MAGNETIC FIELDS OF THE SEISMOLOGY TARGETS OF KEPLER

part of a vast program to study magnetic fields
of cool and hot seismology targets of MOST, CoRoT & Kepler

C. Catala, S. Aigrain, T. Arentoft, A. Baglin, J. Christensen-Dalsgaard,
J.F. Donati, Y. Fremat, A.M. Hubert, H. Kjeldsen, O. Kochukhov, C. Martayan,
J. Matthews, C. Neiner, E. Shkolnik, G. Walker

stellar magnetic activity

- is one of the most important unsolved problems in solar and stellar physics
- is a severe source of perturbation for planetary transit detection
- is also a source of perturbation for asteroseismology

coupling Kepler photometric data and groundbased spectropolarimetric data

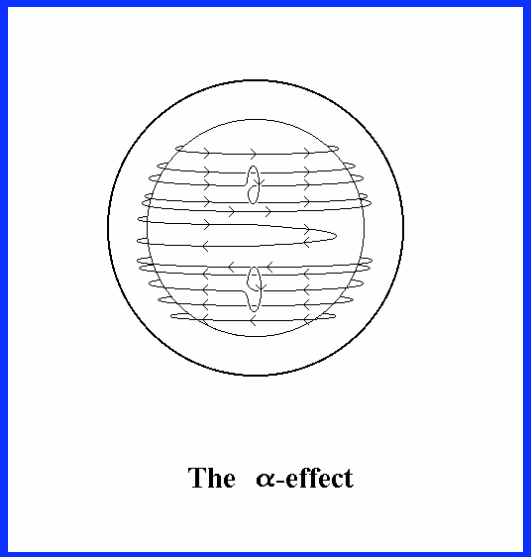
- can help us optimize the exploitation of space seismology and transit data
- provides an efficient tool to study stellar magnetic activity

