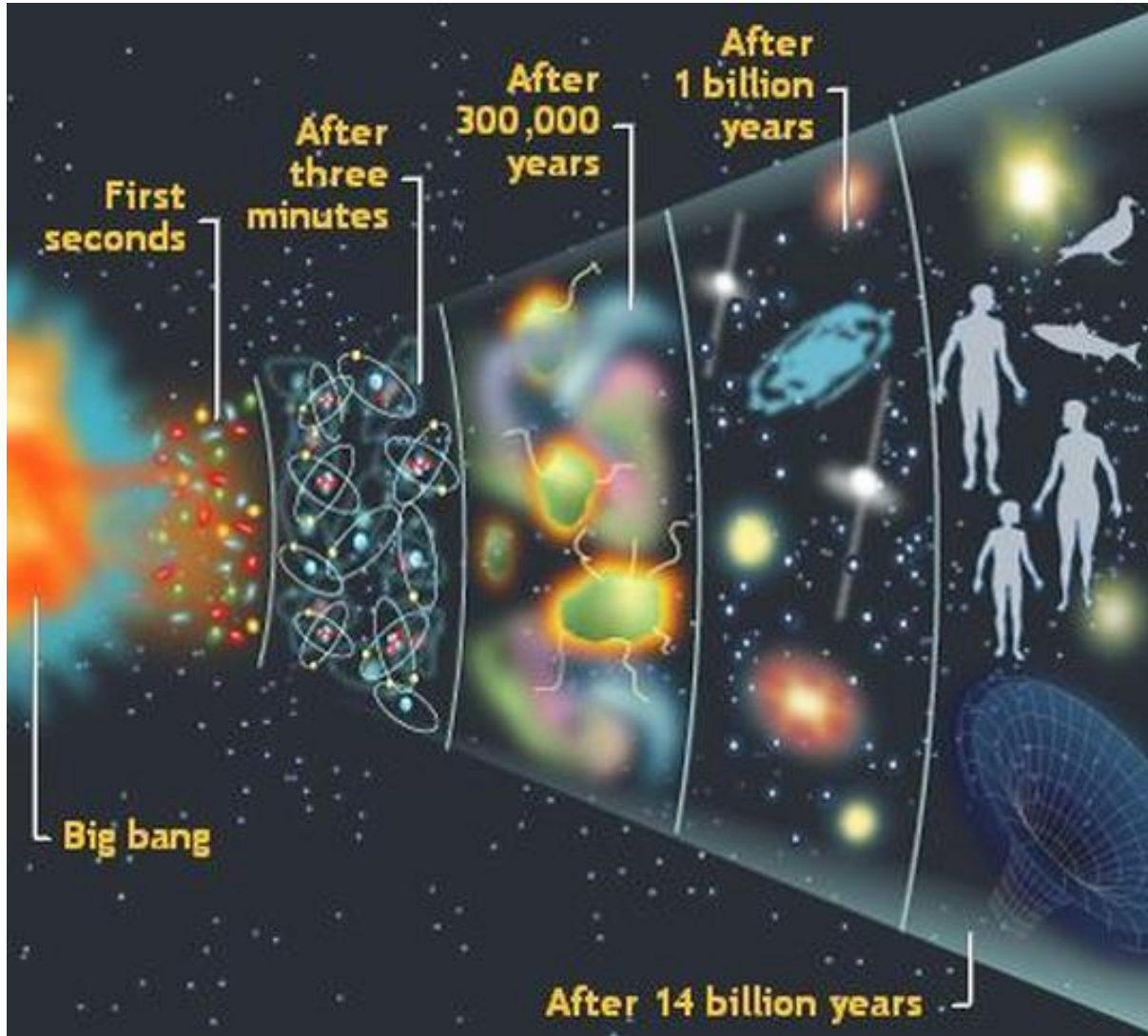


MİNERAL VE KAYAÇ JEOKİMYASI

EVREN NASIL ORTAYA ÇIKTI?



