Experimental study on the influence of directional spread on wave breaking

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There are many experiments focusing on 2D wave breaking, and all previous studies expanded the knowledge of wave breaking. However, in the open ocean, waves usually propagate in multi-directions, which will cause a large difference in wave breaking. Until now, the dynamics of fully 3D wave breaking has far from being understood due to its complexity. Liu et al. (2015) designed an experiment with an 'X' configuration (Figure 1) to study wave breaking induced by two identical wave groups which were propagating with an intersecting angle of 16^o (2θ). It is shown that, compared with unidirectional results, the directional spreading plays an important role in wave breaking. Very recently, a new experiment has been conducted in a configuration with an intersecting angle of 24^o (2θ) to examine the influence of directionality further. Therefore, the data obtained in the two experiments is used in the present study to reveal the propagation directionality on the wave-wave interactions and the wave breaking. The nonlinear energy transfer during the wave-wave interactions is particularly sensitive to the directional spread. Furthermore, it is found that the severity of breaking is depending on propagating directionality. Greater breaking occurs when the wave packets propagate with a relatively larger angle, and hence the energy loss increases with the increase of the approach angle generally (Figure 2).

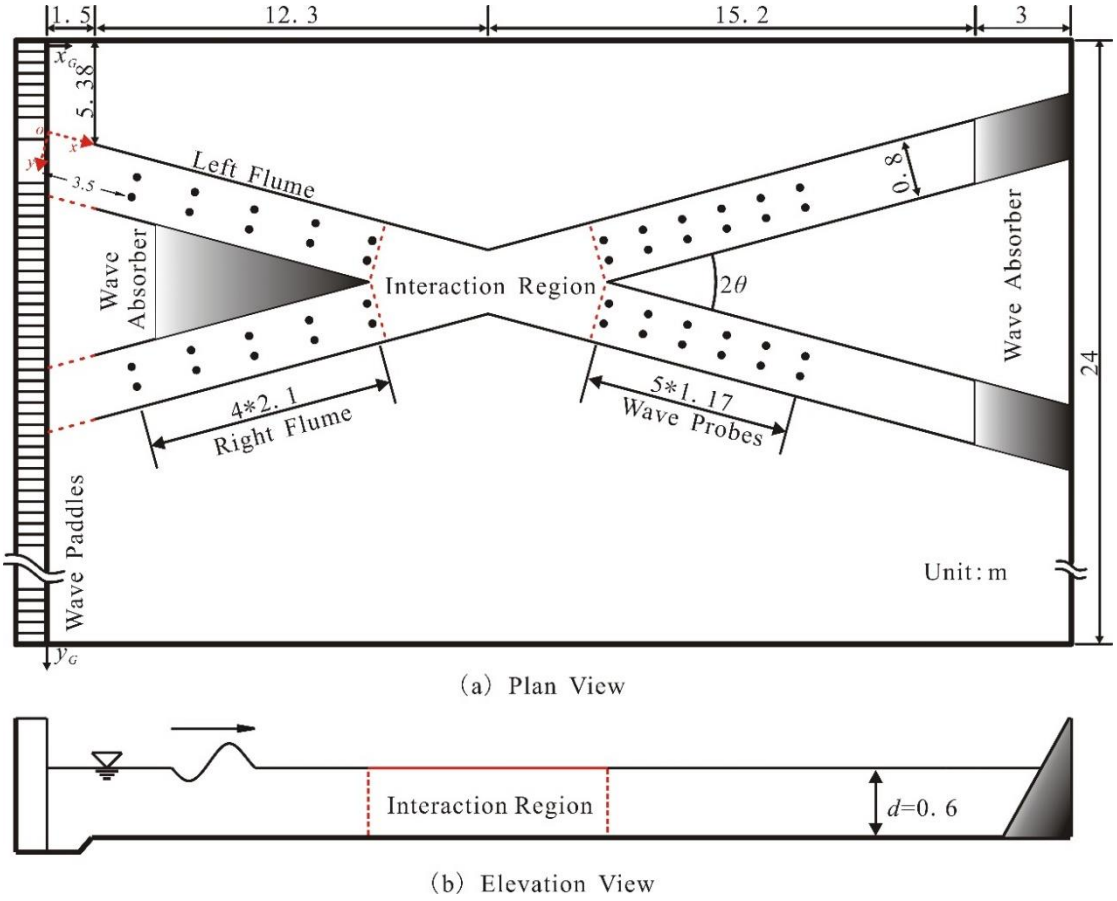

Figure. 1. Experimental set-up for the surface elevation measurements. (Not to scale.)

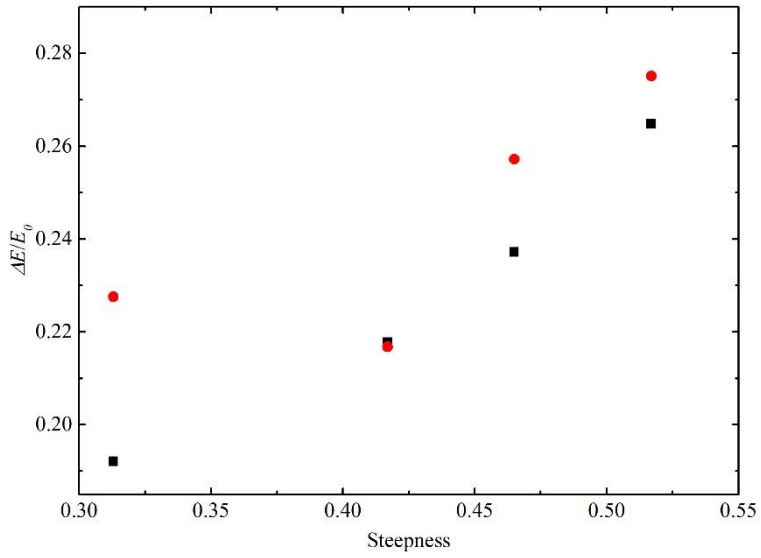

Figure 2. Energy dissipation as a function of wave steepness. The squares represent the case with θ = 8°; the circles represent the case with θ = 12°.