

First Detection of the Polarization of the Submm Diffuse Galactic Dust Emission by ARCHEOPS



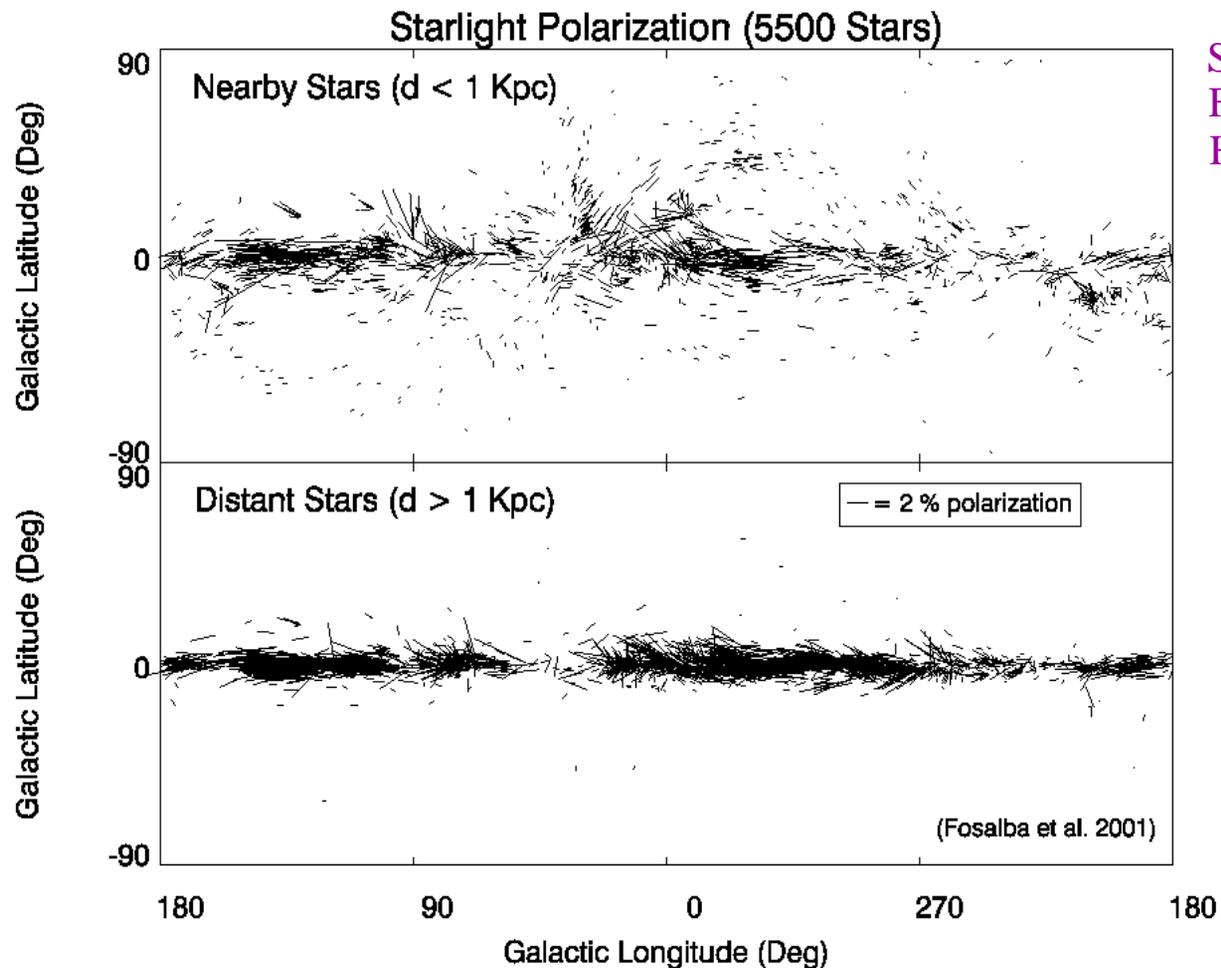
N. Ponthieu

*On behalf of Archeops
collaboration*

Outline

- Motivations for dust polarization studies
- Archeops polarized channels
- Results
- Conclusions

Why search for dust submm polarization ?



