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Accurate calculation of the 1st,2nd and 3rd derivatives of the poloidal flux in KSTAR

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Accurately determining higher order derivatives in a consistent manner can greatly help the further numerical simulations like MHD stability, turbulence and particle dynamics to understand underline physics in detail. Here, a systematic approach for calculating the successive derivatives of the equilibrium poloidal flux is presented, demonstrating its application in KSTAR equilibrium.

In tokamaks, equilibrium is constructed using the magnetic probe with the help of the core profiles given by other diagnostics like MSE. For the case of the KSTAR, equilibrium fit (EFIT) code is used for kinetic construction of the equilibrium flux which uses the structured mesh.[1] On the other hand, to understand detailed physics like MHD, turbulence and particle dynamics for the tokamak, precise equilibrium data is essential for simulations, often requiring unstructured mesh domains. To correctly adopt experimental data (EFIT) to other simulation code, a fixed boundary solver like CHEASE, HELENA codes are adopted.[2] But these equilibrium solvers have definite limitations : attempting to obtain higher order derivatives through direct finite difference or interpolation methods results in a significant loss of convergence accuracy. A new mathematical method for calculation of the derivatives are given and numerical experiments shows that successive derivatives gives almost same rate of the convergence.

References

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