

The Science of the Smallest and the Largest

Assoc. Prof. Dr. Altuğ Özpineci
Physics Department, METU
ozpineci@metu.edu.tr

What is Physics

Physics is not about formulas, it is about understanding nature

Searching for the Smallest

An ancient question:

Given a magic knife and unlimited time, how long can you keep on dividing a material into two?

- Atomists: there are indivisible blocks, called atoms (Leucippus, Democritus 5th Century BC)
- Continuum theory: Aristotle 4th Century BC)

Searching for the Smallest

A Modern Question:

What are the fundamental building blocks of matter?

Fundamental building block ~ “atom” in atomistic theory

Searching for the Smallest

A Glossary:

- Building blocks of matter ~ atom
- Particle accelerator ~ magic knife(huge microscope)
- High integrated luminosity ~ unlimited time

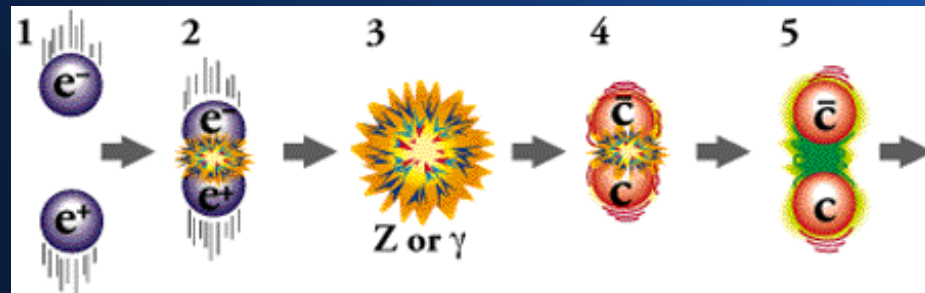
Angels and Damons by Dan Brown



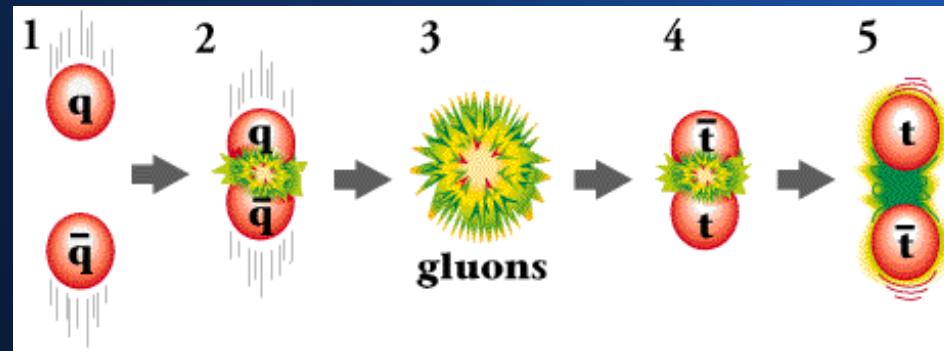
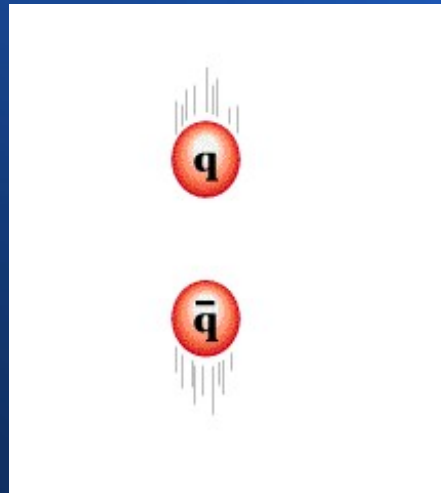
Anti-Matter

- Anti matter has the same properties (like the mass) as ordinary matter but opposite charge
- Anti-electron (positron) first predicted in 1928 by P.A.M. Dirac and discovered experimentally 4 years later.

Electron-Positron Annihilation into Quarks



Quark-anti-Quark Annihilation into Different Quarks

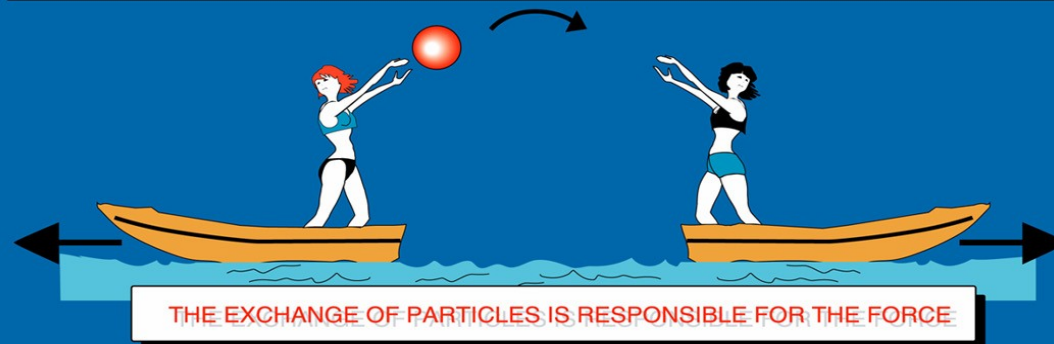


What is force?

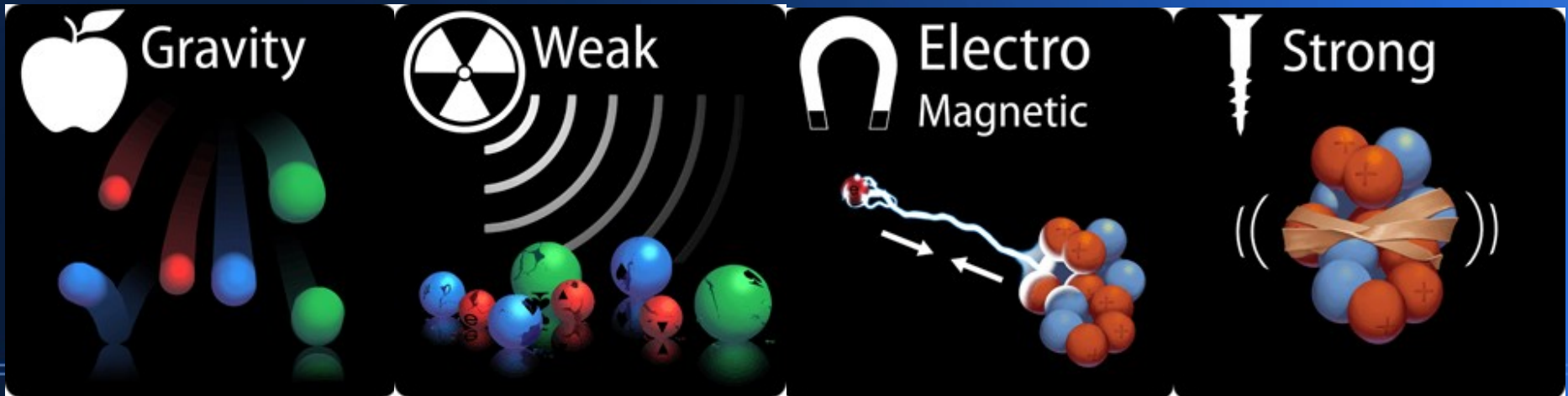
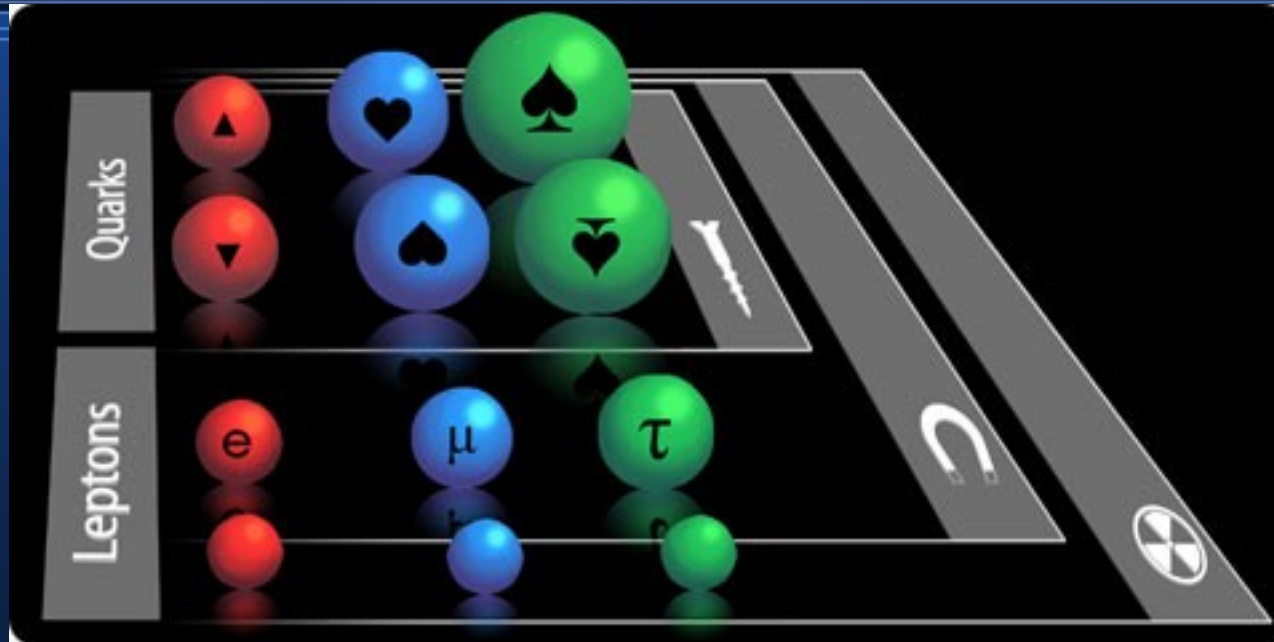
$$F = \Delta p / \Delta t$$

The forces in Nature

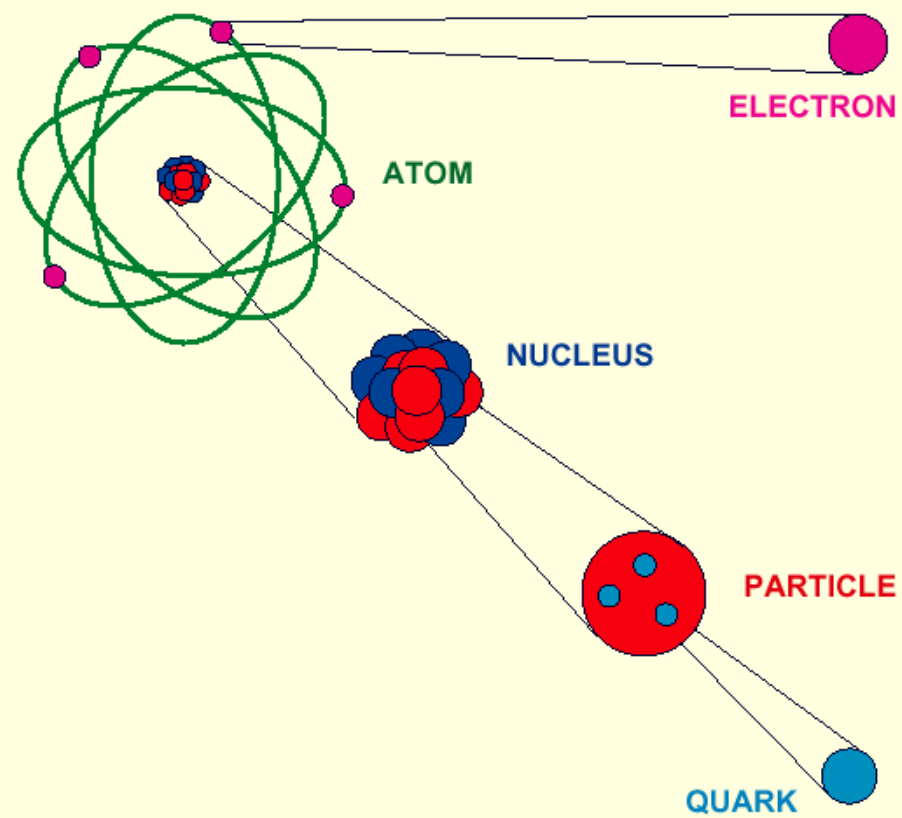
TYPE	INTENSITY OF FORCES (DECREASING ORDER)	BINDING PARTICLE (FIELD QUANTUM)	OCCURS IN :
STRONG NUCLEAR FORCE	~ 1	GLUONS (NO MASS)	ATOMIC NUCLEUS
ELECTRO -MAGNETIC FORCE	$\sim 10^{-3}$	PHOTONS (NO MASS)	ATOMIC SHELL ELECTROTECHNIQUE
WEAK NUCLEAR FORCE	$\sim 10^{-5}$	BOSONS Z^0, W^+, W^- (HEAVY)	RADIOACTIVE BETA DESINTEGRATION
GRAVITATION	$\sim 10^{-38}$	GRAVITONS (?)	HEAVENLY BODIES



