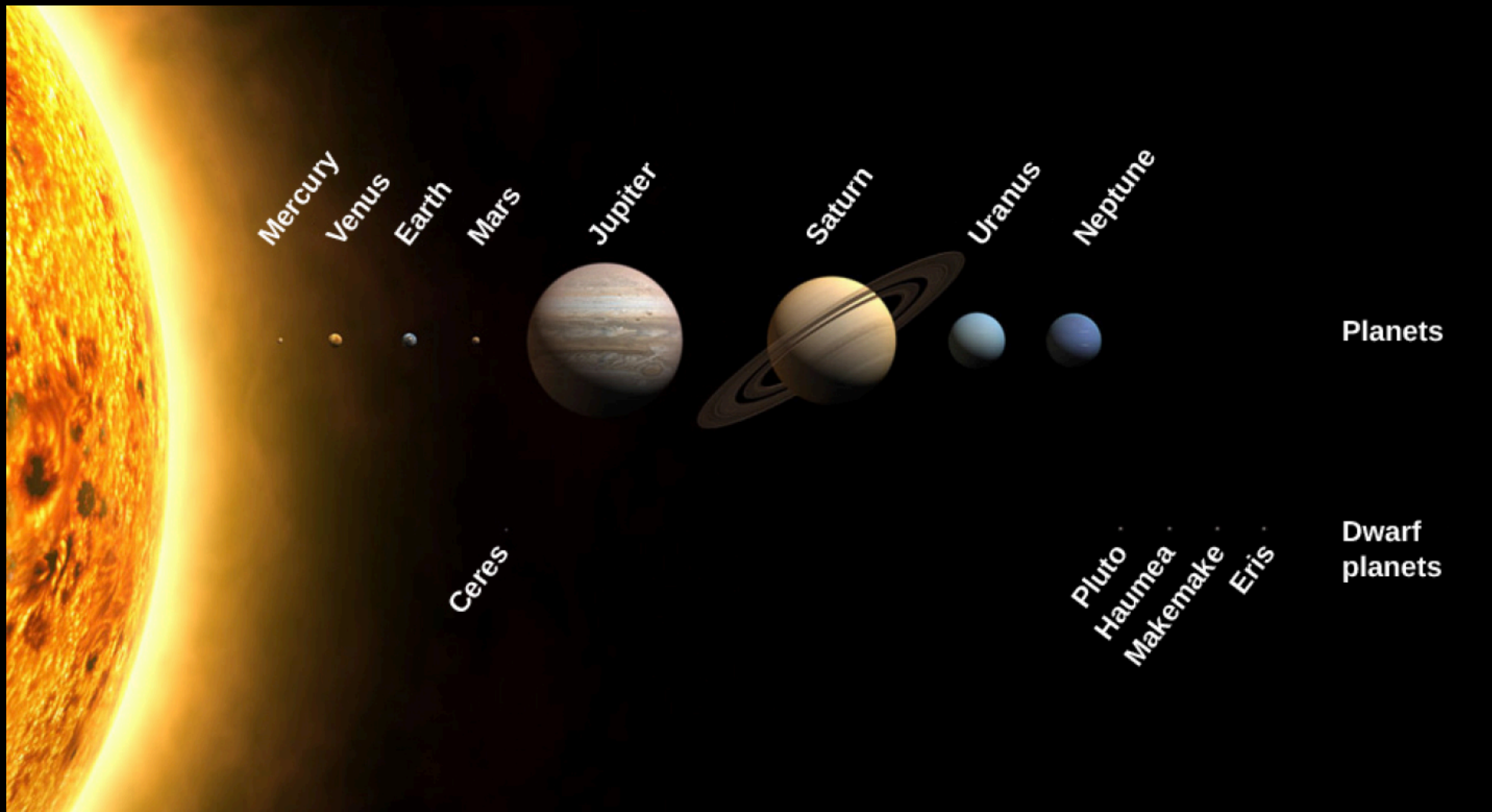
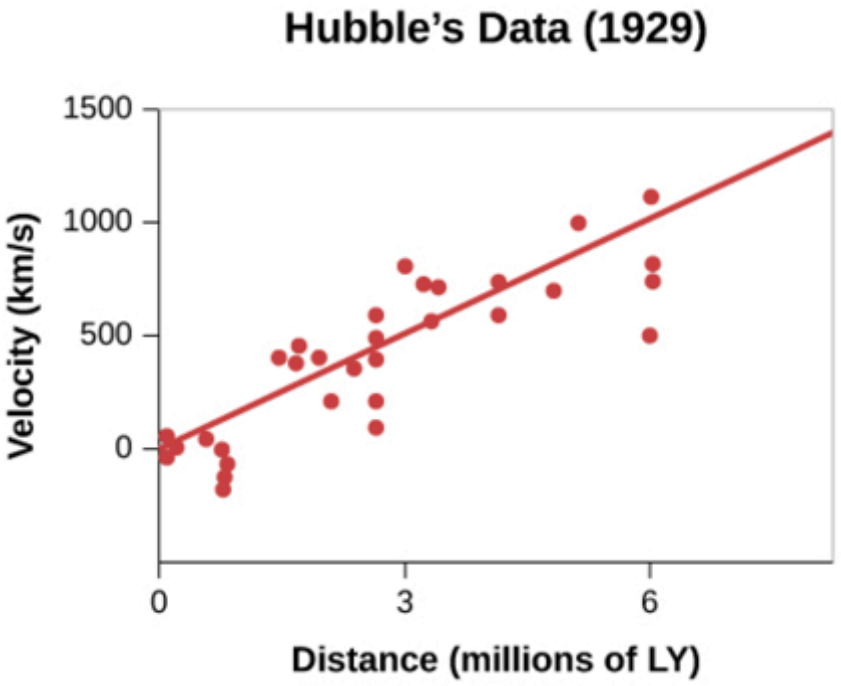
Our solar system!

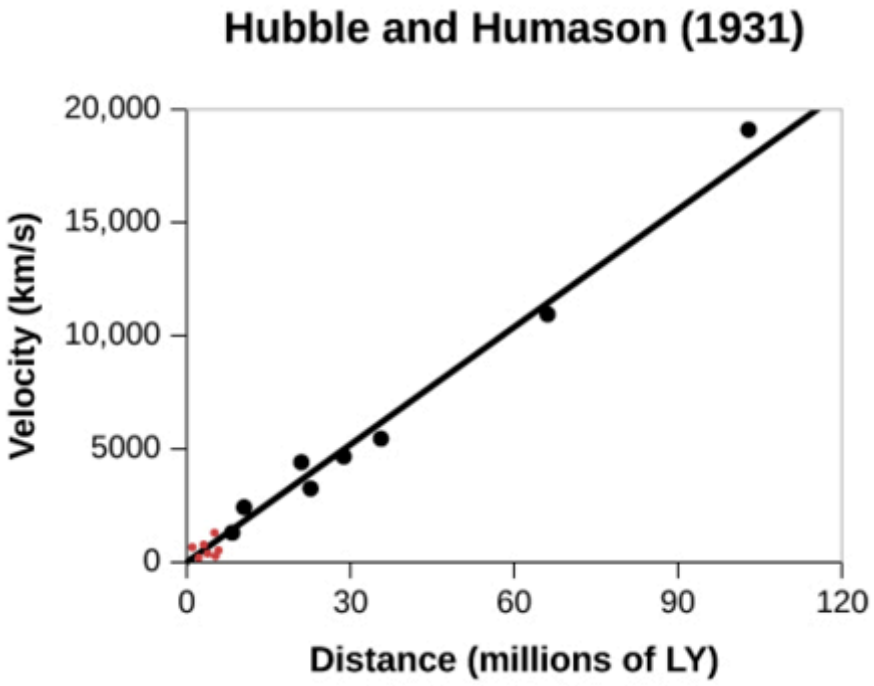


Last homework and final project

- Homework: pdf or paper due on May 16, 1pm
- Project: Citizen Science!
  - Written report due May 29, 10pm
  - Slides (pdf) due May 29, 10pm
  - Oral report on May 30 (6 minutes)
- Maybe filming class on May 9????

