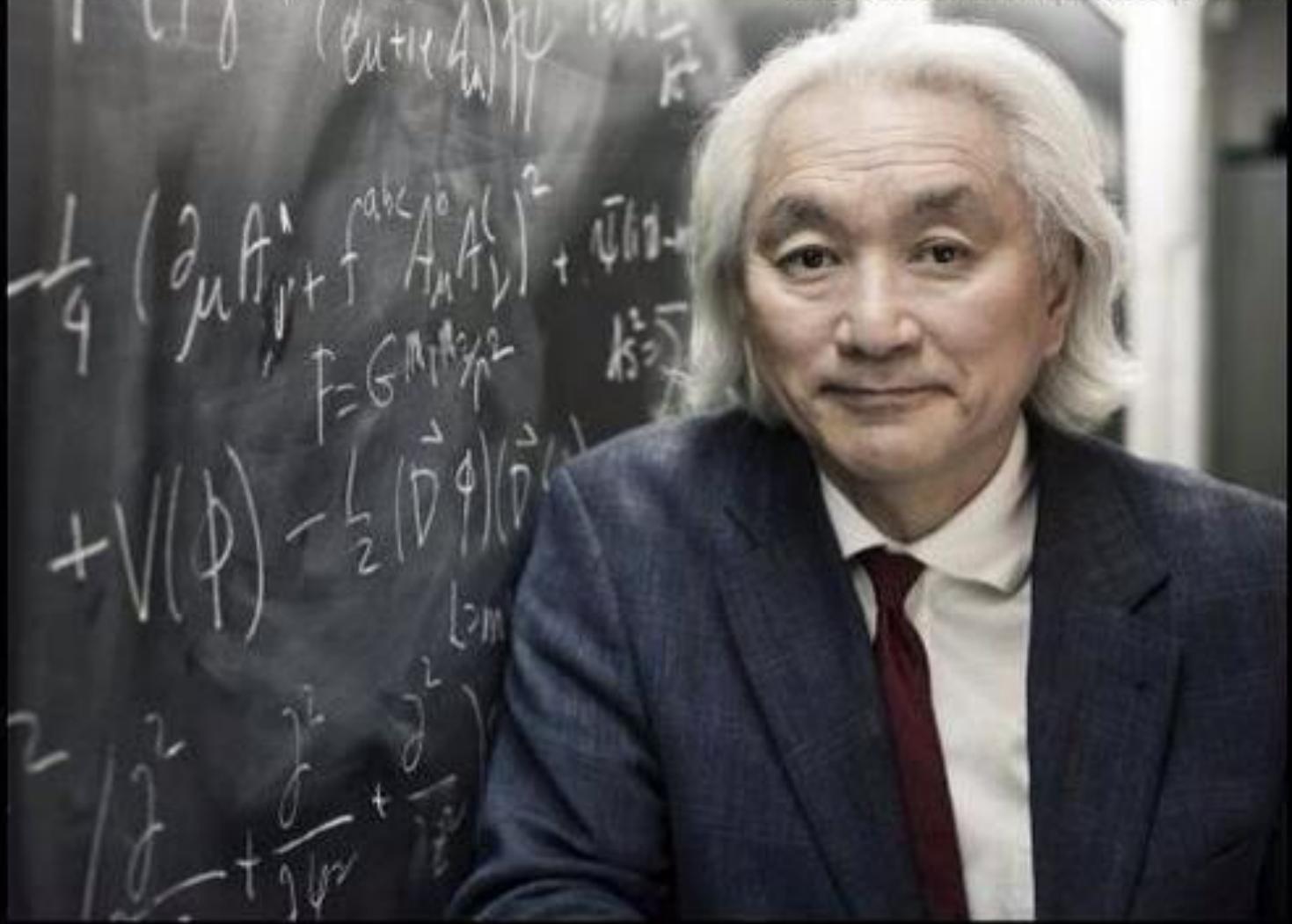


*From the Big Bang to the...
parallel Universes
We are stardust!*

Catalina Curceanu, LNF-INFN
INSPYRE, 16 February 2016

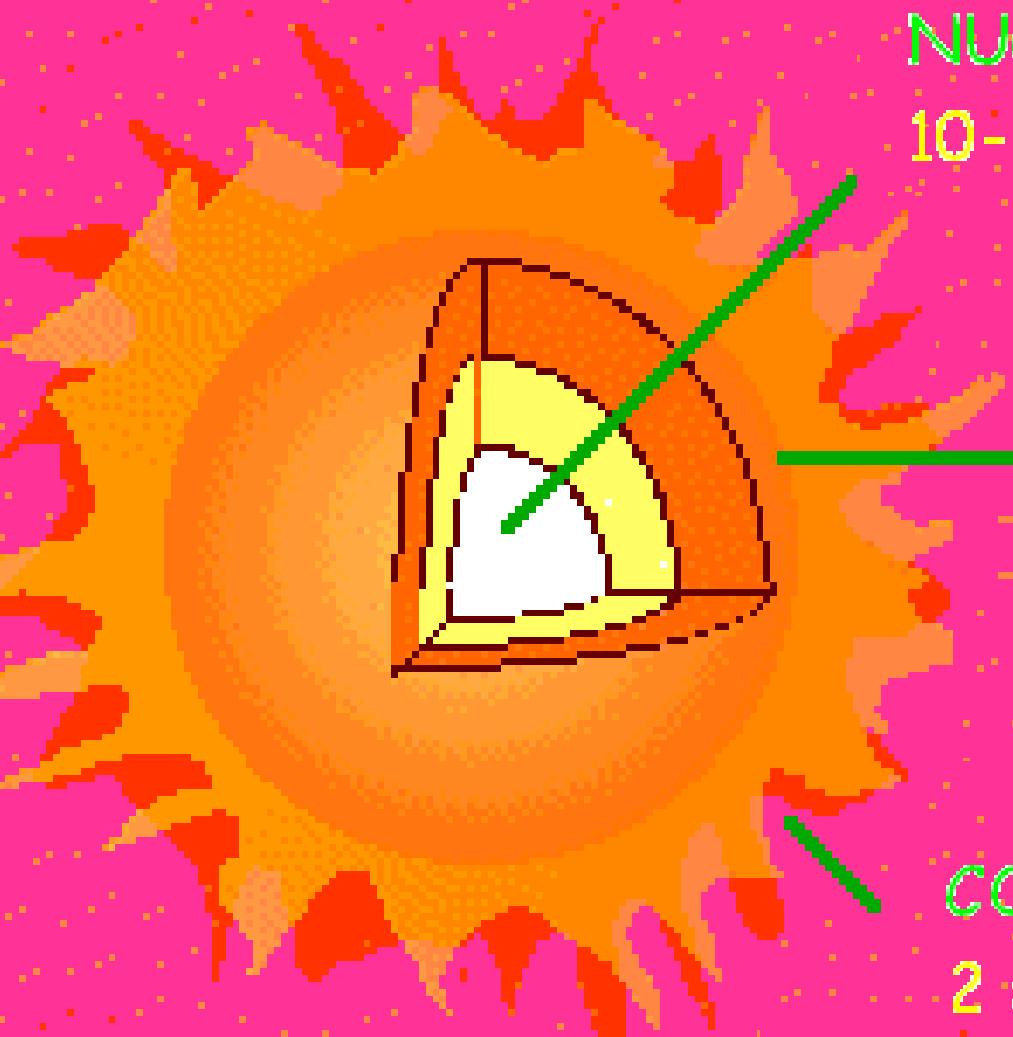


"It must be a strange world not being a scientist,
going through life not knowing -- or maybe not caring about
where the air came from, where the stars at night came
from or how far they are from us. I want to know."

