Progress On Implicit Coupling Of Fluid-Plasma And Monte-Carlo-Neutral Models For Edge Plasma Simulation*

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An accurate coupled treatment of fluid-plasma and kinetic-neutrals models of the tokamak edge and scrape-off layer is necessary for the prediction of tokamak plasma performance. We report on investigations of various approaches to the efficient implicit coupling of such models.

While a highly efficient implicitly coupled combination of *fluid* neutrals and plasma models exists within the UEDGE code, a kinetic [e.g. Monte-Carlo (MC)] treatment of the neutrals is necessary in some important regimes. Existing couplings of these with plasma-species models are explicit, often making them very slow computationally due to "stiffness" associated with the strong mutual dependences of the plasma- and neutral-species.

In prior work[a] a combination of functional iteration and relaxation was used to achieve implicitness in the coupling of the UEDGE plasma model and the EIRENE neutrals code. The results of that work were inconclusive with respect to demonstrating a robust speedup of the coupled system.

We further investigate this approach as well as several algorithms in the "Broyden-like class"[b] including variants of "Anderson mixing." In our case the constituent codes are the plasma component of the UEDGE code and the DEGAS 2 MC neutrals code.

We use a Cartesian box geometry and plasma conditions based on previous studies.[c] Additional insight is gained through comparison with and analysis of a simplified model system consisting of two fields diffusing in one dimension with controllable sources and coupling terms.

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