Perfect Resonant Absorption of Guided Water Waves by Autler-Townes splitting

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Wave phenomena are pervasive, making wave control a dynamic field of study. This is evidenced by the significant advancements in metamaterials over the past few decades. Among the various forms of wave control, absorption is particularly intriguing due to its potential for energy harvesting and noise cancellation. The concept of perfect absorption (PA) of waves using compact devices presents a scientific and technological hurdle. This challenge has garnered considerable attention in recent years across various disciplines, including optics, acoustics and, in our case, water waves.

The control of guided water wave propagation based on the Autler-Townes splitting resonance concept is demonstrated experimentally, numerically, and theoretically. The results are presented in Euvé et al.[1]. We achieve total wave absorption using an asymmetric, point-like scatterer. As shown in figure 1, this scatterer is composed of two closely spaced resonant side channels and connected to a guide. It is designed to balance its energy leakage perfectly with the system inherent viscous losses. We show that the characteristics of the resonators and the junction of the guide entirely dictate the positions of the wave numbers at the reflection and transmission zeros on the real axis. Similarly, the asymmetry of the resonators fully determines their positions on the imaginary axis. By fine-tuning these two separate parameters, we can achieve zero reflection and transmission leading to perfect absorption.

Such a system could then be placed at the entrance of a harbor to absorb the waves coming from the sea. The same concept could also be applied to create a barrier that would be capable of absorbing the waves while allowing ships to pass, as well as marine fauna and flora.

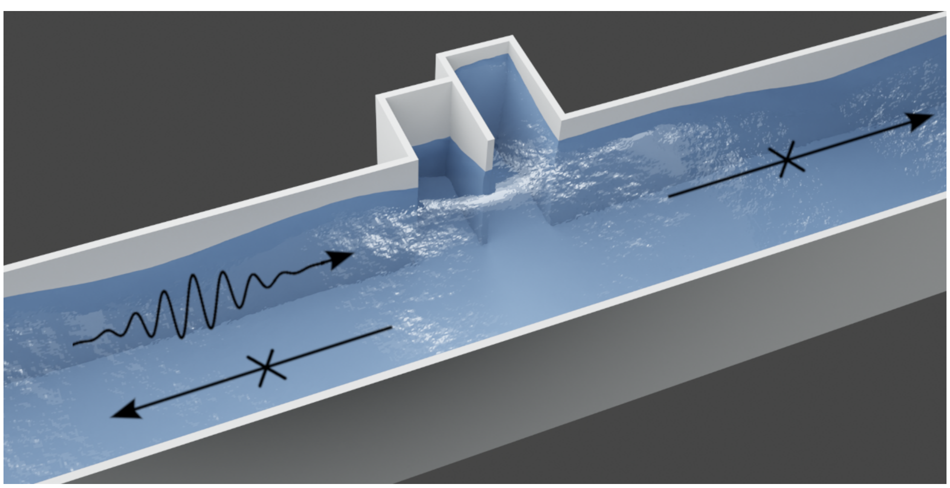

Figure 1: Conceptual view of the setting made of two closely spaced resonant channels (acting as a scatterer) connected to a guide where water waves propagate.

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[1]Euvé et al.,"Perfect resonant absorption of guided water waves by Autler-Townes splitting.", *Physical Review Letters* **Vol 131** (2023).