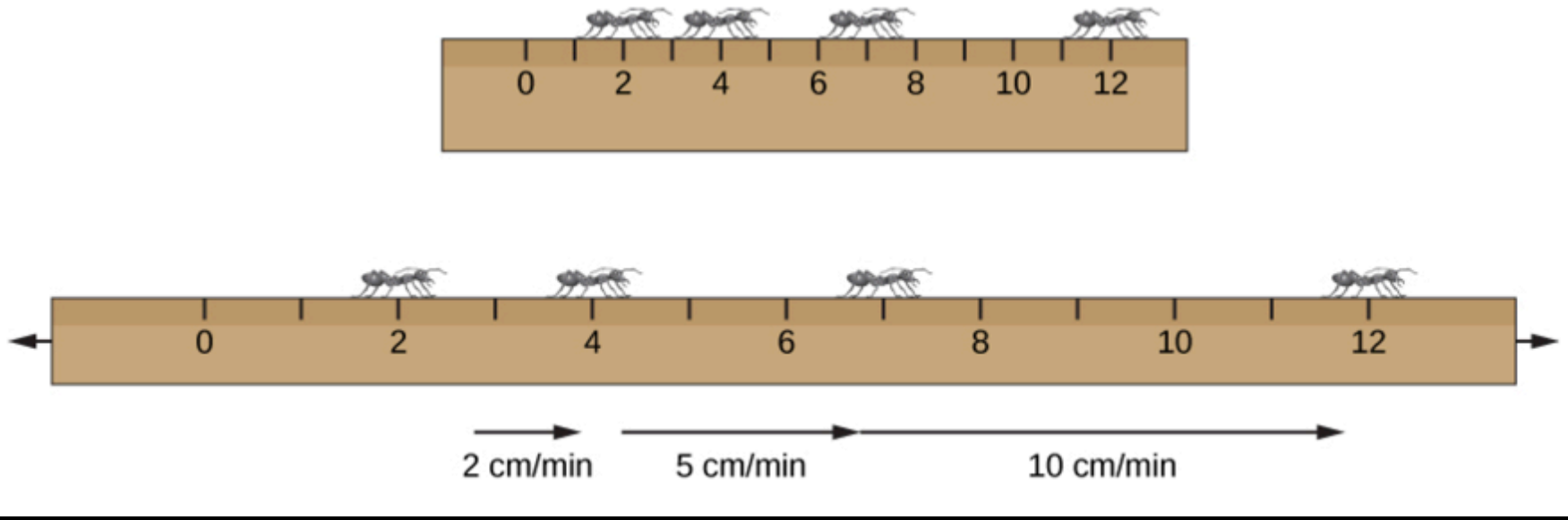
Hubble's Law: distance proportional to redshift
Redshift: spectrum of light shifted to red (going away from us)

