Electron Cyclotron Heating/Diagnostics via Microwave Optical Vortex

S. Kubo[1*], T. I. Tsujimura[2] and M. Nishiura[3]

[1]*Department of Math. & Phys. Sciences, College of Science and Engineering, Chubu University, Kasugai, 478-8501, Japan*

[2]*Kyoto Fusioneering Ltd., Chiyoda-ku, Tokyo, 100-0004, Japan*

[3]*National Institute for Fusion Science, National Institutes of Natural Sciences, Toki, 509-5292, Japan*

Optical Vortex (OV) has been interested in a wide range of wavelength and interaction with various materials in particular in the context of the interaction of the topological charge of photon and material. Magnetized plasma is one of these materials. The dispersion properties and the propagation and absorption of the OV is not well investigated so far. The optical vortex in the vacuum is well expressed by the para-axial approximation of the wave equation as Laguerre-Gauss beam. A theory of quasi-geometrical optics [1] is developed introducing the complex eikonal with an azimuthal mode number (topological charge). This theory predicts a strange property of the propagation, that seems OV-O mode injected from low field side is transformed to the OV-X and might further excite electron OV-Bernstein mode. In order to check this property, high power OV injection systems using spiral mirror plate [2] are installed on LHD and Heliotron-J and preliminary experiment were performed in Heliotron-J. Another experimental plan is to investigate a basic property of the OV propagation in HYPER-I device. In parallel, numerical code to describe OV propagation / scattering absorption in an inhomogeneous magnetized plasma is underdevelopment extending the quasi-optical code. This OV propagation /scattering /absorption might open a new feature to plasma diagnostics such as electron cyclotron emission, (collective) Thomson scattering. The experimental /numerical trials to investigate OV heating/propagation in the magnetized plasma and applications to the heating/diagnostics are discussed.

[1] T. I. Tsujimura and S. Kubo, Physics of Plasmas **28**, 012502 (2021).

[2] T. I. Tsujimura *et al.,* Review of Scientific Instruments **93**, 043507 (2022).

[*]Presenting author: kuboshin@isc.chubu.ac.jp