Lattice-Tuned Magnetism of Ru$^{4+}$(4d$^4$) Ions in Single-Crystals of the Layered Honeycomb Ruthenates: Li$_2$RuO$_3$ and Na$_2$RuO$_3$† JINCHEN WANG, Renmin Univ of China, JASMINKA TERZIC, TONGFEI QI, University of Kentucky, FENG YE, Oak Ridge National Laboratory, SHUJUAN YUAN, SAICHRAN ASWARTHAM, University of Kentucky, SERGEY STRELTSOV, Ural Federal University, DANIEL KHOMSKII, Universitaet zu Koeln, RIBHU KAUL, GANG CAO, University of Kentucky — We synthesize and study single crystals of the layered honeycomb lattice Mott insulators Na$_2$RuO$_3$ and Li$_2$RuO$_3$ with magnetic Ru$^{4+}$(4d$^4$) ions. The newly found Na$_2$RuO$_3$ features a nearly ideal honeycomb lattice and orders antiferromagnetically at 30 K. Single-crystals of Li$_2$RuO$_3$ adopt a honeycomb lattice with either C2/m or more distorted P2$_1$/m below 300 K, depending on detailed synthesis conditions. We find that Li$_2$RuO$_3$ in both structures hosts a well-defined magnetic state, in contrast to the singlet ground state found in polycrystalline Li$_2$RuO$_3$. A phase diagram generated based on our results uncovers a new, direct correlation between the magnetic ground state and basal-plane distortions in the honeycomb ruthenates.

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