- Michio Kaku



TEMPERATURE SUL SOLE



NUCLEO

10-22 milioni di gradi

SUPERFICIE

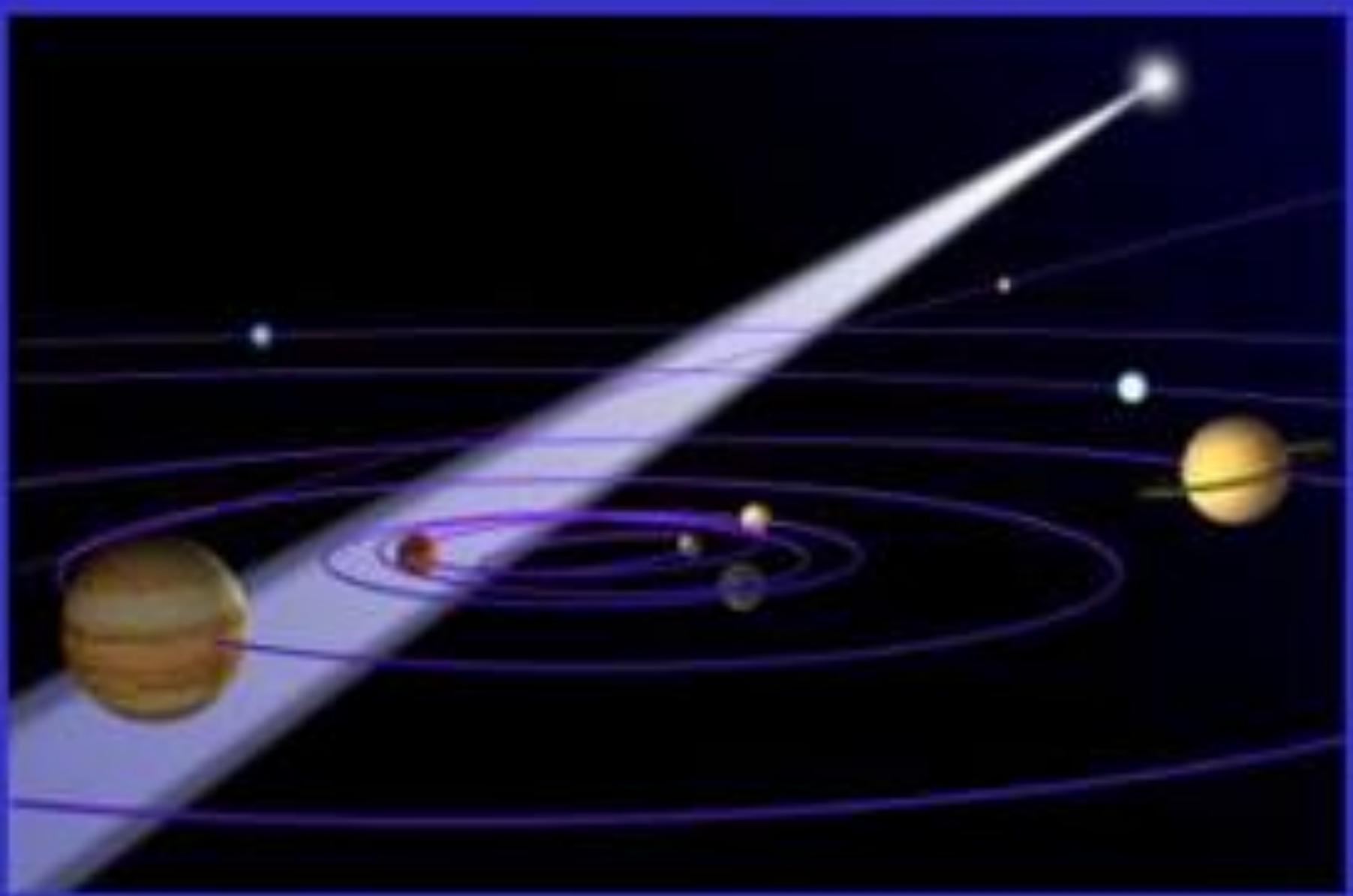
5500 gradi C

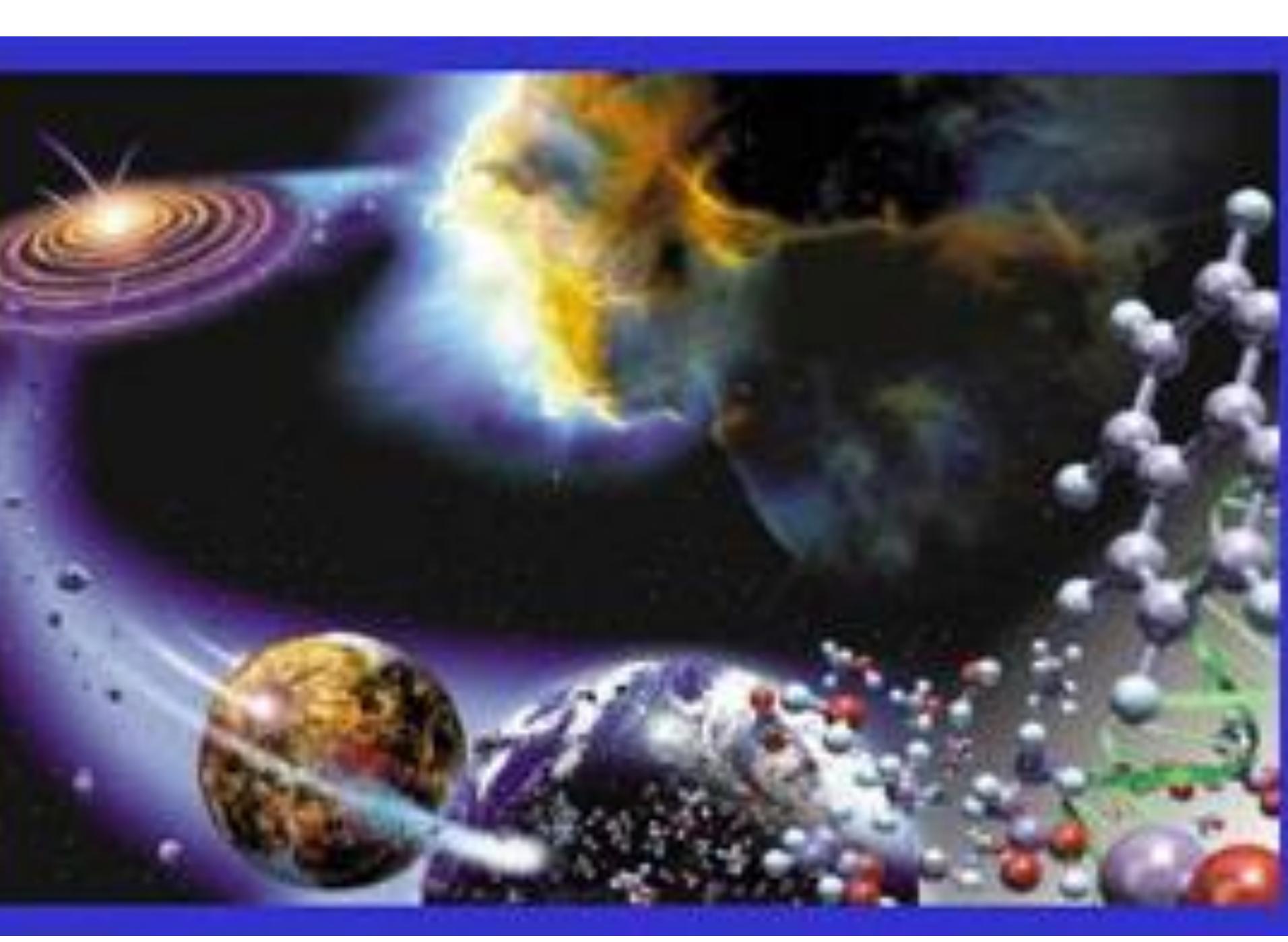
CORONA

2 milioni di gradi C

Our Solar System

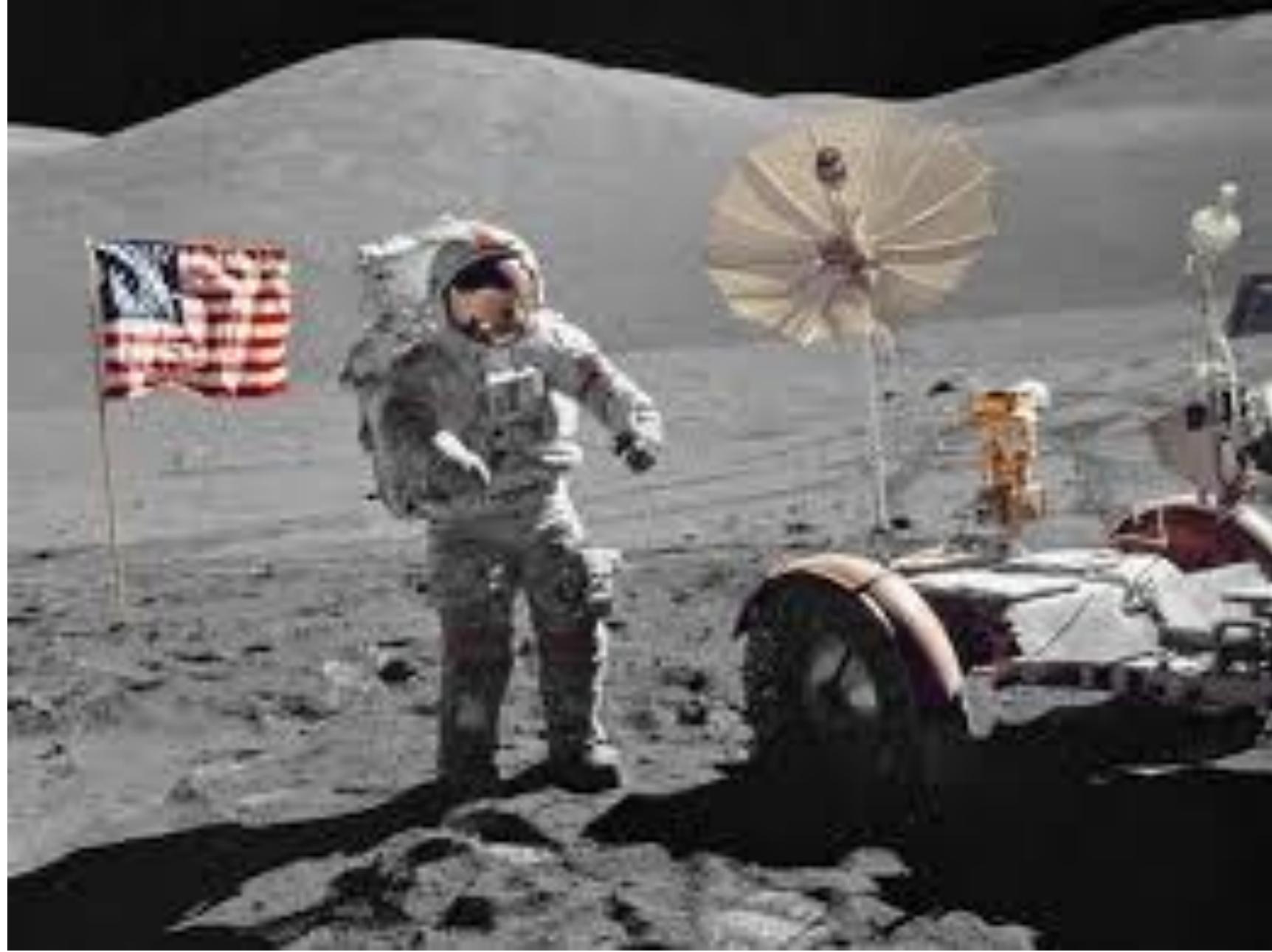


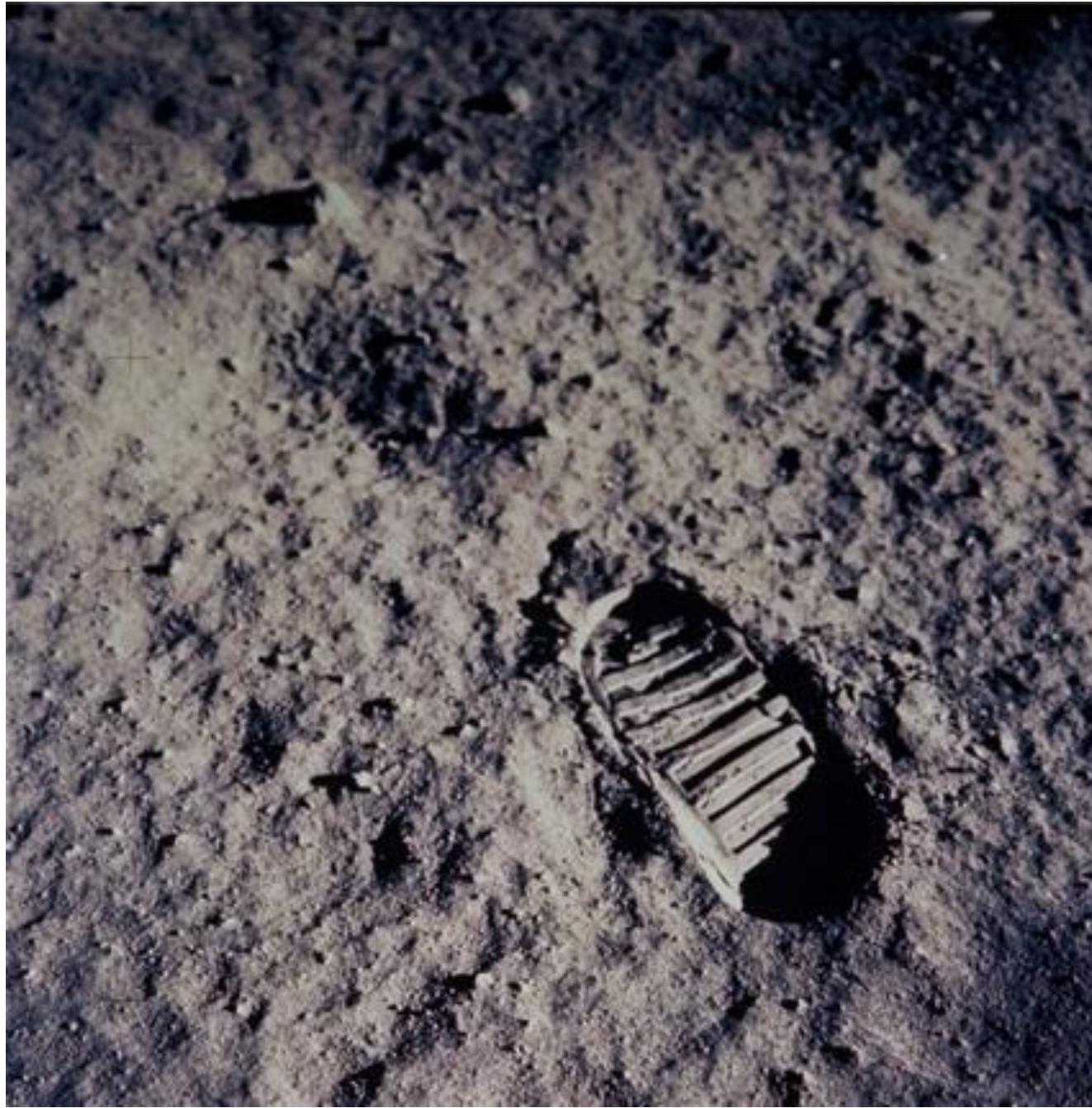






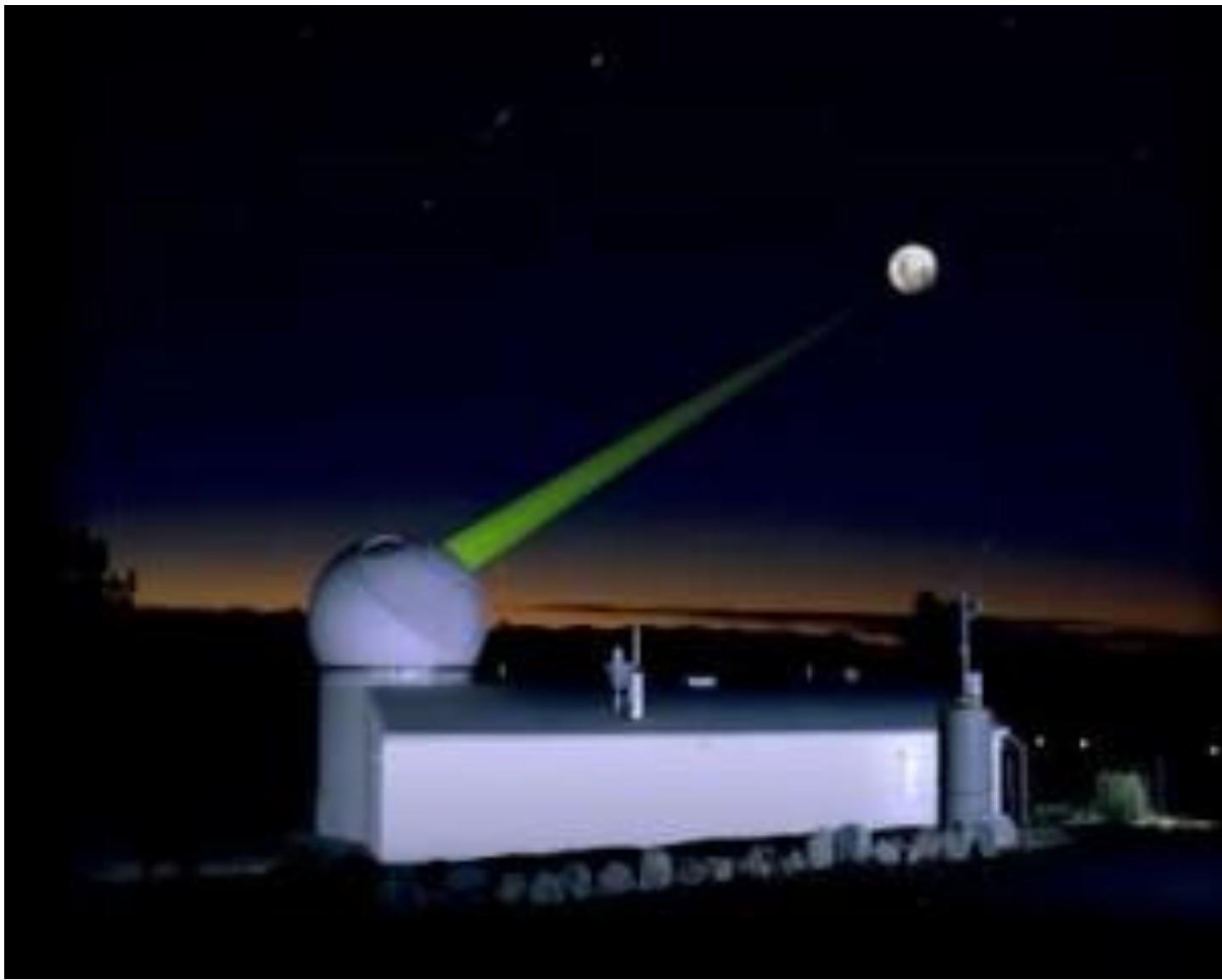


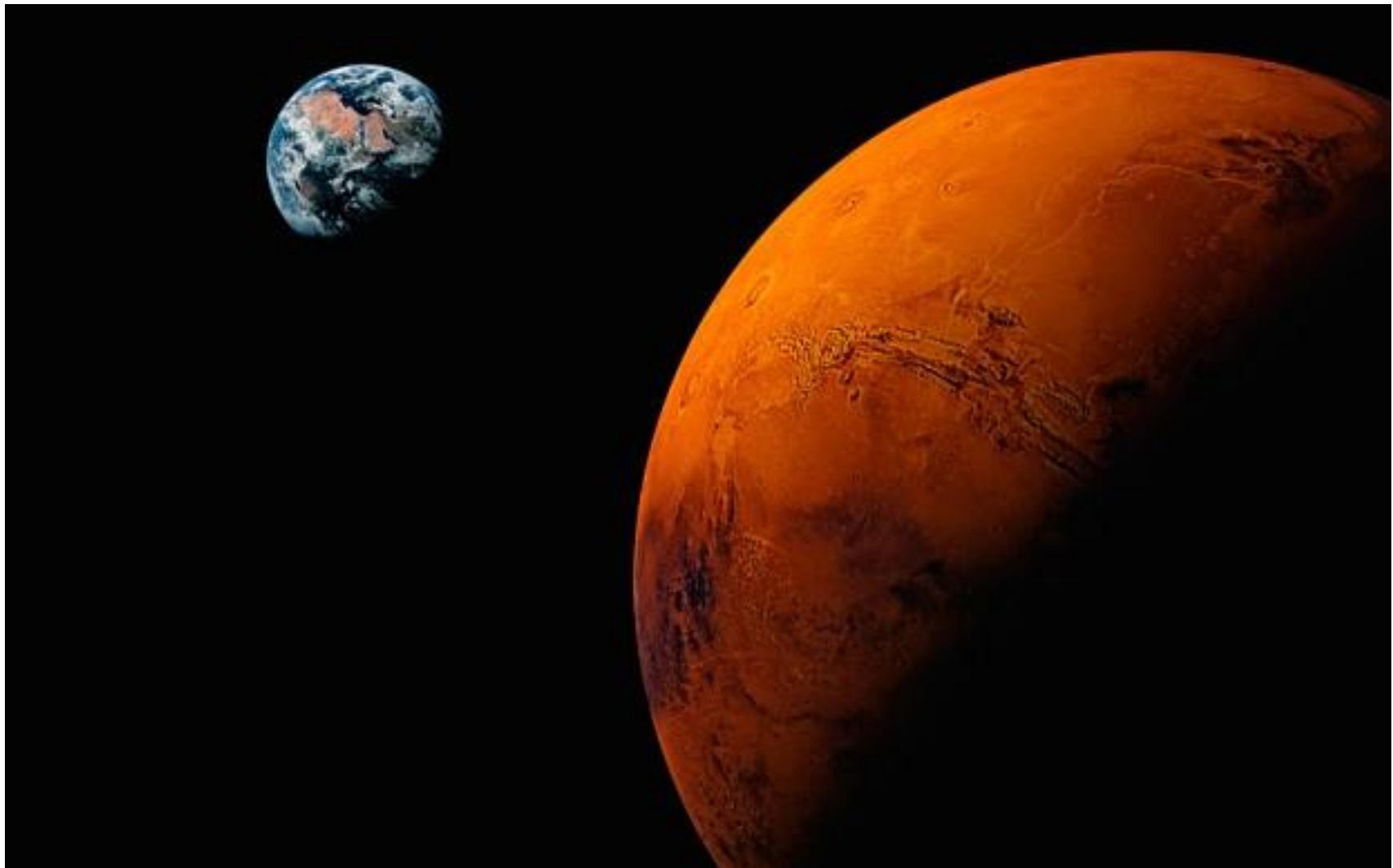
















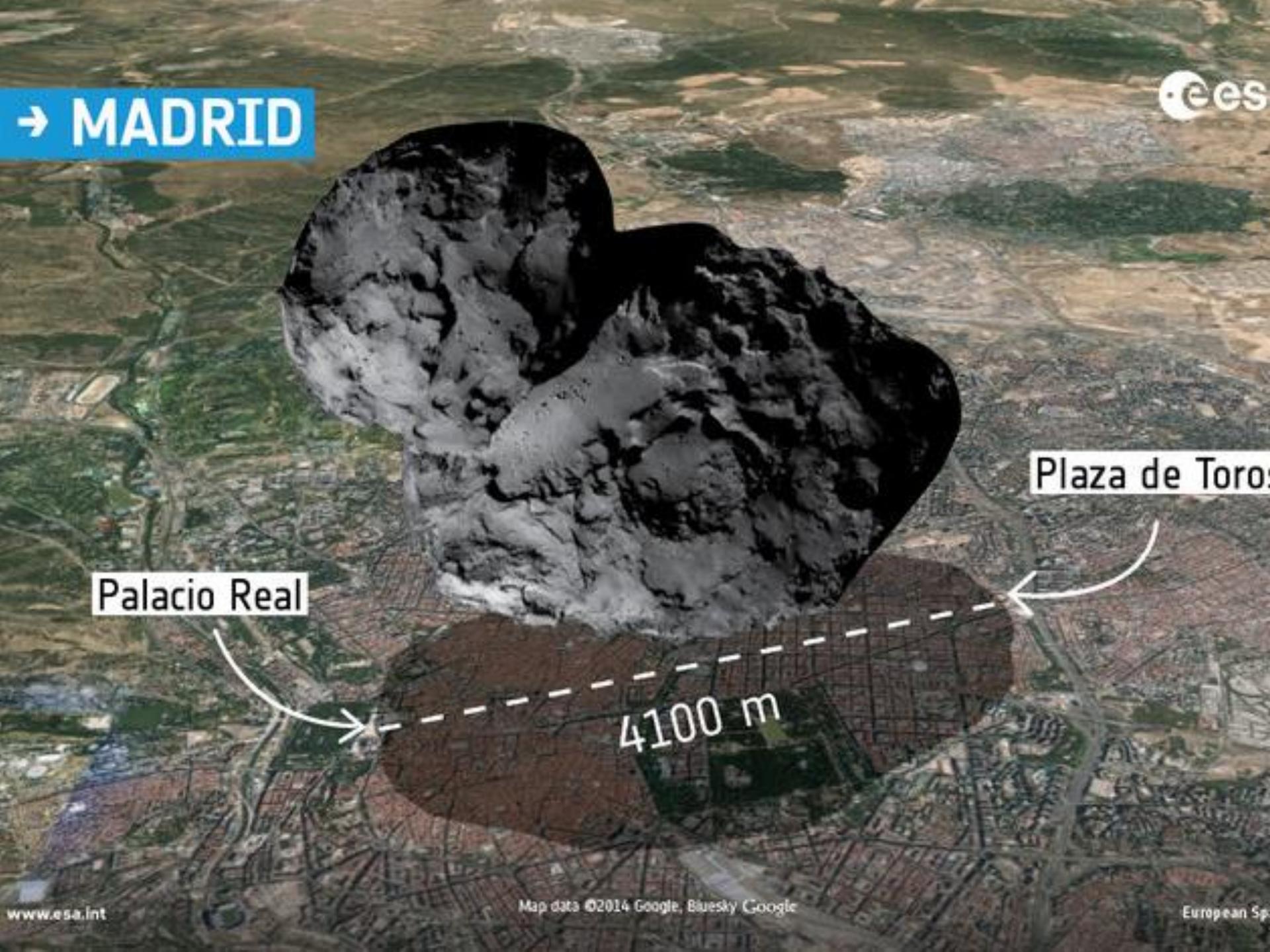


→ MADRID

Palacio Real

4100 m

Plaza de Toro:





Philae carries 10 research tools and a transmitter that can communicate data to Rosetta to be relayed home. Philae can swivel on its base to sample different areas.

Lander

A monitor studies the magnetic field and solar wind

Ovens analyze comet material

Solar cells gather weak sunlight to power the craft after the main battery dies

When they're on opposite sides of the comet, Rosetta and Philae send each other radio signals to map 67P's internal structure

Seismographs in Philae's feet detect activity in 67P's core as

INSIDE THE COMET

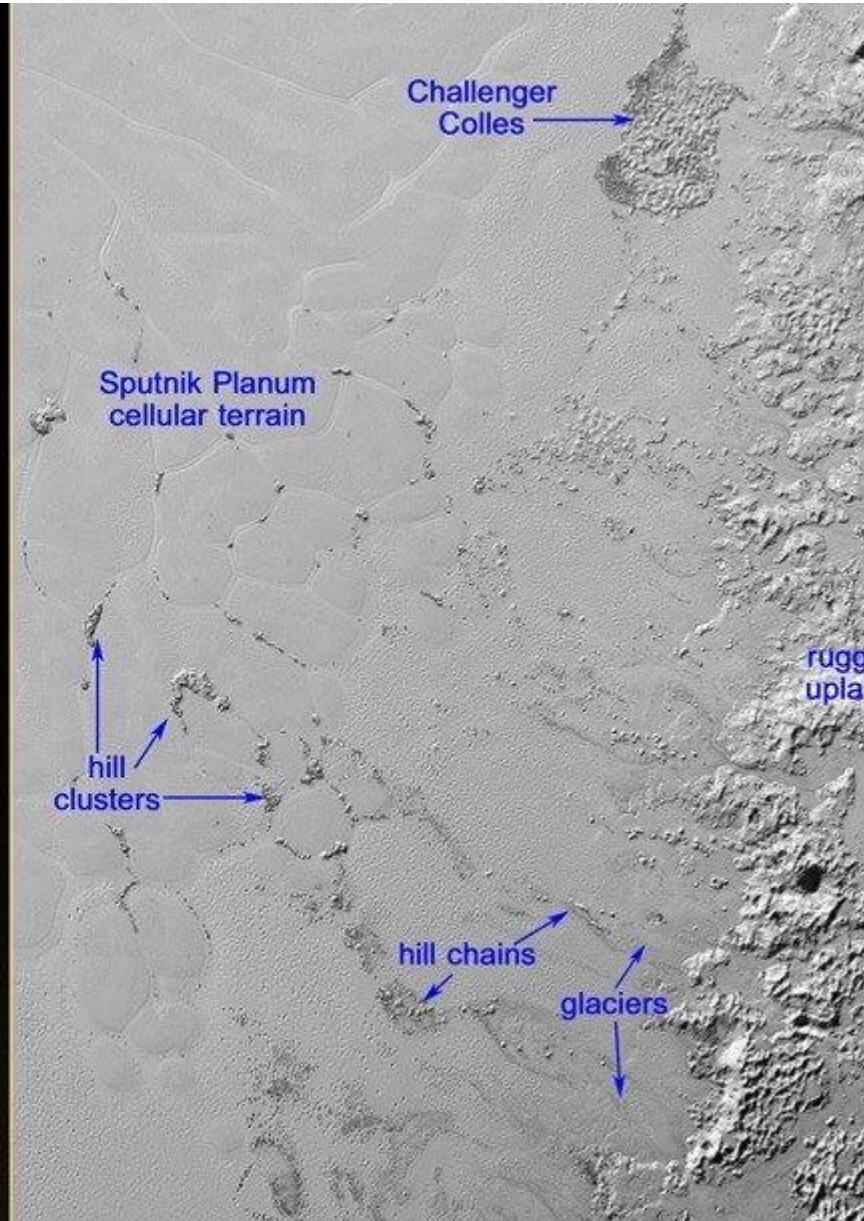
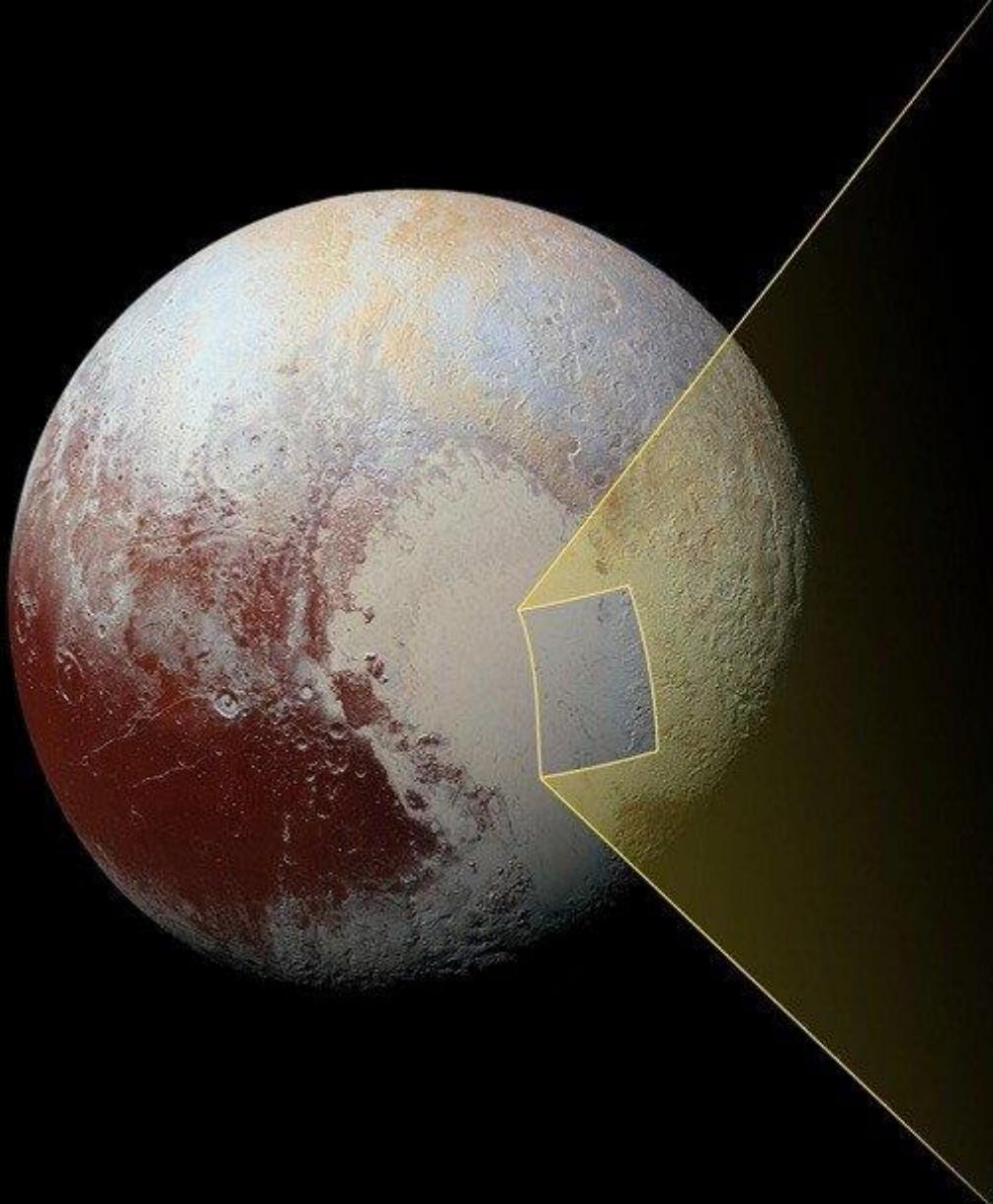
A probe will penetrate the comet if the surface layers are porous