Fundamental Particles and Forces

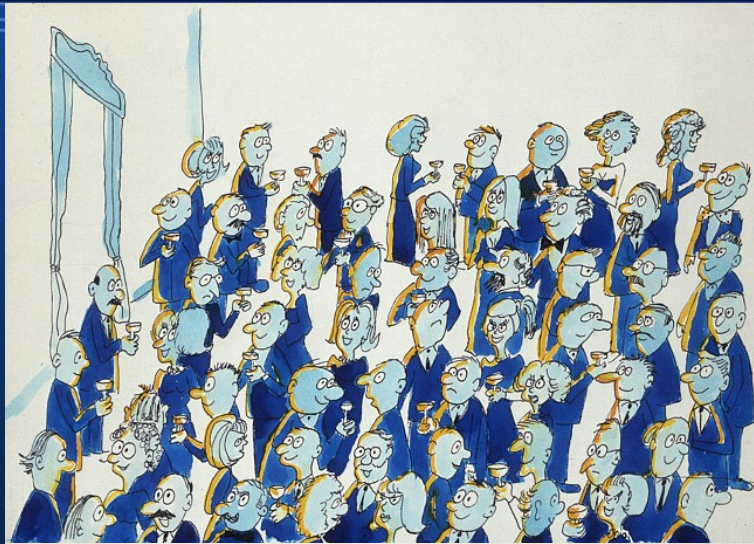


Constituents of Matter

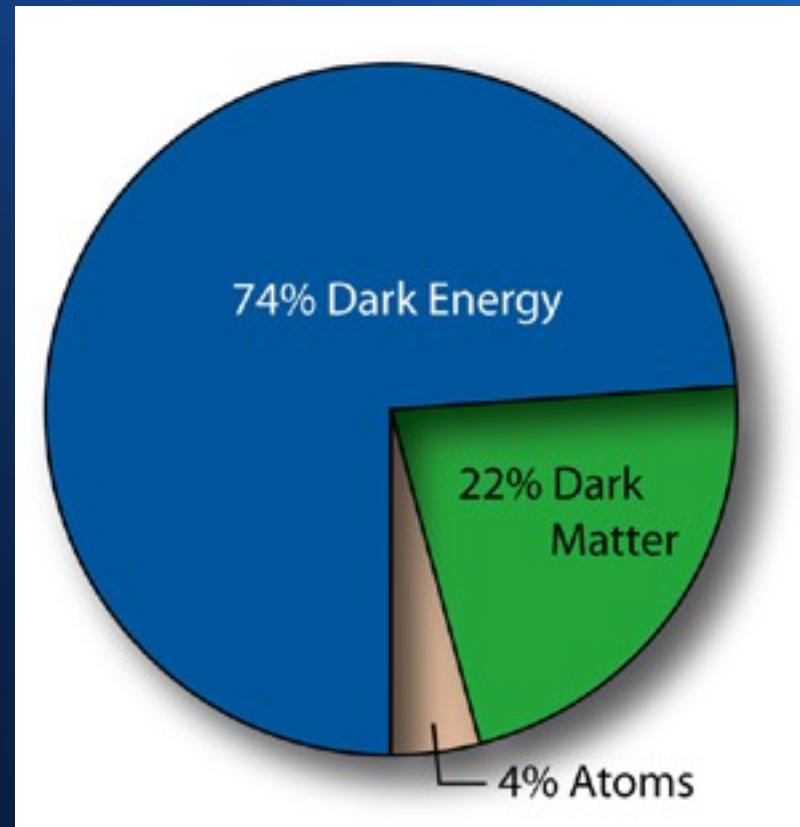


Why do particles have mass?

What is mass?

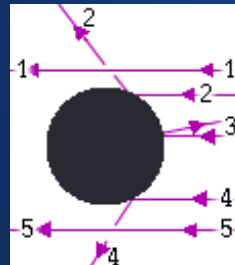
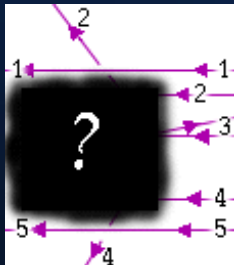
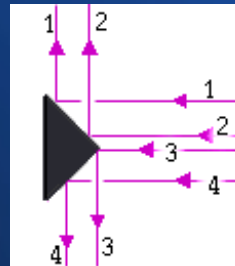
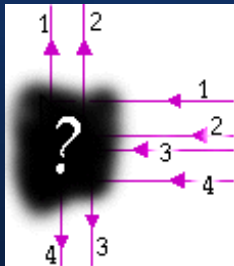


Energy Distribution of the Universe



How Do We Know The Internal Structure of Matter?

- In accelerator, particles collide at high energies
- The outcome is studied



LHC-September 2008



LHC-NOVEMBER 2009

ntvmsnbc

sitede ara web

yayınlar: NTV CNBC-e NTV Spor NTV Yayınları Doğuş Yayın Grubu

Anasayfa / Teknoloji / Bilim ve UzayGüncelleme: 12:07 TSİ 06 Kasım. 2009 Cuma

Kategoriler

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Hadron Çarpıştırıcısı'na ekmek kaçtı

Büyük Hadron Çarpıştırıcısı, bir kuşun düşürdüğü ekmek parçası yüzünden durdu.

ntvmsnbc
Güncelleme: 12:07 TSİ 06 Kasım. 2009 Cuma

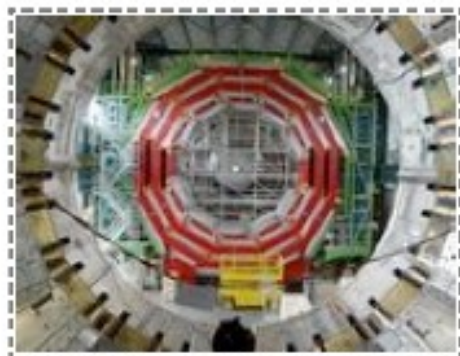
CENEVRE - Yüzyılın en büyük deneyinin gerçekleştirileceği Büyük Hadron Çarpıştırıcısı (LHC), bir kuşun düşürdüğü ekmek parçası yüzünden tamamen durduruldu. Hızlandırıcının proton çarpışmasına sahne olacak tünel kısmı dışındaki aksamın bir bölümünde meydana gelen olay ertesinde, LHC'de ek güvenlik



reklam

October 13, 2009 5:55 PM

Time-travelling Higgs sabotages the LHC. No, really



Richard Webb, physics features editor

Could the [Large Hadron Collider](#) be sabotaging itself from the future? That's the suggestion of a couple of reasonably distinguished theoretical physicists, which has received a fresh airing [in the New York Times](#) today.

Actually, it's the Higgs boson that is doing the sabotage. Apparently, among the many singular properties of the Higgs that the LHC is meant to discover could be the ability to turn back time to stop its cover being blown.

Or as the *New York Times* puts it:

"the hypothesized Higgs boson... might be so abhorrent to nature that its creation would ripple backward through time and stop the collider before it could make one, like a time traveler who goes back in time to kill his grandfather."

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LHC becomes most energetic accelerator of all time

› 02 December 2009

› Magazine issue 2737. [Subscribe](#) and get 4 free issues.

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2028 GMT, 29 November 2009. That's when the Large Hadron Collider became the highest-energy particle accelerator ever.

Researchers at CERN accelerated a beam of protons in the LHC to energies of 1.05 teraelectronvolts (TeV), breaking the previous record of 0.98 TeV held by the Tevatron accelerator at Fermilab in Batavia, Illinois. "Everything is going much faster than even the most optimistic of us dreamed," says Steve Myers, director for research and technology.



