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Air Force Research Laboratory (AFRL)'s Thermal Roadmap for Space: Enabling the US Space Force

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Abstract

The Air Force Research Laboratory (AFRL) has a long history of thermal management research, now foundational for the United States Space Force's technology portfolio. The AFRL Space Vehicles Directorate focuses on technologies strengthening the US supply chain and contributing to the space economy. This presentation details AFRL's thermal roadmap for space systems, a unique perspective shaped by decades of R&D, and its vision for future focus areas. Key technologies like Evolved Expendable Launch Vehicle (EELV) Secondary Payload Adapters (ESPAs), Oscillating Heat Pipes (OHPs), and Variable Emissivity Materials (VEM) will be discussed.

This presentation will highlight key AFRL-developed technologies, including advancements in Oscillating Heat Pipes (OHPs), Additively Manufactured – Loop Heat Pipes (AM-LHP), and Variable Emissivity Materials (VEM), all of which are enabling critical capabilities for the US space community. The talk will detail the directorate's vision for its thermal roadmap, outlining future focus areas and strategic priorities to address the evolving thermal management challenges of next-generation space systems. We will delve into the current state-of-the-art for select technologies, showcasing recent advancements and performance characteristics.

Finally, the presentation will conclude with a discussion of collaborative opportunities, inviting participants to engage with AFRL in advancing thermal management solutions for the benefit of the US Space Force and the broader space economy. This presentation aims to foster partnerships and accelerate the development and deployment of innovative thermal technologies for future space missions.