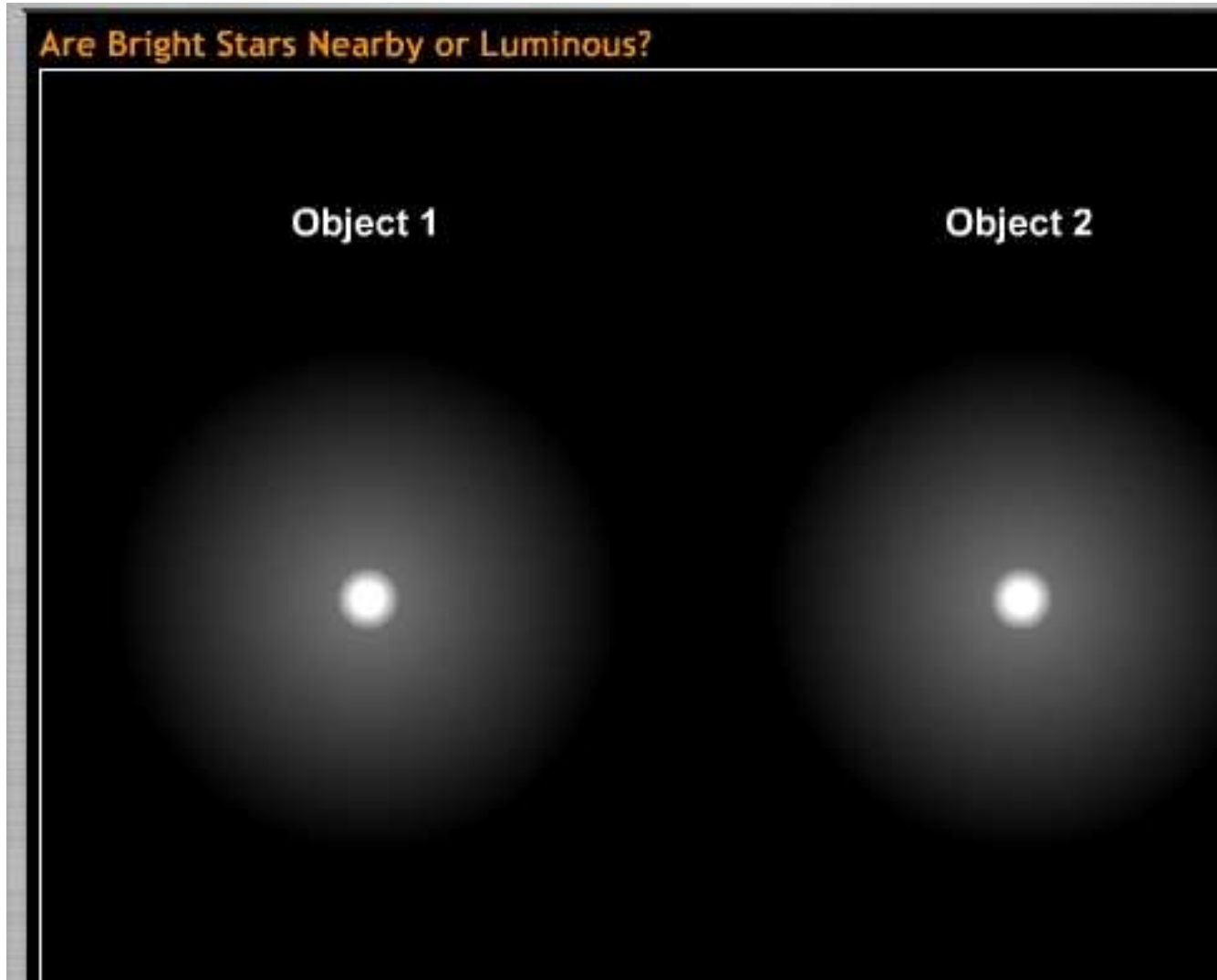


## Lecture 28: Astronomy Picture of the Day

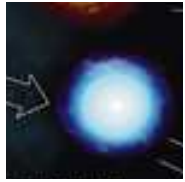


Which of these stars has a higher luminosity?

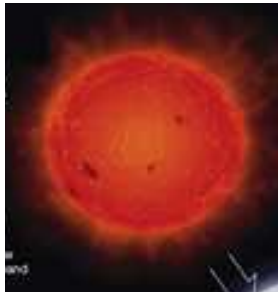
## *Lecture 28: Announcements*

- 1) Quiz on Wed Apr 13 based on reading assignment  
Ch 20, Galaxies: From Here to the Horizon (Cosmic Perspectives, 3<sup>rd</sup> Ed)  
Main ideas in “Summary of Key Concepts” at end of chapter.

