Contribution ID: **50** Type: **poster**

Refinement of Edge Plasma Density Measurement Using Bayesian Inference, Gaussian Process Methods, and CR Model Utilizing Hydrogen Atomic Data in the KSTAR BES System

Tuesday, 16 July 2024 16:10 (1h 30m)

In this study, we present an approach for the precise determination of edge plasma density profiles in the KSTAR tokamak, leveraging Bayesian inference and Gaussian process regression techniques in conjunction with atomic data. The methodology relies on a collisional radiative model that captures the interactions between neutral deuterium beam atoms and plasma constituents. This model, built upon atomic cross-sections and rate coefficients, enables the representation of D-alpha line intensities as functions of plasma density. The hydrogen beam emission spectroscopy (H-BES) diagnostic, with its 16 radial and 4 poloidal channels offering ˜1 cm spatial resolution, provides high-resolution measurements of Doppler-shifted D-alpha emissions. The incorporation of poloidal measurement channels and the assimilation of equilibrium data significantly enhance the precision of radial density profile estimations. Gaussian process priors are employed to model the density profiles, and the posterior distribution is investigated using Markov Chain Monte Carlo (MCMC) methods. The integration of H-BES measurements with data from two-color interferometry and Thomson scattering enables the simultaneous estimation of edge plasma density profiles and the calculation of an absolute calibration factor. The successful application of Bayesian inference and Gaussian process density profile prior, coupled with the utilization of atomic data in the collisional radiative model, represents a significant advancement in plasma diagnostic capabilities. This development enables more accurate and reliable edge plasma density profile estimations, which are crucial for understanding edge plasma physics in KSTAR tokamak.

Primary author: KIM, Jaewook (Korea Institute of Fusion Energy (KFE))

Co-authors: Dr NAM, Y.U. (Korea Institute of Fusion Energy (KFE)); Dr KWAK, Sehyun (IPP Greifswald - Max-Planck-Institut für Plasmaphysik); Mr AHN, Bin (korea Advanced Institute of Science and Technology); Prof. GHIM, Y.-c. (korea Advanced Institute of Science and Technology); Dr KIM, Jayhyun (Korea Institute of Fusion Energy (KFE)); Dr LEE, Y.H. (Korea Institute of Fusion Energy (KFE)); Dr JUHN, J.W. (Korea Institute of Fusion Energy (KFE)); LEE, Jongha (Korea Institute of Fusion Energy (KFE))

Presenter: KIM, Jaewook (Korea Institute of Fusion Energy (KFE))

Session Classification: Poster session