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Stability analysis of implicit and fractional-step algorithms for plasma-neutral coupling[1] SINA TAHERI, URI SHUMLAK, University of Washington, JACOB R KING, Tech-X Corporation — Interactions between plasma and neutral species can largely alter the dynamic behavior of magnetically confined devices and having a tractable plasma-neutral model helps to study these effects. A previous work [Taheri, APS-DPP 2016] incorporated a reacting plasma-neutral model presented by E.T. Meier and U. Shumlak [Meier, PoP 2012] in NIMROD code [Sovinec, JCP 2004] to include electron-impact ionization, reactive recombination and resonant charge exchange. However, the atomic physics terms in this model are highly nonlinear and may cause numerical instabilities in simulations. Two separate algorithms for atomic physics terms, namely implicit Crank-Nicolson and fractional-step with Strang splitting, are used in this research to ensure stability in handling these nonlinear terms. The Strang splitting utilizes a stiff ODE solver to advance the nonlinear source terms. Linearized plasma-neutral system is analyzed with von Neumann's method to show the stability of each algorithm. In addition, the accuracy and stability of the algorithms are compared on a battery of nonlinear test cases.

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