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Transverse Coherence at Short Wavelength

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Spatially filtered particle and photon sources with nanometer wavelength will enable applications in microscopy and coherent scattering with high spatial resolution and unusual contrast mechanisms. The necessary phase space acceptance in such experiments, which is set by the uncertainty principle, places high demands on source brightness, as measured by particle flux per unit area and solid angle. Much progress along these lines has been accomplished in electron microscopy, where field emission cathodes provide high enough brightness that coherence is now used in many imaging applications. I will present results that illustrate potential applications of two developing sources, one based on soft x-ray undulators at third generation synchrotron radiation facilities and the other based on free jet expansions of helium atoms and hydrogen molecules from a microcapillary nozzle. The coherent flux from these sources provides a useful probe of spatial and temporal correlations on the nanometer length scale and thus will address important issues in how complexity emerges in a variety of soft and hard materials.