Electronic structure of Lu$_{1-x}$La$_x$VO$_3$ single crystals using soft x-ray spectroscopy$^1$ BO CHEN, JUDE LAVEROCK, JAMES MCNULTY, DAVE NEWBY, KEVIN SMITH, Boston University, ANDERS GLANS, JINGHUA GUO, Advanced Light Source, GEETHA BALAKRISHNAN, RAVI SINGH, University of Warwick — The rare-earth vanadates, RVO$_3$, offer a rich phase diagram of both orbital and spin ordering phenomena, stemming from their two-fold occupation of the three-fold degenerate V $t_{2g}$ orbitals. It has been discussed that, in RVO$_3$, which shows the $t_{2g}$ orbital ordering, the Jahn-Teller coupling suppression is much weaker than that in the $e_g$ electron systems. In order to address the orbital ordering effects, we report soft x-ray measurements of Lu$_{1-x}$La$_x$VO$_3$ single crystals, which approach both the smallest and largest rare-earth ionic sizes. X-ray absorption spectroscopy and x-ray emission spectroscopy, which reveal both the unoccupied and occupied partial density of states, are employed to observe the changes in the V 3$d$ and O 2$p$ states, across the orbital ordering transitions and $R$-site ionic radii. Also, resonant inelastic x-ray scattering is applied to probe the O 2$p$-V 3$d^*$ charge transfer excitations and V 3$d$-3$d^*$ transitions. Together, these complementary techniques provide a picture of the electronic structure of Lu$_{1-x}$La$_x$VO$_3$ to test the role of the orbital ordering during phase transitions with varying rare-earth ionic sizes.

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