An Overview of Solar Sails
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What are Solar Sails?
Solar sails function by absorbing the momentum from reflected photons and using that momentum to propel the spacecraft forward. They are made of a thin, reflective material, usually Mylar or a coated polyimide.

History of Solar Sailing
Johannes Kepler - 1608
Kepler considers the notion of a sail designed to capture solar winds to propel a spacecraft.

Mariner-10 - 1974
After running out of fuel, NASA engineers replicated solar sail effects using the attached solar panels.

IKAROS - 2010
[Interplanetary Kite-craft Accelerated by Radiation Of the Sun]
JAXA launches the first successful spacecraft powered by solar sail.

LightSail - 2015
The Planetary Society launches LightSail 1, a CubeSat that uses solar sail propulsion.

NEA Scout - 2021
[Near-Earth Asteroid Scout]
NASA prepares to launch a CubeSat to investigate a near-Earth Asteroid

Solar Sails: Advantages and Disadvantages
Advantages
• Able to function indefinitely (Theoretically)
• Saves weight by not carrying fuel
• Requires less energy to maintain
• Could be interlaid with thin solar panels that restore energy to the spacecraft

Disadvantages
• Large
• require a deployment mechanism to expand and hold the sail in position
• Needs to be carried into orbit by another spacecraft or have a combination of the two propulsion systems
• Fragile, could be torn by large debris.
• Rely on intensity of the nearest star to move
• difficult to perform emergency maneuvers
• Loss of efficiency at long distances

Thruster-based Propulsion Systems: Advantages and Disadvantages
Advantages
• Greater technology readiness level
• Able to leave Earth’s atmosphere
• Easier to control thrust output

Disadvantages
• Difficult to extend duration of fuel for long-term missions
• Sacrifices thrust performance
• Fuel is volatile
• Can cause serious damage if impacted

Glossary
Satelloon: portmanteau of Satellite and Balloon, used to describe the Echo craft
CubeSat: Satellite made of multiple cubes measuring 10x10x10 cm

References
The European Space Agency (n.d.). “Solar Sails.”

Conclusions
The field of solar sails is new and ever-expanding. It is worth investigating how this method of propulsion compares to other methods and what the best circumstances for its use. Given time, the use of solar sails has the potential to become one of the safest and most efficient methods of travel.