Rapidly Rotating Convection: When Geometry Matters

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  - Rotationally constrained: \( E = \frac{\nu}{\Omega d^2} \ll 1, \ Ro = \frac{U}{\Omega d} \ll 1 \)
  - Highly turbulent: \( Re = \frac{U d}{\nu} \gg 1 \)
  - Unstably stratified
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Earth’s core:

\( Ro \sim 10^{-7}, E \sim 10^{-15}, Re \sim 10^8 \)
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MHD environment, but don’t understand convection yet
Spherical vs. Cartesian

- Traveling Rossby waves
- Scalings:
  \[ k_\phi \sim E^{-1/3} \quad k_R \sim E^{-2/9} \quad k_Z \sim O(1) \]

- Stationary for Pr > 1
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Small scales directly influenced by geometry!
Parameterization?
Small Scale Model for Sphere: The Annulus

- Annulus inscribed within sphere
- Captures “local” convective structures
- Theory/asympototics allows for identification of small-scales
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What to do next?
- Couple to large-scale models
- Prandtl number effects