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Wave modulation: the geometry, kinematics, and dynamics of surface-wave packets NICHOLAS PIZZO, W. KENDALL MELVILLE, Scripps Institution of Oceanography, UCSD — We derive moment evolution equations of the modified nonlinear Schrodinger equation (MNLSE) with application to interpreting the geometry, kinematics and dynamics of focusing deep-water wave packets. Our theory predicts modifications to the group velocity and associates wave packet convergence with the breakdown of equipartition between kinetic and potential energy. The evolution of the first moment of the energy density yields a natural way to interpret the concept of group velocity for these compact wave groups, predicting a velocity increase as the packet focuses, and is found to be up to 10% larger than that predicted by linear theory, consistent with laboratory observations. The second moment yields a virial theorem, associating energy convergence with deviations from equipartition. The derivation of these moment equations relies crucially on the variational structure of the spatial version of the MNLSE, and the subsequent derivation of three conservations laws. These predictions are then examined numerically for focusing wave packets governed by both the MNLSE as well as the full potential flow equations, and the results are discussed in the context of existing theoretical, numerical and laboratory studies.

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