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【458】Precision spectroscopy and coherent manipulation of single trapped N2+ molecules

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Trapped atoms and atomic ions are among the best-controlled quantum systems which find widespread applications in quantum science. However, a similar exquisite control over molecules has remained elusive so far due to their complex energy-level structure with additional rotational and vibrational degrees of freedom. We employ a quantum-logic protocol which uses a single co-trapped atomic ion as a probe for the molecular state. Specifically, we demonstrate a quantum non-demolition state detection on N2+ with fidelities exceeding 99% without destroying the state itself. The present method paves a way for the implementation of molecular qubits, establishing new frequency standards in the mid-IR regime, and for investigating state-to-state dynamics of chemical reactions.

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