11 in. deep

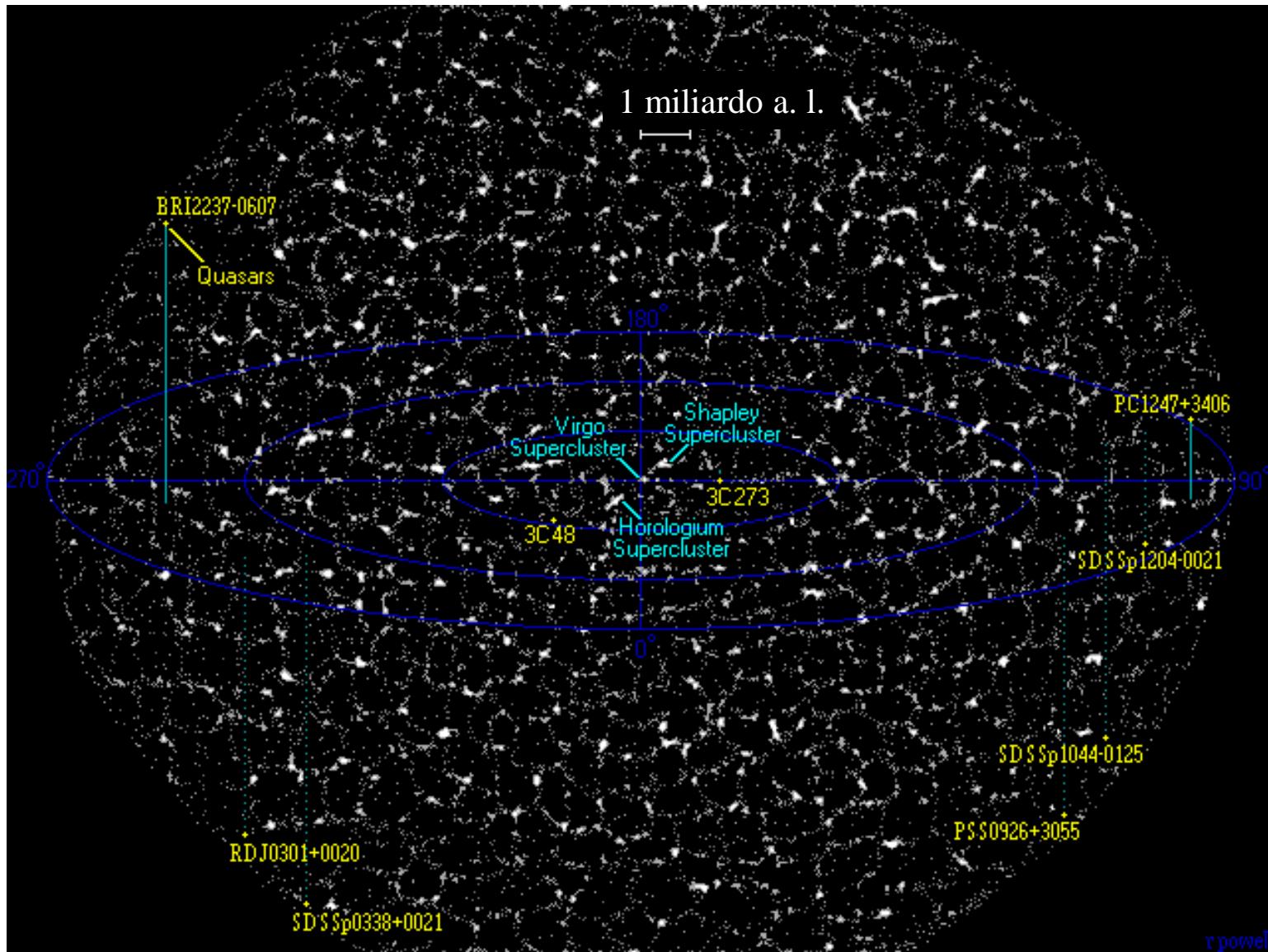
Measurement will include the temperature and density of the comet's interior

10

YEARS
TO REACH



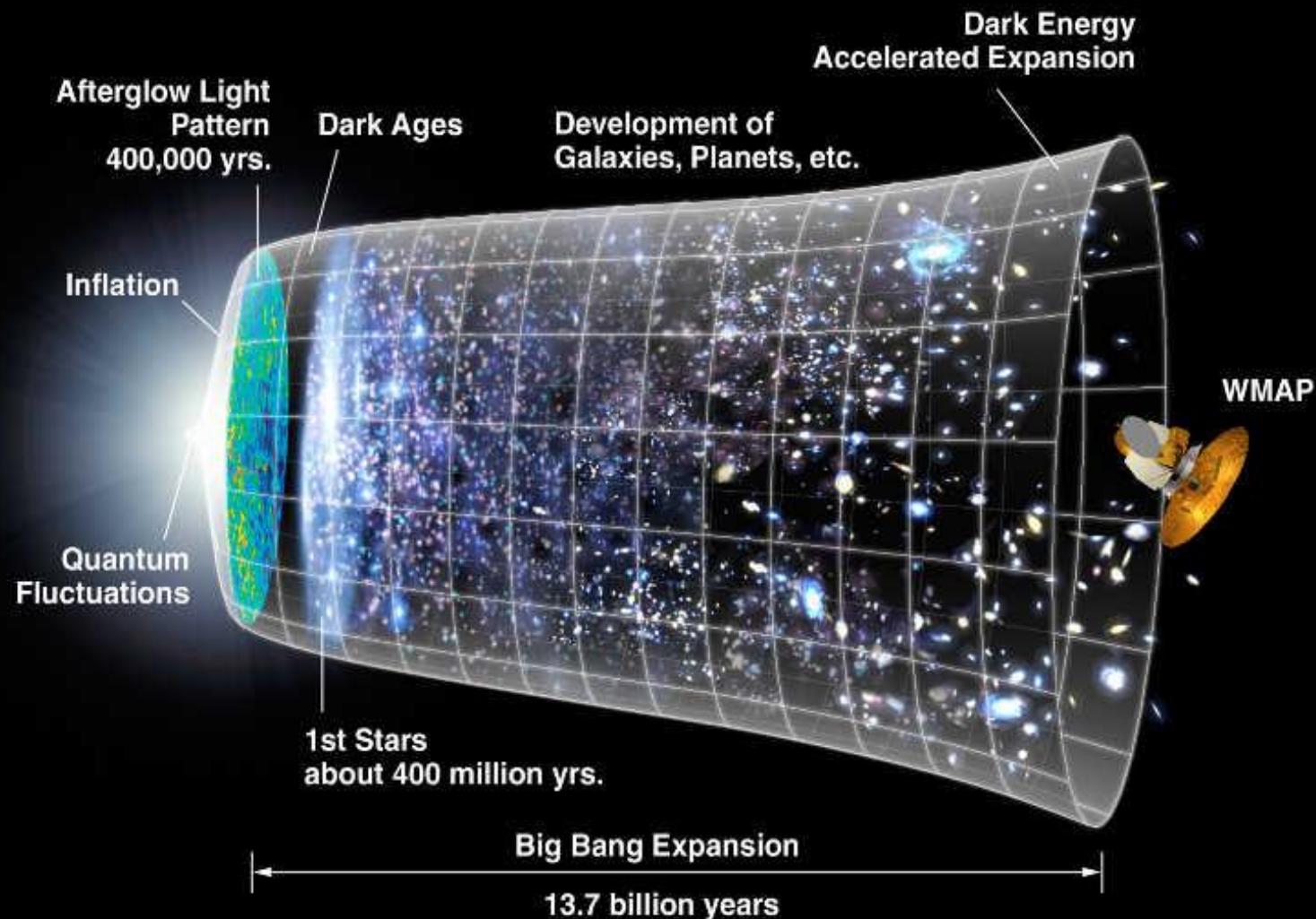




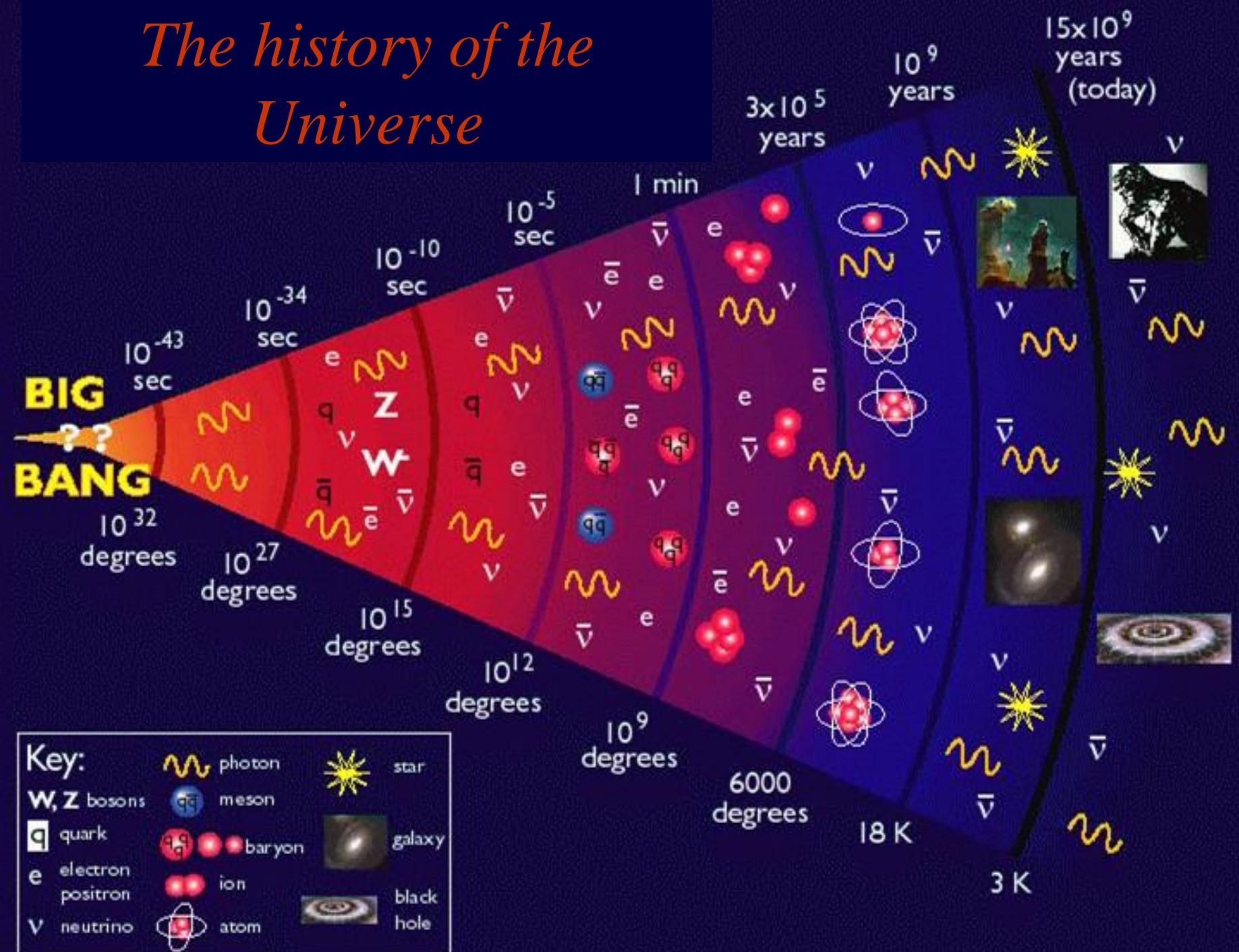
Zoom In x15

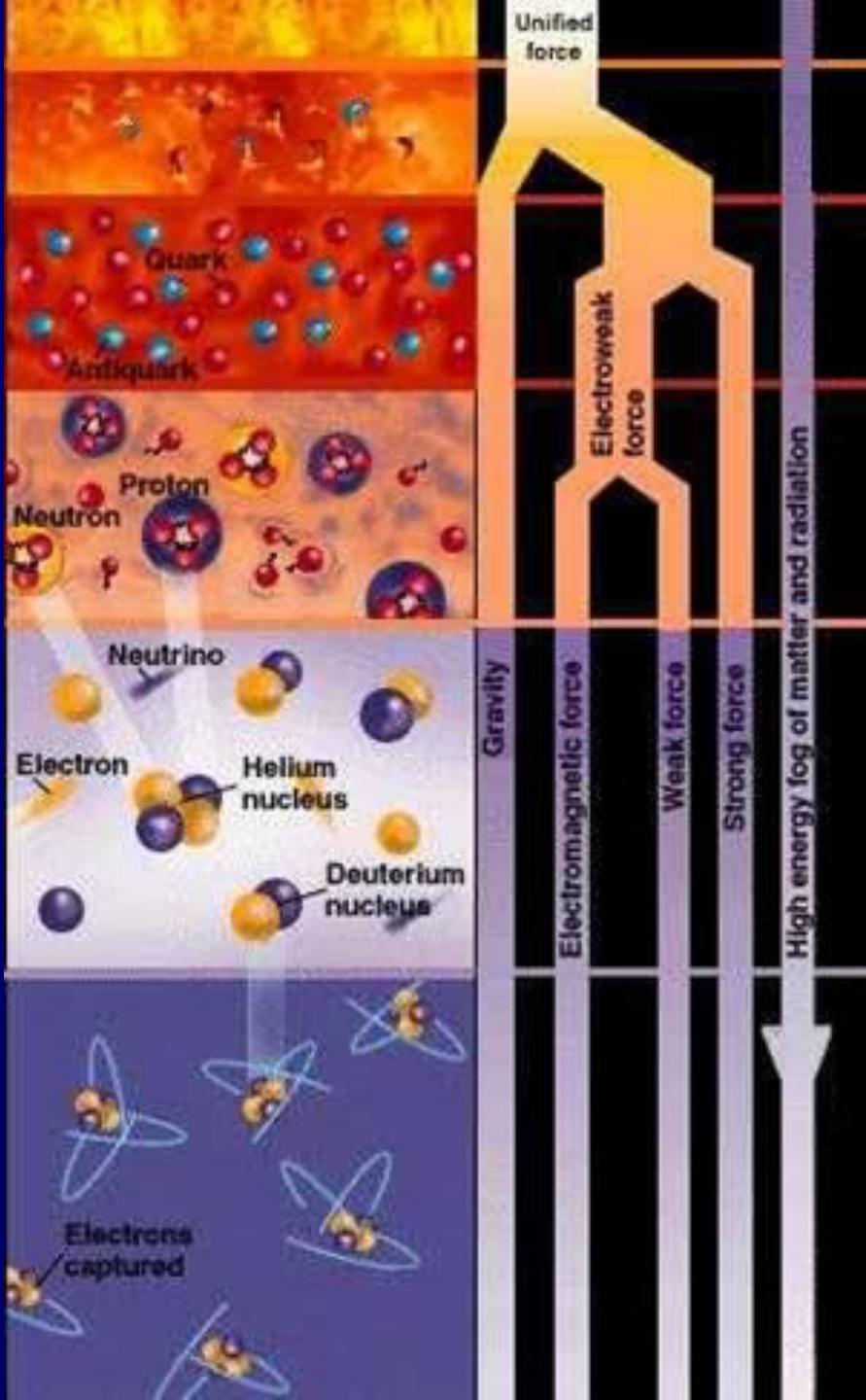
r powell

The Big Bang Model



The history of the Universe

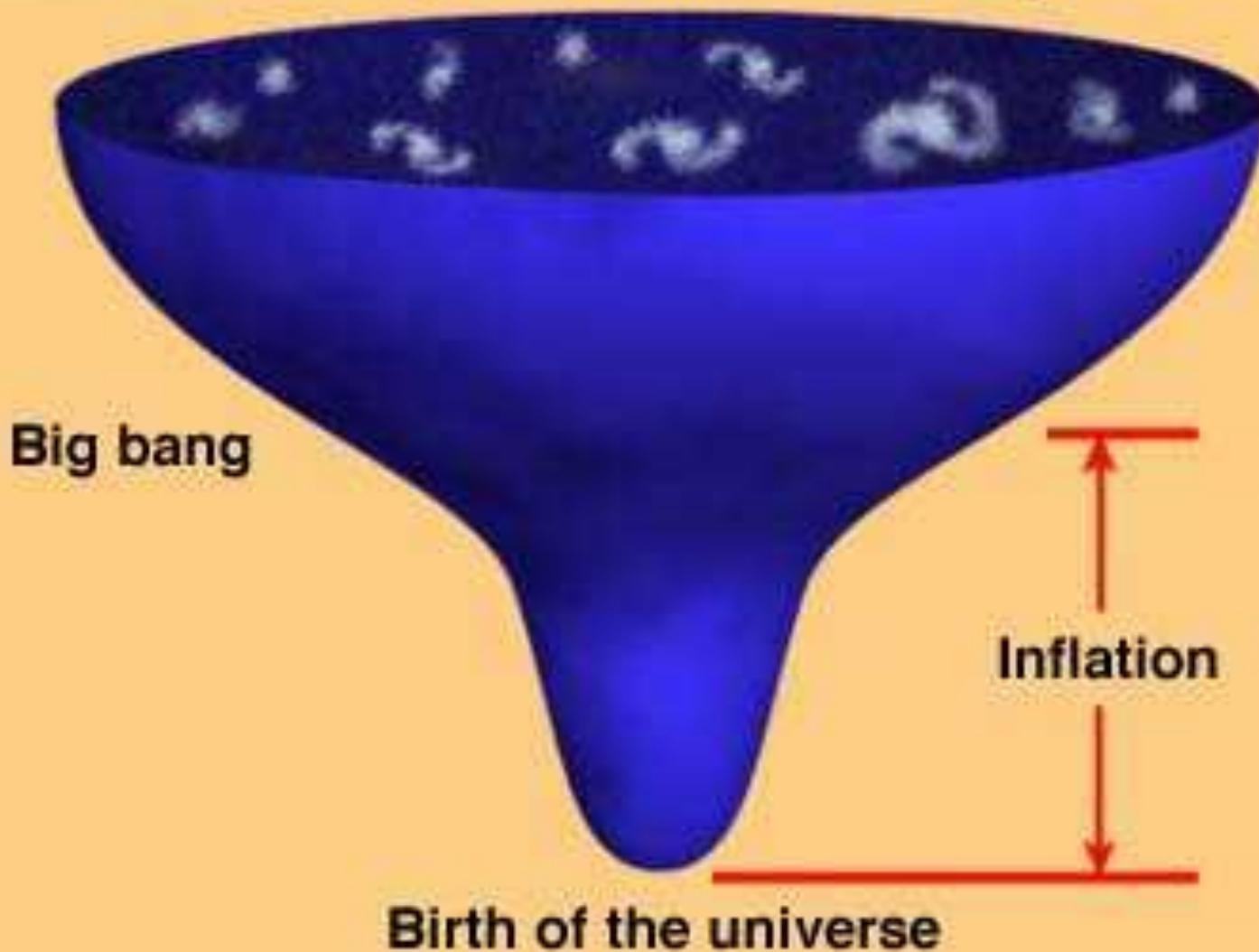


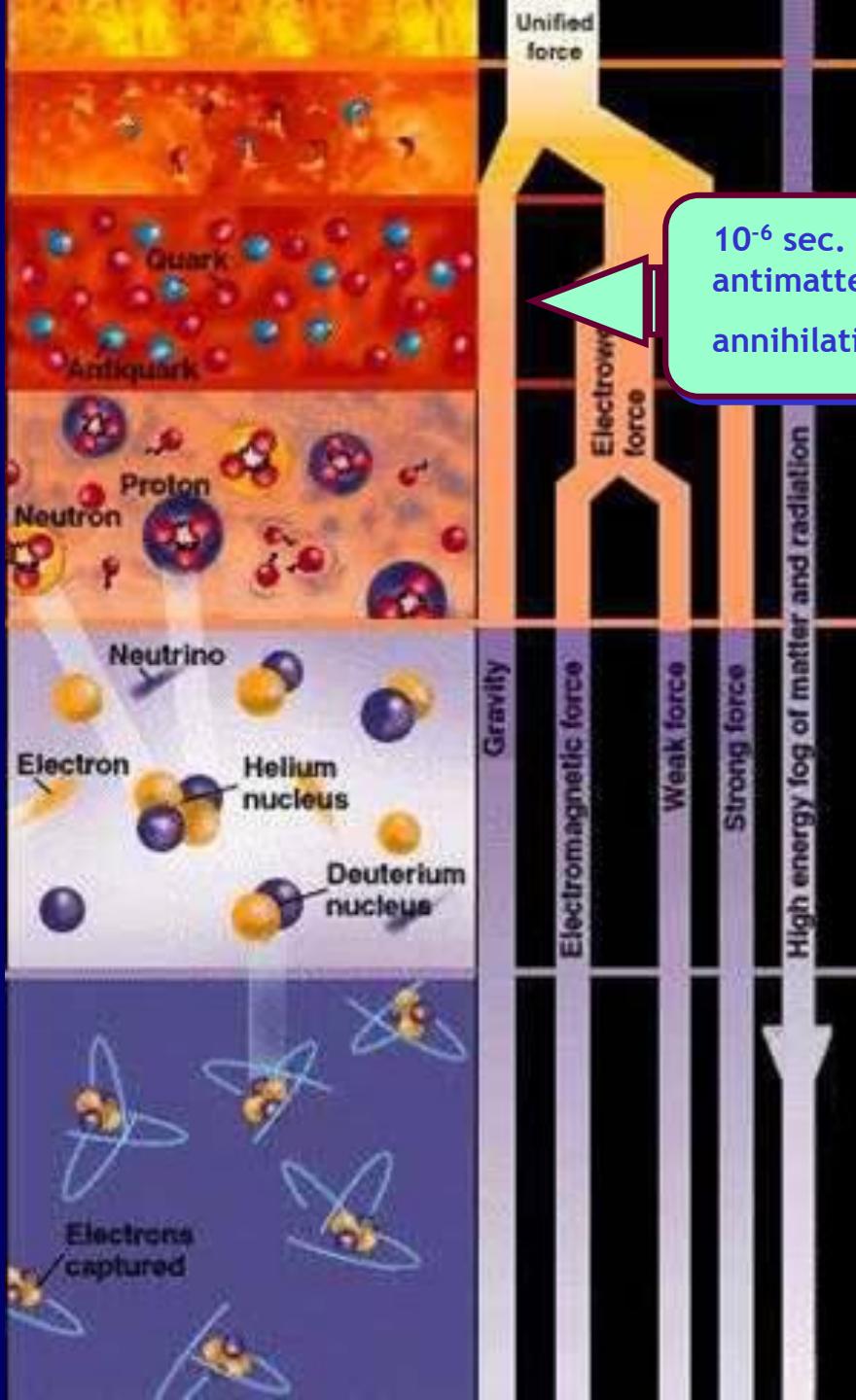


10^{-35} sec.