Serkowski et al, 1975
Fosalba et al 2002
Heiles, 2001

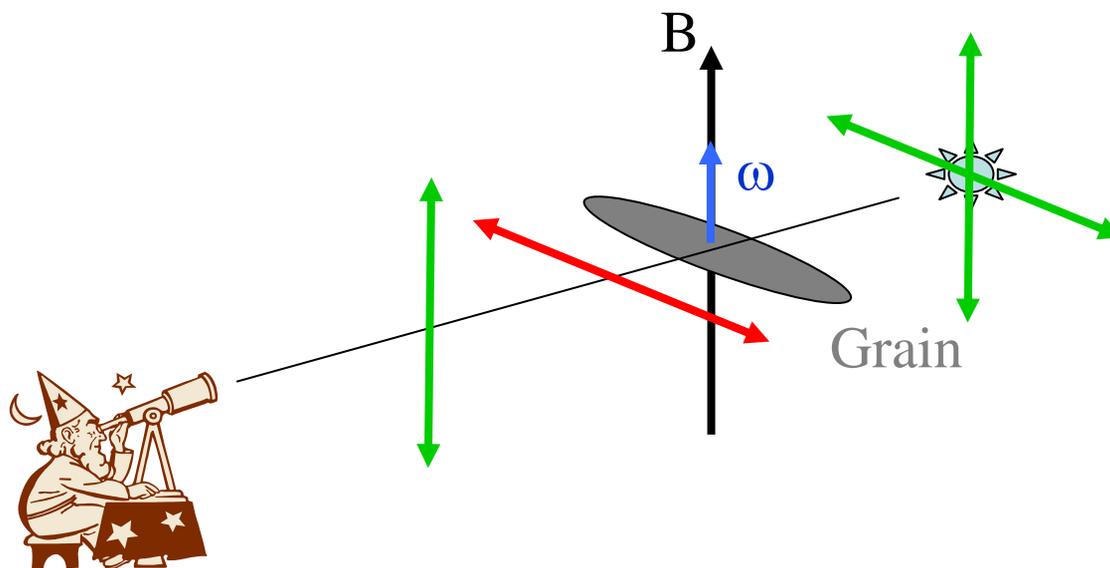
Optical data show that dust polarizes light and that the polarization direction is correlated to the galactic magnetic field.



Dust and magnetic field physics + CMB foreground

Dust polarization: basic principle

- Dust grains are aspherical and align with the magnetic field
- They absorb the optical light better along their longest axis
- They radiate in the IR in the direction of their long axis

