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Measuring nm-scale Interaction Potentials with a Microscope: Light Microscopy at Maximal Precision BRIAN LEAHY, MATTHEW BIERBAUM, JAMES SETHNA, ITAI COHEN, Cornell University — Tremendous effort has been put into improving both microscope design and imaging techniques over the past few decades, resulting in an enormous increase in image quality and resolution. We show that a similarly large improvement can be achieved in the analysis of microscopy images. We demonstrate our approach on an image of colloidal particles, improving the measurement of object positions and radii in a microscope image by up to a factor of 100 over current methods. We measure object properties by fitting experimental images to a detailed model of the physics of image formation, a method we call Parameter Extraction from Reconstructing Images (PERI). This unprecedented resolution immediately opens a new window into colloidal science. We use this resolution to measure 10 nm screening lengths in colloidal pair potentials from direct imaging of a colloidal suspension. Importantly, the ideas behind our technique can be readily applied to other imaging modalities such as brightfield microscopy or even STEM and STM.

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