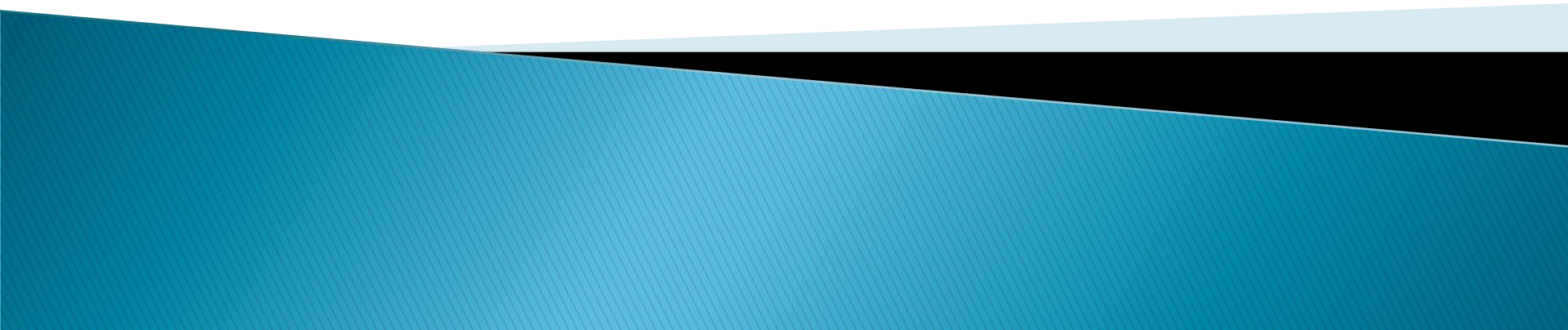


PC Club Astronomy using Computers

Peter Hirsch



Quote

- ▶ There are two ways to live your life
 - One is as though nothing is a miracle
 - The other is as though everything is a miracle
- Albert Einstein



Grandson
Jayden Robeck
Born: 9/8/08

New Tools to Observe the Universe

- ▶ Hubble Space Telescope
- ▶ Compton Gamma-Ray Observatory
- ▶ Spitzer Infrared telescope
- ▶ International Space Station
- ▶ Probes on Mars
- ▶ Spacecrafts in Space



Astronomical Objects

▶ Sun/Stars

- A ball of mostly hydrogen and helium gas that shines extremely brightly

▶ Planet is a celestial body that:

- Is in orbit around the Sun/Star,
- Has sufficient mass so that it assumes a hydrostatic equilibrium (nearly round) shape, and
- Has “cleared the neighborhood” around its orbit.
- Our solar system planets
 - "My Very Educated Mother Just Served Us Nine Pizzas."
 - Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto
- Dwarf Planets
 - Pluto, Eris, Ceres

▶ Solar System

- The **Solar System** consists of the Sun/Star and those astronomical bodies bound to it by gravity



Astronomical Objects

▶ Globular Clusters

- Large group of old stars that are closely packed in a symmetrical, somewhat spherical form



▶ Galaxy

- Massive , gravitationally bound system consisting of stars, an interstellar medium of gas and dust galaxy



▶ Asteroid

- Called minor planets or **planetoids**, are Solar System bodies smaller than planets but larger than meteoroids (which are commonly defined as being 10 meters across or less),and that are not comets.



▶ Comet

- Small Solar System bodies that orbit the Sun/Star and, when close enough to the Sun, exhibit a visible coma (or atmosphere) and/or a tail — both primarily from the effects of solar radiation upon the comet's nucleus. Comet nuclei are themselves loose collections of ice, dust and small rocky particles, measuring a few kilometers or tens of kilometers across.



Astronomical Objects

▶ Black Hole

- Region of space in which the gravitational field is so powerful that nothing, not even light, can escape its pull after having fallen past its event horizon



▶ Cosmic Dust

- A type of dust composed of particles in space which are a few molecules to 0.1 mm in size



▶ Dark Matter?

