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Inductive Tunnel Diode Resonator Circuit for Precision Magnetic Measurements NICHOLAS BRESLIN, OWEN HUFF, ALEXANDER BLANTON, RYAN GORDON, Western Illinois University — A tunnel diode resonator (TDR) circuit is a specially designed radio frequency circuit consisting of an LC tank oscillator that is powered by a properly biased tunnel diode. Under optimal design considerations, this circuit is capable of parts-per billion stability in the drift of its resonance frequency, hence making it an ideal tool for studying changes in material properties that can either couple to the magnetic field of the inductor coil or to the electric field of the capacitor in the tank oscillator portion of the TDR circuit. My presentation will focus on the design and construction of a TDR circuit for measuring properties of materials using the inductor as the sense element for measurements in the condensed matter physics lab of Dr. Ryan Gordon at Western Illinois University. In particular, this circuit is being fitted onto the cooling stage of a closed-cycle helium refrigerator, where its base temperature can be as low at 10 K. By mounting samples with size dimensions on the order of 1 mm onto a small sapphire stage that can be inserted into the inductor coil of the TDRs tank oscillator, shifts in the resonance frequency due to the presence of the material can be studied from just above 10 K to room temperature.

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