Thermal Radiation Heat Transfer Solution Method Investigation

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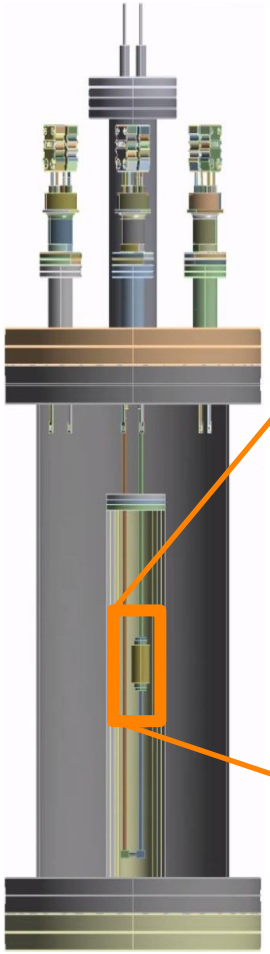
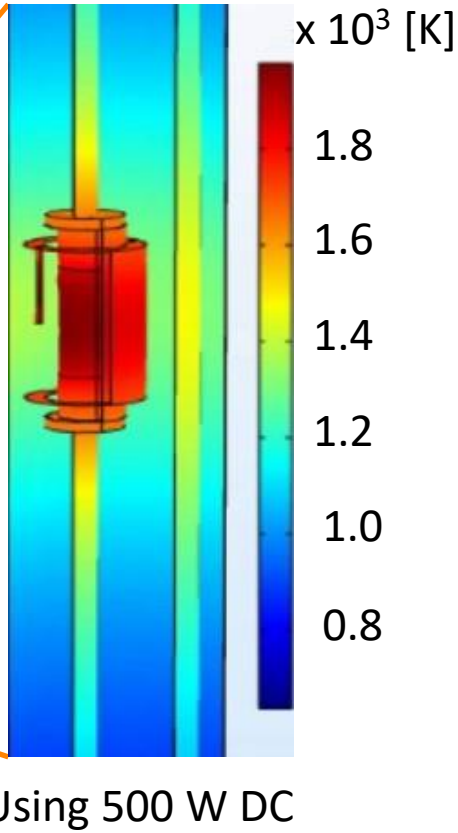
INSET Experiment





Using 500 W DC

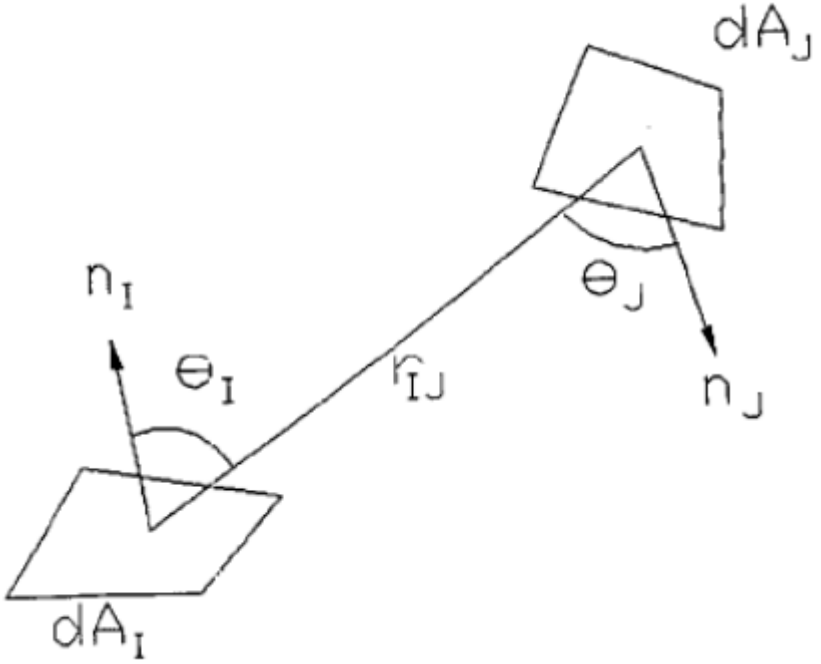
[1]

Heat Transfer in Vacuum

$$Q_{IJ} = \frac{(E_{I\lambda b} - E_{J\lambda b})d\lambda}{\frac{1-\epsilon_I}{\epsilon_I A_I} + \frac{1}{A_I F_{IJ}} + \frac{1-\epsilon_J}{\epsilon_J A_J}}$$

View factor is a challenging, but essential value to define

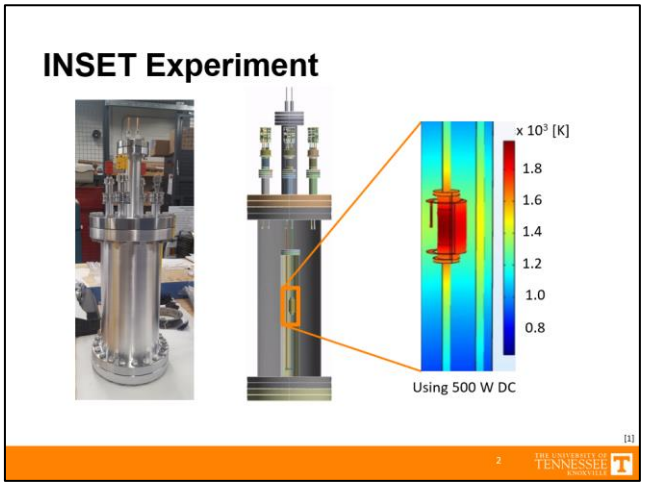
$$A_I F_{IJ} = \int_{A_I} \int_{A_J} \frac{cos(\theta_I) cos(\theta_J)}{\pi r_{IJ}^2} dA_I dA_J$$

