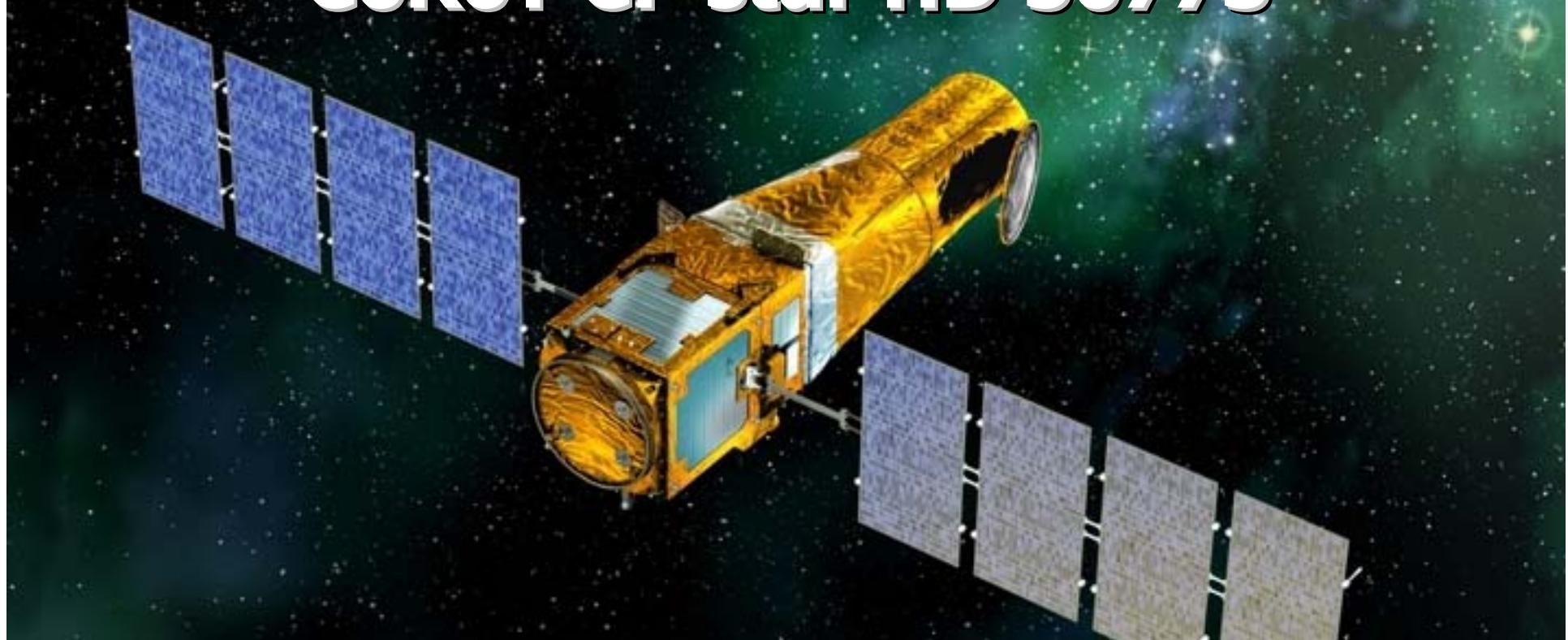


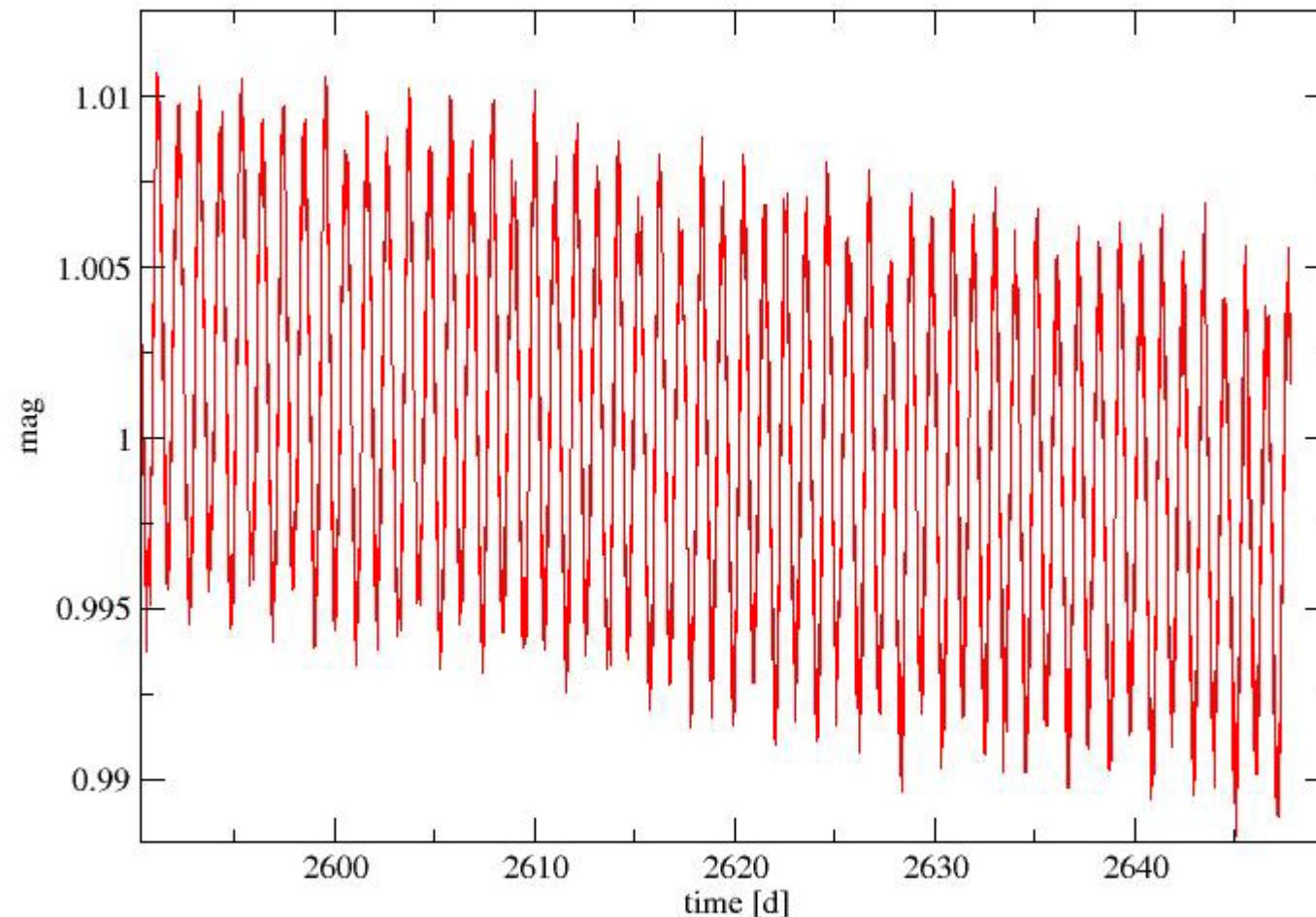
# Magnetic and chemical structure of the CoRoT CP star HD 50773



