On the Global Asymmetry of the Solar Electromagnetic Radiation

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Luminosity variations of the Sun in different spectral ranges are associated with a wide variety of solar phenomena: sunspots, active regions, faculae and plages, bright points, granulation and bright network, a nonuniform filamentary distribution of emission excess outside active regions, oscillations and waves. The relative importance of these and other causes depends on the wavelength and the solar activity. Solar cycle variations and near 27-day periodicities due to the solar rotation are well-known in the total irradiance and in the spectral ranges from radio-emissions up to X-rays. The main purpose of this paper is an attempt to broaden our knowledge of the 27-day variations of the quiet Sun radiation and their physical origins.

Solar disc and limb extreme ultraviolet (EUV) luminosity variations in the Fe XII line (195 Å) during many solar rotations in 1996 – 1999 are analysed. A nearly continuous imaging and intensity measurements of the different structures on the Sun were allowed by SOHO/EIT. We used the reduced data set consisting of more than 10^3 images (one half-resolution image, i. e. 512×512 pixels, per day).

We find that the dominant contributions to the longitudinal asymmetry explaining the 27-day variability of the quiet Sun EUV radiation are provided by the numerous brighter network elements globally distributed on the large areas of the disk which are comparable to the whole surface of the Sun, and not by more localized active regions.

Brighter EUV radiation sides of the Sun corespond to "active longitudes" with stronger total irradiance and increased magnetic field of the Sun as a star, which also indicates the global nature of the longitudinal asymmetry. Other types of the global asymmetry are also investigated (north – south and east – west ones are among them).

We conclude that the most common solar activity manifestations (like sunspots and active regions) are only tracers but not drivers of the more global and powerful nonlocal dynamics responsible for the global asymmetry and 27-day variations.