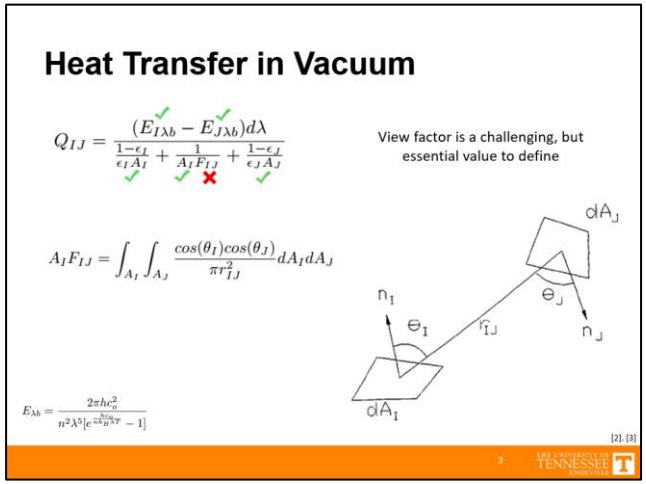


$$E_{\lambda b} = \frac{2\pi h c_o^2}{n^2 \lambda^5 [e^{\frac{hc_o}{nk_B \lambda T}} - 1]}$$

[2]. [3]

Verification

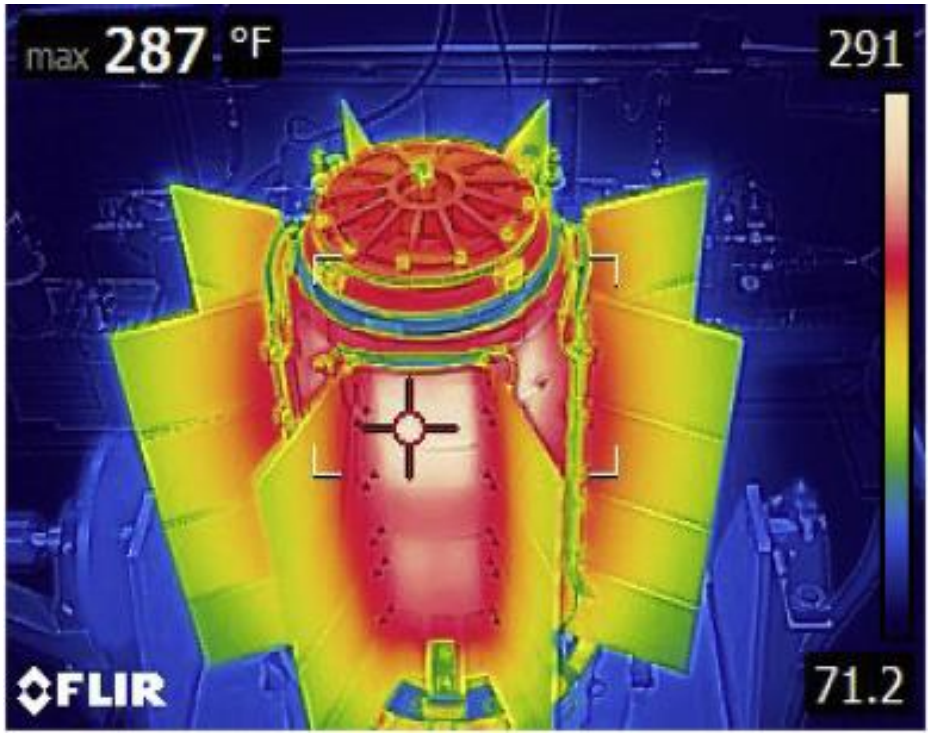




Use experiment to verify radiative heat transfer assumptions, solution methods, and programs

Radiative Heat Transfer in Space

- NTP experimental testbed validation
  - INSET
- RTG
  - Rover
  - Flyby
    - Incoming and outgoing
- Surface power



[4]

Thank You

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References

[1] COMSOL 5.4 Multiphysics User Manual. Heat Transfer Module. 2019.

[2] R. Siegel, J. Howell; Thermal Radiation Heat Transfer. Taylor and Francis, 4th edition. 2001.

[3] A.F. Emery, O. Johansson, M. Lobo, A. Abrous; A Comparative Study of Methods for Computing the Diffuse Radiation View factors for Complex Structures. ASME Journal of Heat Transfer, vol 113, no 2, pg 413-422. 1991.

[4] Ralph D. Lorenz, Eric S. Clarke; Influence of the Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) on the local atmospheric environment. Planetary and Space Science, vol 193. 2020.