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Nuclear and Emerging Technologies for Space in Today's Society

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Abstract. *The cesium vapor diode is the only demonstrable power producing thermionic energy conversion (TEC) device deployed in space to date. It remains a promising candidate for nuclear space power applications given its high power density and simplistic design. In the current state of the art, emission electrons ionize the Cs vapor which conducts the electrons across the interelectrode gap, losing 50% of their energy in the process. This fundamental physics drawback constrains a TECs design (interelectrode gap, wgap<0.5mm) and limits operating efficiencies (5.5%, TOPAZ reactor). The author proposes an alternative plasma ignition source for in-core nuclear reactor TECs: heavy ions from fissioning a cladless nuclear fuel element. This concept was explored briefly by General Motors and the Office of Naval Research in the 1960s and yielded promising results, yet was never pursued further by either group. This plasma ignition scheme would simultaneously enhance device efficiency (>30%) and relax design constraints (wgap>5mm) by raising the plasma Teand allowing for noble gas electron conduction instead of Cesium. LBNLs Nuclear Data Group is collecting dE/dx data in plasma targets of various compositions and ionizations using the 88-inch cyclotron as a source of low energy (~1MeV/nucleon), high charge-state heavy ions.This data will benchmark Michigan State Universitys Plasma Theory and Simulation Group PIC code to verify its applicability Heavy Ion Thermionic Energy Converter (HITEC) reactor design.This graduate work is being carried out in collaboration with Argonne National Laboratory, Michigan State University, and University of California Berkeley.*

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