[포 SS-03] Simulation and Quasi-linear Theory of Magnetospheric Bernstein Mode Instability

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Multiple-harmonic electron cyclotron emissions, often known in the literature as the (n + 1 / 2)fce emissions, are a common occurrence in the magnetosphere. These emissions are often interpreted in terms of the Bernstein mode instability driven by the electron loss cone velocity distribution function. Alternatively, they can be interpreted as quasi-thermal emission of electrostatic fluctuations in magnetized plasmas. The present paper carries out a one-dimensional relativistic electromagnetic particle-in-cell simulation and also employs a reduced quasi-linear kinetic theoretical analysis in order to compare against the simulation. It is found that the Bernstein mode instability is indeed excited by the loss cone distribution of electrons, but the saturation level of the electrostatic mode is quite low, and that the effects of instability on the electrons is rather minimal. This supports the interpretation of multiple-harmonic emission in the context of the spontaneous emission and reabsorption in quasi-thermal magnetized plasma in the magnetosphere.

[포 SS-04] Statistical Properties of Spiral Wave Patterns Observed in Sunspots.

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Recent observational works have reported spiral wave patterns (SWPs) in sunspots, but there is a lack of samples to derive the physical properties. In this presentation, we suggest the automatic method to detect the SWPs in observational data and present their statistical properties. From our method, we find more than 1000 SWPs observed by the Atmospheric Imaging Assembly onboard in the Solar Dynamic Observatory from 2013 to 2018. From our samples, more than half of the SWPs has the one spiral arm. The predominant oscillation period is 2 to 3 minutes. The rotating direction of the spiral arms does not depend on the latitude and the polarity of the sunspots. Our statistical results support the physical model suggested by Kang et al. (2019) that explain the generation of SWPs as the depth of the wave driving source and azimuthal modes in the straight vertical magnetic flux tube.

[포 SS-05] 3-Component Velocity of Magnetized plasma at Solar Photosphere

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We present a method to estimate 3-component plasma velocity (Vx, Vy and Vz) at solar photosphere near solar disk center, using the Helioseismic and Magnetic Imager (HMI) onboard the Solar Dynamics Observatory (SDO) called Space-weather HMI Active Region Patch (SHARP). In Heliocentric-Cartesian Coordinates, the component of Vz is obtained from Dopplergram while the components of Vx and Vy are derived from the relation of $B_Z \vec{u} = B_Z \vec{v_t} - v_Z \vec{B_t}$ (Demoulin & Berger 2003) using a series of vector magnetograms by an optical flow technique NAVE (Nonlinear Affine Velocity Estimator). This velocity measurement method is applied to AR 12158 producing an X1.6 flare along with a coronal mass ejection. We find noticeable upflow motions at both ends of flux ropes which become a major eruption part, and strong transverse motions nearby them before the eruption. We will discuss the change of plasma motions and magnetic fields before and after the eruption.

[포 SS-06] Application of Image Super-Resolution to SDO/HMI magnetograms using Deep Learning

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Image super-resolution (SR) is a technique that enhances the resolution of a low resolution image. In this study, we use three SR models (RCAN, ProSRGAN and Bicubic) for enhancing solar SDO/HMI magnetograms using deep learning. Each model generates a high resolution HMI image from a low resolution HMI image (4 by 4 binning). The pixel resolution of HMI is about 0.504 arcsec. Deep learning networks try to find the hidden equation between low resolution image and high resolution