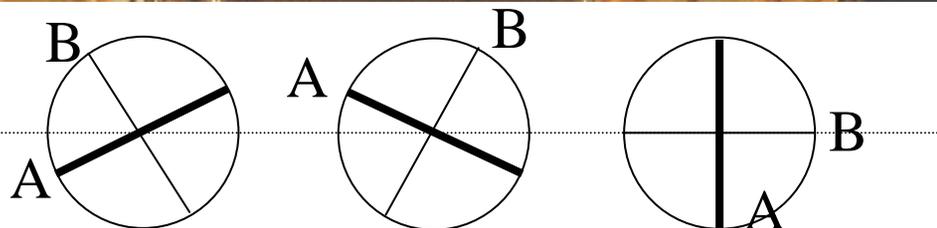
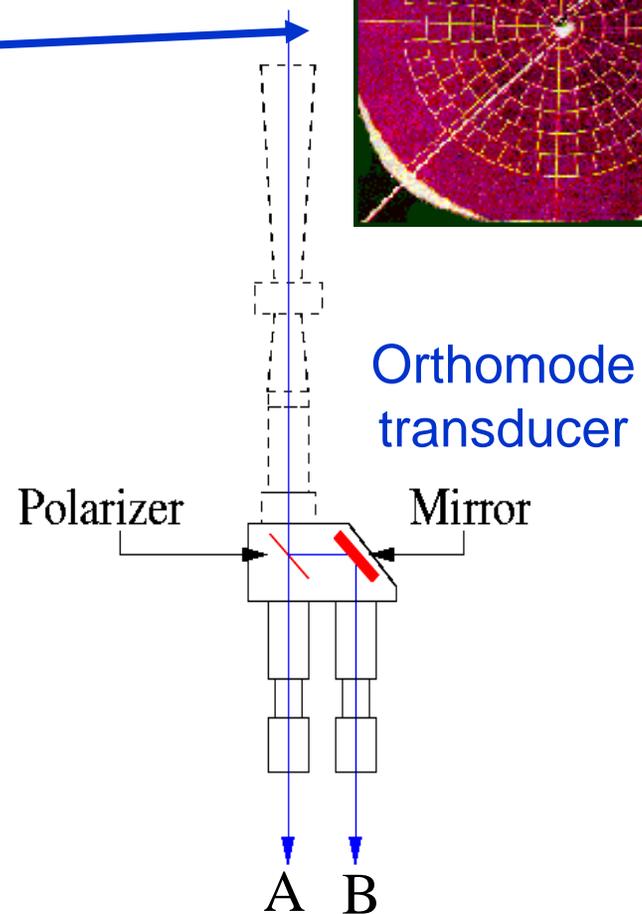
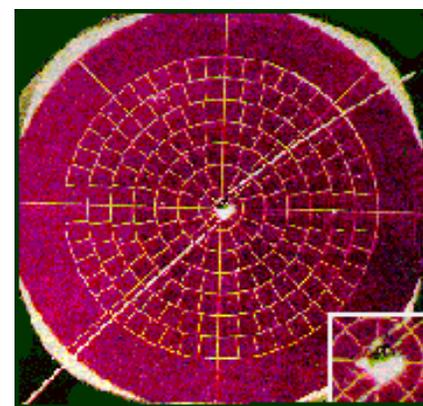
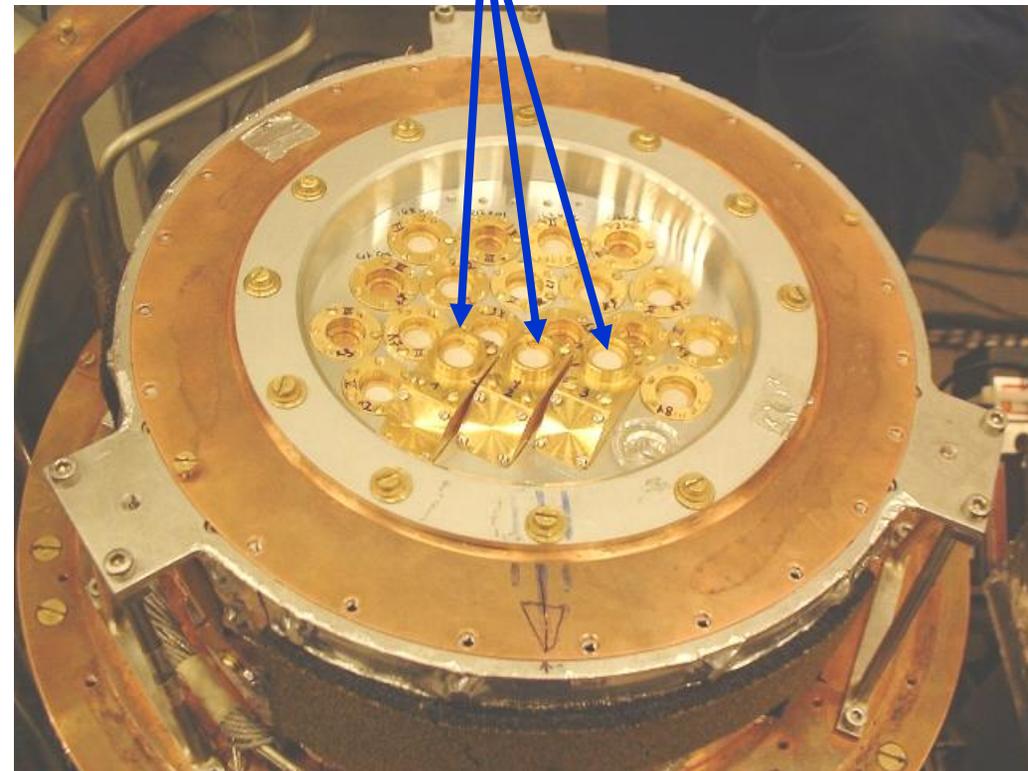


The optical polarization has an IR counterpart
that must be polarized at a few percents Stein, 1966

- How does it compare to CMB polarization ?
- No measurement available on large scale