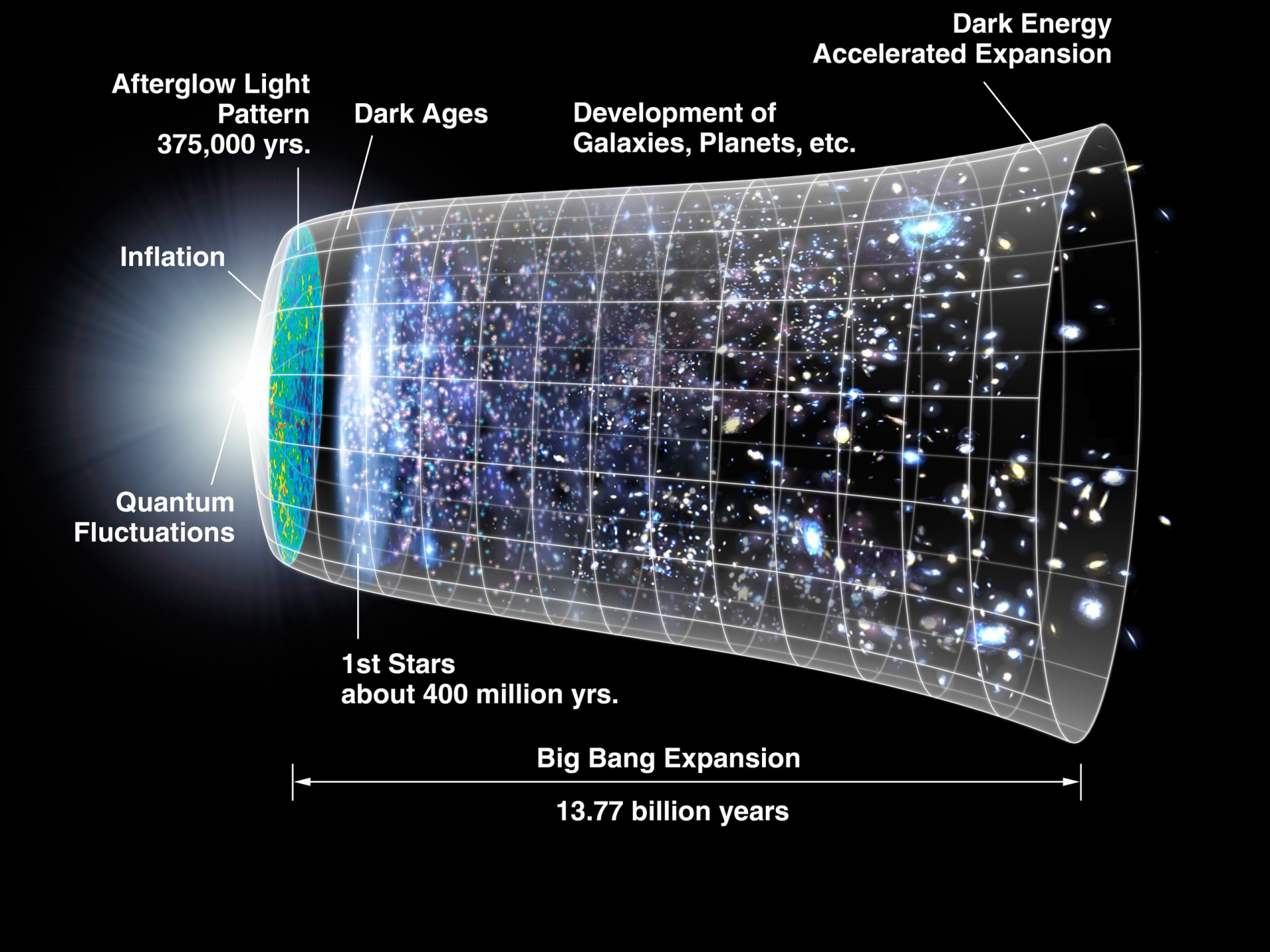


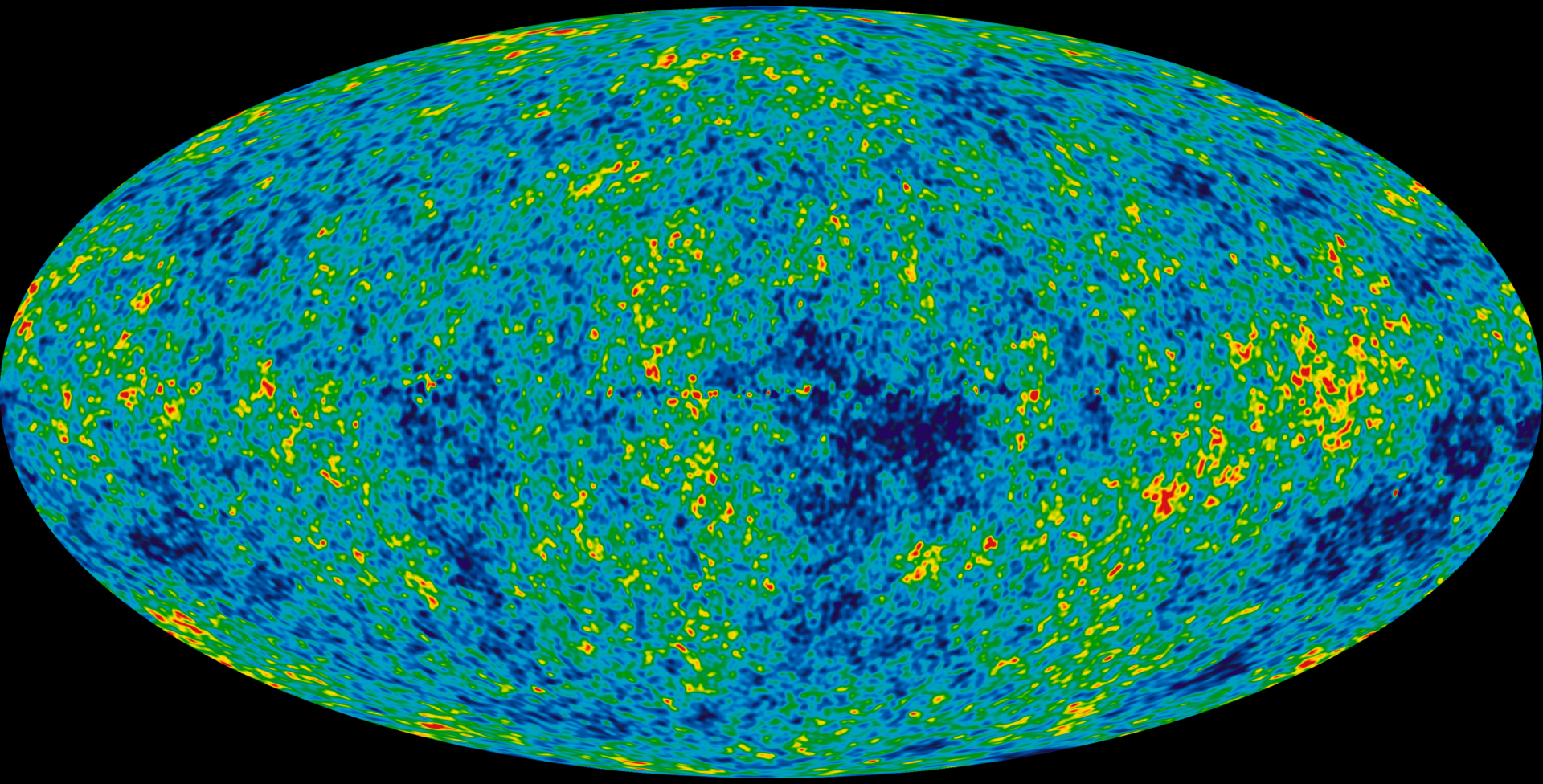


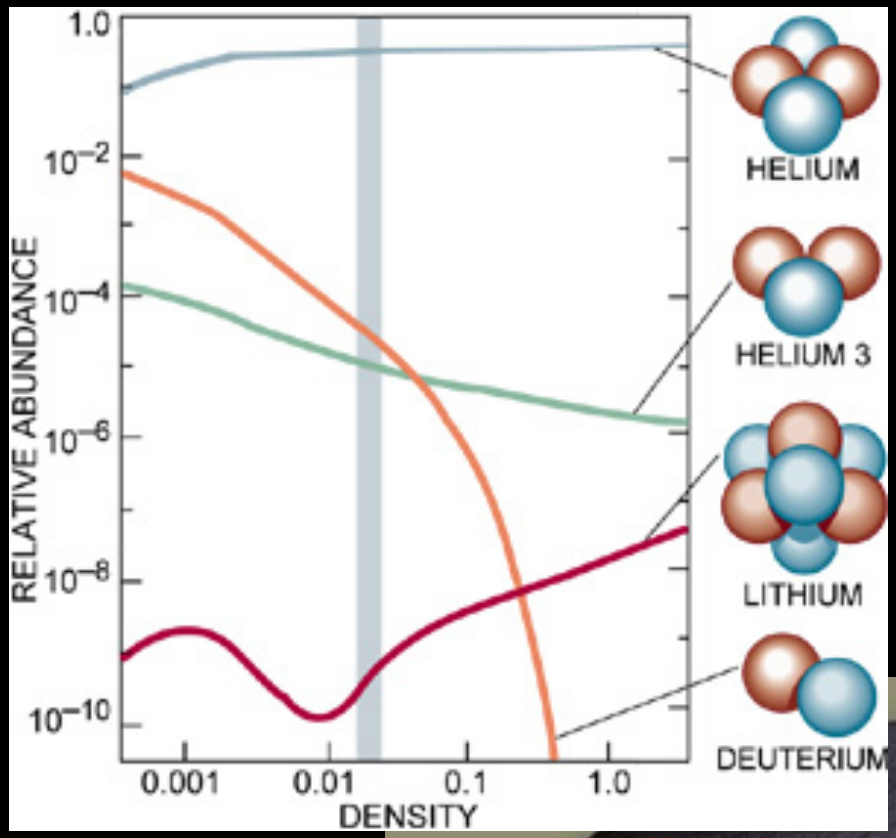
$$V = H \times d$$

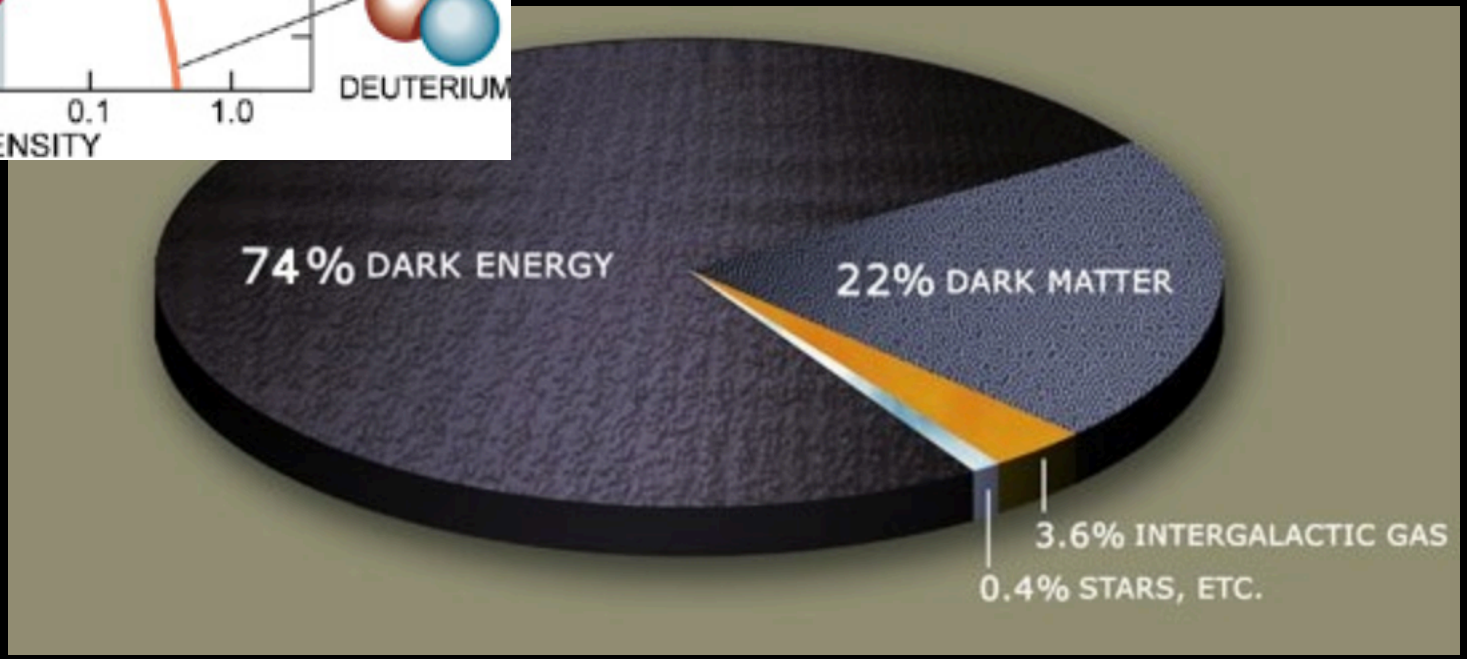
Expansion of universe

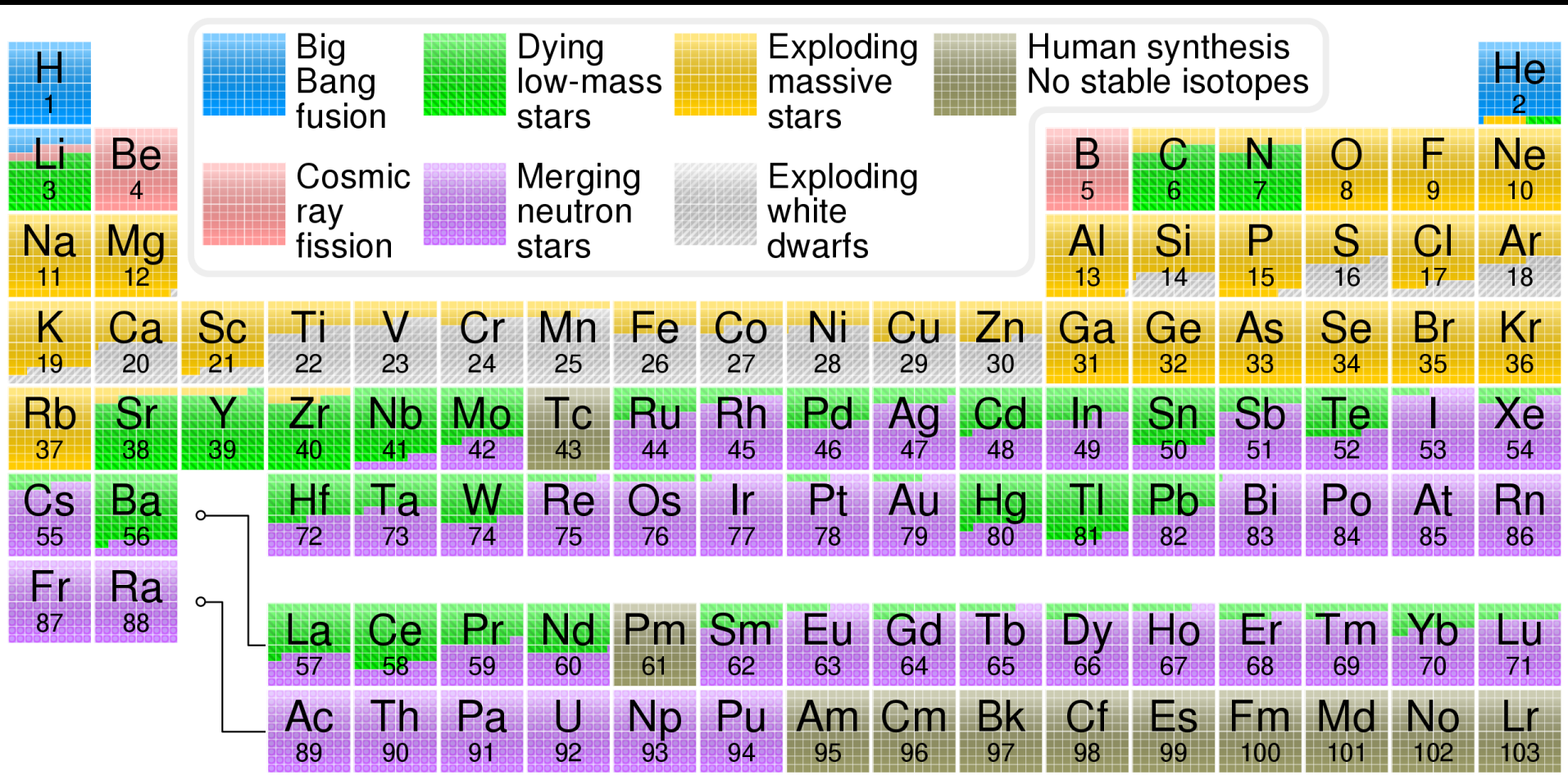


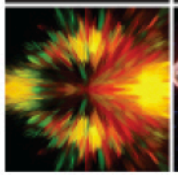
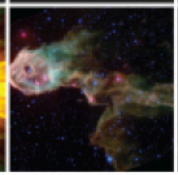
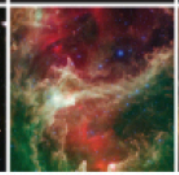
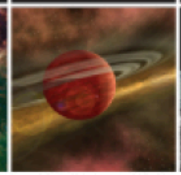
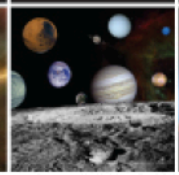
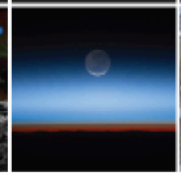
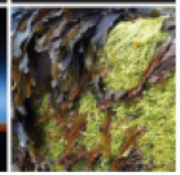

Dark Energy
Accelerated Expansion
Afterglow Light
Pattern
375,000 yrs.
Dark Ages
Development of
Galaxies, Planets, etc.
Inflation
Quantum
Fluctuations
1st Stars
about 400 million yrs.
Big Bang Expansion
13.77 billion years



