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Selection Rules for Internal Gravity Waves and Inertial Waves
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— Perturbation methods are used to calculate nonlinear interaction of waves, however most analyses skip the question as to whether the 0^{th} order solutions exist. The dispersion relation for internal gravity waves does *not* relate the magnitude of the wave vector and its frequency, rather it relates the frequency and *direction* of the wave vector. Thus, spatially columnated beams of internal waves are made of a continuum of plane waves with different wavelengths, but the same frequency. For two parent beams to create a daughter, the plane waves within the parent and daughter beams must obey the triad condition (the spatial wave vector of the daughter equals the sum of the parents' vectors, and temporal frequency of the daughter equals the sum or difference of the parents' frequencies) and the dispersion relationship. Contrary to what is assumed implicitly, these conditions cannot always be satisfied. If they could, then the interaction of two beams of gravity waves would produce 8 daughter beams, consisting of two St Andrew's crosses (each with 4 beams). The beams in one cross have a frequency equal to the sum of the frequencies of the parents and the beams in the other have a frequency equal to the difference. Most of these daughter beams cannot exist. We derive selection rules for the beams. We extend our analysis to a more generic set of waves.

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