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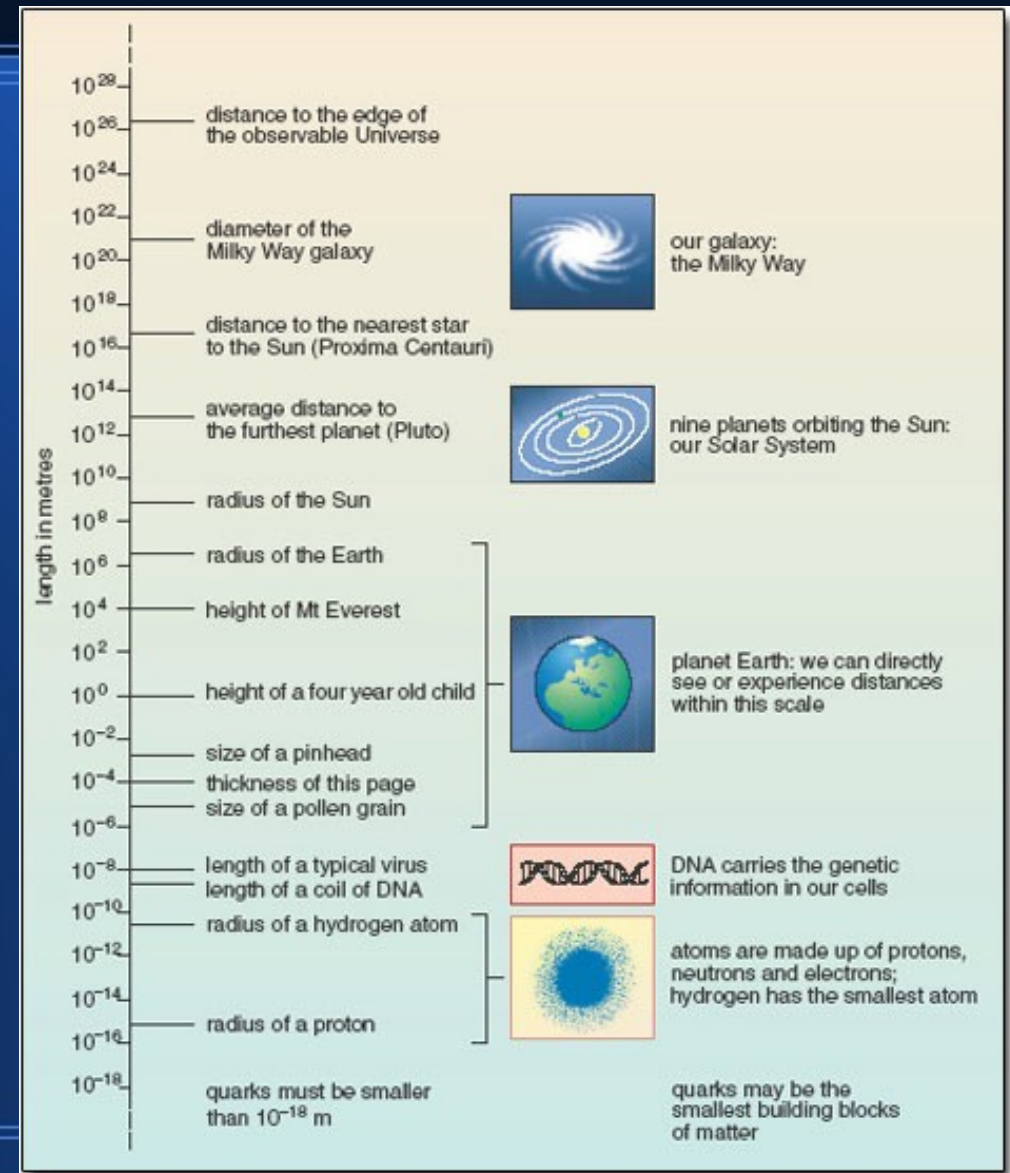
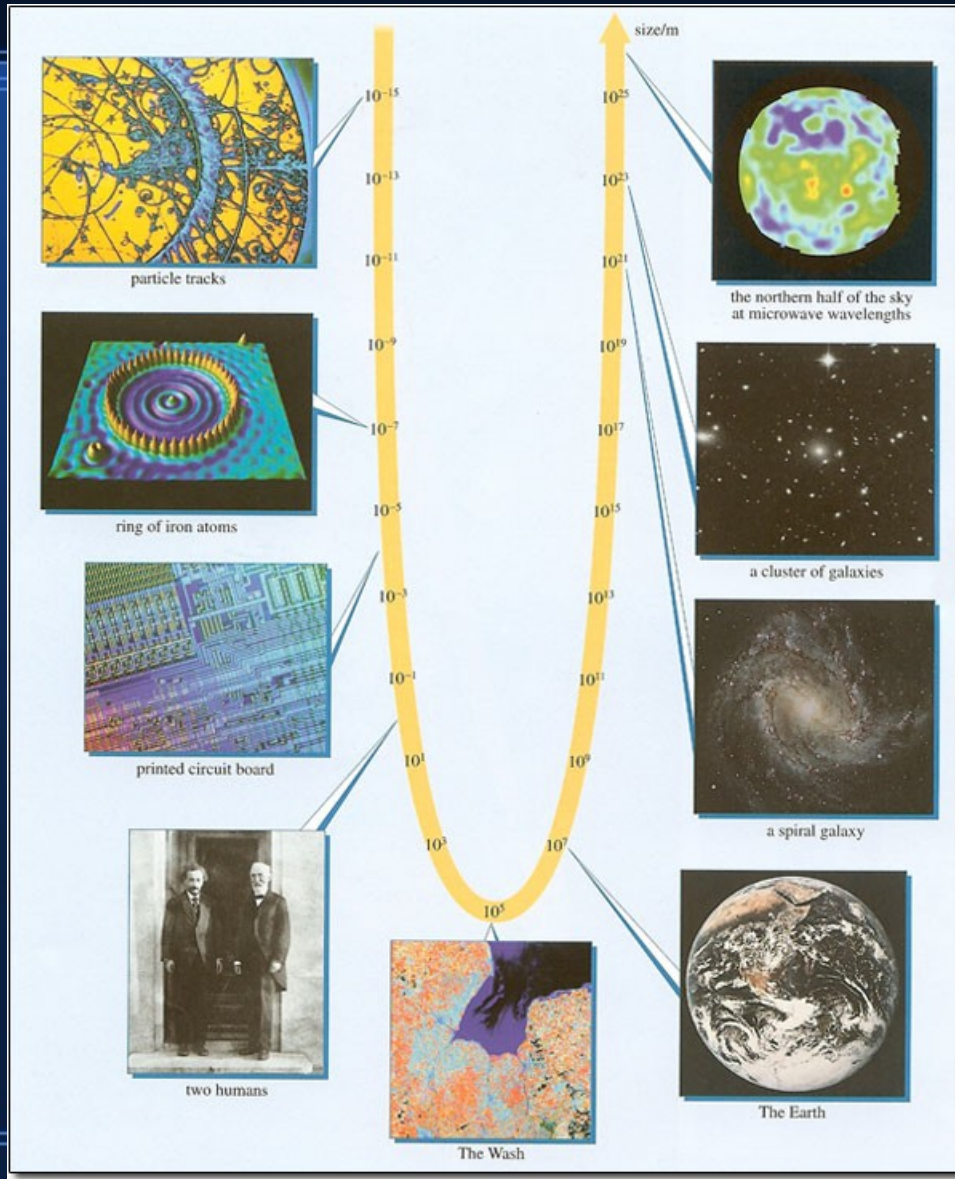
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NewScientist

What would
happen if aliens
stole the moon?

