Observations and modelling of dust emission and scattering

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Cold Cores
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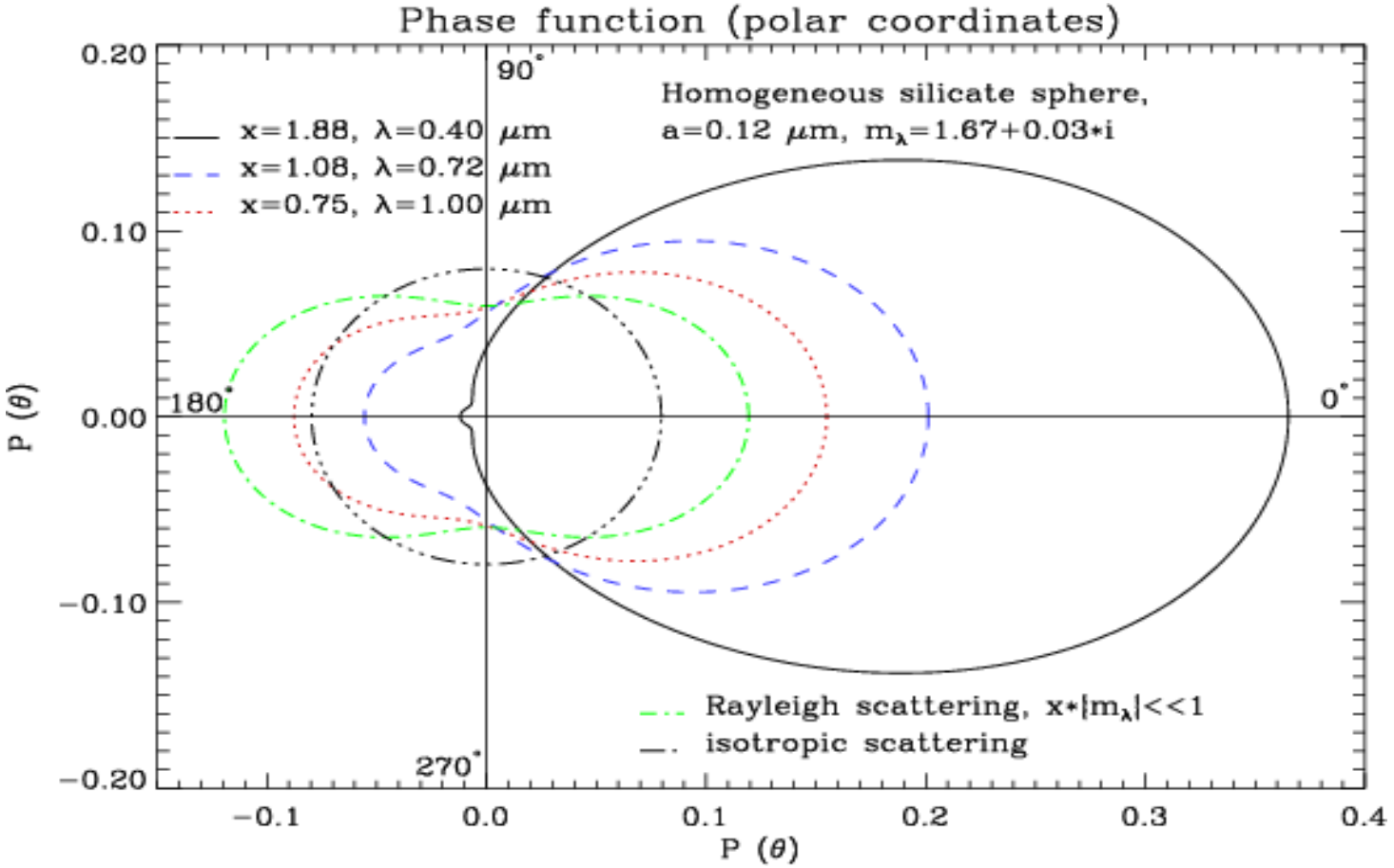
Outline:

- Near-infrared scattering as a dust diagnostic
  - Introduction
  - Radiative tranfer and McMC
  - Some results
- L1512
  - Observations
  - Density structure
  - MIR extinction

The scattering project

- Can we use NIR scattering to estimate the properties of the dust grains?
  - Assuming a population of large grains



