VIRGO Science Proposal E7

Diameter and oblateness measurements using LOI guiding pixels

Main Investigator

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Co-Investigators

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Objectives

- Measure the diameter variations of the Sun
- Measure the oblateness (J2) variations of the Sun

Scientific Rationale

Several authors have claimed that the radius of the Sun varies with solar cycle. Measurements show contradictory results, some are correlated (Ulrich et al., 1995), some anti-correlated (Laclare, Delache ,....1991) and some non-correlated at all (Brown et al.) with solar cycle. Obviously the interpretation of this results are very complicated as it is not quite clear what observable are really measuring with each instrument.

The LOI instrument has 4 guiding pixels in a ring shape around 12 central pixels. This ring has an internal radius of 15.12 $arcmin$ and it is 1.68 $arcmin$ width. Each guiding pixel is a quadrant of an annulus and it is in one of the geographic directions: North, South, East and West. With these pixels, several signals can be derived that might be used as a measure of the solar shape: diameter, oblateness

etc. Using data from LOI-T, Rabello Soares et al. (1995, 4th SOHO Workshop, Monterey) have already shown that the guiding pixels are capable of producing a signal that can be easily calibrated in terms of solar diameter and, although the length of data is not enough to show any variations with cycle, the errors obtained (< 0.1 *arcsec*) show clear evidence that variations of the ones already found can be easily measured. Obviously, with LOI-VIRGO the errors are expected to be less than in the actual case.
As far as the oblateness measurements are concerned, data on LOI-T show evidence of good prospects; this allows us to believe that LOI-VIRGO will be in a position so as to measure such variations. In order to measure its absolute value, the instrumental and systematic errors might prevent an eventual success.

Work Plan

The plan is to use LOI-VIRGO data to derive the radius and oblateness signals much in the same direction as the already used for LOI-T. Also, we plan to calibrate the LOI Qualification Model which is operational at Observatorio del Teide (LOI-T) using the space data. The objective of this effort is to enlarge the duration of the observations when SOHO is out of business.
Unfortunately, a cause of systematic error and other problems in the LOI data is the dependence of limb brightness on latitude due to faculae, sunspots, prominences, magnetic fields, and variation with latitude of photospheric brightness, chromospheric brightness, and possibly the limb darkening curve. To take this into account and correct the data, we will use MDI data (or GONG or TON data). In this sense, this proposal is complementary of the one already sent by Bo Andersen and others.

Outstanding problems

The insufficient knowledge of the performance (aberrations on the telescope, sensitivity and aging of the pixels in the detector, the performance of the servo, etc.) might prevent an absolute measure of both parameters and could jeopardize the measurement of its variations. In this sense, a good tracking of this parameters and its variations would be highly desirable; also, a good knowledge of LOI-T housekeeping data could also help.

Responsabilities and Management

All investigators have experience in handling LOI data.