UAHuntsville
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE
4th Wernher von Braun Memorial Symposium
October 24 – 26, 2011

American Astronautical Society

Test and Evaluation of Fusion System Components for Space Integration

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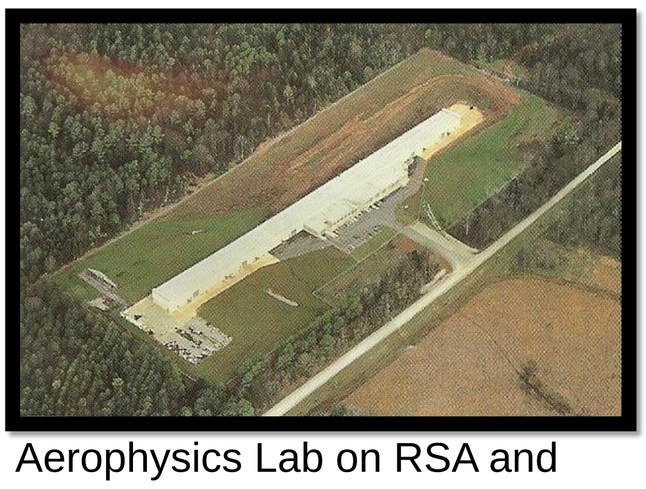
Overview

A top level discussion highlighting the need for well planned test matrices and test evaluation strategy leading to a better understanding of how to successfully manage and integrate a fusion propulsion system.

Key Findings

• Specific Power • Specific Impulse • Thrust • Beta • Ignition • Efficiency • Throttle Capability • Electrical Power Variability • Dual Mode Operation • Space Restart Capability • Radioactivity

The truncated list of concepts above are an example of the type of parameters that must be determined through testing and development for a fusion propulsion system before a fully integrated system can be assembled. Several of the items listed have never been addressed (such as electrical power variability and dual mode operation) and would require initial testing such as burn experiments and net power demonstrations. The items to be tested would require prioritization, with several items dependent on a previous test (such as modes of operation will follow net power demonstrations). It is easy to see how the timeline and cost are extensive for the testing and qualification of the design concepts and will more than likely require a second round of testing for design verification of the actual component that will be integrated onto the system. Many items will never be “earth tested” such as life of the system and will not be determined until consolidated with the entire system during actual flight.



Aerophysics Lab on RSA and future home of DECADE Module II

Princeton Plasma Physics Lab

LDX experiment under construction at MIT

Explanation

According to the American Astronomical Society website, the mission of the organization is to **“enhance and share humanity's scientific understanding of the Universe.”** Test and evaluation results in both successes and failures; each road brings one closer to a better understanding of the subject matter being evaluated. While research and development is the starting line on the journey to exploration, testing and evaluation is the bridge connecting the idea to the finish line of a product in its intended environment.

Impact

A well maintained and detailed test matrix, to include entrance and exit criteria of each milestone, will maximize test funding and provide valuable data applicable to every element of the system. A successful set of component tests will help to ease concerns over the estranged fusion propulsion concept by providing a positive network of notable achievements linked with pertinent data to help advance the system as a whole. Component testing can also lead to the development and use of other test methods to meet certain specific needs. Such advances in the field of testing could lead to methods branching further than fusion systems and would undoubtedly bolster the scientific community. A leading example of this concept can be found in the development of a diagnostic system to measure fluctuation-induced transport designed during testing of the NASA-Lewis Electric Field Bumpy Torus. Above all, a detailed, compartmentalized testing scheme will result in the better understanding of each fusion propulsion subsystem, which will produce diagnostic skills that will increase the successful completion of both manned and unmanned missions.

Acknowledgements: Dr. Jason Cassibry