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THE PLAUSIBILITY OF UTILIZATION OF GAS CORE REACTORS FOR DEEP SPACE MISSIONS

Abstract

Le Rêve d'Étoiles or the **Dream of Stars** have been a common dynamo for mankind since the dawn of the civilization. Since mankind has looked upon the stars, he has felt the compulsion to reach out there. Although there have been many advancements in space technology since the time of Korolev and von Braun, mankind can still be considered as being in the infancy stage when it comes to deep space missions. When it comes to manned missions, the farthest location that we have been able to reach is the Moon. Going to a nearby planet such as Mars with a manned mission still seems to be at least a decade away with the present technology.In addition, transportation of unmanned probes for deep space missions also had not really advanced too much as compared to the technologies of the Voyager missions era. Current technology allows for decades to pass before it can even be possible to reach heliopause with a new probe.

One way to overcome these difficulties would be to use Nuclear Propulsion Systems to obtain the necessary high velocities. However a quick review of literature will quickly show that standard Nuclear Thermal Propulsion systems have a very low specific impulse. Hence while they may shorten the time of the mission, it is still long way from viable deep space missions. However, review of existing literature as well as analytical and numerical study of gas core reactors show promisingly high specific impulses which can be sustained over long periods of time.It is a well established fact that high temperatures in the combustion chamber of rockets can lead to correspondingly high exhaust velocities and hence high specific impulse. In gas core nuclear reactors, the classic combustion process is replaced by a fission process where the fission fuel is Uranium Hexafluoride in gaseous form and the rocket fuel is diatomic Hydrogen. The high temperatures attained in the reactor core due to fission kinetics of Uranium Hexafluoride leads to high excitation values of Hydrogen causing high exhaust velocities. This paper describes these processes in detail along with numerical simulations using relevant software. The velocity and energy values are calculated in a case study including fission kinetics in a gas core reactor and their correlation to exhaust velocities are discussed.