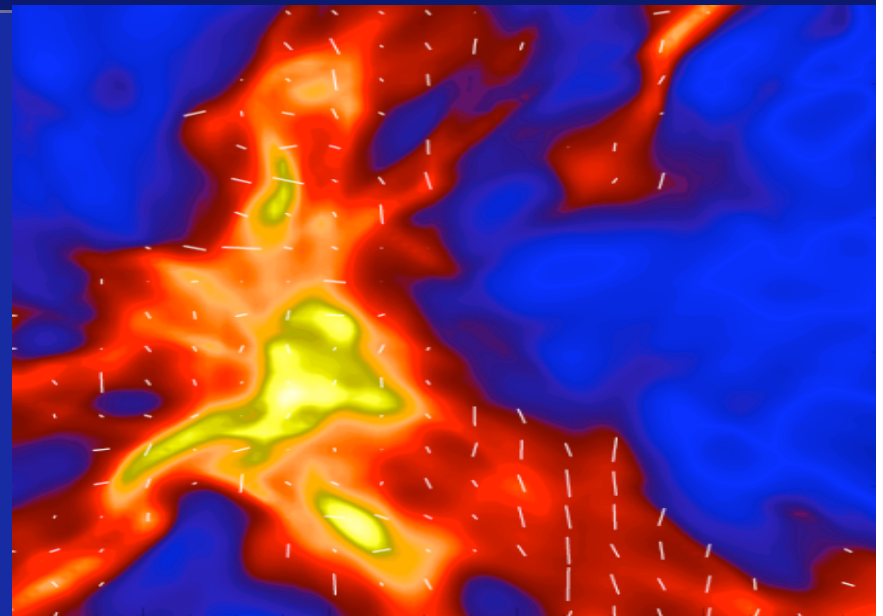
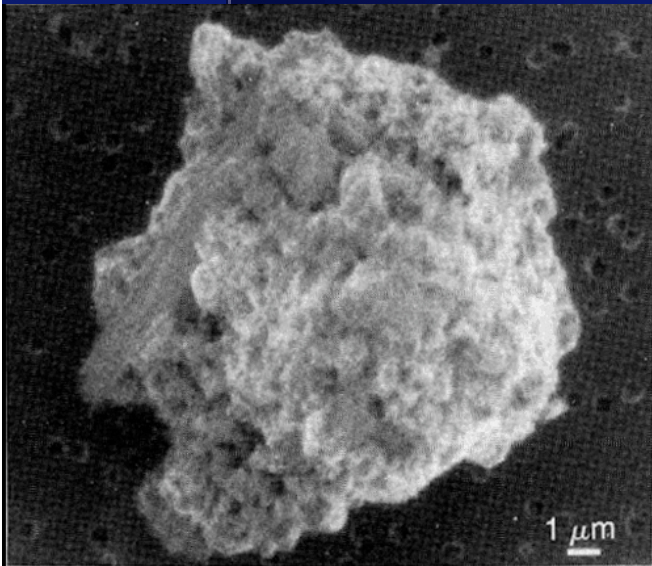


Dusty way of magnetic field studying: Phil Myers and quantitative theory of grain alignment

