Lecture #15 Thurs 18 Mar 2010 Introduction to Astronomy

Age of Universe = 13.7 billion years
Age of our sun and solar system = 4.5 billion years

Distance between Earth and Sun = 93 million miles (150 million km)
= 1 Astronomical unit (AU)

Distance from Sun:
Mercury 0.38 AU
Venus 0.72 AU
Earth 1 AU
Mars 1.5 AU
Jupiter 5.2 AU
Saturn 9.5 AU
Uranus 19 AU
Nepture 30 AU
Pluto 39 AU

Light travel time: at 186,000 mi/s = 300,000 km/sec
1 Light year = distance light travels in 1 year
= 6 trillion miles = 9 trillion km = 62,000 AU
Distance to nearest star (alpha centauri) = 4.3 light years
Distance to Tau Ceti = 11 light years
1 parsec (pc) = 1 parallax-arc-sec = 3.26 light years

1 kiloparsec (kpc) = 1000 pc = 9,000 trillion km
1 megaparsec (Mpc) = 1,000,000 pc

Distance to center of Milky way = 8 kpc = 26,000 light years
Distance to Large Magellenic Cloud = 50 Kpc = 160,000 light years
Distance to Andromeda galaxy = 2 million light years
Distance to Virgo Cluster = 50 Mpc = 160 million light years

The Need for Speed
Walking = 3 miles / hr
Pluto Express = 30,000 miles/hr; reached Moon in 9 hrs, Jupiter in 13 months, Pluto in 9.5 years (July 2015) Another factor 1,000 increase would be 30 million miles / hr
Speed of light = 670 million miles / hr
At 30 million miles per hour, would take 100 years to reach Alpha Centauri.

Lives of Stars

Stars are gigantic balls of hydrogen (75%), helium (25%) (and a sprinkle of a few other elements). Their energy comes from **nuclear fusion**

Topics:

Classification of stars

Life cycles of stars

Death of stars

Classification of Stars

type	temp (K)	mass (sun=1)	luminosity (sun =1)	lifetime
O	40,000	40	400,000	1 million yrs -- *hottest, least common*
B	20,000	15	13,000	10 million yrs
A	10,000	3.5	80	400 million yrs
F	7,500	1.7	6.5	3 billions yrs
G	5,500	1	1	10 billion yrs -- *Our Sun*
K	4,500	0.8	.5	17 billion yr
M	3,0000	0.5	.08	50 billion yrs -- *coolest, most common*

Star life

Stars "shine" due to nuclear reactions. Most common: convert hydrogen H to helium He 1 atom of helium is less massive than 4 hydrogen atoms— the "missing mass" converted to energy via $E = mc^2$. Stars are big balls of hot gas – thermal energy "inflates" them

Towards the end of its life, a star will run out of fuel. Many stars swell up to "red giants." Low-mass stars eventually shrink to a "white dwarf" star, very compact (about the size of Earth).

Death of stars

A massive (> 8 solar masses) star will "burn" helium to carbon and oxygen, then carbon and oxygen to magnesium, magnesium to silicon and sulfur, and finally silicon to iron. The iron core cannot "burn" so there is no thermal energy to resist gravity.

When the iron (Fe) core has about 1.4 solar masses, gravity will crush it into a neutron star. A shockwave will eject the rest of the matter into space, where it forms clouds of gas and dust…which eventually forms new stars!

Which stars do we want to travel to?

F, G, K stars are the most likely candidates to support life: not too hot, not too cool, not too short of lifetime

average distance to nearest star = 5 light years.

Traveling at the speed of light to Tau Ceti would take 12 years.

(At 95% of speed of light (= *c*), time-dilation would make it seem like only 4 years)

However, you need to *accelerate* to that velocity! Acceleration at 10 meter per sec per sec = 1 "gravity" will take *one year* to accelerate to 0.95 *c*

What I want you to know

Definitions of:

Astronomical unit (AU) = average distance between Earth and Sun

light year (l.y.) = distance light travels in 1 years

parsec (from parallax) = 3.26 l.y.

A wide variety of stars:

Massive, hot stars are very bright, bluish/UV

live very short lives (few million years); very rare

Small, cool stars are very dim, red

live long lives (100 billion years); very common

Our sun: medium mass, brightness, yellowish

lives 10 billions yrs; about 3% of all stars

Average distance to nearby stars is 5 to 10 light years.

Will take enormous time and energy to visit