Successive symmetry-breaking bifurcations for antisymmetric Euler flows

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We investigate the spectral behavior of the 2-D linearized Euler and inviscid quasi-geostrophic equations around a steady antisymmetric flow in a *closed* domain Ω with large aspect ratio. Using results of [1], we are able to demonstrate the existence of positive real eigenvalues and genuine symmetry-breaking bifurcations depending on the spectral behavior of the perturbed Shrödinger operator

$$\mathcal{L}^\epsilon \phi = \Delta_\epsilon \phi - [F + G'(\psi_0)]\phi - G'(\psi_0)\frac{1}{T}\int_0^T \phi(X(s), Y(s))\, ds, \qquad (1)$$

where $\epsilon = L_x/L_y$ is the aspect ratio, $(X(s), Y(s))$ are the characteristic coordinates along the streamlines of the steady solution ψ_0 such that $\Delta_\epsilon \psi_0 - F\psi_0 + h(y) = G(\psi_0)$, and T is the corresponding period. Numerical evidences are also given.

This work is motivated by the results obtained by [2] on dissipative quasi-geostrophic models of the double-gyre circulation, where similar phenomena are observed.

References

[1] Z.Lin, *Some stability and instability criteria for ideal plane flows*, Comm. Math. Phys. **246** (2004), 87–112.

[2] E.Simonnet, *Quantification of the low-frequency variability of the double-gyre circulation*, J. Phys. Oceanogr. **35**, (2005), 2268–2290.