Developing an Accurate Model of Microwave Propulsion

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Spacecraft are often limited by the efficiency of their engines and the amount of propellant they can carry. Recently, however, a new experimental propulsion technique known as microwave propulsion has emerged which could potentially rival more conventional high efficiency propulsion techniques such as ion or plasma propulsion in terms of thrust produced and energy required. The propulsion technique has been experimentally researched by several independent research groups including NASA and the Northwestern Polytechnical University in Xi'an, China. The majority of the work on the device, however, was done more to prove the concept rather than understand the underlying mechanisms of the device. Each group seemed to produce their own separate hypothesis as to how the device worked which focused on four very different approaches: the particle dynamics, wave dynamics, quantum field dynamics, and thermodynamics coupled with fluid dynamics of the system. My project was to determine mathematical theories based off of the first principles of each approach and compare the theoretical results with publicly available experimental data in order to correctly model the thrust produced by microwave propulsion in order to develop our understanding of this propulsion technique and the underlying physics behind the device as well as potentially provide a basis for optimization and scaling up of the device.

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