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Finite-size Scaling at First-order Superfluid to Mott-insulator Phase Transitions in Spinor Condensates ZIHE CHEN, JARED AUSTIN, ZACHARY SHAW, LICHAO ZHAO, PERRY HURD, YINGMEI LIU, Oklahoma State University — We present an experimental study on finite-size scaling effects at superfluid (SF) to Mott-insulator (MI) quantum phase transitions in antiferromagnetic spinor condensates confined by cubic optical lattices. Possessing a spin degree of freedom, atoms in antiferromagnetic spinor condensates can cross first-order (second-order) SF-MI transitions when the quadratic Zeeman energy is set at a value smaller (larger) than the spin-dependent interaction. We start every experimental cycle with an antiferromagnetic spinor condensate at its SF ground state, and monitor evolutions of spin populations as the lattice potential is quenched to a sufficiently large value where atoms enter into the MI phase. The observed quench dynamics, especially the freeze-out time near the phase boundary, show a power-law scaling dependence on the quench speed. We compare our observations with the quantum Kibble-Zurek model, and also study the relationship between the scaling exponents and the nature of the SF-MI phase transitions.

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