10⁻⁴³ seconds
Temperature 10³²K
Gravity emerges

10⁻³⁵ seconds
Temperature 10²⁸K
Inflation era

10⁻⁴ seconds
Temperature 10¹³K
Antimatter disappears

THERMAL EQUILIBRIUM ERA

10⁻² seconds
10¹¹K

Equal numbers of protons and neutrons



1 billion photons for every proton or neutron



Proton	Neutron	Antineutrino
Electron	Neutrino	Positron

HYDROGEN ERA

1 second
10¹⁰K



6 protons for every neutron

HELIUM ERA

100 - 300 seconds
100,000 K

Tritium decays with half-life of 12 years, so very little survives

Almost 25% of visible universe is helium; 75% is hydrogen plus some tritium

DEUTERIUM ERA

100 seconds
10⁹K



7 protons for every neutron

380,000 years
Atoms form.
Cosmic microwave background permeates universe

100 - 200 million years
First stars form

THE BIG BANG

Şişme

GALAKSİ EVRİMİ
Devam ediyor

İLK YILDIZLAR
Büyük Patlamadan
400 milyon yıl sonra

DARK ENERGY ?

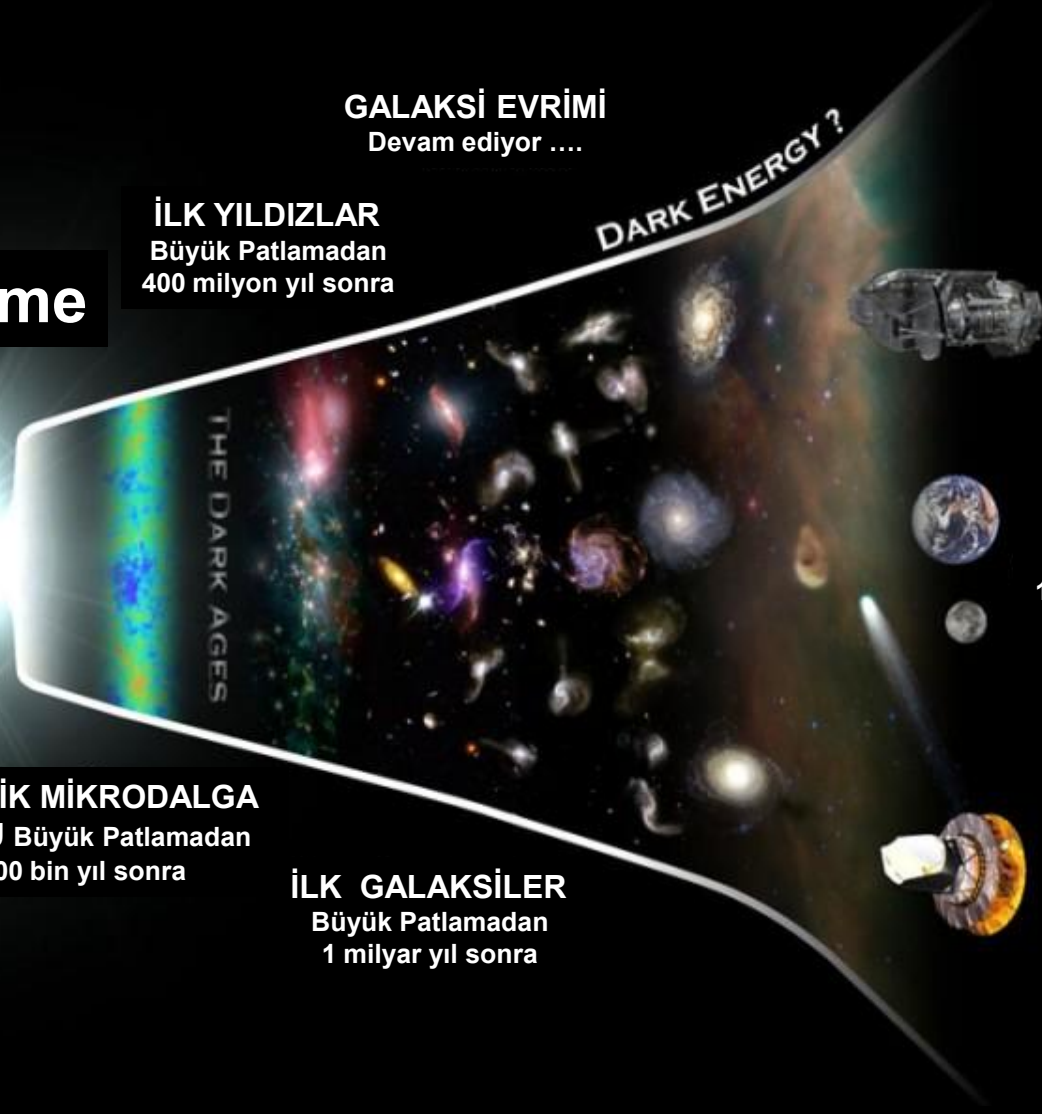
GÜNÜMÜZ !
Büyük Patlamadan
13,7 milyar yıl sonra