→ Model light scattering at
J, H, K and 3.6 μ

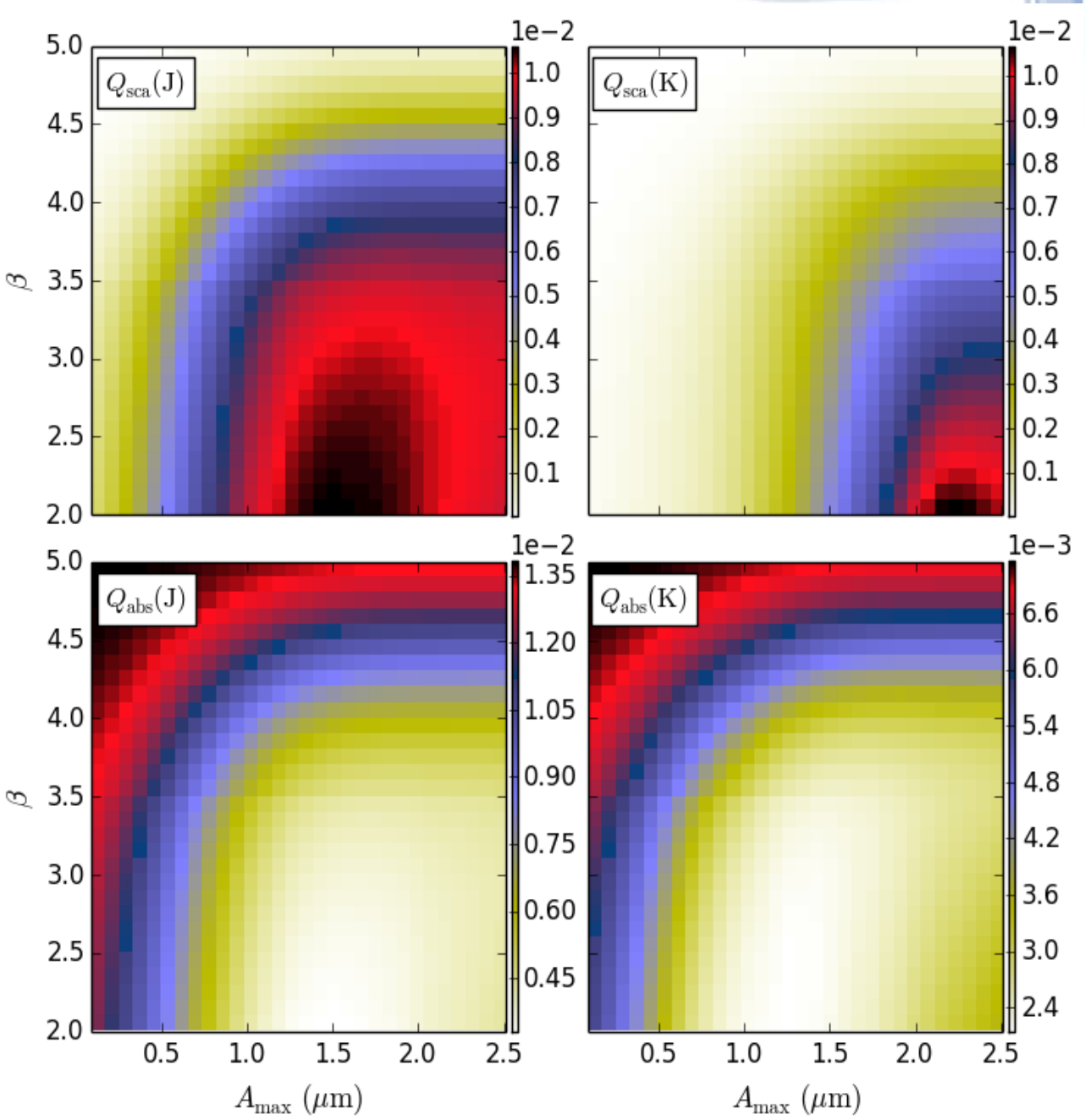
- Two cloud models
  - Spherical 1D
  - Elliptical 3D
- Grain properties based on
  Draine & Li model
- Population of silicate and carbon grains
  - No PAH's

Radiative transfer

- Observed surface brightnes:
  - Scattered light plus background seen trough the cloud
  - Thermal emission negligible
- Compare the surface brightness of the cloud against the background intensity

$$I\ (\lambda) = I_{sca}\ (\lambda) + I_{bg}\ (\lambda)\ e^{-\tau} - I_{bg}\ (\lambda)$$

