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Experimental Validation of a Hydromagnetic Rankine-Hugoniot Model for Pulsed Plasma Thrusters FLAVIO POEHLMANN, NICOLAS GASCON, MARK CAPPELLI, Stanford University — The most commonly used model for the Pulsed Plasma Thruster (PPT) is based on an electric circuit analysis, which provides only little physical insight to the mechanism by which the discharge accelerates the propellant. We present a model for the acceleration mechanism in gas-fed PPTs that is derived from early work on coaxial plasma deflagration guns[1] and is based on an analogy to chemical combustion waves. More specifically, the Rankine-Hugoniot theory for detonations and deflagrations can be extended to include magnetohydrodynamics in plasmas. Equations have been derived for the exhaust velocity and a mode transition to the so-called plasma deflagration mode that was independently observed by several researchers[1,2] can be explained based on this model. Experimental data was taken at Stanford to verify the validity of the derived equations.

[1]Cheng, D.Y., "Plasma Deflagration and the Properties of a Coaxial Plasma Deflagration Gun", Nuclear Fusion 10, 1970
[2]Woodall, D.M., Len, L.K. "Observation of current sheath transition from snowplow to deflagration" J. Appl. Phys. 57 (3), Feb 1985

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