TIFR Centre for Interdisciplinary Sciences
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Seminar

Fluctuation dynamos: theory, simulations and observational consequences

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Turbulent astrophysical systems like galaxies and galaxy clusters generically host fluctuation dynamos, which even for modest magnetic Reynolds numbers, can act to convert kinetic energy into magnetic energy on the short eddy turn over time-scales. We generalize the only analytical model given by Kazantsev (in 1968) which assumed a delta- correlated in time velocity field to include effects of a finite correlation time, τ. We show, an intriguing result, that to the leading order in τ, the magnetic power spectrum, preserves the Kazantsev form, $M(k) \propto k^{3/2}$. An important issue for astrophysical applications is whether the magnetic Fields can become more coherent when the fluctuation dynamo saturates. We have studied this issue by direct numerical simulations of the fluctuation dynamo in periodic boxes with a resolution up to 1024^3. We show that when the dynamo saturates, the rms value of Faraday rotation measure (RM), a direct observable in galaxy clusters, is of the order of 40-50 per cent of the optimum value expected in such a random and intermittent field. Thus magnetic fields from fluctuation dynamos are sufficiently coherent to explain the observed RM in cluster plasma.

Thursday, Jan 29th 2015

11:30 AM (Tea/Coffee at 11:15 AM)

Seminar Hall, TCIS