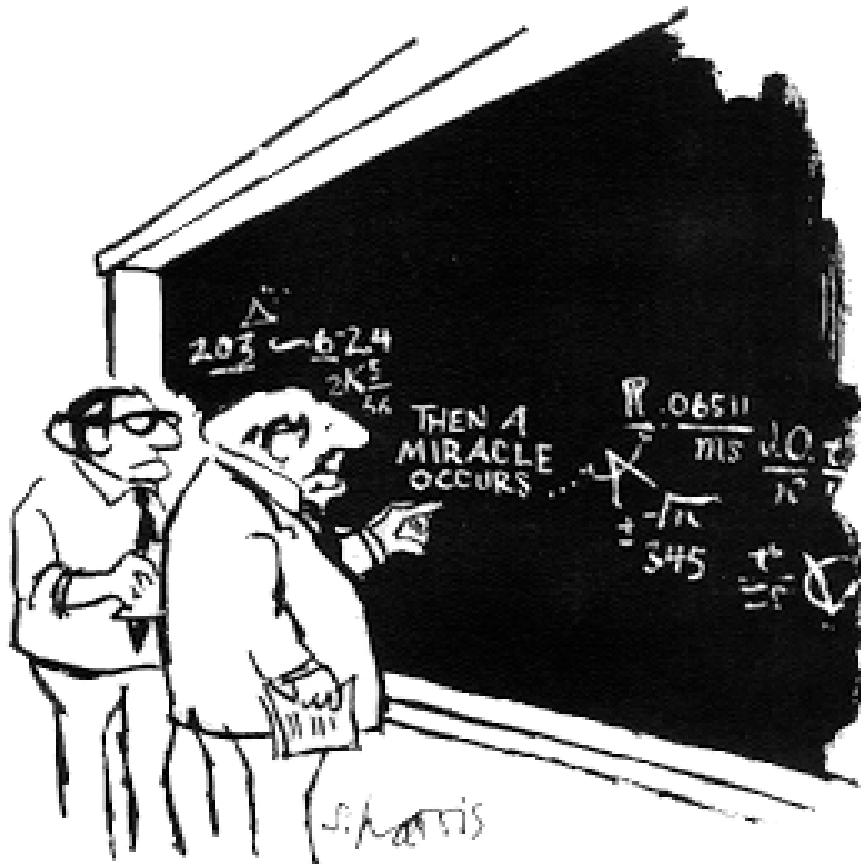
A Lazarian

Astronomy Department and CMSO
UW-Madison



Collaboration:
T. Hoang UW-Madison

Grain alignment for decades was thought to be a mysterious but universal phenomenon...



"I think you should be more explicit here in step two."