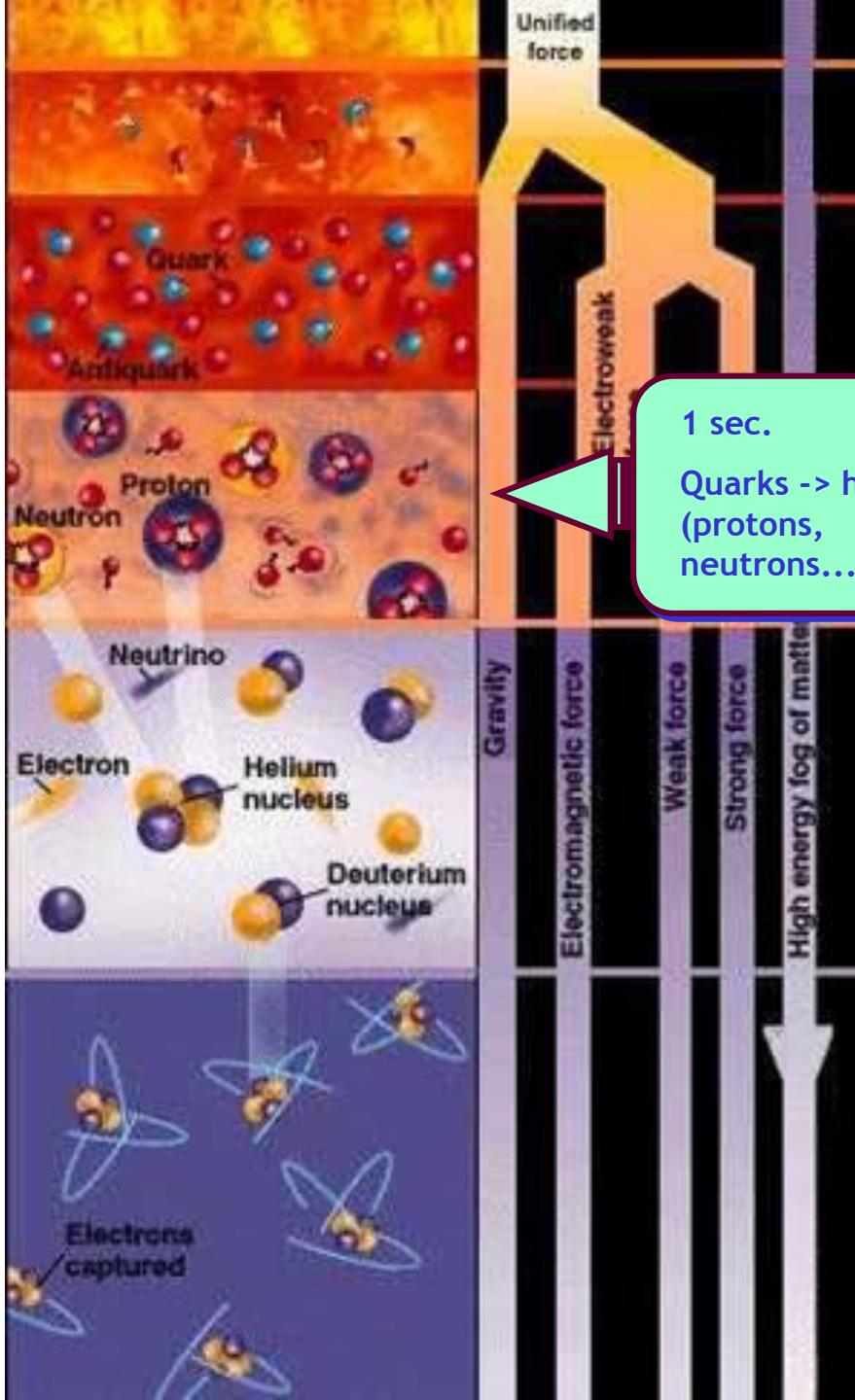
Inflation

Universe according to the inflation theory



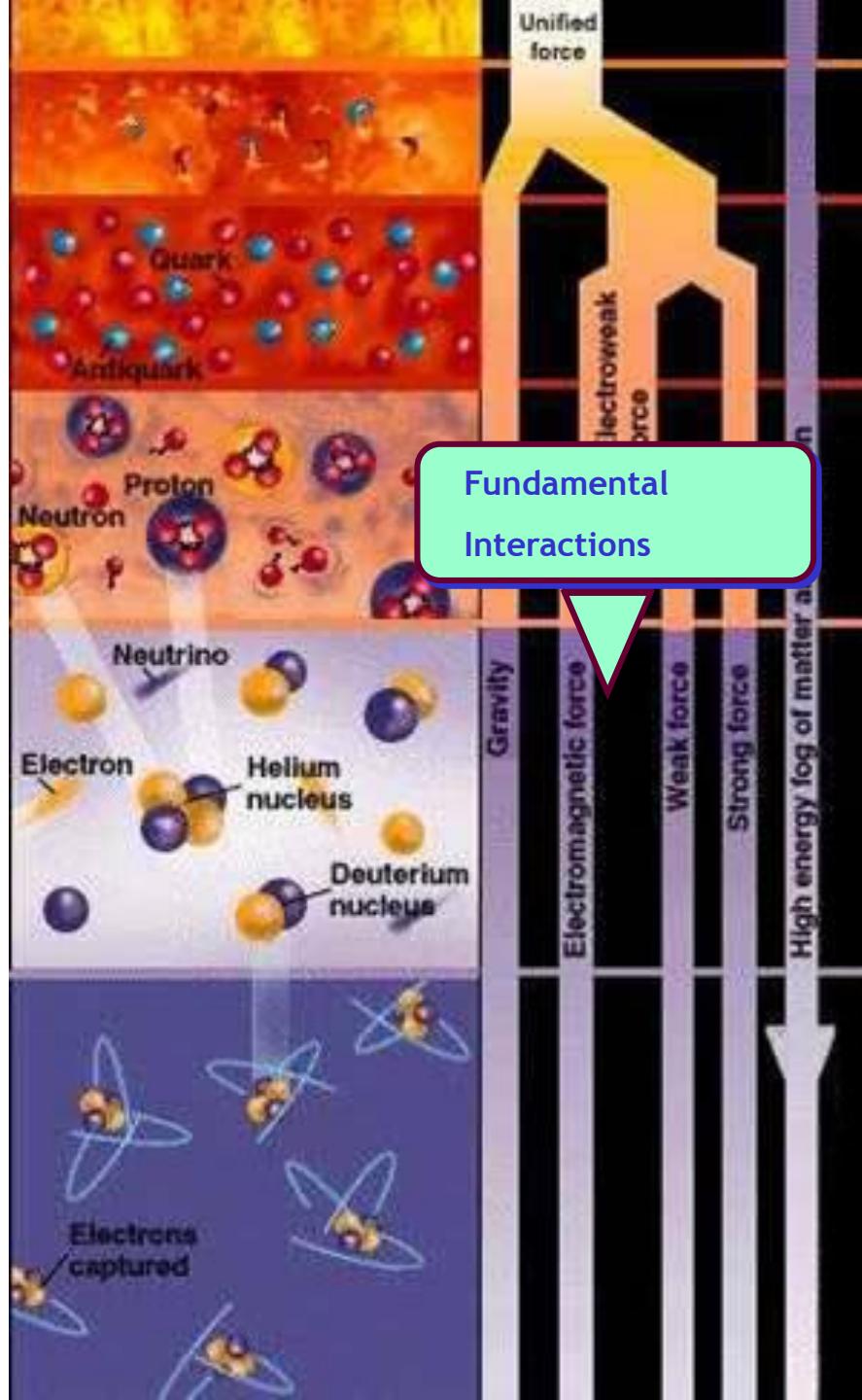


10⁻⁶ sec. Matter -
antimatter
annihilation

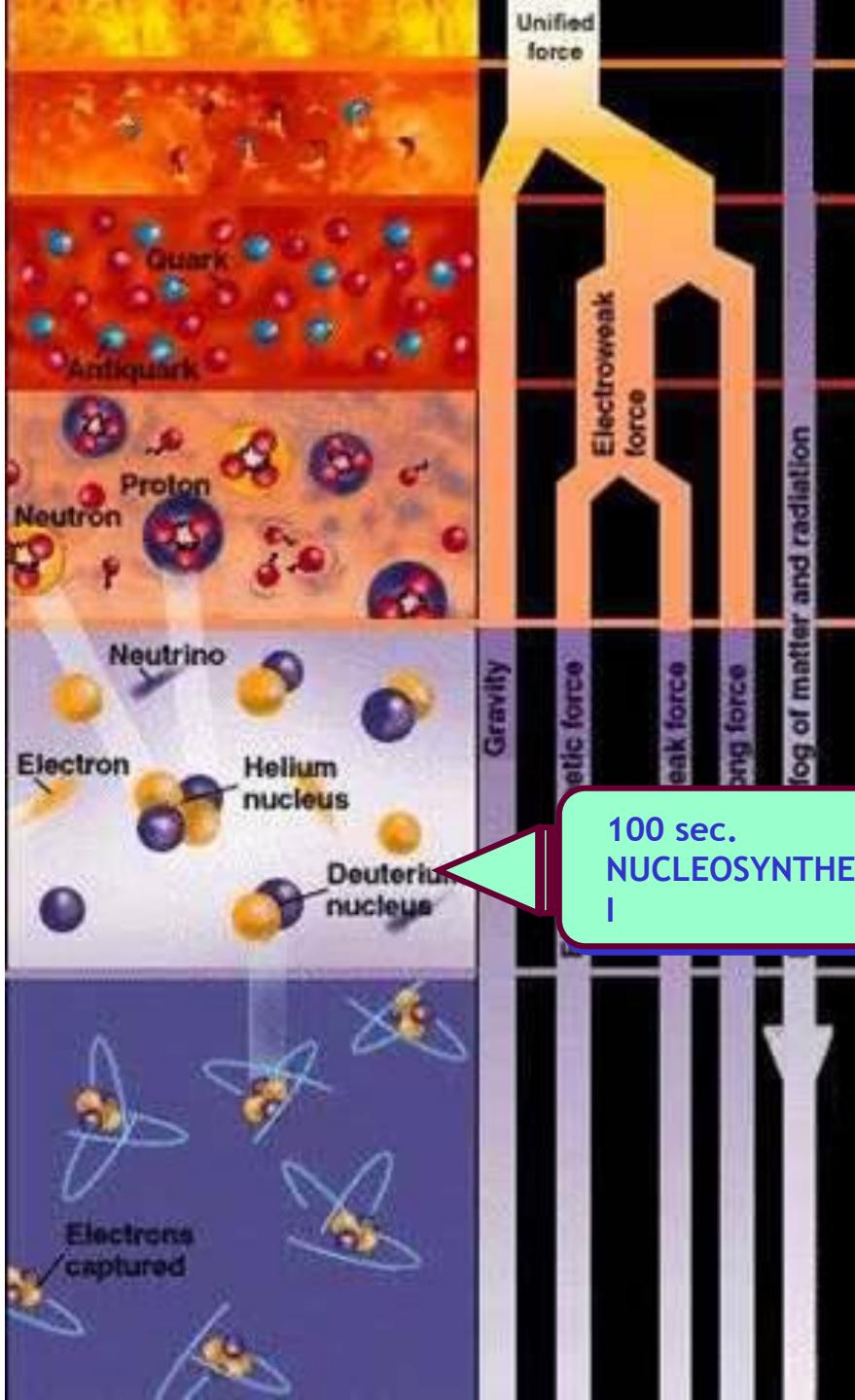


1 sec.

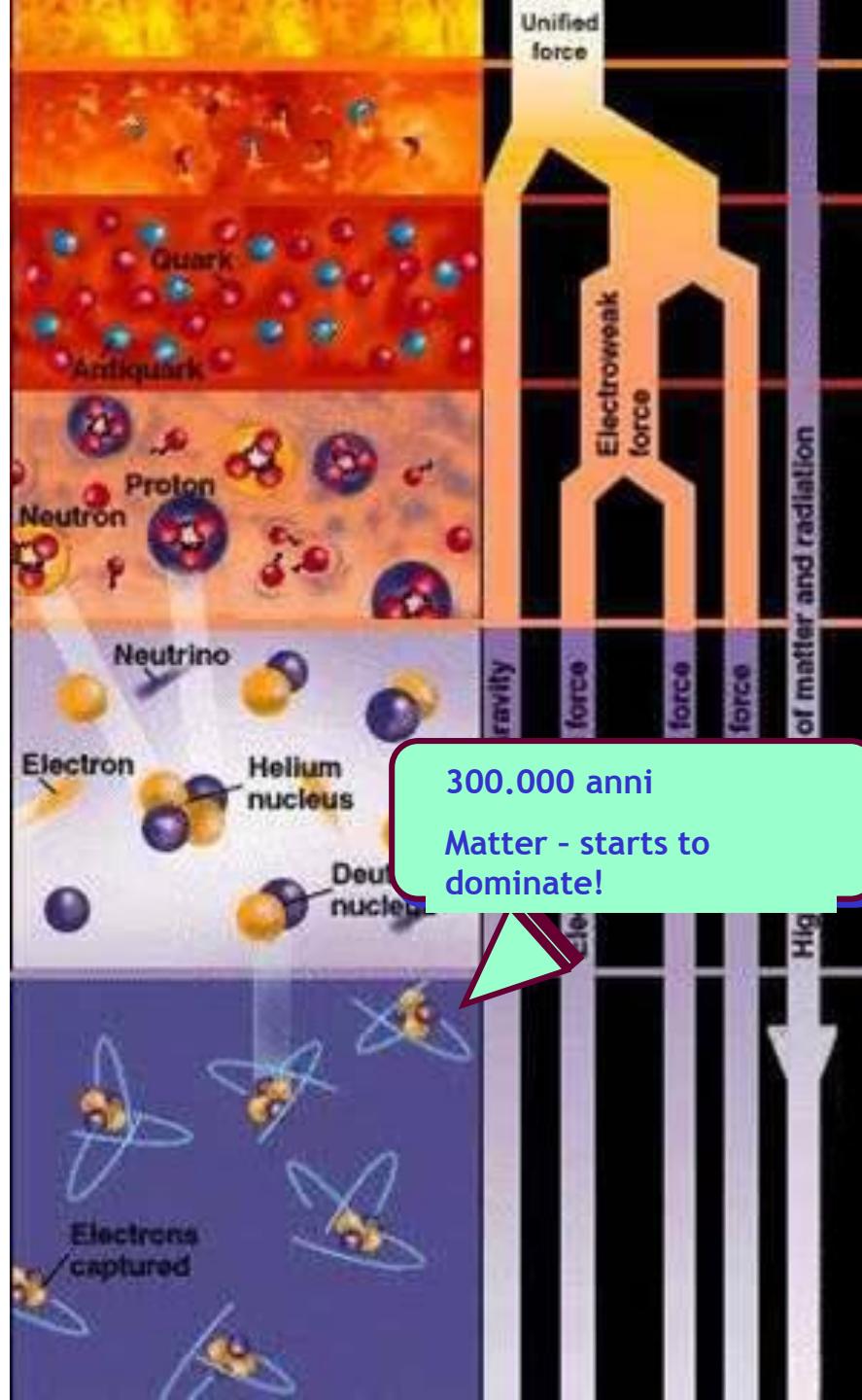
Quarks -> hadrons
(protons,
neutrons...)



Fundamental
Interactions

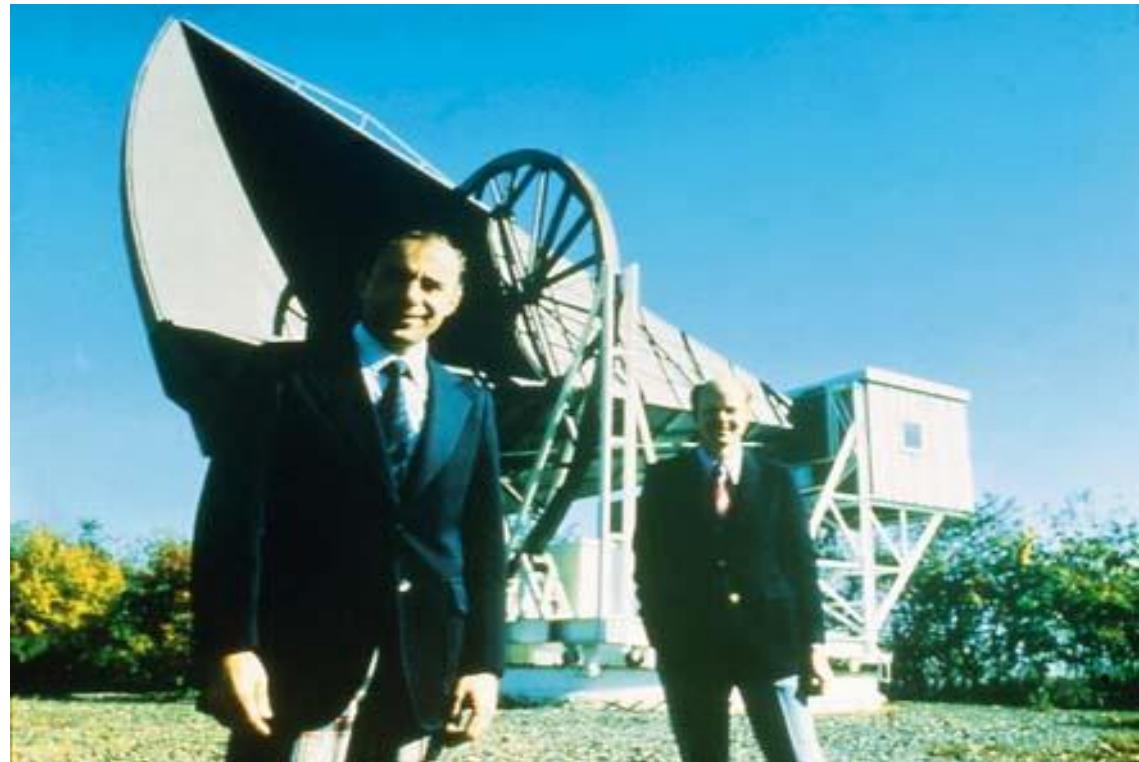


100 sec.
NUCLEOSYNTHESIS
I

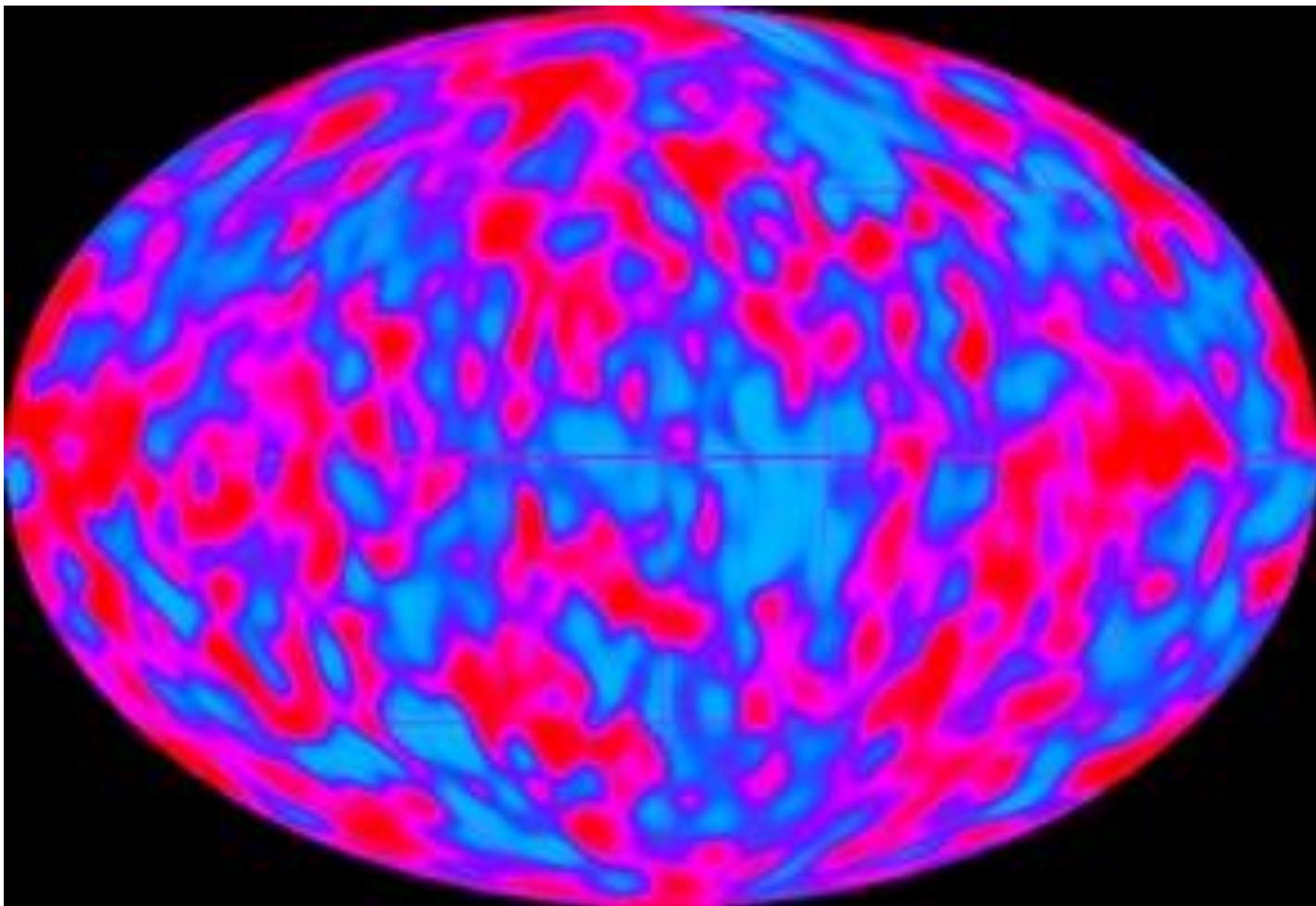


Cosmic Microwave Backgr. Radiation: “serendipity”

