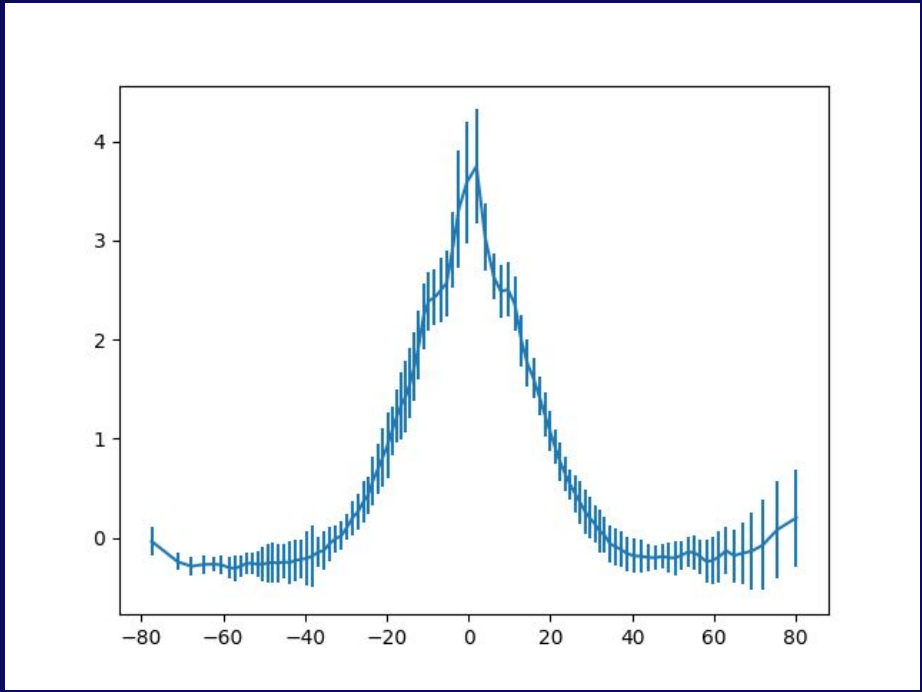
THEMIS : The Heterogeneous dust Evolution Model for Interstellar Solids



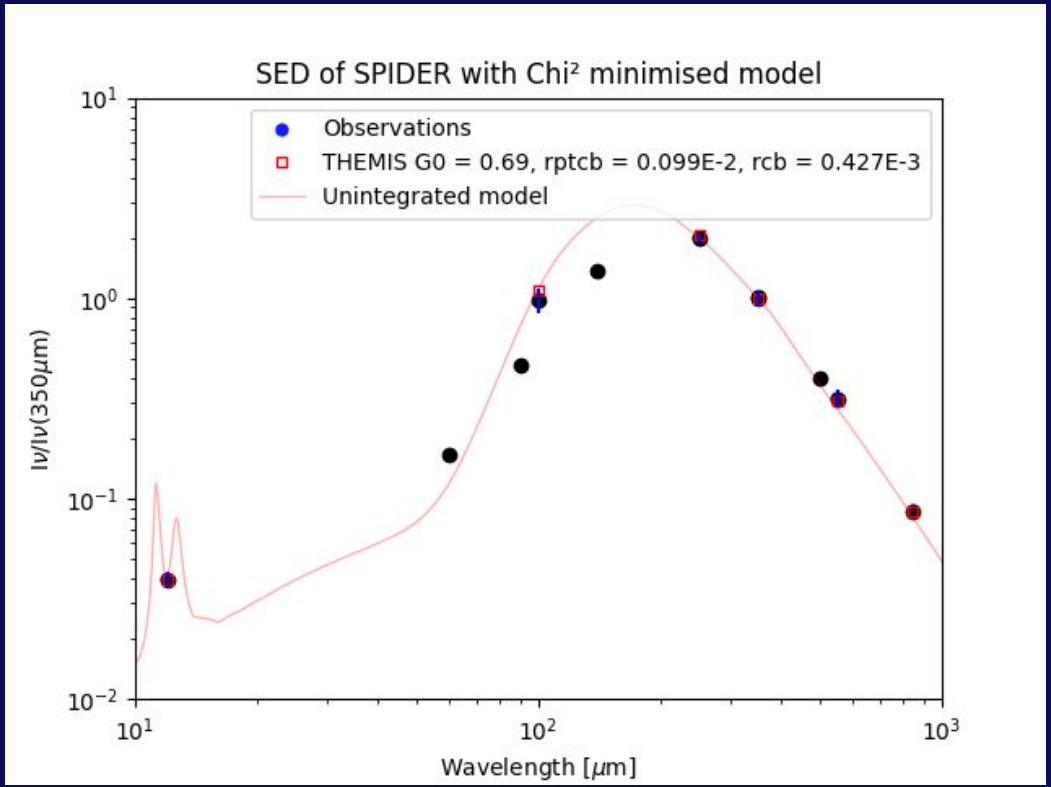


- Nano-carbones amorphes riches en cycles aromatiques (a-C, ~<10nm)
- Carbones amorphes riches en liaisons aliphatiques avec un manteau riche en cycles aromatique de ~5nm (a-C:H/a-C ~>20nm)
- Silicates amorphes avec manteau de carbone aromatique-riche de ~5nm et nano-inclusions de fer (a-Sil/a-C)

Zodiacal Light simple model (elat)



THEMIS 2 :


SED of SPIDER with Chi² minimised model
Observations
THEMIS G0 = 0.69, rptcb = 0.099E-2, rcb = 0.427E-3
Unintegrated model
Iν/Iν(350μm)
Wavelength [μm]
10^1
10^0
10^-1
10^-2
10^1
10^2
10^3