AST414
Yıldız Evriminin Son Safhaları

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2017-2018 Bahar Dönemi

Akademik Takvim

Derslerin başlama- bitiş tarihleri (14 hafta)
14 Şubat 2018 - 23 Mayıs 2018

Yapılamayacak dersler: Vize haftası ve 7 Mart

Vize dönemi : Nisan 2018

Final dönemi : 26 Mayıs - 13 Haziran

Bütünleme dönemi: 23 Haziran - 1 Temmuz 2018

Dersin işlenme yöntemi

- Devam Durumu: %70

  (15-2)*0.7=9 hafta devam, 4 hafta devamsızlık
- 1 Vize & 1 Final
- Vize & Final: 10 soru → 5 klasik, 5 çoktan seçmeli
- Değerlendirme: Mutlak (Elle harf notu atama)

Kaynaklar

- An Introduction to Modern Astrophysics
  Bradley W. Carroll & Dale A. Ostlie
- AST414 Yıldız Evriminin Son Safhaları Ders Sunuları ve İçlerinde Yer Alan Kaynaklar
- Ders Notları

A yıldızı

5 milyar yıl yaşında
bir anakol yıldızı

B yıldızı

1 milyar yıl yaşında
bir kırmızı dev yıldız

Hangi yıldız daha genç?
Hangi yıldız daha fazla evrimleşmiş?

C yıldızı

1 milyar yıl yaşında
bir anakol yıldızı

B yıldızı

1 milyar yıl yaşında
bir kırmızı dev yıldız

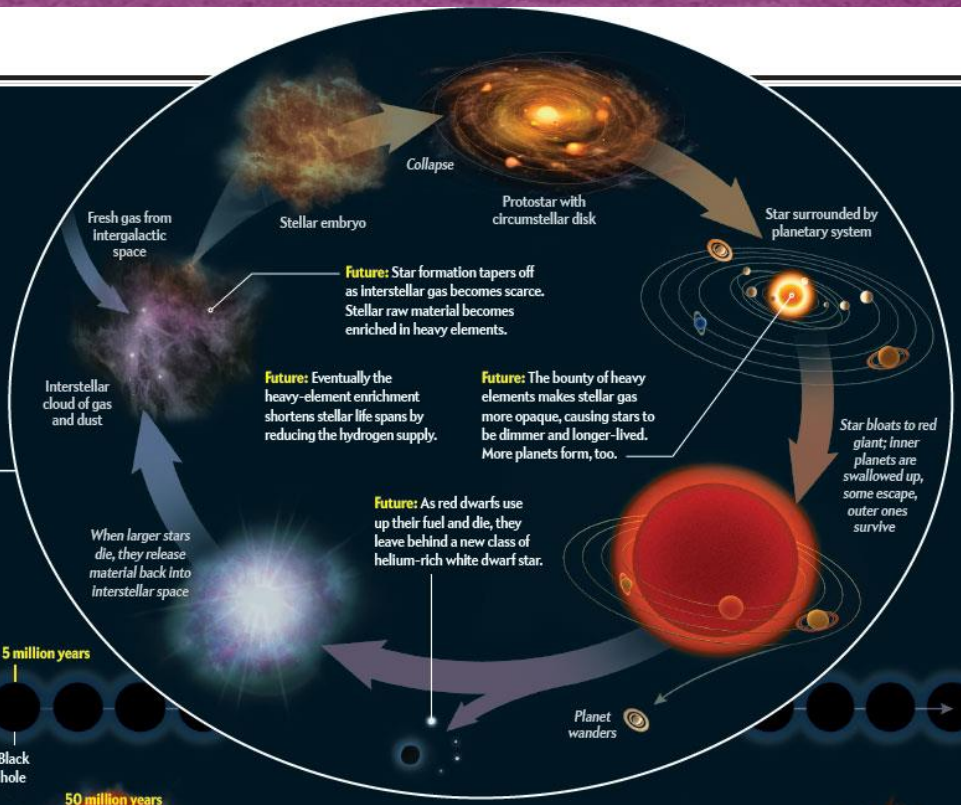
Hangi yıldızın kütlesi daha büyük?

The Meek Shall Inherit the Universe

In terms of raw brilliance, the glory days of the cosmos are already behind it. In subtler ways, though, it will remain vibrant for trillions of years to come. Red dwarfs, by far the most common type of star even today, have hardly even begun their life cycles and will eventually develop into novel stellar types. New generations of stars will incorporate the heavy elements forged by their predecessors, changing their appearance and life spans. Planets will, if anything, become even more abundant. Over the vastness of time, rare processes such as direct stellar collisions will become commonplace.

Slow but Steady Wins the Cosmic Race

The life cycle of stars follows a simple rule: the bigger they come, the harder they fall. Massive stars have more fuel but consume it at a disproportionate rate and go out with a bang. Because they live for but a cosmic eyeblink, they rule the galaxy only as long as new ones are continually being born. The future belongs to lesser, longer-lasting stars.

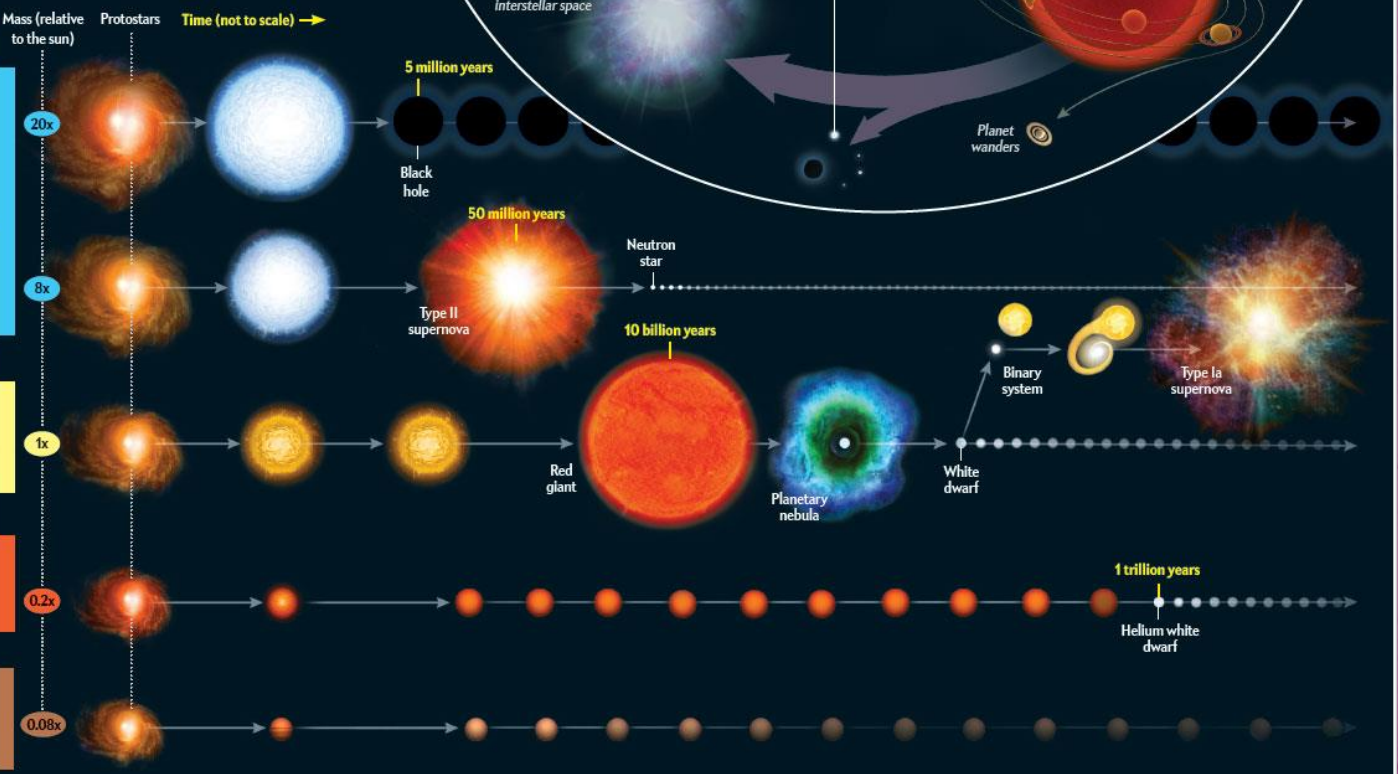


SUPERGIANTS
When the mightiest stars cease to generate enough power to hold up their own weight, they collapse abruptly—which can trigger a supernova explosion or gamma-ray burst—and leave behind a neutron star or black hole.

SUNLIKE STARS
Sunlike stars die by ejecting their outer layers as a colorful nebula, while their core collapses to a white dwarf star. The dwarf usually fades away like a burnt-out cinder but can blow up by merging with another white dwarf or cannibalizing a companion star.

RED DWARFS
Red dwarfs, the most common type of star, keep on shining until they have converted every last drop of their hydrogen to helium. They turn into a special type of white dwarf.

BROWN DWARFS
Stars below a certain mass threshold never get hot enough to ignite proton-proton fusion. They just cool off and fade away.



