Contribution ID: **70** Type: **Contributed Oral**

C2Or4B-08: The design of a flow boiling visualization experiment for liquid hydrogen

Tuesday 20 May 2025 18:00 (15 minutes)

Liquid hydrogen is the highest specific impulse rocket fuel available and is used on roughly 25% of active United States rocket launch systems. However, these systems are informed by heat transfer correlations, the most recent of which has 50% root-mean-squared error when used with liquid hydrogen. No previous experiment has optically determined multiphase hydrogen flow regimes with heat transfer measurements, contributing to this error. To address this gap, this publication presents the design and preliminary results of a two-phase hydrogen visualization flow cell that can address uncertainty in existing models by providing velocity, mass flow rate, void fraction, and pressure drop data while identifying flow regimes in two-phase hydrogen. Preliminary results using liquid nitrogen are provided with uncertainty analysis. The resulting system will be used to characterize departure from nucleate boiling and heat transfer criticality for increased confidence in multi-phase liquid hydrogen flow estimates for system design.

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Session Classification: C2Or4B - Instrumentation, Visualization, and Controls II