# Probing symmetry, spin, and valency of metal centers via ultra-sensitive soft X-ray detectors

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Nature has found molecules to efficiently store, transport, and utilize energy, and research at the intersection of biology and physics aims to model and mimic these molecular systems. Energy transformations often feature an active metal site surrounded by a large matrix of light elements. One of the grand challenges in this field is to understand the unique local electronic structure that gives rise to the efficiency and selectivity of natural systems.

Core-level spectroscopy is a unique probe of local structure that offers a window into the electronic configuration of an active metal site. L-edge spectrosocpy of 3d transition metals in the soft x-ray regime can yield element, site, symmetry, and spin selective spectral information, but the application of these measurements has been hampered by the inability of current technology to detect low concentrations of metal embedded in a larger matrix, especially in radiation sensitive samples.

Superconducting transition edge sensor (TES) technology has been used to build novel detectors with greatly increased sensitivity in the x-ray regime at intermediate energy resolution (~1 eV, with a future goal of 0.5 eV). This spring we commissioned a new soft x-ray TES spectrometer at SSRL, with a scientific agenda driven in part by ultra-low concentration active site measurements in biology. We will present the most recent demonstrations from this new detector and scientific prospects for the TES at synchrotrons and free electron lasers. Recent measurements include model iron compounds and preliminary results on dry hemoglobin samples.