# Picophotonics - Subatomic Optical Localization Beyond Thermal Fluctuations

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Despite recent tremendous progress in optical imaging and metrology, the resolution gap between atomic scale transmission electron microscopy and optical techniques has not been closed. Is optical imaging and metrology of nanostructures exhibiting Brownian motion possible with resolution beyond thermal fluctuations? Here we report on an experiment in which the average position of a nanowire with a thermal oscillation amplitude of ~150 pm is resolved in single-shot measurements with accuracy of 39 pm using light at a wavelength of λ = 488 nm, providing the first example of such sub-Brownian metrology with ~λ/12,000 resolution. To localize the nanowire, we employ a deep learning analysis of the scattering of topologically structured light, which is highly sensitive to the nanowire's position. As a non-invasive optical metrology with sub-Brownian absolute errors, down to a fraction of the typical size of an atom (Si: 220 pm diameter), it opens the exciting field of picophotonics.