Direct Energy Conversion in a Portable, High-Energy Quantum-Nuclear Reactor Based on Electrohydrodynamic Power Cell Dynamics

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Portable nuclear reactors are novel solutions to the impending energy crisis, providing large amounts of electrical power in a mobile, clean and efficient manner. In my past work, I developed and demonstrated the effectiveness of a novel nuclear reaction known as Quantum Anti-Zeno Effect catalyzed Double Beta Decay (AZE-BetaBeta) in an Extremely Compact Nuclear Reactor (ECNR), potentially opening avenues to “handheld” nuclear reactors. However, a method of converting the reaction into electrical power is yet to be investigated. This study aims to develop an efficient Direct Energy Conversion (DEC) system to convert the kinetic energy of charged particles from AZE-BetaBeta reaction into electrical energy. Current DEC schemes, such as magnetohydrodynamic generators, use nuclear reactions to ionize a gas, which is then propelled through a magnetic field to generate an induced current. This process is inherently inefficient. Instead, this study quantifies the highly energetic beta particles from the AZE-BetaBeta reaction as a 3-dimensional Fermi Gas, allowing for the particles to be used directly in the DEC scheme rather than using the particles to ionize a secondary gas. This system was modelled using CERN Geant4 via high-energy electron toolkits. Theoretical induced currents were investigated in these simulations. Using this data, a hyperparameterization algorithm was written using MATLAB which models a 3-dimensional “electrohydrodynamic” direct energy converter; a scheme which also accounts for electrons with excess energy. This optimized geometry was re-tested in Geant4. The DEC yielded an average 86% efficiency, which is highly favorable. This reactor-DEC design could potentially provide power on the scale of megawatts, while remaining extremely compact.

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