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Large scale dynamo action precedes turbulence in shearing box simulations of the magnetorotational instability[1] PALLAVI BHAT, FATIMA EBRAHIMI, Princeton Plasma Physics Laboratory, ERIC G. BLACKMAN, University of Rochester — We study dynamo generation (exponential growth) of large scale (planar averaged) fields in the in shearing box simulations of magnetorotational instability (MRI). By computing space-time planar averaged fields and power spectra, we find large scale dynamo action in early MRI growth phase, a previously unidentified feature. Non-axisymmetric linear MRI modes with low horizontal wavenumbers and vertical wavenumbers near that of expected maximal growth, amplify the large scale fields exponentially before turbulence and high wavenumber fluctuations arise. Thus the large scale dynamo requires only linear fluctuations but not nonlinear turbulence (or mode-mode coupling). In contrast to previous studies restricted to horizontal (x-y) averaging, we also show the presence of large scale fields when vertical (y-z) averaging is employed instead. We compute the terms in the mean field equations to identify the contributions to large scale field growth in both types of averaging. The large scale fields obtained from vertical averaging are found to match well with global simulations and quasilinear analytical analysis from a previous study by Ebrahimi & Blackman. We discuss implications of our new results for understanding large scale MRI dynamo saturation and turbulence.

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