

Potential Uses of Deep Space Cooling for Exploration Missions

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Nearly all exploration missions envisioned by NASA provide the capability to view deep space and thus to reject heat to a very low temperature environment. Environmental sink temperatures approach as low as 4 Kelvin providing a natural capability to support separation and heat rejection processes that would otherwise be power and hardware intensive in terrestrial applications. For example, radiative heat transfer can be harnessed to cryogenically remove atmospheric contaminants such as carbon dioxide (CO₂). Long duration differential temperatures on sunlit versus shadowed sides of the vehicle could be used to drive thermoelectric power generation. Rejection of heat from cryogenic propellant could avoid temperature increase thus avoiding the need to vent propellants. These potential uses of deep space cooling will be addressed in this paper with the benefits and practical considerations of such approaches.