Experimental search for 3D Anderson localisation of acoustic (scalar) waves

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Anderson Localization is probably one of the most fascinating and remarkable wave phenomena, which is still challenging to demonstrate for classical scalar waves in 3D disordered systems. Inspired by recent advances in the field of soft acoustic metamaterials [1], we have recently proposed to use locally resonant ultrasonic metafluids to observe 3D Anderson localization of acoustic waves. We first studied the ultrasonic wave transport in concentrated disordered resonant emulsions without being able to find any evidence of localized states [2]. To transcend this limitation, we then considered suspensions composed of soft metallic beads exhibiting strong scattering resonances, randomly dispersed in a yield-stress fluid.

In this talk, I will report a set of two independent time- and position-resolved experiments performed at ultrasonic frequencies to present direct evidence of unambiguous transitions between diffusion and Anderson localization, and accurately determine the mobility edges. As it is easy to vary the concentration in our model system of disordered resonant scatterers, we will finally show that localization is observed *only* for an intermediate concentration of beads.

[1] T. Brunet, J. Leng & O. Mondain, “Soft acoustic metamaterials”, *Science* **342**, 323 (2013)
[2] B. Tallon, T. Brunet & J.H. Page, “Ultrasonic wave transport in concentrated disordered resonant emulsions”, *Phys. Rev. B* **108**, L060202 (2023)