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Multiple Reference Soft X-ray Fourier Transform Holography¹

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Stanford Synchrotron Radiation Laboratory — We demonstrate multiple reference Fourier transform holography with soft x-rays. This technique results in enhanced image quality without increased exposure to the sample. There are two categories of experiments where this is particularly relevant: imaging with limited intensity sources and imaging radiation sensitive samples. In Fourier transform holography a unique image of the sample object is reconstructed for each reference source that is used to record the hologram. Thus with multiple reference sources, multiple images are reconstructed with the same radiation exposure to the sample necessary for a single image. When the multiple images are formed by effectively identical reference sources the images can be averaged to enhance image quality. X-ray free electron lasers are an example of sources where single shot images must be captured with one ultrafast x-ray pulse. Since the number of photons in each pulse, incident on a nanoscale sample, is finite, high efficiency imaging is essential. To mimic a finite illumination scenario we have successfully imaged a nanoscale test object by detecting fewer than 2500 soft x-ray photons.

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