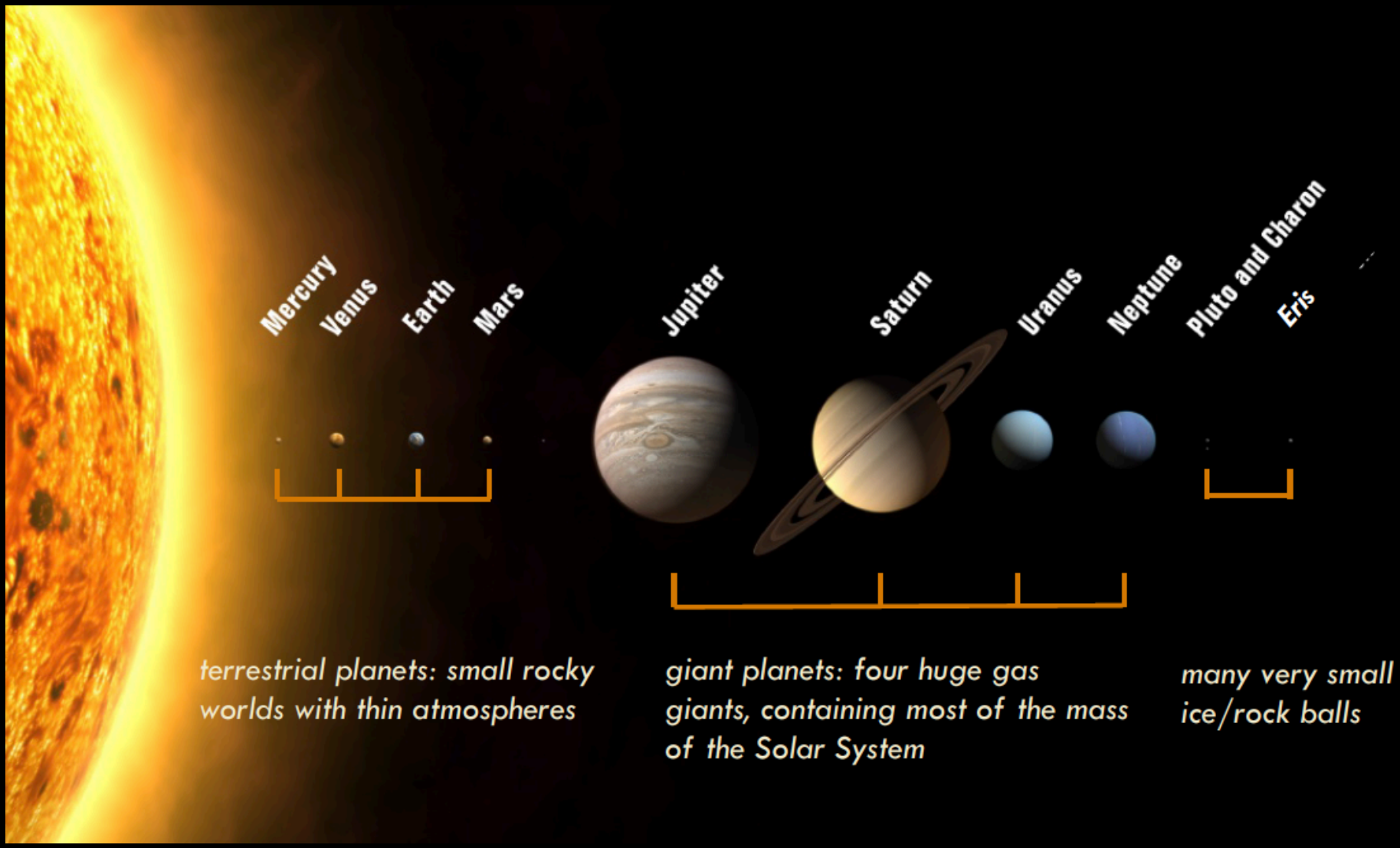

1.0
10^{-2}
10^{-4}
10^{-6}
10^{-8}
10^{-10}
RELATIVE ABUNDANCE
0.001
0.01
0.1
1.0
DENSITY
HELIUM
HELIUM 3
LITHIUM
DEUTERIUM

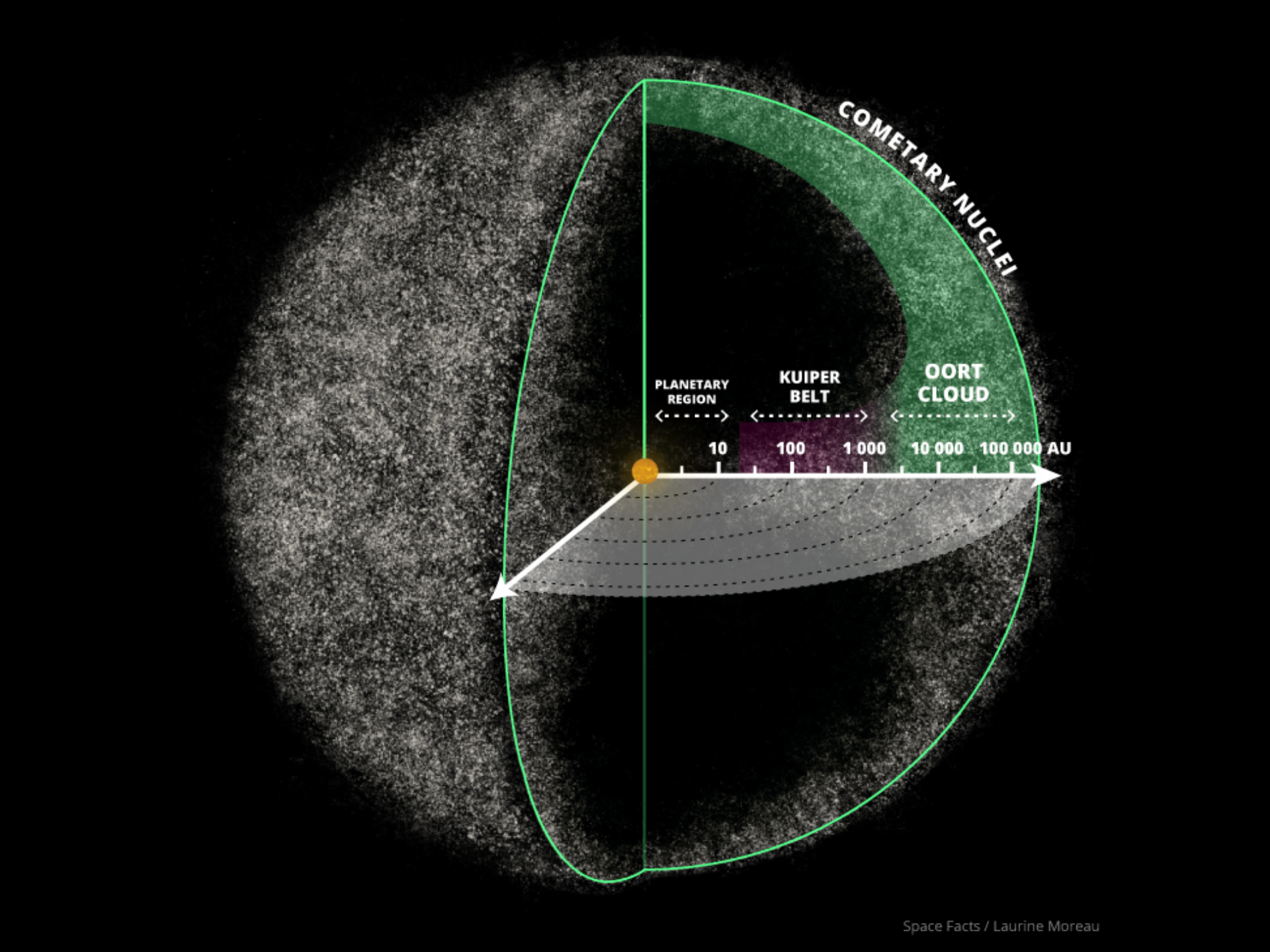

74% DARK ENERGY
22% DARK MATTER
3.6% INTERGALACTIC GAS
0.4% STARS, ETC.