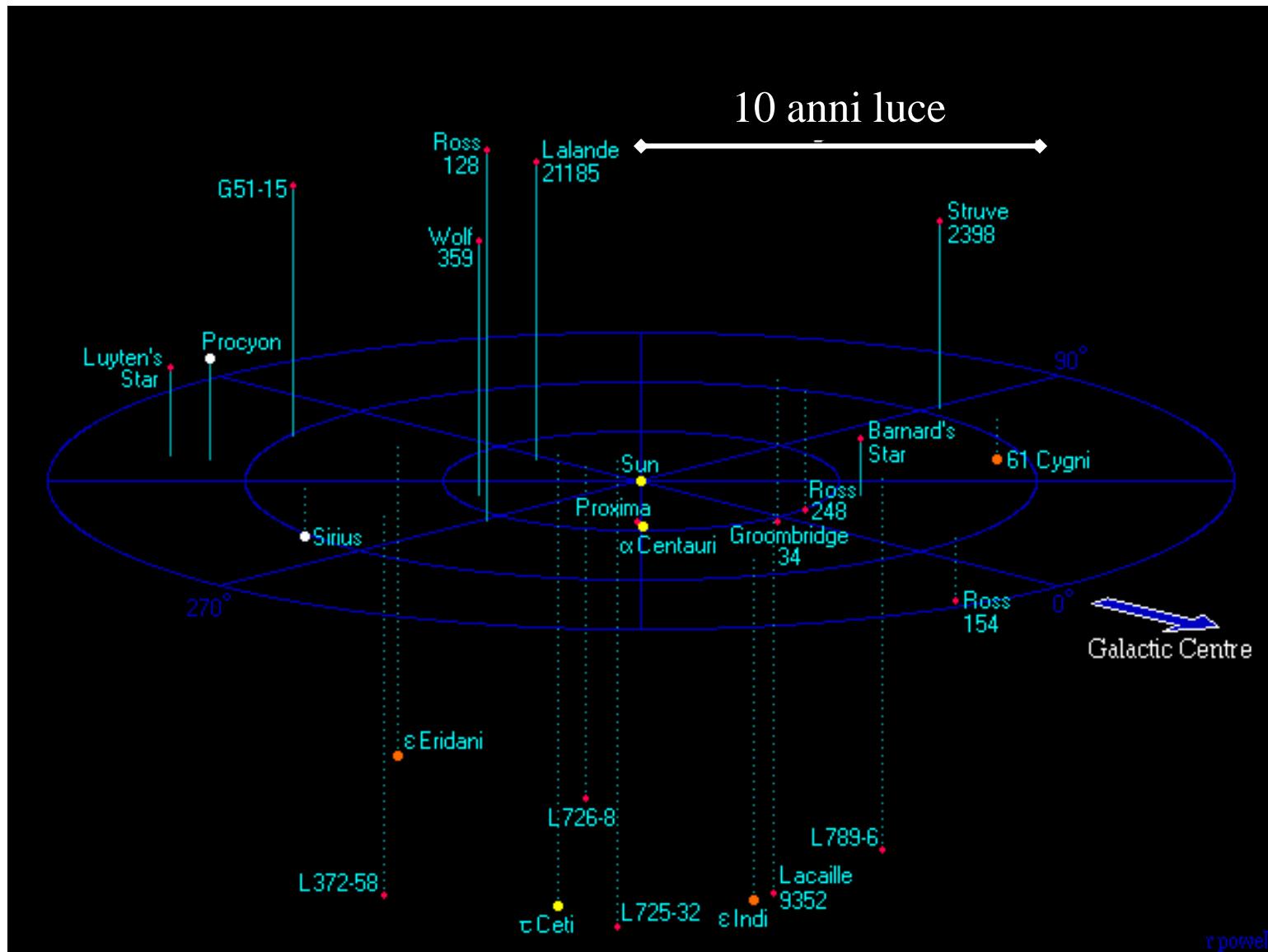
1964, Arno Penzias and
Robert Wilson,

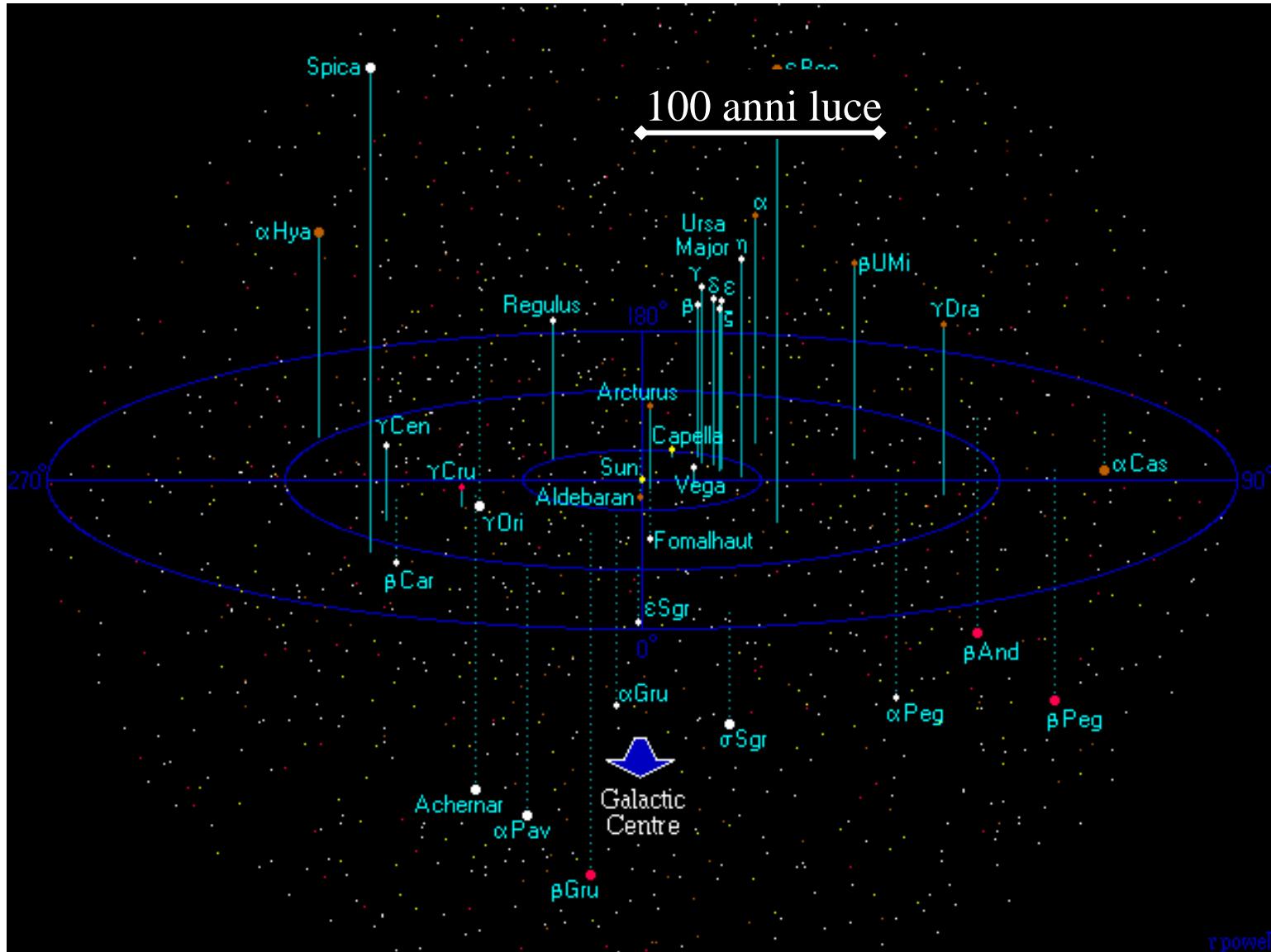


CMBR



COBE

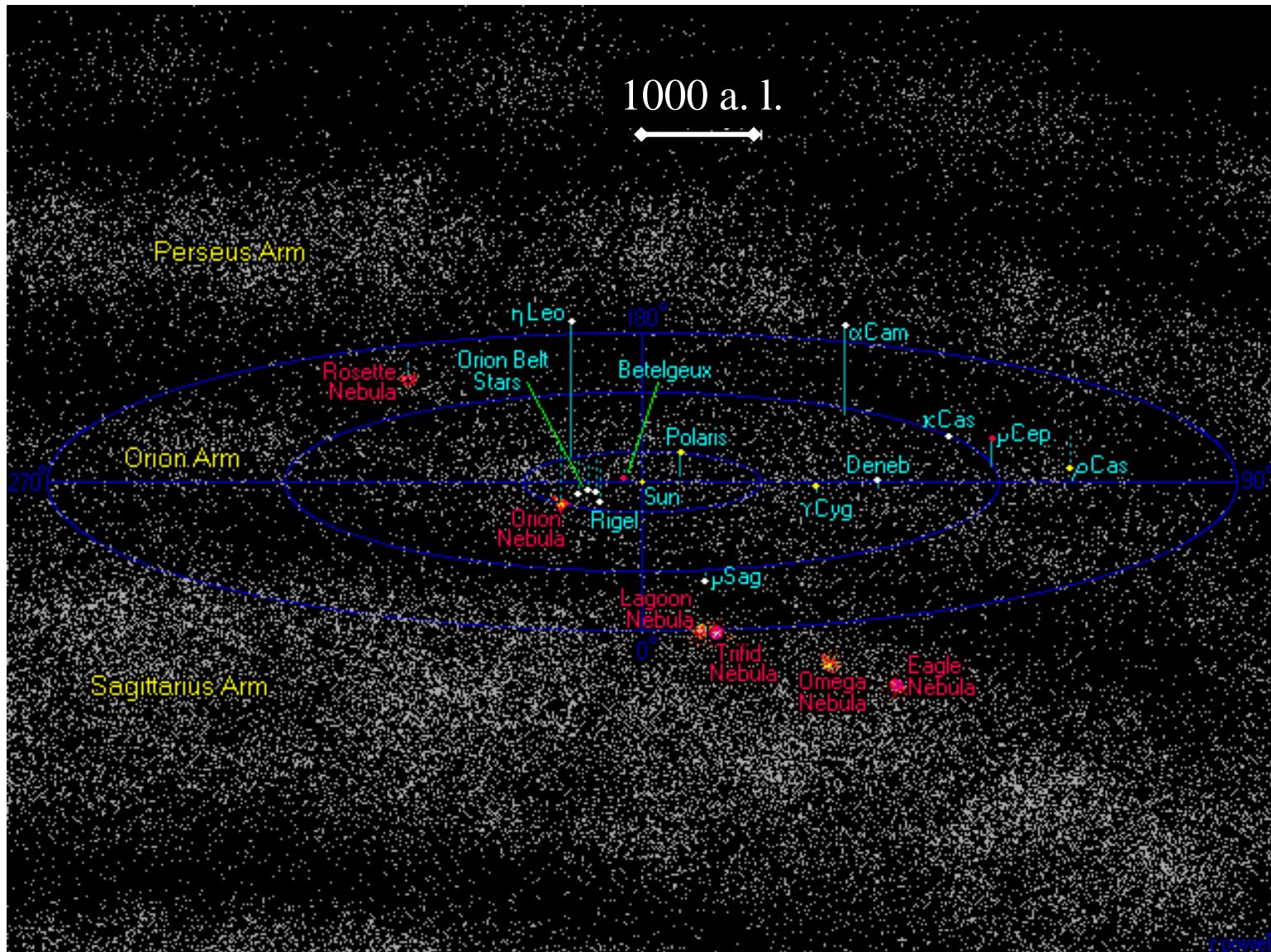




r powell

Zoom In x20

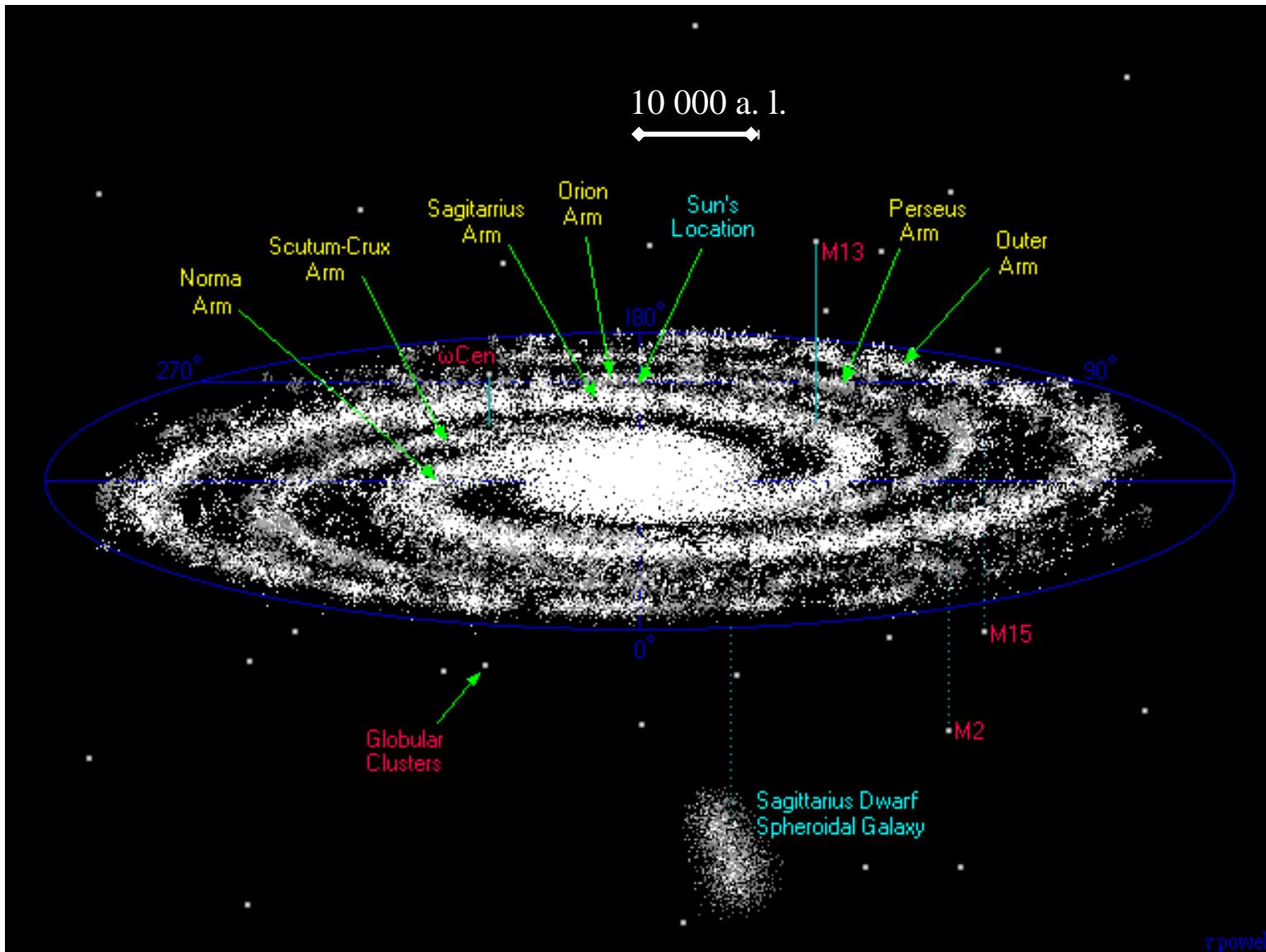
Zoom In x20



rpowell

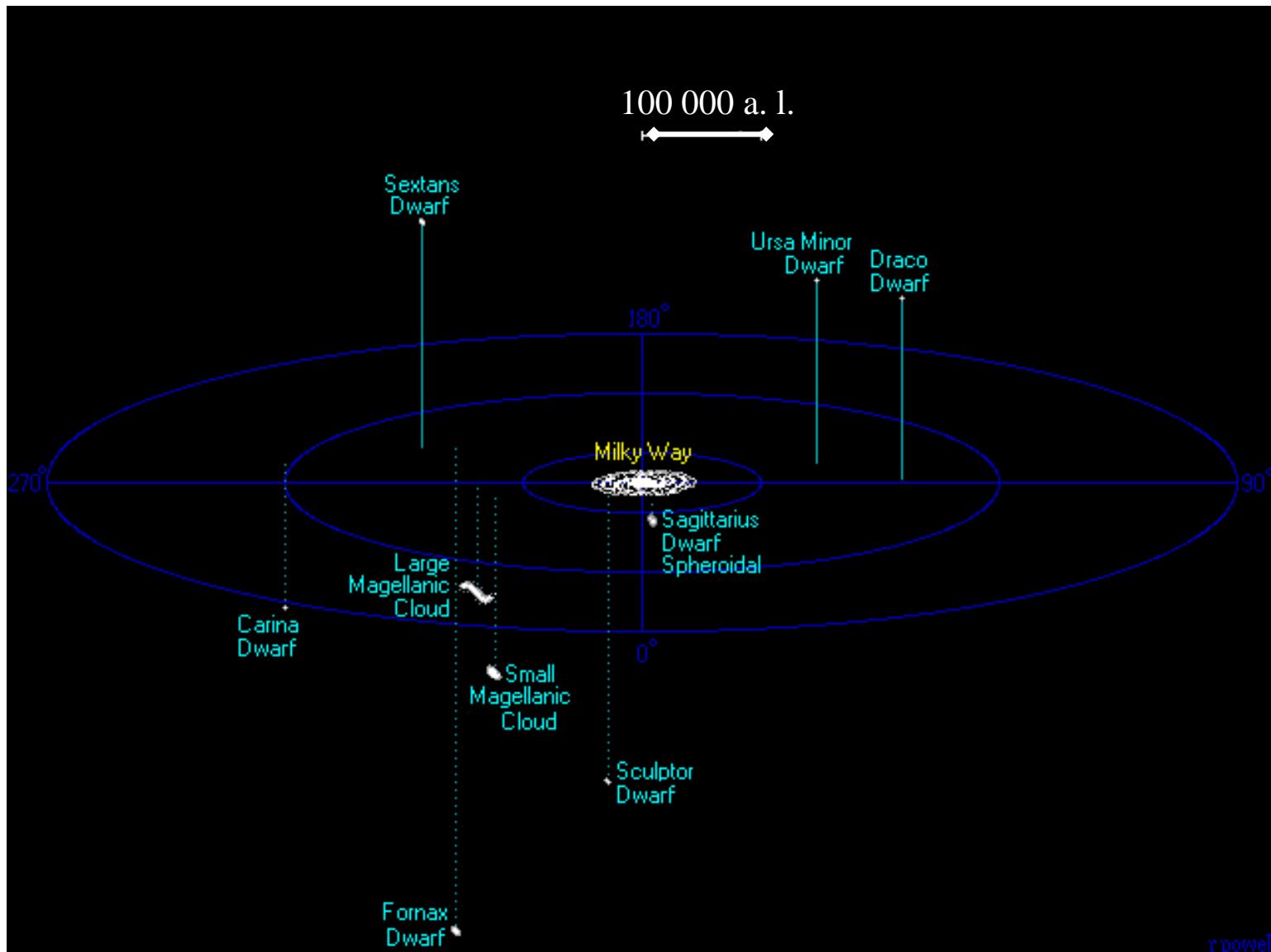
Zoom In x20

Zoom Out x10



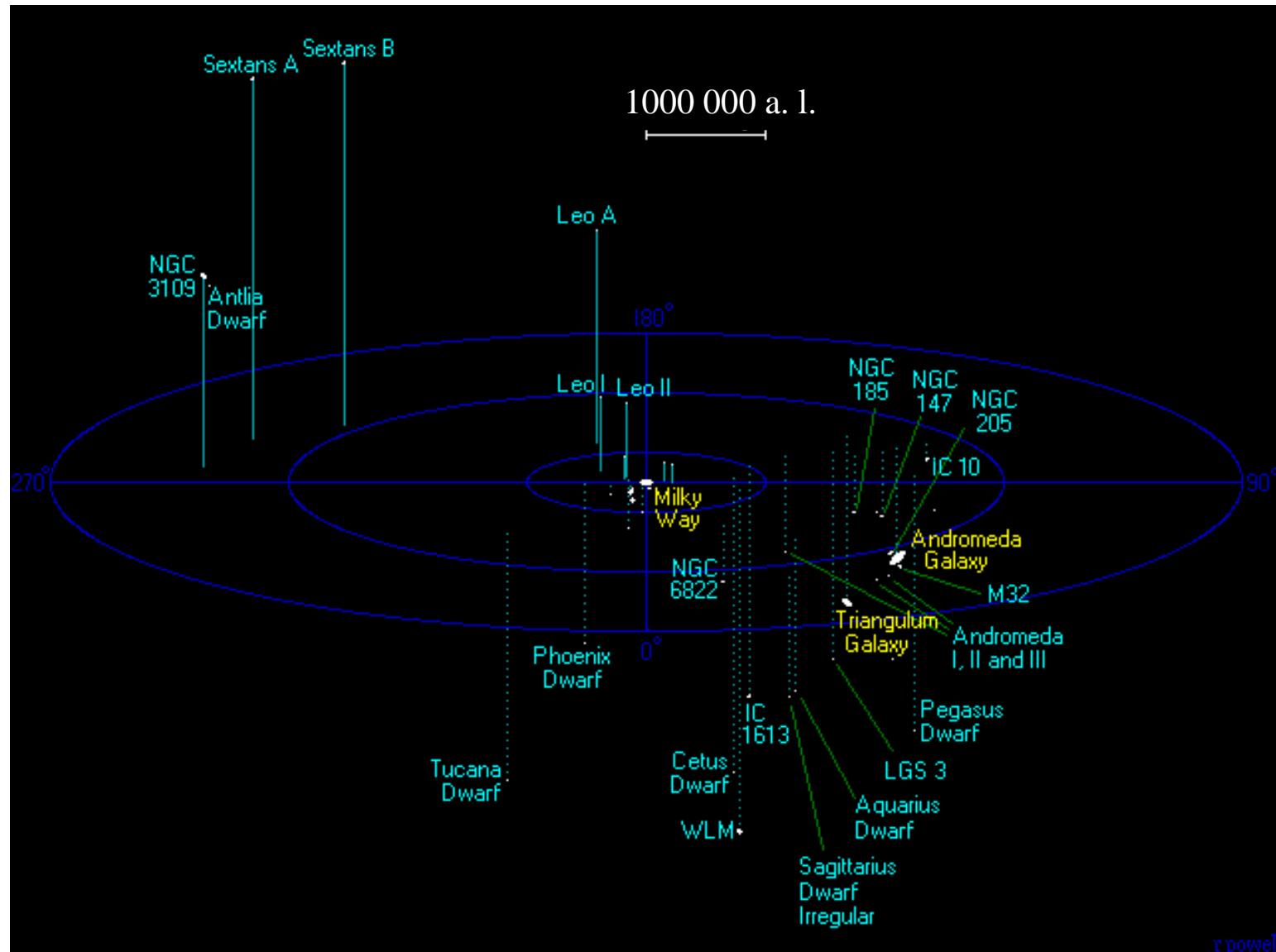
Zoom In x10

Zoom Out x10



Zoom In x10

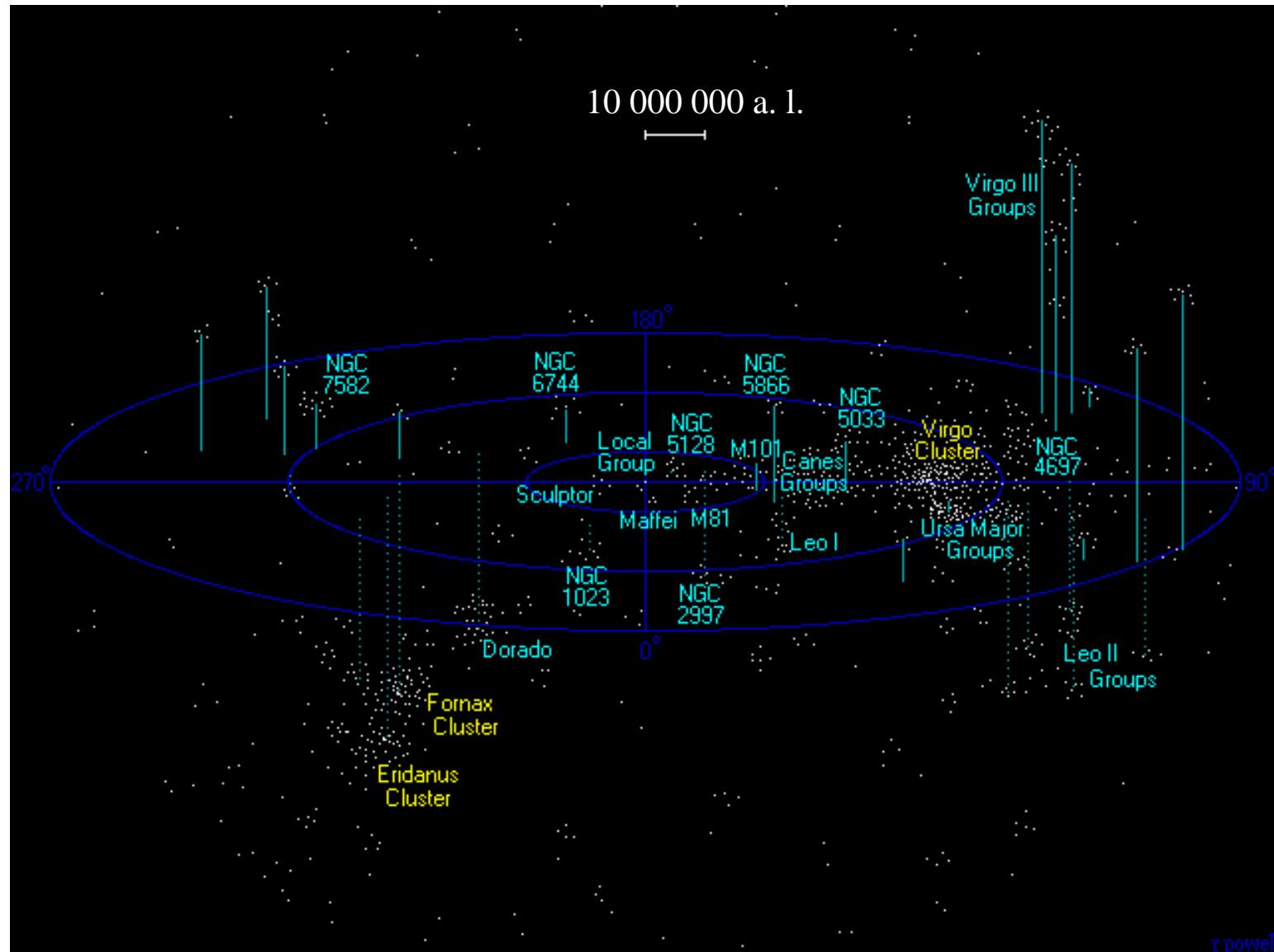
Zoom Out x10



