The shadow of a single atom

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We have performed absorption imaging of a single atom for the first time [1]. A trapped Yb+ atomic ion scatters light out of an illumination beam tuned to atomic resonance at 369.5 nm. When the beam is reimaged onto a CCD camera, we observe an absorption image of 440 nm diameter and 5% contrast. The absorption contrast is investigated as a function of laser intensity and detuning, and closely conforms to the limits imposed by simple quantum theory and known properties of our imaging system. Defocused absorption images provide spatial interferograms of the scattered light, permitting accurate retrieval of the amplitude and phase of the scattered wave. We measure a phase shift of >1 radian in the scattered light as a function of laser detuning, which may be useful in quantum information protocols. The interferograms point to the possibility of observing the focusing of light by a single atom.

[1] EW Streed et al., Nature Commun., doi:10.1038/ncomms1944