HVAR CONTRIBUTION TO THE WP 2 IN THE SECOND YEAR

We have worked on the two subtopics:

a) Position measurements of sunspots and sunspot groups and the determination of the solar differential rotation

Encouraged by literature dealing with analysis of high-precision positions and rotational velocities of sunspot groups (interactions of magnetic flux tubes on the solar plasma - Wöhl, 1983; dependence of the differential rotation of sunspots on the phase of the cycle - Balthasar and Wöhl, 1980; dependence of solar rotation on time - Brajša et al. 2006; relationship between the solar rotation and activity - Brajša et al. 2007) we started to analyze two data sets that contain information about the positions of sunspot groups, GPR (Greenwich Photoheliographic Results) and SOON/USAF/NOAA (Solar Optical Observing Network/United States Air Force/National Oceanic and Atmosferic Administration). For comparison we have used a third data set, the Kanzelhöhe Observatory data set. Solar Observatory Kanzelhöhe provide the digitized sunspot drawings, from which the positions of selected sunspot groups were determined with a special software Sungrabber. Later, the comparisons were extended by including few more data sets like those from Kodaikanal, Debrecen and Kandilli Observatory. At the beginning we made a test – two observers have made the same comparisons. Negligible differences between their results were observed. It shows that the differences between the different observatory measurments are caused by other factors (quality of the solar drawings, conditions in the atmosphere, stability of the telescope mount, accuracy of the tracking, accuracy of positioning the projected solar image, the time needed to draw the image, lens aberrations of the projected image, observer's experience) and not by the human factor, i.e., measurments of the two observers. So, occurrence of systematic differences of the sunspot groups positions and rotation velocities suggests a need for a more detailed analysis of the data accumulutaion procedures. Also, the physical interpretation of the determined solar differential rotation will take into account the proper motions, evolution and other characteristics of sunspot groups. Further, the GPR data set was used for the determination of the solar rotation, meridional motions on the Sun and Reynolds stresses. The results were compared with those obtained by small bright coronal structures measured in SOHO-EIT images and with the angular velocity of subphotospheric levels determined with helioseismological methods.

b) An analysis of the solar cycle variability and a prediction for the 24th solar cycle using different methods

We have analyzed solar cycle variability on the short and long time scales. The short time scale embraces the period after the Maunder minimum with an aim to predict the amplitude and epoch of the next solar activity maximum. The following methods were used:

- Asymmetry of the ascending and descending solar cycle phases
- Correlation of the relative sunspot number in the minimum and maximum activity with a time lag
- Autoregressive Moving Average Model (ARMA)
- Combination of the asymmetry and ARMA methods
- Connection between the starting latitudes and amplitudes of the solar cycles
- Relationship between the number of spotless days during the minima and the amplitude of the subsequent maxima

The results indicate that the next solar maximum will be 30 – 60 % weaker than the previous one. Further, we studied the periodicity of the solar activity cycle on the time scale of about last 10 000 years. The cosmogenic C-14 and Be-10 data were used. It was found that the solar activity cycle is on the edge of the chaotic behaviour.

The Pulication list in Soteria wiki hase been updated.

Staff members from HVAR that contributed to WP2:

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