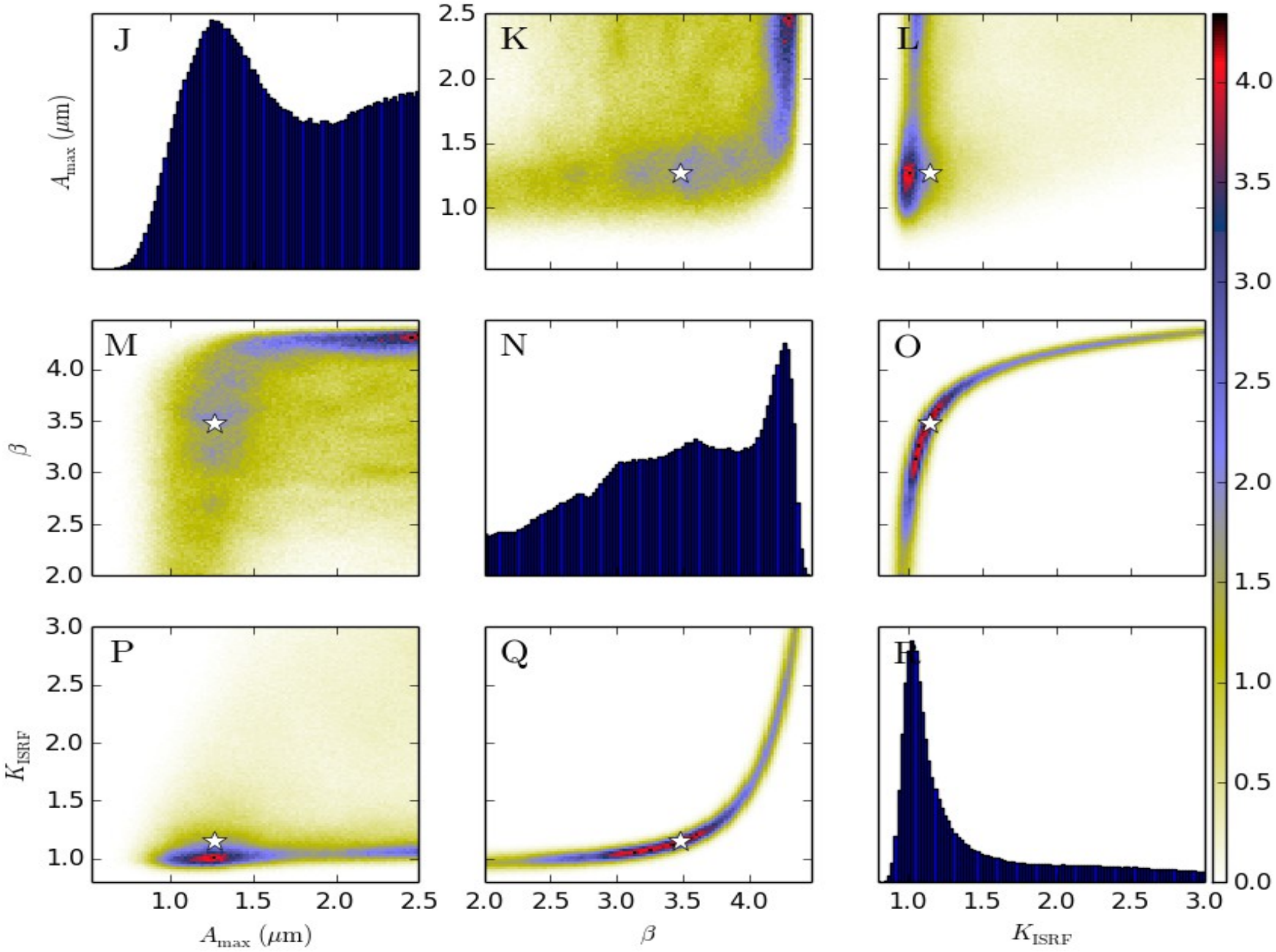
- Change A_{max}
- Change β
- Or change the albedo of the grains
- RT computation with the new dust properties

