

Structure of electron-fluid fluctuation in a field-reversed configuration

T. Urano¹ and T. Takahashi¹

¹*Graduate School of Science and Technology, Gunma University, Gunma, 376-8515, Japan*

e-mail: t09306013@gunma-u.ac.jp

The lifetime of field-reversed configuration (FRC) formed by conventional field-reversed theta pinch method is as short as several tens or hundreds of micro-seconds. Thus, improvement of transport properties of FRC is indispensable for being used as a fusion reactor plasma. Therefore, investigation of dominant transport mechanism in FRC plasma by a simulation study is worthwhile to upgrade an FRC experiment.

Because the toroidal plasma current maintaining an FRC plasma is mainly the electron current, we focus here on particle behavior of electrons and employ a full-particle model, where the time variation of electromagnetic field is calculated by Maxwell's equations considering displacement current. The coordinate system is a two-dimensional cylindrical coordinate system assuming axial symmetry. The initial pressure and magnetic distributions are the solution to the Grad-Shafranov equation. In order to reproduce the initial electron flow velocity, we assumed that only the toroidal component is given to be the shifted Maxwellian distribution and the other two components are zero. On the other hand, the initial ion flow velocity is assumed to be zero. Resultantly, the initial electric field depends on the ion pressure gradient. Under the above calculation model, the structure of electromagnetic fluctuation generated by electrons in an FRC is investigated in the present study.

As a result, fluctuations of the electron fluid velocity and electromagnetic field are found and the fluctuation frequency is found to be nearly that of the electron plasma oscillation by the Fourier analysis. Also, since the fluctuation component near the separatrix is larger than that near the field-null region, it is possible to cause cross-field particle transport.