VIRGO Science Proposal
Obliquely rotating core of the sun

Main Investigator

Any one of the 4 below

Co-Investigators

T.Appourchaux, D.O.Gough, A.Kosovichev, T.Toutain

Objectives

To detect whether the sun's core rotates at an angle different from the surface rotation. This has some useful implications especially for rotation inversions.

Work plan

The technique is to use the amplitude leakage that an obliquely rotating core would generate. The spherical harmonic normal modes are projected onto a set of spherical harmonics with respect to an axis perpendicular to the line of sight using the standard rotation matrices. The outcome is that there are temporal frequency leaks into each harmonic, which should be detectable in the power spectrum. The power in each of these projections is a function of the pulsation-axis angle (presumed to be different from zero).
The investigation should proceed in the following steps:

- Using at least the LOI, determine whether modes of $\Delta m = \pm 1$ can be detected in a given l, m spectrum. The fits will be done using maximum-likelihood estimators, taking coherent interference into account by means of a model of the mode excitation.
- Estimate for each l, m, n mode the pulsation angle using the information provided by the fit.
- Invert the pulsation angle data to obtain the angle at which the core rotates

Preliminary results could be obtained with the ground-based observations of the LOI. In this latter case the effect of the attitude of the sun on the detector is worse than for the SOHO based instrument (Maximum P angle is 22 degrees).

Outstanding problems

This technique is well understood for the p modes. We have no clue whether this would make the detection of g modes more difficult, would the core rotate obliquely! In addition, the optimal extraction of a given l, m mode can generate power at the same place as the mode of interest. This additional crosstalk due to the attitude of the sun on the LOI detector may hamper the detection of the modes of interest.

Responsibilities and Management

T.Appourchaux will be for generating the power spectra and for providing the crosstalk for each spectra of an l, m mode. He will also be responsible for studying the effect of the attitude of the sun on the detectability of the "parasitic" modes. T.Toutain will be responsible for fitting the parasitic modes. A.Kosovichev will be responsible for inverting the data. D.O.Gough and A.Kosovichev will be responsible for the scientific interpretation of the data.