İçerik

- Bölüm 1: Yıldızlararası ortam (ISM)
  - Genel özellikler
  - Yıldızlararası toz: Sönümleme ve Kızarma
  - Bulutsular
- Bölüm 2: Anakol sonrası evrim
  - HR diagramı ve anakol
  - Alt devler kolu, Kırmızı devler kolu, Yatay kol
  - Asimptotik devler kolu
  - Gezegenimsi bulutsular

İçerik

- Bölüm 3: Büyük kütleli yıldızların sonu
  - Parlak mavi değişenler
  - Wolf-Rayet yıldızları
  - Süpernovalar
    - Sınıflandırma
    - Çekirdeği çöken süpernovalar
- Bölüm 4: Yıldızların dejenere kalıntıları
  - Beyaz cüceler
  - Nötron yıldızları
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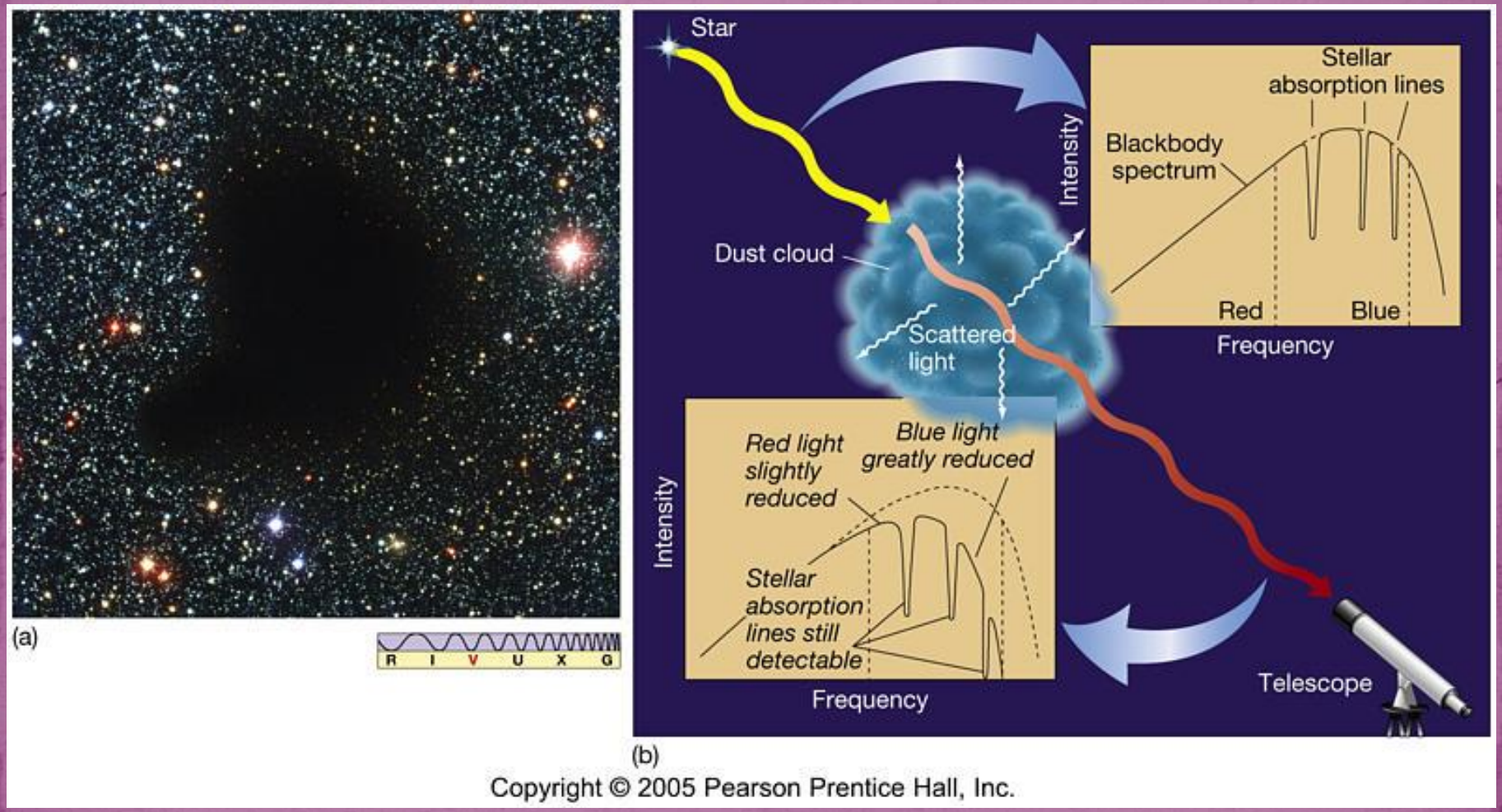
  - Karadelikler

Bölüm 1: Yıldızlararası ortam

Yıldızlararası toz: Sönümleme ve Kızarma



Bulutsular

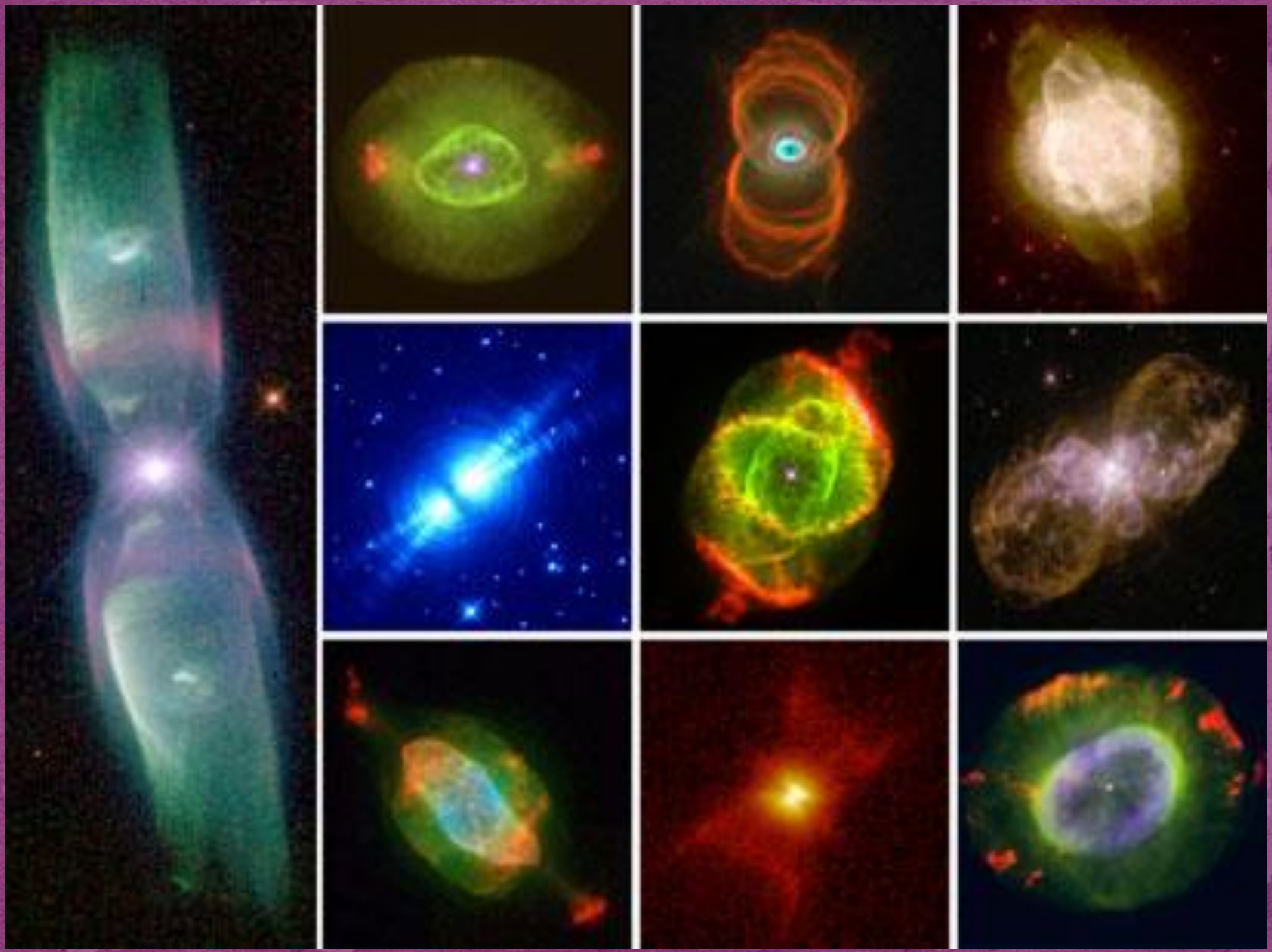
- Yansıtıcı bulutsular,
  - Örnegin; Pleiades açık yıldız kümesindeki yıldızları kuşatan bulutsu
- Salma bulutsuları (HII bölgeleri),
  - Örnegin; Orion bulutsusu
- Karanlık bulutsular (soğurma bulutsuları)
  - Örneğin; Barnard 68
- Moleküler bulutlar
  - Örnegin; Kartal bulutusu