rpowell

Zoom In x10

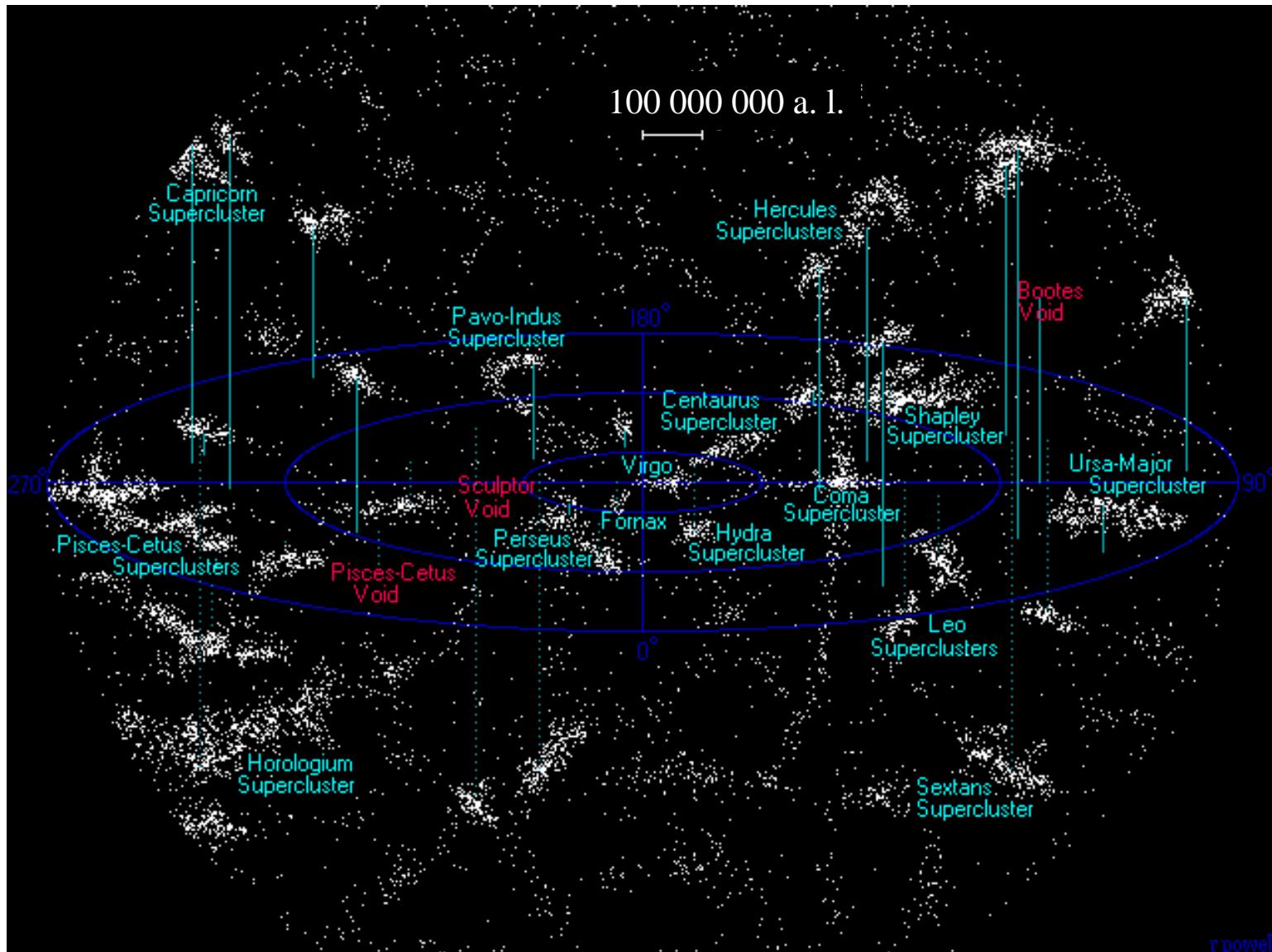
Zoom Out x20



rpowell

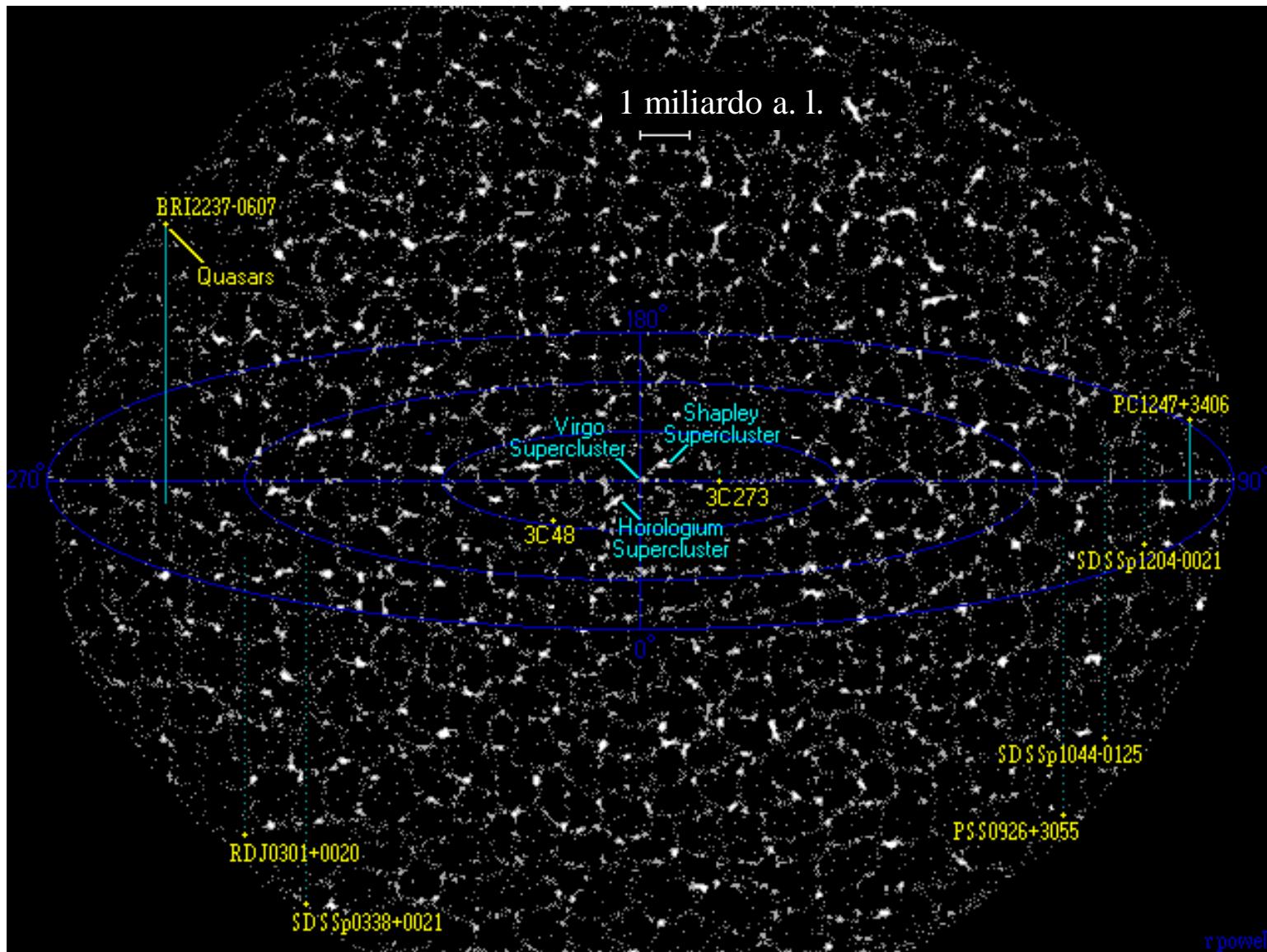
Zoom In x20

Zoom Out x10



Zoom In x10

Zoom Out x15



Zoom In x15

Spiral Galaxies



Elliptical galaxies



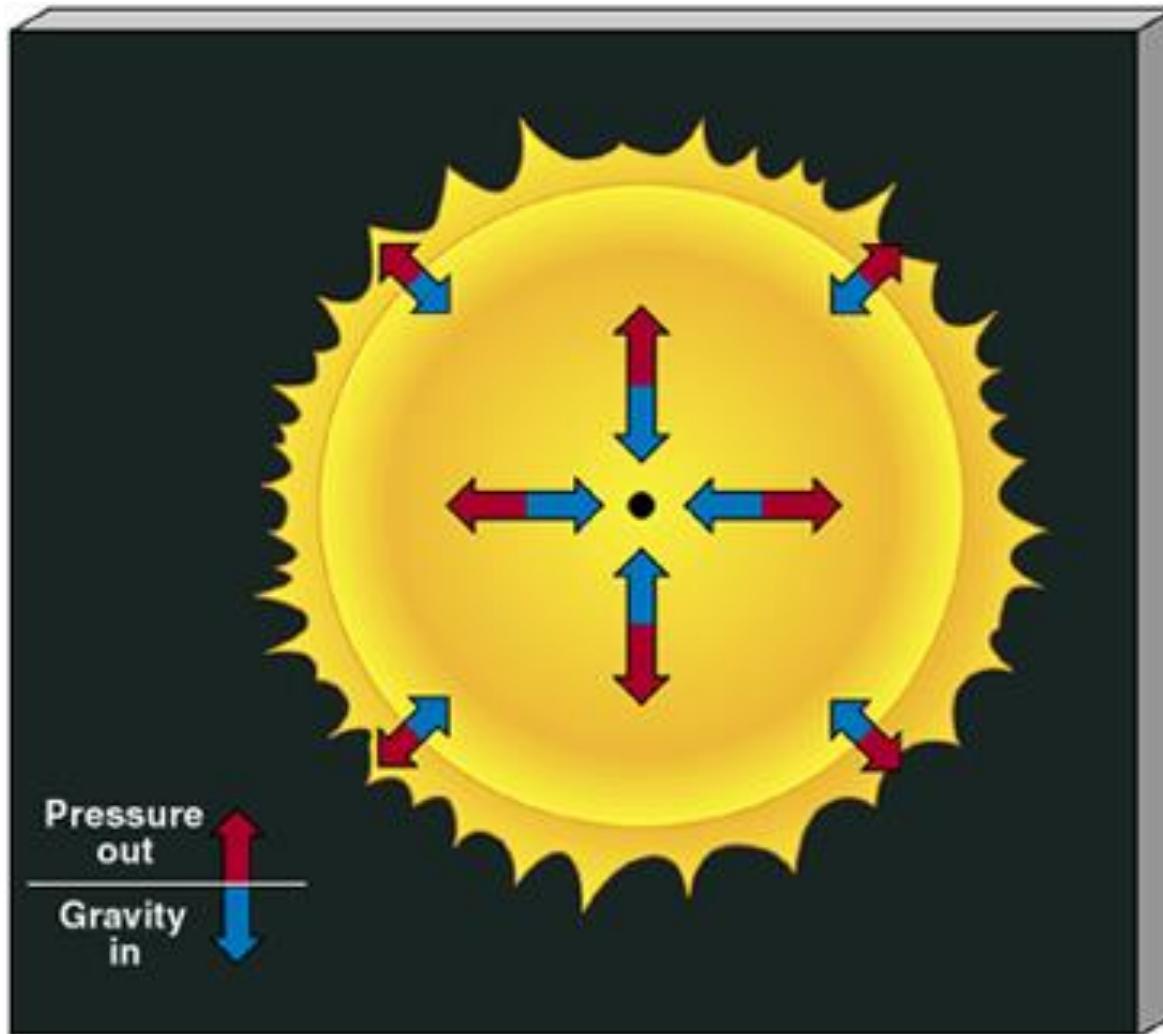
Lens-type galaxies

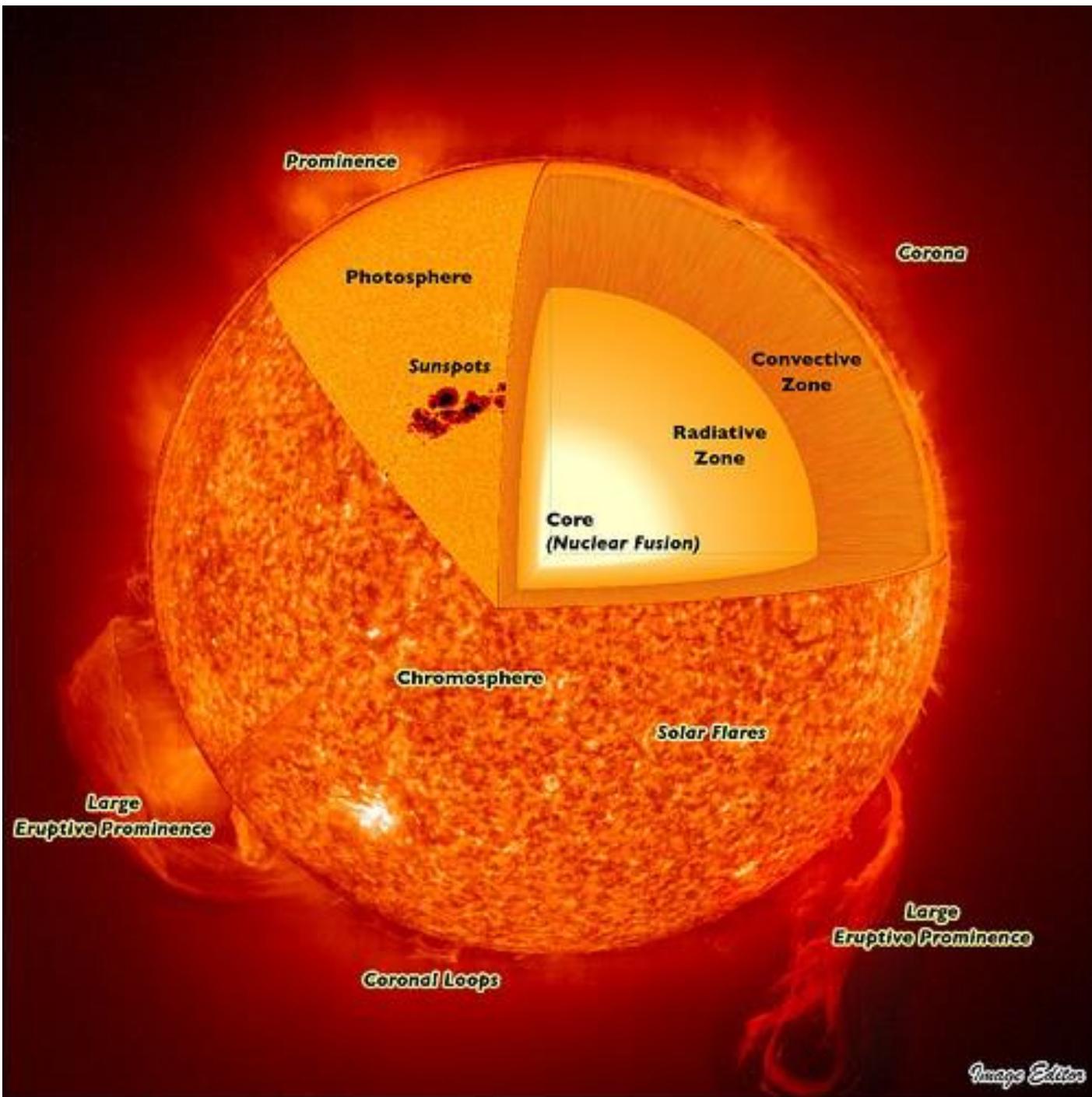


Irregular shape galaxies

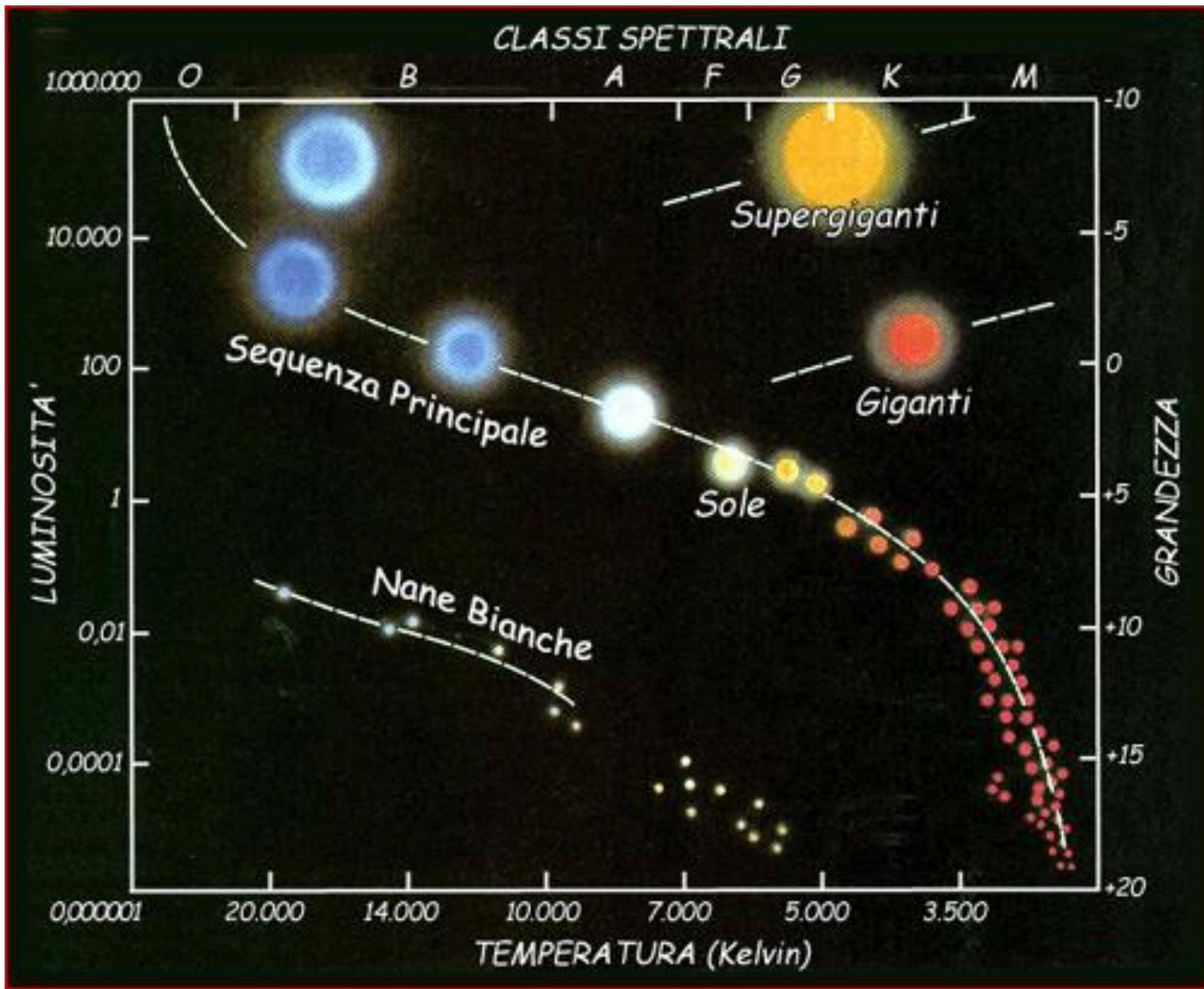


Star - equilibrium (gravity and nuclear reactions)