Big Bang fusion
Dying low-mass stars
Exploding massive stars
Human synthesis No stable isotopes
Cosmic ray fission
Merging neutron stars
Exploding white dwarfs
H 1
He 2
Li 3
Be 4
B 5
C 6
N 7
O 8
F 9
Ne 10
Na 11
Mg 12
Al 13
Si 14
P 15
S 16
Cl 17
Ar 18
K 19
Ca 20
Sc 21
Ti 22
V 23
Cr 24
Mn 25
Fe 26
Co 27
Ni 28
Cu 29
Zn 30
Ga 31
Ge 32
As 33
Se 34
Br 35
Kr 36
Rb 37
Sr 38
Y 39
Zr 40
Nb 41
Mo 42
Tc 43
Ru 44
Rh 45
Pd 46
Ag 47
Cd 48
In 49
Sn 50
Sb 51
Te 52
I 53
Xe 54
Cs 55
Ba 56
Hf 72
Ta 73
W 74
Re 75
Os 76
Ir 77
Pt 78
Au 79
Hg 80
Tl 81
Pb 82
Bi 83
Po 84
At 85
Rn 86
Fr 87
Ra 88
La 57
Ce 58
Pr 59
Nd 60
Pm 61
Sm 62
Eu 63
Gd 64
Tb 65
Dy 66
Ho 67
Er 68
Tm 69
Yb 70
Lu 71
Ac 89
Th 90
Pa 91
U 92
Np 93
Pu 94
Am 95
Cm 96
Bk 97
Cf 98
Es 99
Fm 100
Md 101
No 102
Lr 103

January	February	March	April	May	June	July	August	September	October	November
										
Big Bang occurs.				Milky Way Galaxy forms.				Our solar system forms. Life on Earth begins.	Earth's atmosphere becomes oxygenated.	First complex life forms appear.

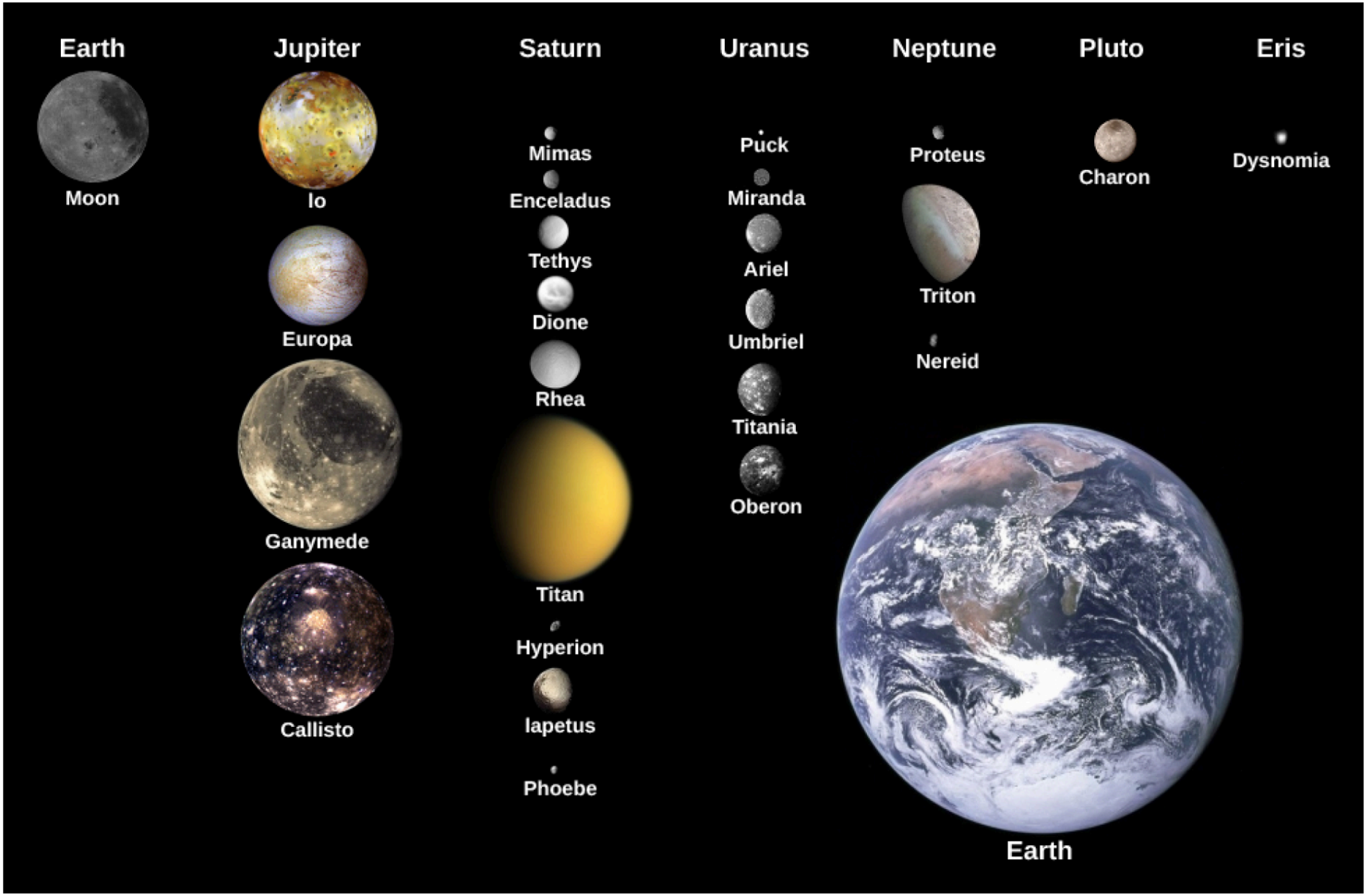
December						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19 Vertebrates appear.	20 Land plants appear.	21
22	23	24	25 Dinosaurs appear.	26 Mammals appear.	27	28
29	30 Dinosaurs become extinct.	31 Humans appear.				

