In 2011, NASA deployed the 10 square meter, NanoSail-D2 satellite, which used the pressure from sunlight to push the satellite around in its orbit. At the distance of Earth from the sun, the solar pressure is only about 0.000009 Newtons per square meter.

The Parker Solar Probe spacecraft will reach a distance of only 7 million kilometers from the sun, where the sunlight pressure is 0.0047 Newtons per square meter.

At this distance, the pressure of sunlight has to be accounted for in order to predict an accurate orbit for the spacecraft near the sun!



The Pressure of Sunlight with the ***Parker Solar Probe***

**Problem 1** – The Parker Solar Probe mission will travel to the vicinity of the sun with its heat shield facing the sun at all times. If the heat shield is rectangular with dimensions of 2.4 meters by 3.1 meters, what is the total surface area of the heat shield in square meters to the nearest tenth?

**Problem 2** – At its closest distance to the sun, the radiation pressure from sunlight will be 0.0047 Newtons per square meter. What will be the total force acting on the spacecraft heat shield at this location?

**Problem 3** – The spacecraft has a total mass of 530 kilograms. What acceleration will the spacecraft feel from the radiation pressure in meters/sec2?

NanoSail D2 press release: <http://www.nasa.gov/mission_pages/smallsats/11-010.html>

**Problem 1** – The Parker Solar Probe mission will travel to the vicinity of the sun with its heat shield facing the sun at all times. If the heat shield is rectangular with dimensions of 2.4 meters by 3.1 meters, what is the total surface area of the heat shield in square meters to the nearest tenth?

Answer: A = 2.4 x 3.1 = 7.4 square meters.

**Problem 2** – At its closest distance to the sun, the radiation pressure from sunlight will be 0.0047 Newtons per square meter. What will be the total force acting on the spacecraft heat shield at this location?

Answer: F = Pressure x Area

= 0.0047 N/m2 x 7.4 m2 = 0.035 Newtons.

**Problem 3** – The spacecraft has a total mass of 530 kilograms. What acceleration will the spacecraft feel from the radiation pressure in cm/sec2?

Acceleration = Force/mass

F = 0.035 Newtons

M = 530 kg

A = 0.035/530 = **0.000066 meters/sec2**

**Extra problem:**

If the spacecraft spends 30 hours at this distance, what will be its change in speed in meters/sec?

Speed = acceleration x time

30 hours x (3600 sec/1 hour) = 10800 seconds.

Speed change = 0.000066 m/sec2 x 10800 sec = **0.72 meters/sec**

Answer Key