- A hypothetical form of matter that does not emit or reflect enough electromagnetic radiation to be observed directly, but whose presence can be inferred from gravitational effects on visible matter



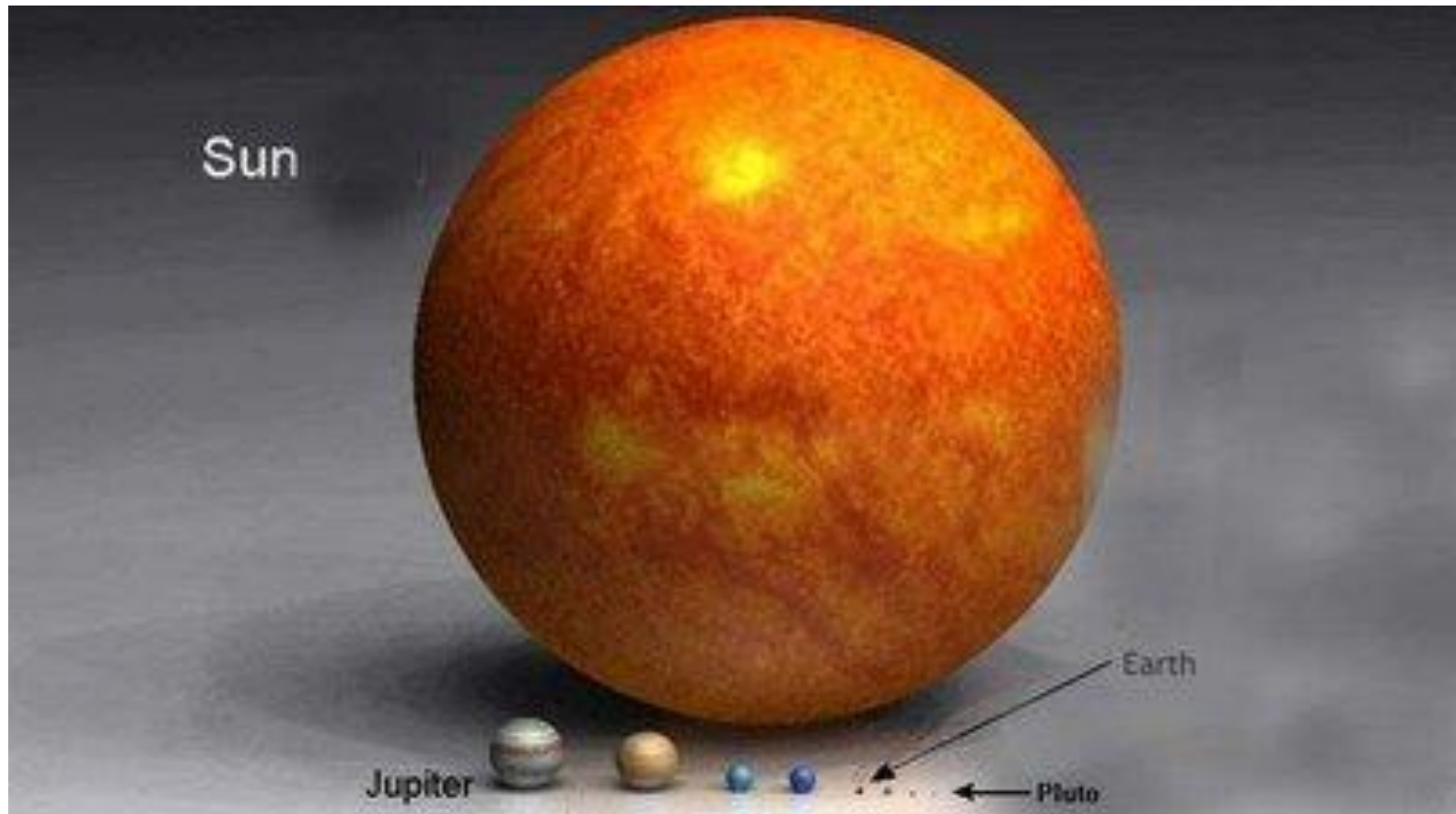