T. Lueftinger, H.-E. Fröhlich, P. Petit, M. Aurière, W. Weiss,  
M. Gruberbauer, N. Nesvacil, E. Alecian, C. Catala,  
J.-F. Donati, T. Kallinger, O. Kochukhov, T. Roudier, D. Shulyak

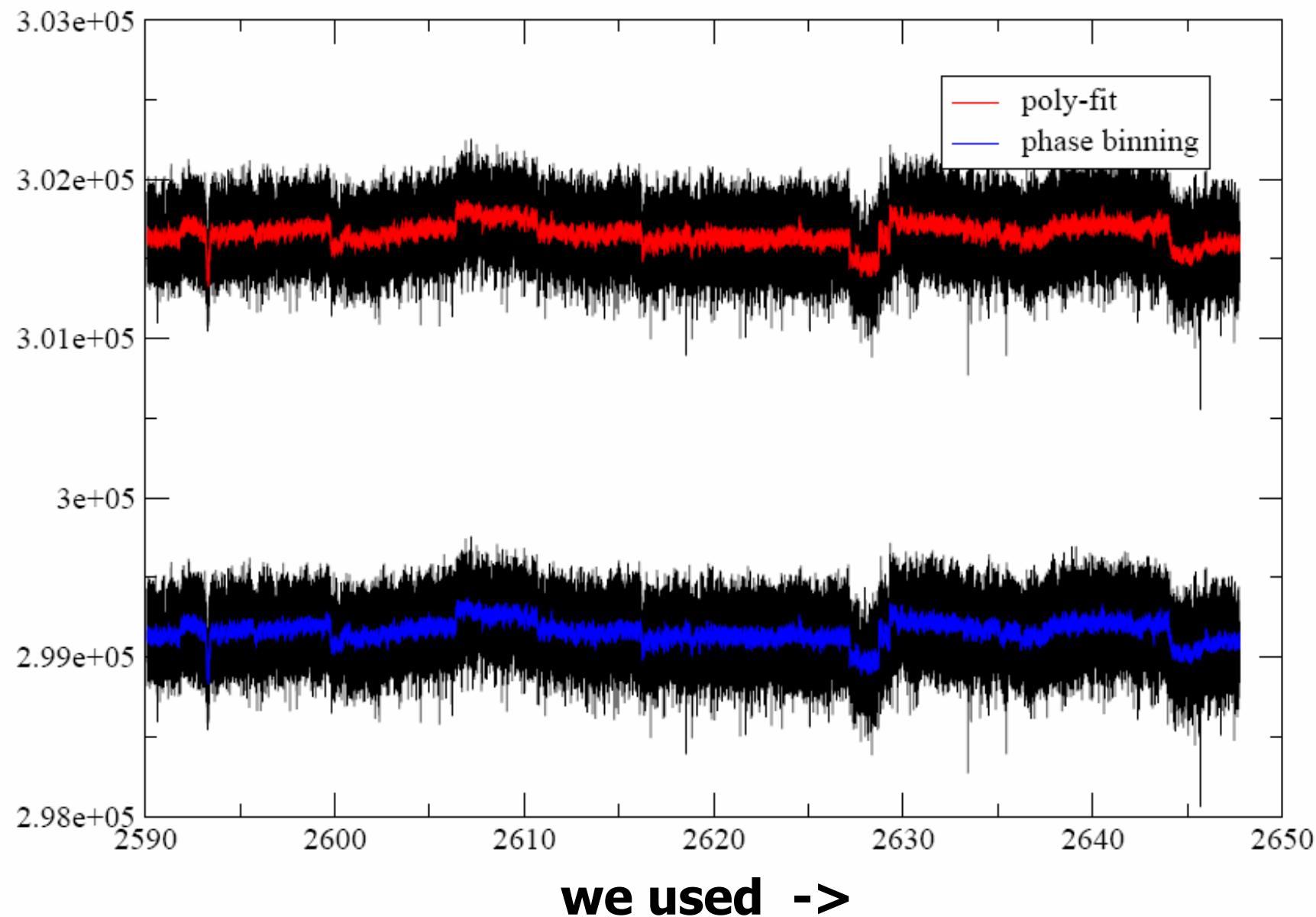
probing stellar surface structure of CP stars with COROT

