Time of Flight analysis of accelerated electrons in solar flares by using Fermi Gamma-ray Space Telescope

*Masaya Yakura[1], Satoshi Masuda[1]

1. ISEE, Nagoya University

It is known that particle acceleration occurs during a solar flare. However, the detail of this process is not known well. In 1990’s, Aschwanden and his colleagues performed so-called Time-of-Flight (ToF) analysis for many solar flares observed with CGRO and concluded that the electron acceleration site is located slightly above the corresponding soft X-ray flare loop. Although the time evolution of the acceleration site is one of the important information to understand the acceleration process, there are no studies about it. Therefore, we are trying to investigate it during a solar flare based on ToF analysis, using the solar flare data taken by Fermi Gamma-ray Space Telescope.
To derive a time evolution of the acceleration site, we must divide a flare period into proper (more than two) number of time windows. Then ToF analysis should be done for the light curves of multi-energy bands in each time window. For this purpose, it is good to analyze a flare with a larger number of photons (but, not saturated) and a longer duration. In this study, we selected an M7.9 flare on 25 June 2015 among the flares which meet the conditions described above. We used high time-resolution (0.064 s) data taken by GBM on board Fermi for this study. At first, we divide a light curve into high- and low- frequency components. This process is executed for more than two energy bands in hard X-rays. We use the high-frequency component of each energy band for the ToF analysis, considering that these emissions are caused by direct precipitation from the acceleration site (corona) to the footpoint region (solar surface). Comparing with the light curves of high-frequency components in two energy bands, we derive the time-lag between the two light curves through cross-correlation analysis. This time-lag corresponds to the distance between the acceleration site to the footpoint region. Although we have not found any significant variation of the time-lag for a preliminary result, we are investigating the most suitable parameters for this analysis, such as the boundary frequency between high- and low-frequency components and the size of the time window for each ToF analysis.

Keywords: solar flare, particle acceleration