Archeops polarized channels

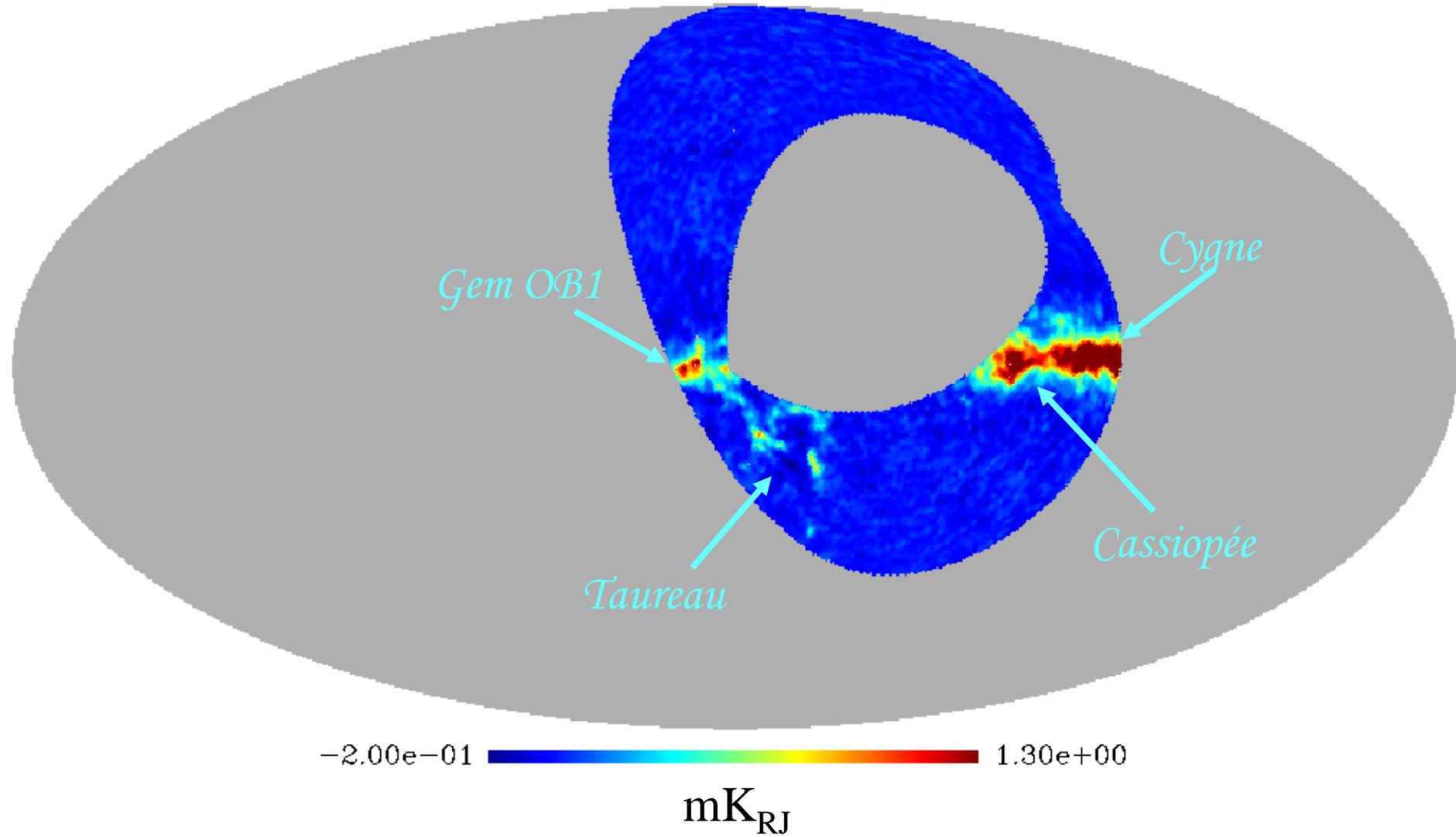
6 spider web bolometers @ 353 GHz



$$s_I = 48 \mu\text{K}_{\text{RJ}} \cdot \text{sec}^{1/2}$$

$$s_{\text{Q,U}} = 68 \mu\text{K}_{\text{RJ}} \cdot \text{sec}^{1/2}$$

I (353 GHz)

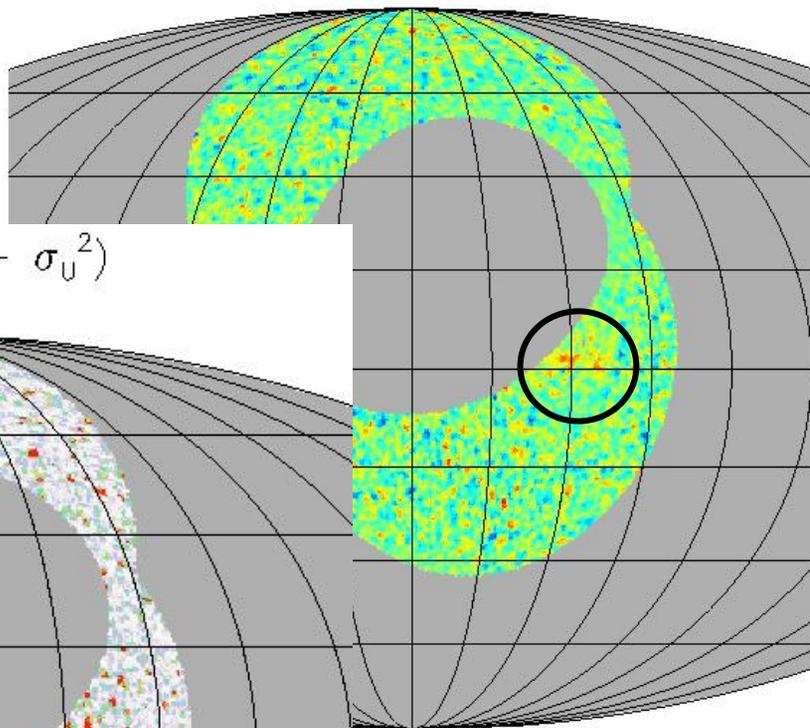
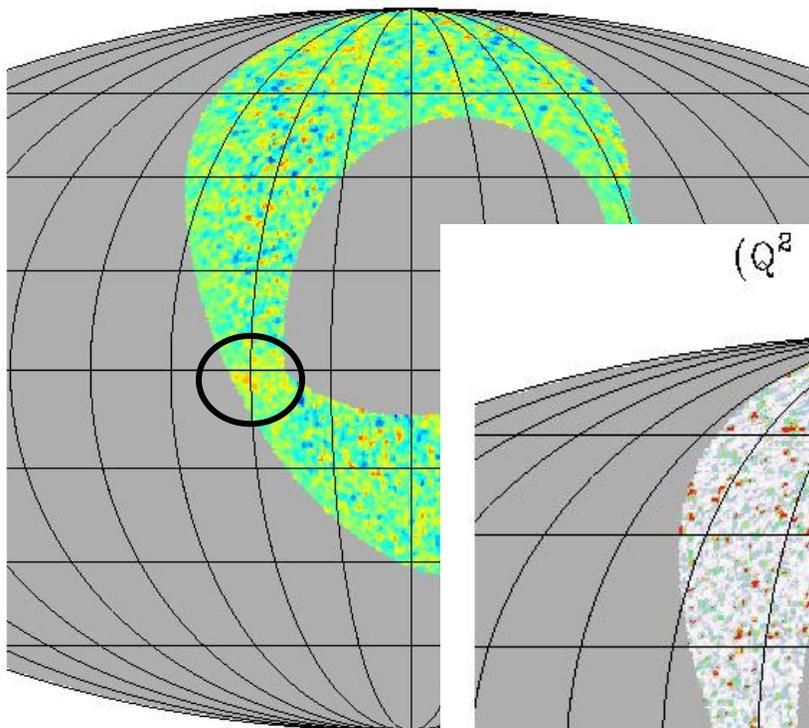