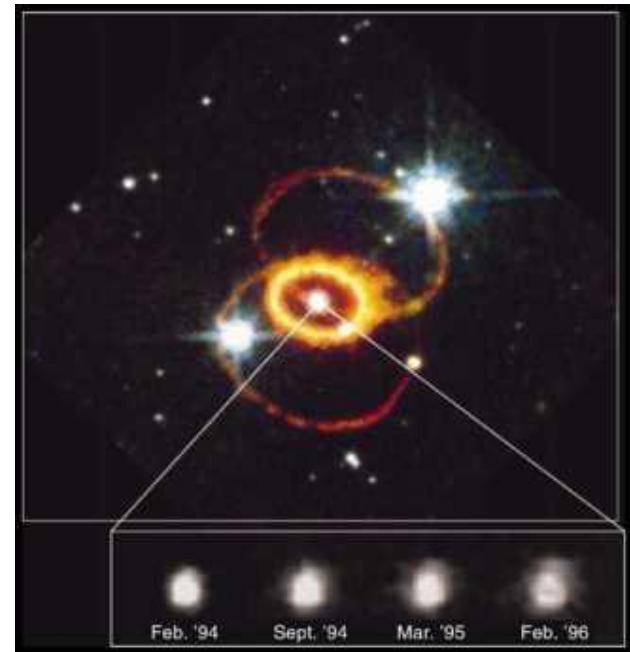




Supernova explosion

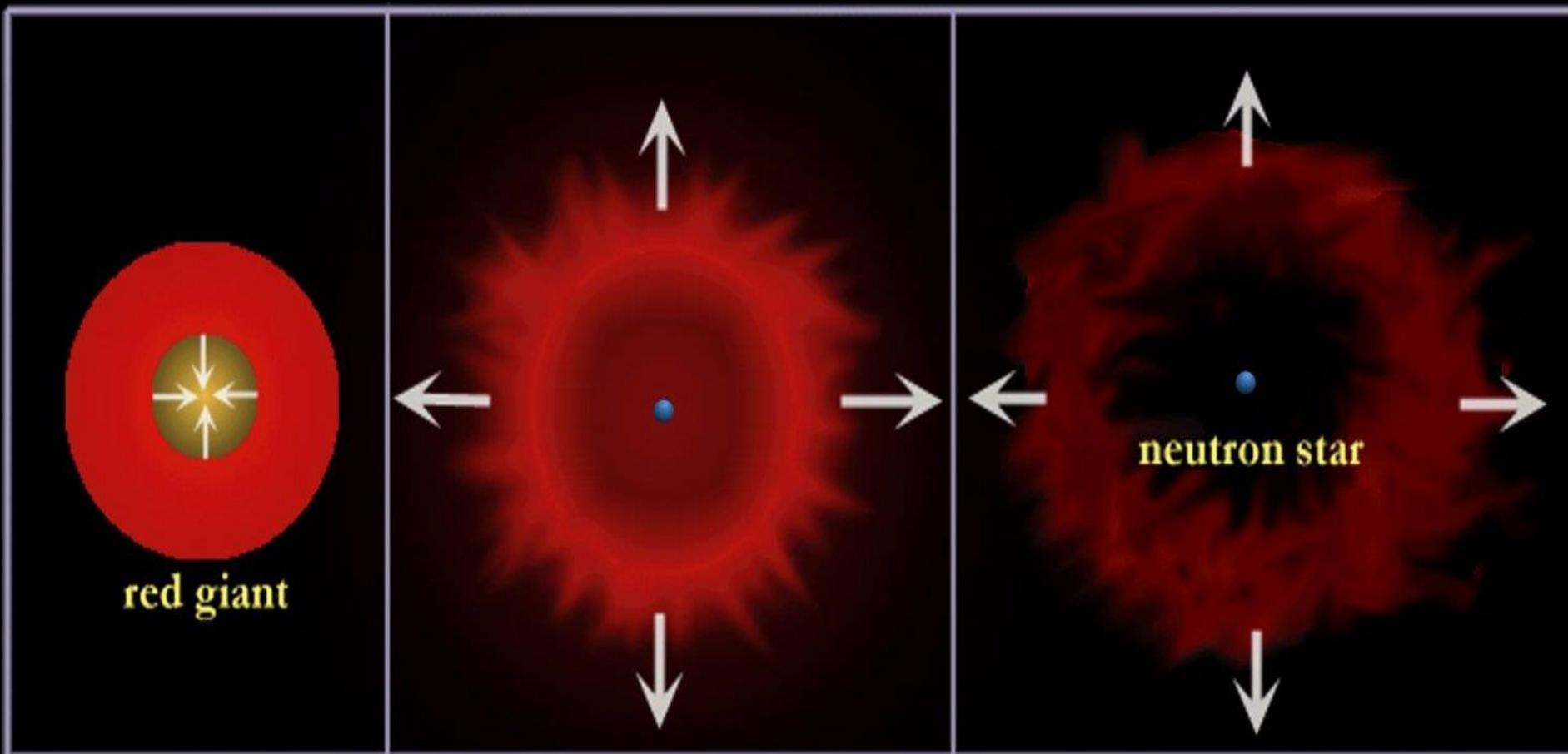


SN 1987A

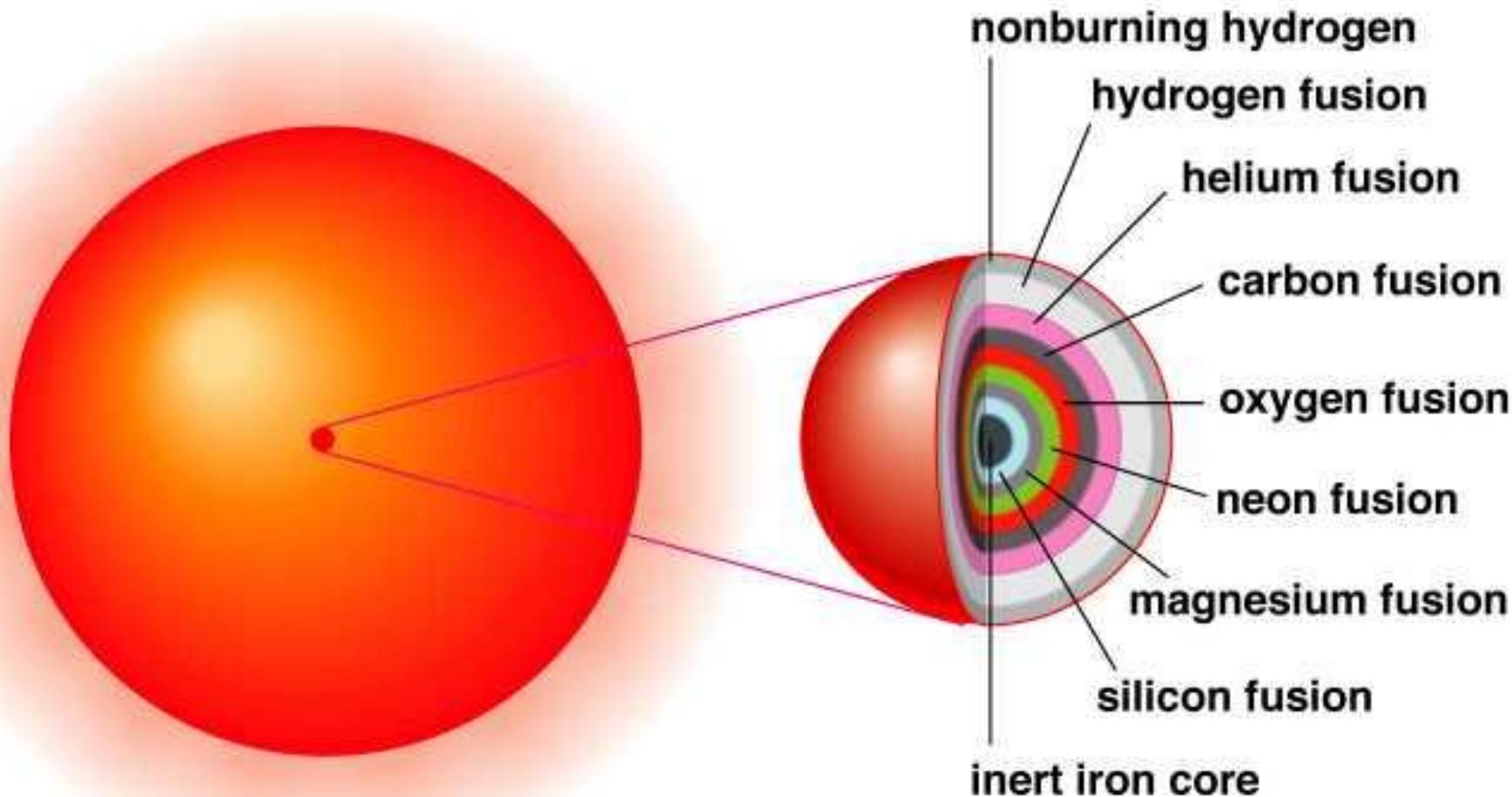


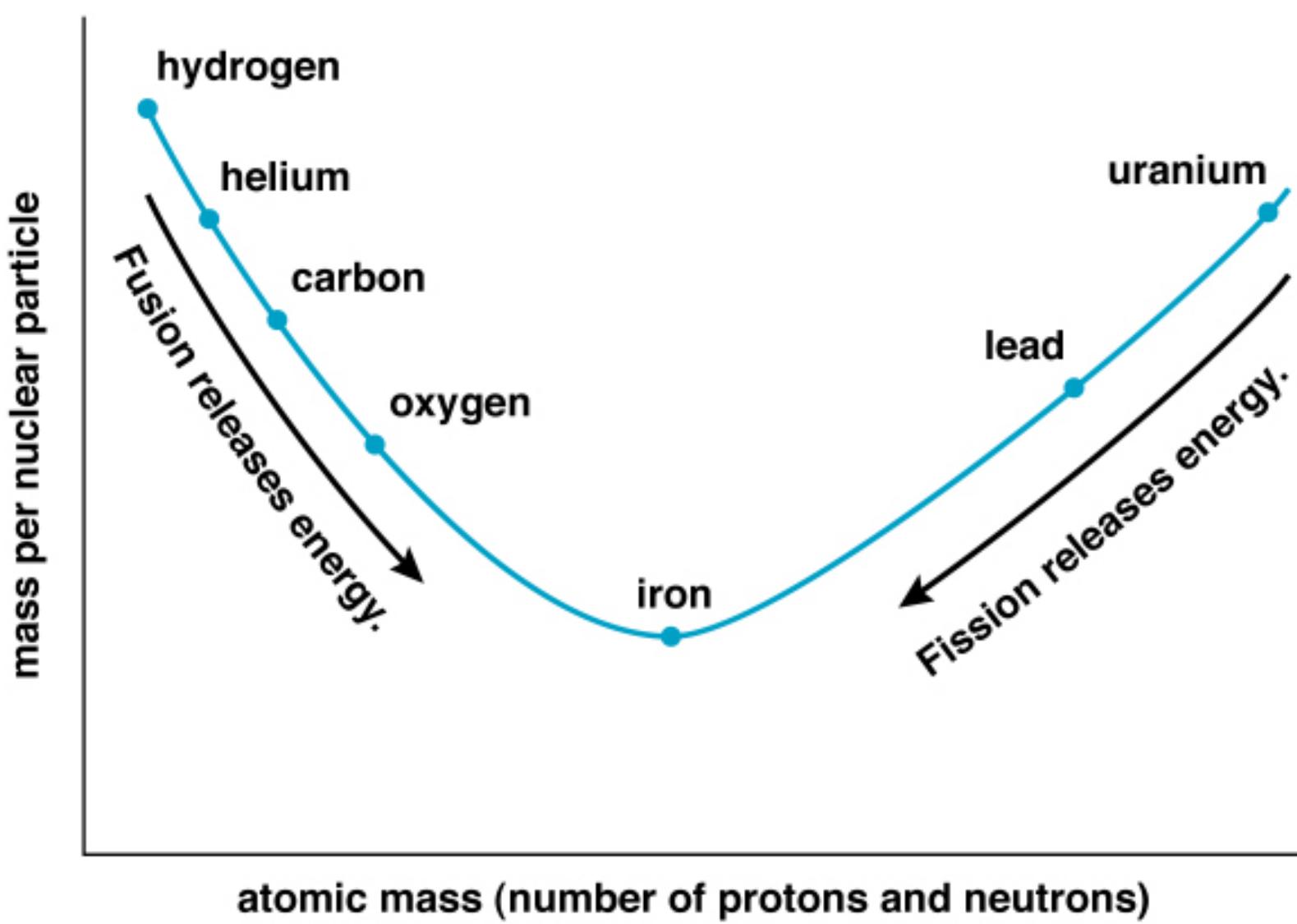
Birth of a Neutron Star and Supernova Remnant

(not to scale)

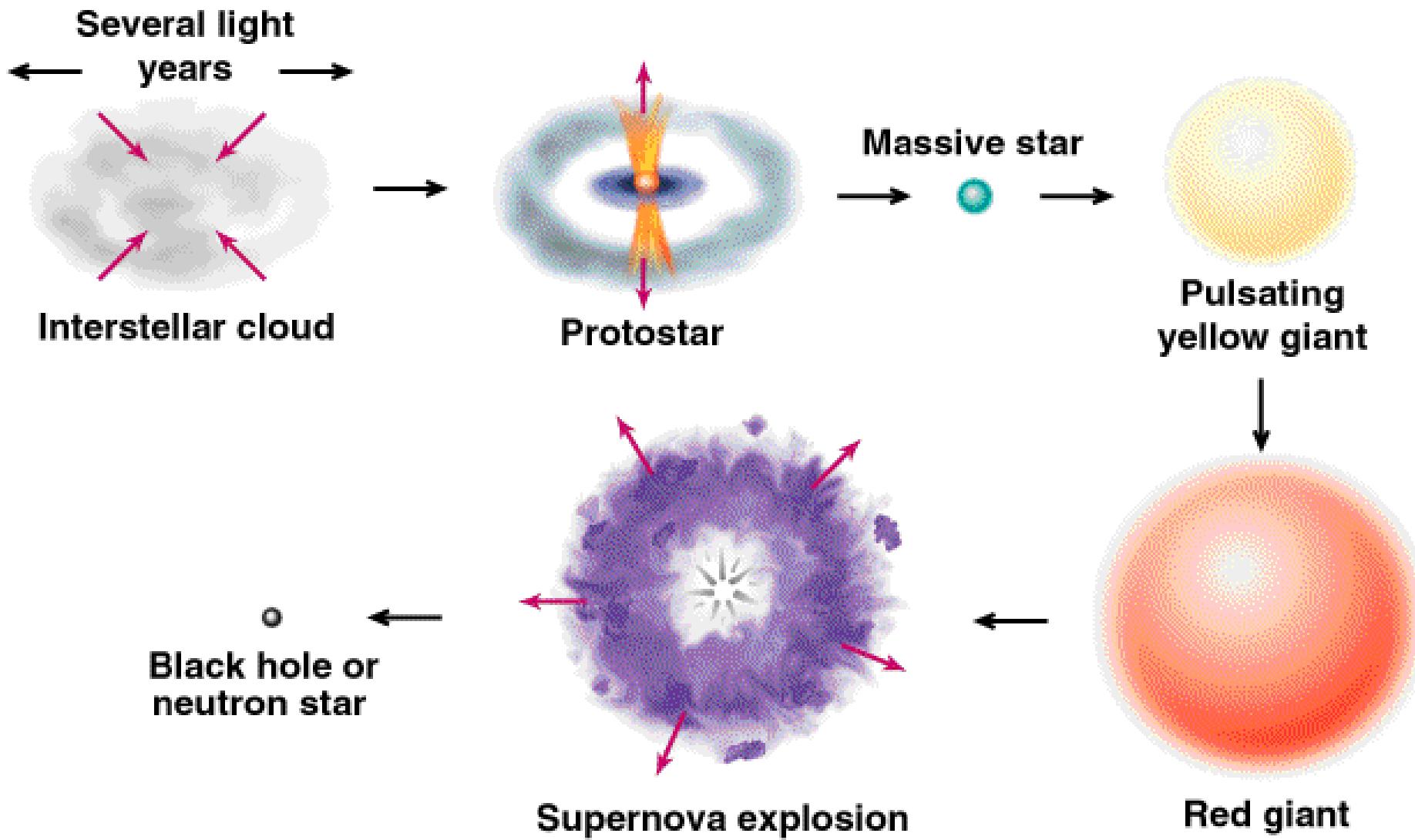


Core Implosion → Supernova Explosion → Supernova Remnant





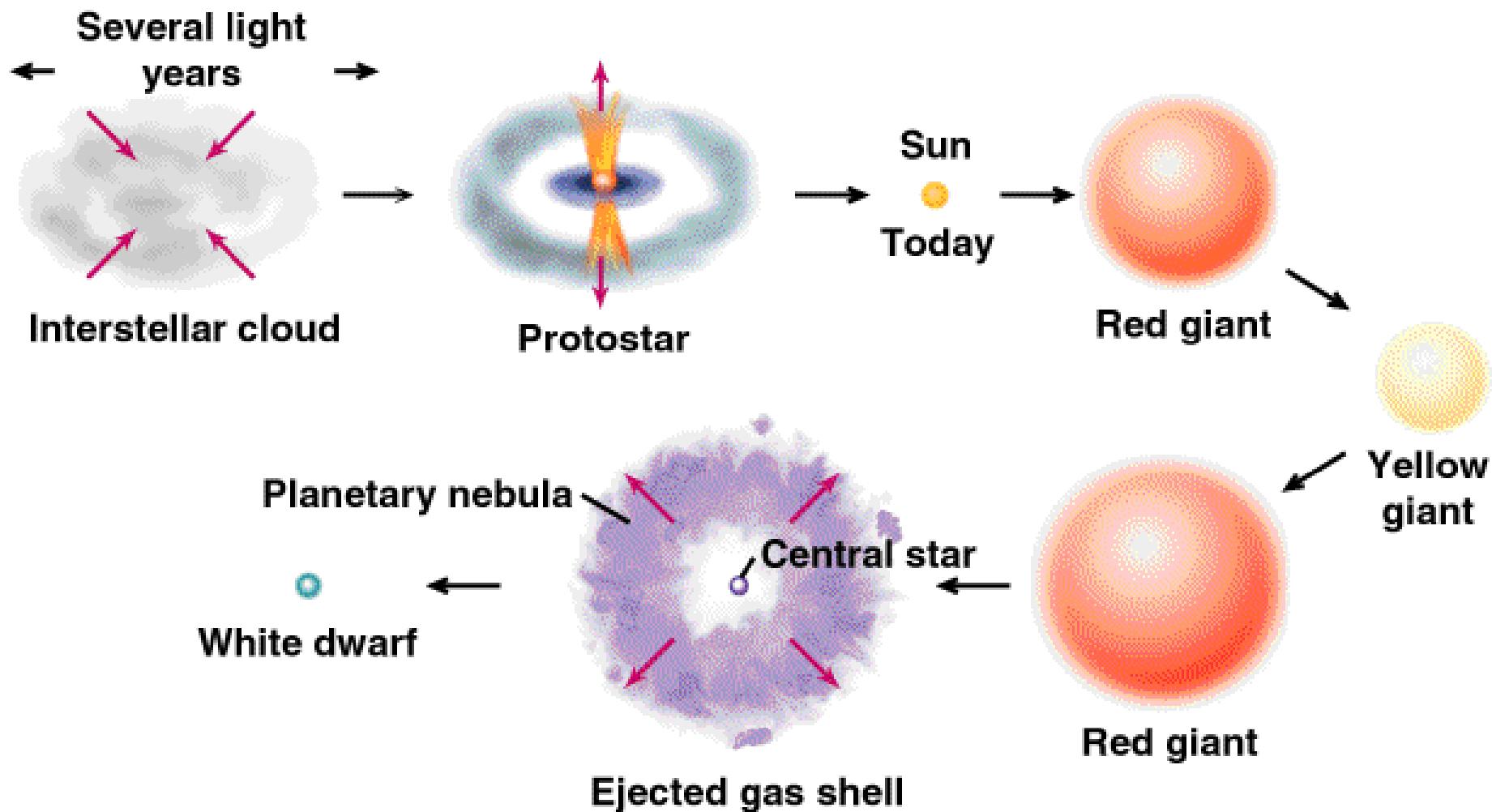
Life of a High Mass Star



What about the Sun?



