

The Cosmic Landscape - What's in the Universe?

- Cosmic Scale and Structure:

notes from the web

- Size of the universe - (5 orders of magnitude)

- proton = [redacted] meters 10^{-9}

protons · neutrons · electrons → ^{Full} atoms - [redacted] meters (size) 10^{-15}

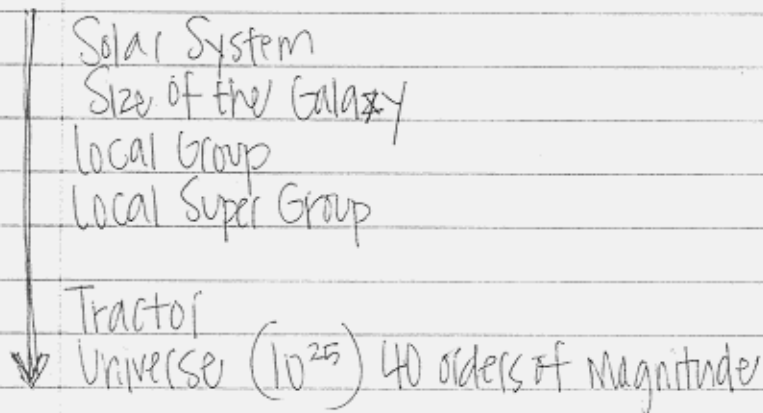
* hydrogen atom is less than 10^{-10} meters

- virus 10^6 [redacted] size. (really small organisms)

- millimeter size [redacted] 10^{-3}

- meter size [redacted] 10^{-1}

- size of the solar system 40 astronomical units (10^{10} meters)



What's the smallest?

What's the largest?

What are the orders of magnitude between each?

- Powers of 10.

$$10^0 = 1 \quad 10^{-1} = .1$$

$$10^1 = 10 \quad 10^{-2} = .01$$

$$10^2 = 100 \quad 10^{-3} = .001 \text{ (Milli)}$$

$$10^3 = 1000$$

Common prefixes

Kilo = 10^3 ThousandMega = 10^6 Millioncenti = 10^{-2} hundredthmilli = 10^{-3} thousandthmicro = 10^{-6} Micronano = 10^{-9} billionth of a meter

nanometer

micrometer

millimeter

centimeter

meter

kilometer

AU (astronomical unit)

Light Year (ly): $(3 \times 10^8 \text{ meter/sec.}) (3.16 \times 10^7 \text{ s}) = 9.5 \times 10^{15} \text{ m}$ 3.26 Light years - Parsec - the distance of which 1 AU subtends an angle of 1 arc 2nd $(3.26 \text{ ly} \approx 3.09 \times 10^{16} \text{ m})$

• Elements / Atoms / Energy / Matter.

• Matter & Energy can be converted into one another

• Universe is made up of matter consisting of elements, atoms, and subatomic particles.

• Atoms consist of protons, electrons, and neutrons.

• How to Distinguish between periodic elements.

Matter is built of basic elements \rightarrow atoms (protons, neutrons, electrons)difference \rightarrow hydrogen vs. lithium # of protons in that elementISOTOPES = # of neutrons in the nucleus of an atom change
role of - electrons = influence ability of atom to form
with other atoms

(organic bonds - breakable readily)

Energy = comes in different forms

- electro-magnetic spectrum
- all space is affected by electro magnetic waves
 - gamma waves
 - x-rays
 - radio waves
- infrared waves (heat waves you can feel)
- millimeter size of the electro-magnetic spectrum
 - use to interrogate the surface of venus — RADAR

★ The Four Fundamental Forces that control everything that happens

◦ Gravity

- an attractive force
 - acts in all mass objects
 - low mass object
 - high mass object
 - Inverse Square - gravity goes every way and effects everything
 - photons at rest (have no affective on gravity when have no mass)
- only thing not affected by gravity ↑

◦ Coulomb

- Electricity and magnetic
- 2 positives repel - 1 negative / 1 positive - attract
- can be attractive or repulsive
- Mitigates all electrical and magnetic forces / powers
 - only affects positive forces.
- relevance to us → Coulomb repulsion keeps my hand from going through the desk.
- Coulomb force starts to draw closer to strong nuclear force

◦ Strong Nuclear

◦ why does the nucleus of an atom stick together?

Strong nuclear force

◦ very power force

◦ only w/ short ranges (10^{-14} meters)

◦ Step function (really powerful and then steps off w/ no power)
- Coulomb force is in effect

◦ Weak Nuclear:

◦ radio-active decay

◦ GUT - grand unification theory

◦ try to unify all forces into one

All physics want credit for

(subconducting)

✧ Gravity is the sore spot w/ all physics - unknown
(other 3 are well known)

Gravitational Theory (most pervasive force in all the universe) - GRAVITY

can't find the particle