THE MAGNETIC FIELDS OF LATE TYPE STARS

generated by dynamo

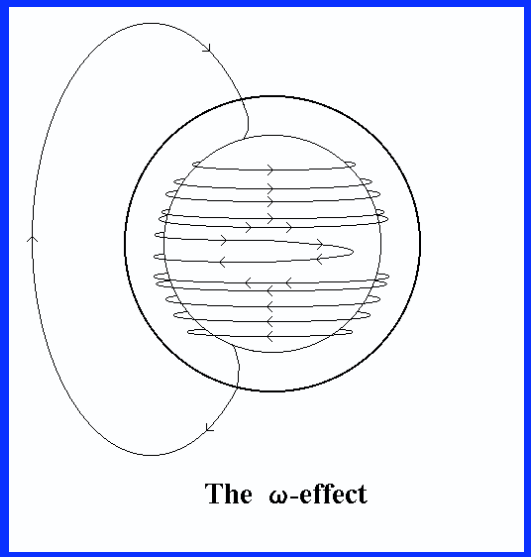
basic ingredients

- convection + rotation:
  regenerate poloidal field through α effect



The α-effect

- differential rotation:
  transforms poloidal field into toroidal field



The ω-effect

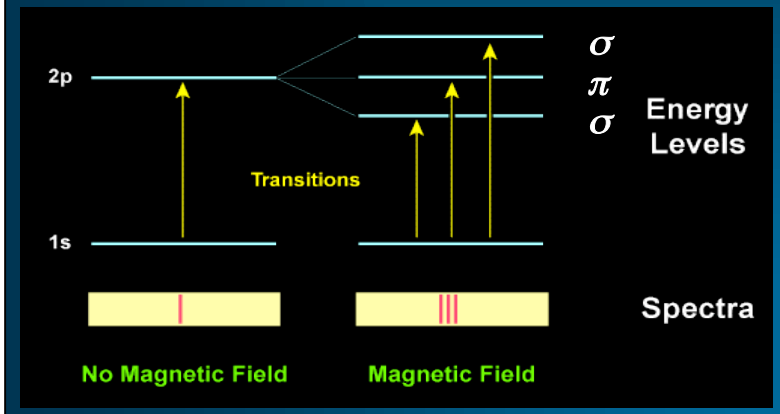
output

magnetic field : intensity, topology, cycle

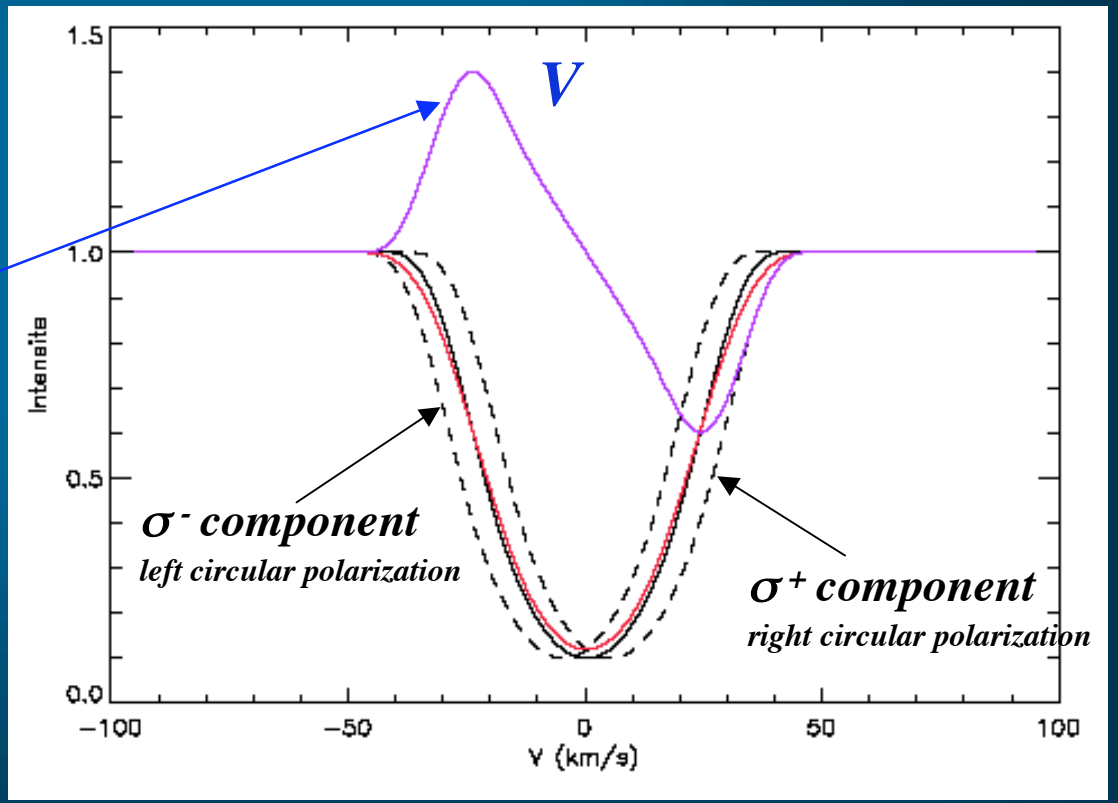
→ obtain constraints on both ingredients and outputs of dynamo

MEASUREMENT OF STELLAR MAGNETIC FIELDS

Zeeman effect in polarized light



in a magnetic field, the line is polarized by Zeeman effect



$$\Delta\lambda \propto B_z \lambda^2 \quad \rightarrow \quad V \propto B_z \lambda^2 \, dI/d\lambda$$

THE ESPaDOnS SPECTROPOLARIMETER AT CFHT

telescope interface and calibration unit

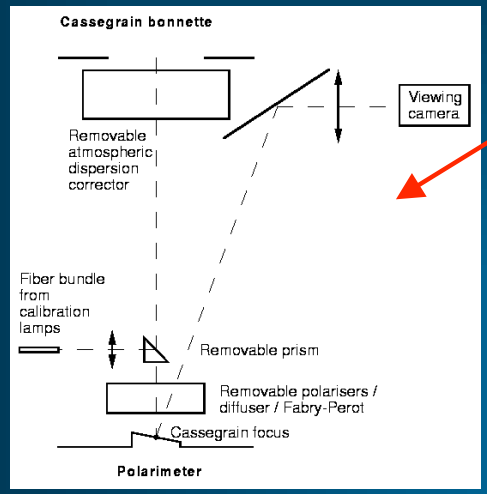
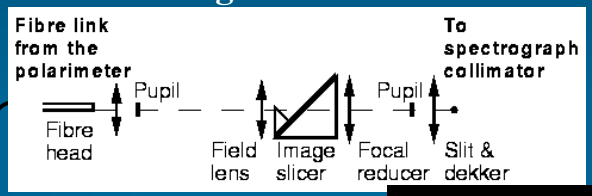
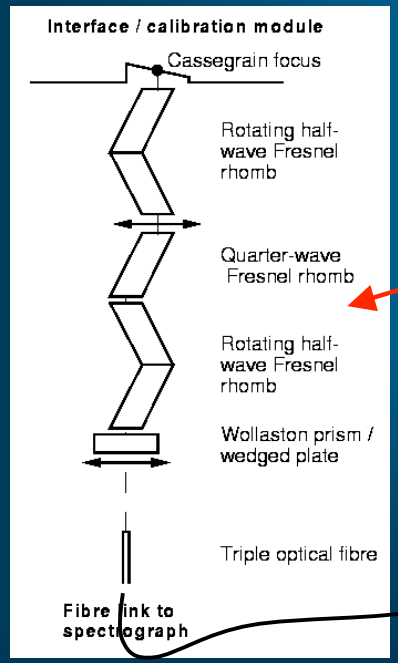