# Evolution of high-mass ( $M > 8M_{\odot}$ ) stars



Blue main sequence star. H fusion in core via CNO cycle



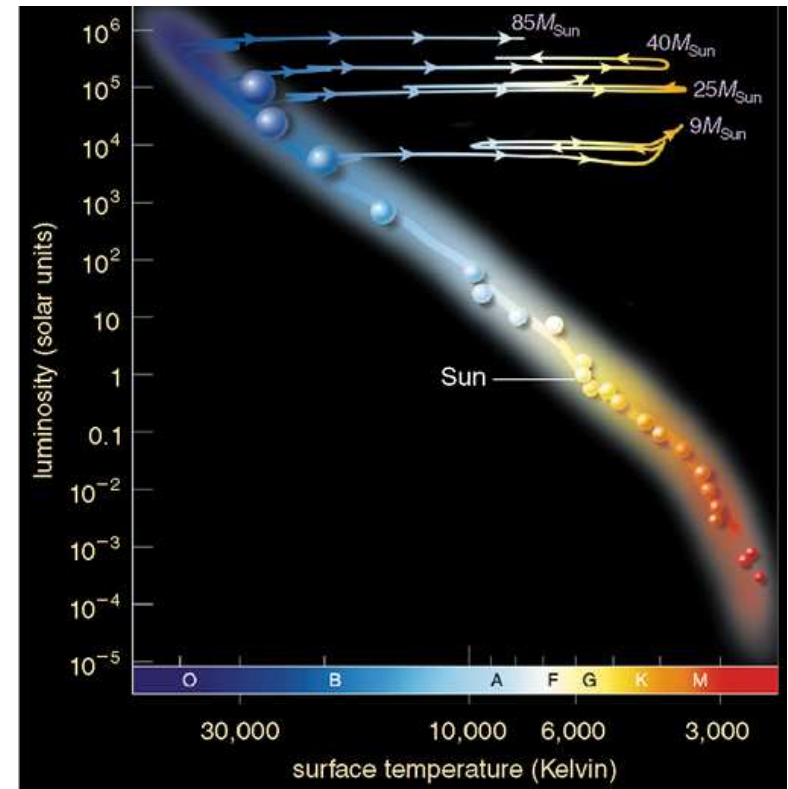
Red supergiant:  
Inert He core  
H-burning shell



'Blue' supergiant:  
He-burning core +  
reduced H-burning  
in shell



Supergiant phases.  
Inert C core shrinks till fusion of C starts, then of O, then...of Si until iron collects in core.  
Multiple shells burning C, O, He, H



When it is no longer supported by deg-pressure, iron core collapses, and  $e^- + p^+$  combine to form a neutron star or BH. Star explodes outer layers into SN

# Evolution of high-mass star

In class-movie  
Stages of evolution  
of high-mass star

The screenshot shows a Flash movie window titled "death\_seq\_of\_high-mass\_star.swf". The main content area is titled "The Death Sequence of a High-Mass Star" and features a "Simplified core fusion cycle of high-mass star" diagram. A "Begin" button is located below the title. To the left of the diagram is a "Core Key" with five color-coded entries: nonburning hydrogen (grey), hydrogen fusion (light grey), helium fusion (orange), carbon fusion (yellow), and inert oxygen (green). The diagram itself is a circular cross-section with concentric layers: a central green core, followed by a yellow layer, an orange layer, and an outer light grey layer. Lines connect the key entries to their corresponding layers in the diagram. Below the diagram is a "View from Space" window showing a large orange sphere against a black background with small white stars. At the bottom of the movie window, there is a "How To Use" tab, a "Credits" tab, a progress bar showing "00:00:00", and a set of navigation controls including a volume icon, a play button, and several arrow buttons. A copyright notice on the right side reads "©2004 Pearson Education, Inc., publishing as Addison Wesley".