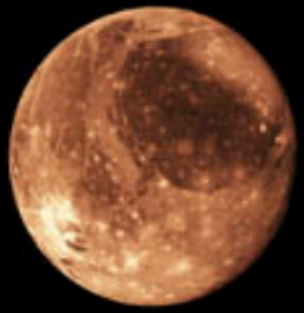

Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto and Charon
Eris
terrestrial planets: small rocky worlds with thin atmospheres
giant planets: four huge gas giants, containing most of the mass of the Solar System
many very small ice/rock balls



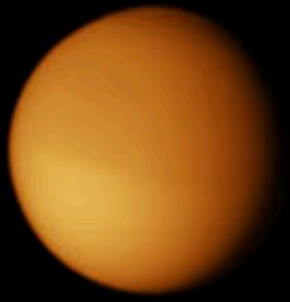
Space Facts / Laurine Moreau


Earth

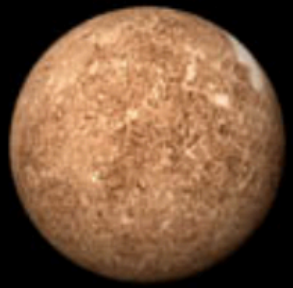

Earth
Moon
Jupiter
Io
Europa
Ganymede
Callisto
Saturn
Mimas
Enceladus
Tethys
Dione
Rhea
Titan
Hyperion
Iapetus
Phoebe
Uranus
Puck
Miranda
Ariel
Umbriel
Titania
Oberon
Neptune
Proteus
Triton
Nereid
Pluto
Charon
Eris
Dysnomia
Earth



