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【504】Experimental certification of millions of genuinely entangled atoms in a solid

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Quantum theory predicts that entanglement can also persist in macroscopic physical systems, albeit difficulties to demonstrate it experimentally remain. Recently, significant progress has been achieved and genuine entanglement between up to 2900 atoms was reported. Here we demonstrate 16 million genuinely entangled atoms in a solid-state quantum memory prepared by the heralded absorption of a single photon. We develop an entanglement witness for quantifying the number of genuinely entangled particles based on the collective effect of directed emission combined with the nonclassical nature of the emitted light. The method is applicable to a wide range of physical systems and is effective even in situations with significant losses.

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