TEMPORAL BEHAVIOR OF DETACHED DIVERTOR PLASMAS*

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The temporal behavior of detached divertor plasmas for an ITER geometry is studied using the time-dependent mode of the UEDGE 2-D fluid transport code. The two-fluid Braginskii equations describe the hydrogenic plasma and a reduced Navier-Stokes model describes the neutral gas. Impurities are represented by either fixed-fraction or multi-charge state models. Steady-state solutions are generally found for moderate impurity levels where the divertor plasma has substantial particle and energy flux to the divertor plates, often referred to as the attached or high-recycling mode. These plasmas can exist with no particle throughput for the system. However, as the radiation loss from impurities is increased, the plasma particle and energy fluxes to the plate are drastically reduced. As this detached plasma mode becomes more pronounced, an ionization front moves some distance from the plate and becomes a strong source of hydrogenic ionization and recombination radiation loss.[1] Here it is found that this strongly detached mode occurs in two states: One has a small, but finite, particle-throughput for the system with inflow from the core and outflow near the divertor plate which produces steady-state solutions when balanced. The second state has no particle-throughput and results in periodic temporal oscillations of the plasma changing from weaky attached to strongly detached over the course of the oscillation. A MARFE under the x-point can play an important role in these oscillations which are likely the extension to strongly detached plasmas including impurities of oscillatory divertor-plasma solutions described previously.[2] The general behavior described is found for either impurity model, and a quantitative comparison of the results for the two models is given. The effect of gas puffing and pumping at various locations is analyzed as a means of controlling the detached plasma.

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[1] A. Kukushkin, H. Pacher, *et al.*, 16^{th}IAEA Fusion Energy Conference, Montreal, Canada, 7-11 Oct., 1996, paper FP-27.

[2] S.I. Krasheninnikov, A.S. Kukushkin, *et al.*, Nucl. Fusion **27**, 1805 (1987).