Paper ID: 20012
student

SPACE PROPULSION SYMPOSIUM (C4)
Joint Session on Nuclear Propulsion and Power (7-C3.5)

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DESIGN OF THE MIXING CHAMBER IN A GAS CORE NUCLEAR REACTOR FOR SPACE PROPULSION

Abstract

The most feasible option for tomorrow's round trips to celestial objects within a short span of time is Gas Core Nuclear Reactors based Rockets (GCNRR). GCNRR works when the Uranium plasma present in the core of the reactor emits thermal radiation which is absorbed by the H2 propellant flowing around the plasma picking up the thermal energy. Due to which H2 molecules get excited leading to increase in velocity in-turn when expanded through the nozzle producing very high thrust and specific impulse theoretically around 1000-5000 seconds. This work is an effort to make GCNRR a reality by eliminating any hindrance for its success. One of the most important factors for a GCNR to be successfully implemented in Space Propulsion is to obtain a homogeneous mixture of UF6 and liquid H2 before it enters the reactor core. To obtain the same we need to determine characteristic mixing length rather say all design parameters of the mixing chamber are to be determined. In order to design the reactor core appropriately we need to predict the exact physical parameters of the UF6 and liquid H2 mixture, just before it enters the core of GCNRR i.e. at the outlet of the mixing chamber. Apart from this Uranium consumption rate needs to be maintained at 1Therefore numerical simulations are conducted to determine the design parameters of the mixing chamber, in which desired species ratio could be obtained at the outlet of the mixing chamber. Also predict physical properties of the mixture which could be used to design a successful reactor core. Software such as ANSYS and COMSOL are used along with Fortran code to predict the optimal working parameters for a gas core reactor utilized in a rocket. The paper discusses the design parameters and gives specific design recommendations using this reactor for space propulsion.