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The role of current helicity in driving solar dynamo

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In the traditional picture of alpha-omega dynamo, the alpha effect is regarded as responsible for producing the large-scale poloidal magnetic field and the alpha coefficient is estimated from the calculation of flow helicity. However, according to Pouquet et al. (1976), in a strong MHD helical turbulence the alpha coefficient in a nonlinear dynamo is determined by the difference between a purely kinetic and a purely magnetic helical term. Here we present a series of numerical simulations of convective dynamos with varying grid resolution, with or without explicit magnetic diffusivity and viscosity. We show that with the increase of Reynolds number, current helicity plays a more and more important role and the competition between the kinetic helicity and current helicity leads to an interesting dynamo behavior of the large-scale mean magnetic field that resembles the 'dynamo-disappear-and-recover' phenomena reported by Hotta et al. (2016).

References:

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