Astronomy 120

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Course material is located at the Observatory Web:
Access via CSI website “quick links”
Then access via Prof. Robbins Link and go
to the course section AST 120
Observing Requirement -10%

- Report on 2 observations: use forms found on line in “Student Required Observing and Extra credit opportunities.” or from CSI observing schedule link
- There are a number of other locations for observing in the city and NJ see the observatory website
Extra Credit
MAXIMUM of 8 points on final average

• Term paper on line details
• One or two AMNH Field trips whose details are on-line in “Student Observing and Extra credit opportunities”

• Additional observations above the two required: such as views of the Moon, planets, stellar clusters, galaxies, stellar nurseries and general Nebula, double stars etc.
FIELD TRIP NOTES

Two trips possible to AMNH
TRIP I: THE ROSE CENTER  Hayden Planetarium”
REPORT - American Museum of Natural History (AMNH)- 81 st and Central Park West.
TRIP II: General overview of Life and Earth at AMNH

BOTH REPORTS CONSISTS OF QUESTIONS TO ANSWER found online
TRIP I can cost you about $20
Hand in FINANCIAL RECEIPT AS PROOF OF VISIT FOR MUSEUM TRIPS.

NOT THE TICKET STUBS!!!
GRADING

GRADE =
45% (Quizes + MidTerm + Final Exam)
+ 25% Homework Average
+ 20% Laboratory Exercises
+ 10% Observing Report
+ Extra Credit Points (MAX of 8)
- excessive Absence penalty points (beyond 15% cuts!)
YOU are expected to come to class
-- disruptive penalty points
“How to Study Astronomy” (or any science) is ONLINE and may be useful to your...also
“How to write an excellent Term Paper” is ONLINE
CHECK THESE OUT...YOU WON’T BE SORRY!
Please GET TEXTBOOK  at bookstore by next time!
“Astronomy –A Physical Perspective”
2nd Marc Kutner

Lab exercises will be assigned and in most cases you are to Use the web to print up student manuals (before the Laboratory session) or use the web to solve the exercises
• IT'S A BIG UNIVERSE! WE WILL EXPLORE Some its COMPONENTS TO THE OUTER PART THE KNOWN UNIVERSE

FIRST HOMEWORK!
HW 1 Write down Key terms In this lecture And Chapter one and Define in your own words By doing research On the web or library And answer the HW questions As posed.

"I'LL BE WORKING ON THE LARGEST AND SMALLEST OBJECTS IN THE UNIVERSE—SUPERCLUSTERS AND NEUTRINOS. I'D LIKE YOU TO HANDLE EVERYTHING IN BETWEEN."

LABEL ALL HW’S WITH #
HOW DO WE KNOW?

ELECTROMAGNETIC RADIATION IS THE KEY!

Astronomy is mostly an Observational Science Not an Experimental One!
Our Earth is a dynamic Rocky Planet of constant Change in the family of the Sun (Solar System)
Nearest to us in our Solar System is The Moon—a large rocky body.

Useful approximate values:

- Earth has a radius of 6000 km
- Mass of $6 \times 10^{27}$ grams
- Moon’s distance is $4 \times 10^5$ km from earth

Or about 1 light second

you will do the exact # for HW.
The Sun Rules the Solar System
Sun is about $1.5 \times 10^8$ km from Earth =
1 Astronomical Unit = 1 AU (Definition!)
Solar Mass = $2 \times 10^{33}$ g

HW 2
How many earth Masses in the Sun?
Solar radius = $6 \times 10^5$ km

HW 3
How many Earths across The Solar diameter?
The Sun’s energy is driven by Nuclear Fusion- matter in the plasma state interacting with strong magnetic forces. Radiative Transfer Physics=Conduction, Convection, Radiation helps us understand the sun as well as interstellar matter or planetary atmospheres.
C = SPEED OF LIGHT = 300,000 k/s

HW 4
1 lsec = ? km, lmin = ? km,
Ly = ? km

HW 5
(use appendix to find distance in km of Sun and Moon)
then
Distance to Sun = ? lmin,
Distance to the moon = ? lsec
Venus (0.7AU from Sun) in the Pleades Cluster
Why is dark side of moon lit?

HW 6  How many AU to Jupiter?
Radar view of Venus breaks through the clouds to reveal a young volcanic world
Mars from the Hubble Space Telescope
Clouds, deserts, craters and Ice cap are viewed

1.5 AU from The Sun = HW 7
Mars = ? Lmin
Light Minutes
(lmin or Lm From sun)

HW 8 Mars = ? Lmin from earth at closest approach to earth.
Size-wise Mars is humble yet has the greatest Volcanoes and canyons of the Solar System
These are the size of the planet Mercury.
Saturn and its’ mysterious rings

HW 9  10 AU to Sun = ? Lmin to sun?
Pluto..now known as a “dwarf Planet”
is 40 AU to Sun = ? lh?
The Solar system also contains, Comets and Asteroids. Which can be lethal to life on planet Earth or bring life? from time to time. Coming from the Ort Cloud some 50,000 to 100,000 AU where the Sun’s Gravity still prevails.
Asteroid Gaspra—asteroids also bring death and have been implicated in the demise of large dinosauria. Most asteroids are in a belt between Mars and Jupiter. Some journey into the sun region and back out again. See a problem?
Our Milky Way galaxy from Earth contains > 150 billion other Suns and their systems (NOTE: Dust, glowing gas and stars)

Stellar distances are measured in Light years
1 ly $\sim 10^{13}$ km or we use parsecs for distance
1 parsec $\sim 3$ ly (2.56!)

