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P4.1044 Rotating halo current during disruption phase of vertical displacement event in KSTAR

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Disruption in the TOKAMAK device is generally known as one of the most harmful events. The thermal and current quench and the consequent heat load and magnetic force on the facing components are destructive. These are relatively well conceivable because it is a consequence of the eruption of two kinds of the energies, thermal and magnetic field energies, stored in the device. During the disruption, abrupt change of the magnetic energy associated with the plasma current induces the eddy and halo current on the facing component and structures. The induced current cooperation with the externally applied magnetic field results in magnetic forces on the structure. In addition to the direct magnetic forces by the eddy and the halo current, there is a relatively unknown harm source. During the disruption followed by the vertical displacement event (VDE), several devices reported the toroidally rotating halo current. Even if the magnetic force caused by the halo current itself is not strong enough, the resonant coupling of the rotating and the structural vibration frequency might be destructive. Recently it has emerged as one of an important issue for the ITER safe operation. Even though the projection to ITER is urgent, there is no relevant explanation of the rotation frequency and the direction so far. Through the data analysis of the KSTAR disruption event from 2015 to 2018 campaign, we found ample examples of rotating halo current. With the statistical analysis of the data, we propose a new physics model which elucidating the rotation frequency and the direction of the halo current. The model is assuming that the tokamak plasma can be regarded as a rigid body with the momentum and then the external torque exerted on the plasma results in a precession motion of the plasma. We explain the rotating halo or any other induced current on the structure is a consequence of the precession motion. The KSTAR experiment is analyzed based on this model and compared with the diagnosed data.

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