

COSMOS 1: FIRST SOLAR SAIL SPACECRAFT

A Project of The Planetary Society & Cosmos Studios

SOLAR SAIL FAQs

Does a solar sail fly on the solar wind?

No! The solar wind is made up of ionized particles ejected by the Sun. These particles move much slower than light. A solar sail does not stop or reflect them, although they also may impart some of their momentum to the solar sail. However, the force from the solar wind is less than one percent of that from light pressure.

How does a solar sail work?

When the light from the Sun reflects off the surface of the solar sail, the energy and momentum of light particles known as "photons" is transferred to the sail. This gives the sail a "push" that accelerates it through space. Although the acceleration is very slight, it is also continuous, enabling the sail to reach very high speeds in a relatively short time. The direction of the push is controlled by the angle of the sail with respect to the Sun, adding to or subtracting from the orbital velocity.

How fast does a solar sail go?

The speed of an interplanetary solar sail spacecraft will depend on how long it has been propelled by the pressure of sunlight. The acceleration from sunlight is very small – approximately half a millimeter per second per second, depending on size and weight of the sail and the spacecraft. Over one day, that is a velocity increase of 45 meters per second or about 100 miles per hour. *Cosmos 1*, being heavier than an interplanetary sail, and traveling in and out of the sunlight while in Earth orbit, will go slower than this.

The real advantage of solar sailing is that, unlike a chemical rocket that applies a lot of thrust but only for an instant, sunlight hitting the sail applies thrust continuously. In 100 days a sail could reach 10,000 miles per hour; in one year it could reach 36,000 miles per hour. In just three years, a solar sail could reach a speed of over 100,000 miles per hour. At that speed you could reach Pluto in less than five years.

What can a solar sail be used for?

Solar sails can be used to boost or decrease the orbits of spacecraft, travel between the planets within our solar system, and someday take us to worlds around other stars. However, once you get much beyond the orbit of Jupiter, energy from sunlight is too weak. When far from the Sun, lasers can be directed at the sails.

What is the advantage of using a solar sail?

The great advantage of a solar sail is that it requires no fuel. A solar sail spacecraft can, in time, move the spacecraft even faster than a chemical rocket. For a round trip solar sails have a great advantage since no fuel is needed for the return.

How is the sail controlled?

Cosmos I is designed as eight triangular blades. When combined, their total structure is equivalent to a disk. Each blade can be pitched, similar to how a helicopter blade changes angle so the pilot can control the motion of the aircraft. The pitch angle varies the direction of the reflected sunlight pressure so that force may be applied in any direction. The control algorithms for the spacecraft are programmed onto the on-board computer and can be operated by commands from the ground or, if necessary, autonomously.

How thin are the reflective sails, and what material are they made of?

The sails are made of 5-micron-thin aluminized reinforced Mylar. That is about 1/4 the thickness of a trash bag. The sail must be as light as possible to maximize the acceleration.

How much does your spacecraft weigh and how big are the sails?

The spacecraft mass is approximately 100 kilograms. This is extremely light for a spacecraft. *Cosmos I* has eight rotating solar sail blades. Each one is triangular in shape, about 15 meters (50 feet) in length. The total area is 600 square meters.

What is the mission destination?

Our goal is to fly in Earth's orbit to demonstrate control under sunlight pressure.

Who is the Project Director?

Dr. Louis Friedman, Executive Director of The Planetary Society is the *Cosmos I* Project Director. He was the program leader of the NASA Solar Sail program in the 1970s and is author of the book, *Starsailing: Solar Sails and Interstellar Travel*.

How was *Cosmos I* funded?

Cosmos Studios, the science-based entertainment company led by Ann Druyan, is the primary sponsor of the project with additional funding donated by members of The Planetary Society.