**KOZMİK MİKRODALGA
FONU** Büyük Patlamadan
400 bin yıl sonra

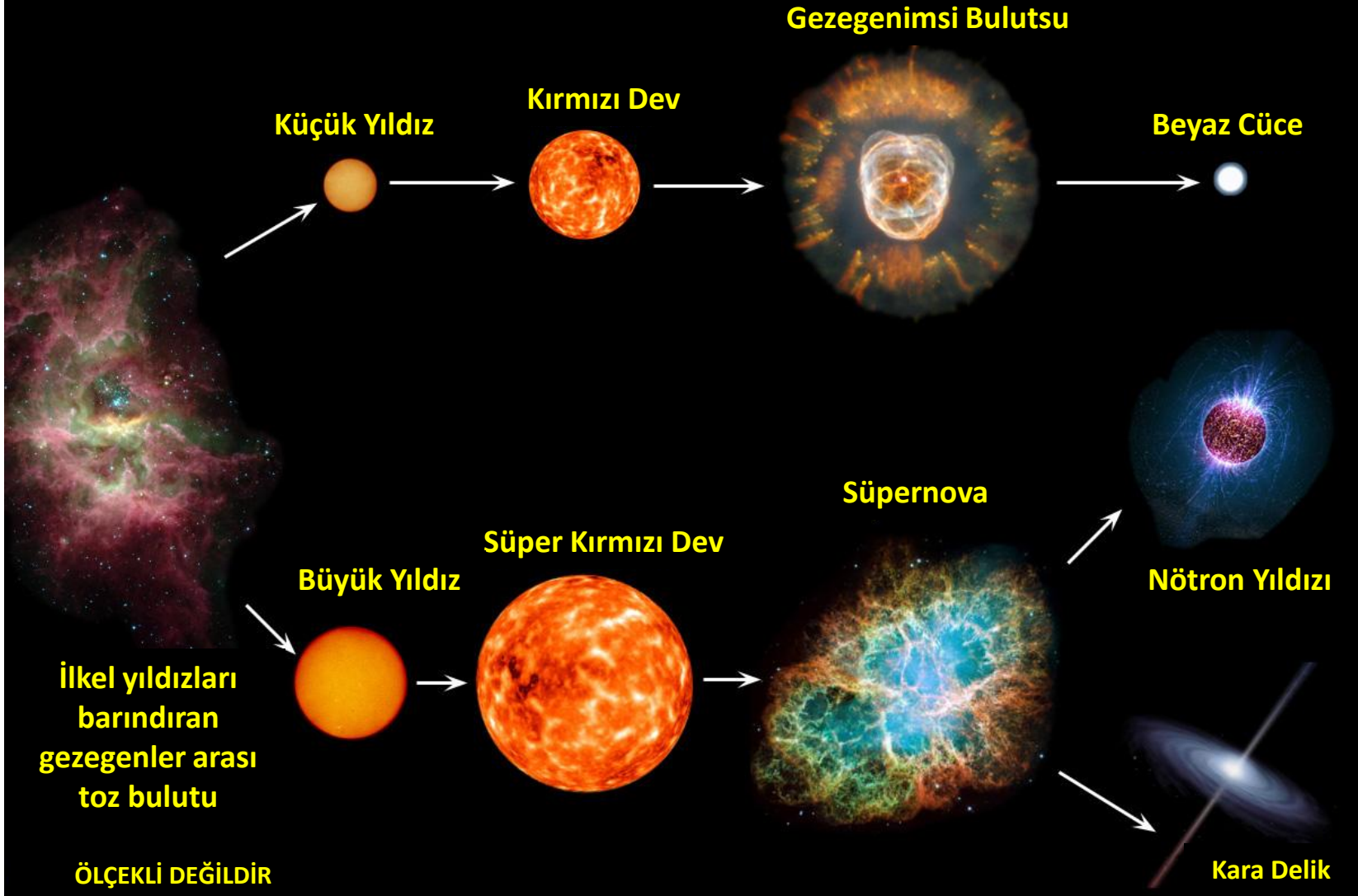
İLK GALAKSİLER
Büyük Patlamadan
1 milyar yıl sonra