But then someone decided to relate magnetic field and gas filaments

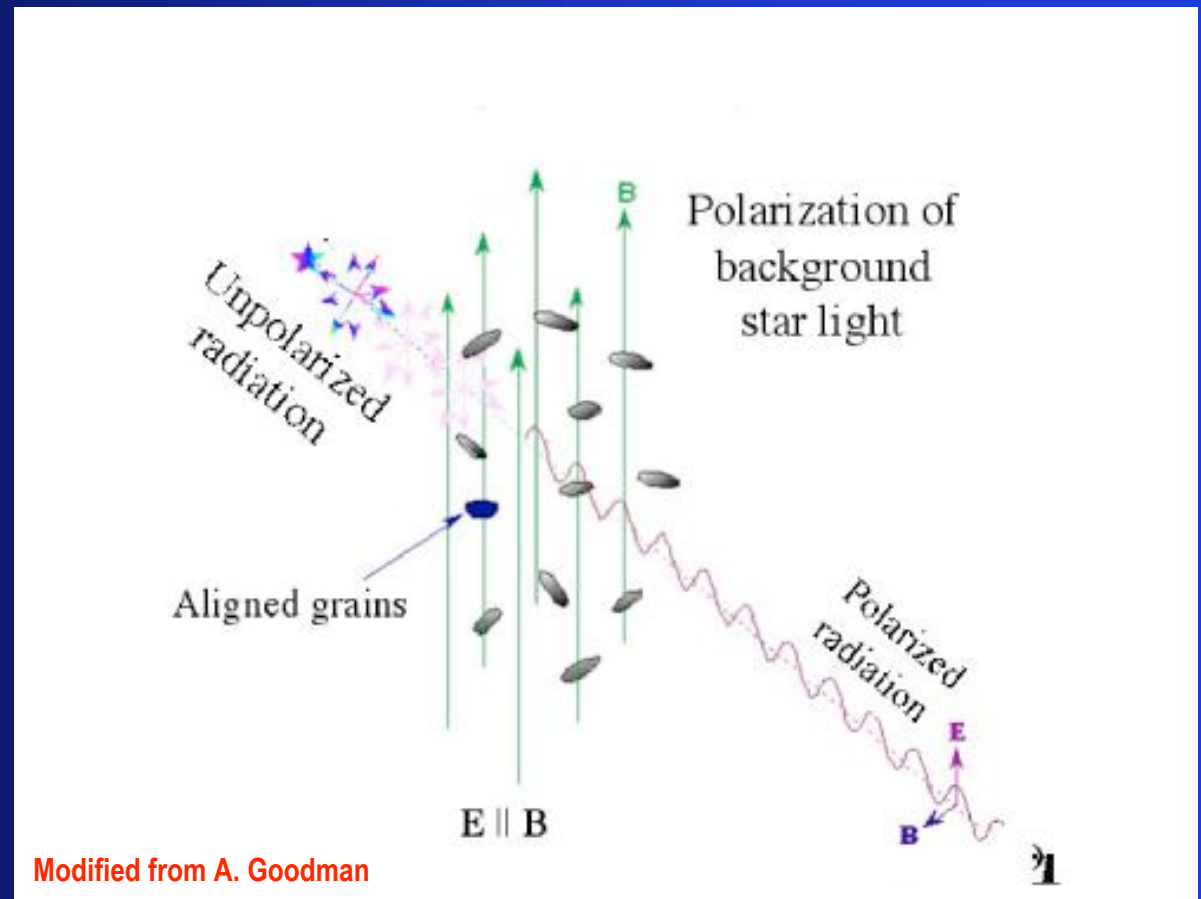


Goodman, Jones, Lada,
Myers 1992, 1995

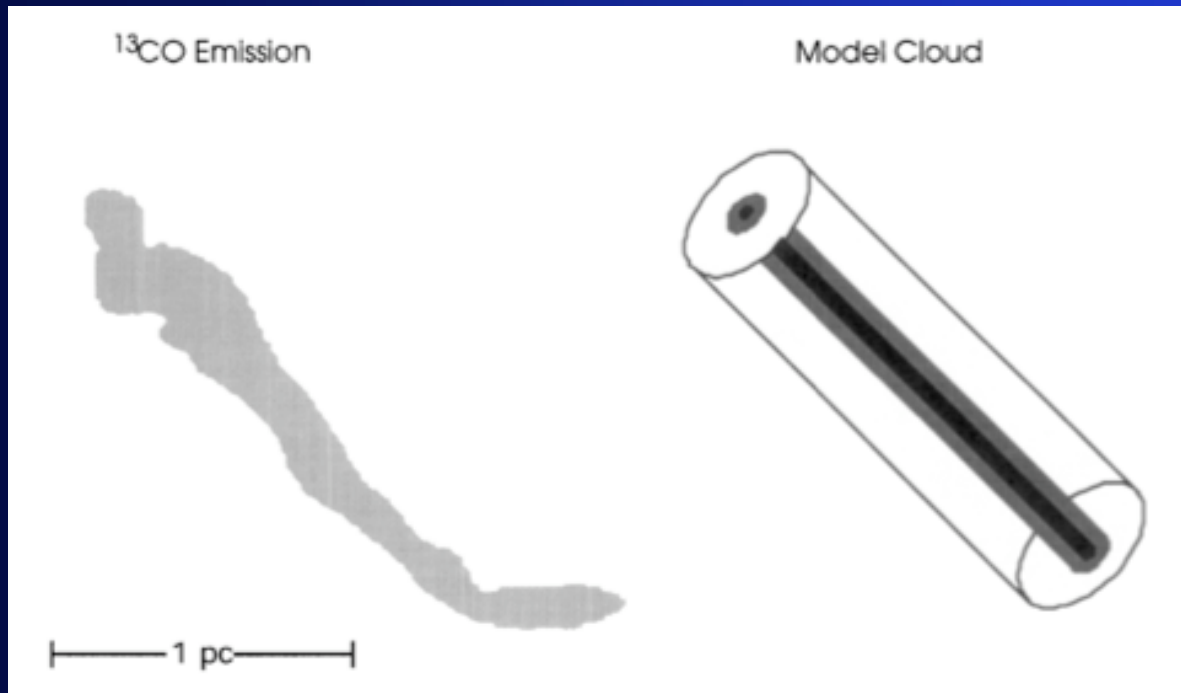


Grains were shown to fail tracing magnetic field for $A_V \gg 1$

“Bad” grains or “unprivileged” ones? Alignment problem or spherical grains?



