Increasing Amplitude of the Small-scale Motions of the Filaments as the Precursors of their Eruptions

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Filaments, the dense cooler plasmas in the solar corona, often become unstable and erupt into the interplanetary space as coronal mass ejections (CMEs). The CMEs may cause geomagnetic storms that result in various societal and economical impacts such as huge blackouts[1], so that it is important to predict when filament eruptions will occur. From the space weather point of view, monitoring filaments as the progenitor of CMEs has a following advantage that we can monitor the eruptions from quiet regions that may also cause severe geomagnetic storms. The aim of this study is to investigate the characteristics of eruptive filaments that can be used as the precursor of eruptions.

For this purpose, we analyzed the solar full disk images captured by Solar Dynamics Doppler Imager (SDDI) installed on Solar Magnetic Activity Research Telescope(SMART) at Hida Observatory, Kyoto University[2]. SDDI can obtain solar full disk images in 73 wavelengths between Hα center - 9 Åand Hα center + 9 Åper 0.25 Åwith the time resolution of about 15 seconds. Therefore this instrument can observe unprecedented detailed line-of-sight velocities of filaments. Focusing on this feature, in our previous work[3] we calculated the line-of-sight velocities of the filament observed on 2016 November 5 by utilizing Beckers' cloud model[4] from before the eruption (Figure, Step 1) and tracked the standard deviation of the line-of-sight velocities inside the filament (Figure, Step 2). As a result, we found an increase of the standard deviation, that is, an increase in the amplitude of line-of-sight velocity of the small-scale motions in the filament about 1 hour before the onset of the eruption.

In this work, we newly found 6 events that showed the increase in the standard deviation of the line-of-sight velocities inside filaments before eruption. The features were seen 1.7 hours before their eruptions on average (standard deviation: 0.75 hours). We concluded that this result can support utilizing the increase of small-scale motions in a solar filament as the precursor of a filament eruption.

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