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Inertial modes in a rotating tilted cylindrical annulus with free surface

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Rotating fluids frequently show nonlinear wave interactions and turbulence. This is true in particular for non-uniformly rotating systems. One example of such a non-uniform rotating object is the Earth. Due to its fast rotation it is not exactly spherical. As a result of the interaction with the Sun and Moon the non-spherical Earth cannot rotate uniformly but shows precession and libration. This has consequences for the fluid enclosed in the outer Earth core. Due to the forcing it might become turbulent, one of the key factors in the present theories explaining the generation of the geomagnetic field. In the present paper we show experimental results from a system that is simpler than classical precession experiments but for which very similar wave interactions and a collapse to turbulence can be found. This system consists of a rotating annulus that rotates about its symmetry axis slightly tilted with respect to the gravity vector. In contrast to classical precession experiments, the annulus has a free upper surface. Due to the tilt with respect to gravity a spin-over mode is excited even without precession. In analogy to the more classical precession experiments we also find a geostrophic mode and free Kelvin modes that show triadic interactions.