W64a XRISM Spectroscopy of the Stellar-Mass Black Hole 4U 1630−472 in Outburst

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We report on XRISM/Resolve spectroscopy of the recurrent transient and well-known black hole candidate 4U 1630−472 during its 2024 outburst. The source was captured at the end of a disk-dominated high/soft state, at an Eddington fraction of $\lambda_{\rm Edd} = 0.046$ ($10\ M_\odot/M_{\rm BH}$). A highly variable absorption spectrum with unprecedented complexity is revealed with the Resolve calorimeter. The strongest lines are fully resolved, with He-like Fe XXV separated into resonance and intercombination components, and H-like Fe XXVI seen as a spin-orbit doublet. This is also one of the detections of the absorption lines at the smallest Eddington ratio in black hole X-ray binaries. The depth of the absorption lines varied significantly during the observation, which was too large to be explained by the change in the ionization parameter associated with the observed $\sim 10\%$ variation in the X-ray flux. We discuss the impact of these findings on our understanding of accretion in stellar-mass black holes, and potential consequences for future studies.