# HD 50773

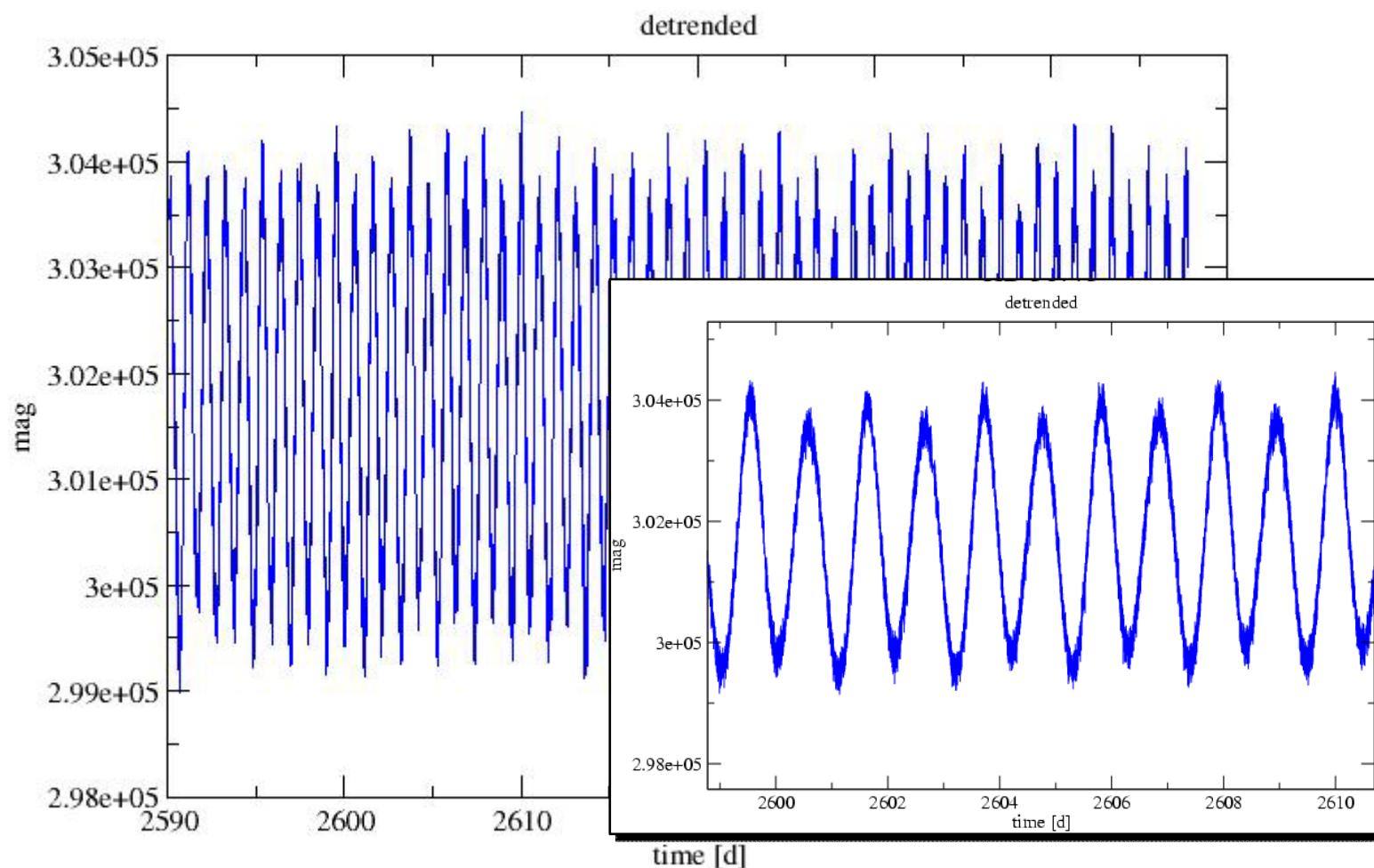


beautiful lightcurve, but there is a trend

**removing this trend**



# HD 50773



corrected lightcurve to determine spot locations on the surface using a Photometric Imaging method based on **Bayesian parameter estimation** (H.-E. Froehlich)

# Bayesian data analysis

e.g. two spots on a stellar surface □

nine free parameters:

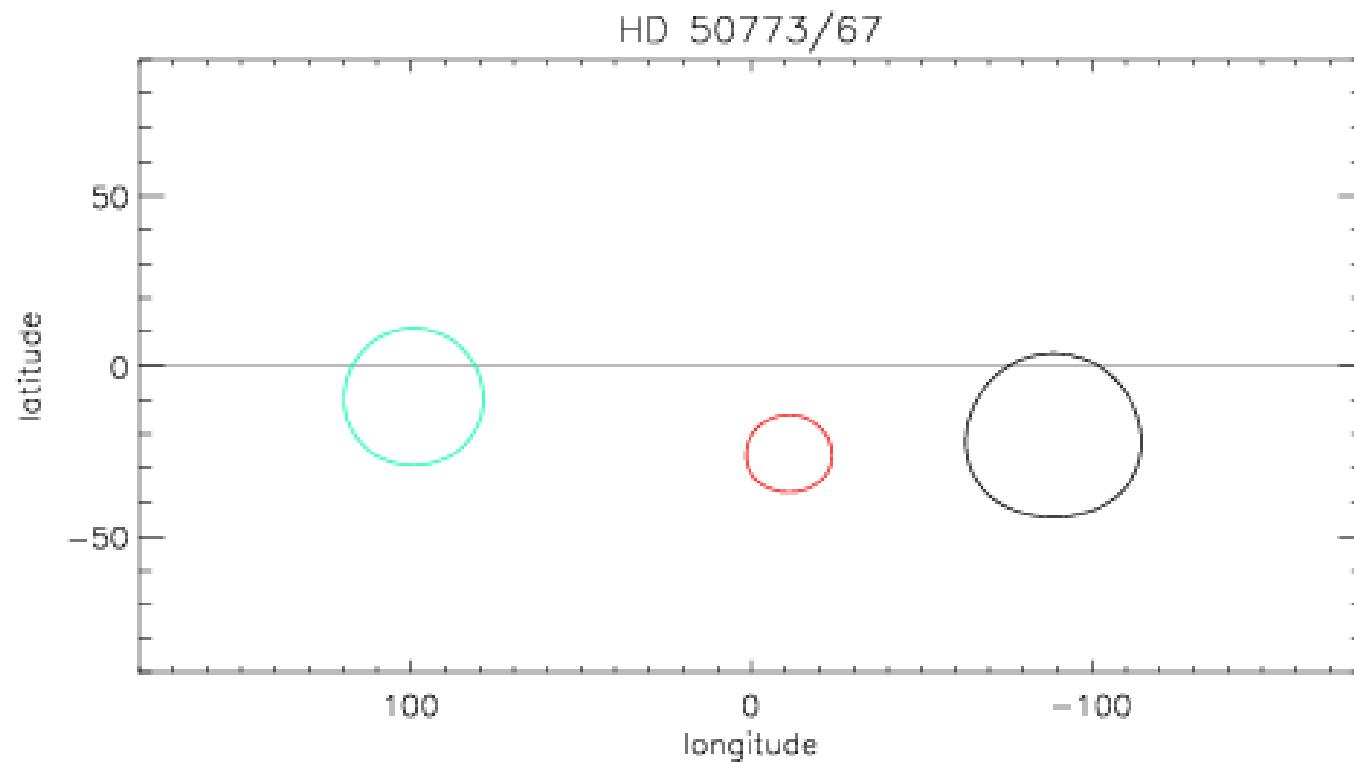
two periods, two epochs, two latitudes, two spot areas, and the star's inclination

splitting the nine-parameter problem (unsolvable) into two parts:

1. finding the two periods and epochs (times of minimal light) - AMOEBA
2. scanning the remaining parameter space - FROEHLICH
3. Bayesian data analysis: the whole likelihood mountain is considered, integrating all parameters, except one, we obtain the marginal probability distribution of this parameter

