Dynamic regimes in simulations of magnetized spherical Couette flow

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The Derviche Tourneur Sodium Experiment (DTS) is a spherical Couette flow experiment with a liquid sodium medium between inner and outer spheres of copper and stainless steel, respectively. The apparatus has the same aspect ratio as the Earth, and a strong dipole magnetic field imposed from the inner sphere. The operation of the experiment reveals a collection of flow states dependent on the balance of inertial, Coriolis, and magnetic forces (represented by the Elsasser and Rossby numbers). The experimental diagnostics register the change between states, but don't provide a full picture of what these states actually look like inside the sphere. To rectify this the xshells code has been run in a similar range of Rossby (Ro) and Elsasser (Λ) numbers. For $Ro \sim 1$ (where the inner sphere rotates faster than the outer sphere) the mean flow is mostly quasigeostrophic, while counterrotating spheres transition from a regime dominated by an instability centered in the still point between outward and inward flowing jets to an instability occupying the return flow along the outer sphere as the differential rotation increases ($Ro \underset{\sim}{\in} (-2, -1)$). This talk will aim to explain these simulations, in particular the balances between the Coriolis and Lorentz forces (aka magnetostrophic regime), their underlying assumptions, and how their outputs relate to the physical system of the DTS.
