Quasi-3D ordered lattice modulations in a bilayer ruthenate with no long-range order$^1$ ZAHIRUL ISLAM, Argonne National Laboratory (ANL), ZHE QU, Tulane University (TU), YEJUN FENG, JONATHAN LANG, ANL, JIN PENG, ZHIQIANG MAO, TU — Bulk measurements reveal disorder-induced unconventional quantum critical behaviors in $(\text{Sr}_{1-x}\text{Ca}_x)_3\text{Ru}_2\text{O}_7$ (SCRO) compounds, in particular, near $x = 0.3$. Here we report X-ray scattering studies on SCRO with $x = 0.3$, as well as those for the end members. We find that at $x = 0.3$ robust 2-unit-cell periodic lattice modulations exist that are characterized by $(\frac{1}{2}, 0, 0)$ and $(0, \frac{1}{2}, 0)$, respectively, even at room temperature. These modulations are transversely polarized and quasi-3D ordered in that they are fully coherent in the basal plane with $c$ axis correlations at least one unit cell in extent. These modulations are due to correlated displacements of the O atoms. The displacement pattern is consistent with $t_{2g}$-modes of distortion of RuO$_6$ octahedra, signifying the presence of lattice and orbital correlations, although no long-range magnetic or orbital order is present. These modulations are absent in the end members.

$^1$Use of the Advanced Photon Source is supported by the DOE, Office of Science, Contract No. DE-AC02-06CH11357. Work at TU is supported by NSF under DMR-0645305, by DOE under DE-FG02-07ER46358, and the Research Corporation.

Zahirul Islam
Argonne National Laboratory

Date submitted: 26 Nov 2007

Electronic form version 1.4