17 % of the sky, galactic anticenter

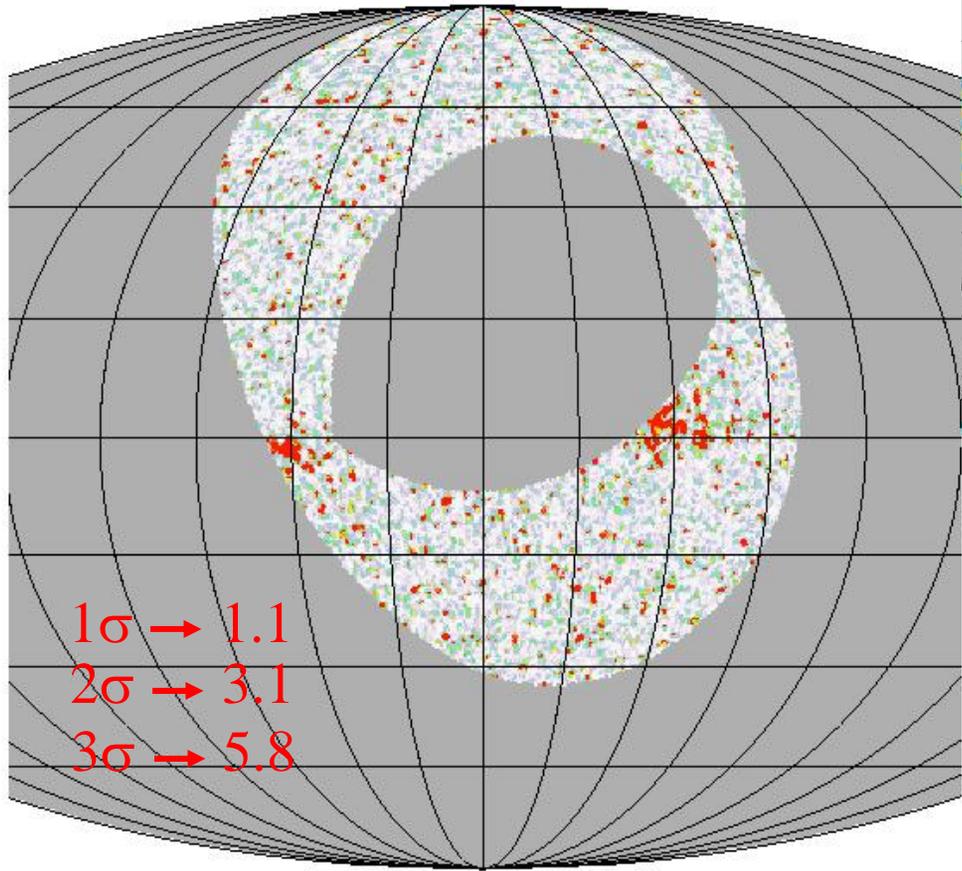
smoothed, 1deg

Q (mKrk)

U (mKrk)

