Angular Momentum in Terms of Toroidal and Poloidal Stream Functions

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1 Prior Work Considered

In this set of notes, we consider 3D nonlinear dynamo simulations that explored magnetic-field amplitudes at a variety of rotation rates (enough to make a scatter plot and thus theoretically address the activity-rotation relation). We aim to determine what region of parameter space has been explored by global models, and in particular, how the rotation-activity relation may have been addressed. The works considered are:

Christensen & Aubert (2006),

Christensen et al. (2009),

Strugarek et al. (2017),

Guerrero et al. (2019),

Brun et al. (2022),

References

Brun, A. S., Strugarek, A., Noraz, Q., Perri, B., Varela, J., Augustson, K., Charbonneau, P., & Toomre, J. 2022, "Powering stellar magnetism: Energy transfers in cyclic dynamos of Sun-like stars", Astrophys. J., 926, 21, doi: 10.3847/1538-4357/ac469b

Christensen, U. R., & Aubert, J. 2006, "Scaling properties of convection-driven dynamos in rotating spherical shells and application to planetary magnetic fields", Geophysical Journal International, 166, 97, doi: 10.1111/j.1365-246x.2006.03009.x

Christensen, U. R., Holzwarth, V., & Reiners, A. 2009, "Energy flux determines magnetic field strength of planets and stars", Nat., 457, 167, doi: 10.1038/nature07626

Guerrero, G., Zaire, B., Smolarkiewicz, P. K., de Gouveia Dal Pino, E. M., Kosovichev, A. G., & Mansour, N. N. 2019, "What sets the magnetic field strength and cycle period in solar-type stars?", Astrophys. J., 880, 6, doi: 10.3847/1538-4357/ab224a

Strugarek, A., Beaudoin, P., Charbonneau, P., Brun, A. S., & do Nascimento, J.-D. 2017, "Reconciling solar and stellar magnetic cycles with nonlinear dynamo simulations", Sci., 357, 185, doi: 10.1126/science.aal3999