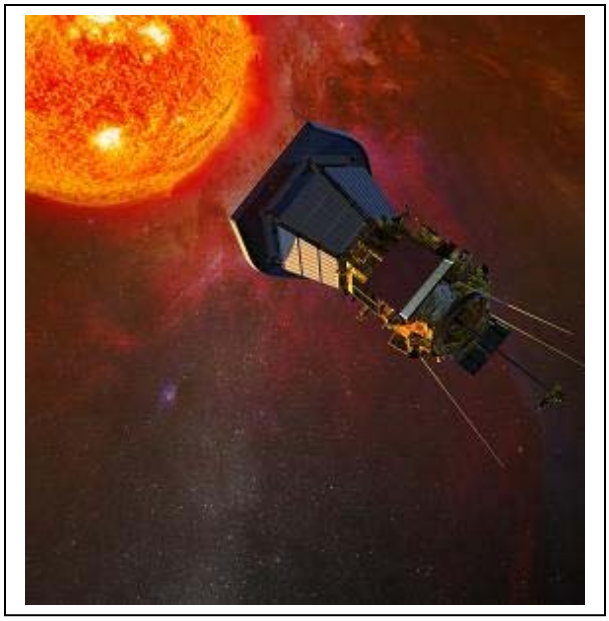

The Solar Probe Plus mission will be launched in 2018 for a rendezvous with the sun in 2024. To lose enough energy to reach the sun, the spacecraft will make seven fly-bys of Venus.

The 480 kg spacecraft, costing $740 million, will approach the sun to a distance of 5.8 million km. Protected by the heat shield will be five instruments that will peak over the edge of the heat shield and measure the particles and radiation fields in the outer solar corona.

At the closest approach distance, the sun will occupy a much larger area of the sky than what it does at the distance of Earth.

The angular size of an object as it appears to a viewer depends on the actual physical size of the object, and its distance from the viewer. Although physical size and diameter are usually measured in terms of meters or kilometers, the angular diameter of an object is measured in terms of degrees or radians. The angular size, t, depends on its actual size d and its distance r according to the simple formula

$$\theta = 2arcTan\left(\frac{d}{2R}\right)$$

For example, the angular size of your thumb with your arm fully extended for d = 2 centimeters and r = 60 cm is just θ = 2 arcTan(0.016) so θ = 1.8 degrees.

Problem 1 – At the distance of Earth, 147 million kilometers, what is the angular diameter of the sun whose physical diameter is 1.4 million kilometers?

Problem 2 – At the distance of closest approach to the solar surface Solar Probe Plus will be at a distance of 5.8 million kilometers from the solar surface. What will be the angular diameter of the sun if its physical diameter is 1.4 million kilometers?

Problem 3 – A DVD disk measures 12 cm in diameter. How far from your eyes will you have to hold the DVD disk in order for it to subtend the same angular size as the disk of the sun viewed by Solar Probe Plus at its closest distance?

Problem 1 – At the distance of Earth, 147 million kilometers, what is the angular diameter of the sun whose physical diameter is 1.4 million kilometers?

Answer: $\theta = 2arcTan\left(\frac{1.4million}{2x147million}\right)$

θ = 2 arctan(0.0048)

so θ **= 0.55 degrees**.

Problem 2 – At the distance of closest approach to the solar surface Solar Probe Plus will be at a distance of 5.8 million kilometers from the solar surface. What will be the angular diameter of the sun if its physical diameter is 1.4 million kilometers?

Answer: θ = 2 arctan (1.4/(2 x 5.8)) so θ **= 14 degrees**.

Problem 3 – A DVD disk measures 12 cm in diameter. How far from your eyes will you have to hold the DVD disk in order for it to subtend the same angular size as the disk of the sun viewed by Solar Probe Plus at its closest distance?

Answer: The desired angular diameter of the sun is θ = 14 degrees, and for the DVD disk we have d = 12 cm, so we need to solve the formula for r.

Tan (θ/2) = d/2r so

2r = d / tan(θ/2) then

r = 6 cm / tan(7) yields

r = **49 cm. This is about 18 inches**.

Note: From the vantage point of the Solar Probe Plus spacecraft, the sun's disk at a temperature of 5570 K is much larger (14 degrees) than it appears in Earth's sky (0.5 degrees), and this results in the spacecraft heat shield being heated to over 1600 K.

For more mission details, visit:

http://solarprobe.jhuapl.edu/

http://www.nasa.gov/topics/solarsystem/sunearthsystem/main/solarprobeplus.html