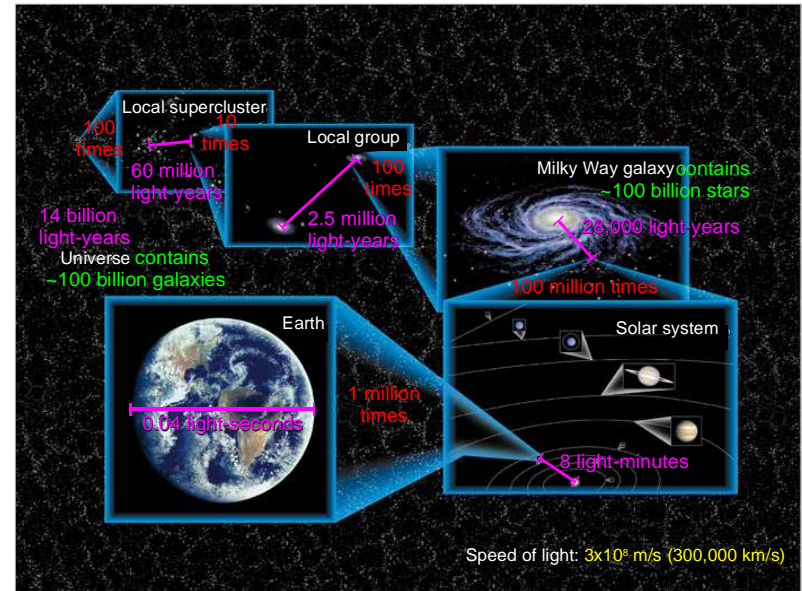


## AST 221 - Stars and the Solar System

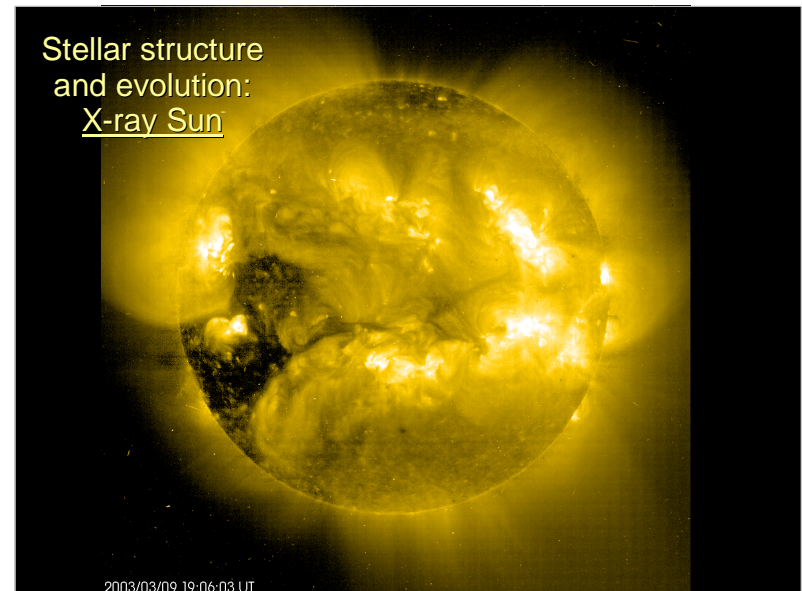
Problem sets (35%)	5 problem sets, due every other Friday; discussion OK, but write up yourself!
Presentation (10%)	15 min., half talk, half discussion; joint with another student; see web site
Midterm (20%)	In-class, 1-hour, open-book exam
Final (35%)	3-hour, calculator-only exam