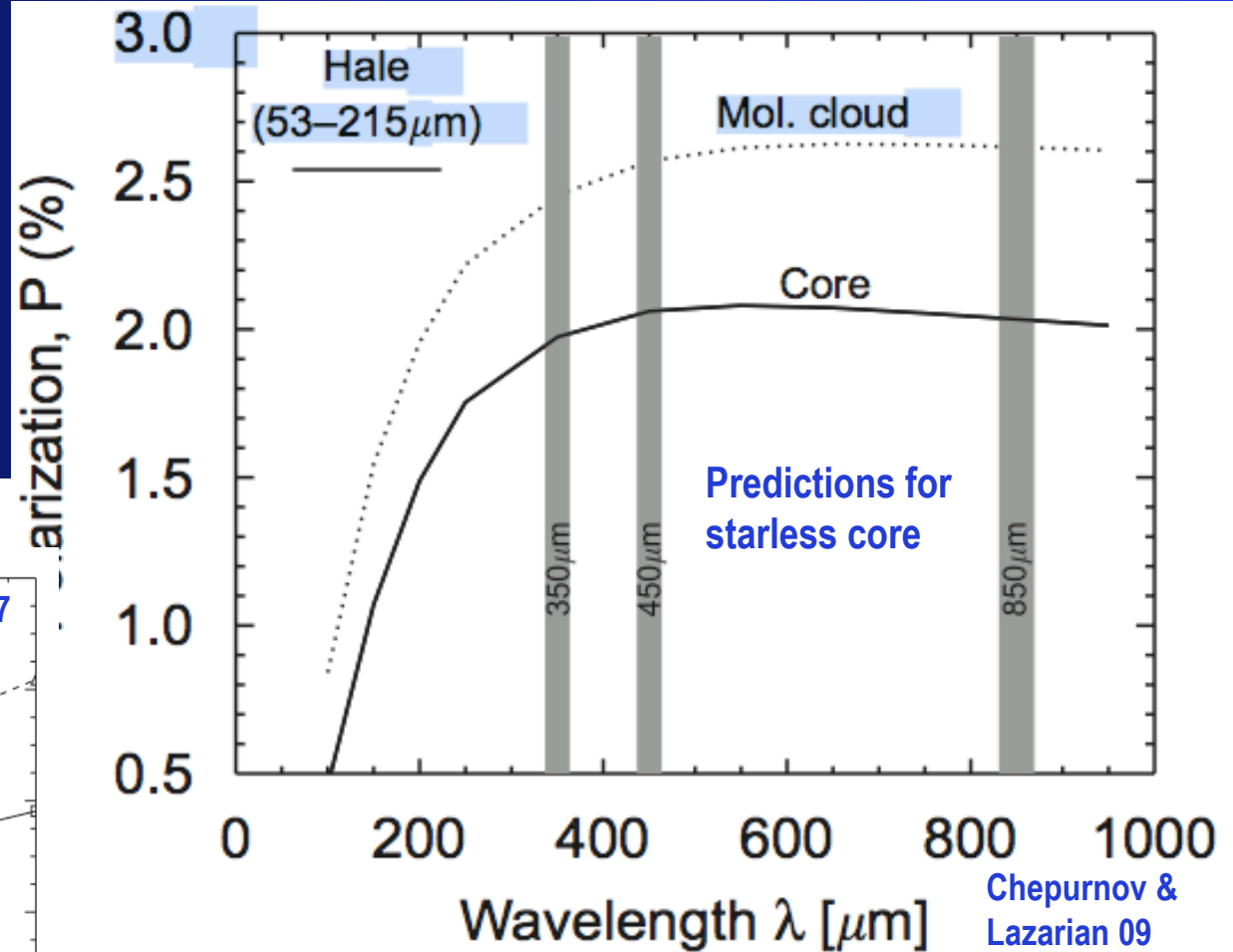
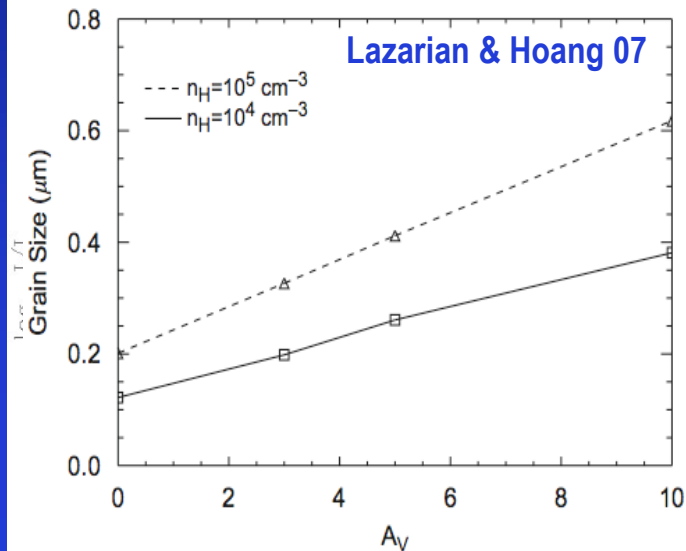
Important conclusion of Lazarian, Goodman & Myers 97 is the failure of all grain alignment mechanisms at $A_V \gg 1$ in starless cores