HD 50773 □ results suggest three circular dark spots

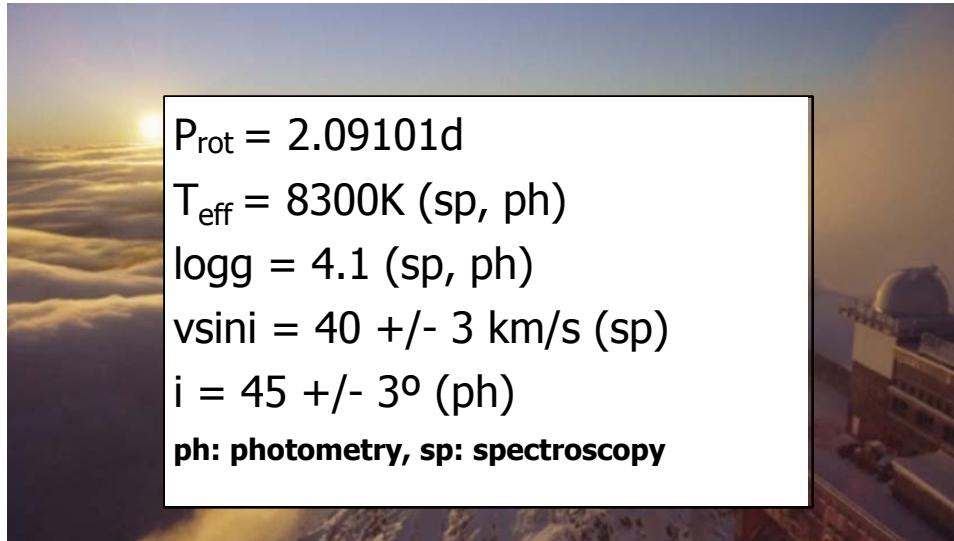
# Dark spots on the surface of HD 50773



# Spectropolarimetry

**high-resolution spectropolarimetry ( $R=65000$  to  $R= 80000$ )**

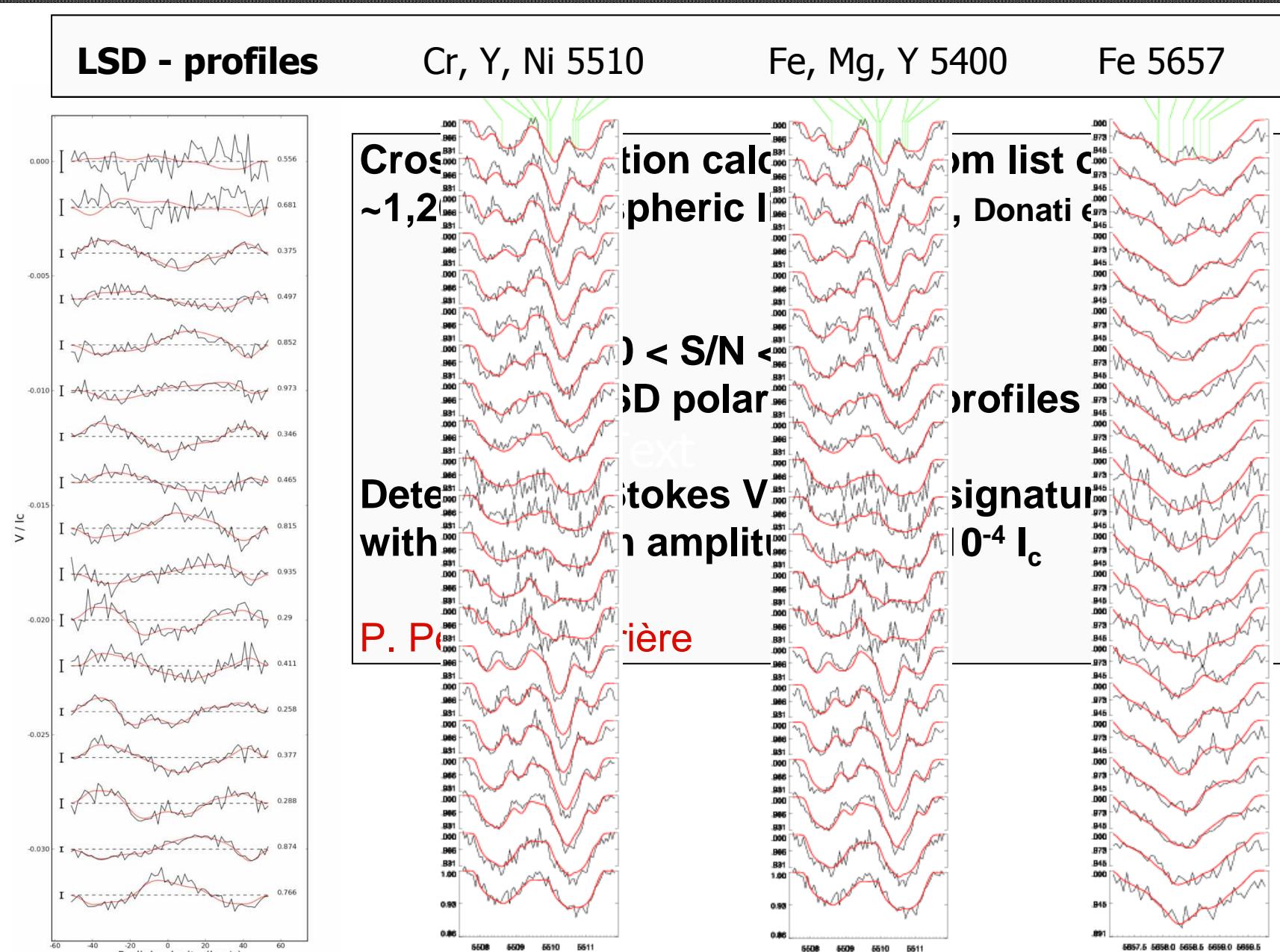
**more than 24 spectra/phases in Stokes I and V from**



**NARVAL@TBL (C. Catala et al.)**  
**ESPaDOnS@CFHT (J.-F. Donati et al.)**  
**SemPol@AAT (T. Lueftinger et al.)**  
 **$S/N \approx 150$**

