Single crystal preparation and long-range charge fluctuations in the square-planar nickelate La$_4$Ni$_3$O$_8$.\textsuperscript{1} JUNJIE ZHANG, Argonne National Laboratory, YU-SHENG CHEN, Argonne National Laboratory/The University of Chicago, HONG ZHENG, DANIEL PHELAN, JOHN MITCHELL, Argonne National Laboratory — Since the discovery of high-Tc superconductivity in cuprates, intensive effort has been focused on a search for superconductivity in related materials, with particular attention on nickelates. Bulk nickelates containing square-planar coordinated Ni$^+$ are of interest because Ni$^+$ is isoelectronic with Cu$^{2+}$, the building block of high-Tc cuprates. Here we report the first single crystal synthesis of La$_4$Ni$_3$O$_8$, a layered nickelate containing square-planar coordinated Ni$^+$ with crystallographic and electronic structure related to that of cuprates. Magnetic susceptibility, resistivity, and heat capacity measurements confirm the reported phase transition at $\tilde{105}$ K\textsuperscript{1}. Long-range charge fluctuations with $q\sim(1/3, 1/3, L)$ was observed for the first time through synchrotron X-ray single crystal diffraction. Our results challenge the current understanding of the origin of the phase transition. Availability of bulk La$_4$Ni$_3$O$_8$ single crystals is also of significant importance for unraveling its ambiguous ground-state magnetic structure, the spin state of the Ni ion, and potential for superconductivity in nickelates involving Ni$^+$ in a square-planar coordination. [1] Poltavets, V. V. et al. PRL 2010, 104, 206403.

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