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Soft X-Ray Science – From Photon Drought to X-Ray Lasers

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Soft x-ray science, loosely defined as research with 200-2000 eV photons, has come a long way over the last 30 years. This talk highlights some of the scientific developments and gives a glimpse of the future. Today, high-intensity soft x-rays are available with meV spectral resolution, picosecond pulse lengths and nanoscale spot sizes. Their tunable energy and polarization allows the control of electronic core-to-valence transitions that provide access to the fundamental charge and spin properties of valence electrons in matter. Large resonant cross sections associated with absorption edge resonances provide sensitivity to small numbers of atoms, as encountered in nanostructures, ultra-thin films, interfacial layers and surfaces. Presently, the most advanced experiments use sophisticated spectro-microscopy and lensless coherent imaging techniques with nanoscale spatial and picosecond temporal resolution. On the horizon are experiments with soft x-ray lasers which, among other things, will provide femtosecond snapshots of matter.