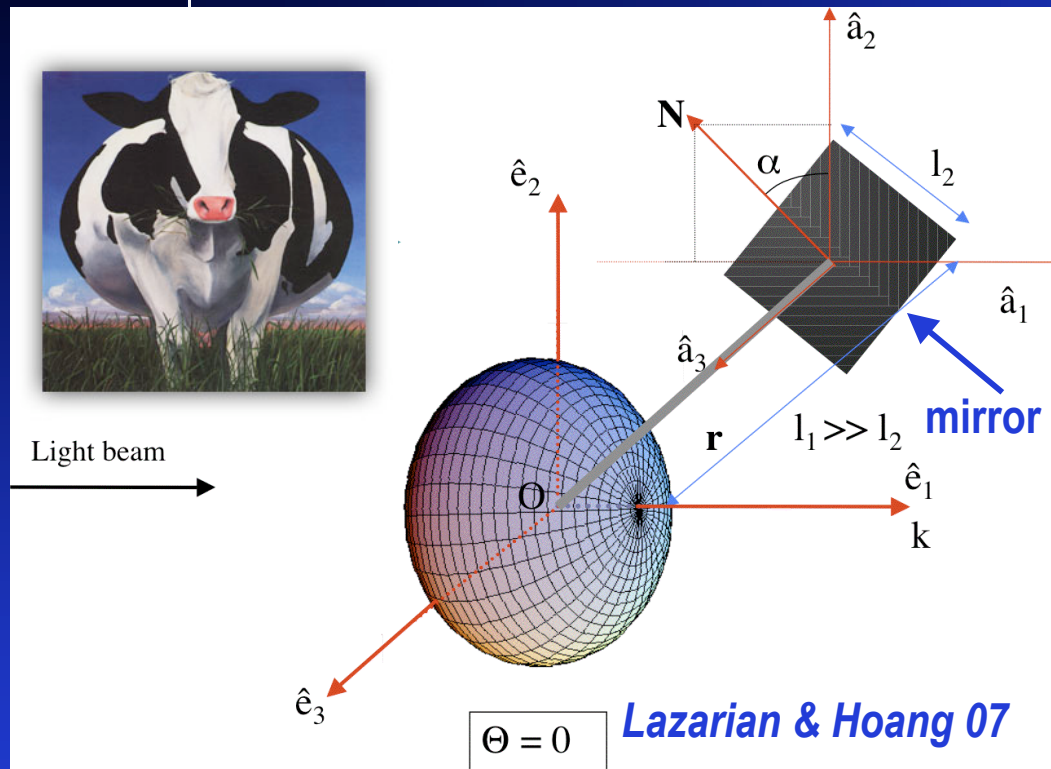
1. The actual critical A_V was shown to depend on the alignment mechanism and grain properties.
2. The difference between extinction and emission polarimetry was explained by selection and grain size.
3. Importance of radiative torques introduced by Dolginov & Mytrophanov 76 and evaluated by Draine & Weingartner 96 was stressed.

