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Robust creation of arbitrary-sized Dicke states of trapped ions by global addressing IAN LININGTON, NIKOLAY VITANOV, University of Sofia — We propose a novel technique for the creation of entangled Dicke states in a chain of trapped ions. Our approach is robust against experimental imperfections, largely insensitive to motional heating and applicable to arbitrary numbers of ions and excitations. Individual addressing is not required, since the method uses only a single laser, interacting simultaneously with all ions. By factorizing the overall Hilbert space, we show that the dynamics is confined to a ladder of symmetric states which are invariant under permutation of the ions. Sweeping the laser detuning through resonance and enforcing adiabatic evolution then induces a "bow-tie" level-crossing wherein the two ends of the ladder are smoothly connected. An initial product state may be transformed into an entangled Dicke state using only two laser pulses. The technique is naturally robust against fluctuations in the laser intensity and the chirp rate. Furthermore, because the method is significantly faster than existing approaches, heating effects can be very small, even when the centre-of-mass mode is used. We quantify the adiabaticity requirements and the effects of motional heating, and estimate an overall fidelity exceeding 98% for the generation of a ten-ion Dicke state. The method may readily be adapted in order to create non-classical superposition states of the ions' collective motion and Greenberger-Horne-Zeilinger states of their internal states.

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