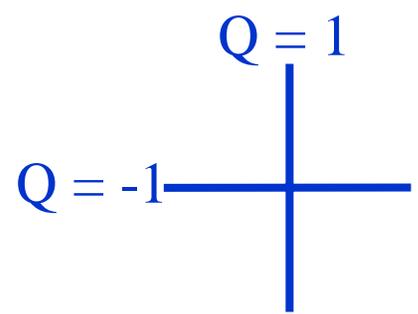


$$(Q^2 + U^2) / (\sigma_Q^2 + \sigma_U^2)$$

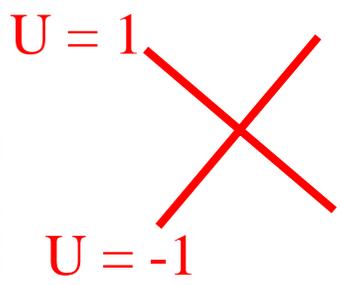


-2.00e-01

2.00e-01



1σ → 1.1
 2σ → 3.1
 3σ → 5.8



0.00e+00 4.00e+00



\mathcal{P} (%)

θ (deg)

(Stat, syst)

$12.1 \pm 1.8 \pm 1.8$

$59 \pm 4.7 \pm 1.0$

$8.5 \pm 0.7 \pm 2.6$

$85 \pm 2.8 \pm 3.1$

$22.2 \pm 3.4 \pm 4.0$

$78 \pm 3.7 \pm 0.8$

Taurus

$5.3 \pm 3.1 \pm 1.5$