Radiative torques explain polarization from starless cores

Polarization from starless cores was a big puzzle:
“Crisis of grain alignment theory”
First explained by Cho & Lazarian 05



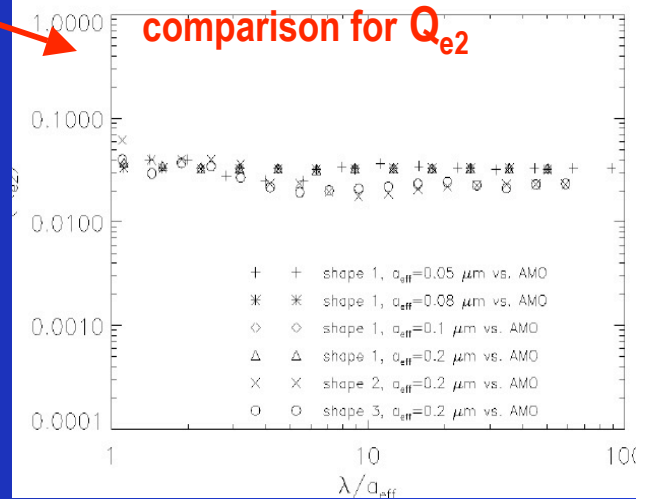
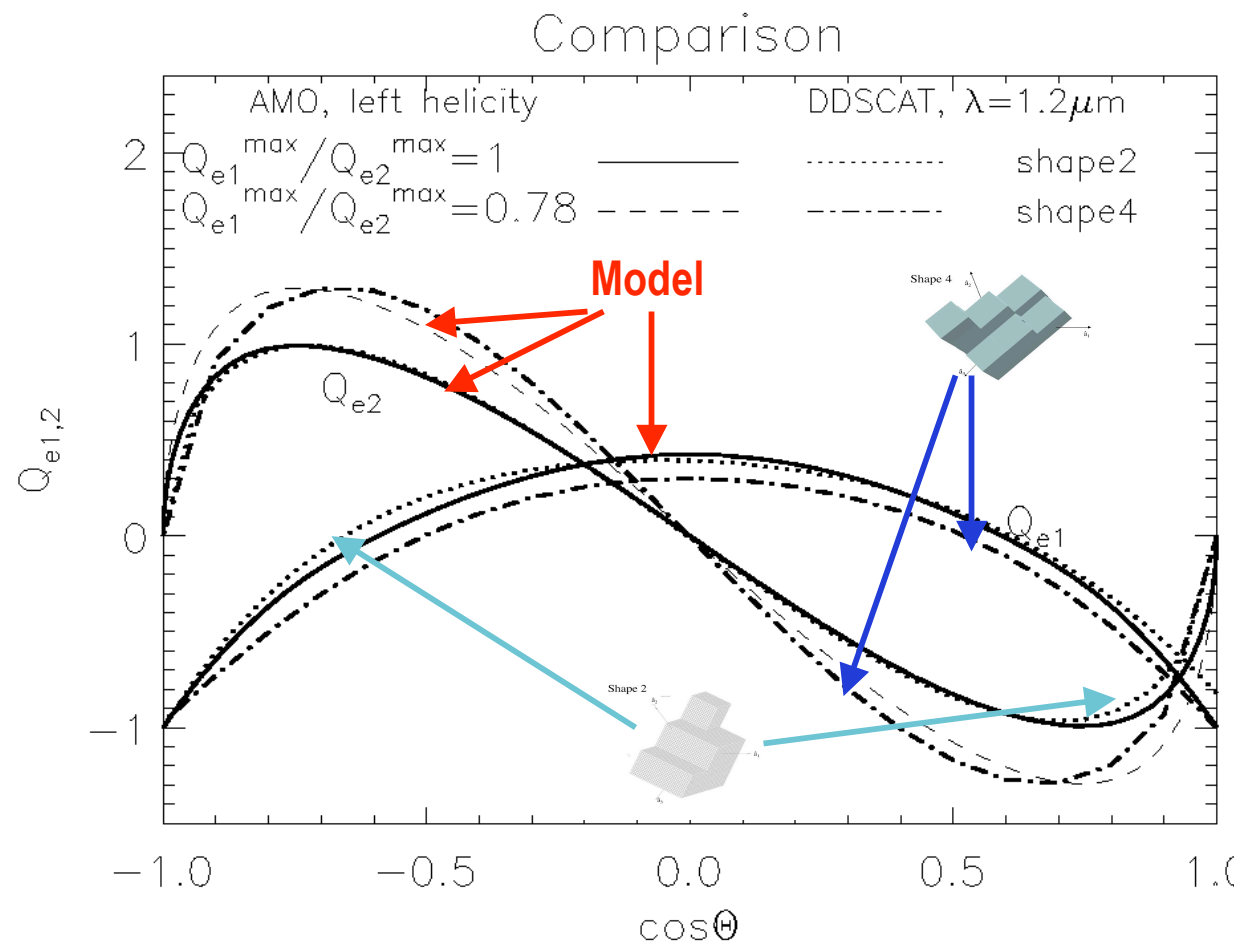
Quantitative Theory Exists now: Analytical model (AMO) provides quantitative insight into radiative torque (RAT) alignment