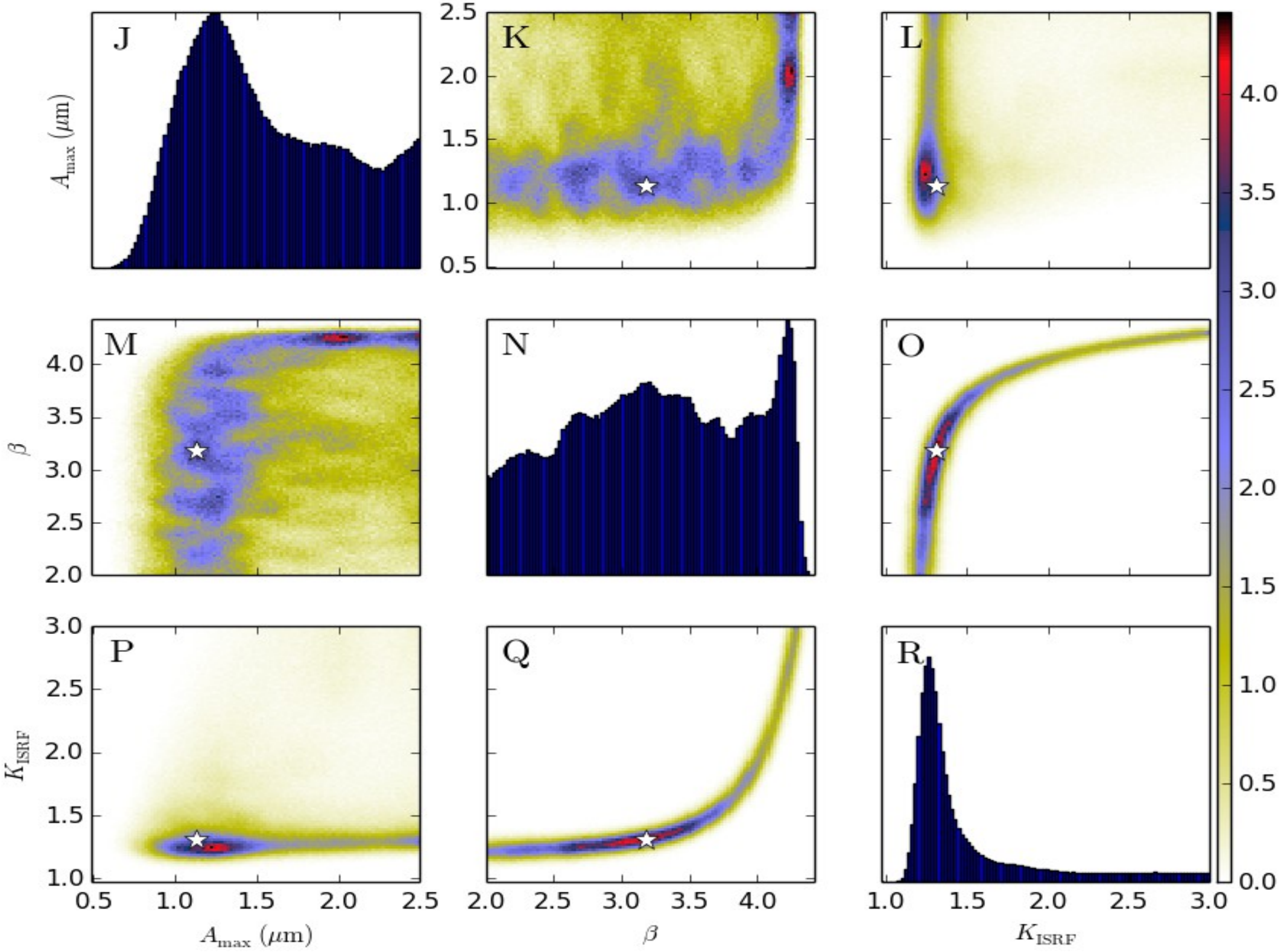


- RT only on a fixed grid of parameter values
  - Linear interpolation between values
- McMC:

  sample the probability distributions of the dust parameters to estimate the limits that observations can place on dust models
- The RT computations use a fixed radiation field
  - In McMC: add scaling of the radiation field

    $K_{ISRF} = 0.3 \rightarrow 3.0$
- $\rightarrow$ Marginalised probability distributions for dust parameters


J
K
L
M
N
O
P
Q
R
$A_{\max}$ (μm)
β
$K_{\rm ISRF}$
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0.0
0.5


