Statistical and observational research of solar flare for constructing total emission spectra prediction model

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Impulsive energy release phenomena such as solar flares, sometimes affect to the solar-terrestrial environment. Usually, we use soft X-ray flux (GOES class) as the index of flare scale. However, the magnitude of effect to the solar-terrestrial environment is not proportional to this scale. Therefore, it is considered that the GOES class is not optimal parameter for predicting the Sudden Ionospheric Disturbance (SID). To identify the relationship between solar flare phenomena and influence to the solar-terrestrial environment, we need to understand the full spectra of solar flares in detail.
There is the solar flare irradiance model named the Flare Irradiance Spectral Model (FISM) (Chamberlin et al., 2006, 2007, 2008). FISM is the most used model, and can estimate solar flare spectra with high wavelength and temporal resolution. However, this model can not express the time evolution of emitted plasma during the solar flare, and has low accuracy on short wavelength that might strongly affect to the total flare spectra. Therefore, individual SID phenomenon can not be reproduced.
In this work, in order to solve the problems of FISM, we performed statistical analysis on observational data during the solar flares. From This study, we tried to find the parameters that control the solar flare emission spectra. We selected solar flare events larger than M-class from the Hinode flare catalogue (Watanabe et al., 2012). First, we focused on the EUV emission observed by the SDO/EVE. We examined the intensities and time evolutions of five EUV lines (Fe XX, Fe XVIII, Fe XVI, Fe VIII, and He II) for 54 flare events. As a result, we found positive correlation between the “GOES class” and the “EUV peak flux” for all Fe lines. Moreover, we found that hotter lines peaked earlier than cooler lines. On the other hand, He II line data have poor correlation with GOES X-ray data. Furthermore, we considered that the geometrical features of solar flares effect to those time evolutions. We measured flare ribbon length for 33 flare events observed by SDO/AIA, and found positive correlation between the “flare duration” and the “ribbon length”. From the statistical research of these observational data, we found that the time evolution of EUV emission can be explained by the X-ray emission.
Then, we tried to identify parameters that determine the solar flare spectra by comparing the flare emissions derived from physical based numerical model of solar flare with the actual observational data. Consequently, we used numerical simulation same as Imada et al.(2015). This numerical model can reproduce the movement and ionization of the plasma in the flare loop.
In this presentation, we will show some results of numerical simulation, and discuss the parameters for total solar flare emission spectra by comparing of simulation results, observational data and FISM.

キーワード：宇宙天気、太陽フレア
Keywords: Space Weather, Solar Flare