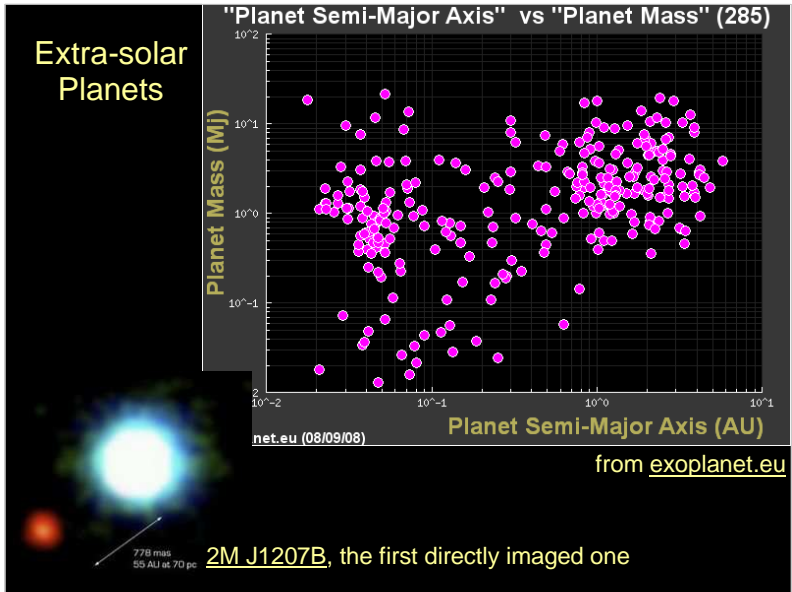
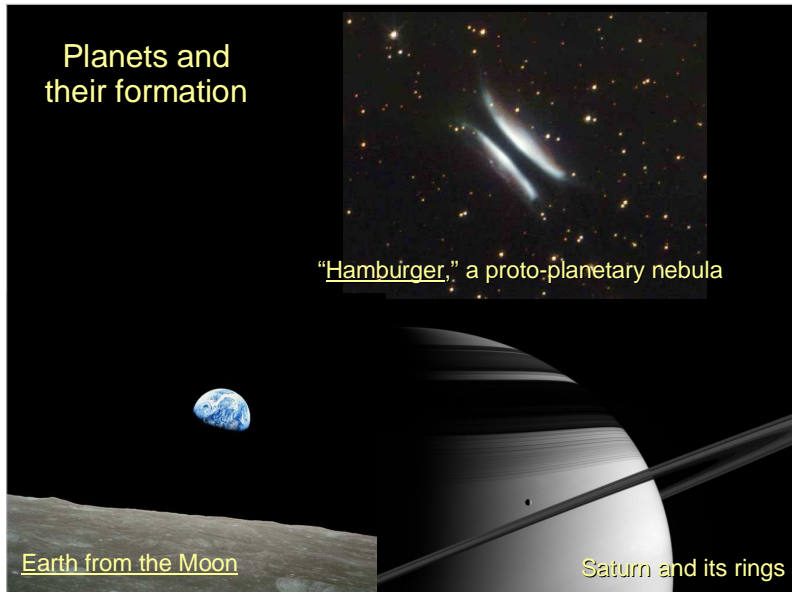
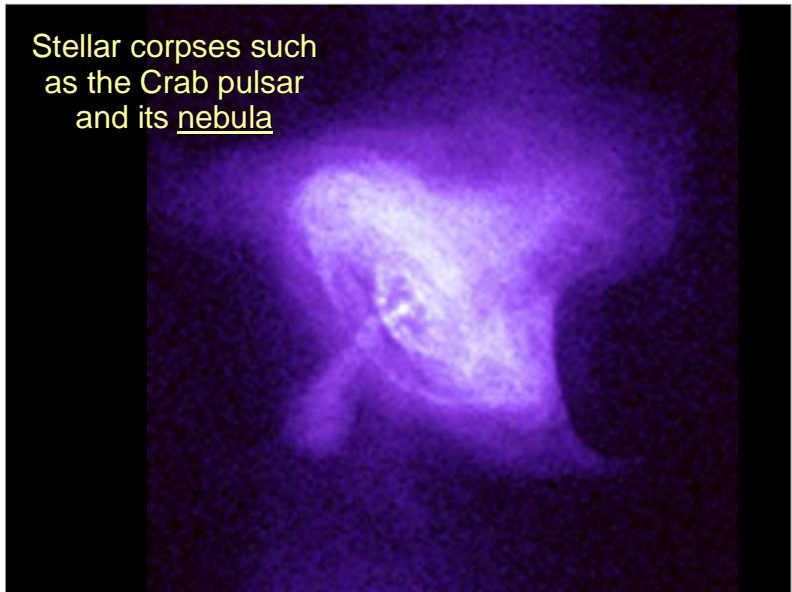
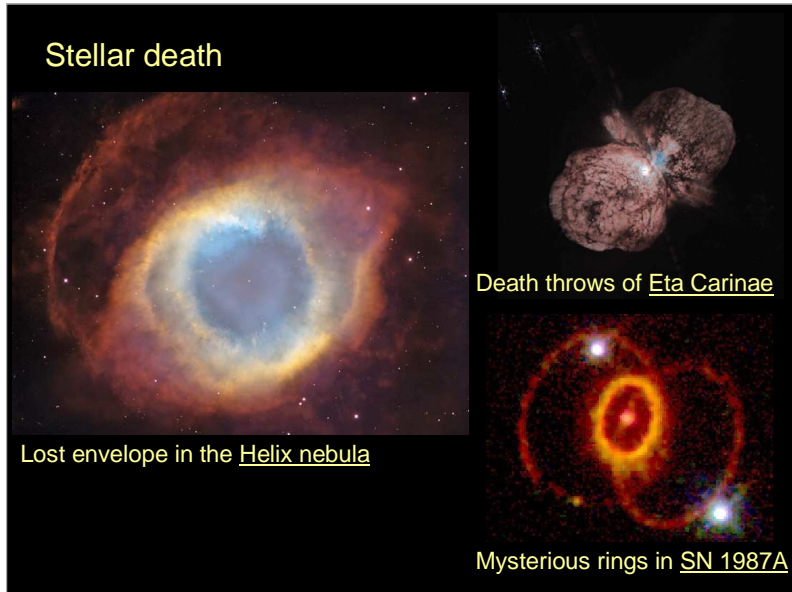