J
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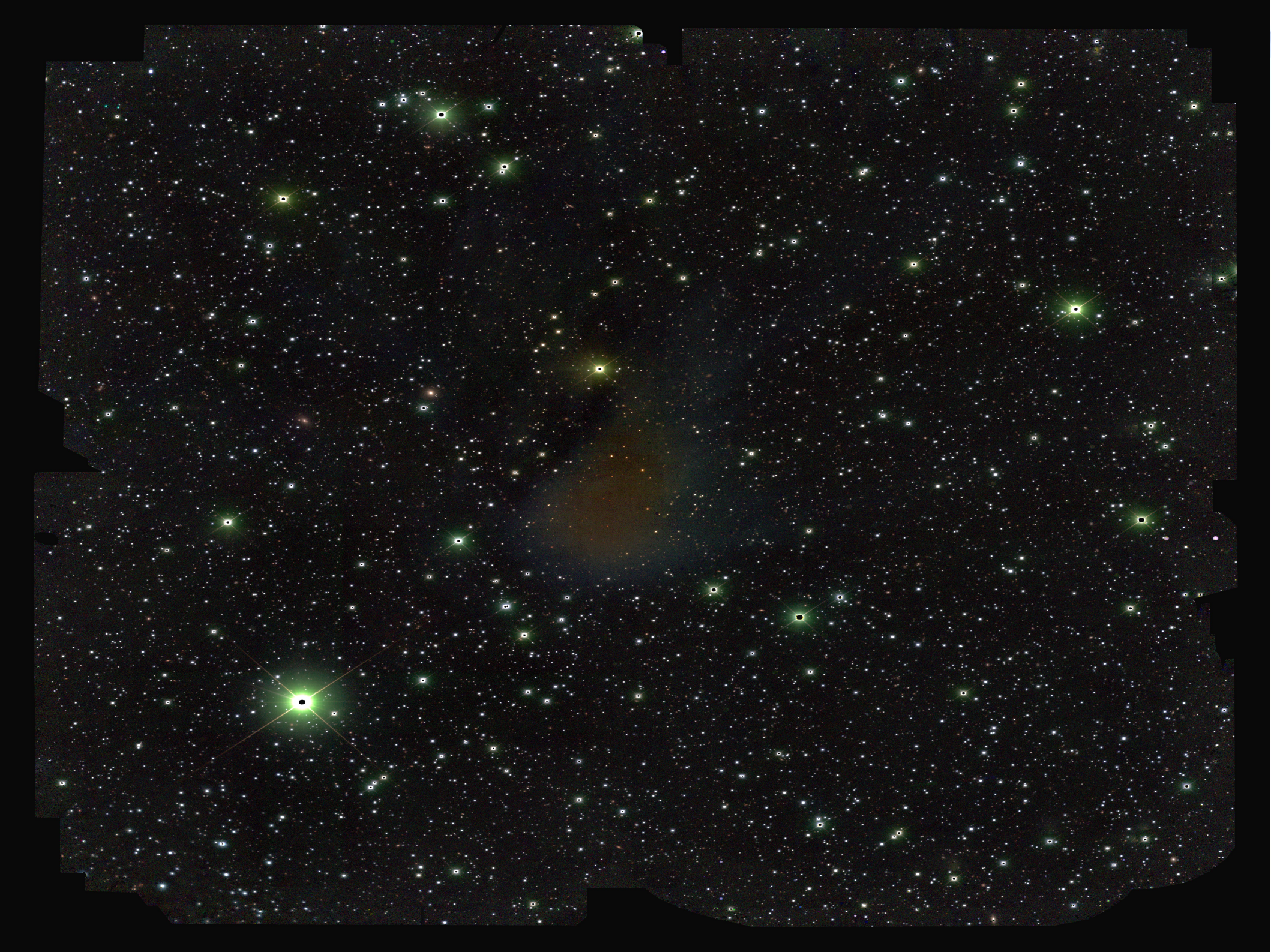
$A_{\max}$ (μm)
β
K_{ISRF}
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0.0

Some results:

