Tilting at wave beams: a new perspective on the St Andrew’s Cross

T R AKYLAS, MIT, T KATAOKA, Kobe University, S J GHAEMSAIDI, N HOLZENBERGER, T PEACOCK, MIT — The generation of internal gravity waves by a vertically oscillating cylinder that is tilted to the horizontal in a stratified fluid of constant buoyancy frequency, is investigated theoretically and experimentally. This forcing arrangement leads to a variant of the classical St Andrew’s Cross that has certain unique features: (i) radiation of wave beams is limited due to a lower cut-off frequency set by the cylinder tilt angle to the horizontal; (ii) the response is essentially three-dimensional, as end effects eventually come into play when the cut-off frequency is approached, however long a cylinder might be. These results follow from kinematic considerations and are also confirmed by laboratory experiments. The kinematic analysis, moreover, suggests a resonance phenomenon near the cut-off frequency, where viscous and nonlinear effects are likely to play an important part. This scenario is examined by an asymptotic model as well as experimentally.

1Supported in part by NSF Grant DMS-1512925