

The Study of MHD Relaxation Process during Solar flare on the AR1093 0

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Solar flare is widely believed to be the released phenomenon of the magnetic energy in the solar corona. J.B. Taylor had proposed that the minimum energy state under the conservation of the magnetic helicity corresponds to the Liner Force-Free (LFF) field and the potential field or LFF like structure as a relaxation structure after a flare occurring have been often observed as the post flare loops in the solar corona. However, it is not clearly known that the relaxation process from the energy stored state before a flare occurring through after that. First of all in this study, three-dimensional (3D) magnetic configuration before the flare was extrapolated from vector-field obtained by Hinode/SOT. Next, MHD simulation, an initial condition is set by 3D magnetic configuration and the boundary condition imposed on the vector-field after the flare, was performed to investigate the relaxation process during the flare occurring.

As a result, before the flare occurring, the characteristic structure "Sigmoid", an S-shaped sheared structure observed by X-ray telescope, was well reconstructed by our extrapolation method. As a result of investigating the change of magnetic configuration during the relaxation, at first, MHD simulation shows the field line forming the curved part structure expands (or erupts), especially we can clearly find that the first expansion loop is outer field line forming the S-shaped structure of sigmoid and the inner loops also have same behavior as time passes. Then, MHD simulation also shows the part of field line forming spine of sigmoid relaxes to the state of the potential or LFF field like structure, therefore this result suggests the magnetic reconnection is cause of the energy release in this region. Furthermore, because the upward velocity distribution above photosphere have the high value in the region where the forming spine of sigmoid, magnetic structure causing huge flare is suggested by the eruption of the spine of the sigmoid. From these results, the relaxation process during solar flare is suggested that the main process is eruption of the spine of sigmoid due to decrease of magnetic pressure of ambient field corresponding to the curved part structure of the sigmoid.

Keywords: Solar flare, Solar active region, MHD relaxation