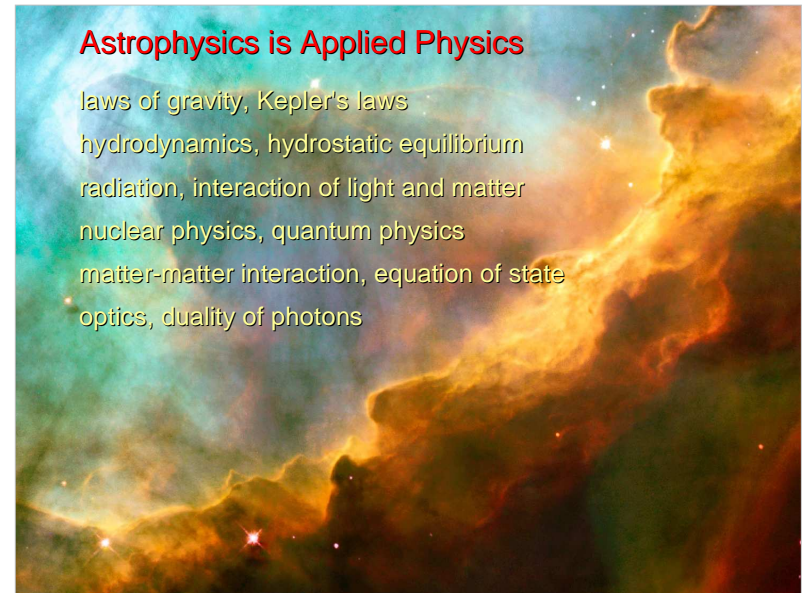
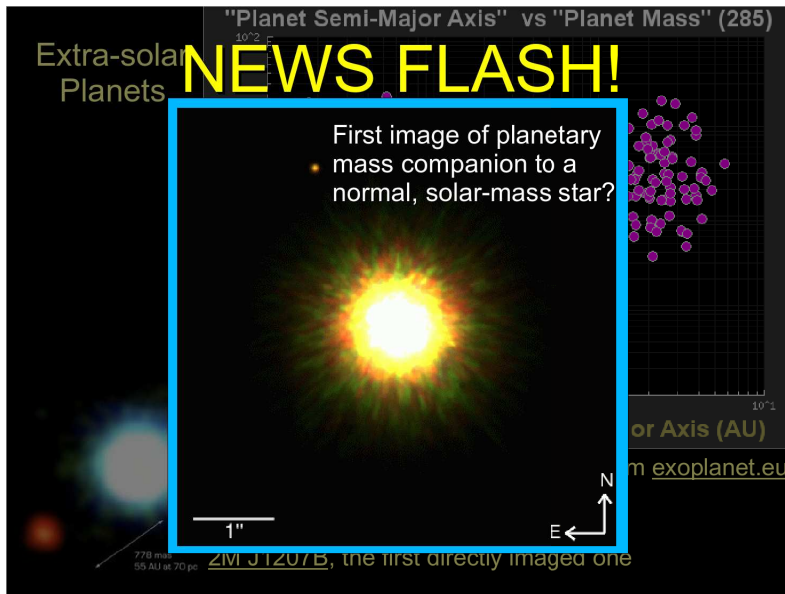
## Stellar birth in M 17