GÜNEŞ SİSTEMİNİN OLUŞUMU
Büyük Patlamadan
8,7 milyar yıl sonra

THE DARK AGES



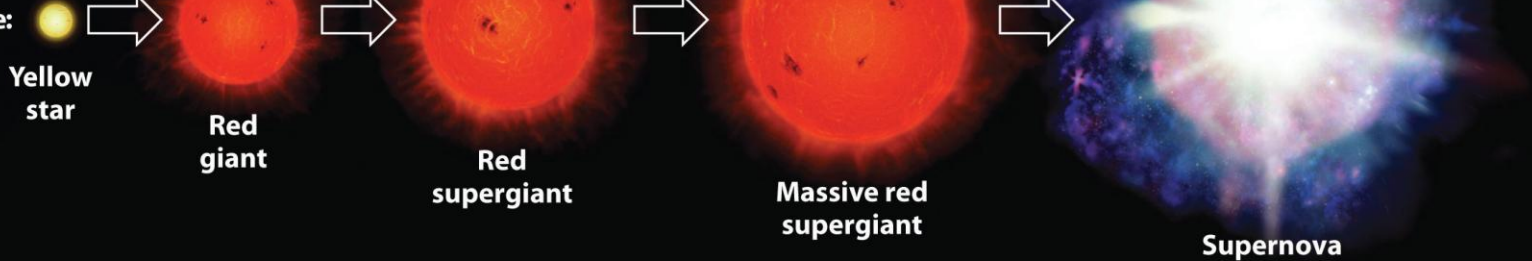
YILDIZLARIN EVRİMİ



Bir yıldızın yaşamı

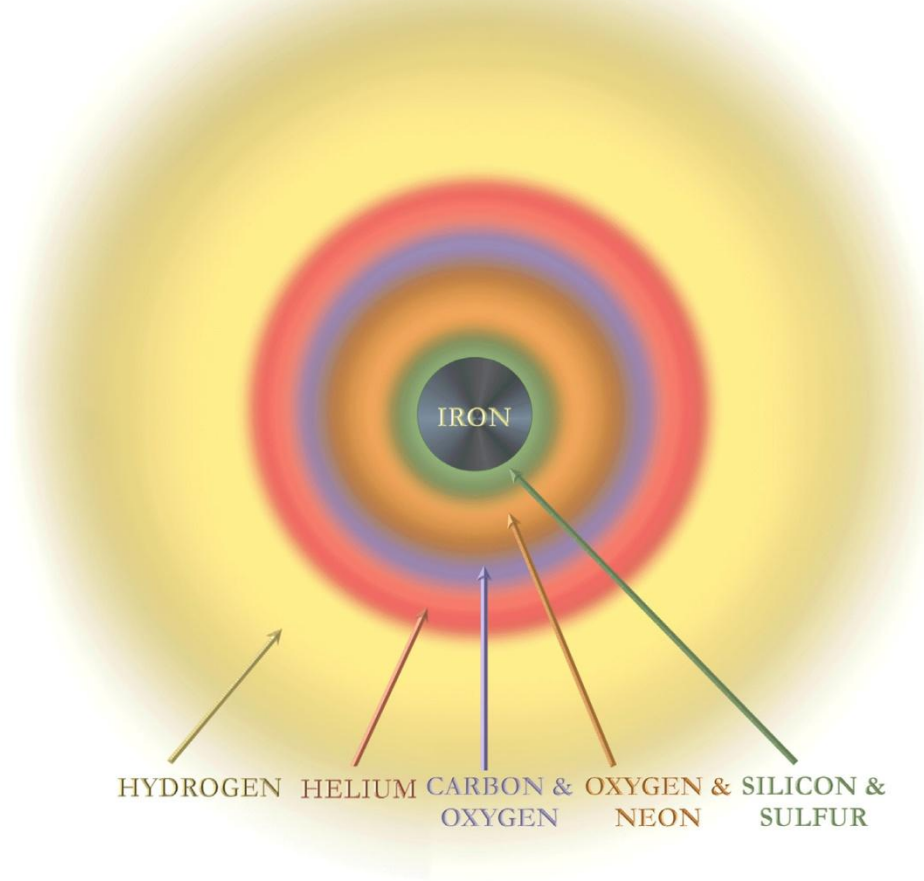
Element sentezi

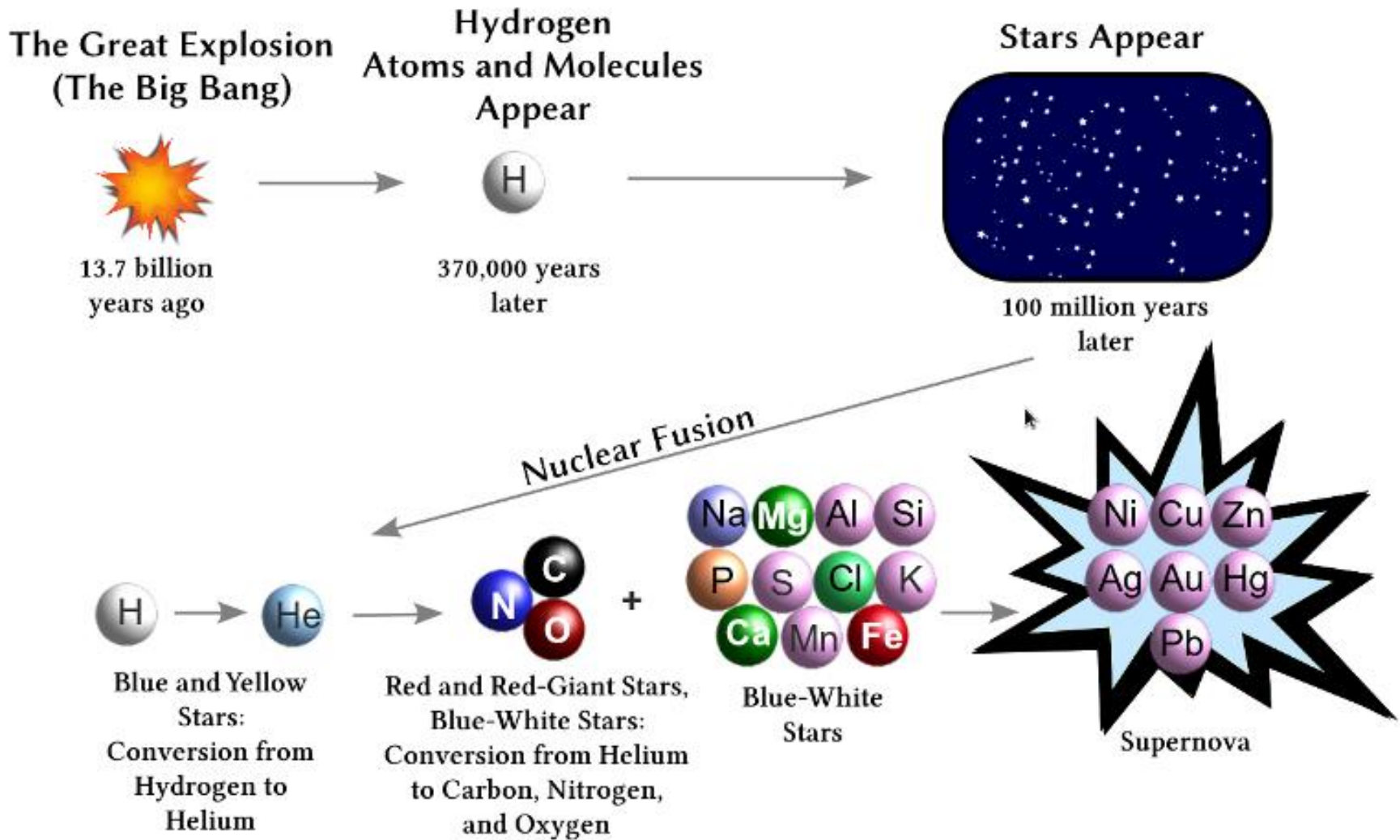
Stages in star lifetime:



Core Temperature:	1.5×10^7 K	2×10^8 K	7×10^8 K	3×10^9 K	1×10^{11} K
Primary Nuclear Reaction:	^1H fusion	^4He fusion	$^4\text{He} + ^{12}\text{C}$ $^{12}\text{C} + ^{12}\text{C}$ $^{12}\text{C} + ^{16}\text{O}$	Proton–neutron exchange reactions	Multiple neutron captures
Elements Formed:	He	C, O, Ne, Mg	Na, Si, S, Ar, Ca	Fe, Ni	Elements with $Z > 28$

