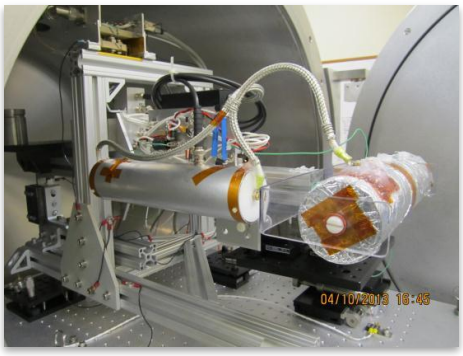
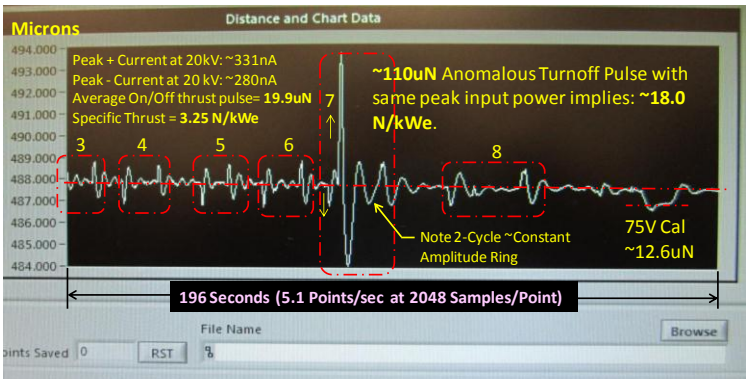
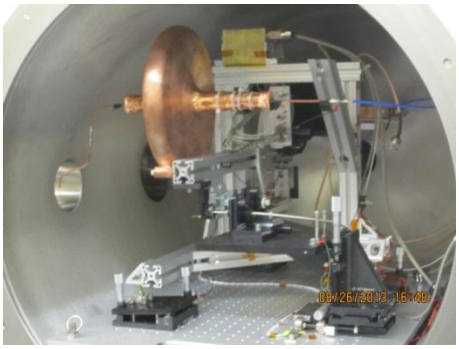
Q-Thrusters

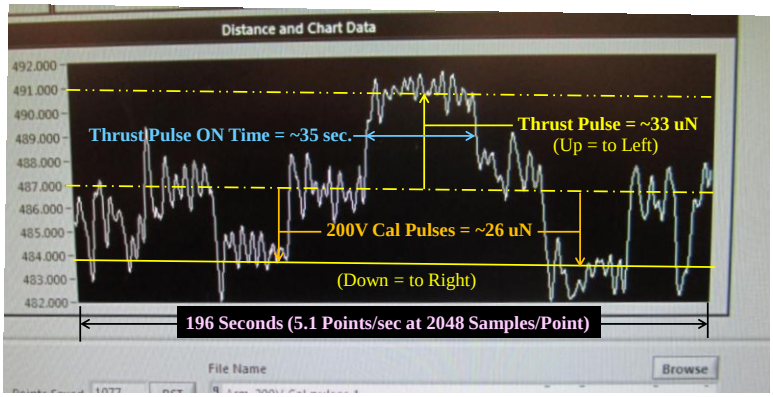
NASA/Boeing/SFE Campaign: Boeing/DARPA sent Eagleworks Lab an SFE test article for testing and evaluation. The guest thruster was evaluated in numerous test configurations using varying degrees of Faraday shielding and vacuum conditions. Observations show that there is a consistent transient thrust at device turn-on and turn-off that is consistent with Q-thruster physics. The magnitude of the thrust scaled approximately with the cube of the input voltage (20-110uN). The magnitude of the thrust is dependent on the AC content of the turn-on and turn-off pulse. Thrust to power of transient thrust was in the ~1-20 N/kW range.





NASA/Cannae Campaign: The lab worked with Cannae to develop a ~1GHz RF test article for evaluation in the lab using the low thrust torsion pendulum. Two test articles were evaluated and both generated continuous thrust in the 30-50 micro-Newton range. The thrusters were operated in 30-60-90 second intervals which confirms that the RF approach will be a quicker path to long-life flight thrusters. Thrusters were mounted in opposite orientation to demonstrate thrust reversed sign, and dummy loads were tested to quantify any RF interaction with the environment (none detected). NASA and Cannae will continue to partner working towards implementing a Phase Lock Loop-enabled test article for Independent Verification and Validation at GRC and JPL. Some additional IV&V locations equipped with low-thrust torsion pendulums are the Aerospace Corporation, Naval Research Labs, and Busek.

