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Photoacoustic tomography with a single detector in a reverberant cavity

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In biomedical photoacoustic tomography (PAT), acoustic pulses, generated by the absorption of pulses of near-infrared light, are recorded on an array of ultrasound detectors, and the measured pressure time series are subsequently transformed into an image of the absorbed optical energy density within the tissue. For high resolution imaging, large-area detector arrays with a high density of sensitive, small elements are required. Such arrays can be expensive, so reverberant-field PAT is proposed as a means of obtaining PAT images using smaller arrays or even a single detector. By recording the reflections from a reverberant cavity surrounding the detector(s), in addition to the primary acoustic waves, sufficient information can be captured to allow a PAT image to be reconstructed, without the requirement for a large-area array. Image reconstruction, time reversal, non-uniqueness, and related ideas in quantum chaos will be discussed.