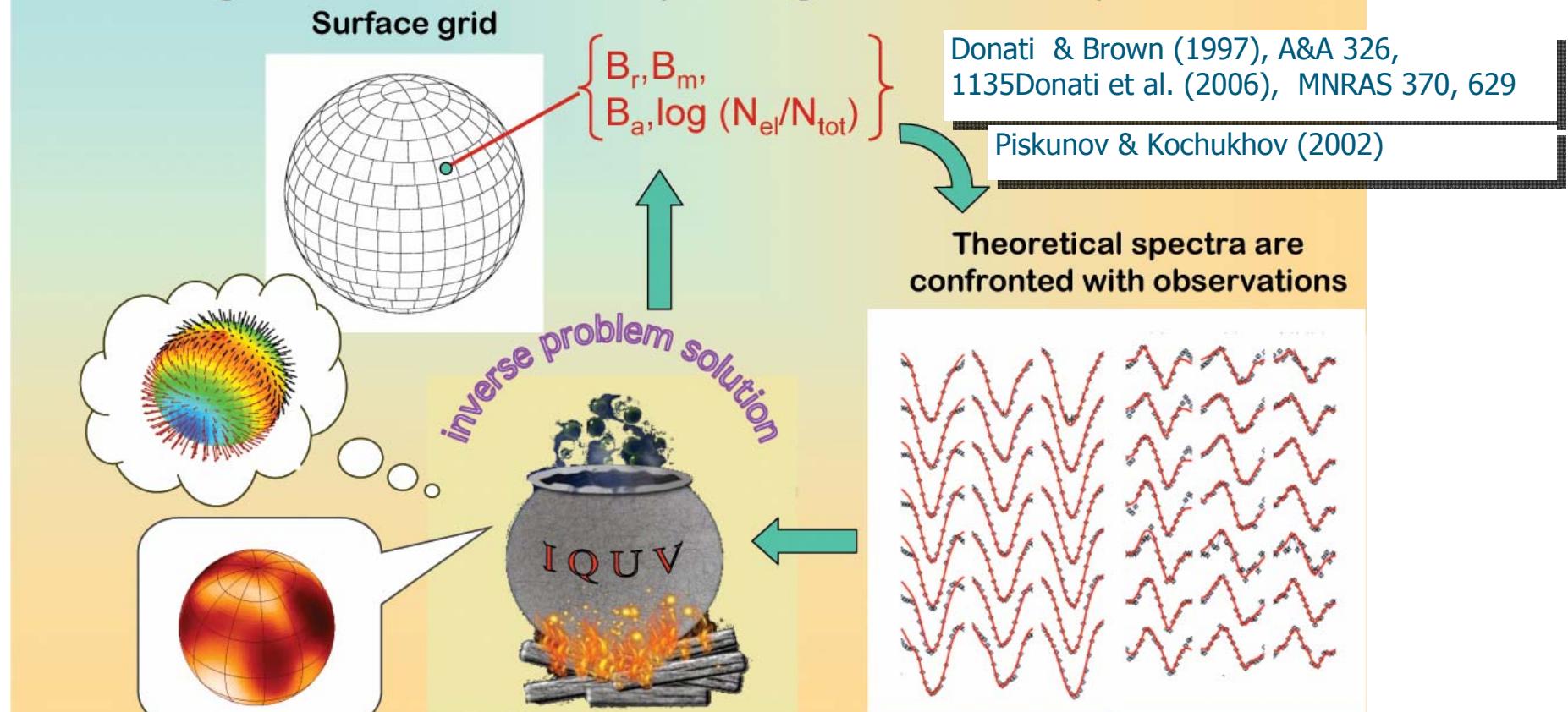


# Fit to the line profiles



# Magnetic Doppler Imaging

- Self-consistent, assumption-free reconstruction of horizontal magnetic and chemical maps using Stokes *IQUV* spectra