## Stellar structure and evolution: X-ray Sun







## Brightness measure

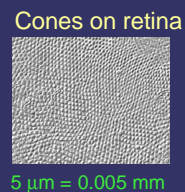
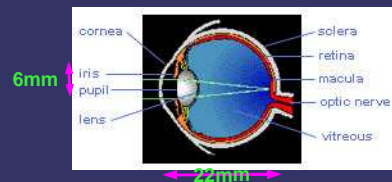
**magnitude:** a logarithmic brightness scale  
 difference of 5 mag. = factor 100 in brightness  
 larger values are *dimmer*

apparent magnitude (*m*): brightness as observed

Sun  $m_V = -26.74$ , Sirius (brightest star on sky)  $m_V = -1.46$   
 human eyes see down to  $m_V = +6$  (telescope down to  $m = +30$ )

absolute magnitude (*M*): *m* at 10pc, **intrinsic brightness**

Sun  $M_V = +4.83$ , Sirius  $M_V = +1.43$   
 $m - M = 5 \log_{10} (d/10\text{pc})$



## Distance measures

**AU:** astronomical unit, mean Earth-Sun distance ( $1.496 \times 10^{11} \text{ m}$ )  
 Mercury 0.4 AU; Mars 1.5 AU; Pluto 39.5AU

**arcsecond ("): a circle 360 deg( $^\circ$ ),**  
 each deg ( $^\circ$ ) has 60 arcminutes ( $'$ ),  
 each arcminute ( $'$ ) has 60 arcseconds ( $''$ )  
 1 radian =  $180/\pi$  deg; the whole sky has  $4\pi$  ster-radian  
 $= 4\pi (180/\pi) (180/\pi) = 360^2/\pi \sim 4.12 \times 10^4$  square degrees  
 angular resolution of human eye  $\sim 1$  arcminute  
 (diffraction limit of 6 mm pupil & matched cone size in retina)  
 $\Rightarrow$  precision of pre-telescope astronomy  
 best current day angular resolution  $\sim$  milli-arcsecond

**pc:** parsec, *defined* as the distance at which 1 AU is  $1''$   
 1 parsec =  $1 \text{ AU} * 180^{\circ} * 60' * 60'' / \pi \sim 3 \times 10^{16} \text{ m} \sim 20,000 \text{ AU}$   
 closest star ( $\alpha$  Cen system, Proxima Centauri) at 1.3 pc (4.3 light-yr)  
 galactic center at  $\sim 8 \text{ kpc}$   
 nearest galaxy -- Large Magellanic Cloud  $\sim 50 \text{ kpc}$   
 end of the universe at  $\sim 4 \text{ Gpc}$  (speed of light x age of universe 13 Gyr)

## History of the Universe in 200 words or less

Quantum fluctuation. Inflation. Expansion. Strong nuclear interaction. Particle-antiparticle annihilation. Deuterium and helium production. Density perturbations. Recombination. Blackbody radiation. Local contraction. Cluster formation. Reionization? Violent relaxation. Virialization. Biased galaxy formation? Turbulent fragmentation. Contraction. Ionization. Compression. Opaque hydrogen. Massive star formation. Deuterium ignition. Hydrogen fusion. Hydrogen depletion. Core contraction. Envelope expansion. Helium fusion. Carbon, oxygen, and silicon fusion. Iron production. Implosion. Supernova explosion. Metals injection. Star formation. Supernova explosions. Star formation. Condensation. Planetesimal accretion. Planetary differentiation. Crust solidification. Volatile gas expulsion. Water condensation. Water dissociation. Ozone production. Ultraviolet absorption. Photosynthetic unicellular organisms. Oxidation. Mutation. Natural selection and evolution. Respiration. Cell differentiation. Sexual reproduction. Fossilization. Land exploration. Dinosaur extinction. Mammal expansion. Glaciation. Homo sapiens manifestation. Animal domestication. Food surplus production. Civilization! Innovation. Exploration. Religion. Warring nations. Empire creation and destruction. Exploration. Colonization. Taxation without representation. Revolution. Constitution. Election. Expansion. Industrialization. Rebellion. Emancipation Proclamation. Invention. Mass production. Urbanization. Immigration. World conflagration. League of Nations. Suffrage extension. Depression. World conflagration. Fission explosions. United Nations. Space exploration. Assassinations. Lunar excursions. Resignation. Computerization. World Trade Organization. Terrorism. Internet expansion. Reunification. Dissolution. World-Wide Web creation. Composition. Extrapolation?

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