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Edge-core interaction via vorticity filaments emerging from ion inertial dynamics in tokamak plasma

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The regime of the tokamak plasma that is relevant for the achievement of thermonuclear fusion strongy exhibits interplay between turbulence and structures. The complexity of the relation between edge and the core regions is underlined by the turbulence inward spreading from the region near the Last Closed Magnetic Surface. It has been observed that structures consisting of pairs of blobs and voids (in density) arise at relaxation of gradients, with the voids propagating toward the core and being absorbed after emission of Cherenkov-like (drift waves) radiation. The generation and the displacement of the two perturbations (blobs and voids) is not fully understood but it is considered as related to the vectorial nonlinearity, i.e. a regime described by Hasegawa-Wakatani equation.
We propose a model in which the random plumes (as in Rayleigh Benard convection) are the source of the formation of the Larichev-Reznik dipolar solution of the Hasegawa-Mima equation, which is known as resulting from the ion inertial dynamics. Either including the density (i.e. Hasegawa Wakatani eq.) or using Ertel's theorem, we connect the vorticity with the density perturbations (blob-void). Next we discuss the separation into monopolar vortices that move in opposite direction on the background of the gradient of vorticity (sheared velocity). The processes that are involved are: clusterization of like-sign vorticity and tendency to self-organization of the vorticity field. The turbulence-induced dissipation of the vorticity can sustain plasma rotation, in particular Zonal Flow

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