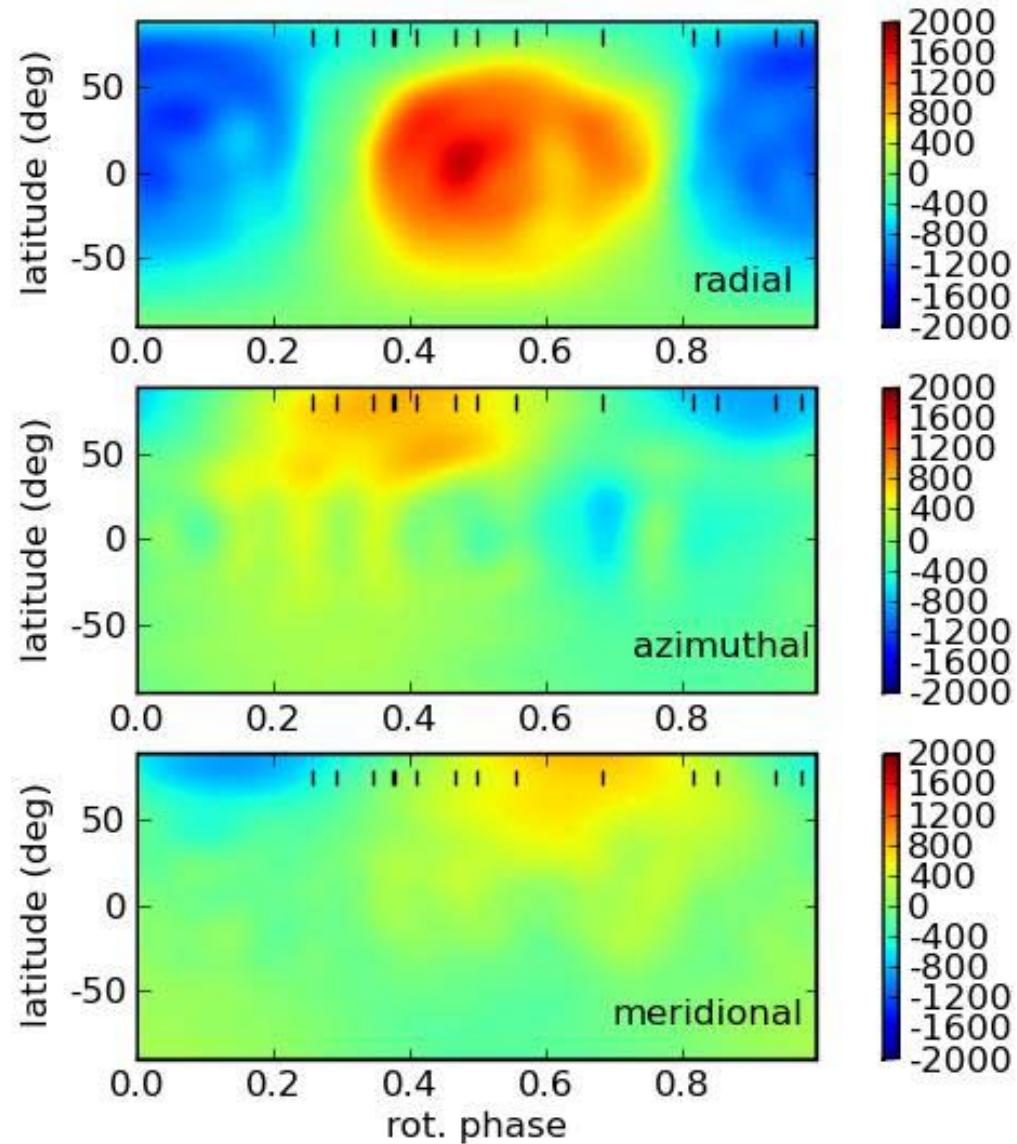


# Magnetic field geometry of HD 50773

## Zeeman-Doppler Imaging:

2D map of the surface  
magnetic vector

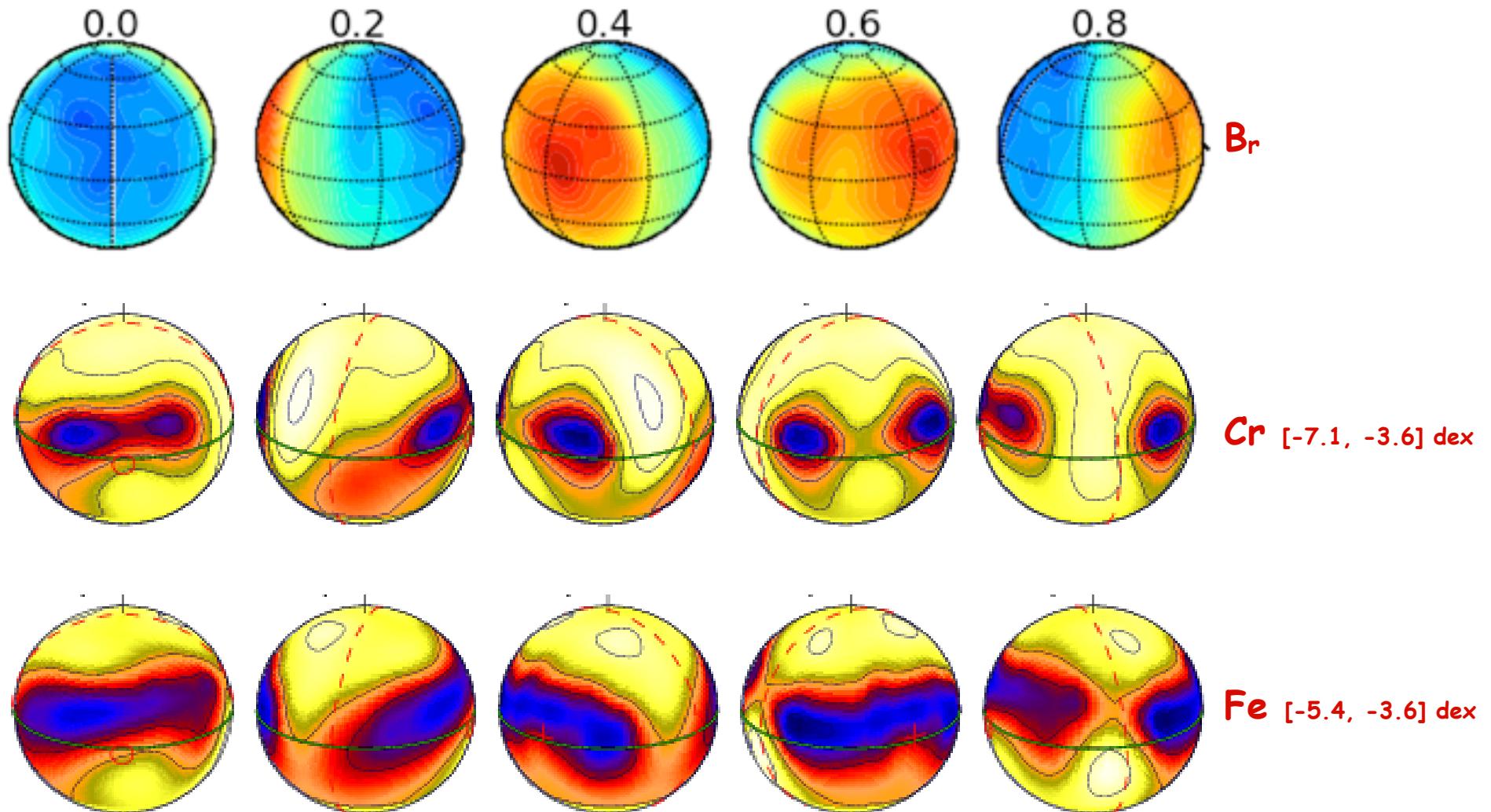
- Stokes V time-series consistent with purely poloidal field.
- 90% of mag. energy in highly inclined dipole
- Rotation phases of mag. equator equal to COROT photometric minima



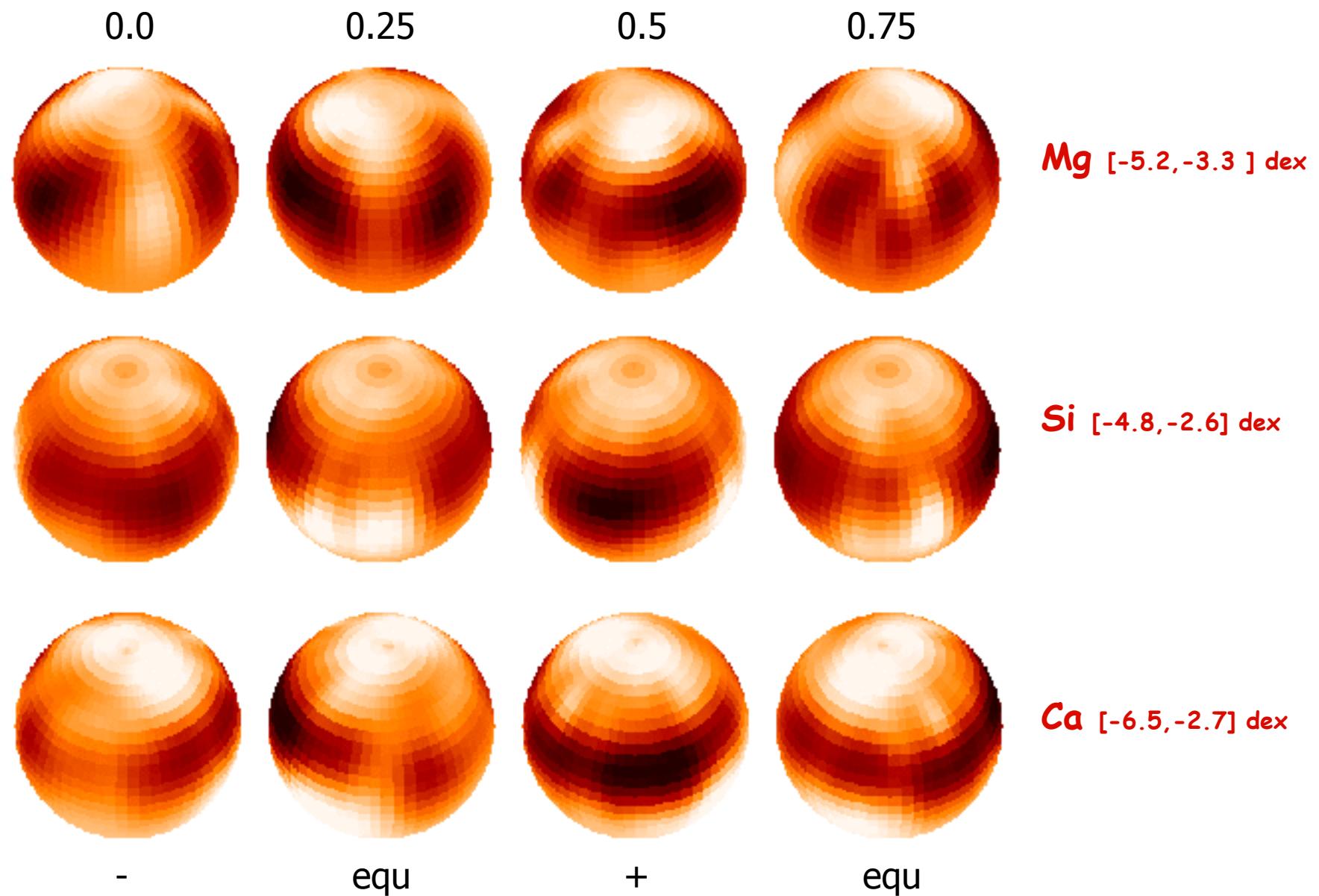
# Elements mapped on the surface of HD 50773