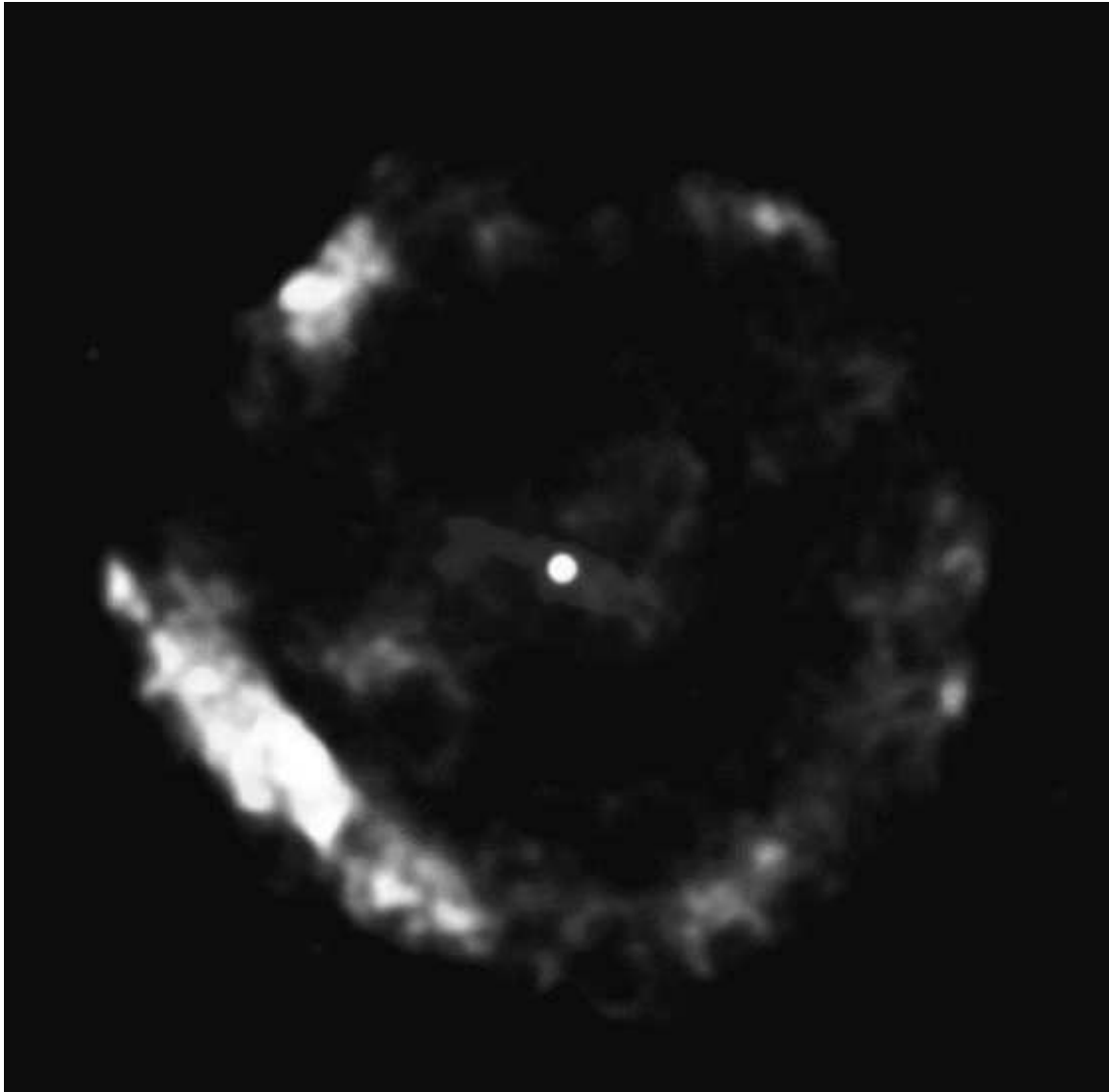
## *Evolution of high-mass stars*



Visible image of  
the Crab nebula  
Supernova remnant  
in constellation  
Taurus

Expanding shock-heated gas ejected during a supernova explosion, away from the collapsed core of a massive star. Spinning neutron star at center seen in radio images

## *Evolution of high-mass stars*



X-ray image from  
CXO of a neutron star  
at center of old  
supernova remnant



**before**



**after**

Visible image of  
Supernova  
1987A in LMC

## *Mass Limit for White Dwarfs*



Chandrasekhar computed mass limit for a white dwarf in 1931 at age 19!. Ridiculed by Eddington at Cambridge. Awarded Nobel prize 30 years later in 1962



## Neutron Stars



Fritz Zwicky ; 1934: suggested supernova forms when star collapses into neutron star



Jocelyn Bell . Discovered first rotating neutron star or pulsar in 1967.