Slow magnetic Rossby waves in Earth's core

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Magnetohydrodynamic waves excited in fluid cores of rapidly-rotating terrestrial planets can produce time variations of the magnetic fields. Magnetic Rossby waves riding on a mean zonal flow may account for some of the geomagnetic westward drifts observed at mid-latitudes and have the potential to allow the 'hidden' toroidal field strength within the planetary core to be estimated. The nonaxisymmetric, quasi-geostrophic waves are investigated in spherical dynamo simulations. We find that a predicted dispersion relation matches well with the longitudinal drifts seen in our strong-field dynamos, in which the Coriolis and Lorentz forces predominantly balance in the vorticity equation. The validity of our linear theory is also discussed to yield that the nonlinear Lorentz terms influence the observed waveforms. Finally we report the corresponding radial magnetic field variations observed at the surface of the shell in our simulations where the fields are not too strong, suggesting that the internal core field should be the Elsasser number of O(1) to host detectable magnetic Rossby wave motions.

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