Atbaşı bulutsusu
© Anglo-Australian Observatory

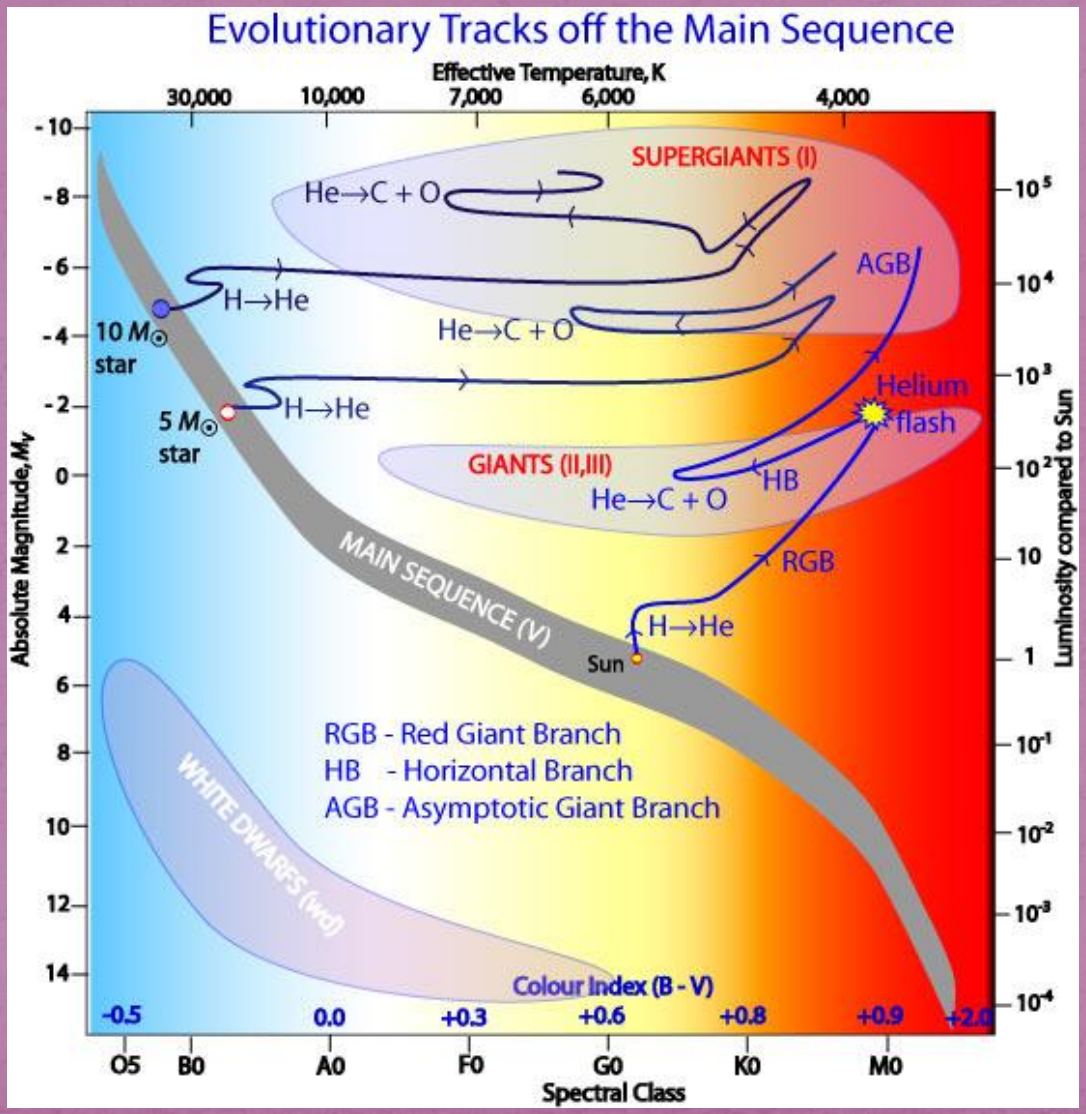

Orion Bulutsusu
© Anglo-Australian Observatory


Pleiades bulutsusu

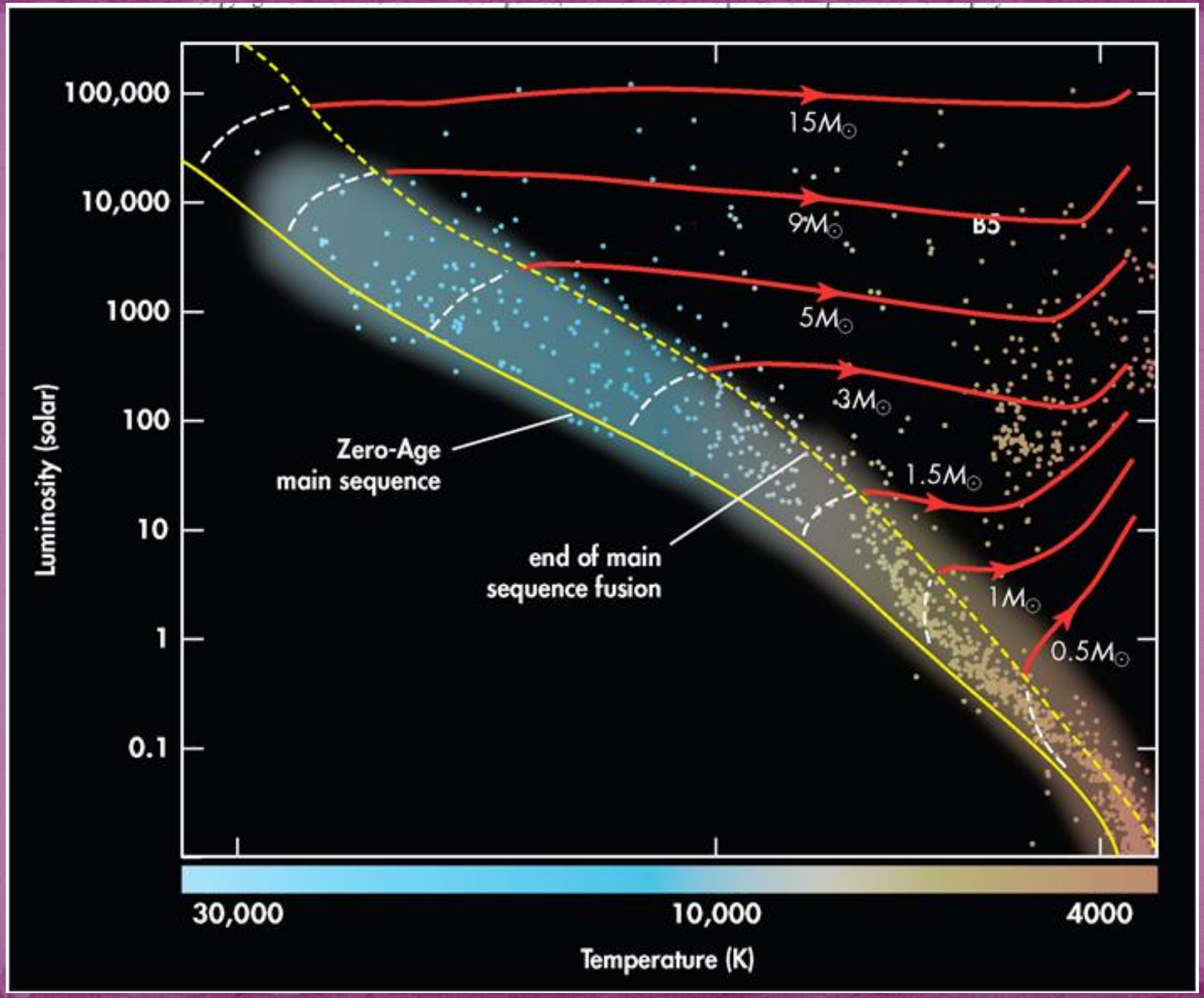

Kartal
bulutsusu

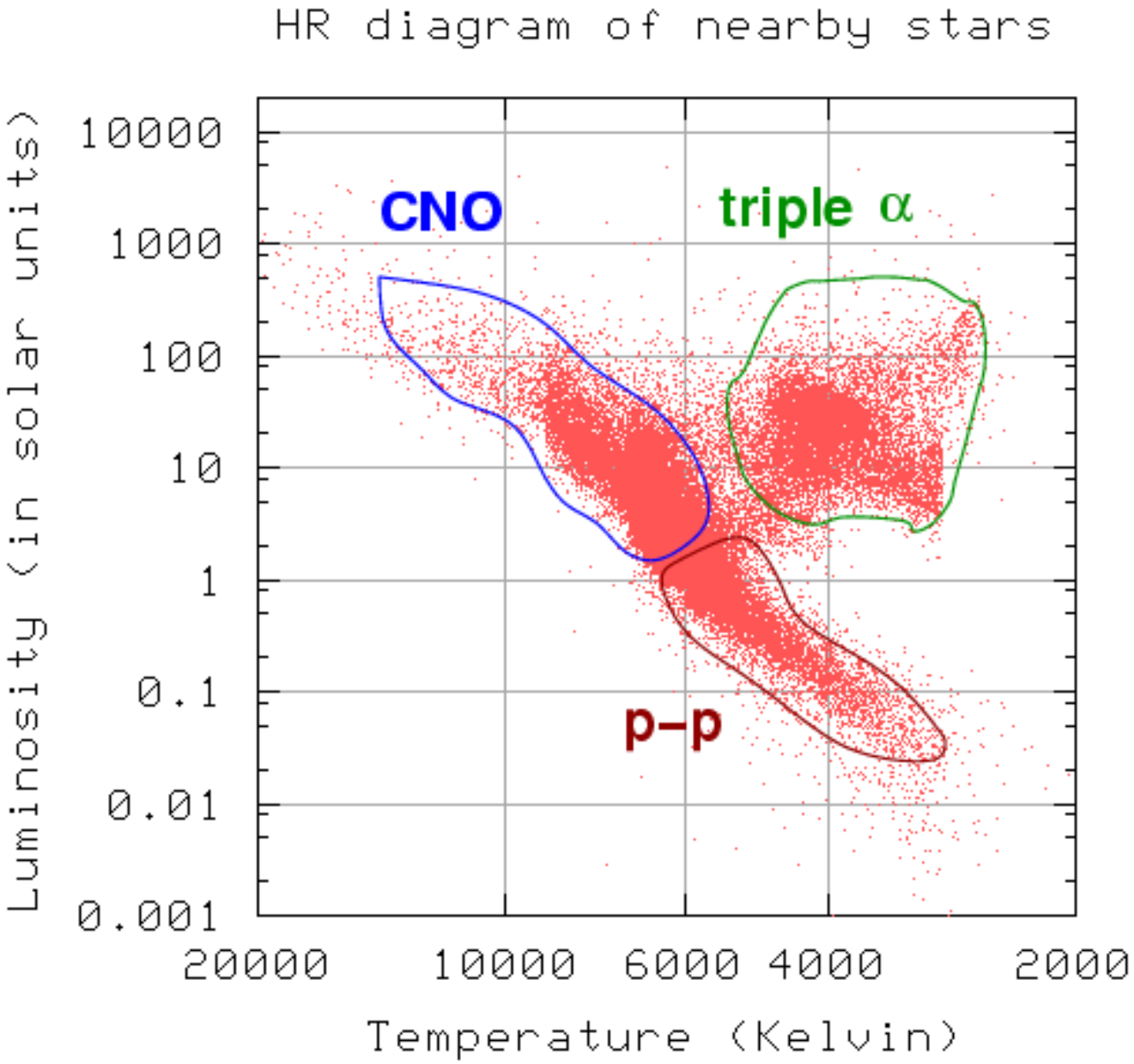


Bölüm 2: Anakol sonrası evrim

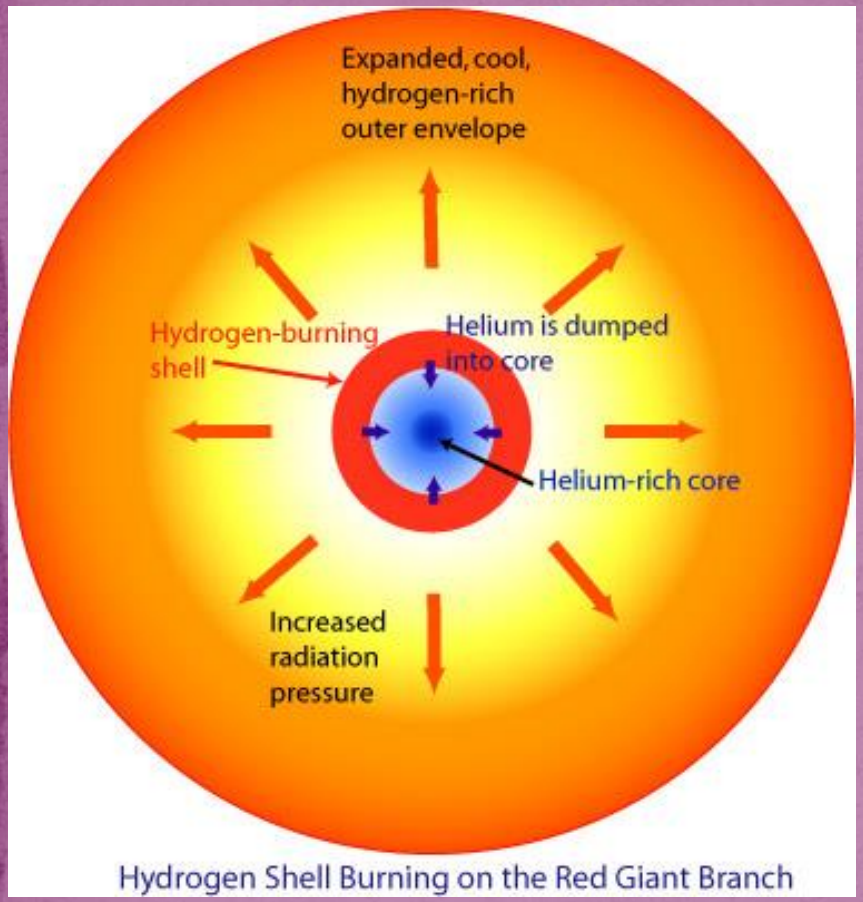


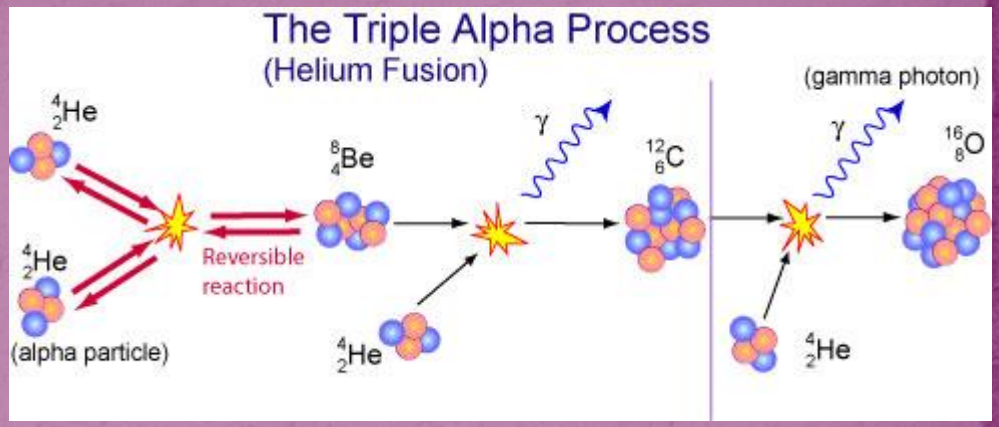
http://outreach.atnf.csiro.au/education/senior/astrophysics/stellarevolution_postmain.html#postmainevotrack

