CONCAVE HAMBURGER EQUILIBRIUM OF ROTATING BODIES

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Equilibria of rigidly rotating polytropic gas with small compressibilities are computed in order to investigate the relation between the incompressible and compressible equilibria. The equilibrium figure varies from a spheroid-like shape to a concave hamburger as the angular velocity increases. This result is supported by the fact that a concave hamburger equilibrium is obtained even in the complete incompressible case. Thus the Maclaurin spheroid does not represent the incompressible limit of the rotating polytropic gas because of its restriction of the figure. The computed sequence of equilibria clarifies the relation between the Maclaurin spheroid and the Dyson-Wong toroid. Moreover it is the sequence of minimum-energy configuration. These results suggest that our solutions are more physical and probably stabler than any other equilibrium of incompressible fluids.

DISCUSSION

Roxburgh: If you have a sequence corresponding to increasing angular momentum, do you find a ring of increasing diameter and decreasing angular velocity? Is there not another sequence with a Maclaurin spheroid inside a ring?

Fukushima: The method used here is not applicable to bodies whose central density is exactly zero and/or which have disconnected regions. So a nearly ring structure is obtained for high angular momentum, but the exact ring or Maclaurin-spheroid-inside-a-ring structure is not computed.

Durisen: What are the values of $T/|W|$ at which the hamburger, and then the toroidal figures first appear along one of your sequences and how do they compare with other stability limits and bifurcations?

Fukushima: When the value of $T/|W|$ reaches about 0.48, the concave hamburger structure appears. We have not carried out a stability analysis, but the total energy of the concave hamburger is less than that of spheroids and toroids.

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