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State selective excitation of a trapped ion qubit with broadband laser pulses[1] ANTHONY RANSFORD, CONRAD ROMAN, MICHAEL IP, WESLEY CAMPBELL, UCLA — Excitation by picosecond pulses can be used for background-free detection of fluorescence by temporally separating the prompt incidental scatter from the subsequent atomic emission. This scheme can be applied to state detection of trapped ion qubits to eliminate the need for expensive, high-NA imaging optics (trading spatial filtering for temporal filtering, which should allow for even higher NA). For hyperfine structure, however, the necessarily large bandwidth of the pulse is greater than the qubit splitting and the excitation will not be state selective or state preserving. We present a technique using sub-nanosecond pulse pairs to recover the requisite state selectivity. Using fast electronics the fluorescence from the ion can be detected unambiguously in the presence of large amounts of laser scatter and used to readout the original state.

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