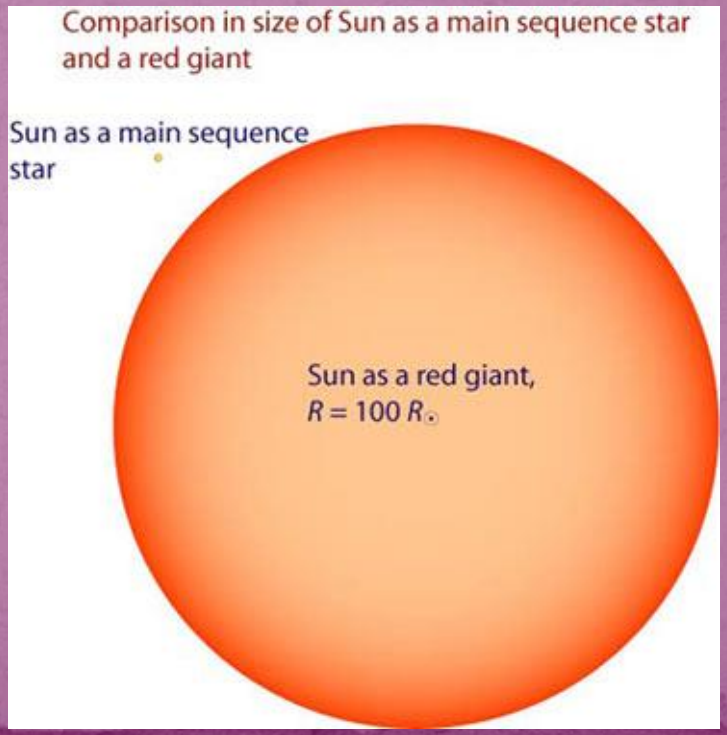

100,000
10,000
1000
100
10
1
0.1
Luminosity (solar)
15M⊙
9M⊙
5M⊙
3M⊙
1.5M⊙
1M⊙
0.5M⊙
B5
Zero-Age
main sequence
end of main
sequence fusion
30,000
10,000
4000
Temperature (K)


HR diagram of nearby stars
Luminosity (in solar units)
10000
1000
100
10
1
0.1
0.01
0.001
CNO
triple α
p–p
20000
10000
6000
4000
2000
Temperature (Kelvin)

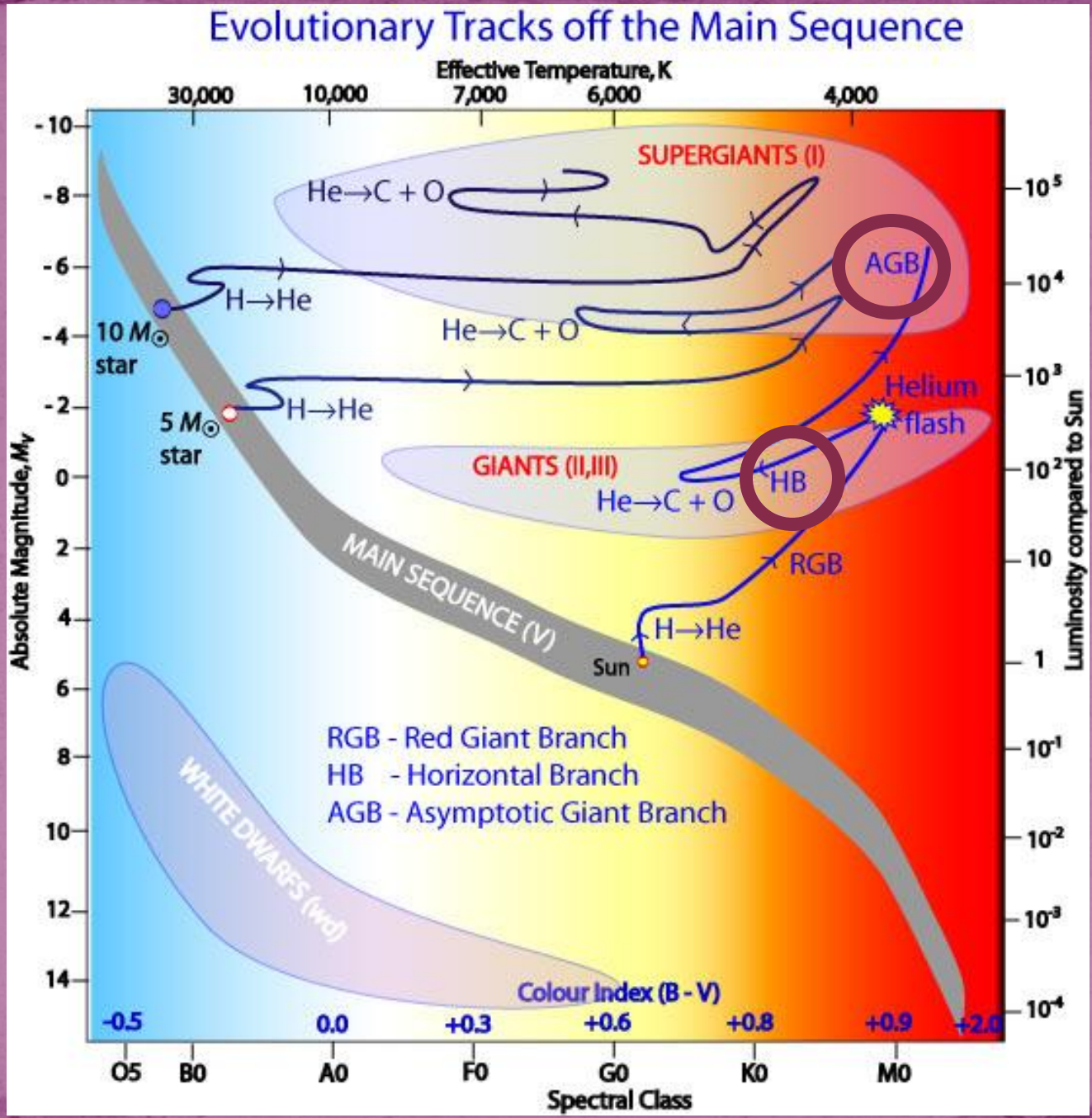
Kırmızı Dev Kolu (RGB)