LHC RAP

Fizikte Boyutlar



Ankara Üniversitesi



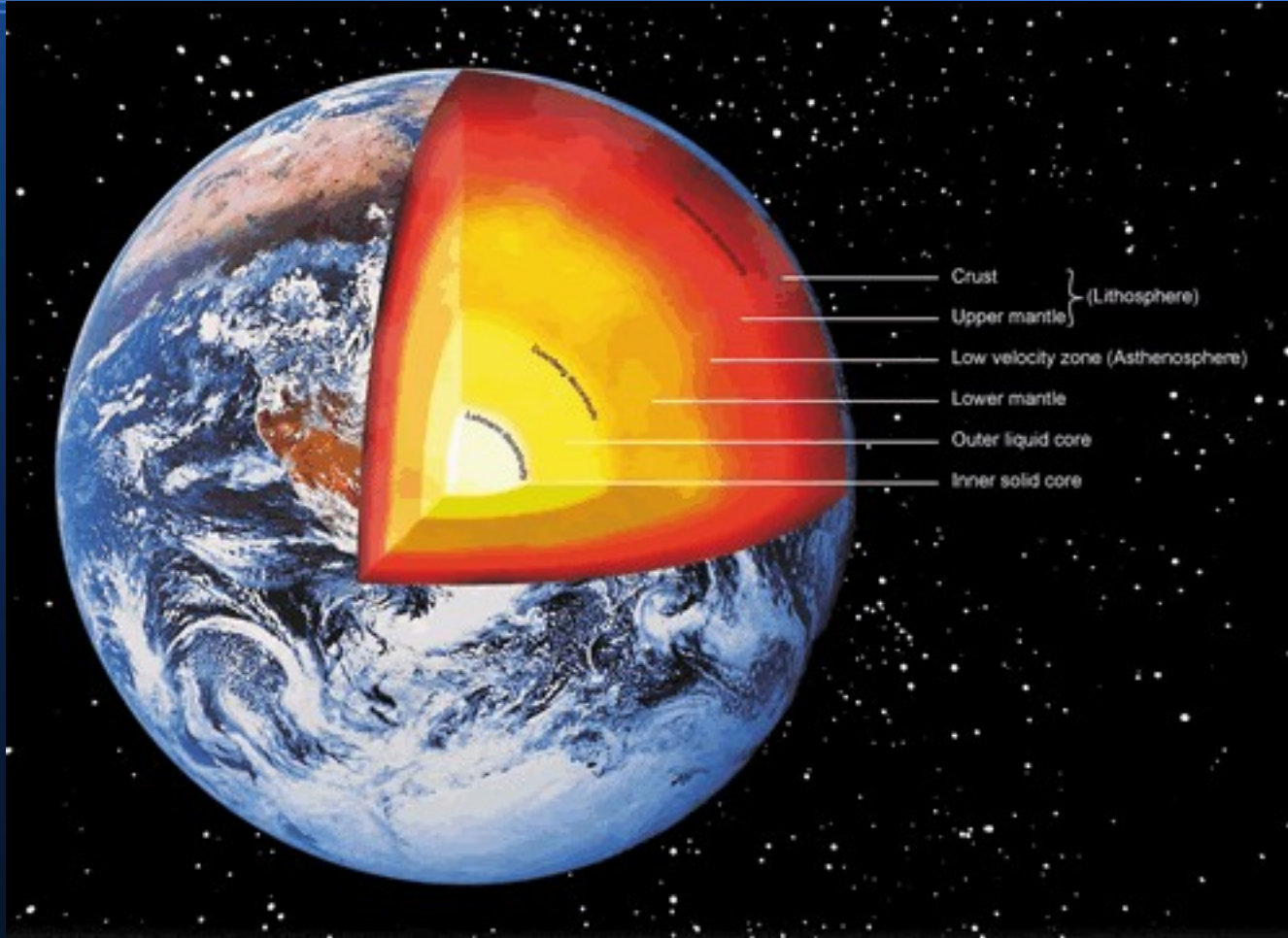
Uzaydan Türkiye



Dünyanın Doğuşu 10^4 km

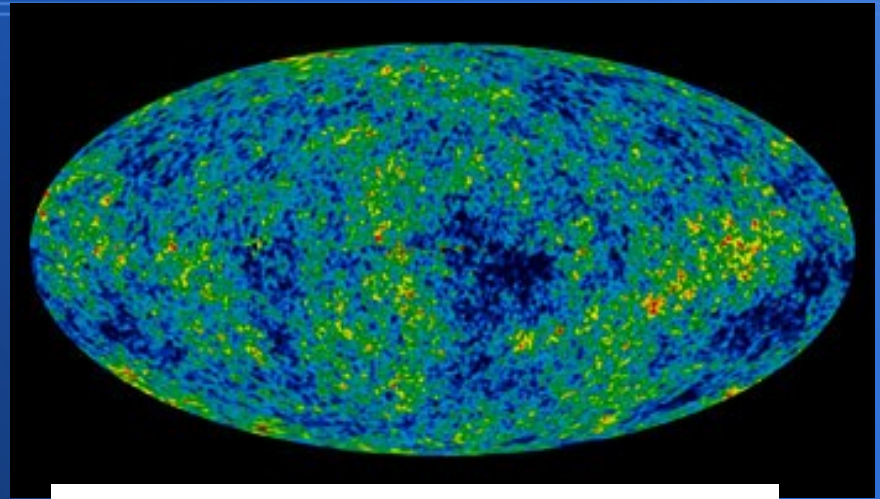


Dünyanın İçi

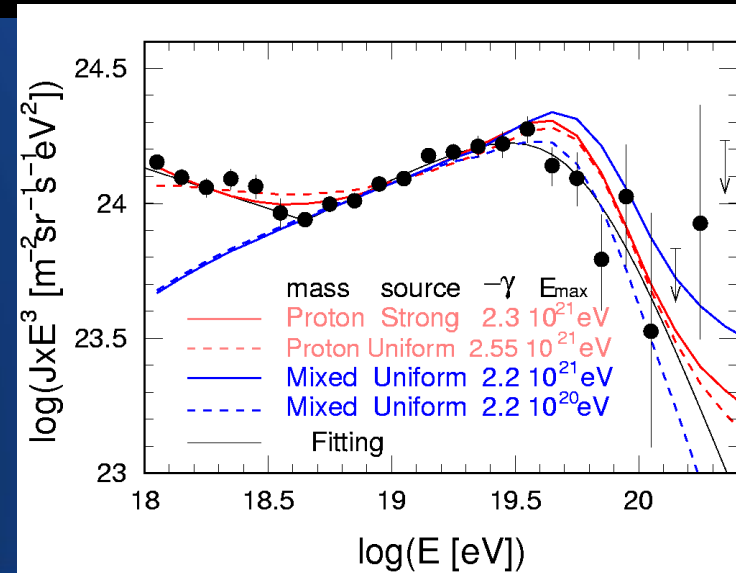


Kozmik Işıklar

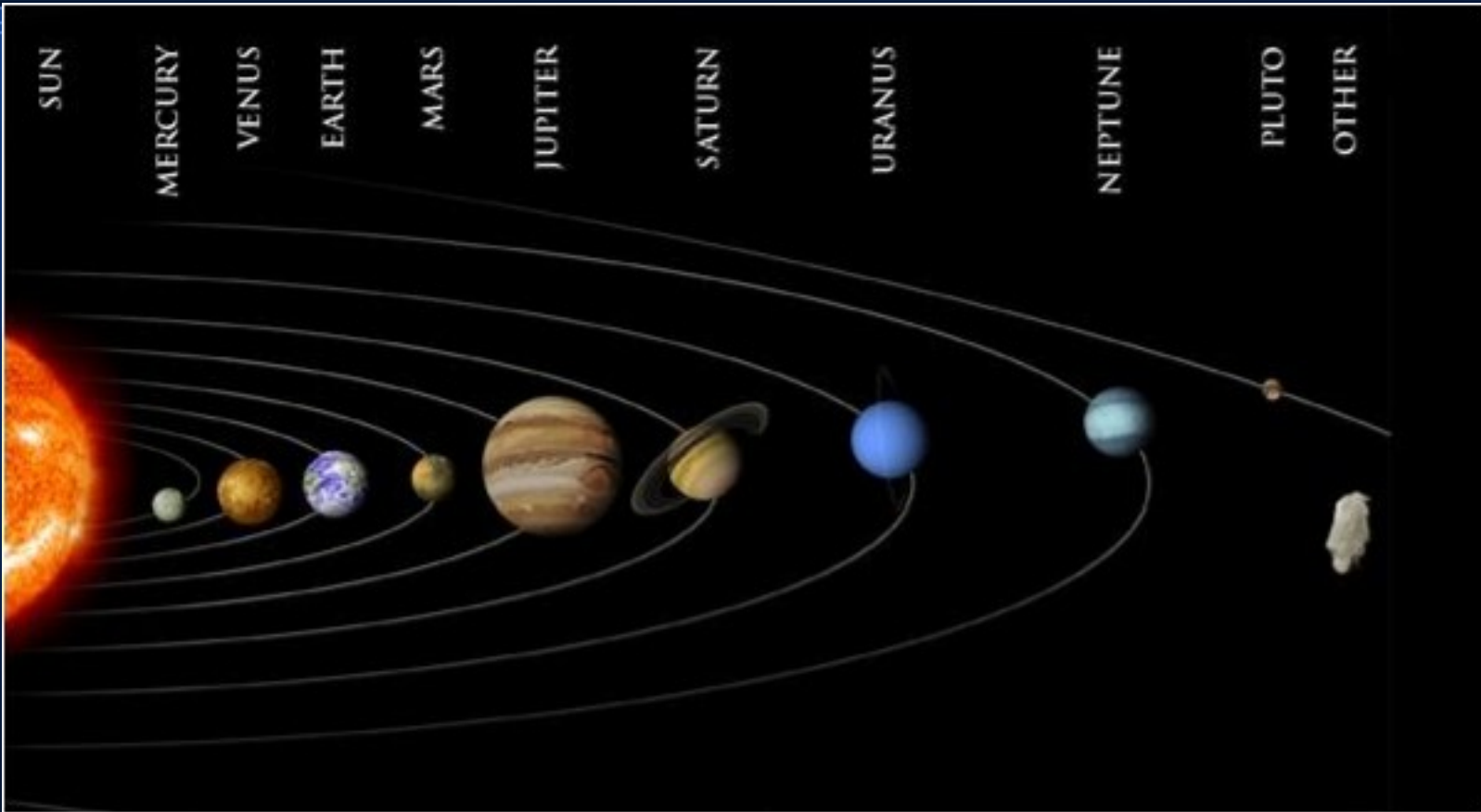
Kozmik Mikrodalga
Işıması



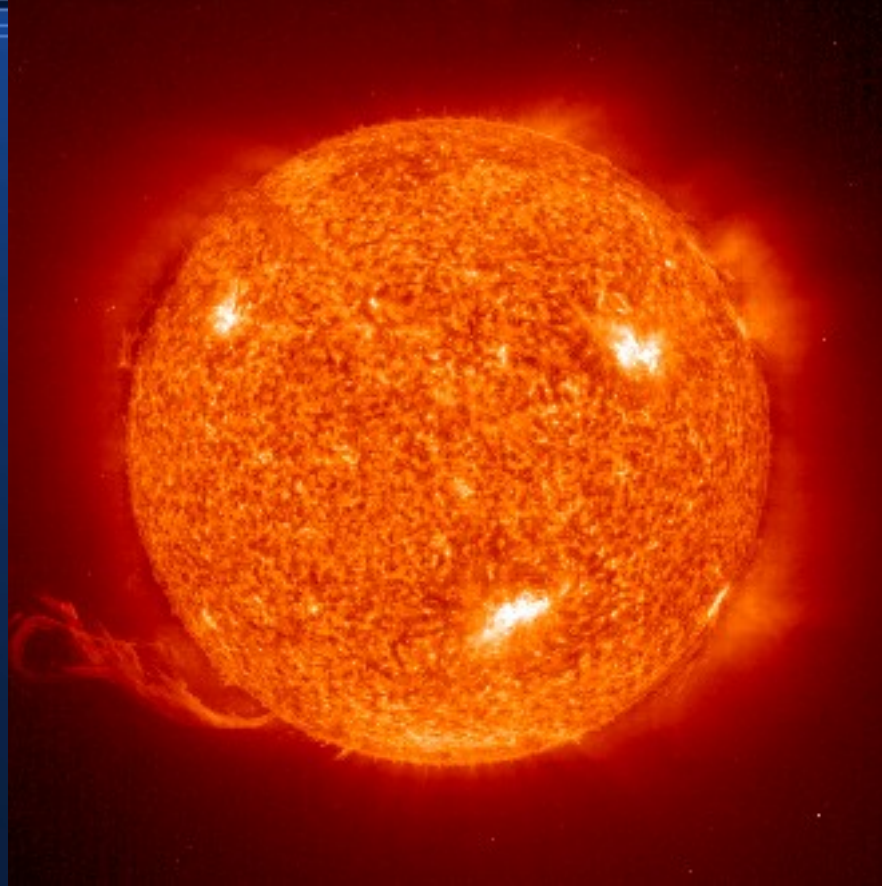
Ultra Yüksek Enerjili
Kozmik Işıklar



Güneş Sistemi 10^9 km



Bir Yıldız: Güneşimiz 10^6 km



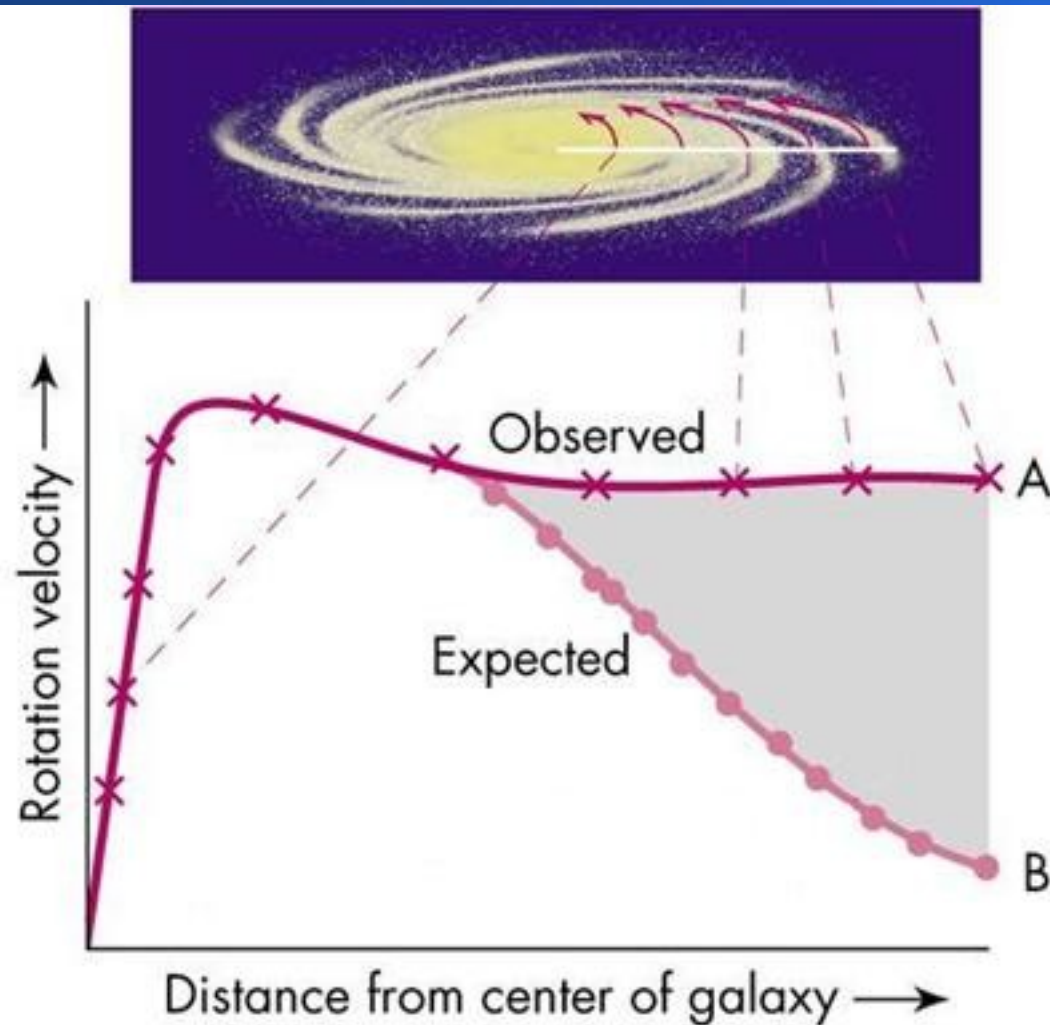
Andromeda Galaksisi

10^6 ışık yılı uzaklıkta

10^5 ışık yılı genişlikte



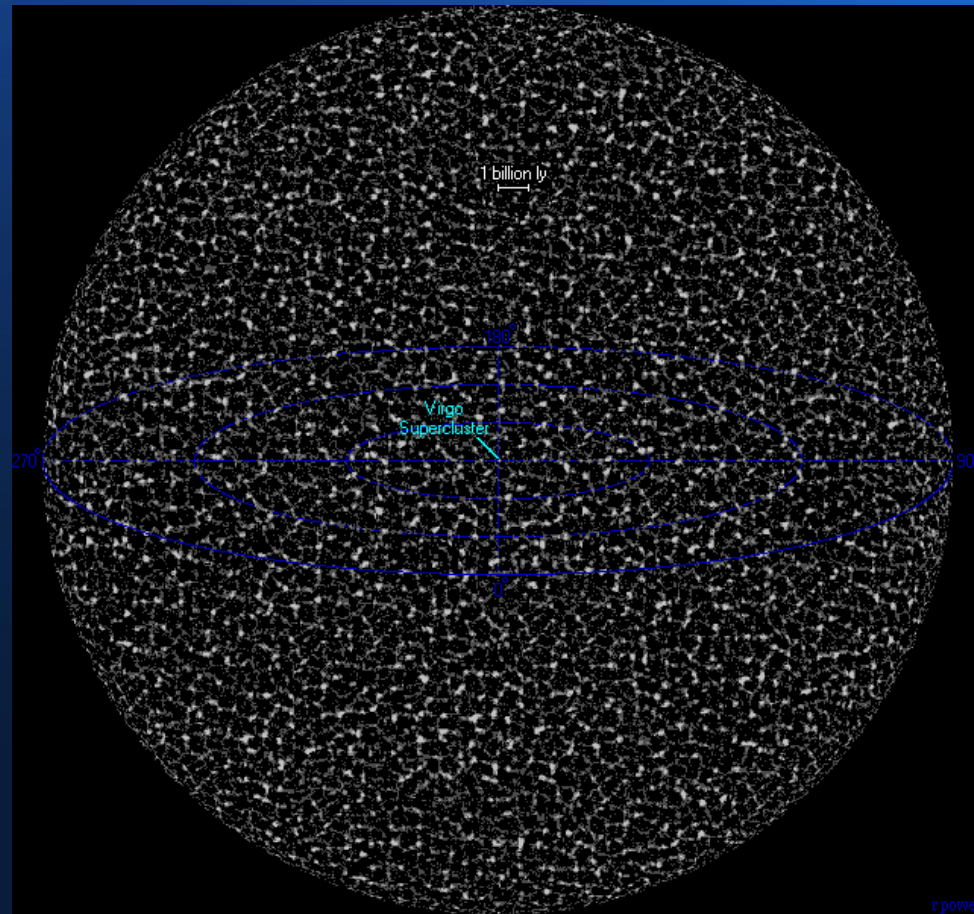
Karanlık Madde?



