"Opaque lenses: Using disorder to bring laser light to a focus".

Allard Mosk
Complex Photonic Systems, MESA + and Dept. of Science & Technology, University of Twente

Abstract:
Materials such as white paint, skin or bone are opaque because they have a microscopic disordered structure that scatters light. Light impinging on such a material becomes diffuse and only a fraction of it is transmitted. By controlling the shape of the incoming wavefront, using a two-dimensional spatial phase modulator, we can cause coherent light to interfere constructively at a target point behind an opaque sample. We find that at the target point, the light forms a tight focus that is up to 1000 times brighter than the diffuse background.

Theorists have predicted that in any non-absorbing disordered sample there exist open eigenchannels: specific linear combinations of incoming waves which experience a transmittance of nearly one. Such eigenchannels have not yet been directly observed in condensed matter systems, however, they are the cause of phenomena such as universal conductance fluctuations. By carefully constructing a suitable wavefront we find we can selectively couple light to the open eigenchannels in a disordered optical material. As a result, the total diffuse transmittance increases. The magnitude of the increase is exactly as predicted by random matrix theory.