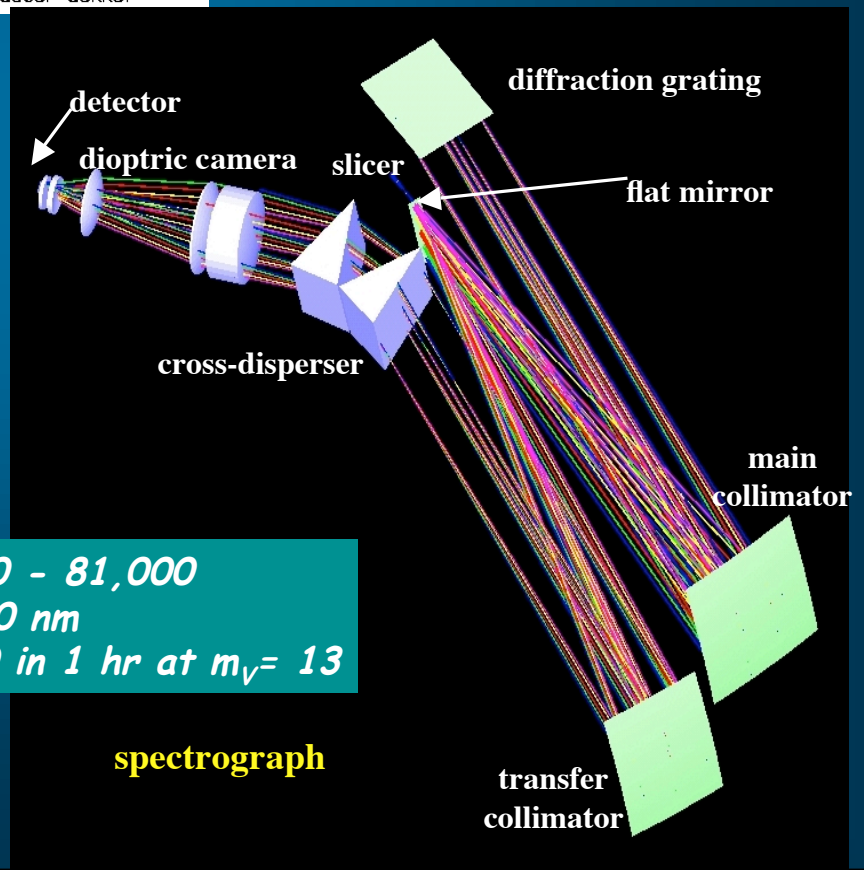
image slicer





polarimetric module

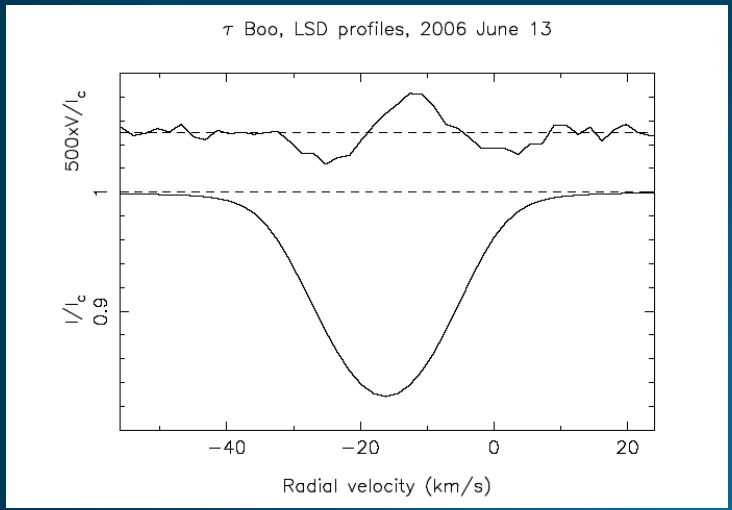
fiber link



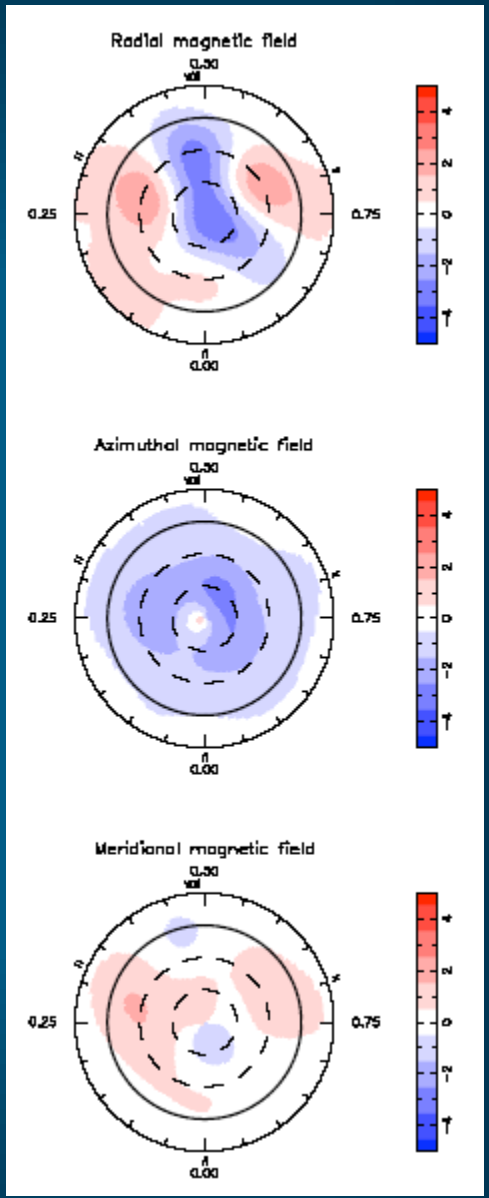
R = 68,000 - 81,000
370 - 1050 nm
S/N = 100 in 1 hr at m_V = 13

spectrograph

WHAT SPECTROPOLARIMETRY BRINGS US

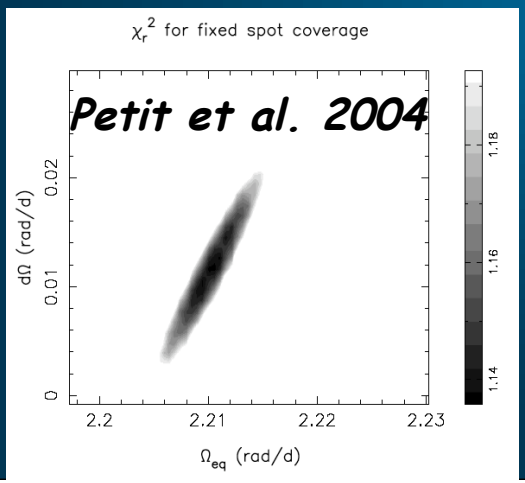


