PRC Student Luncheon - Faculty/Industry Mentoring
UAH Propulsion Research Center, Friday, January 25, 2019

"DEVELOPMENT PLAN FOR A FISSION AND FUSION POWERED PROPULSION SYSTEM TO REACH MARS IN 45 DAYS"

Speaker: Dr. Jason Cassibry

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Bimodal nuclear fusion-fission propulsion offers a distinct, high-payoff strategy for minimizing the time of deep space exploration missions. Using straight line trajectory estimates, a 45 day rendezvous with Mars requires a ~20 MW power supply, 250 N thrust, and an Isp of ~5,000 s, assuming a specific power of 5 kW/kg. A deep space mission to 125 AU in 10 years requires a 500 kW reactor running continuously for 6 years, 1 N thrust, and an Isp of 75,000 s. Although these performance estimates are close approximations, they ignore two important details. First, the vehicle needs high thrust to escape Earth's gravity well, otherwise the propulsion system may require a long spiraling departure. Fusion or fission/fusion hybrid propulsion can provide the specific power and very high specific impulse (Isp) during heliocentric cruise to enable the mission transit time goals to be met. However, like NEP, it may not satisfy the high thrust needs for time efficient planetary departure and capture maneuvers. Furthermore, in addition to many complex operational and technical challenges, a fusion module requires the availability of an initialization energy source (e.g., electric power) for reliable restarts of the engine. Therefore, a hybrid propulsion system employing bimodal fission modules and a fusion module would be a viable approach. Some of the key challenges to developing critical technologies will be discussed in this paper, and multi-body trajectory analysis will be performed to indicate the performance requirements and capabilities of such a system. A growth path for the bimodal fission system will be presented. For the fusion system, initial experiments, diagnostics and modeling emphasizing the thermonuclear burn physics and magnetic nozzles will be discussed to show the scaling from laboratory to breadboard.

There will also be short guided tours of our Johnson Research Center Laboratories at 1:30 p.m. following the luncheon.

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