

Solar Thermal Propulsion for Small Spacecraft: The Future of Efficient Space Travel

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Why Small Spacecraft Need a Propulsion Upgrade

Traditional chemical propulsion systems are heavy, expensive, and inefficient for modern small satellites. A CubeSat weighing just 10 kg can devote up to 30% of its mass to fuel tanks alone. With over 2,000 small spacecraft launched annually--60% of which serve Earth observation or communications roles in low-Earth orbit--the limitations are clear. How can we extend mission lifetimes without sacrificing payload capacity? Enter solar thermal propulsion, a technology redefining mobility in space.

How Solar Thermal Propulsion Works

Unlike solar-electric systems that convert sunlight into electricity, solar thermal propulsion uses concentrated solar energy to directly heat propellants like hydrogen or ammonia. This process achieves specific impulse (Isp) values exceeding 800 seconds--triple the efficiency of conventional hydrazine thrusters. For instance, NASA's 2022 ASTHROS mission demonstrated a 40% mass reduction in propulsion systems using this method, enabling longer-duration lunar exploration.

Key Advantages Over Competing Systems

- **No onboard batteries****: Direct solar energy eliminates heavy energy storage
- **Scalable design****: Works for CubeSats (1U-12U) and microsattellites (

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