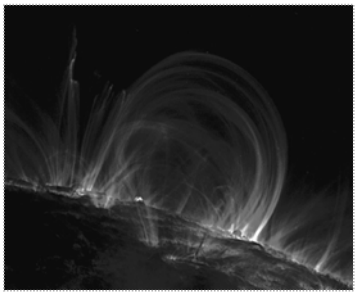
ASTR 1120: Stars & Galaxies



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Lecture 8 Fri 28 Jan 05

zeus.colorado.edu/astr1120-toomre

Topics for Today

- Look briefly at X-ray and radio telescopes
- Then turn to our nearest star, the Sun
- Overview of how Sun is put together
- Why is a star spherical, and does not collapse?
- Why does it shine? What is the energy source?

- Pick up *Homework # 1* graded, plus answer sheet -- turn in completed *HW # 2* today

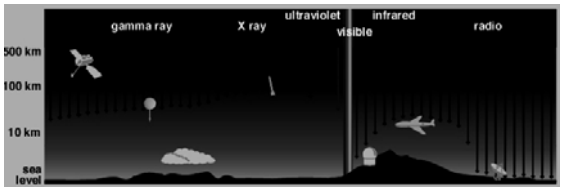
- *Homework # 3* available now, due next Friday

Understanding Clicker Q B.

- *Which wavelength regions CAN be studied with ground-based telescopes?*
- A. All light with wavelengths longer than ultraviolet
- B. Radio, visible, and very limited portions of infrared and ultraviolet
- C. All light with wavelengths shorter than infrared
- D. Infrared, visible, and ultraviolet

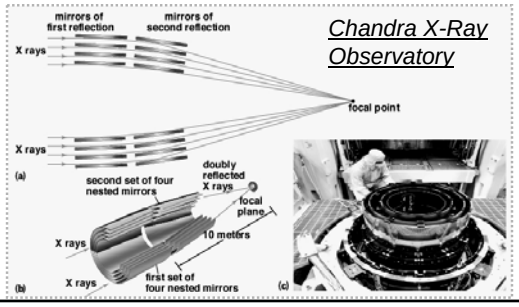
What light gets through?

- Atmosphere protects us from most (nasty) high energy photons
- …But many very hot objects shine brightest in such UV, X-ray and gamma-ray photons
- …And cool star-forming regions are brightest in IR



X-Ray Telescopes – do it their own way!

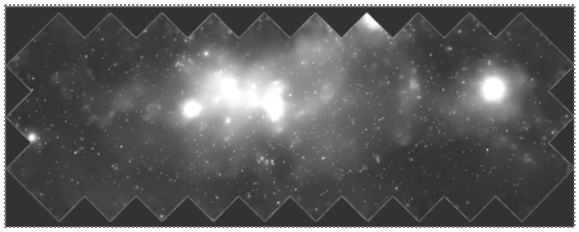
- X-ray photons can pass right through a mirror
- Such photons can only be reflected at shallow angles, like "skimming stones" off water surface



Chandra X-Ray Observatory

"Nonvisible" Light – X-ray,UV, IR, Radio

- Most light is invisible to human eye
- Special detectors can record such light
- Digital images built using false-color coding



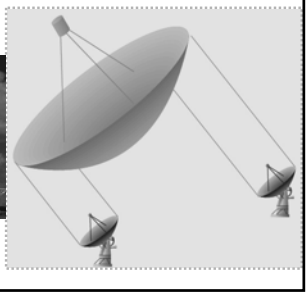
Chandra X-ray image of center of our Milky Way Galaxy

Radio Telescopes – Biggest Single Dish

305 m Arecibo PR

Radio Interferometry – <u>many small look big!</u>

- Two (or more) radio dishes observe the same object
- Signals from each "interfere" with each other
- Can construct image whose angular resolution is like that from a huge dish!