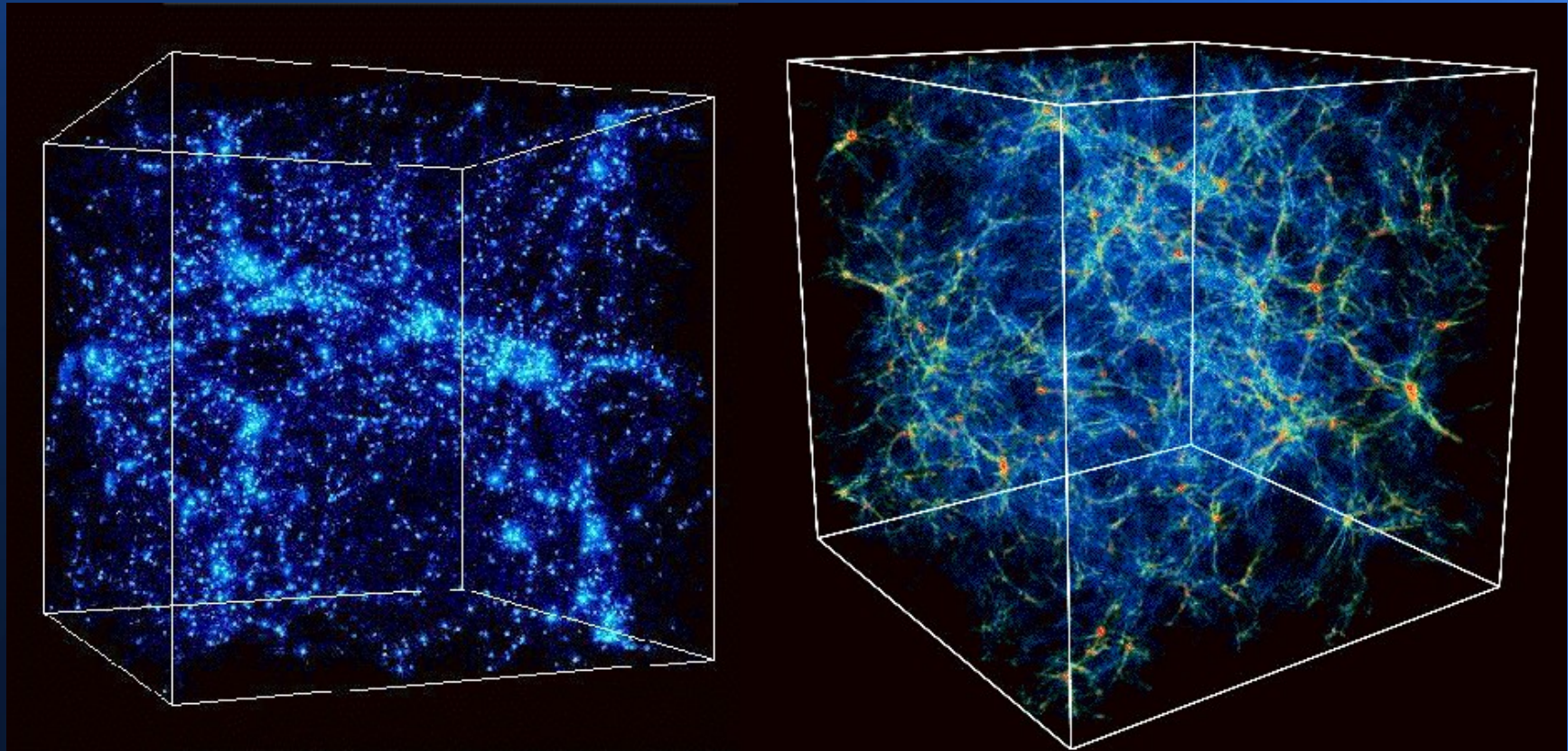
Galaksi Kümeleri: 10^{10} LY



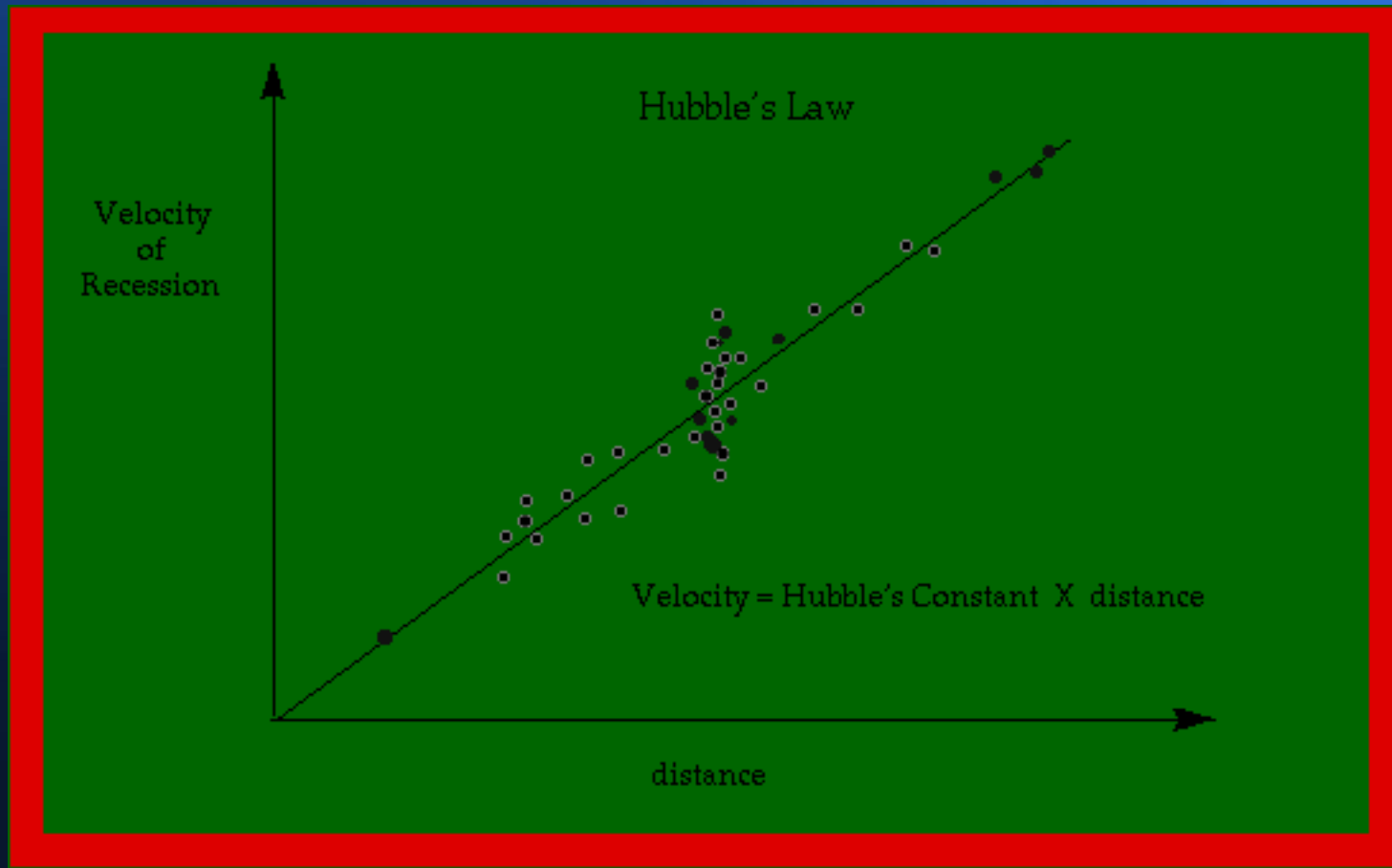
Bilinen Evren: 10^{10} LY



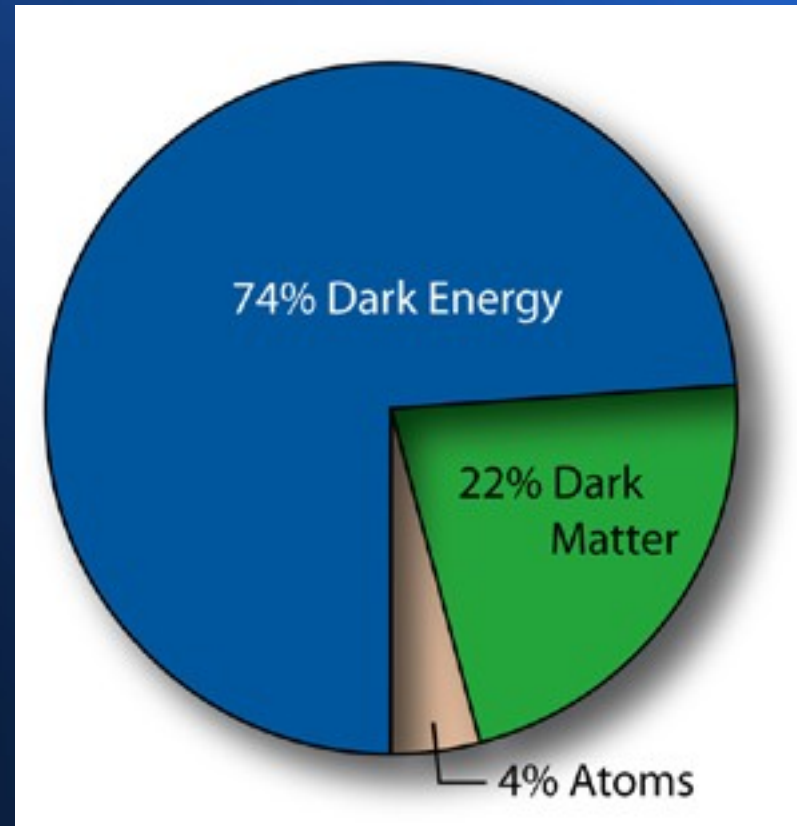
Galaksi Oluşum Modelleri



Bütün Galaksiler Bizden Uzaklaşıyorlar-Karanlık Enerji

