Abstract Submitted
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From Weibel instability to fluctuation dynamo in collisionless plasma simulations[1] MUNI ZHOU, Massachusetts Institute of Technology , VLADIMIR ZHDANKIN, MATTHEW KUNZ, Princeton University, NUNO LOUREIRO, Massachusetts Institute of Technology, DMITRI UZDENSKY, University of Colorado, Boulder — The amplification of seed magnetic fields by the turbulent dynamo is believed to be essential in forming large-scale cosmic magnetic fields with dynamical strengths. However, how these seed fields are generated and how the turbulent dynamo operates in the weakly collisional intergalactic/intracluster medium remains a mystery. We employ first-principles 3D particle-in-cell simulations of driven non-helical turbulence to study the generation and amplification of magnetic fields in an initially unmagnetized collisionless plasma. For computational feasibility and physical clarity, we consider a relativistically hot pair plasma. Pressure anisotropy develops due to the local shear flows caused by the forcing and triggers the Weibel instability, which generates the kinetic microscale seed magnetic fields with a filamentary morphology. During the subsequent nonlinear Weibel stage, the coherence length of the magnetic field grows via the coalescence of filaments until the turbulent dynamo develops and starts governing the magnetic field evolution. The turbulent dynamo saturates when the bulk kinetic and magnetic energies come into equipartition. This work demonstrates self-consistently the operation of dynamo in collisionless plasma and informs our understanding of cosmic magnetogenesis.

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