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Studying two-level systems in Josephson junctions with a Josephson junction defect spectrometer M.J.A. STOUTIMORE, M.S. KHALIL, SERGIY GLADCHENKO, Laboratory for Physical Sciences, University of Maryland, R.W. SIMMONDS, National Institute of Standards and Technology, C.J. LOBB, University of Maryland, K.D. OSBORN, Laboratory for Physical Sciences — We have fabricated and measured Josephson junction defect spectrometers (JJDSs), which are frequency-tunable, nearly-harmonic oscillators that probe two-level systems (TLSs) in the barrier of a Josephson junction (JJ). A JJDS consists of the JJ under study fabricated with a parallel capacitor and inductor such that it can accommodate a wide range of junction inductances, L_{J0} , while maintaining an operating frequency, f_{01} , in the range of 4-8 GHz. In this device, the parallel inductance helps the JJ maintain linearity over a wide range of frequencies. This architecture allows for the testing of JJs with a wide range of areas and barrier materials, and in the first devices we have tested Al/AlOx/Al JJs. By applying a magnetic flux bias to tune f_{01} , we detect TLSs in the JJ barrier as splittings in the device spectrum. We will present our results toward identifying and quantifying these TLSs, which are known to cause decoherence in quantum devices that rely on JJs.

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