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Experimental investigation of blob physics in the TORPEX toroidal plasma

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Extensive experimental data from tokamaks, stellarators, reversed field pinches and basic linear devices reveal that particle and energy transport in the Scrape-Off-Layer is mostly non-diffusive and associated with the intermittent propagation of blobs. These are poloidally-localized regions extending along the field lines where the plasma pressure is enhanced compared to the surrounding plasma. Significant advances in understanding the mechanism for blob generation and the associated turbulent transport are achieved in the TORPEX toroidal device (R=1m, a=0.2m) using an experimental setup in which blobs are produced and diagnosed under controlled laboratory conditions. Full spatio-temporal imaging of blobs and associated energy and particle transport are obtained using conditional sampling of data from movable electrostatic probes with high spatial and temporal resolution. For the first time, the mechanism for plasma blob generation is experimentally identified on the basis of two-dimensional profiles of electron density and temperature, plasma potential and velocity fields. We show that blobs form from a radially elongated structure that is sheared off by the ExB flow. The structure originates from an interchange wave that increases in amplitude and extends radially in response to a decrease of the local radial pressure scale length. The dependence of the blob size upon the radial density gradient is also discussed. Two mechanisms for the transport across the magnetic field can be clearly quantified: the flux driven by the fluctuating density and potential associated with interchange modes, and the radially propagating blobs. Preliminary simulations of blob generation using a non-linear two-fluid numerical code are also presented.