$101 \pm 13.6 \pm 6.3$

$23.3 \pm 6.7 \pm 9.7$

$175 \pm 7.5 \pm 3.2$

$7.2 \pm 2.8 \pm 4.1$

$133 \pm 11.5 \pm 3.8$

$12.3 \pm 2.9 \pm 2.6$

$87 \pm 6.7 \pm 2.8$

< 3.4

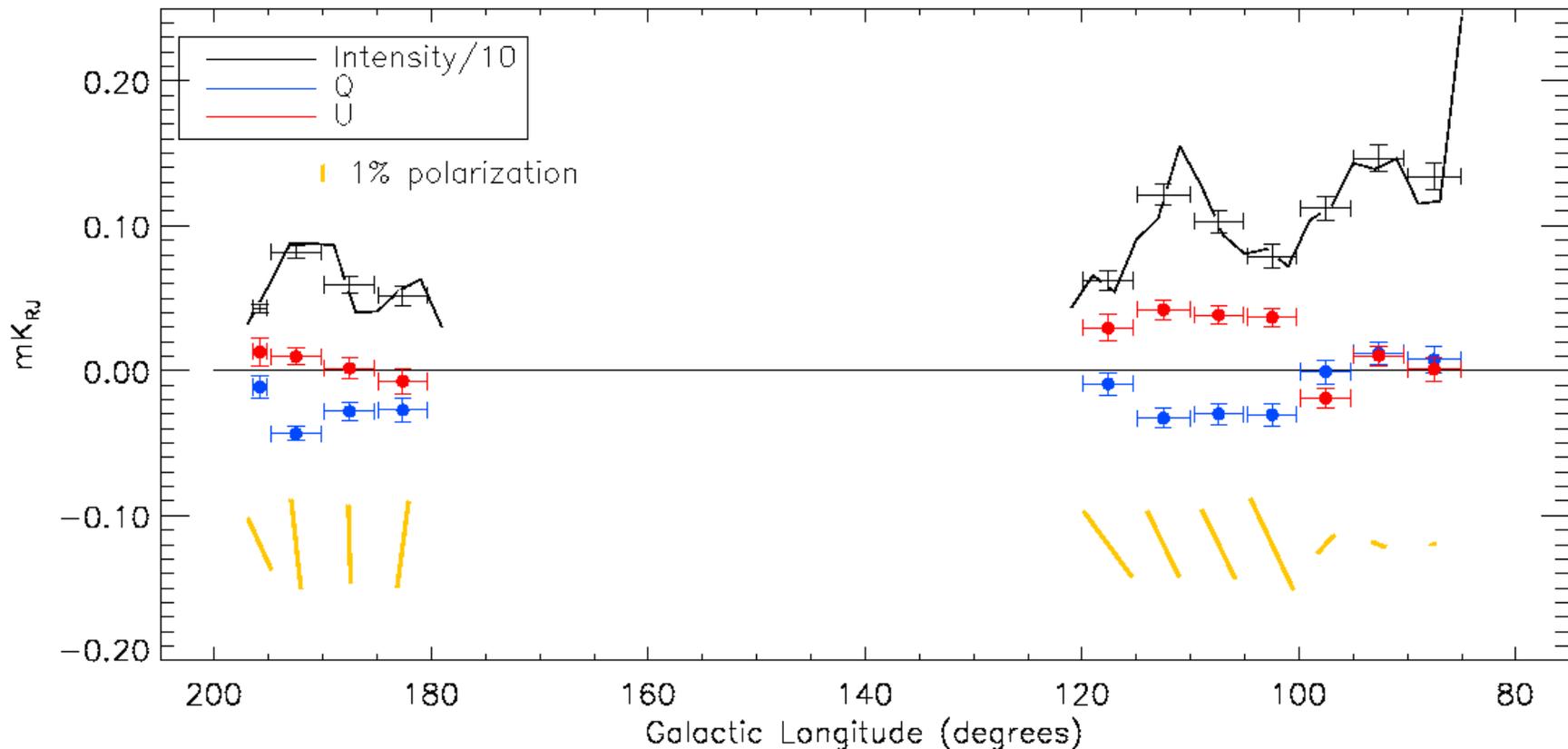
$23 \pm 16 \pm 105$

$16.3 \pm 1.7 \pm 3.5$

$89 \pm 3.2 \pm 1.1$

5 deg wide bands (except edges)

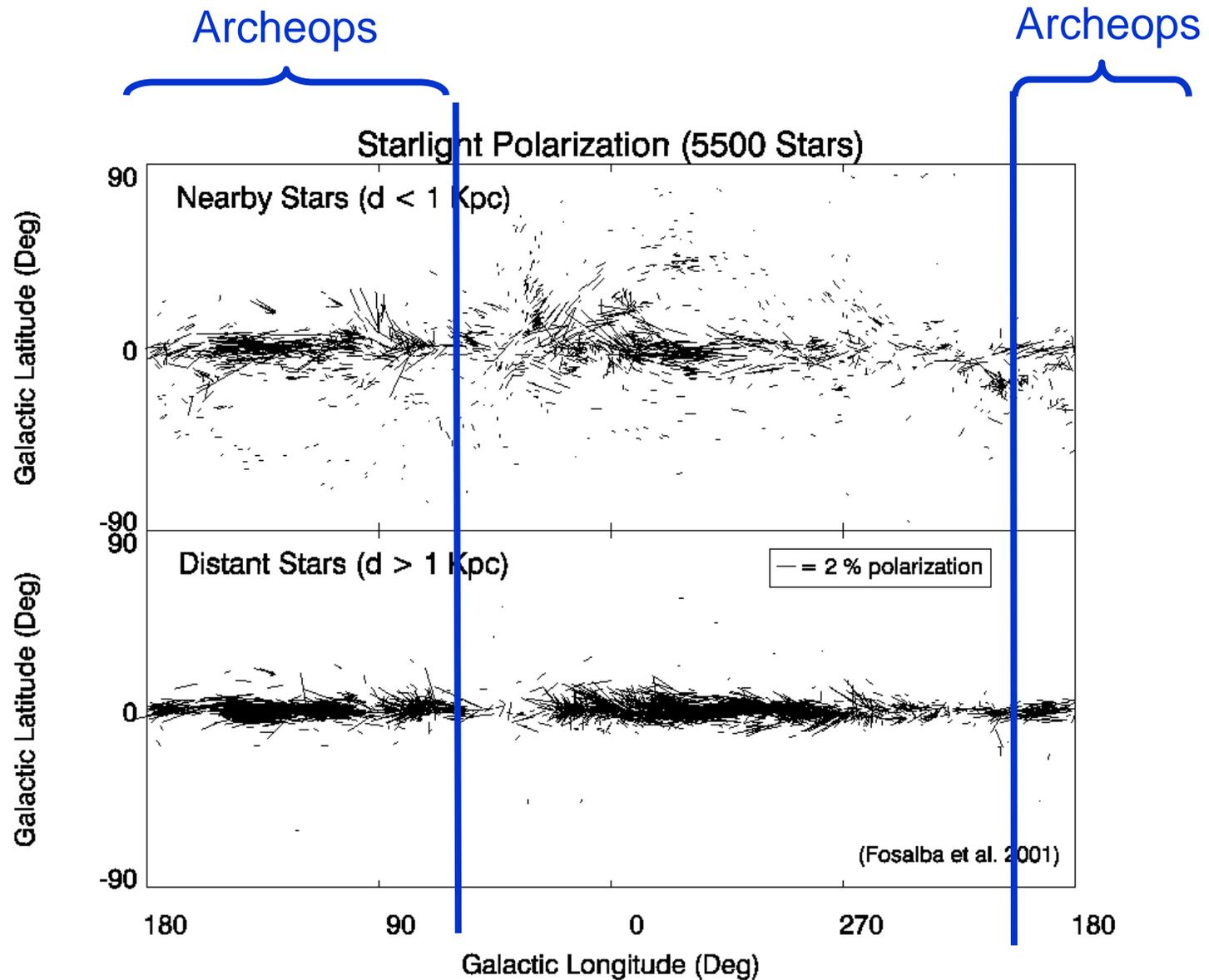
Values scaled to intensity averaged on $-2 < b < 2$