Element	wavelength	blended with
Magnesium I	5169, 5172	Fe, Ni
Silicon II, I	5055, 5421	single; Cr, Mn
Calcium I, II	6102, 6456	Fe, Fe
Titanium II	5154	Cr, Fe
Chromium II	5237, 5280, 6089	
Iron I	5383, 5400	
Nickel I	5510	Cr, Fe, Y
Yttrium II	5510, 5662	Cr, Fe, Ni; Fe
Copper I	5153	Crr, Ti, Fe

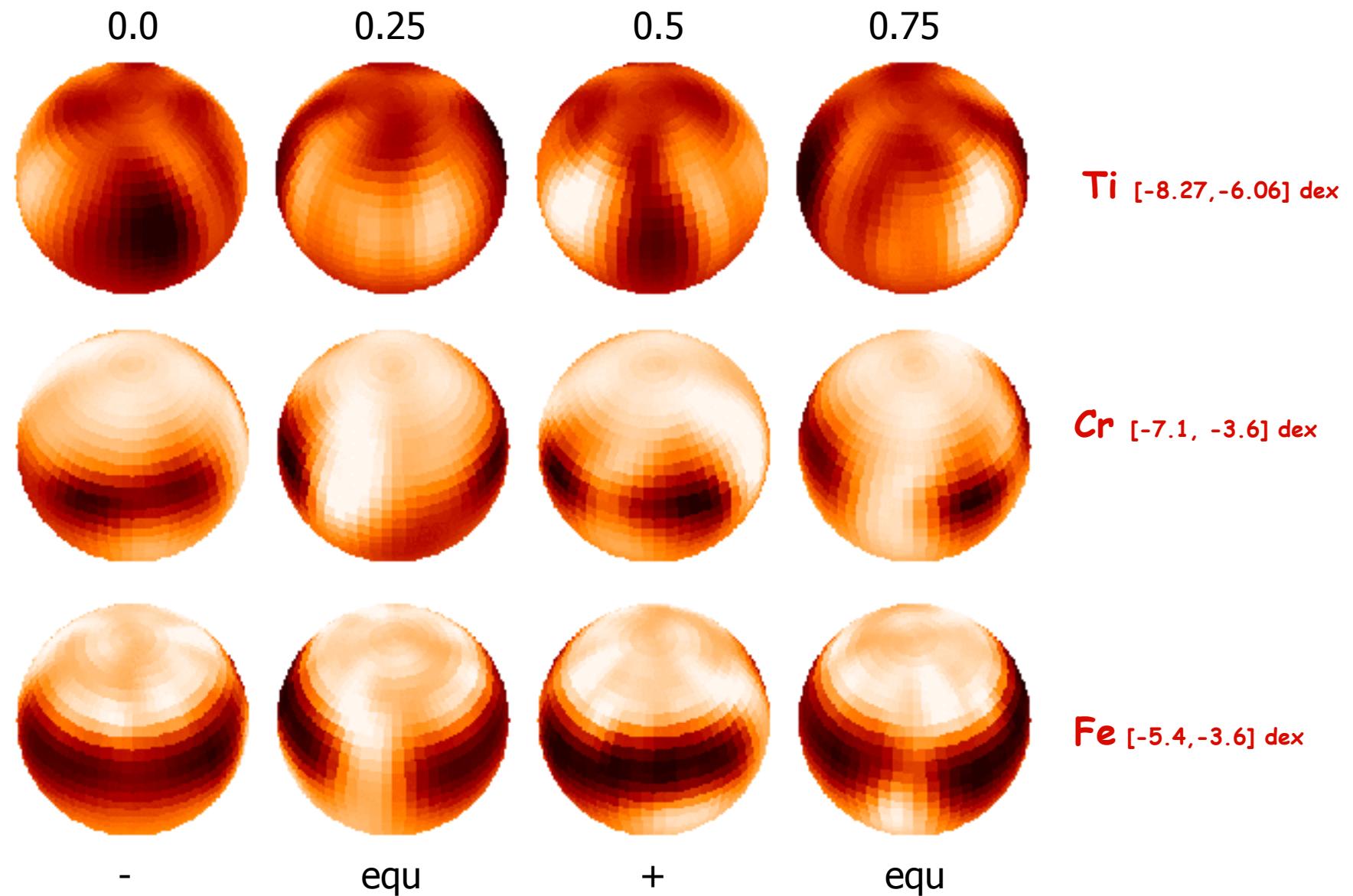
# Magnetic field geometry and elemental abundances



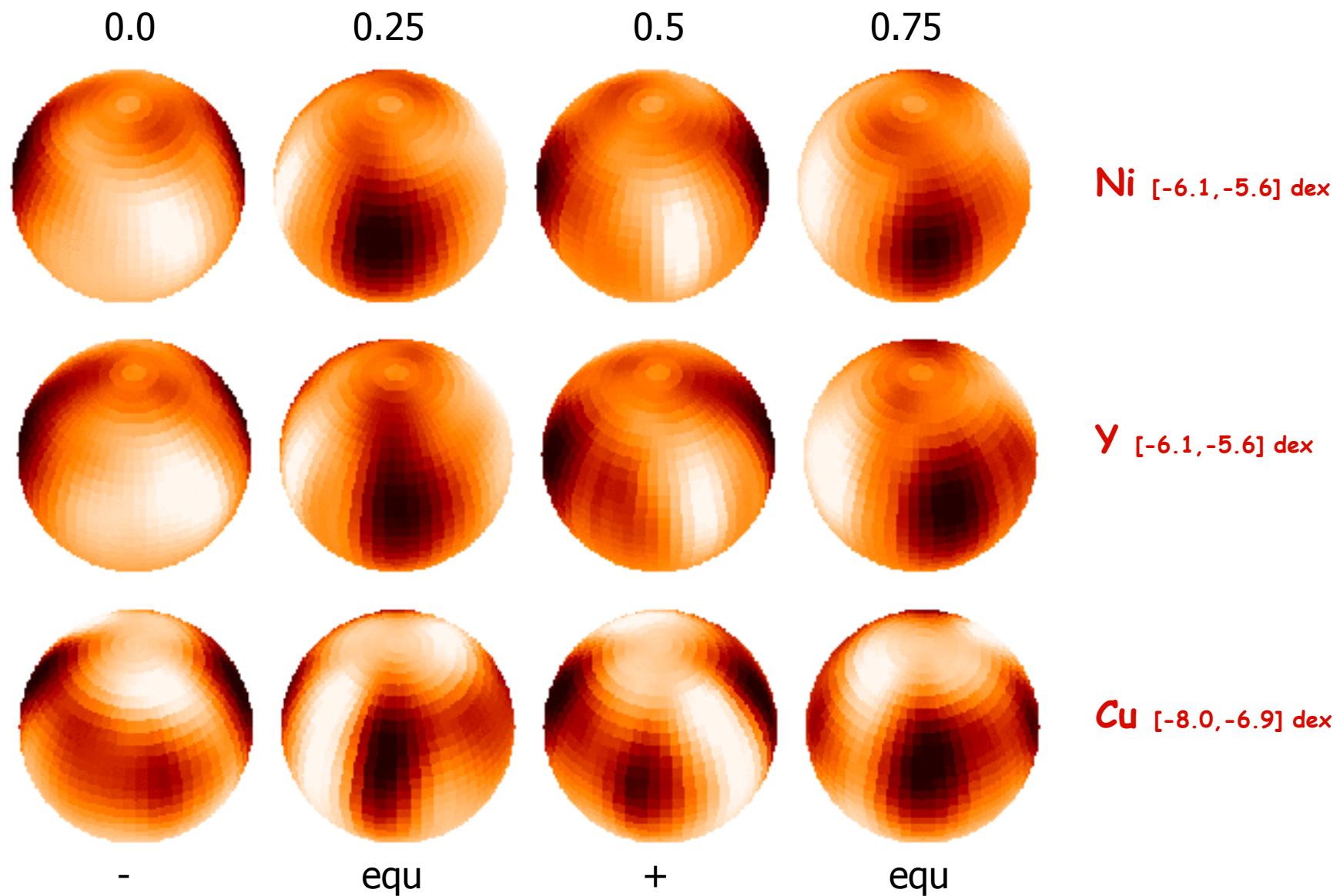
# Elemental abundances on the surface of HD 50773



