Origin of Galactic and Extragalactic Magnetic Fields Lawrence M. Widrow Department of Physics, Queen’s University, Kingston, Ontario, Canada K7L 3N6

abstract

A variety of observations suggest that magnetic fields are present in all galaxies and galaxy clusters. These fields are characterized by a modest strength ($10^{-7} - 10^{-5}$ G) and huge spatial scale ($\lesssim 1$ Mpc). It is generally assumed that magnetic fields in spiral galaxies arise from the combined action of differential rotation and helical turbulence, a process known as the -dynamo. However fundamental questions concerning the nature of the dynamo as well as the origin of the seed fields necessary to prime it remain unclear. Moreover, the standard -dynamo does not explain the existence of magnetic fields in elliptical galaxies and clusters. The author summarizes what is known observationally about magnetic fields in galaxies, clusters, superclusters, and beyond. He then reviews the standard dynamo paradigm, the challenges that have been leveled against it, and several alternative scenarios. He concludes with a discussion of astrophysical and early Universe candidates for seed fields.
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