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Scale by scale energy flux in rotating homogeneous turbulence
FABIEN GODEFERD, DONATO VALLEFUOCO, AURORE NASO, Fluid Mechanics and Acoustics Laboratory, CNRS, University of Lyon — Homogeneous rotating turbulence is strongly anisotropic and exhibits vortices elongated along the rotation axis, and reduced downscale energy cascade w.r.t. isotropic turbulence. We characterize its dynamics by the Karman-Howarth-Monin equation for 2nd-order 2-point velocity correlations $R(\mathbf{r}, \mathbf{t})$, where $\mathbf{r}$ is the *vector* separation: $\partial_t R/2 = \nabla \cdot \mathbf{F/4} + \nu \nabla^{\mathbf{2}} \mathbf{R} + \phi_{\mathbf{inj}}$ showing the balance between energy flux $\mathbf{F}$ (3rd-order moment of velocity increment $\mathbf{u}(\mathbf{x}+\mathbf{r}) - \mathbf{u}(\mathbf{x})$), dissipation, and injected energy. From Direct Numerical Simulations of forced rotating turbulence, we get estimates of all terms in the KHM eq. at each scale $\mathbf{r}$. A map of $\mathbf{F}$ components in the axisymmetric frame is obtained, and compared with experimental data (Lamriben et al. 2011) for two components measured in an azimuthal plane. We evaluate the role of the unmeasured azimuthal component of energy flux, at different Rossby numbers. We also explain why experiments and inertial wave turbulence theory by Galtier (2013) predict opposing trends in the dependence of the radial energy flux with the direction of $\mathbf{r}$, by identifying two separate regimes in different scale ranges.

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