Astronomical Objects

► Nebula

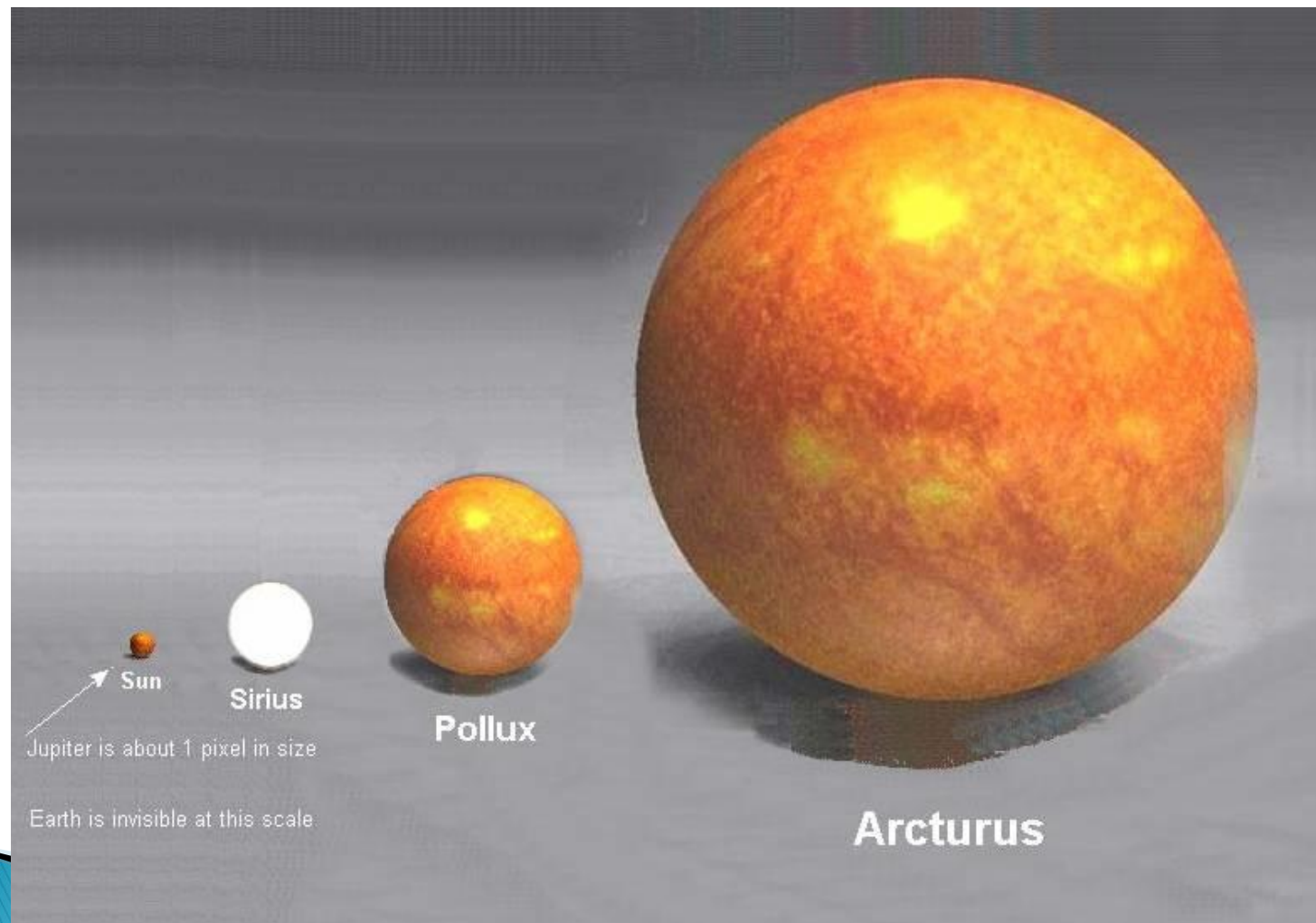
- A nebula (from Latin: "mist" [1]; pl. nebulae or nebulæ, with ligature or nebulas) is an interstellar cloud of dust, hydrogen gas and plasma. It is the first stage of a star's cycle.



