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Impurity Effects on Momentum Transport and Residual Stress

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— Impurities are inevitable during tokamak plasma operation because of strong interaction of plasma and plasma facing component and helium ash as a byproduct of fusion process. They cause problems such as radiation power loss and fusion fuel dilution. On the other hands, they are used to diagnosis plasma parameters (CES, XICS etc) and to suppress edge-localized mode by wall-coating. In this research, we study the impact of impurities on turbulence driven intrinsic rotation (via residual stress) in the context of the quasi-linear theory. A two-fluid formulation for main and impurity ions is employed to study ion temperature gradient modes in sheared slab geometry modified by the presence of impurities. An effective form of the parallel Reynolds stress is derived in the center of mass frame of a coupled main ion-impurity system. Analyses show that the contents and the radial profile of impurities have a strong influence on the residual stress. In particular, an impurity profile aligned with that of main ions is shown to cause a considerable reduction of the residual stress, which may lead to the reduction of turbulence driven intrinsic rotation.

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