The Case for Vibrational Resonant Inelastic X-Ray Scattering (VRIXS) on an FEL

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A number of x-ray techniques now have sufficient energy resolution to observe molecular vibrations. One such method is nuclear resonance inelastic scattering (NRVS), which involves pumping a sample with a ~1 meV wide beam near a Mössbauer resonance. Another approach is non-resonant inelastic x-ray scattering at high energies, which can also sub meV resolution. Finally, even high-resolution x-ray absorption in the soft x-ray region can detect vibrational fine structure. Each of these approaches has its own strengths and limitations. Another approach to vibrational information is vibrational resonant inelastic x-ray scattering (VRIXS). At the moment, there are no sub meV x-ray analyzers that can be tuned to an arbitrary absorption edge, but such devices are now being designed. When combined with an meV FEL x-ray source, the resulting instrument could do unique experiments in materials research and bioinorganic chemistry. I will discuss the LBNL meV analyzer, the complementary requirements for an FEL source, and some of the experiments that could be done when both are in operation together.