Early Uses for ^{3}He and a Development Path to a D^{3}He Fusion Power Plant

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For the past 15 years, scientists and engineers have studied the use of the valuable isotope of ^{3}He. Since the first realization of its immense value in 1986 [1] the focus has been on the use of this isotope in a fusion reactor to produce electrical power [2,3] or propulsion in space [4,5]. The advantages of the D^{3}He reaction compared to the more conventional DT fuel include: much reduced radiation damage to the fusion reactor confinement structure, much lower long lived residual radioactivity in structural components, no need to breed tritium, and the potential for direct conversion to electricity at 60-70%.

More recently, it has been shown that the near term applications of the D^{3}He fuel cycle may have near term commercial benefits long before it becomes a factor in the production of electricity [6,7,8]. The short-term attractiveness stems from the fact that small Inertial Electrostatic Confinement (IEC) devices have been operated with the D^{3}He fuel cycle [9]. These devices appear to be attractive in making much-needed short lived radioisotopes for medical diagnostics. Once the physics of small IEC devices is understood, there will be a credible path to larger facilities to produce electricity. Thus, the near term demonstration of D^{3}He fusion in an IEC device will help to develop the demand for larger quantities of lunar ^{3}He needed for commercial power plants.

This paper will describe the operation of the world's first steady state D^{3}He fusion plasma (see attached figure) and it will discuss one possible pathway to commercial utilization of lunar sources of ^{3}He.

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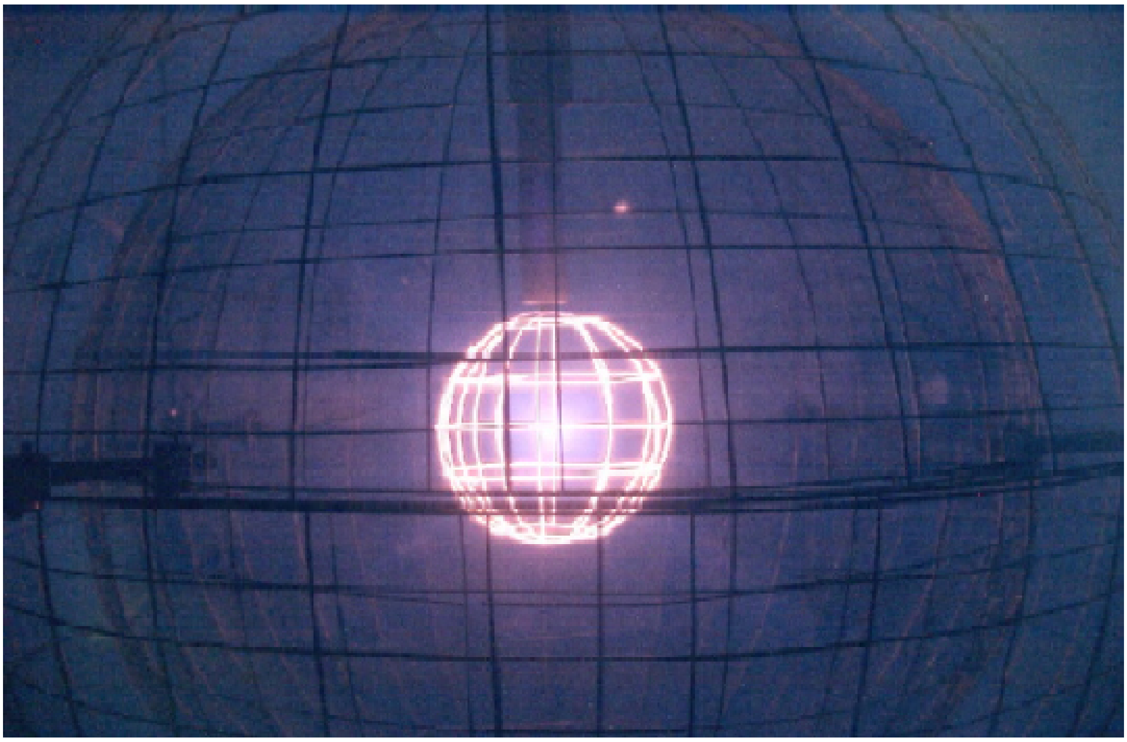

Operation of a Steady State D3He Plasma in an Inertial Electrostatic Confinement Device at the University of Wisconsin