SÜPERNOVA ÖNCESİ YILDIZ GÖRÜNTÜSÜ





The Great Explosion
(The Big Bang)

Hydrogen
Atoms and Molecules
Appear

Stars Appear



13.7 billion
years ago



370,000 years
later



100 million years
later

Nuclear Fusion



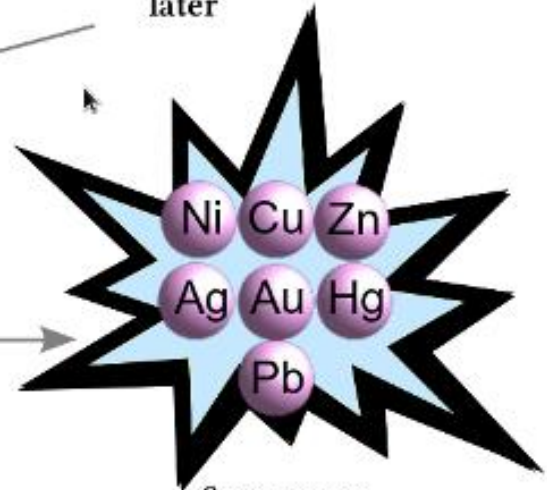
Blue and Yellow
Stars:
Conversion from
Hydrogen to
Helium



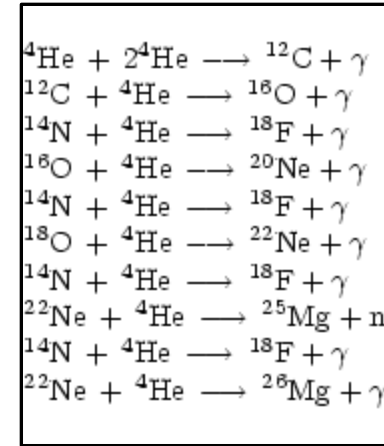
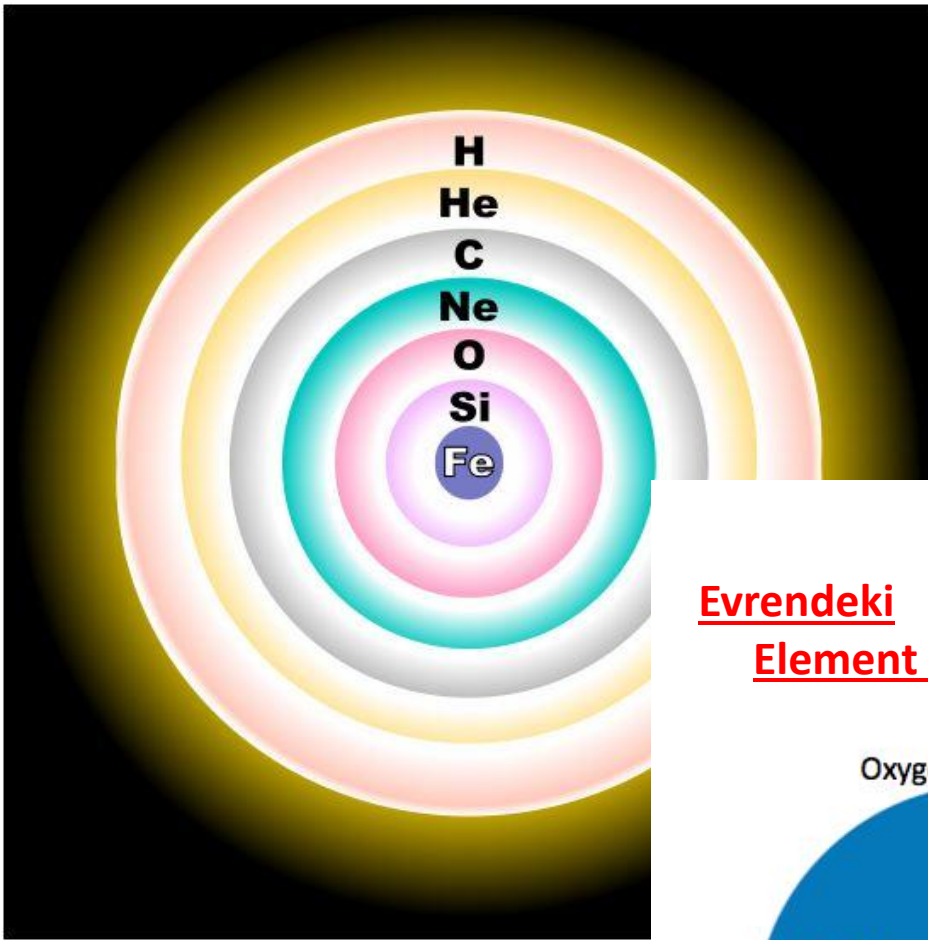
Red and Red-Giant Stars,
Blue-White Stars:
Conversion from Helium
to Carbon, Nitrogen,
and Oxygen