Simple analytical expressions are available for Q_{e1} and Q_{e2} torques.

Present day theory: Our model (AMO) represents well the RATs on irregular grains. The accuracy is within 10%

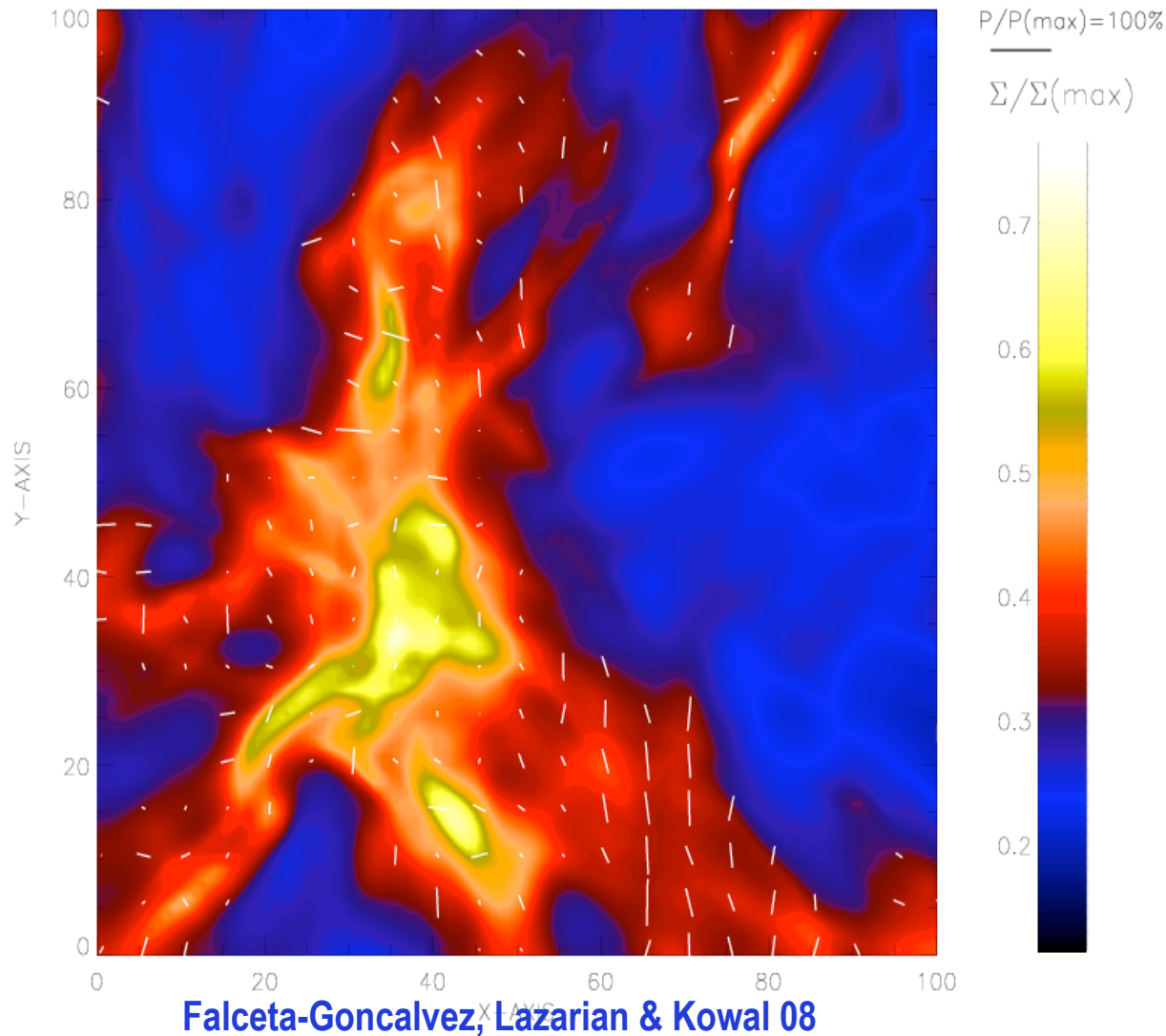
Deviations from AMO for irregular grains



