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Order/disorder transition for ultrasonic propagation in 2D scatterer arrays

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Recently, intriguing phenomena in quantum mechanics, such as the Aharonov-Bohm effect [P. Roux et al., Phys. Rev. Lett. 79, 3170 (1997)], weak localization in disordered media [A. Tourin et al., Phys. Rev. Lett. 79, 3637 (1997)] and maybe one of the most striking, tunnelling [S. Yang et al., Phys. Rev. Lett. 88, 104301 (2002)], have been revisited using acoustic waves. The advantages of using ultrasound for such studies lie in the macroscopic character of samples and the possibility of directly measuring the phase of the wavefield. Here we explore propagation of MHz-ultrasound in a medium which is either ordered or disordered in the two transverse dimensions (x,y) but invariant in the propagation direction (z). An equivalent scheme has been recently used in optics to demonstrate transverse localization of light [T. Schwartz et al., Nature 446, 52 (2007)]. Our samples are made of a parallel arrangement of cylindrical scatterers (0.8mm in diameter) embedded in a PVA matrix. In the ordered case, the probe beam undergoes ballistic transport. In the disordered case transport becomes diffusive and as the sample length increases the wave tends to be laterally confined.