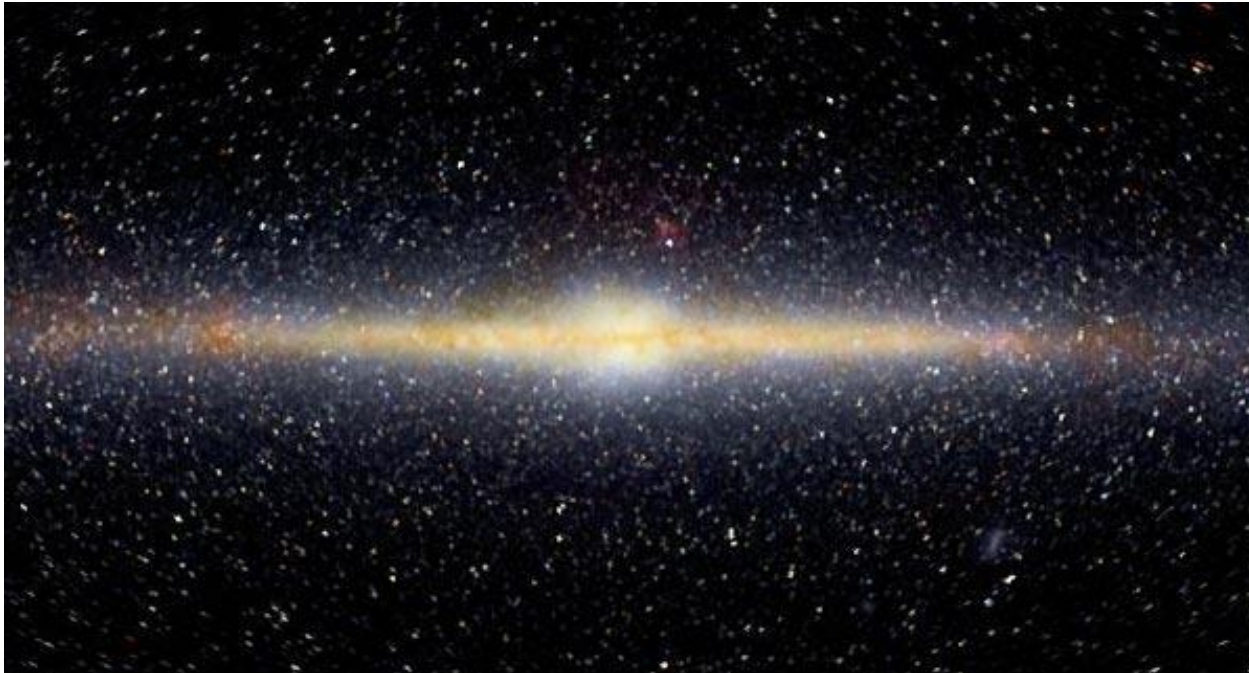
Size of Planets relative to Sun



The Sun is not the biggest Star



Milky Way (Our Galaxy)



- ▶ At night, from a dark location, part of the clear sky looks milky. This unusual swath of dim light is generally visible during any month and from any location. Until the invention of the telescope, nobody really knew what the "Milky Way" was. About 300 years ago telescopes caused a startling revelation: the Milky Way was made of stars. Only 70 years ago, more powerful telescopes brought the further revelation that the Milky Way is only one galaxy among many. Now telescopes in space allow yet deeper understanding. The above picture was taken by the COBE satellite and shows the plane of our Galaxy in infrared light. The thin disk of our home spiral galaxy is clearly apparent, with stars appearing white and interstellar dust appearing red.

Astronomical Distances

(They are very big)

◆ Light Year

- ◆ Speed of light is 186,000 miles/sec
- ◆ 1 LY = 5,878,625,373,183.61 Miles (5.8 Trillion Miles or 5.8×10^{12})
- ◆ Earth to Sun is on average 8.3 light minutes and 93,000,000 miles
- ◆ “Once the Phoenix lands on Mars, NASA won't know if the mission was successful until 15 minutes and 20 seconds later”
 - ◆ The radio signals move at the speed of light and will travel approximately 171 million miles to reach Earth from Mars
- ◆ Pluto is 3.6 billion (3.6×10^9) miles from the sun, 5.5 light hours
- ◆ Milky Way galaxy is about 150,000 LY in diameter and 2,000 LY thick

Nearest Astronomical Objects to Earth

- ▶ Nearest Star
 - Centaurus 4.2 LY
- ▶ Nearest Galaxy (outside of the MilkyWay)
 - Canis, Major Dwarf Galaxy, 25,000 LY
- ▶ Nearest Black Hole
 - The black hole in the constellation Sagittarius, along with a normal star dubbed V4641 Sgr
 - 1,600 LY

Fastest Travel

- ◆ Fastest Satellite (man-made object)
 - ◆ Two vehicles called Helios launched to study the Sun during the 1970s.
 - ◆ Both of these probes attained maximum speeds of around 150,000 mph at closest approach to the Sun in their highly elliptical orbits.
 - ◆ 186,000 mph = $1/3600$ the speed of light
- ◆ It would take 31 million years to go 1 LY at 186,000 mph

Barred Spiral Galaxy NGC 1300



NGC 1300 spans over 100,000 light-years and the Hubble image reveals striking details of the galaxy's dominant central bar and majestic spiral arms. In fact, on close inspection the nucleus of this classic barred spiral itself shows a remarkable region of spiral structure about 3,000 light-years across. Unlike other spiral galaxies, including our own Milky Way, NGC 1300 is not presently known to have a massive central black hole.

Spiral Galaxies in Collision



Billions of years from now, only one of these two galaxies will remain. NGC 2207 and IC 2163 will slowly pull each other apart. The space between stars is so vast that when galaxies collide, the stars in them usually do not collide.

Galaxy with Black Hole at center



- ▶ **Explanation:** Active galaxy NGC 1275 is the central, dominant member of the large and relatively nearby Perseus Cluster of Galaxies. A prodigious source of x-rays and radio emission, NGC 1275 accretes matter as entire galaxies fall into it, ultimately feeding a supermassive black hole at the galaxy's core. This stunning visible light image from the Hubble Space Telescope shows galactic debris and filaments of glowing gas, some up to 20,000 light-years long. The filaments persist in NGC 1275, even though the turmoil of galactic collisions should destroy them. What keeps the filaments together? Recent work indicates that the structures, pushed out from the galaxy's center by the black hole's activity, are held together by magnetic fields. Also known as Perseus A, NGC 1275 spans over 100,000 light years and lies about 230 million light years away.

