VIRGO Science Proposal F4

The gravity modes spectrum of the Sun

Main Investigator

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Co-Investigators

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Objectives

- Measure the solar g-modes power spectrum.
- Obtain the structure and dynamics of the solar core.

Scientific Rationale

The success achieved by Helioseismology in measuring the solar interior finishes at about 0.3 $R_\odot$, where actual inversions fail due to a lack of enough accurate observations of low n low l p-modes and, mainly, g-modes. The measure of the spectrum of solar g-modes hold the key to our direct knowledge of the Sun's core. The problems that we had in the recent past to find them have been summarized in the review by P.L. Pallé (1990). It is believed that the data from the Helioseismology experiments on board SOHO could achieve the required sensibility and accuracy to allow its measurement.

Work Plan

The investigation will be based on all available data in VIRGO instrumentation. Data from the sunphotometers and radiometers will be treated in a "standard way", understanding by this the procedure used already by our group (Pallé et al.,1986, 1987, 1988) which can be summarized in the following scheme:

- Formation of the time series and "cleaning of known" variations (trends) present in housekeeping and/or guiding data or in similar information. (AJ & TRC).
- Make the power spectra, and look for g-mode signal with statistical methods already proven and used. (PLP & TRC).
- Use of fitting techniques to get the g-mode spectra parameters (frequencies, splittings, amplitudes, etc..). (PLP & TRC)
- Use of correlation techniques, between spectra, of independent measurements in order to enhance the signal/noise level. Remake the analysis of the latest point above for the search. (PLP & TRC).
- Make the appropriate inversions to get the rotation, density .... in the core. (FPH & AD).

When data from LOI is considered, a similar procedure will be used using the optimal filters already developed by CRS. In this sense, good computed visibility functions will have to be used. Cross-correlation techniques will also be used between SPM and radiometers and LOI data.

Outstanding problems

The big problem is the amplitude of such modes and the noise in this region of the power spectra. It may turn out that a mixed type of analysis which include prediction of sun-models may have to be used in a procedure with analysis of the data to reveal whether or not signals are in there.
On the other hand, in a second phase, it may turn out to be necessary the use of GOLF and/or MDI data to seek for g-modes. Due to this likely possibility, we strongly encourage to create a joint team to help in this kind of common work.

Responsabilities and Management

See working plan.