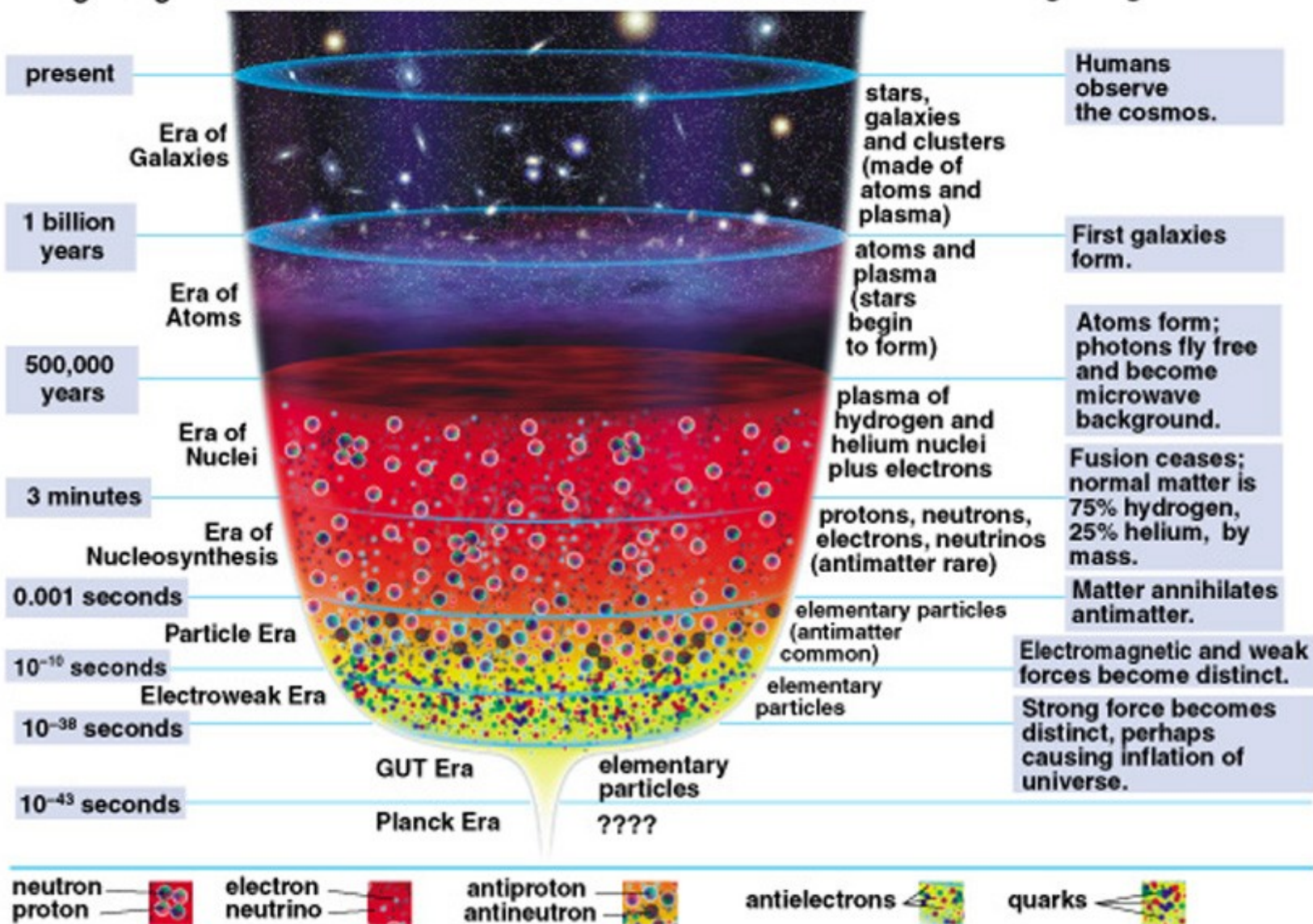


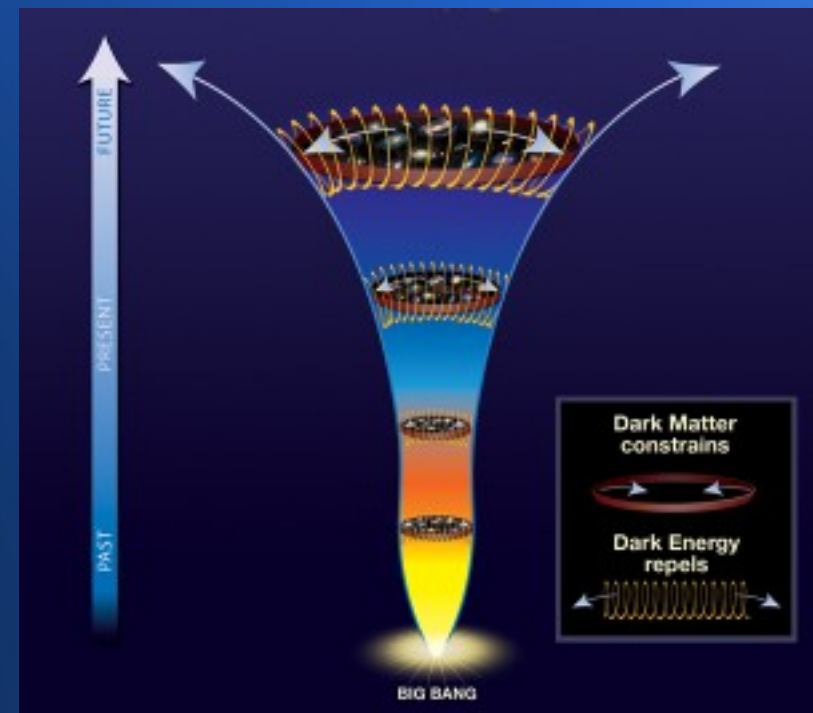
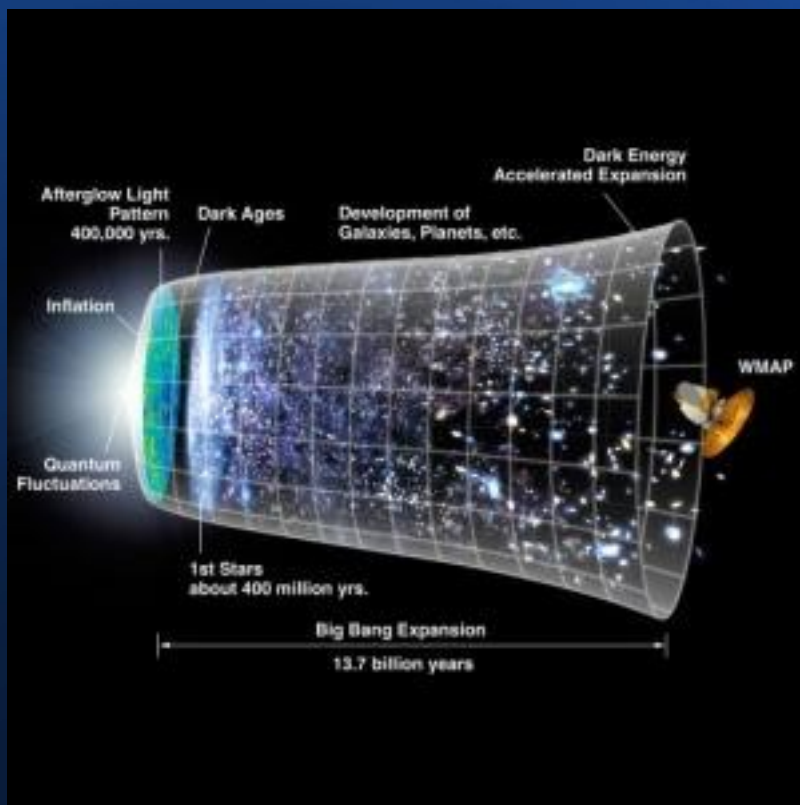
Evrendeki Enerji Dağılımı



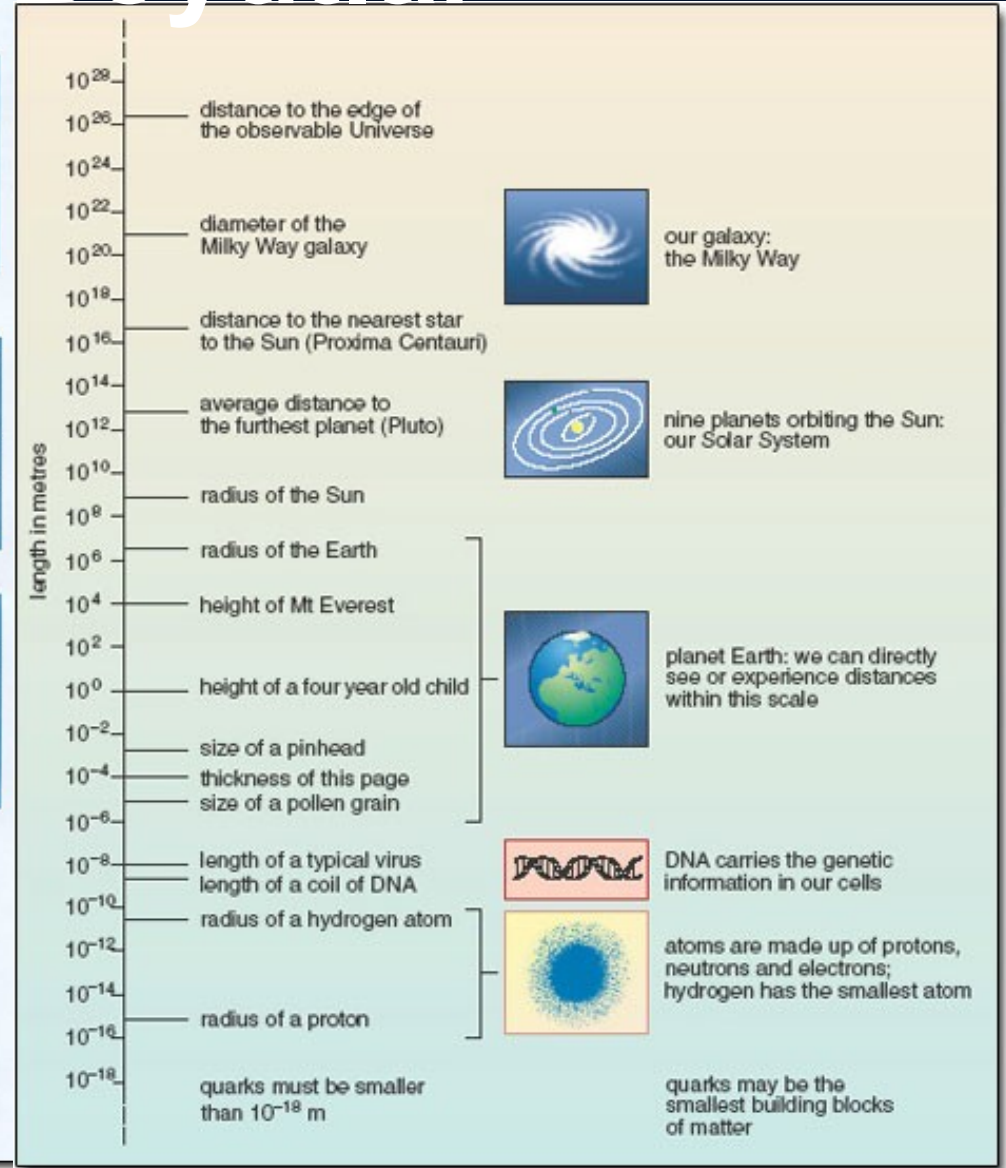
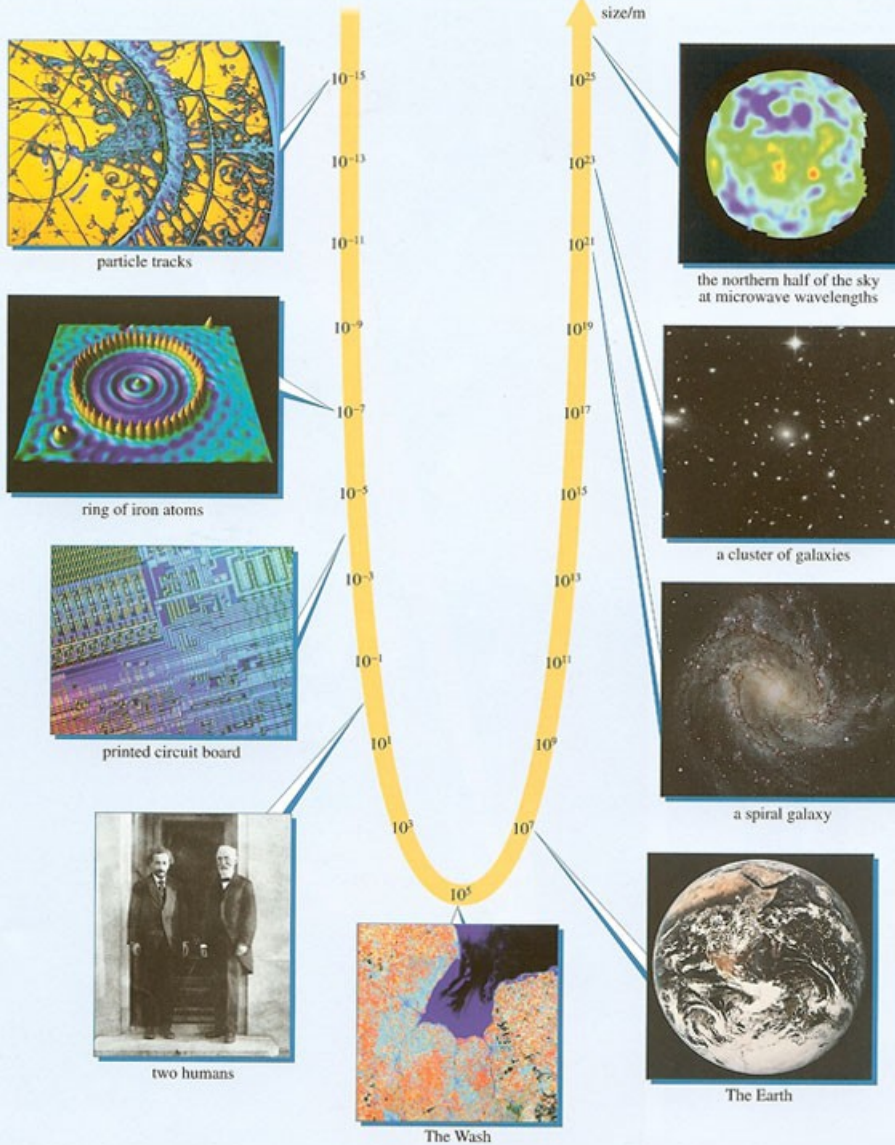
Time Since Big Bang

