Electric Field Effects on Pool Boiling Heat Transfer in Low-G Environments (FP-09)

STATUS QUO

- **Single phase heat exchangers are currently used for cooling on ISS and other space platforms.**
- **Pool boiling can provide much higher heat transfer than single phase in low-g, but the amount of heat that can be transported is limited by the lack of buoyancy**
- **It is known that electric fields can be used to partially replace gravity as a body force, thereby allowing high heat transfer, but the effects are difficult to quantify at present.**

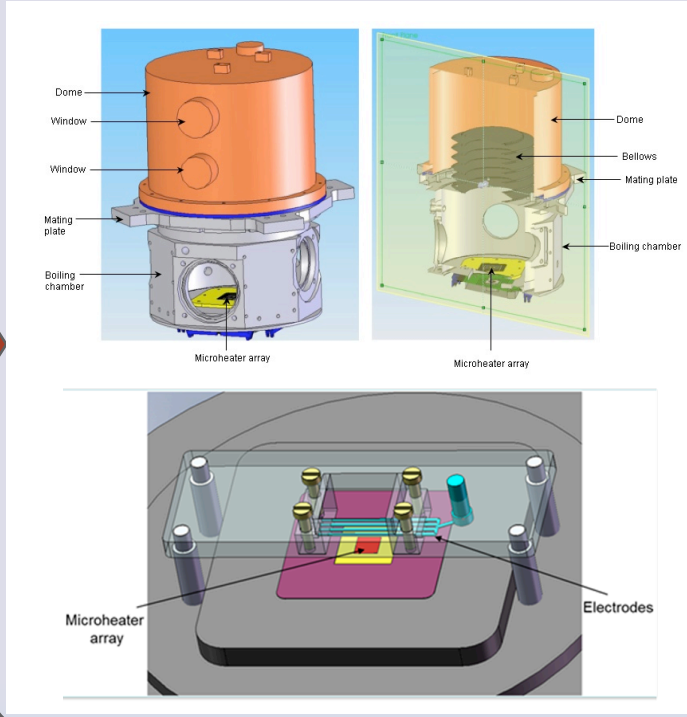
NEW INSIGHTS

Technology Focus Area: Fluid Physics

A microheater array with 96 independently controllable heaters is used to measure the local heat transfer. An electrode array placed above these heaters will provide a non-uniform electric field that will remove bubbles that are formed on the heater surface. By comparing the heat transfer level with and without electric fields, we can quantify the effective gravity level provided by the electric field.

TEST APPARATUS OVERVIEW:

Two racks are used. The first rack contains the microheater array and the associated control electronics. A second rack contains displays, power supplies, and video recorders. The electrodes are powered by a high-voltage supply up to 20 kV (extremely small currents).



QUANTITATIVE IMPACT

Requested Zero-G conditions

- Up to 30 1.8 g to zero-g parabolas per day
- 4 days of flying

Test Parameters to be varied

- Liquid and heater temperatures
- Electric field intensity

No. of Personnel:

- 3 test personnel per flight

Additional Requirements:
1 air bottle per flight.

END-OF-PHASE GOAL

Project Impact:

- The tests will allow the effective body force provided by an electric field to be quantified under a range of test conditions.
- The data generated will provide experimental results with which to verify models of electric field effects on pool boiling heat transfer, and possibly lead to more compact, higher efficiency space heat exchangers.

The experiment will quantify the effect of electric fields on heat transfer during pool boiling heat transfer, possibly leading to more compact and efficient space heat exchangers.