Contribution ID: **236** Type: **Poster**

Unexpected Frequency of Horizontal Oscillations of Magnetic Structures in the Solar Photosphere

Magnetic elements are well-known to cover the entire lower layer of the Sun's atmosphere, the photosphere. These magnetic structures and their associated dynamics can potentially explain long debated questions in solar physics, such as coronal heating and the acceleration of solar wind. The aim of this work is to study the coherent transverse oscillations observed in magnetic concentrations within the lower solar atmosphere with unprecedented statistical accuracy. Exploiting unmatched high-stability and temporal coverage of magnetograms acquired by the Helioseismic and Magnetic Imager (HMI) onboard of NASA's Solar Dynamics Observatory, we investigate the dynamics of small scale elements on the photosphere over the whole operational lifetime of the instruments, currently amounting to more than 10 years. More than 1 million magnetic elements are tracked in HMI magnetograms, at disk center, for an entire solar cycle to investigate the power spectra of their horizontal velocity perturbations. A dominant frequency peak at ≈5 mHz is found in the power spectra of horizontal velocity perturbations. This frequency is not expected at photospheric heights, which is typically dominated by ≈3 mHz oscillations. Since magnetic elements are passively advected by the photospheric plasma, we suggest that the ≈5 mHz dominant frequency may come from the cooperative interaction between different granules that apply forces to the magnetic elements.

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