1. Predicts alignment of ISM grains always perpendicular to B.
2. Predicts better alignment of superparamagnetic grains.

Lazarian & Hoang 07ab

It is not possible to evaluate strength of magnetic fields with polarimetry if grain alignment is not known

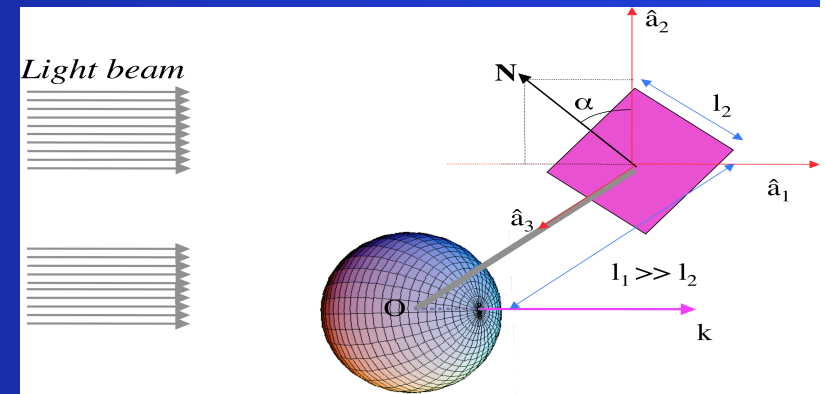
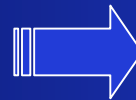
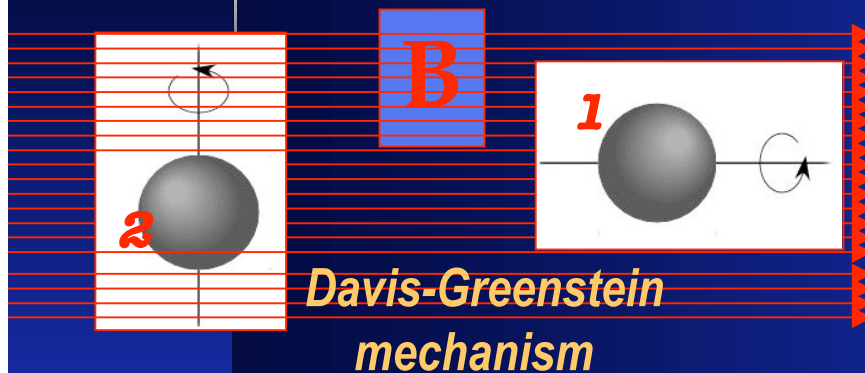


Falceta-Goncalvez et al. 08 finds that C-F technique can provide 20% accuracy if the alignment is known.

How does C-F technique of determining magnetic field strength is affected by incomplete alignment?

Phil's interest to directions of polarization and filaments stimulated the change of the grain alignment paradigm

New analytical model of grain alignment:



RAT alignment

