VIRGO Science Proposal F2
Gravity modes with the helioseismology instrument on-board SOHO
Part A: VIRGO only

Main Investigator

T.Appourchaux

Co-Investigators

B.N.Andersen, G.Berthomieu, P.Gouttebroze, J.Provost, T.Toutain

Objectives

To detect gravity modes with the Luminosity Oscillations Imager, using calculated frequencies and splitting of low-degree g modes.

Work plan

The investigation should proceed in the following steps:

- Give an analytical expression for the flux perturbation for each l, m, n mode (adiabatic case).
- Compute for each l, m, n mode the optimal filters to be applied to the pixel time series; this will include the effects of the change of the apparent solar radius, P and B angles.
- Compute the power spectra
- Identify possible zonal modes with a g-mode frequency table the using Maximum Likelihood Estimators, and a statistical test of significance.
- Identify non-zonal modes with a g-mode frequency and splitting table using Maximum Likelihood Estimators, and a modified and a statistical test of significance.
- Refine the theory to include various effects (non adiabaticity, convection...) not taken into account, and loop the loop...

Outstanding problems

For increasing our chances to detect the gravity modes, the following needs to be either refined or improved:

- The flux perturbations
- The frequencies of the g modes, and splittings
- The technique for detecting the modes

At the time of writing the Eulerian and Lagrangian seem to agree. A parametric expression of the frequencies and splittings may ease the detection.

Responsabilities and Management

T.Appourchaux will be responsible for the overall integrity and management. He will be responsible for the generation of the time series, using his optimal filters; the optimal filters are to be computed using the g-mode flux perturbations provided by the Nice group. He will be also responsible for generating the power spectra and for providing the crosstalk for each spectra of an l, m mode. G.Berthomieu, P.Gouttebroze, J.Provost and T.Toutain will be responsible for producing the analytical flux perturbations (lagrangian or eulerian approach) and frequencies of g modes. B.Andersen, T.Appourchaux and T.Toutain will be responsible for the search of the g-mode in the spectra.

Part B: LOI and GOLF, and/or the LOI proxy of MDI

Main Investigator

T.Appourchaux

Co-Investigators

B.N.Andersen, G.Berthomieu, P.Gouttebroze, G.Grec, T.Hoeksema, A.Kosovichev, J.Provost, T.Toutain,

Objectives

To detect gravity modes with the Luminosity Oscillations Imager and GOLF, or the LOI proxy of MDI, using calculated frequencies and splitting of low-degree g modes.

Work plan

If the detection with the LOI only would have been unsucessful, the next step is to get together with the GOLF and/or the MDI team for a joint analysis.

- Get the LOI power spectra obtained as in the part A.
- If with MDI: get the MDI LOI proxy power spectra.
- If with GOLF: get the GOLF power spectra and the visibility of the g modes in full disk integrated light.
- To identify possible modes using a cross-correlation method or other method using inversion techniques.
- Refine the theory to include various effects (non adiabaticity, convection...) not taken into account, and loop the loop...

Outstanding problems

Same as for the part A. In addition, the visibility of the g modes for GOLF will be recomputed now that the Eulerian and Lagrangian methodologies agree with each other. The Stanford and Nice must agree on the velocity and intensity perturbations. The best method to search for the g modes in many spectra is still to be devised.

Responsabilities and Management

Same as for the part A but in addition G.Berthomieu, P.Gouttebroze, J.Provost and T.Toutain will be responsible for producing the g-mode visibility for the GOLF instrument. G.Grec will be responsible for providing the GOLF power spectrum. A.Kosovichev will be responsible for producing the velocity and intensity perturbation for the LOI proxy. T.Hoeksema will be the SOI coordinator.