Major Events Since Big Bang

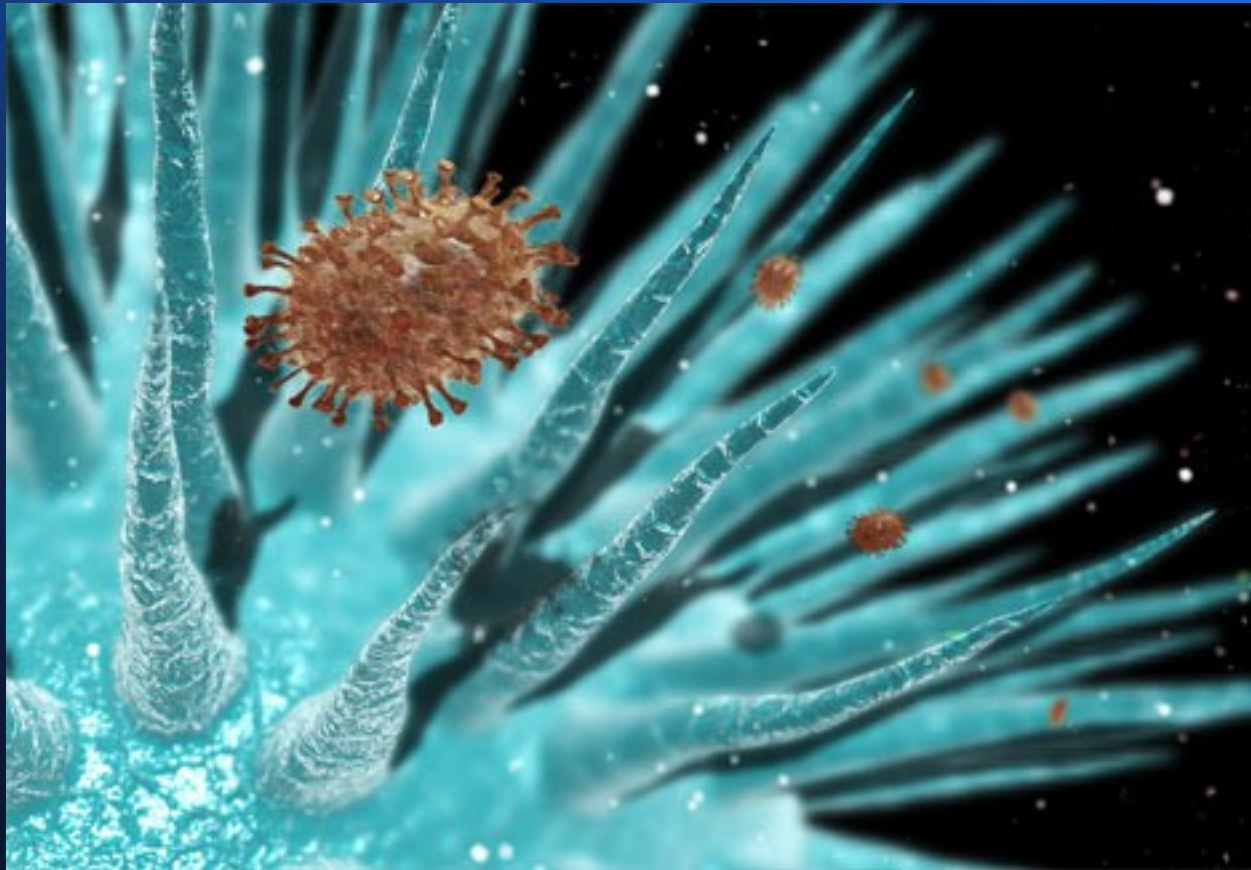




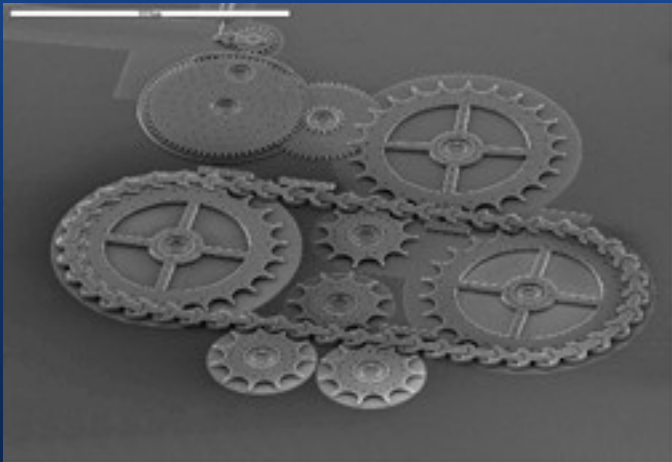
Fizikte Boyutlar



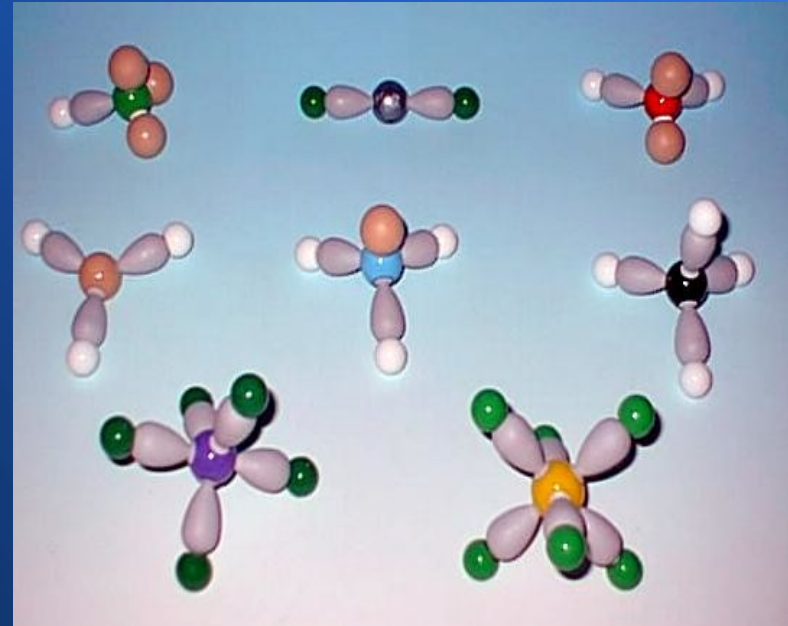
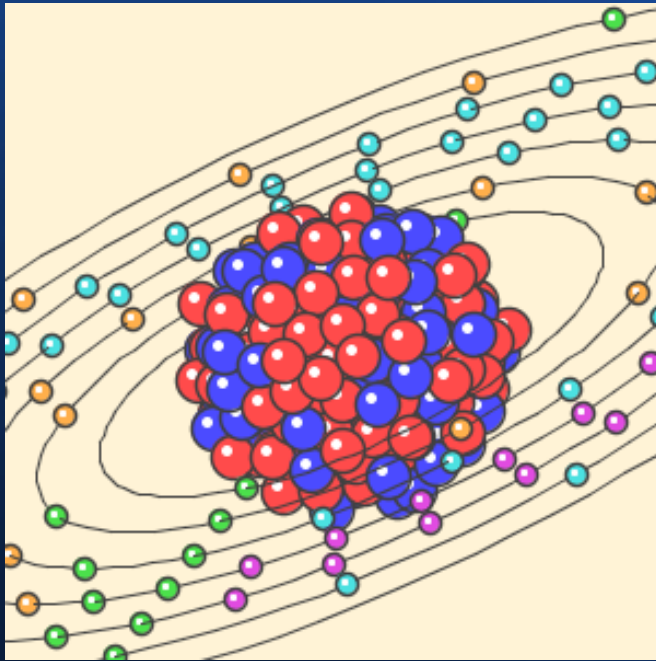
Grip Virüsü: 10^{-7} m



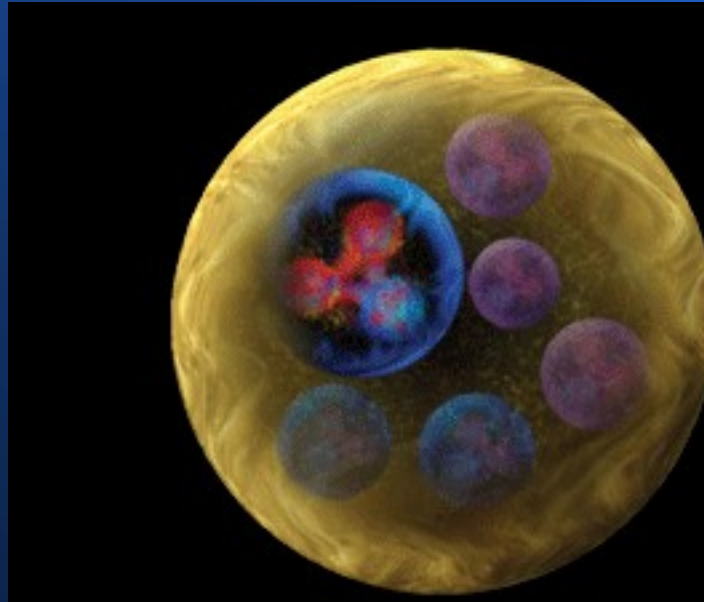
Nanoteknoloji



Atom 10^{-10}m



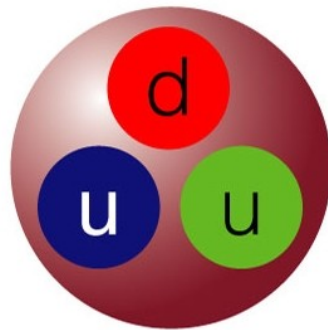
Atom Çekirdeđi: 10^{-15}m



Proton ve Nötron'un İçinde:

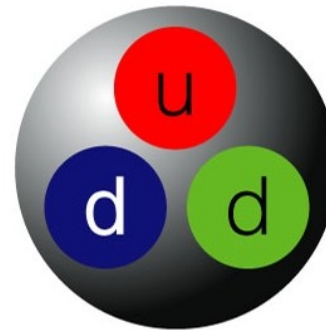
Kuarklar: $<10^{-18}\text{m}$

A proton is composed of 2 up quarks (u) and 1 down quark (d).