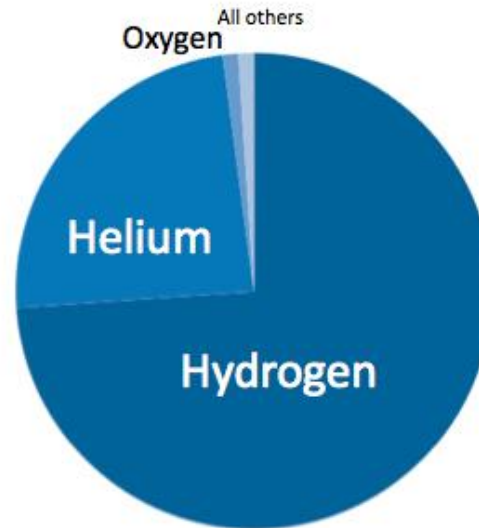
Blue-White
Stars



Supernova



Evrendeki
Element Bolluğu



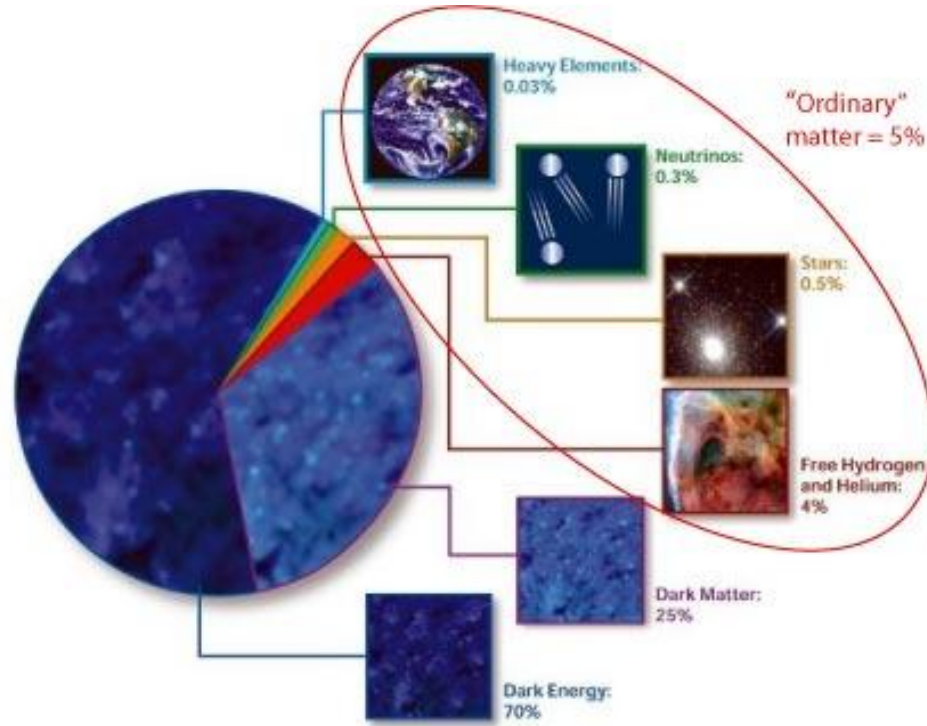
Büyük Patlamadan hemen sonra "Periyodik Tablo"

1 H Hydrogen	2 He Helium
3 Li Lithium	4 Be Beryllium

Günümüzdeki "Periyodik Tablo"

A standard periodic table of elements, showing all known elements from Hydrogen (H) to Oganesson (Og).

ELEMENT SENTEZİ



Evrenin Bileşimi