Orientation mainly orthogonal to the Galactic plane

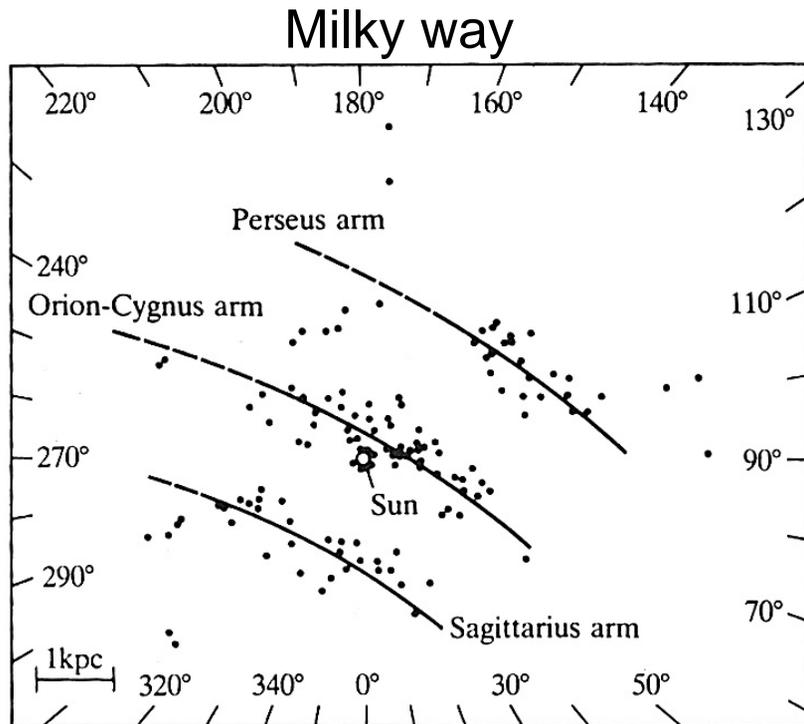
P about 3-5% on average

Compatible with starlight polarization expectations



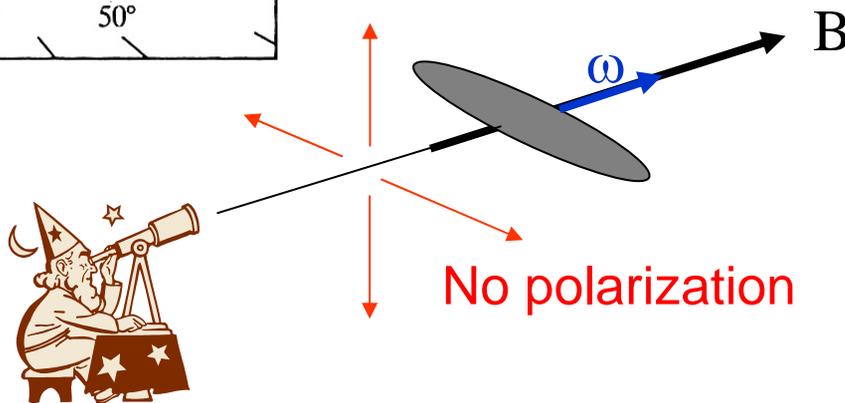
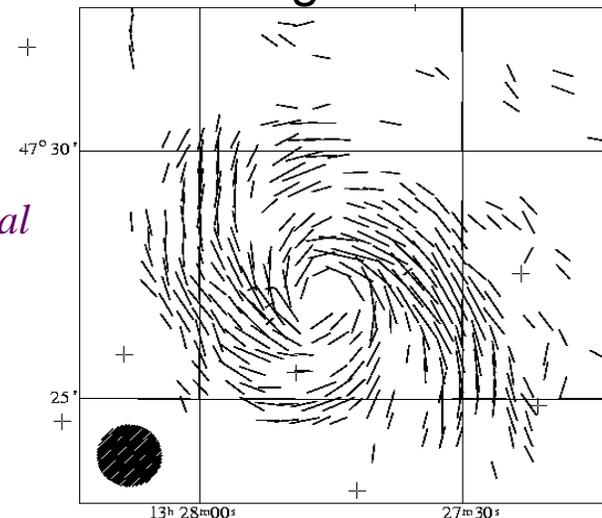
Low polarization on Cygnus :

Compatible with line of sight projection
effect of the spiral arm



Berkhuijsen *et al*
1997

M 51 Magnetic Field



Conclusions

- First detection of the large scale polarization of Galactic dust radiation
- High levels of polarization in the Galactic plane
 - Some clouds are polarized up to 10%
 - Diffuse radiation polarized at 3-5%
 - Coherent alignment of the grains on large scale
 - Compatibility with a magnetic field along the spiral arms

Likely important foreground for CMB
polarization observations