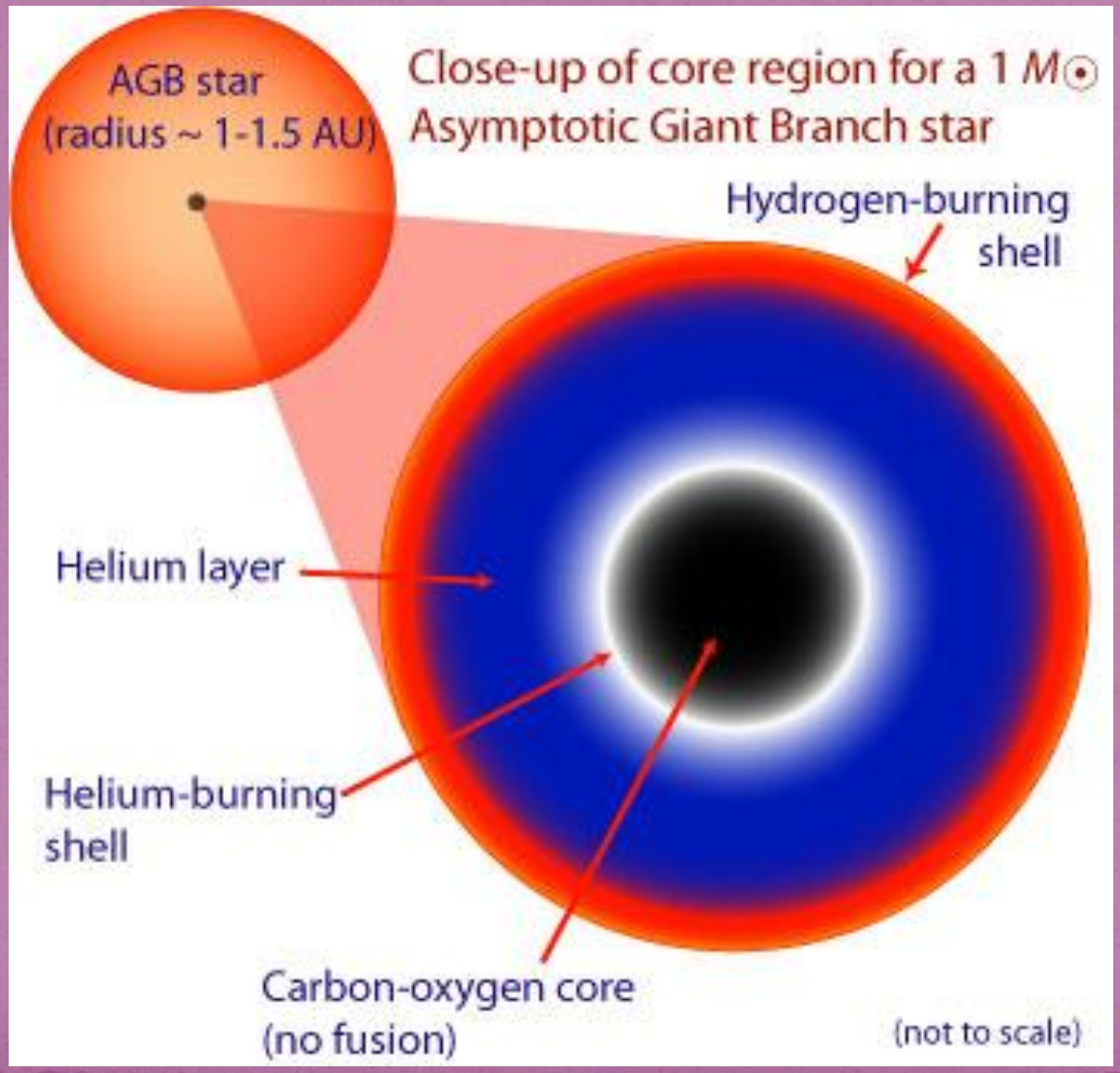




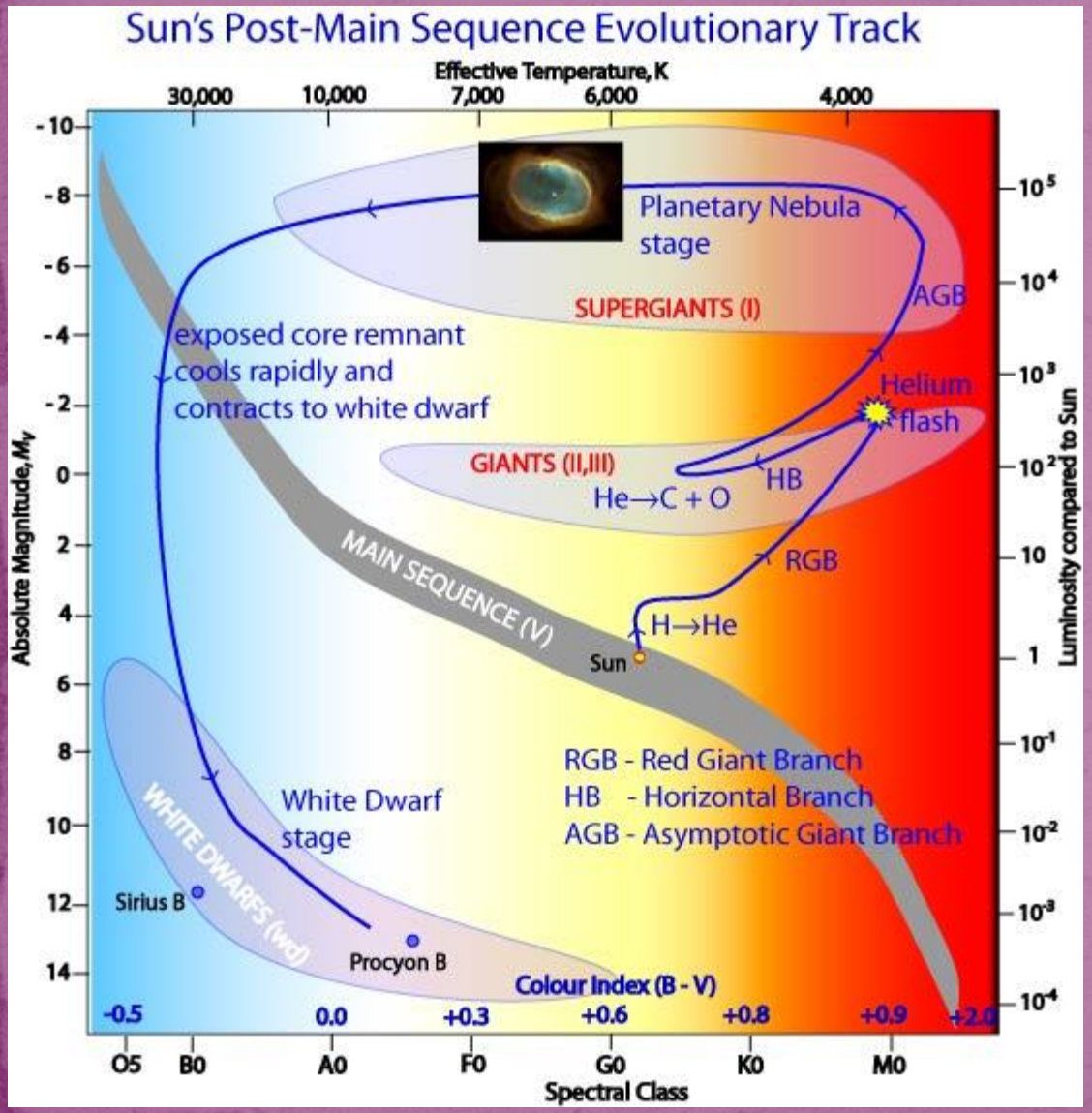
Evolutionary Tracks off the Main Sequence



Asimptotik Dev Kolu (AGB)



