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Demonstration of Single Barium Ion Sensitivity for Neutrinoless Double Beta Decay Using Single Molecule Fluorescent Imaging

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A new method to tag the barium daughter in the double beta decay of ^{136}Xe is described, based on adaptation of the single molecule fluorescent imaging (SMFI) technique. Individual barium dications chelated on a transparent plate are detected at a significance of 12.9 σ, with a spatial resolution of 2 nm rms. Observation of a single-step photo-bleach transition confirms the interpretation of single ion sensitivity. This result is the first step toward an essentially background-free technique in the search for neutrino-less double beta decay in ^{136}Xe, based on robust event discrimination by SMFI in a high-pressure xenon gas TPC.

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