MAR06-2006-040226

Abstract for an Invited Paper
for the MAR06 Meeting of
the American Physical Society

High-Resolution Microcalorimeter Detectors for X-ray Spectroscopy

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For many decades, standard wavelength- and energy-dispersive x-ray detectors have dominated experimental physics. Recently, microcalorimeter detectors of various types that count individual photons have started to make an appearance on the experimental scene. I shall describe the development of Transition Edge Sensor (TES) detectors at NIST, with particular emphasis on their use in high-resolution x-ray spectrometry. These detectors combine the broad energy range of a SiLi or Ge detector with energy resolution approaching that of diffraction-related methods. The technologies for producing ultra-cold temperatures and for fabricating superconducting electronics have made these detectors practical to use on a daily basis. By means of careful matching of absorber and energy, detectors can be built to cover energy ranges from 1 keV to 100 keV. By extrapolating from single-pixel detectors to arrays, the possibility of large detection areas, high count rates, and even imaging is starting to look realistic. While embodying some challenging technical constraints, microcalorimeter x-ray detectors will provide attractive advantages and opportunities for physicists in a number of fields.