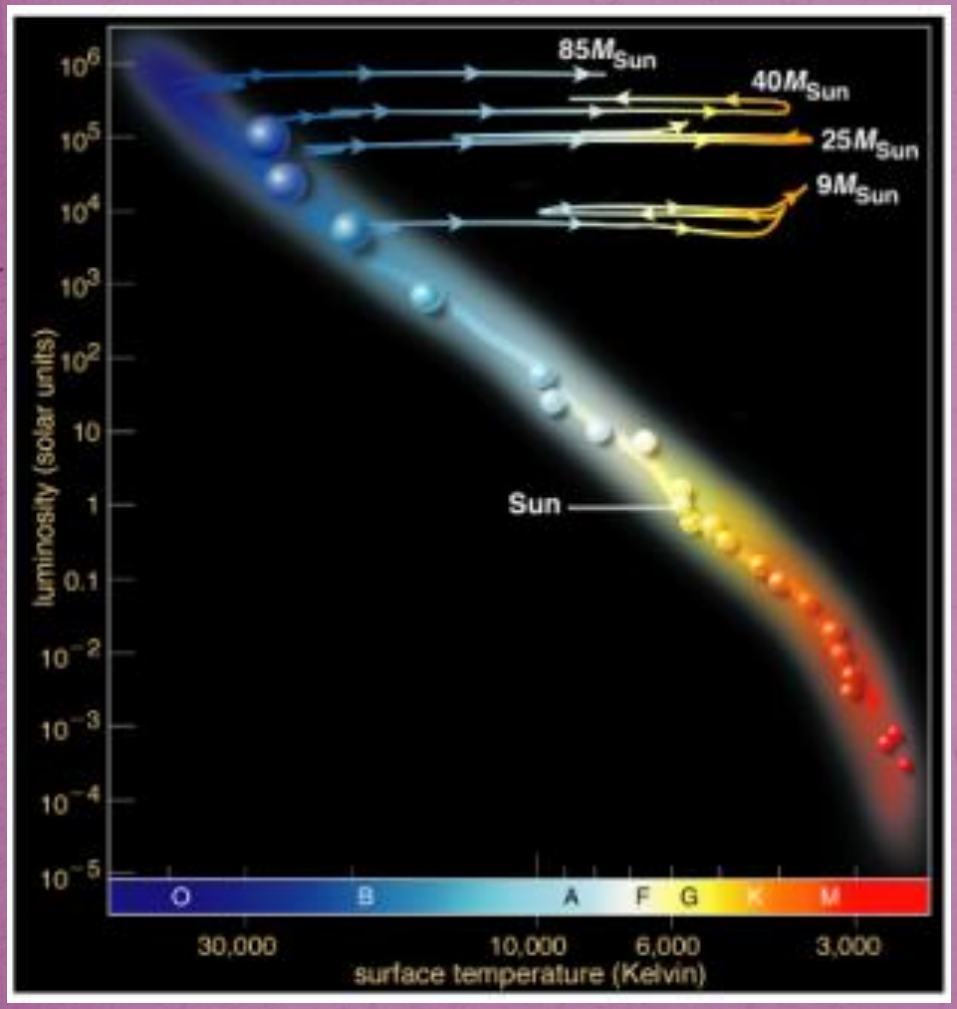
Gezegenimsi bulutsular



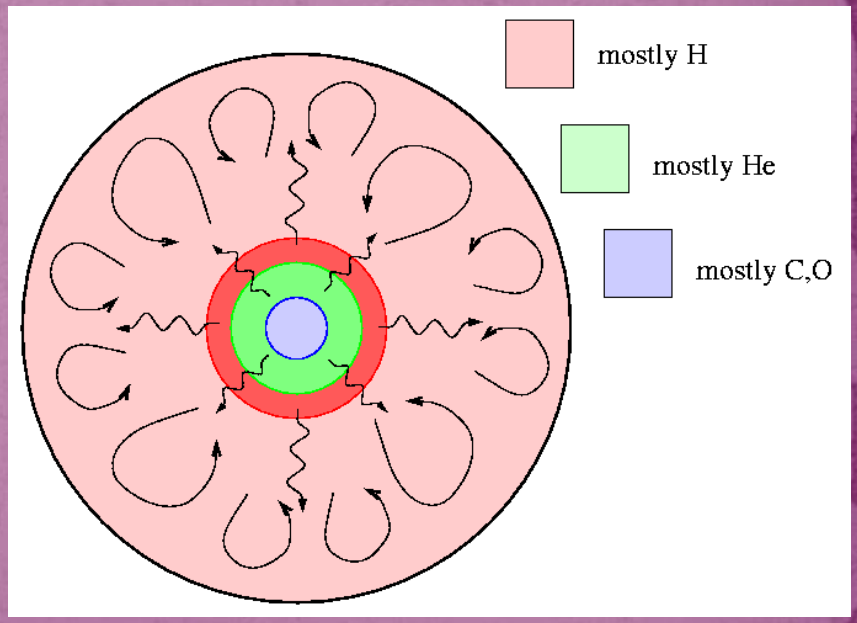
NGC 6543, the Cat's Eye Nebula

NGC 7293, the Helix Nebula

Bölüm 3: Büyük kütleli yıldızların sonu

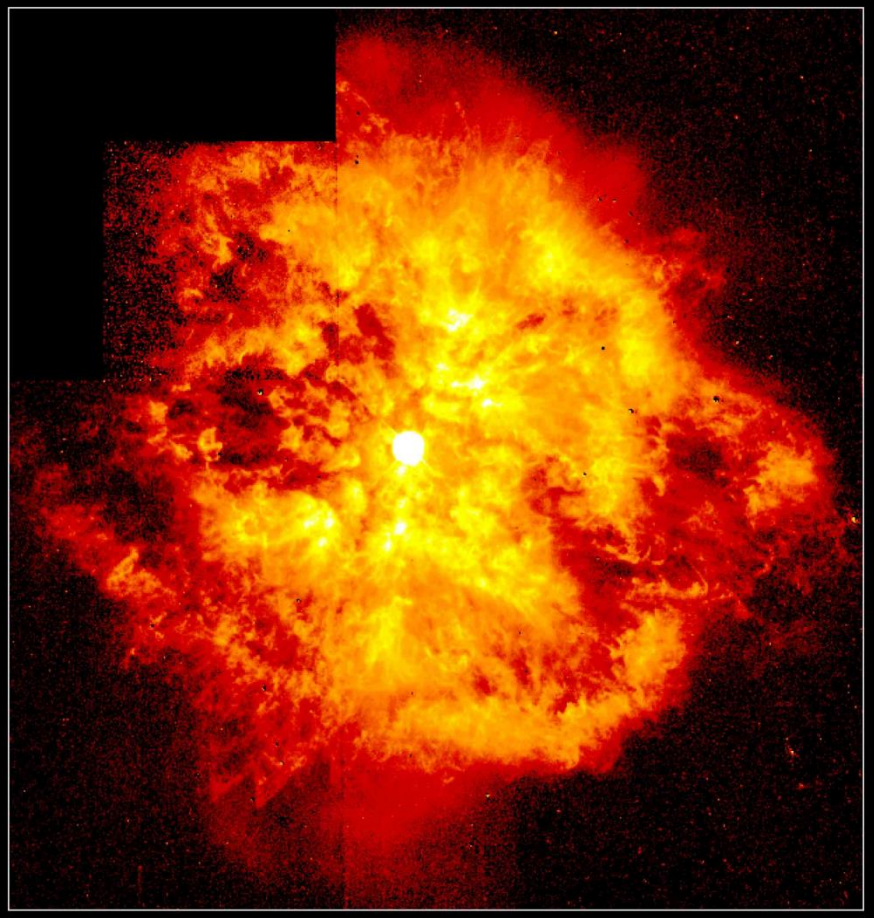


Büyük kütleli yıldızların evrimi küçük kütleli yıldızların evrimine nazaran bir çok yönden farklılık gösterir!



Parlak Mavi Degisenler (LBV) ve Wolf Rayet Yıldızları (WR)

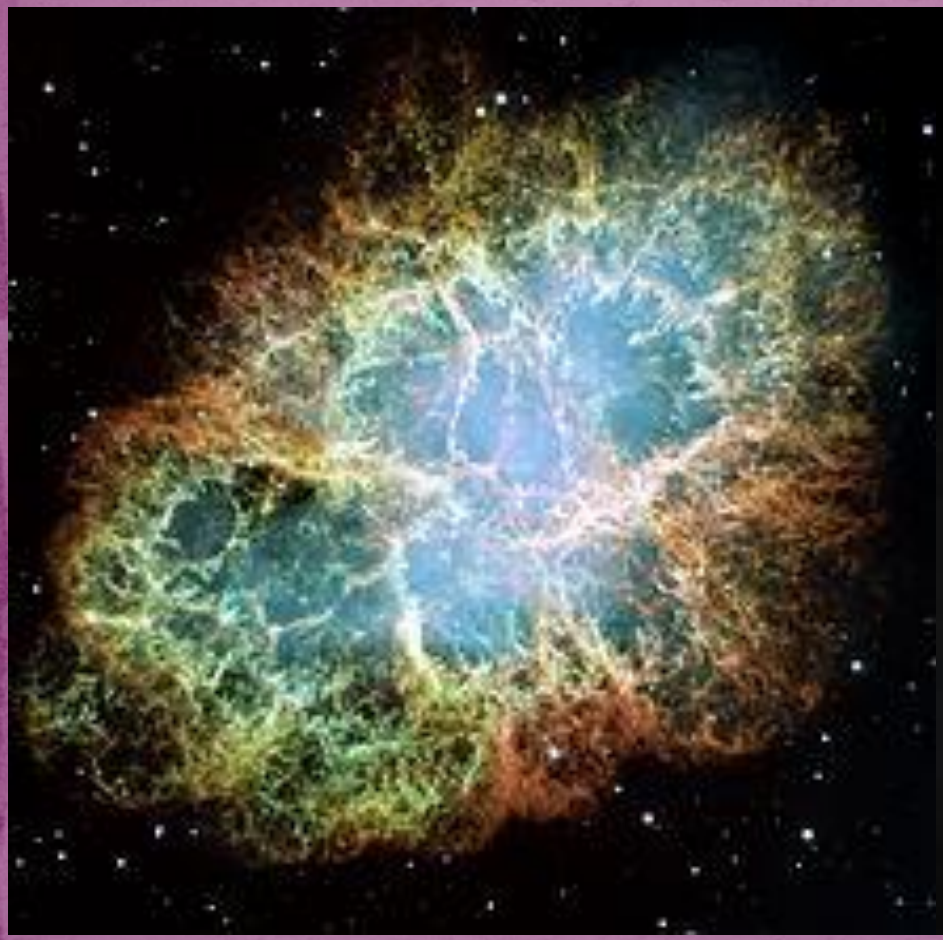
Eta Carina,
kütlesi 120 $M_{\odot}$,
her bir lobun çapı yaklaşık 0.1 pc

