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Time reversal and subwalength focal spot

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When a wave is time-reversed inside a homogeneous medium, the focal spot width at best equals half a wavelength. This limit comes from the loss of evanescent wave during propagation. An analysis of the time reversed field in terms of the Green's function formalism shows that in order to get a finer spot, not only the field has to be time reversed but also the initial source. In such a case, an acoustic sink is obtained. Experimental results are presented. Then we show two methods to obtain subwavelength focal spot without time-reversed source. The first method consists of setting the time reversal mirror in the near field of the initial source. Despite the evanescent wave transmission, we will see that subwavelength focusing is only observed for a special time-reversal mirror. The second method consists of surrounding the initial source by many scatterers. In such a case, the evanescent waves emitted by the initial source are converted into propagating ones. During the time reversal step, back-conversion occurs that leads to a sub wavelength focal spot. Thanks to this principle, a focal spot of a thirtieth of a wavelength has been reported in the case an electromagnetic experiment.