A generalized model for small scale dynamo at finite correlation times

KANDASWAMY SUBRAMANIAN, IUCAA, India, PALLAVI BHAT, PPPL, Princeton, US — Fluctuation (or small scale) dynamos are generic in astrophysical plasmas. The Kazantsev model of the fluctuation dynamo assumes a delta-correlated in time velocity field, which is unrealistic. Using renewing flows with finite time correlation, \( \tau \), we derive a generalized model of the fluctuation dynamo. We recover the standard Kazantsev equation for the evolution of longitudinal magnetic correlation, \( M_L \), for \( \tau \to 0 \). The generalized equation involves third and fourth spatial derivatives of \( M_L \) indicating nonlocality. We solve the equation in the large \( k \) limit and by using Landau-Lifschitz approach, we recast the equation to one which involves at most second derivatives of \( M_L \). Remarkably, we then find that the magnetic power spectrum, remains the Kazantsev spectrum of \( M(k) \propto k^{3/2} \), in the large \( k \) limit, independent of \( \tau \).