

Agenda

Introduction
Space, Time and Matter
Early views of the cosmos
Important Ideas from Classical Physics


Two 20th Century revolutions in Physics
Relativity
Quantum Theory

Interwoven with Ideas from Astronomy and Cosmology

Early ideas of the universe focused on two concepts Finite vs. Infinite

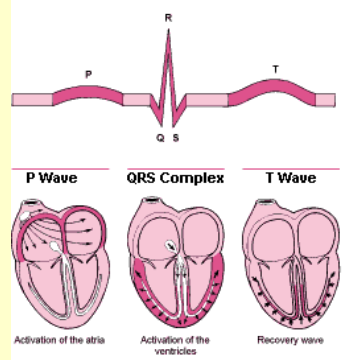
	<i>Finite</i>	<i>Infinite</i>
<i>Space</i>	<i>Finite in extent</i>	<i>Infinite in extent</i>
<i>Time</i>	<i>Began and will end</i>	<i>No beginning and no end</i>
<i>Matter</i>	<i>Atoms (digital)</i>	<i>Continuous (analog)</i>

What is time?

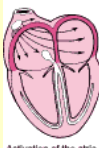


"Time... is what keeps everything from happening at once."
Ray Cummings, science fiction writer

Range of Human perception of time:
1/2 second to 1 year

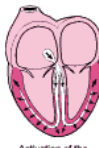


P Wave




Activation of the atria

QRS Complex



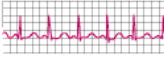
Activation of the ventricles

T Wave




Recovery wave

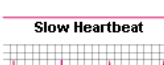
Normal Heartbeat



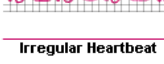
Fast Heartbeat

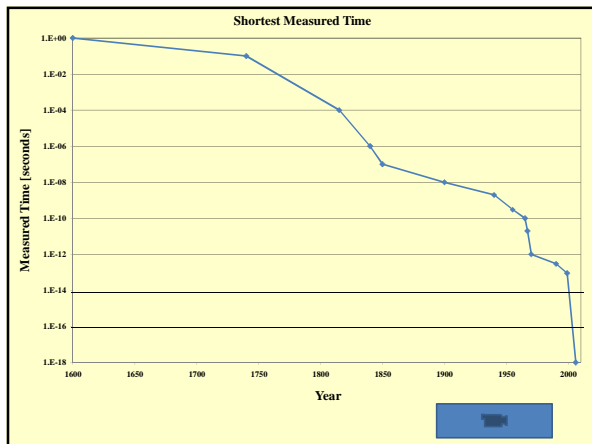


Slow Heartbeat

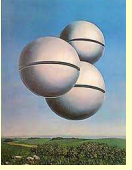


Irregular Heartbeat



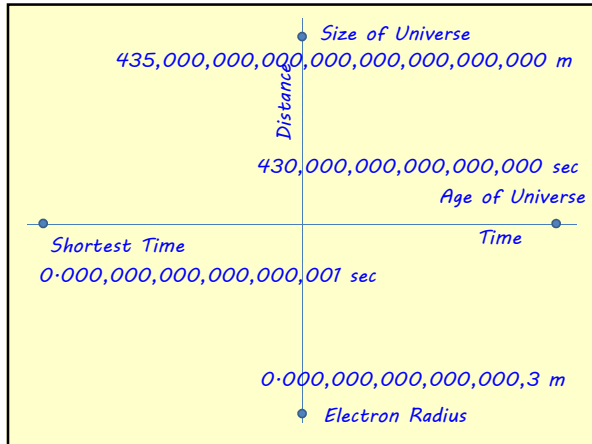


What is space?



Space is big. You just won't believe how vastly, hugely, mind-boggling big it is. I mean, you may think it is a long way down the road to the drug store, but that's just peanuts to space.
Douglas Adams

Range of Human perception of distance:
5 microns to 1 kilometer



*Dealing with
Large and Small Numbers,*

Think of the integers with one digit:
1, 2, 3, 4, 5, 6, 7, 8, 9

Think of the integers with two digits:
10, 11, 12, ... , 98, 99

Think of the integers with three digits:
100, 101, 102 ... , 998, 999

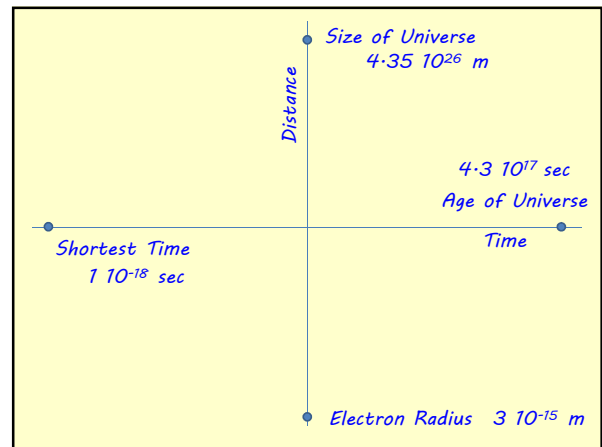
When dealing with numbers that vary over a wide range it is useful to group them by "number of digits" rather than by 10s.

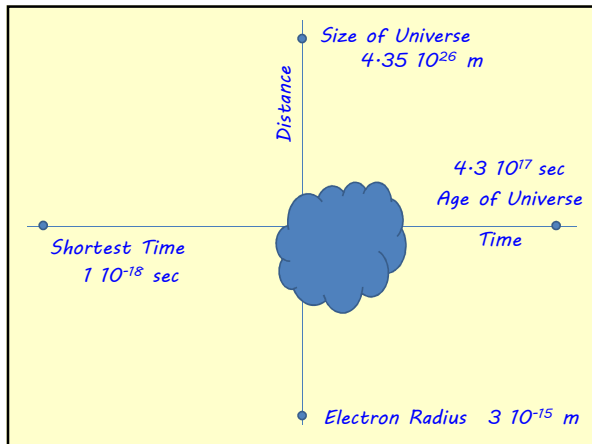
3	1000	1001	...	...	...	...	9,999
2	100	101	...	...	...	999	
1	10	11	...	...	99		
0	1	2	...	9			
-1	.1	.2	...	.9			
-2	.01	.02	...	...	.09		
-3	.001	.002	...	...	...	.009	

$1,234 = 1.234 \times 1,000 = 1.234 \cdot 10^3$

As an order of magnitude estimate 10^3 means about 1,000 (say from 501 to 4,999)

$.00123 = 1.23 \times .001 = 1.23 \cdot 10^{-3}$





What is matter?



"The universe is made mostly of **dark matter** and dark energy, and we don't know what either of them is" Saul Perlmutter

Range of Human perception of :
1 milligram to 100 kilograms

What is not matter?



*What is a vacuum?
What is light?*

We all have an intuitive understanding of the meaning of

Space, Time and Matter.

Our understanding of these ideas comes from what we observe.

Part of the universe exists beyond our direct perception of it.

To understand the universe we must overcome the prejudice of our intuition.