IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

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# ADVANCED PROPULSION FOR INTERSTELLAR EXPLORATION: INTEGRATING SOLAR AND LASER SAIL TECHNOLOGIES

**Abstract**

This research investigates the feasibility of interstellar exploration by leveraging a synergistic combination of solar and laser sail technologies. Building upon the successes of projects like Breakthrough Starshot, this research explores the development of advanced sail materials, including graphene-based structures engineered with metamaterials, to maximise light capture and minimise mass. Furthermore, the project investigates the integration of high-powered laser arrays with solar sail propulsion, enabling continuous acceleration and achieving unprecedented velocities. Key areas of focus include (1) the development of lightweight and durable sail materials with optimised optical properties; (2) the design and construction of scalable and efficient laser array infrastructures; (3) the development of advanced guidance and navigation systems for autonomous interstellar travel; and (4) the exploration of mission architectures that leverage both solar and laser propulsion for optimal trajectories and mission durations. This research aims to demonstrate the feasibility of solar and laser sail propulsion for reaching nearby star systems within a human timescale, paving the way for future interstellar missions and expanding the frontiers of human civilisation.