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Blob motion and control in simple magnetized plasmas[1]

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Intermittent convective transport caused by coherent structures, or blobs, are universally observed in the edge of laboratory plasmas. Besides being of fundamental physics interest, the dynamics of these structures in fusion reactors influence the density scale-length in the scrape-off layer, its impurity screening characteristics, wall-recycling and possibly the overall confinement properties. In TORPEX simple magnetized plasmas, blobs are generated from interchange turbulence and, driven by gradB and curvature-induced charge separation, propagate radially outwards. The magnitude of their velocity depends on the current paths to damp charge separation. Regimes dominated by either parallel or cross-field currents are achieved by varying the ion mass. An analytical expression for the blob velocity including cross-field ion polarization currents, cross-field ion currents due to neutral friction and parallel currents to the sheath is derived and shows good quantitative agreement with the experimental data. To confirm this interpretation, direct measurements of the 2D structure of the blob-induced parallel currents have been obtained using magnetic probes. Parallel blob dynamics are further studied with a Mach probe, revealing the convection of parallel momentum by blobs. Methods to influence and control blob motion are also being explored, such as the variation of the connection length or the use of poloidal arrays of biased electrodes. This study is part of a more general project of code validation on TORPEX. Methodology and results of a comparison of 2D and global 3D fluid simulations with experiments will be presented. (Co-authors: A. Fasoli, I. Furno, D. Iraji, B. Labit, P. Ricci, M. Spolaore (RFX-Padua), N. Vianello (RFX-Padua))

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