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Non-diffusive asymmetric transport of energetic particles in fusion plasmas DIEGO DEL-CASTILLO-NEGRETE, Oak Ridge National Laboratory, DAVID ZARZOSO, Aix-Marseille Universite — Energetic particles (EP), i.e. particles with velocities much larger than the thermal speed, are ubiquitous in laboratory and astrophysical plasmas. In laboratory plasmas, the confinement of energetic alpha particles is critical for sustained controlled nuclear fusion. Here we present a study of EP transport in an oscillating radial electric field modeling energetic geodesic acoustic modes. Integration of the guiding-center equations reveals chaotic regions leading to particle losses consistent with those measured in experiments. The nature of the transport is analyzed in detail by focusing on the stochastic separatrix between passing and magnetically trapped orbits. We perform a statistical study of EP injected in the central region of the tokamak and show the existence of super-diffusive (i.e., faster than diffusion) asymmetric transport from the inner (counter-passing) to the outer (co-passing) regions. The particles' exit-time has a fractal dependence on the initial parallel velocity and magnetic moment, and the probability distribution function of displacement exhibits self-similar evolution with anomalous scaling and algebraic decay characteristic of non-Gaussian (Levy) statistics. The physics implications of the observed transport asymmetry are discussed.

Diego Del-Castillo
Oak Ridge National Laboratory

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