Ganymede
5262 km

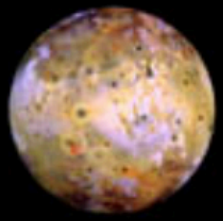


Titan
5150 km



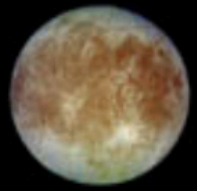
Mercury
4880 km

Callisto
4806 km



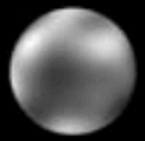
Io
3642 km

Moon
3476 km



Europa
3138 km

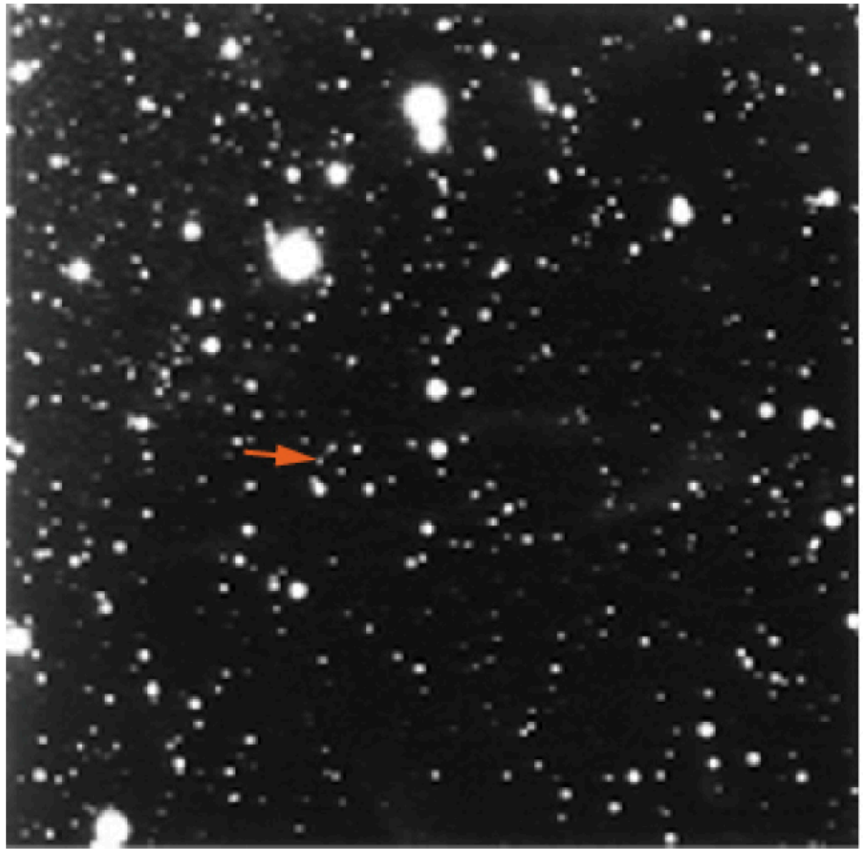
Triton
2706 km

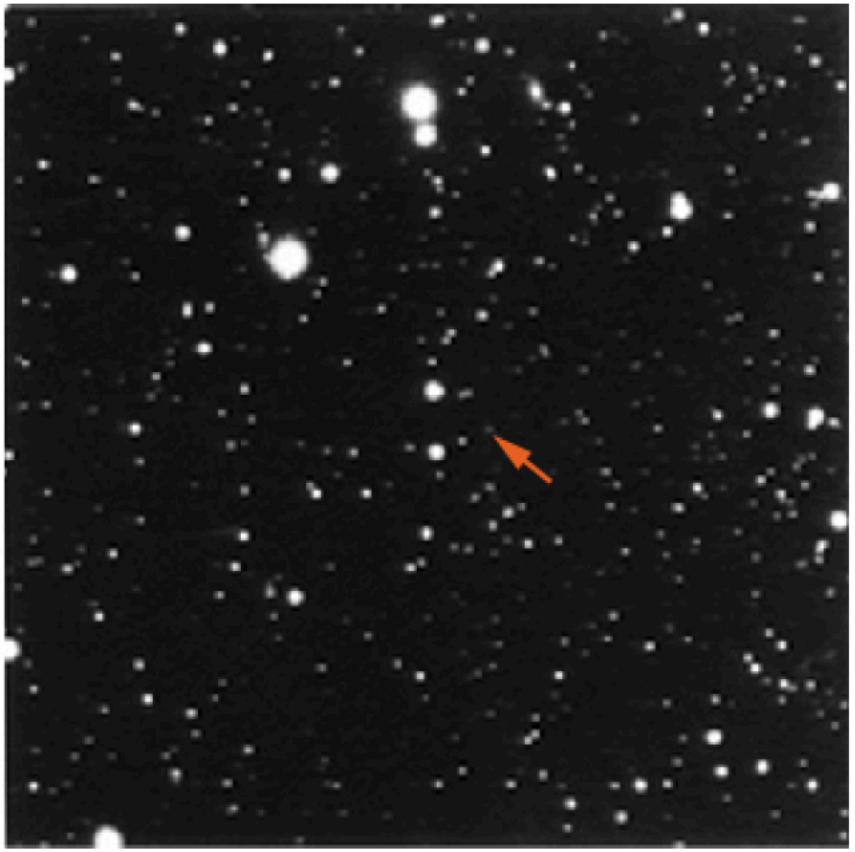


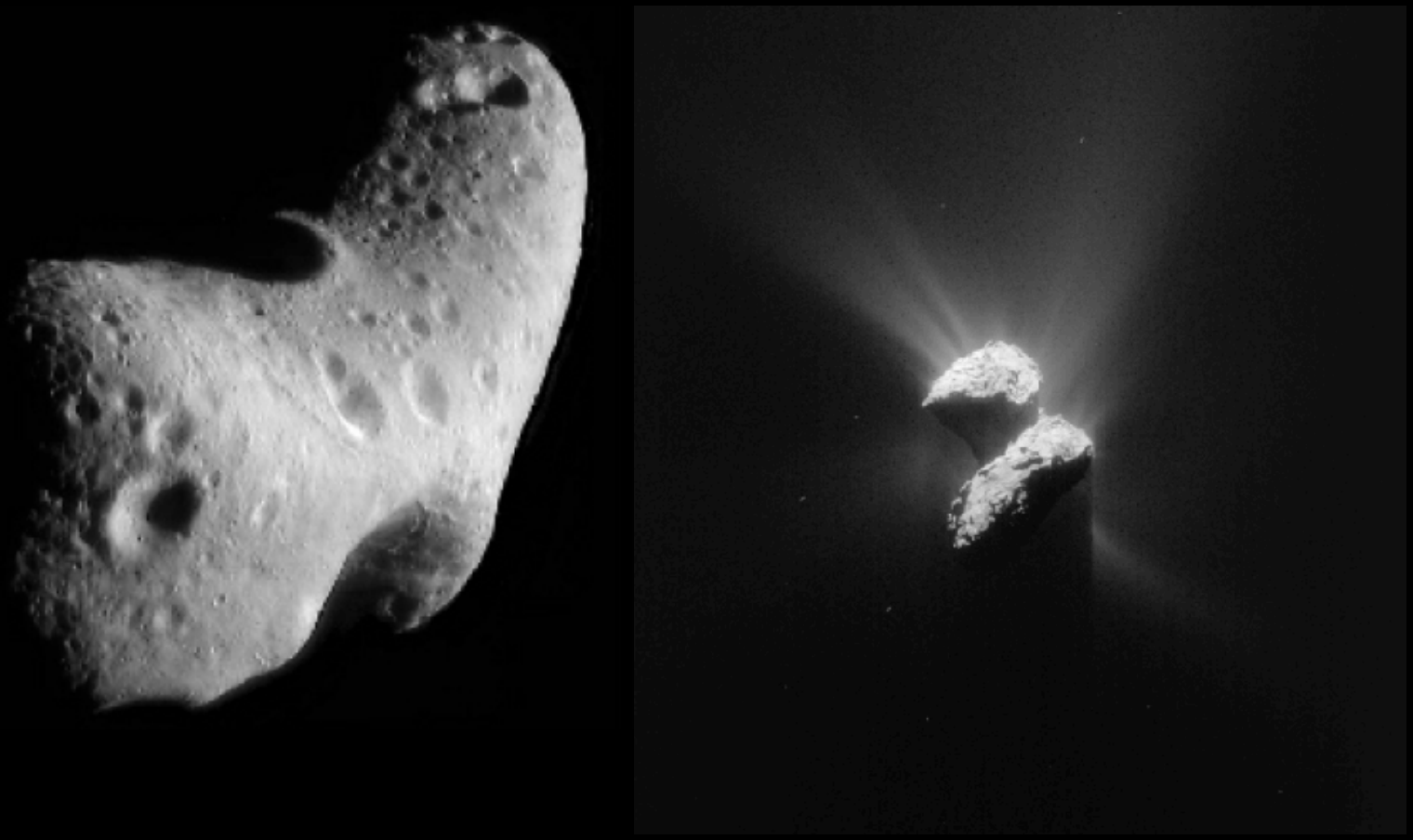
Pluto
2300 km

Titania
1580 km

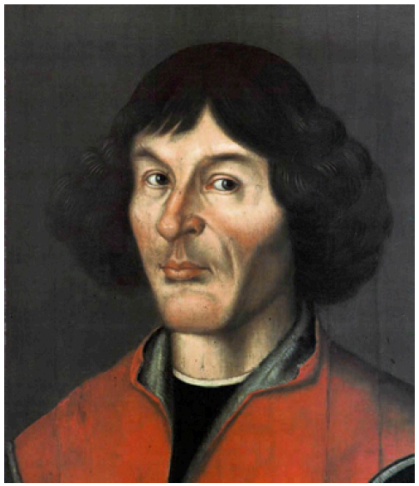
Discovery of Pluto



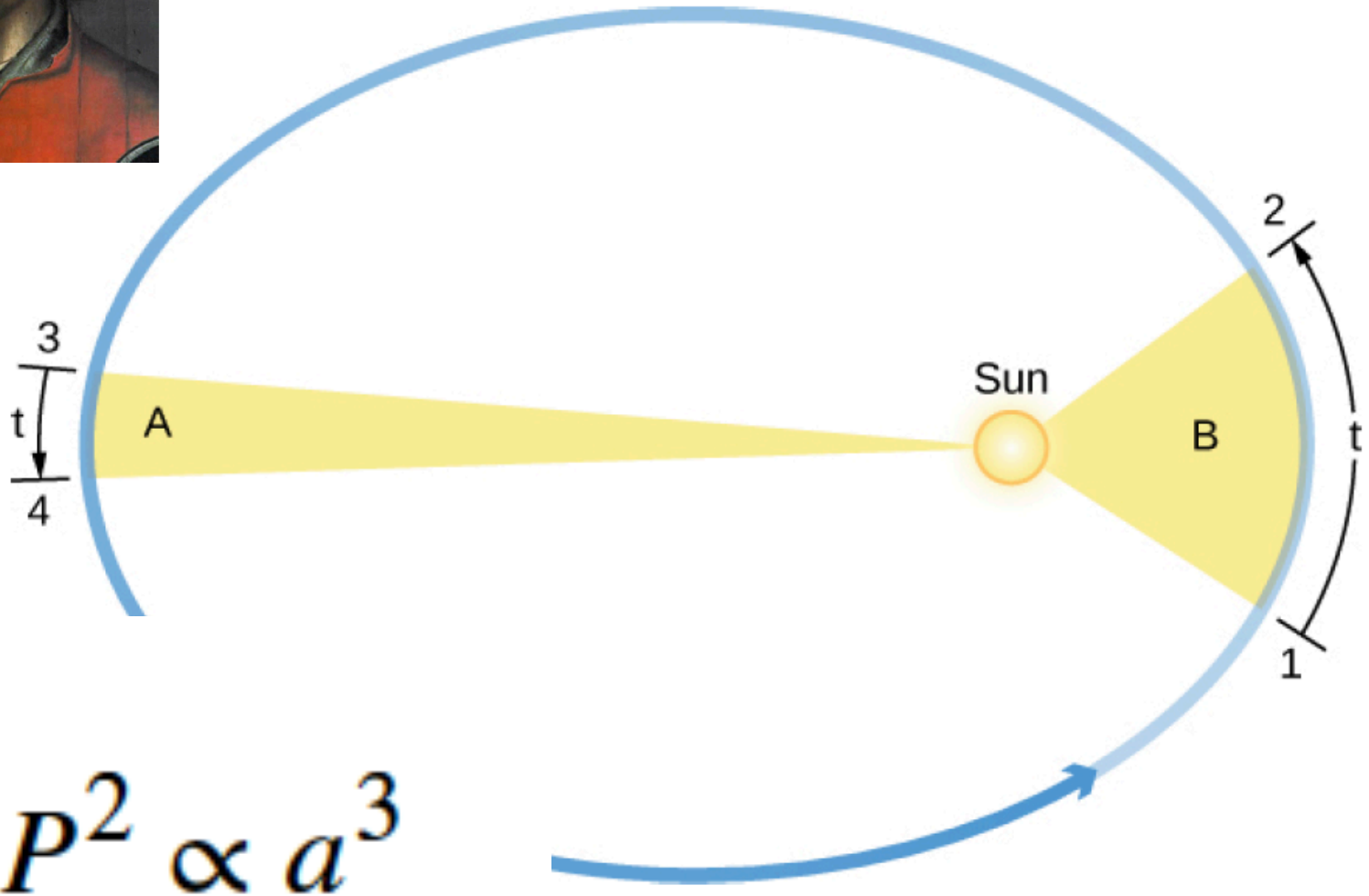




Asteroids



Kepler's Laws
(based on Tycho Brahe's data)



$$P^2 \propto a^3$$