SHORT-PERIOD INTENSITY FLUCTUATIONS OF INTEGRAL SUNLIGHT*

A. CLAVERIE, G. R. ISAAK, and C. P. McLEOD

Department of Physics, University of Birmingham, Birmingham, B15 2TT, England

Abstract. An attempt has been made to detect short-period solar luminosity fluctuations in the vicinity of 5 min, analogous to the observed velocity oscillation. Using silicon photodiodes to monitor integral sunlight, an upper limit for the amplitude of the intensity fluctuations of $3 \times 10^{-5}$ rms was found.

In 1979, 5 min velocity oscillations of the entire Sun have been resolved into discrete spectral lines (Claverie et al., 1979). Confirmation of this structure has been reported at this meeting (Fossat et al., 1981; Scherrer et al., 1981; Severny et al., 1981).

In addition to line of sight velocity measurements of integral sunlight an attempt has been made to monitor the intensity fluctuations in the vicinity of 5 min. The detection of very small fluctuations of the solar luminosity – of the order of $10^{-5}$ (Isaak, 1980) – at ground level is very difficult due to the scintillation and the varying transparency of the Earth's atmosphere. Nevertheless observing intensity fluctuations of the Sun is of interest:

(1) In the context of purely solar oscillations. Integrated velocity and intensity over the solar disk are differently weighted for different $l$ values (Hill, 1978). The mean frequencies in intensity will be shifted somewhat to higher $l$ values which in the context of current models implies lower frequencies. Secondly observations of such oscillations would lead to an estimation of the enhancement factor and the phase shift between luminosity fluctuations and fractional changes of the radius.

(2) Extension of such observations to those of supposedly 'constant' stars would inaugurate the field of stellar seismology.

(3) Such a fluctuating power input would provide a probe for the response of the terrestrial atmosphere.

1. Instrument and Observations

Two types of silicon photodiodes having a maximum response around 800 nm were used. These detectors were fed by a portable equatorially mounted servo controlled coelostat. The sunlight was filtered by either a 100 Å or 10 Å passband interference filter centred on 770 nm. Another type of detector looked at the white light.

The outputs of the photodiodes were digitized with a high precision digital voltmeter. Readings were taken every 2 s and integrated over 40 s in 1980 (42 s in 1979). Observations were made during the 1979 summer at Pic du Midi (French Pyrenees) and in 1980 at Calar Alto (southern Spain).

Fig. 1. Intensity record of integral sunlight (a), (b) and corresponding fractional fluctuation (c), (d) at two different sites.