Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Generation of coherent magnetic fields in periodic (closed) and non-periodic (open) domains[1] PALLAVI BHAT, STEVEN TOBIAS, University of Leeds, FAUSTO CATTANEO, University of Chicago, GIANLUIGI BODO, INAF Osservatorio Astronomico di Torino — The origin of large-scale magnetic fields in most astrophysical systems like the Sun, stars and galaxies remains a challenging open problem. Dynamo action in the underlying turbulent fluid is thought to be responsible for the emergence of coherent magnetic fields. Due to the enormity of magnetic Reynolds numbers in these astrophysical systems, current theoretical models of the turbulent dynamo struggle to generate large-scale field on fast dynamic timescales. The conservation properties of magnetic helicity can constrain the nonlinear evolution of the dynamo. We have performed direct numerical simulations of the turbulent dynamo to investigate if employing open boundaries relaxes the constraint imposed by magnetic helicity conservation. We find that in the open systems a net magnetic flux (or system-scale fields) of significant strength arises. However, the type of open boundary we employ does not alleviate the magnetic Reynolds number (in the range explored) dependence in the nonlinear evolution of the large-scale fields. Finally, simulations performed across different magnetic Prandtl numbers indicate that the behavior of the magnetic helicity evolution is affected by flow properties as well.

[1]European Research Council

Pallavi Bhat
University of Leeds

Date submitted: 31 Jul 2020 Electronic form version 1.4