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Modulated Turbulence HAKKI ERGUN CEKLI, WILLEM VAN DE WATER, Eindhoven University of Technology — Many turbulent flows are subject to periodic modulation, examples are the pulsatile flow of blood through arteries and geophysical flows driven by periodic tides. When the modulation is slow, the turbulence will adjust adiabatically, but when the modulation period comes close to an internal time scale of the flow, the turbulence may resonate with the driving. The possibility of a resonance is intriguing as one may object that turbulence does not have a single dominant timescale, but a continuum of strongly fluctuating times. In our experiment we periodically modulate a turbulent windtunnel flow with an active grid. An active grid is a regular grid of axes with attached vanes which are rotated by servo motors. By controlling the time-dependent angle of all axes precisely, the grid cycles through a sequence of transparency patterns. Thus we modulate turbulence in space, characterized by these patterns, and time, characterized by the modulation frequency. We consider 3 distinct spatial modes, all share the same transparency sequence. We find a large resonant enhancement of the mean turbulent dissipation rate at a modulation frequency which equals the large-eddy turnover rate. Thus, we find the best frequency to inject energy in a turbulent flow. The resonant enhancement depends on the spatial mode of the grid, but all spatial modes share the same behavior of the response. Modulation only affects the large-scale spatial structure of turbulence, leaving the small-scale motion unaltered.

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