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# A COMPREHENSIVE STUDY OF SOLAR AND NUCLEAR HYBRID POWER SYSTEMS IN SPACECRAFT DESIGN FOR DEEP SPACE MISSIONS

**Abstract**

Deep space exploration missions demand robust power systems capable of adapting to diverse and challenging environments. Therefore, it is crucial to consider the target celestial body's location when designing spacecraft's power system. In this article we propose that combining the strengths of solar and nuclear into a hybrid power system, would enable spacecraft to benefit from both the proven reliability of solar panels and the endurance power output of a compact nuclear reactor, offering a versatile and sustainable solution for missions spanning the inner to outer solar system and beyond. By bridging theoretical modelling with empirical evidence, this study endeavours to assess the potential applications, feasibility and limitations of the proposed spacecraft energy systems for upcoming deep space missions. Furthermore, this paper offers an extensive survey of contemporary spacecraft power technologies from decades of space exploration experience, as well as provides actionable insights and recommendations for seamlessly integrating hybrid power systems into spacecraft designs. As deep space exploration becomes an integral facet of humanity's scientific ambitions, this research seeks to provide insights into the strategic deployment of solar and hybrid technologies, to pave the way for missions ultimately expanding our understanding of the universe's frontiers. This research project is part of the Andromeda research program of the Deep Space Initiative, a non-profit space research organisation based in Colorado, USA.