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Ocean crest slowdown and geometric phases FRANCESCO FEDELE, Georgia Institute of Technology — Several studies over the past two decades suggest that the initial speed of breaking crests of dominant open ocean wave groups, or breaker speeds, are typically 20% lower than expected from linear wave theory (Rapp & Melville, 1990). A recent multifaceted study in Banner et al. (PRL, 2014) explains the reduced breaker speed by means of the crest slowdown, a new fundamental property of non-breaking ocean waves as they occur naturally, not as uniform wavetrains, but within evolving groups. Before the focusing point, the crest of the largest wave in the group slows down as it advances leaning forward, and it becomes symmetrical as the maximum height is approached. As the wave decays after focus, the crest accelerates as it leans backward. In this talk, I will show that the crest slowdown and the associated forward/backward leaning are generic features of each crest of water wave groups. They are associated with the energy convergence in the neighborhood of the focal region, irrespective of whether the wave evolves to break or not (Fedele, JFM 2014). In particular, I will show that the crest slowdown is induced by the natural dispersion of unsteady wave groups. Drawing from quantum mechanics and differential geometry, it can be explained in terms of geometric phases associated with the wave motion with U(1) group symmetry (e.g. Berry 1984). The theoretical findings are in fair agreement with ocean field observations off the Venice coast, Italy, obtained by state-of-the-art stereo imaging techniques.

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