

# **Origins of cosmic magnetism**

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The universe is magnetised from stars to the large-scale coherent magnetic fields detected in galaxies and galaxy clusters, and even perhaps the intergalactic medium in voids. The standard picture for the origin of fields in all astrophysical systems involves turbulent dynamo amplification of a weak seed magnetic field. In such dynamos the kinetic energy of motions get converted to magnetic energy. We review the basic idea behind such dynamos and the main challenges they encounter. While it is relatively easy for magnetic energy to grow, explaining the observed degree of coherence of cosmic magnetic fields generated by turbulent dynamos, remains challenging. We outline potential resolution of these challenges, and a new paradigm for rapid unified growth of both large and small scale fields in galaxies. We end with a possible model of inflationary magnetogenesis which addresses several difficulties of such scenarios, and could explain the magnetic field in voids providing also a seed magnetic field for the dynamo.