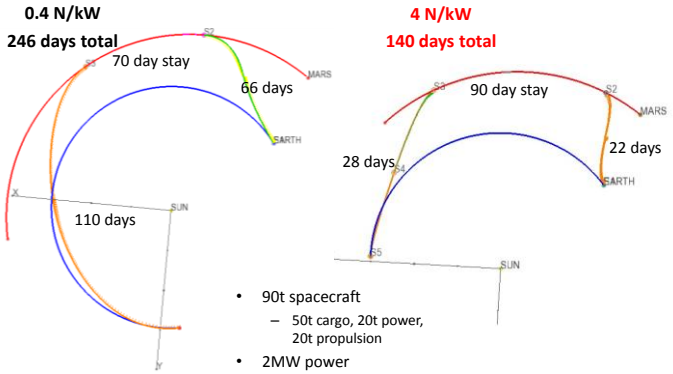




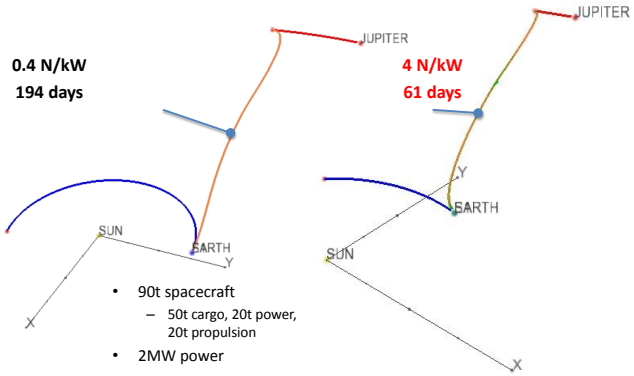
Trajectory Analysis

Lab personnel worked with the developers of Copernicus (trajectory analysis tool) to model q-thruster-enabled missions to multiple destinations in the solar system and beyond. Missions were considered with thrust to power of 0.4 N/kW and 4N/kW. This performance was coupled to a notional 2MW nuclear reactor that is conservative (10kg/kW "John Deere" class). The below trajectories are for a 90 metric ton spacecraft which breaks down to 50 tons cargo, 20 tons power, 20 tons thrusters.

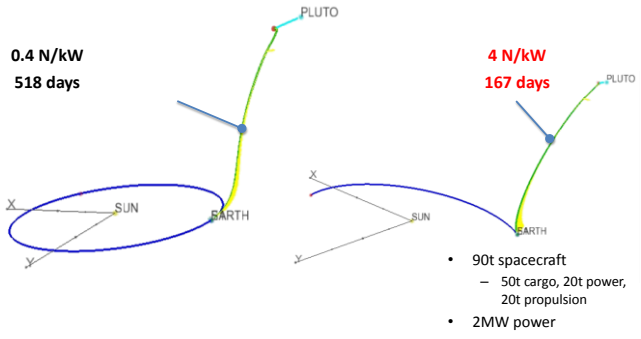
Mars (roundtrip):



Jupiter (capture):



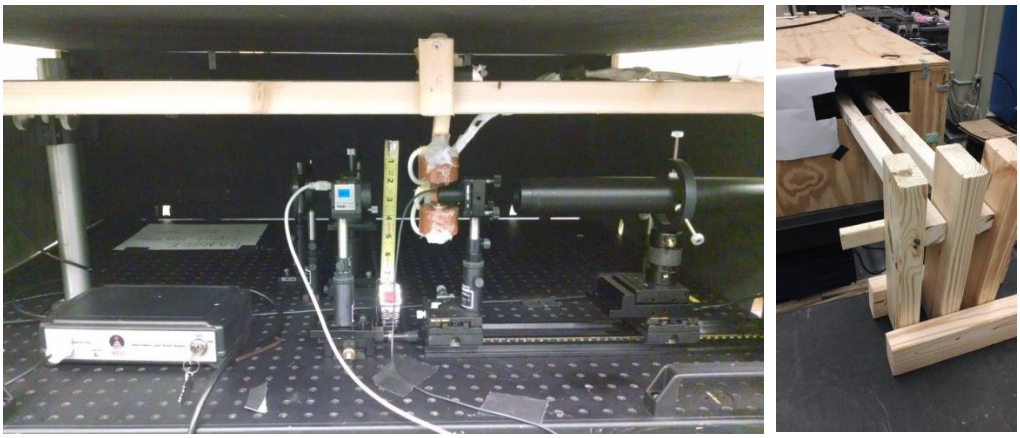
Pluto (capture):



Warp Field Interferometry

Lab performed numerous tests attempting to detect warp bubble utilizing both the Michelson and Fabry-Perot interferometers. Based on some interesting results showing dependency on varying potential ($d\phi/dt$), team is focused on this intersection with q-thruster physics. Q-thrusters use large $d\phi/dt$ to generate non-trivial amounts of negative pressure - both of these conditions are highly desired for warp bubble generation. The pictures below show a test article suspended above the Fabry-Perot interferometer, and the analysis results are depicted below the laboratory setup. The surface plots are the frequency of interest from a Fourier transform of the time history for each pixel. If there is no warping present or changes in optical path length for the photons, then the surface plot would be a flat surface, dark blue in color. The team will continue to work on eliminating all sources of mimicry that could generate this non-null data.

Test article in optics lab



Fourier transform data for imager (left pane is for floated lab, right two are non-floated lab)