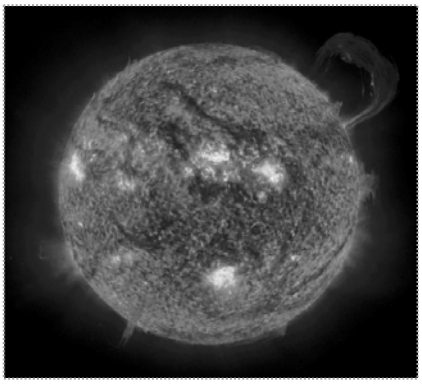
VLA – Large Aperture Synthesis

Clicker Q - galaxy *B.*

REDSHIFTED

- *In observing a distant galaxy, the H alpha spectral line of hydrogen (usually in the visible) is now in the IR portion of the spectrum. What can you conclude?*
- *A. Galaxy is made purely of hydrogen*
- *B. Galaxy is moving away from us*
- *C. Galaxy is moving towards us*
- *D. Galaxy has very weak gravity*

Now to Our Nearest Star Chap 15

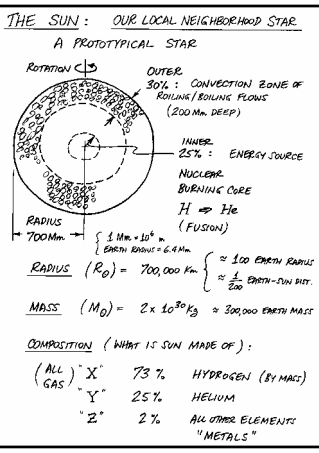


Big Qs about the Sun (and any star)

- Why is a star ROUND?
- What keeps a star from collapsing inward?
- What keeps it shining?
- Why does it rotate and have varying magnetic fields?

OVERVIEW of the Sun

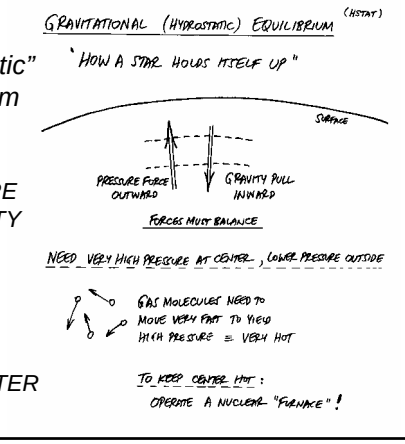
Round, rotates, burns H to He



"Hydrostatic" equilibrium

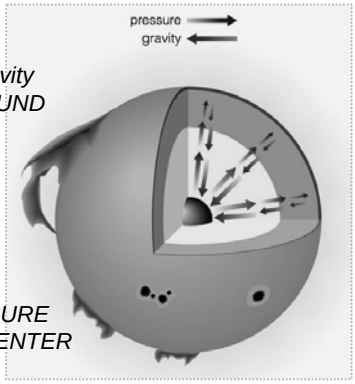
PRESSURE vs GRAVITY

HOT CENTER



Pull of gravity = Push of pressure gradient

SPHERICAL nature of gravity makes it ROUND



High PRESSURE needed at CENTER

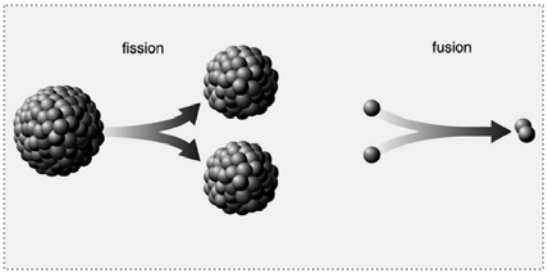
How to get high central pressure?

In gases, plasmas, "equation of state" is roughly

PRESSURE = DENSITY x TEMPERATURE

1. *Making the CENTER HOT yields high pressure that keeps star from collapsing*
2. *If really hot, NUCLEAR BURNING can supply the energy that always leaks away from hot places*

Fusion or fission as star's energy source?



Fusion is the answer: H converted to He

Sun is a big ball of "plasma"

- *Hydrogen and helium are <u>ionized</u> by the high temperature throughout most of star*
- *Such electrically-conducting GAS is called a PLASMA*
- *Movement of plasma has currents flowing, builds magnetic fields and electric fields*
- *Now for "Tesla coil" demo*