

Observation of band gaps and self-collimation for liquid surface waves propagating in periodic structures

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Waves propagating in periodic structures are strongly modulated by the introduced periodicity. As a result, multiple Bragg scatterings in periodic structures lead to complicated band structures. Between bands there may exist band gaps for waves with frequency within which propagation is absolutely forbidden. The most noticeable example is electronic band gaps in semiconductors. It has been found recently that band gaps can also exist in other kinds of waves propagating in periodic structures, e. g., electromagnetic waves in photonic crystals and sound waves in sonic crystals. The existence of band gaps renders a control of wave propagation in a desired way possible.

When propagating in periodic structures, liquid surface waves will be also modulated by the introduced periodicity. Band structures and band gaps [1,2] can also exist in liquid surface waves. As a result, many interesting phenomena found in photonic or sonic crystals can also exist in liquid surface waves. For instance, we successfully observed the superlensing effect in liquid surface waves [3]. In the present work, we will present the experimental observations in a visualized way that complete band gaps and self-collimation effect do exist in liquid surface waves when propagating over a periodically drilled bottom.

[1] X. Hu, Y. Shen, X. Liu, R. Fu, and J. Zi, Phys. Rev. E **68**, 066308 (2003).

[2] X. Hu, Y. Shen, X. Liu, R. Fu, J. Zi, X. Jiang and S. Feng, Phys. Rev. E **68**, 037301 (2003).

[3] X. Hu, Y. Shen, X. Liu, R. Fu, and J. Zi, Phys. Rev. E **69**, 030201 (2004).