Public Abstract
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Detection of nuclear or fissile materials is made difficult due to the speed, quantity and variety of entrance points of transported goods in a global market. Inspecting transported goods under these conditions requires a convenient and portable device that uses proven methods. Active nuclear detection can be performed by using neutrons to induce a nuclear reaction in a radioactive material which can then be detected by an appropriate sensor. The University of Missouri is developing an ultra compact deuterium ion accelerator to induce D-D fusion as a source of neutrons for detection purposes. The proposed accelerator utilizes a lithium niobate piezoelectric transformer capable of producing a 100 kV output when driven with a low radio frequency resonant voltage. The transformer is a Rosen type transformer composed of a rotated y-cut polarized rectangular crystal, with the primary voltage applied through the crystal's thickness and the secondary developed along its length. The transformer will be used to supply and accelerate deuterium ions by field emission from a tip attached to the crystal's output electrode. The deuterium ions then impact a deuterated target inducing a D + D -> 3He + n reaction. Advantages of this circuit include low power consumption, quick turn on, and compactness.
A resonant piezoelectric transformer circuit was developed for high voltage generation. The goal of this project was to produce 100 kV with a reasonably sized piezoelectric crystal. Several mechanisms leading to less than expected high voltage have been addressed. This project addresses problems associated with high power, high stress, high voltage, mechanical loss, and high output impedance measurements. A method for eliminating unwanted discharges and a technique for measuring the true output voltage of the transformer were tested. A way to minimize the mechanical stress while creating high voltage was sought. The research performed in this project extended the state of the art for high voltage piezoelectric transformers.