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Towards a theory for the Pierson and Moskowitz spectrum[1] ANTHONY BONFILS, WOOSOK MOON, DHRUBADITYA MITRA, JOHN WETTLAUFER[2], Nordic Institute for Theoretical Physics — The spectrum of surface gravity waves was measured in the sixties by Pierson and Moskowitz for a fully developed sea, however a theory explaining their observations has been lacking. In 1957, Miles proposed an instability mechanism for single mode growth involving the solution of the hydrodynamic Rayleigh equation at the critical level, which is the height at which the phase speed of the wave is equal to the wind speed. The turbulent wind is modeled by a logarithmic profile. We show that the introduction of a viscous sublayer does not affect the growth rate. Because there is a continuous spectrum of waves, we study the interaction between the different critical layers (the counterpart of wave-wave interactions) in the framework of the quasi-linear model of Janssen (1982). The natural small parameter in this system is the air/water density ratio, which introduces a scale separation in wind-wave generation. Whereas the evolution of gravity waves occurs on a short (fast) time scale, the energy transfer from the wind occurs on a long (slow) time scale. The feedback of growing surface waves on the wind profile occurs on an intermediate time scale. A decrease of its curvature leads to the saturation of the waves, which is the first step in the transition towards a fully developed sea.

[1]Swedish Research Council Grant No. 63820139243
[2]Yale University, New Haven, CT, United States

Anthony Bonfils
Nordic Institute for Theoretical Physics

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