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Ultrafast Generation of Large Schrodinger Cat States[1] KALE JOHNSON, BRIAN NEYENHUIS, DAVID WONG-CAMPOS, JONATHAN MIZRAHI, Joint Quantum Institute, University of Maryland Department of Physics and National Institute of Standards and Technology, College Park, Maryland 20742, WES CAMPBELL, Department of Physics and Astronomy, University of California, Los Angeles, Los Angeles, California 90095, CHRISTOPHER MONROE, Joint Quantum Institute, University of Maryland Department of Physics and National Institute of Standards and Technology, College Park, Maryland 20742 — Using a series of spin-dependent kicks on a trapped Yb+ ion, we create large, entangled, Schrodinger cat states. We prepare the ion in a superposition of its two $m_f = 0$ hyperfine ground states, representing an effective spin-1/2 system. Trapped in a harmonic potential, the ion is illuminated with a specially shaped, 1.5 ns pulse that imparts a momentum kick on the ion with a spin-dependent direction. A fast Pockels cell allows us to change the direction of the spin-dependent kick from each subsequent pulse out of an 80MHz mode-locked laser. By concatenating a series of these very high fidelity spin-dependent kicks, we separate the ion's wave packet into two, spatially distinct states separated by about 200 recoil momenta and involving about 70 phonons. This method for creating a Schrodinger cat state is not time-limited by the trap frequency, and does not rely on confinement in the Lamb-Dicke regime.

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