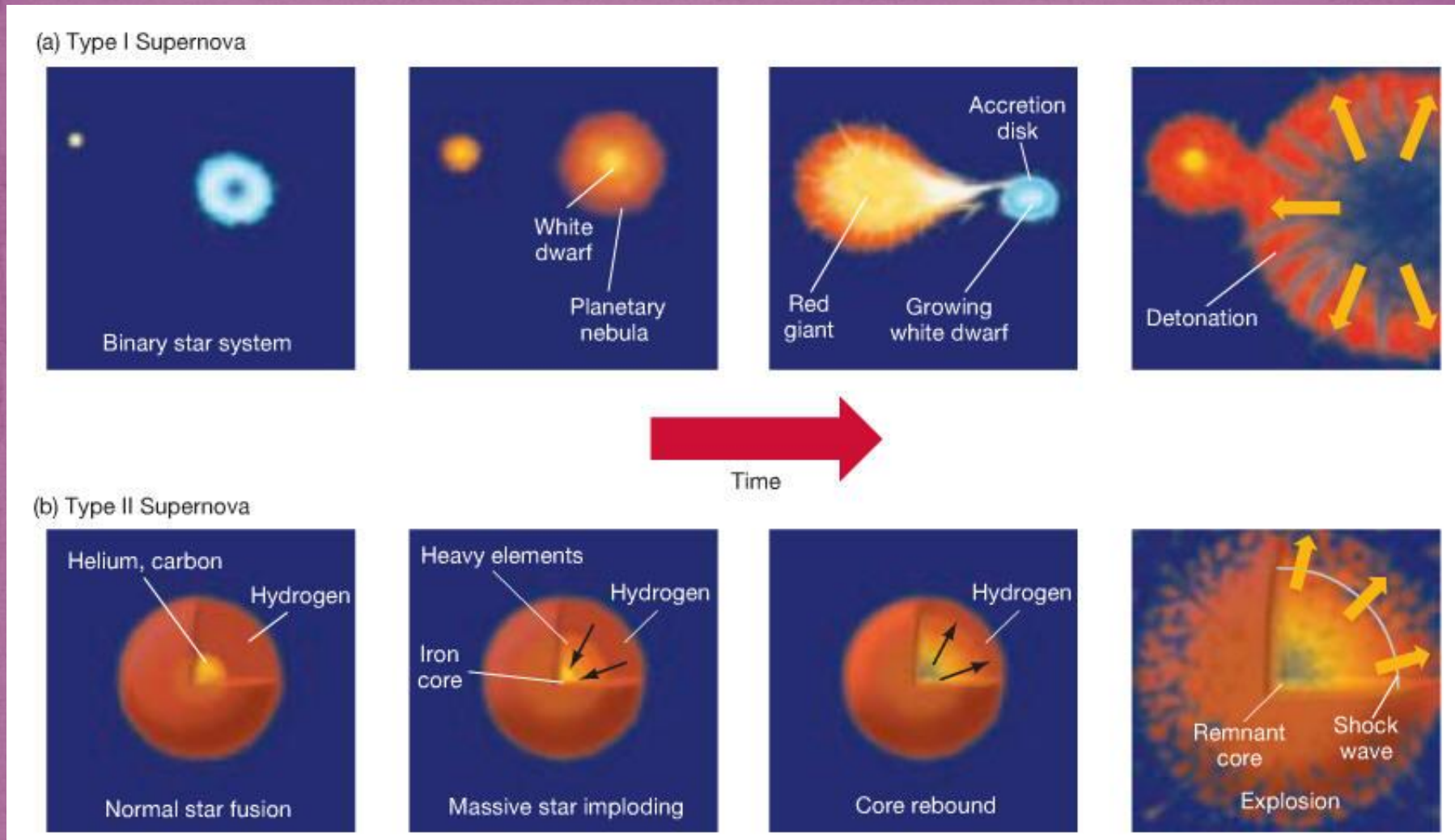


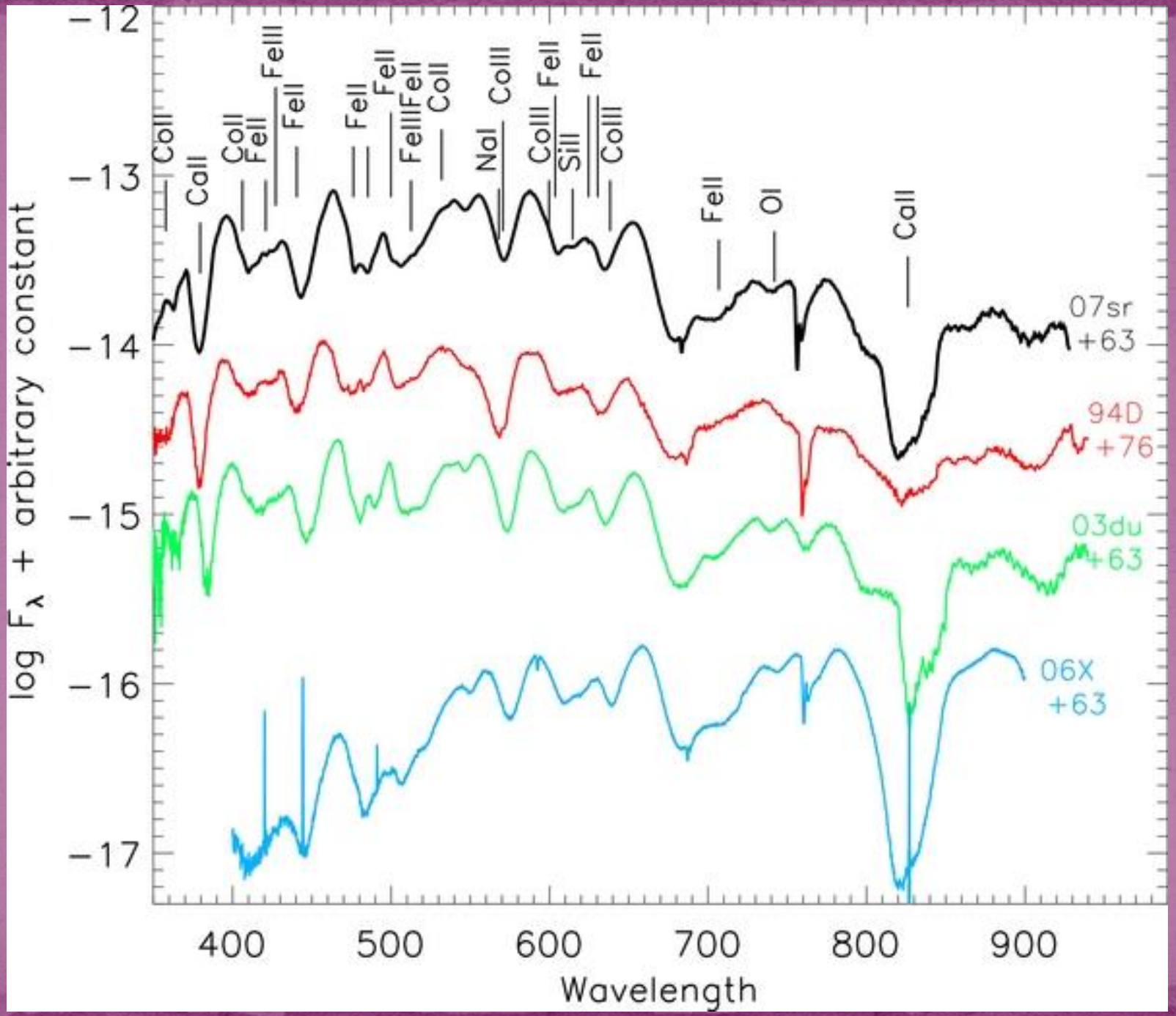
Nebula M1-67 around Star WR224
Hubble Space Telescope • WFPC2

PRC98-38 • STScI OPO • Y. Grosdidier and A. Moffat (University of Montreal) • NASA

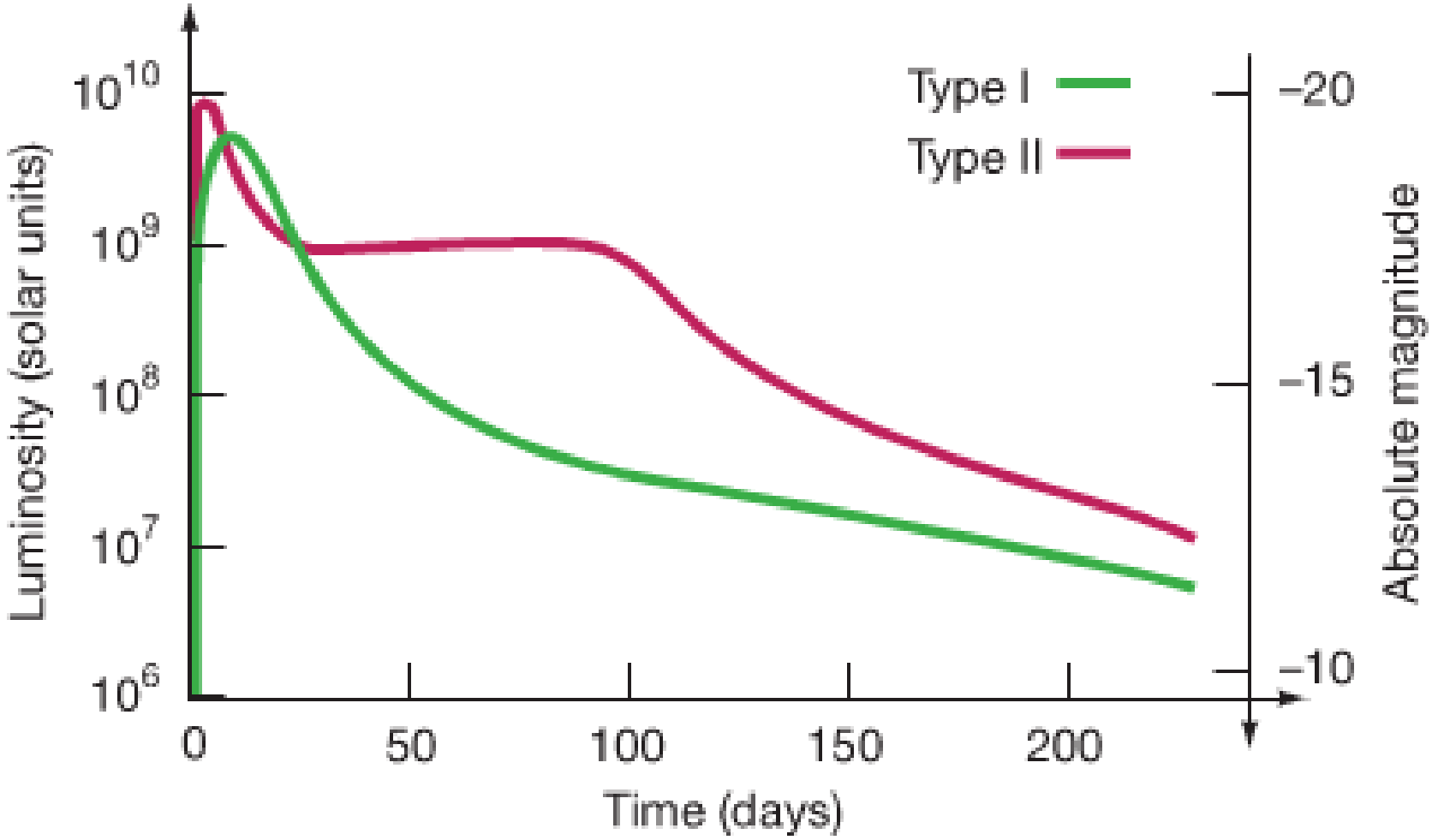
Süpernovalar




(a) Type I Supernova
Binary star system
White dwarf
Planetary nebula
Accretion disk
Red giant
Growing white dwarf
Detonation
Time
(b) Type II Supernova
Helium, carbon
Hydrogen
Normal star fusion
Heavy elements
Hydrogen
Iron core
Massive star imploding
Hydrogen
Core rebound
Remnant core
Shock wave
Explosion