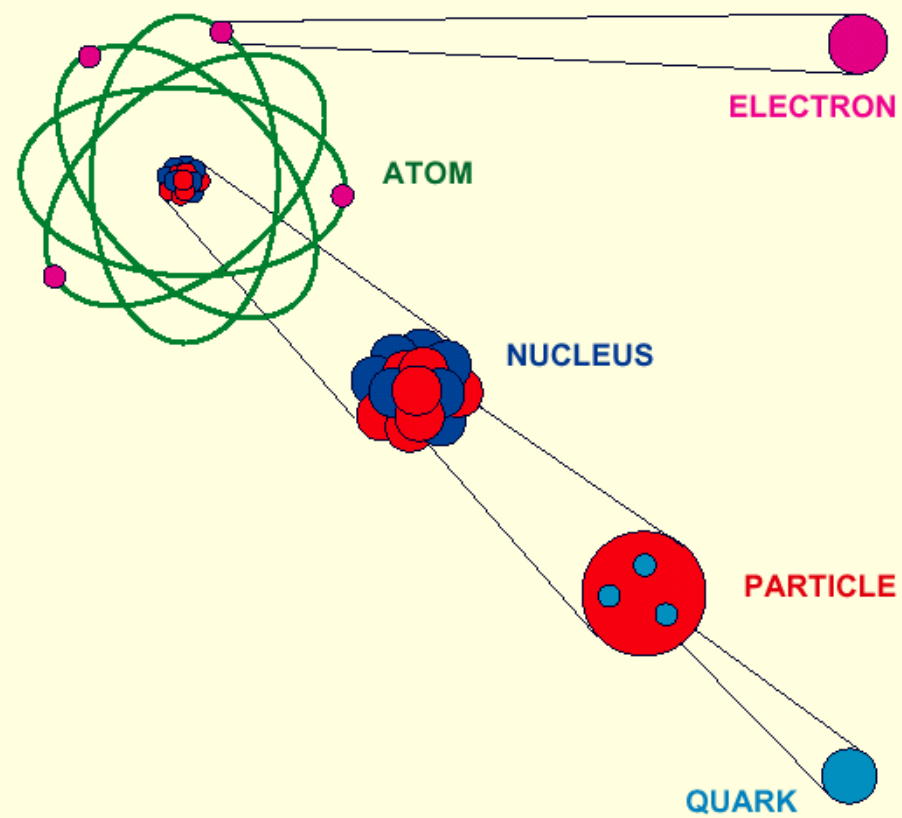
Total charge:
 $+ 2/3 + 2/3 - 1/3 = +1$

A neutron is composed of 1 up quark (u) and 2 down quarks (d).

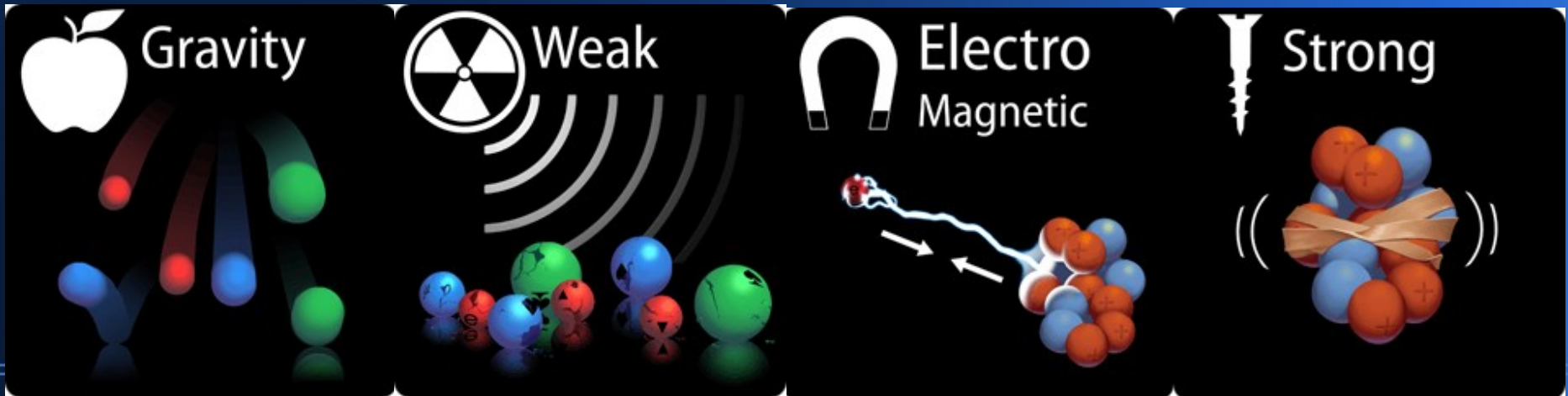
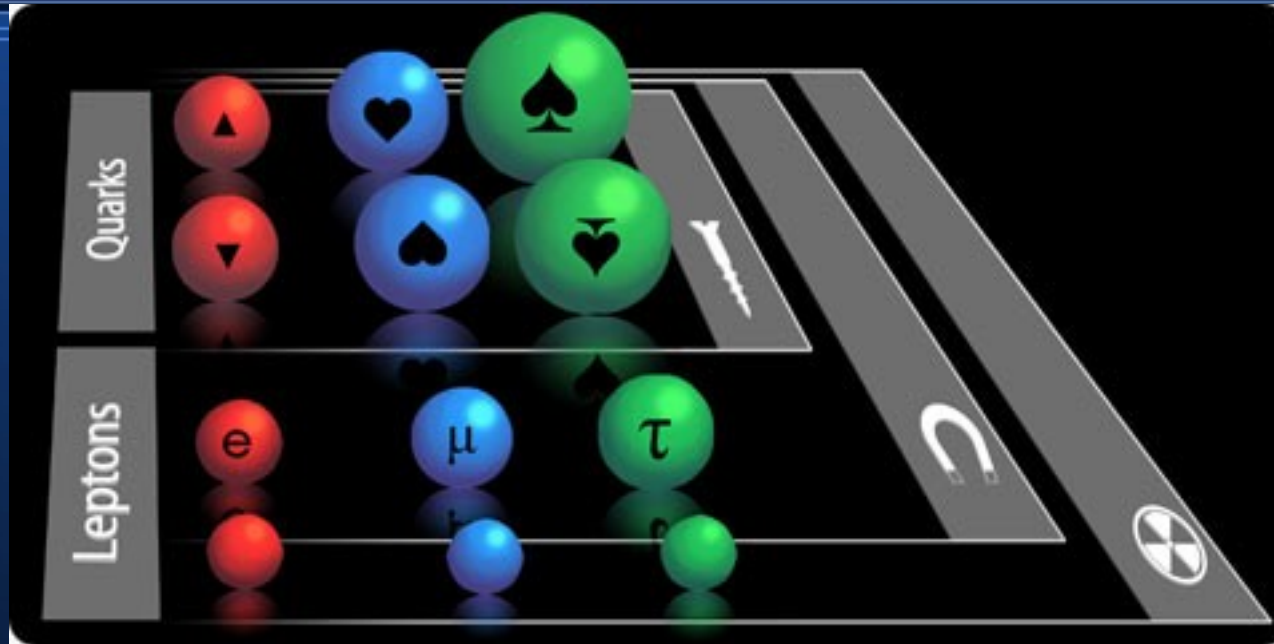


Total charge:
 $+ 2/3 - 1/3 - 1/3 = 0$

Constituents of Matter



Temel Parçacıklar ve Kuvvetler

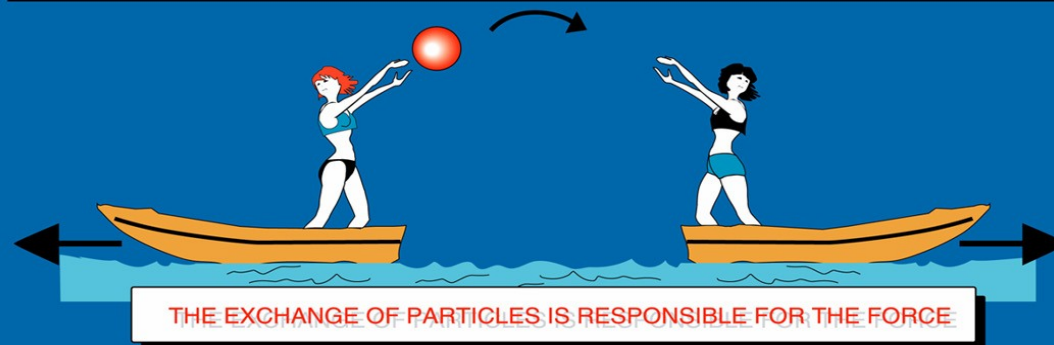


Temel Kuvvetler/Etkileşimler

$F = dp/dt$

The forces in Nature

TYPE	INTENSITY OF FORCES (DECREASING ORDER)	BINDING PARTICLE (FIELD QUANTUM)	OCCURS IN :
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GRAVITATION	$\sim 10^{-38}$	GRAVITONS (?)	HEAVENLY BODIES



Kütlenin Sebebi Ne?



Neden Yüksek Enerjiler

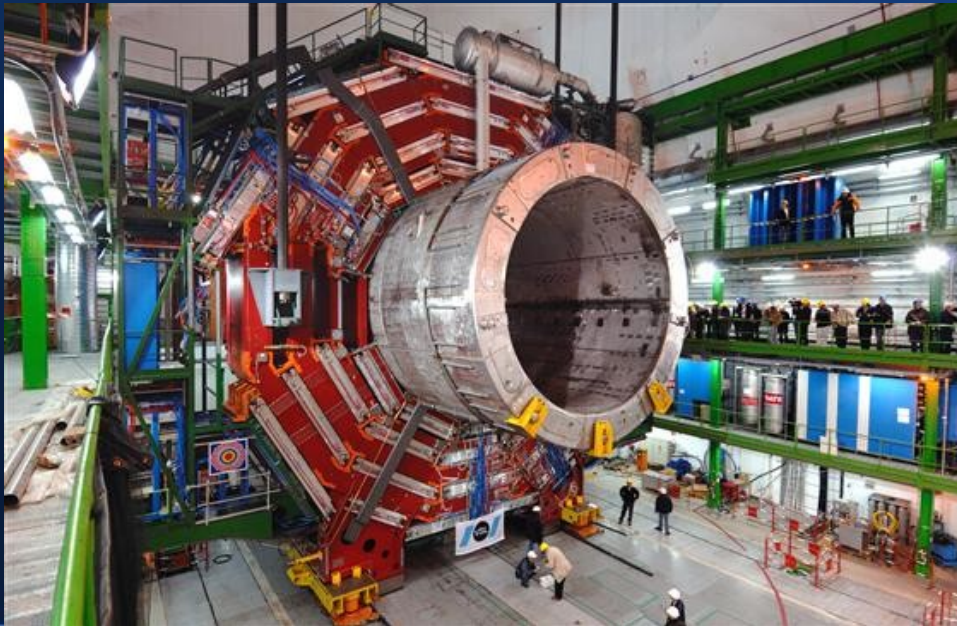
Maddenin daha küçük yapı taşlarını
görebilmek için parçacıkları çarpıştırırız

Ne kadar yüksek enerjiye ulaşırsak, o kadar
küçük parçacıkları görebiliriz

Ayrıca yüksek enerjilerde, ağır parçacıkları
yaratabiliriz

CERN'in Uzaydan Görüntüsü





BHÇ'deki son durum



BHÇ Dünya'nın Sonunu Getirecek mi?

“Teorik olarak, BHÇ'de pembe bir fil oluřma ihtimali sıfır deęildir. Tehlikeli bir karadelik de pembe fil kategorisindedir.” Joe Lykken, Fermilab, USA

Ultra Yüksek Enerjili Kozmik Işıklar

- Atmosferimize, evrenden gelen ve enerjileri 10^8 TeV'e kadar çıkan parçacıklar çarpmaktadır
- Bu parçacıklar milyarlarca yıldır güneşe ve güneş sistemindeki diğer gezegenlere çarpmaktadır
- Bu çarpışmaların hiçbirisi güneşi veya gezegenleri yok edecek bir karadelik oluşturmamıştır

LHC RAP