Pressure-Induced Atomic Disorder in the Heavy Fermion $CeCu_{2+x}Si_2$ using Neutron Diffraction.

Despina Louca, *University of Virginia, Charlottesville, VA 22904; J. D. Thompson and J. L. Sarrao, Los Alamos National Laboratory, Los Alamos, NM 87545.*

Several heavy-fermion materials, including $CeCu_{2+x}Si_2$, exhibit superconductivity as well as magnetism, where the transition from one state to the other is driven by changes in volume and chemical composition that leave the average crystal structure unchanged. However, non-Fermi-liquid characteristics in the properties have been observed that depend on *x* and pressure. Using the pair density function (PDF) analysis of pulsed neutron powder diffraction, we investigated how the local atomic structure changes with the Ce/Cu ratio as well as with pressure. We observed that, for compositions that are non-superconducting at ambient conditions, $x < 0$, the average and local structure are the same, concomitant with a magnetic state. However, for superconducting samples with $x > 0$, deviations of the local atomic structure from the average crystal structure are observed, consistent with a disordered lattice. Similar measurements were carried out under pressure and observed that the local atomic structure of compositions that are ordered at ambient conditions change with pressure while these changes are beyond simple unit cell contraction. In particular, the local lattice changes in an uncharacteristic manner not previously observed. The changes are qualitatively similar to the $x > 0$ composition at ambient pressure. It is possible that spin-lattice coupling in the disordered lattice produces an inhomogeneous magnetic state that allows superconductivity to develop and may contribute to observed non-Fermi-liquid effects.