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Ion-photon entanglement with trapped Ba-138 ions THOMAS NOEL, CAROLYN AUCHTER, CHEN-KUAN CHOU, BORIS B. BLINOV, University of Washington — We demonstrate entanglement between the polarization state of spontaneously emitted photons and the Zeeman state of a single trapped Barium ion. The Barium ion is weakly excited with a short ($\sim$20 ns) pulse of CW laser light. The ion subsequently decays emitting a single photon at 493 nm. Entanglement is verified by measuring the states of the ion and photon in multiple bases, yielding an overlap of 0.84 with the appropriate maximally entangled Bell state. Furthermore, the CHSH form of the Bell inequality is shown to be violated by over eight standard deviations. This work demonstrates elements of an apparatus which will make our long-term goal of achieving a loophole-free test of a Bell inequality possible.

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