Best Hubble Telescope Photos

- ▶ The Sombrero Galaxy – 28 million light years from Earth – was voted best picture taken by the Hubble telescope. The dimensions of the galaxy, officially called M104, are as spectacular as its appearance. It has 800 billion suns and is 50,000 light years across.



Best Hubble Telescope Photos:

The Ant Nebula, a cloud of dust and gas whose technical name is Mz3, resembles an ant when observed using ground-based telescopes... The nebula lies within our galaxy between 3,000 and 6,000 light years from Earth.



Best Hubble Telescope Photos:

Nebula NGC 2392, called "Eskimo" because it looks like a face surrounded by a furry hood. The hood is, in fact, a ring of comet-shaped objects flying away from a dying star. Eskimo is 5,000 light years from Earth.



Best Hubble Telescope Photos:

The Hourglass Nebula, 8,000 light years away, has a "pinched-in-the-middle" look because the winds that shape it are weaker at the centre.



Best Hubble Telescope Photos:

The glowering eyes from 114 million light years away are the swirling cores of two merging galaxies called NGC 2207 and IC 2163 in the distant Canis Major constellation



Interesting Links

- ▶ Astronomy picture of the day
 - <http://antwrp.gsfc.nasa.gov/apod/astropix.html>
- ▶ Interesting Photos
 - <http://antwrp.gsfc.nasa.gov/apod/ap080329.html>
 - <http://antwrp.gsfc.nasa.gov/apod/ap080325.html>
- ▶ <http://hubblesite.org/gallery/album/>
- ▶ Classifying Galaxies
 - <http://cass.ucsd.edu/public/tutorial/Galaxies.html>
- ▶ Microsoft World Wide Telescope
 - <http://www.worldwidetelescope.org/>
- ▶ Moon Landings
 - <http://www.google.com/moon/>
- ▶ Wikipedia Spiral Galaxies
 - http://en.wikipedia.org/wiki/Spiral_galaxies

Interesting Links (cont.)

- ▶ <http://www.wikisky.org/>
- ▶ View Earth from Satellites
 - <http://www.fourmilab.ch/earthview/satellite.html>
- ▶ http://www.jpl.nasa.gov/stars_galaxies/
- ▶ Orbiting Telescopes
 - <http://hubblesite.org/>
 - <http://www.spitzer.caltech.edu/about/index.shtml>
 - <http://chandra.harvard.edu/>
- ▶ Relative size of our solar system planets and sun
 - <http://www.webxact.co.uk/2008/08/these-pictures-will-humble-anyone.html>

Interesting Links (cont.)

- ▶ Solar System is crowded
 - <http://dotearth.blogs.nytimes.com/2008/07/06/solar-system-roulette/>
 - <http://cfa-www.harvard.edu/iau/Animations/Animations.html>
- ▶ <http://planetquest.jpl.nasa.gov/>
- ▶ <http://www.planetary.org/home/>
 - The Planetary Society, founded in 1980 by Carl Sagan, Bruce Murray, and **Louis Friedman**, inspires and involves the world's public in space exploration through advocacy, projects, and education.

Interesting Links (cont.)

- ▶ View of Earth and Moon from 31 million miles away

http://epoxi.umd.edu/4gallery/Earth-Moon_vid.shtml

Videos of the Moon transiting the Earth, as imaged by NASA's EPOXI spacecraft, were made from the still images collected when EPOXI's spacecraft imaged the Earth-Moon system on 28-29 May 2008.

When the images were acquired, the spacecraft was just outside the orbit of the Earth and ahead of Earth by 31 million miles, $1/3$ AU, making it as far from Earth as Mercury is from the Sun.

[Earth-Moon-nir_green_blue2.wmv](#)

Putting things into Perspective

- ▶ There are Rocks on the Moon



- ▶ There is Red Clay soil and Ice on Mars



Putting things into Perspective

- ▶ Let us remember that Earth is the only place in the Universe known to haveChocolate



PC Club Topics

For next few months

- ▶ Anyone have a topic
 - That they would like to present?
 - That they would like to see?

PC Club Topics

- ▶ Anyone interest in working with me on a presentation using Google Lively
 - <http://www.lively.com/html/landing.html>
 - Create an avatar and chat with your friends in rooms you design