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Global 3D Braginskii simulations of the tokamak edge region

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A study of L and H mode-like plasma turbulence in the edge of tokamaks is presented, with an emphasis on characterization of these plasmas in numerical simulations with a new Global Drift-Ballooning (GDB) model. This work employs drift-reduced Braginskii two-fluid equations for electromagnetic low-frequency turbulence and solves them in a global large-aspect ratio annulus centered on the last closed flux-surface (LCFS) as an approximation of small to medium-size tokamaks. The simulations include plasma sources at the inner edge of the pedestal region as well as a limiter region in the Scrape-Off-Layer (SOL) and evolves self-consistently the density, temperature, and ExB shear profiles on the transport time-scale. GDB is able to generate both L and H mode-like plasmas with realistic parameters. L-mode transport appears to be largely driven by resistive-ballooning structures, in the presence of a balance between ExB and the ion-diamagnetic drifts. Pressure profiles also appear to exhibit a near-SOL breakpoint that Mirror Langmuir Probes (MLP) detect in C-Mod, postulated to separate Drift Wave (DW) like and RB-like fluctuations. Separate simulations carried out with H-mode parameters develop improved confinement, E_r wells at the LCFS and spontaneous generation of temperature pedestals with density pedestals remaining absent up to times in the order of 0.2 ms. Candidate first-principles explanations to the modification of the electric field profile are discussed.

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