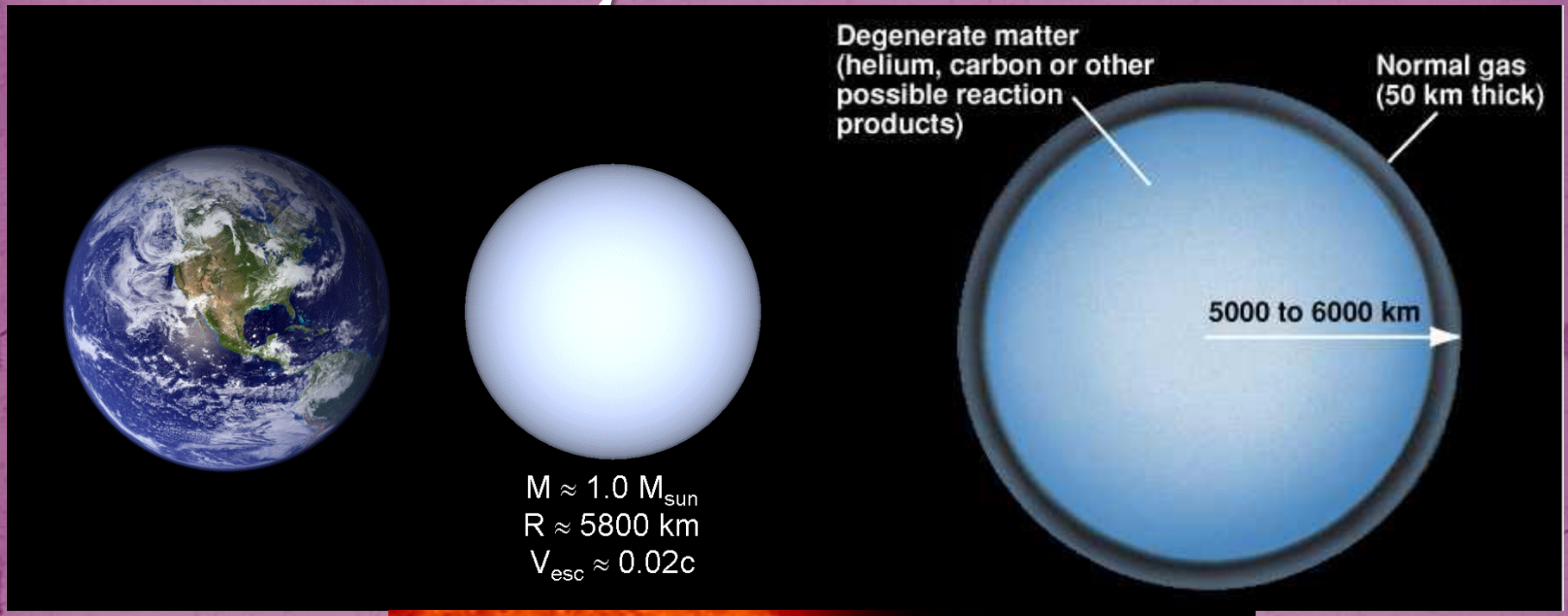


The Astronomical Journal, 145:27 (9pp), 2013 February

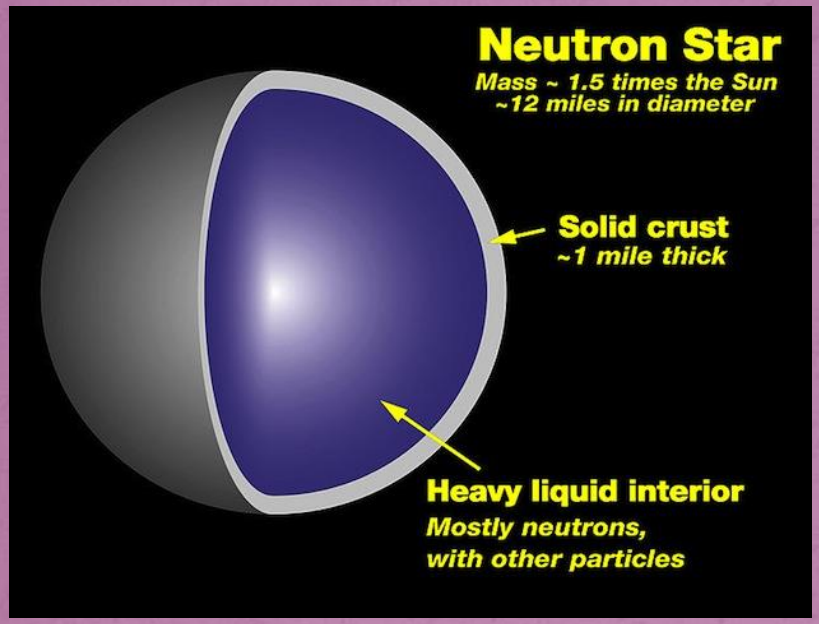

Type I
Type II
Luminosity (solar units)
10^{10}
10^{9}
10^{8}
10^{7}
10^{6}
0
50
100
150
200
Time (days)
−20
−15
−10
Absolute magnitude

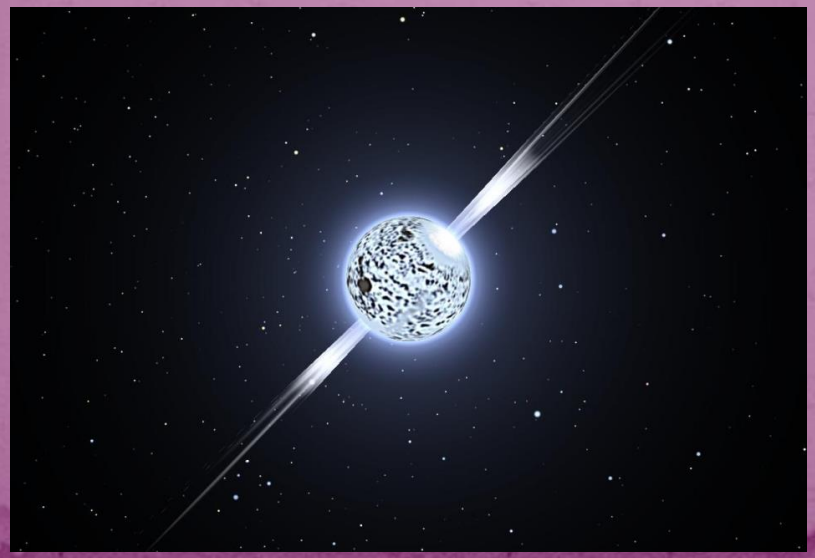

Sirius B / Alhabor B / α CMa B / 9 CMa B / Gliese 244 B
Distance: 137.110 km
Abs (app) mag: 11,34 (-35,42)
Luminosity: 0,00249x Sun
Class: DA2
Apparent diameter: 1° 25' 54,8"
Surface temp: 25.200 K
Radius: 0,00 Rsun
Rotation period: 30,000 minutes
2043 10 31 13:00:22 UTC
Real time
Bölüm 4: Yıldızların dejenere kalıntıları
Speed: 0,00000 m/s
Follow Sirius B
FOV: 6° 27' 38,5" (5,79×)

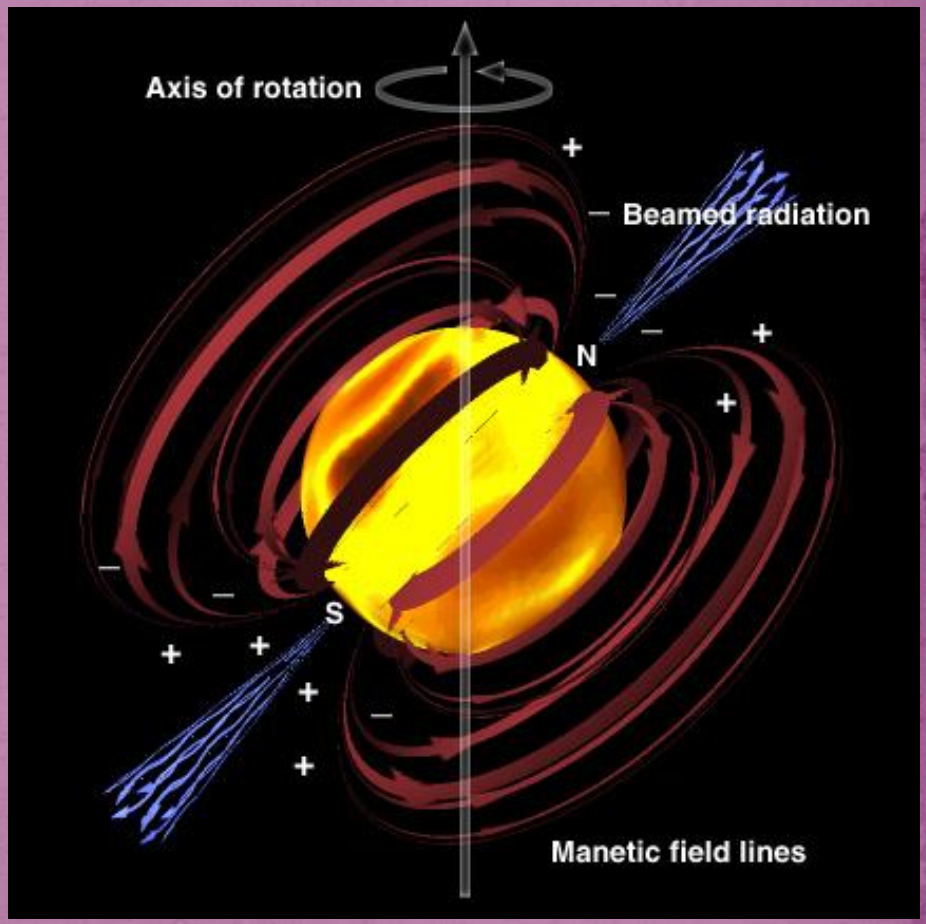
Beyaz cüceler



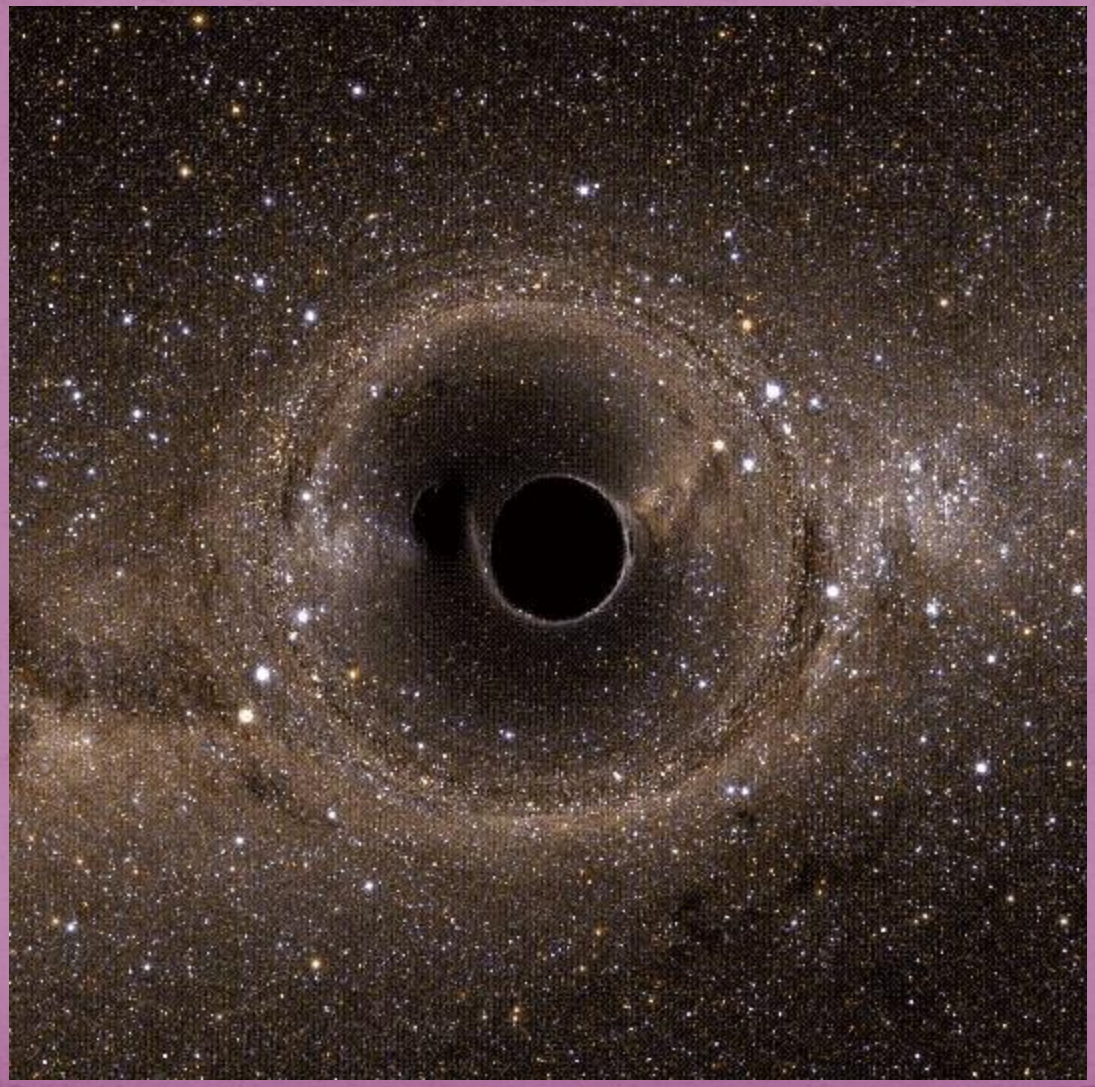
Nötron yıldızları







Karadelikler



Ilk dersin sonu ...