Random Anti-Lasing through Coherent Perfect Absorption in a Disordered Medium

Matthias Kühmayer[1], Kevin Pichler[1], Julian Böhm[2], Andre Brandstötter[1], Philipp Ambichl[1], Ulrich Kuhl[2], and Stefan Rotter[1]

[1]Institute for Theoretical Physics, Vienna University of Technology (TU Wien), A-1040 Vienna, Austria, EU
[2]Institut de Physique de Nice, Université Côte d'Azur, CNRS, F-06100 Nice, France, EU
Author e-mail address: matthias.kuehmayer@tuwien.ac.at

A random laser consists of a disordered gain medium that emits coherent laser light when being pumped sufficiently strongly. Time-reversing such a random laser by turning gain into loss and by reinjecting the outgoing field of the corresponding laser mode into the random structure, results in a highly complex wave state that gets perfectly absorbed without any back-reflection to the asymptotic region. We experimentally realize such a disordered "coherent perfect absorber" [1] or "random anti-laser" for the first time using a microwave setup and demonstrate its ability to absorb a suitably shaped incoming wave front with close to perfect efficiency [2]. In more recent work (in preparation) we demonstrate that random anti-lasing can be used to focus waves on a spot size that is below the standard diffraction limit.

[1] Yidong Chong, Li Ge, Hui Cao, and A. Douglas Stone, "Coherent Perfect Absorbers: Time-Reversed Lasers" Phys. Rev. Lett. 105, 053901 (2010).
[2] Kevin Pichler, Matthias Kühmayer, Julian Böhm, Andre Brandstötter, Philipp Ambichl, Ulrich Kuhl, Stefan Rotter, "Random anti-lasing through coherent perfect absorption in a disordered medium" Nature 567, 351 (2019).