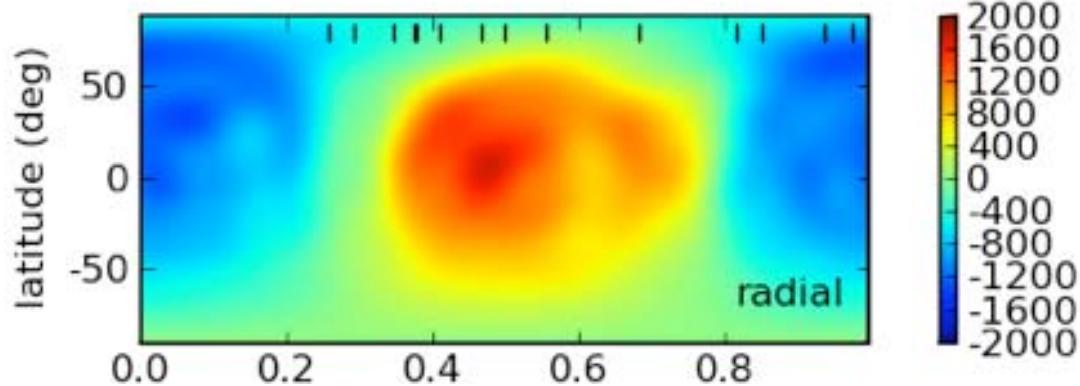
# Elemental abundances on the surface of HD 50773



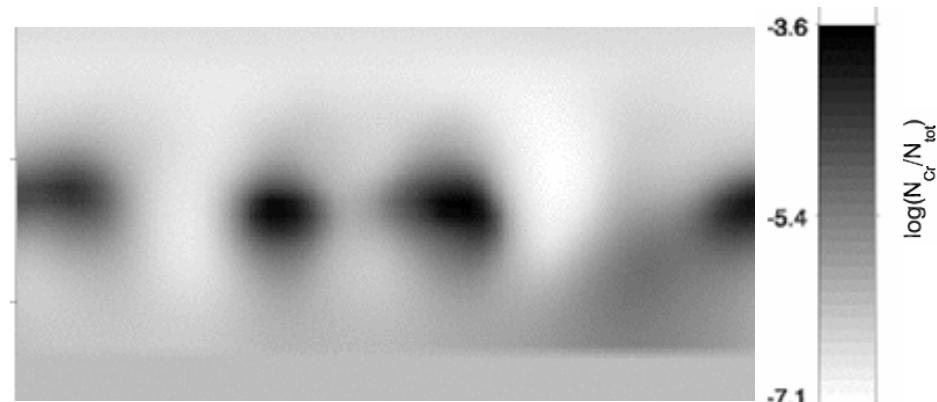
# Elemental abundances on the surface of HD 50773



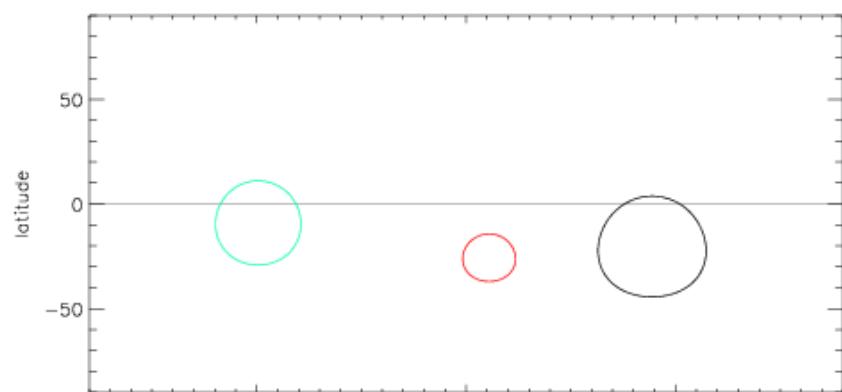
# Magnetic and chemical structure of HD 50773



**Zeeman-Doppler Imaging:**  
2D map of the surface  
magnetic vector  
radial component



**Doppler Imaging:**  
Cr overabundance is correlated  
with magnetic field poles  
Cr, Fe, and Si cause bright spots  
(D. Shulyak, priv. comm.,  
J. Krtička et al., 2007)



**Photometric Imaging (PI):**  
dark spots produced from  
photometry correlate with Cr  
underabundance

# Summary

- magnetic field dipolar, varying between  $\approx \pm 2\text{kG}$
  - the maxima of the lightcurve are correlated with the extrema of the magnetic field (polar regions)
  - Cr spots appear on the poles and avoid magnetic equatorial region
  - Cr, Fe, Si, Ca and Ti show similar distributions
  - Mg more spotty, no clear correlation to magnetic field,
  - Ni, Y, and Cu similar, enhanced at the magnetic equator
- hope for many more CoRoT CP's to come**   
**increase statistics**  **Diffusion theory**

**ENJOY COFFEE**

