LONG - PERIODIC SIGNALS IN THE 8 MM SOLAR RADIO EMISSION

J. Kurths[1], H. Aurass[1], S. Urpo[2]

[1]AdW der DDR - Zentralinstitut für Astriphysik
DDR - 1501 Tremsdorf, Observatorium für solare Radioastronomie

[2]Helsinki University of Technology, Radio Laboratory
Espoo, Finland

ABSTRACT. Using the Helsinki University 14 m radiotelescope at 8 mm wavelength 10 hours time series of quiet Sun radioflux from 5 different areas are analyzed to search for long-periodic signals. Significant components with periods near 260 min, 160 min and 90 min exist. The amplitude of the 160 min period varies along the 5 positions significantly. The results are discussed in terms of g-modes. The 260 min and 90 min period can quantitatively be explained by the rotation of the supergranulation pattern through the beam.

ДОЛГОПЕРИОДИЧЕСКИЕ КОЛЕБАНИЯ В РАДИОИЗЛУЧЕНИИ СОЛНЦА НА ВОЛНЕ 8 ММ: Приведены резильтаты анализа наблюдений временных рядов радиоизлучения в длительности 10 часов из 5 различных областей спокойного Солнца. Временные ряды были получены на 14-метровом радиотелескопе Хельсинского университета на длине волны 8 мм. Найдены достоверные компоненты с периодами около 260 мин, 160 мин и 90 минут. Амплитуда колебаний с периодом 160 мин изменяется в зависимости ит положения области на диске. Полученные резильтаты интерпретируются как g-моды. Колебания с периодами 260 и 90 минут количественно можно объяснить вращением супергрануляции через диаграмму.

DLHOPERIODICKÉ SIGNÁLY V 8 MM RÁDIOVEJ SLNEČNEJ EMISII: Časové rady rádiového žiarenia, každá o trvaní 10 hodín boli analyzované pre 5 rôznych oblastí pokojného Slnka. Časové rady boli získané na 14 metrobom rádiovom ďalekohľade Helsinskej Univerzity. Zistené boli významné zložky s periódami 260, 160 a 90 minút. Amplitúda 160 minútovej periódy sa mení v závislosti od polohy na disku Slnka. Získané výsledky sú interpretované ako gravitačné vlny (g-modes). Oscilácie s periódou 260 a 90 minút môžu byť kvalitatívne interpretované ako dôsledok rotácie supergranulárnej siete cez smerový diagram prístroja.

1. OBSERVATION AND STATISTICAL ANALYSIS

During the past decade, global oscillations of the Sun have been detected in the range 3 - 370 min from Doppler measurements and records of irreadiance fluctuations. They have been applied to test and improve the theory of the solar interior (Fossat, 1985). Some authors have been confidermed the existence of such long-periodic oscillations in solar radio emission, too (cf. Efanov et al., 1983).

Using the Helsinki University 14 m radiotelescope at 8 mm (beamwidth 2.4') on August 9, 1983 the solar radioflux was observed at 5 solar areas, whose centers lay from the equator along the central meridian to the South, and at a off-sun position sequentially with a duration of 5 min per cycle.

After correcting daily variations of the apparatus we apply the techniques of maximum entropy spectral astimation, iterative sine-wave fitting and a stable regression analysis of the autocovariance function to the records (Krths, 1985) which provide the following periodic components significantly:
- periods of about 260 min and 90 min occur for all 5 solar positions
- the 160 min period exists at the positions 2 and 4, only
- the are non of the above mentioned periods present in the off-sun area record.

2. DISCUSSION

First, we discuss our data in terms of g-modes. Assuming a relationship between such signals in radio emission and optical measurements, as proposed by Efanov et al. (1983), we can compare our results with the other ones (detected by Delache and Scherrer, 1983 and Severny et al., 1984).

The 260 min period can be interpreted as an average of some g-modes in the range 250-265 min deduced from the Doppler data.

The strong amplitude variation of the 160 min period seems to give some indications of g-modes with a higher degree ℓ than considered to-day. From the geometrical arrangement of the chosen areas we yield $1 = 5$.

Next, we consider the possible influence of the rotation of supergranulation cells through the beam. According to the explanation by Worden and Simon (1976) in velocity records, we take the characteristic scales of the supergranulation network in the radio emission given by Kundu et al. (1979) which induce our periods of 90 min (width of the bright network of 11 000 km) and 260 min (cell spacing of 32 000 km). The amplitudes of these components deduced from the network to cell contrast are of the same order as those estimated from ourrecords.

The presented results which base on a short observation and on some conjectures have to be checked using further and longer non-full disc measurements in the optical and in the radio range.

REFERENCES

Fossat, E.: 1985, ESA SP-235, 209.
Efanov, V.A., Moiseev, I.G., Nesterov, N.S.: 1983, Pis'ma Astron. Zh. 9, 741.
Kurths, J.: 1985, Automatisierengstechnik 33, 240.
Delache, P., Scherrer, P.H.: 1983, Nature 306, 5944.
Severny, A.P., Kotov, V.A., Tsap, T.T.: 1984, Nature 307, 247.
Worden, S.P., Simon, G.W.: 1976, ApJ 210, L 163.
Kundu, M.R., Rao, A.P., Erskine, F.T., Bregman, J.D.: 1979, ApJ 234, 1122.