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Sorting individual atoms in 3D: an omniscient Maxwell's demon¹ TSUNG-YAO WU, AISHWARYA KUMAR, FELIPE GIRALDO MEJIA, DAVID S. WEISS, The Pennsylvania State University — Combining site-resolved imaging, site-selective state flips and state-dependent motions, we have sorted atoms in randomly half filled 5x5x5 3D optical lattices into 96% filled 5x5x2 or 4x4x3 sub-lattices. The sub-lattice ends up perfectly filled ~30% of the time. Our experiment realizes the full essence of a Maxwell demon [Phys. Rev. A **70**, 040302(R) (2004)]. The sorting reduces the apparent configurational entropy by a factor of 8 and the total entropy by a factor of 2.4. The resulting manifestly low entropy state would be comfortably below the quantum degeneracy threshold if the lattice were adiabatically shut off and the atoms left in a 3D box trap [Phys. Rev. Lett. **89**, 090404 (2002)]. We will use the result of our Maxwell demon as the initial state of a neutral atom quantum computer.

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Tsung-Yao Wu The Pennsylvania State University

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