Contribution ID: **597** Type: **Poster**

TH/P4-12: New Bootstrap Current Formula Valid for Edge Pedestal, and Gyrokinetic Study of its Implication to Pedestal Stability

Wednesday, October 10, 2012 2:00 PM (4h 45m)

Previous formulas on the plasma bootstrap current have been developed for the core plasma. However, the edge plasma has an unconventional and difficult neoclassical property compared to the core plasma. There have been prevailing suspicions that the existing bootstrap current formula may not be accurate enough for pedestal physics study. Kinetic simulation based upon first-principles equations in realistic diverted geometry is needed for a more proper study of the bootstrap current in the edge pedestal. A drift-kinetic neoclassical particle code XGC0, equipped with both a mass-momentum-energy conserving linear operator and a fully-nonlinear collision operator, has been used to study the edge bootstrap current profile in realistic diverted magnetic field geometry under self-consistent radial electric field development. XGC0 is a neoclassical version of the edge gyrokinetic code XGC1 [1].
It is found that when the edge electrons are deep in the weakly collisional banana regime, surprisingly, XGC0 kinetic simulation confirms that the existing analytic expressions, represented by [2], are still valid in this unconventional radial region. However, when the pedestal electrons are in plateau-collisional regime, significant deviation of the numerical results from the existing analytic formulas is observed. In a conventional aspect ratio tokamak with R_0/a ≈ 3 (DIII-D, etc), edge bootstrap current from kinetic simulation is less than that from existing analytic formula. When the aspect ratio is tight R/a < 1.5 (NSTX, etc), numerically obtained edge bootstrap current is greater than the analytic expressions.
A new analytic fitting formula, as a simple modification to the existing Sauter formula, has been developed which brings the analytic expression to a better agreement with the kinetic simulation result in the pedestal. The new formula will give a stronger foundation for the pedestal physics research. As an urgent application of the new formula, effect of the modified edge bootstrap current on the pedestal stability will also be reported using tokamak gyrokinetic codes GEM and XGC1, which will significantly augment the existing MHD studies of pedestal stability.
[1] C. S. Chang, S. Ku, P. H. Diamond, et al, Phys. Plasmas 16, 056108 (2009)
[2] O. Sauter et al, Phys. Plasmas 6, 2834(1999)

Country or International Organization of Primary Author

Republic of Korea

Primary author: Mr CHANG, Choong Seock (Republic of Korea)

Co-authors: Dr KU, S.H. (Princeton Plasma Physics Laboratory); Prof. PARKER, Scott (University of Colorado); Mr KOH, Sehoon (Korea Advanced Institute of Science and Technology); Dr WAN, W. (University of Colorado); Prof. CHOE, Wonho (Korea Advanced Institute of Science and Technology); Dr CHEN, Yang (University of Colorado)

Presenter: Mr CHANG, Choong Seock (Republic of Korea)

Session Classification: Poster: P4

Track Classification: THC - Magnetic Confinement Theory and Modelling: Confinement