example
τ Boo
Catala et al. 2007



output of dynamo

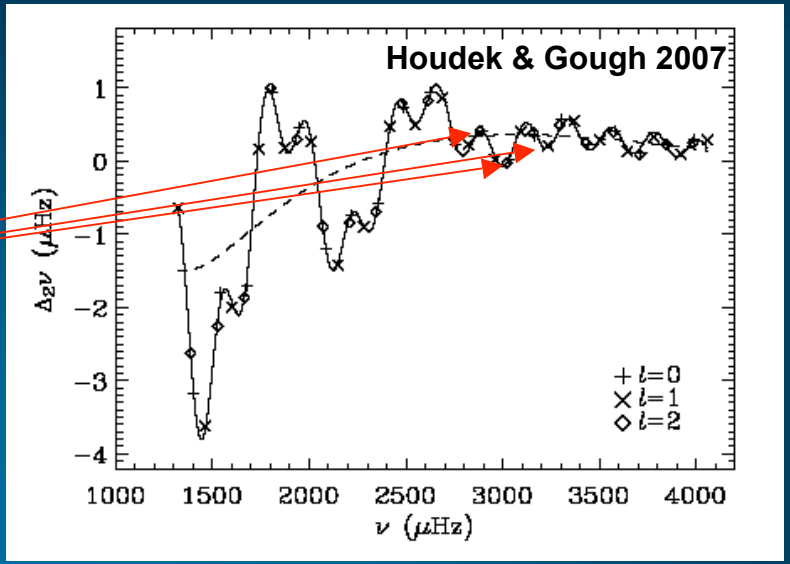
- *detection of magnetic field: as weak as 1 Gauss*
- *intensity and topology of B via Zeeman-Doppler imaging*
- *estimate of inclination angle i*
- *measurement of Prot & surface differential rotation*



