

Next topic: the solar system in a stellar context

Why are we doing this?

Why talk about the solar system in “Stars, Galaxies, & Universe”?

- It is a place to “start” the journey.
- We get a close-up view of a star system and a star, the Sun
- Planetary systems are part of stars, and form when the stars do.

Look further out into space

The study of solar system astronomy is fascinating in its own right

The surface of Mars as seen by the Mars Exploration Rover spacecraft

Size scales in the solar system

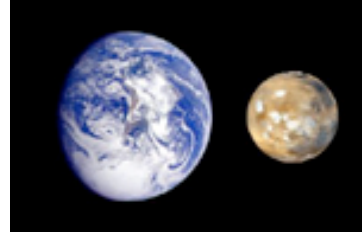
- Basic unit: 1 meter  $\Rightarrow$  demo
- 1 kilometer = 1000 meters = 0.6214 miles
- Diameter of Earth: 12756 kilometers (~ LA to Sydney)  $\rightarrow$
- Closest object in space: Moon, 384,000 km average distance  $\rightarrow$
- Most prominent object in astronomy: Sun, 149.6 million kilometers; 1 **Astronomical Unit**

The Earth and Moon in Space

## The Terrestrial Planets

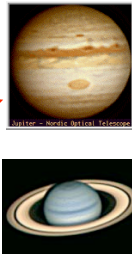
Planet	Distance (au)	Size
Mercury	0.387	0.38
Venus	0.723	0.95
Earth	1.00	1.00
Mars	1.523	0.53

## The Earth and Mars



## The Jovian Planets

Planet	Distance (au)	Diameter
Jupiter	5.2	11.2
Saturn	9.5	9.5
Uranus	19.2	4.0
Neptune	30.1	3.9

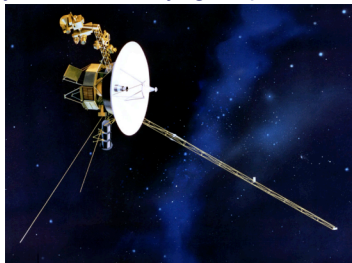


See Jupiter in the sky tonight! Look east at 9PM

## The Earth, Jupiter, and Saturn

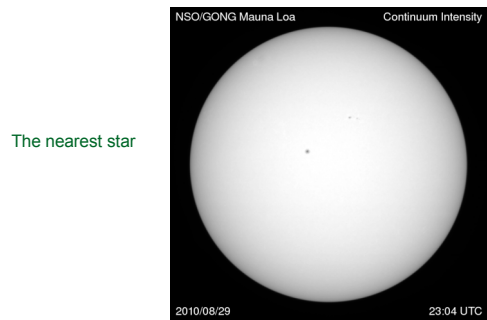


## A piece of Iowa in the distant solar system: the Voyager spacecraft




Voyagers launched in 1977; V1 at 114.2 au from Sun, V2 at 92.8 au.  
Both spacecraft still functioning

## Back to inner solar system: the dominant object in the solar system



## Facts about the Sun

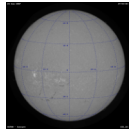
- Distance: 149.6 million kilometers =  $1.496 \times 10^{11}$  meters = **1 astronomical unit**
- Radius = 695,990 kilometers =  $6.960 \times 10^8$  meters (109 times radius of Earth)
- If Earth were scaled to 1 foot globe size, the Sun would extend from goal line to 30 yard line at Kinnick stadium  

- The Sun, not the planets (including Earth) is the dominant object in the solar system

Now on to "Stars, Galaxies, etc, etc, etc. Topic 1: Distances to stars; parsecs and light years



Another way of expressing distances in the solar system

Distance to Sun in terms of light travel time  
 $d=vt$  (like driving to Des Moines)  
 $t=d/v$

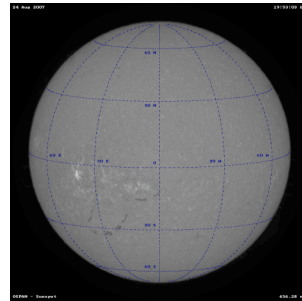


The fastest *anything* can travel is speed of light =  $c = 2.9979 \times 10^8$  meters/sec

Distance to Sun = 1 au =  $1.496 \times 10^{11}$  meters (see Appendix 1), so light travel time from Sun is  
 $t=d/c = 1.496 \times 10^{11} / 2.9979 \times 10^8 =$   
 $t=499.02$  sec

A little over 8 minutes

The Sun could have exploded 7 minutes ago, and we would not have gotten the news yet!

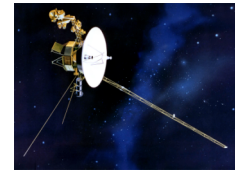


Let's repeat the calculation with the Voyager 1 spacecraft, 114.2 au from Sun



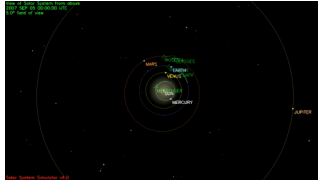
Voyager is a long ways out there

- Light takes 15.9 hours to reach Voyager 2 from Earth.
- Round-trip time is well over a day!



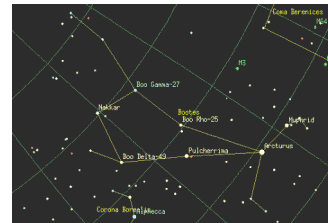
Summary: an alternative description of the size of the solar system

- Inner solar system is light minutes in extent
- Outer solar system is light hours to a light day across



## The Stars

“e quindi uscimmo a riveder le stelle”  
Last words of Dante's *Inferno*



## The Stars are other Suns

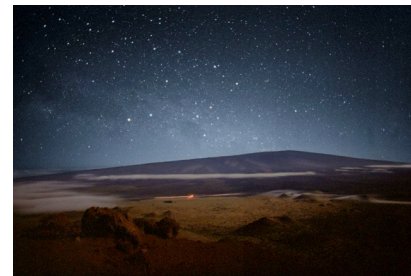
“L'amor che muove il Sole  
E le altre stelle” ... Dante, end  
Of Paradiso

Or...the Sun is the  
closest star



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How far away are they to be glowing  
points in the night sky rather than the  
blazing Sun?



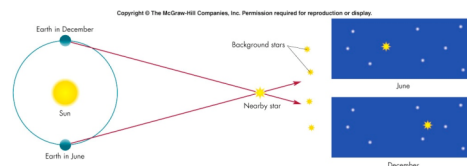
## Basic Questions about Stars

- ➡ How far away are they?
- How hot are they?
  - How massive are they?
  - What are they made of?
  - Do they have planets too?



## Most Basic Method of Stellar Distance Determination

Trigonometric parallax: an  
ordinary surveying technique



➡ DEMO

## Next time:

- How far away are the stars (compared to solar system distances)?
- What units do we use to describe their distances?

