through the process of structuring a coronal electric current in a twisted flux tube emerging to form a coronal magnetic structure. Interestingly, when a strongly twisted flux tube emerges, there spontaneously forms a structure inside the flux tube, where a coronal electric current changes flow pattern from field-aligned dominant to cross-field dominant. We demonstrate that this structure plays a key role in releasing free magnetic energy via rapid dissipation of a coronal electric current, thereby producing a flare.

[구 SS-03] Formation of a large-scale quasi-circular flare ribbon enclosing three-ribbon through two-step eruptive flares

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The formation process and the dynamical properties of a large-scale quasi-circular flare ribbon were investigated using the SDO AIA and HMI data along with data from RHESSI and SOT. Within one hour time interval, two subsequent M-class flares were detected from the NOAA 12371 that had a βγδ configuration with one bipolar sunspot group in the east and one unipolar spot in the west embedded in a decayed magnetic field. Earlier M2.0 flare was associated with a coronal loop eruption, and a two-ribbon structure formed within the bipolar sunspot group. On the other hand, the later M2.6 flare was associated with a halo CME, and a quasi-circular ribbon developed encircling the full active region. The observed quasi-circular ribbon was strikingly large in size spanning 650” in north-south and 500” in east-west direction. It showed the well-known sequential brightening in the clockwise direction during the decay phase of the M2.6 flare at the estimated speed of 160.7 km s-1. The quasi-circular ribbon also showed the radial expansion, especially in the southern part. Interestingly, at the time of the later M2.6 flare, the third flare ribbon parallel to the early two-ribbon structure also developed near the unipolar sunspot, then showed a typical separation in pair with the eastern most ribbon of the early two ribbons. The potential field reconstruction based on the PFSS model showed a fan shaped magnetic configuration including fan-like field lines stemming from the unipolar spot and fanning out toward the background decayed field. This large-scale fan-like field overarched full active region, and the footpoints of fan-like field lines were co-spatial with the observed quasi-circular ribbon. From the NLFF magnetic field reconstruction, we confirmed the existence of a twisted flux rope structure in the bipolar spot group before the first M2.0 flare. Hard X-ray emission signatures were detected at the site of twisted flux rope during the pre-flare phase of the M2.0 flare. Based on the analysis of both two-ribbon structure and quasi-circular ribbon, we suggest that a tether-cutting reconnection between sheared arcade overarching the twisted flux rope embedded in a fan-like magnetic field may have triggered the first M2.0 flare, then secondary M2.6 flare was introduced by the fan-spine reconnection because of the interaction between the expanding field and the nearby quasi-null and formed the observed large-scale quasi-circular flare ribbon.

[구 SS-04] Electrostatic upper-hybrid waves and energetic electrons in the Earth's radiation belt

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Electrostatic fluctuations near upper-hybrid frequency, which are sometimes accompanied by multiple-harmonic electron cyclotron frequency bands above and below the upper-hybrid frequency, are common occurrences in the Earth's radiation belt, as revealed through the twin Van Allen Probe spacecraft. In the literature upper-hybrid emissions are used for estimating the background electron density, which in turn can be used to determine the plasmapause locations, but the role of energetic electrons in generating such fluctuations has not been discussed. The present paper carries out detailed analyses of data from the Waves instrument, which is part of the Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS) suite onboard the Van Allen Probes. Combined with theoretical calculation, it is demonstrated that the peak intensity associated with the upper-hybrid fluctuations is

predominantly determined by tenuous but energetic electrons, and that denser and less energetic background electrons do not contribute much to the peak intensity. This finding shows that upper-hybrid fluctuations detected during quiet time are useful not only for the determination of the electron density, but also they contain information on the ambient energetic electron population as well.

항성

[구 ST-01] The Formation Timescale of the Young Open Cluster NGC 2264: Implication on the Lithium Abundance Distribution of Pre-Main Sequence Stars

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The duration of star formation activity is a key to understanding the formation process of star clusters. Although a number of astronomers have attempted to derive the underlying age spread in photometric diagrams with a variety of stellar evolutionary models, the resultant findings are subject to uncertainties due to intrinsic variability of pre-main sequence (PMS) stars, observational errors, difficulties in reddening correction, and systematic differences in adopted stellar evolutionary models. The distribution of Li abundance for PMS stars in a cluster could, on the other hand, provide an alternative way to estimate the age spread. In this study, a total of 134 PMS stars in NGC 2264 are observed with the high resolution multi-object spectragh Hectochelle attached to the 6.5m Multi Mirror Telescope. We have successfully detected Li λ6708 resonance doublet for 86 low-mass PMS stars. The Li abundance of the stars is derived from their equivalent width using a curves of growth method. After correction for non-LTE effects, the underlying age spread of 3 — 4 Myr is inferred from the Li abundance distribution of low-mass PMS stars. We suggest that NGC 2264 formed on a timescale shorter than 5 Myr given the presence of embedded populations.

[구 ST-02] New Photometric System for CN and CH

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During the last decade, there has been a dramtic paradigm shift on the definition of the globular cluster (GC) systems. The decades-long lighter elemental variation issue in GC stars is now considered to be a generic feature of normal GCs in our Galaxy, most likely engraved during the multiple-phase normal GC formation. In this talk, we will introduce the new photometric system, so-call the JWL System, to measure CN and CH abundances in multiple stellar populations in GCs. The utility and the future application of the JWL System will be discussed.

[구 ST-03] IGRINS Spectral Library

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We present a library of high-resolution (R~45,000) and high signal-to-noise ratio (S/N $\geq$ 200) near-infrared spectra of 147 standard stars. High quality spectra were obtained with Immersion GRating INfrared Spectrograph (IGRINS) covering the full range of H (1.496-1.795 μm) and K (2.080-2.460 μm) bands. The targets are mainly selected as MK standard stars which have well-defined spectral types and luminosity classes, and cover a wide range of effective temperatures and surface gravities. The spectra were corrected for telluric absorption lines and absolute flux calibrated using Two Micron All Sky Survey (2MASS) photometry. We find new spectral indices in H and K bands and provide their EWs. We describe empirical relations between the measured EWs and stellar atmosphere parameters such as effective temperature and surface gravity.

[구 ST-04] Low-Resolution Spectroscopy for the Intriguing Globular Cluster NGC 2808 : Chemical abundance patterns among