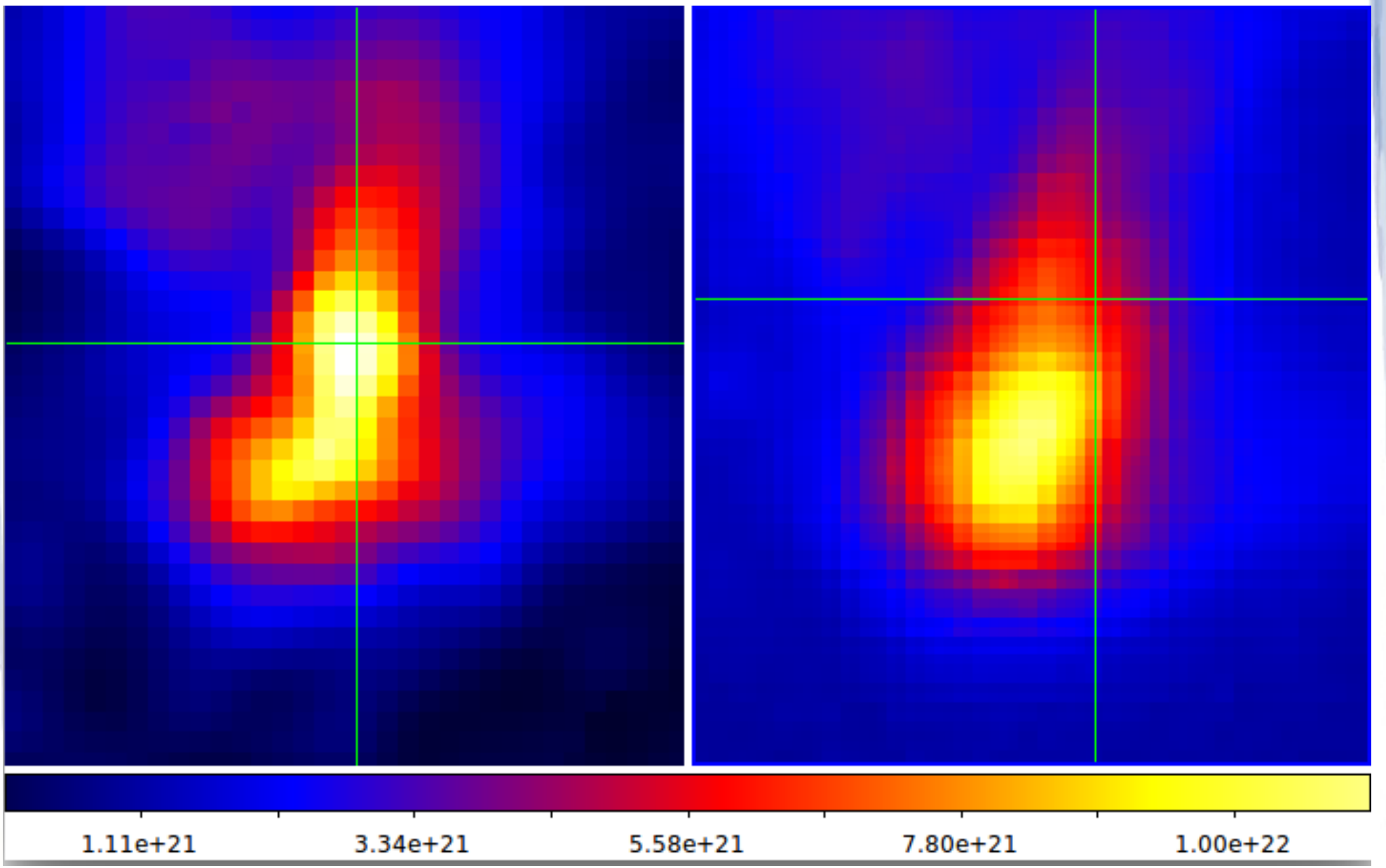
- Scattered NIR light can be used to constrain dust properties
- High precision observations needed
- The $\chi 2$ minima and the maximum of marginalised probability are not perfectly aligned
- Upper limit for β?

L1512

- Compact and nearby 'cometary' cloud
  - Distance 140 pc
  - Size ~ 8' x 8'
- WIRCam
  - J,H,Ks
- Spitzer
  - 3,6 μ – 8 μ
- Herschel
  - 160 μ – 500 μ



Density structure



MIR observations

- Use 8 μ data to place constraints?
  - Kainulainen & tan 2012
  - Butler & Tan 2009, 2012
- Derive column density from 8 μ data
- Combine with the estimate from J,H,K data
- → Problem: 8 μ column density lower by a factor of 4-8

Current status

- Is the Av of our cloud too low?
  - 8 μ method unreliable below Av ~ 3 (BT09)
  - Systematic variation belov Av ~ 9 (KT12)
- The background of the Spitzer maps?
  - No zero-point
- Scale the Spitzer data using DIRBE and WISE
  - Automated code that can be used on any field to get an estimate for the background