Average distance between stars
In our galactic neighborhood
Is about 5 ly

Milky Way rising.. stars rising

HW 10 5 ly = ? km
Our Milky Way Galaxy in Infrared (IR) radiation.

Deep Sky:
Spiral Galaxy M61
In VIRGO Cluster

75,000 ly across

Our Sun is 8500 pc or 25,000 ly from center.
we are in the suburbs!

50 million ly Away from The Milky Way Galaxy

WE TOUR OUR GALAXY NEXT

Our Milky Way Galaxy in Infrared (IR) radiation
Over 200 “globular star clusters” orbit the center of our Milky Way Galaxy, 47 Tucanae is the second brightest, Known also as 47 Tuc or NGC 104, visible from the Southern Hemisphere. Light takes about 20,000 years to reach us. Red Giant stars (yellowish) are easy to see.

**Globular Clusters can contain**
10⁵ to 10⁶ stars> 1AU apart and are
Symmetrically spaced around a Galaxy
Hence we can find our center and place
In the galaxy using them!

**Stars in the cluster are very ancient!**
with
**Simple Chemistry**
And
**ages 10 to 12 Billion Years Old!**
Lagoon Nebula=

ea Stellar nursery

In the our Milky Way Galaxy,
New Stars are born from condensing gas and dust.

DISTANCE = 5.2 KLY
Horsehead Nebula  Combination of Dust and Gas in Our Milky Way Galaxy..located in Orion’s star birth area
A “Dark Nebula” 1500 ly distant
The Rosette Nebula -emission nebula-3000 light-years (ly) away in Our Galaxy. Stellar wind from the open cluster of stars, NGC 2244, has cleared a hole in the nebula's center.

Green= oxygen
Blue= sulfur
Red=hydrogen

NOTE:
ELEPHANT’S TRUNKS
(Hubble): Newborn stars and their Solar Systems are forming in the Eagle Nebula. The giant pillars (elephant trunks) are light years in length and are so dense that interior gas contracts gravitationally to form stars. Stellar nurseries are exposed.

The Eagle Nebula, lies about 7000 light years away
Deep Sky: The Pleiades, the most famous “open cluster” on the sky. Also called the Seven Sisters, M45 or “Subaru” is very bright and easy to see even in NYC. The Pleiades contains over 3000 young stars, is about 400 light years away, and only 13 light years across. Note the blue reflection nebulae surrounding the bright stars.
The Planetary Nebula (show)
Glowing gaseous shrouds shed by dying sun-like stars trying to stabilize as they run out of nuclear fuel. Typically 1,000 times the size of our solar system. These Ten have names like Owl, the Cat's Eye, the Ghost of Jupiter, Ring. This glorious final phase in the life of a star lasts only about 10,000 yrs. The central star will shine for a while and then go out!

Note: The Star Remnant
At center of The Planetary Nebulae.

Called “Planetary” Because the Resemble planets
In a telescope
GOOD-BYE PLANETS!
Supernova Remnant: The Crab Nebula, filled with mysterious filaments, is the result of a star that was seen to explode in 1054 AD. This spectacular supernova explosion was recorded by Chinese and Anasazi Indian astronomers. In the very center lies a pulsar: a neutron star rotating 30 times a second.

**IN CLASS** 20 kiloparsecs across = \(?\) Ly
- Note two dwarf elliptical galaxies

700 kiloparsecs (about 2 million ly) from the Milky way
Your text says = 2100 years for light To reach us..what’s wrong with this?
**IN CLASS** How many years ago did light leave the back of the Galaxy to reach us?
The Virgo cluster of Galaxies is the nearest cluster with connections to us.

**Giant Elliptical Galaxy (E1)-M87**
M for Messier catalog (1780’s)

**Giant Lenticulars S(0)**
M86 & M84

Virgo Cluster center is about $52 \times 10^6$ ly distant
Containing as much as 2000 members

Our Galaxy, Andromeda, Megellanic clouds and about 50 members are called the LOCAL GROUP
Virgo Cluster is part of a Supercluster of which our Local Group is an outlying member
A very distant cluster of mostly spiral galaxies, half-way across the universe.

The reason the Universe is called the Expanding Universe is that galactic velocities are almost all moving away from us and the further from us the greater the value of the velocity. We will exam the BIG BANG that gave rise to the EXPANDING UNIVERSE later.
Ultra Deep Field: Oldest and most distant Galaxies ever Found. Formed 13 billion years ago. Hubble spent 3 month imaging the Same spot.
So you now have a flavor of the large scale Universe

A final perspective when life gets you down

MONTY PYTHON UNIVERSE SONG

Monty Python song