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Overview of recent progress on the QUEST experiments

QUEST is a middle sized spherical tokamak in Japan and has been promoting on non-inductive plasma start-up using electron cyclotron heating (ECH) [1, 2], transient coaxial helicity injection (CHI) [3] and long duration operation of tokamak plasma using a hot wall [4]. A bifurcation of electron energy of dominantly driving plasma current was observed and the bifurcation was triggered by the reduction of fuel neutral in the fully non-inductive plasma current start-up without fundamental EC resonance. The plasma current of more than 90 kA and the density up to 5 x 1018 m-3 could be obtained with proper polarization, focusing and injection angle of RF. The EC launch from high field side (HFS) is promoting [5] and higher density than plasma cut-off could be obtained in only HFS launch. The effective mode-conversion to electron Bernstein wave (EBW) being free from density limit is expected, indicating leak RF power monitoring. More than 40kA of toroidal current was generated by transient CHI and plasma development could be predicted by a model in force-free basis [6]. Progress on fuel particle balance in the long duration discharges can be explained by a combination between hydrogen barrier model and rate equation of hydrogen (H) state [7]. The model is required to secure several parameters such as H flux to the plasma facing material (PFM) flux and recombination rate on the surface of the PFM. The technique to measure them is newly developed and has been applied in the model calculation [8]. The water cooling of the hot wall was firstly operated and was working well to modify the wall temperature and H recycling, although significant unexpected outgas of argon and nitrogen took place.

References
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