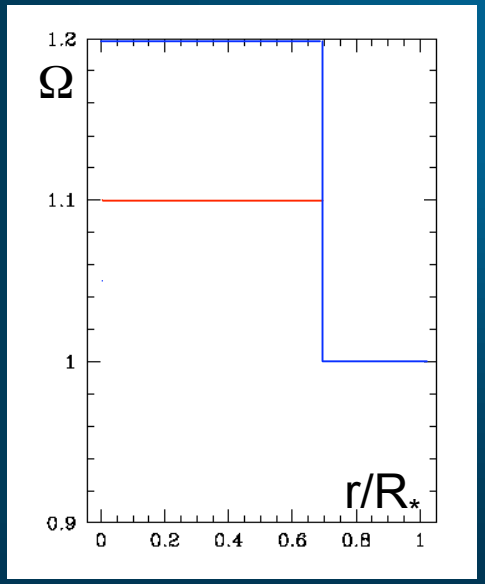
WHAT ASTEROSEISMOLOGY BRINGS US

ingredients of dynamo

- depth of CZ

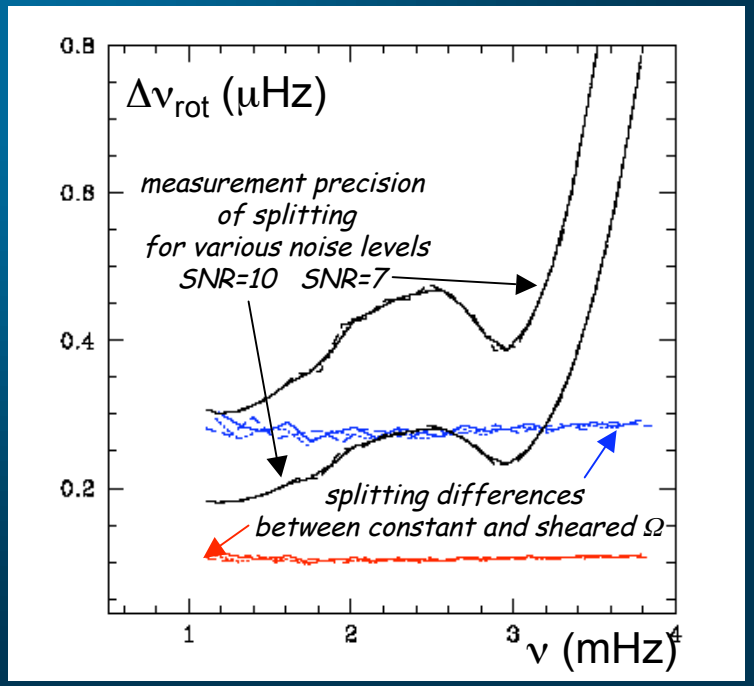


- internal rotation gradients and shears



surface Ω
well determined by
rotational modulation:
to within 0.01 μHz ?

Goupil
private comm.
work in progress



PROPOSED FOLLOW-UP OBSERVATIONS

important synergy between space asteroseismology & G/B spectropolarimetry

Proposal: launch a G/B effort to obtain spectropolarimetric observations of seismology targets of MOST, CoRoT, Kepler

already started for MOST & CoRoT with ESPADONS @ CFHT and NARVAL @ TBL (also including hot stars)

recognized as strategic by MagIcS program (coordination of research on stellar magnetic fields) http://www.ast.obs-mip.fr/users/donati/magics

---

extend the work to a sample of Kepler asteroseismology targets
. $m_V \leq$ 10-11, late-type ⟶ about 40 targets ?
. 10 ≤ vsini ≤ 60 km/s

1. survey ⟶ about 400 CFHT hrs

2. monitoring ⟶ additional 400 CFHT hrs

subject of a large programme
to be submitted to CFHT (Feb 2008, l.o.i. submitted)