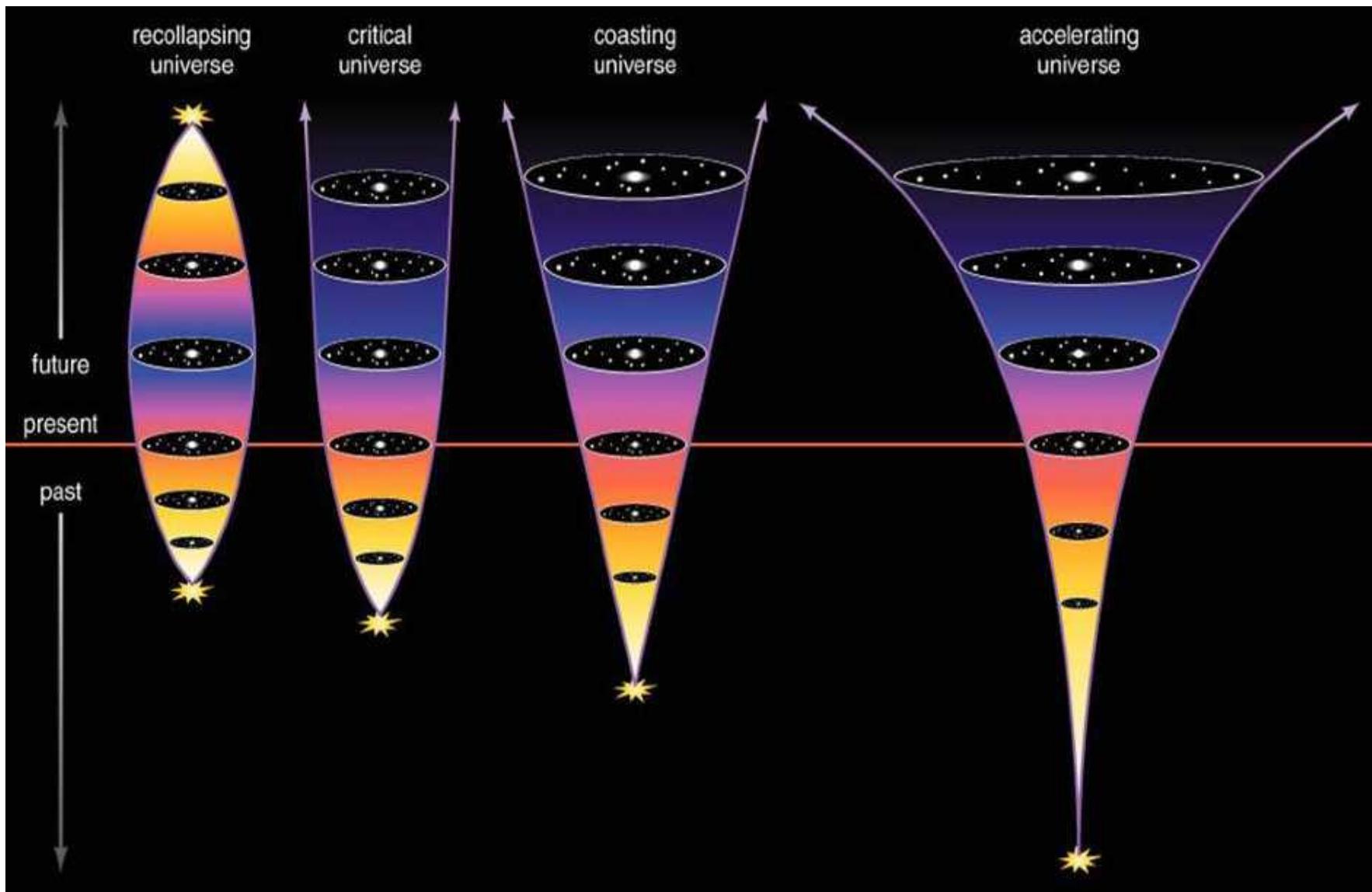
Life of the Sun

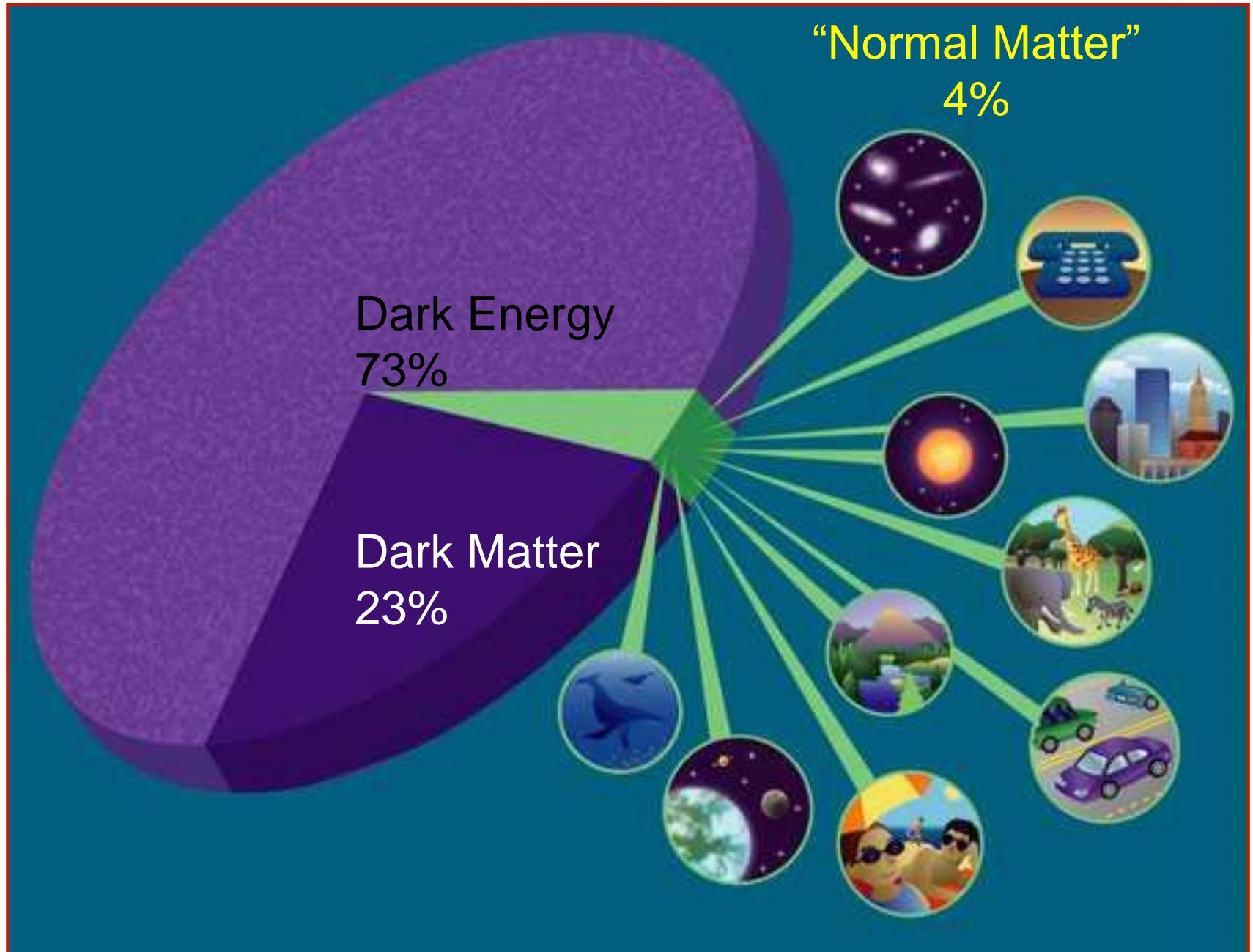


*What is the fate of such new formed elements ??
they will form second generation stars, such as
the Sun,
solar systems and ourselves !!*

*This is the deep meaning of the sentence:
“ we are stardust”*

Cosmological models





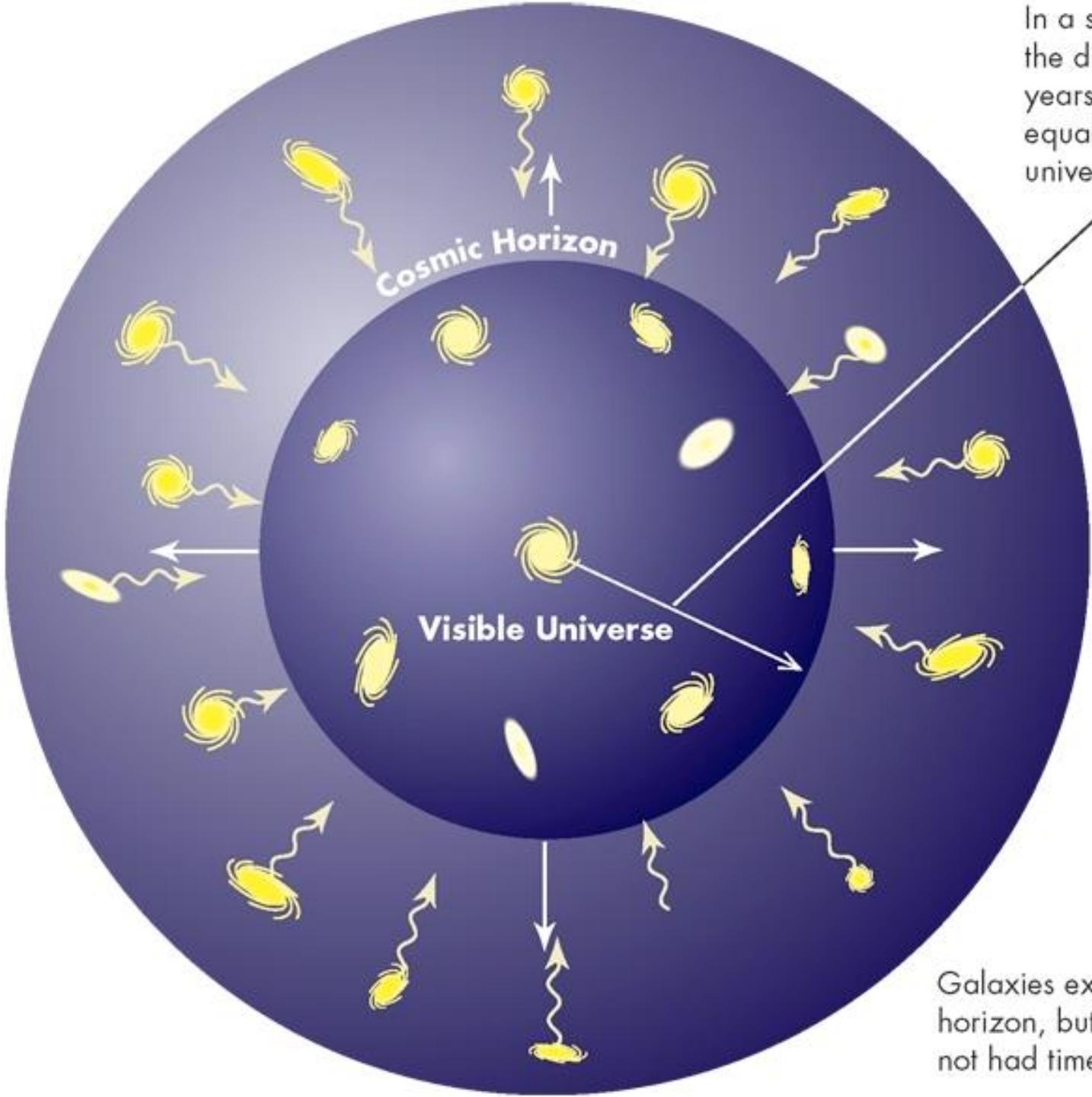
Parallel Universes?



First type of P.U.

The Universe is infinite!

Our Universe can....be repreated!

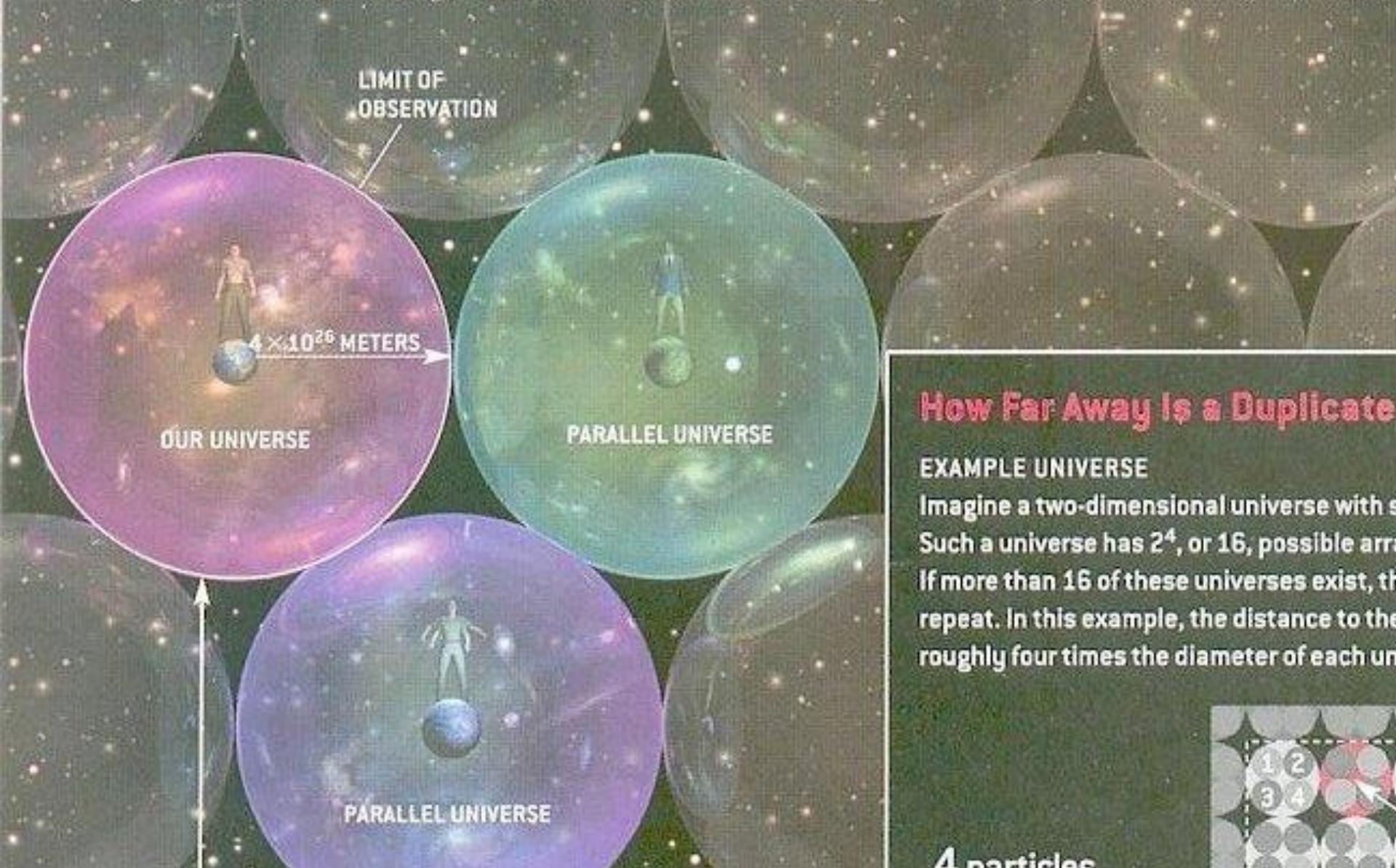


In a static universe,
the distance in light-
years to the horizon
equals age of
universe in years.

Galaxies exist beyond the
horizon, but their light has
not had time to reach us.

THE SIMPLEST TYPE of parallel universe is simply a region of space that is too far away for us to have seen yet. The farthest that we can observe is currently about 4×10^{26} meters, or 42 billion light-years—the distance that light has been able to travel since the big

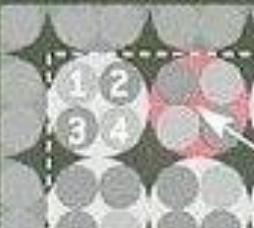
bang began. [The distance is greater than because cosmic expansion has lengthened Level I parallel universes is basically the differences stem from variations in the ini



How Far Away Is a Duplicate?

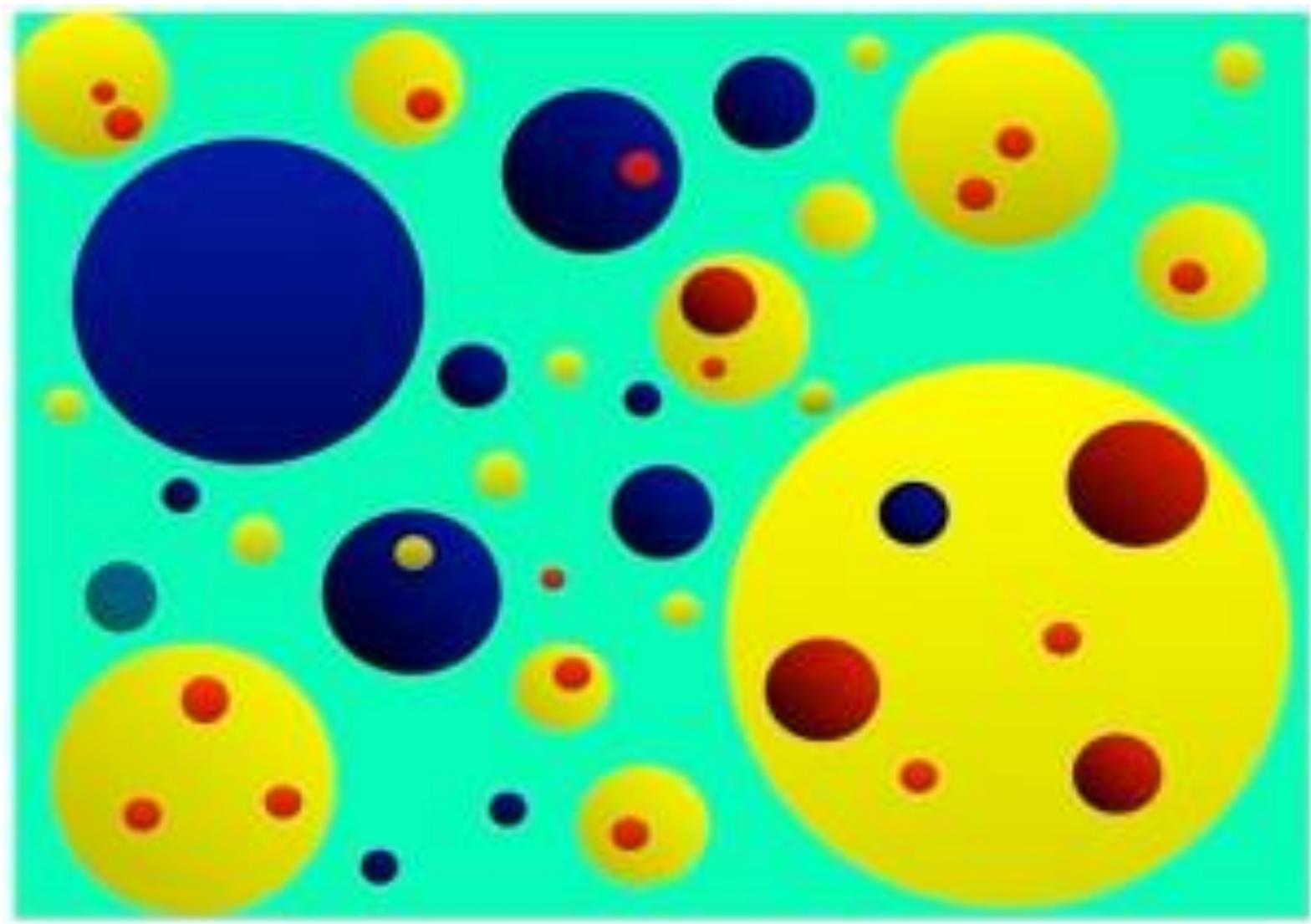
EXAMPLE UNIVERSE

Imagine a two-dimensional universe with 4×10^{26} meters. Such a universe has 2^4 , or 16, possible arrangements of particles. If more than 16 of these universes exist, they repeat. In this example, the distance to the nearest duplicate is roughly four times the diameter of each universe.

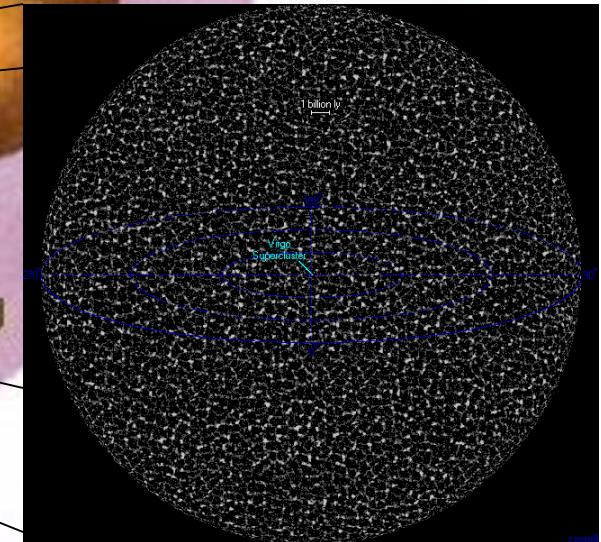
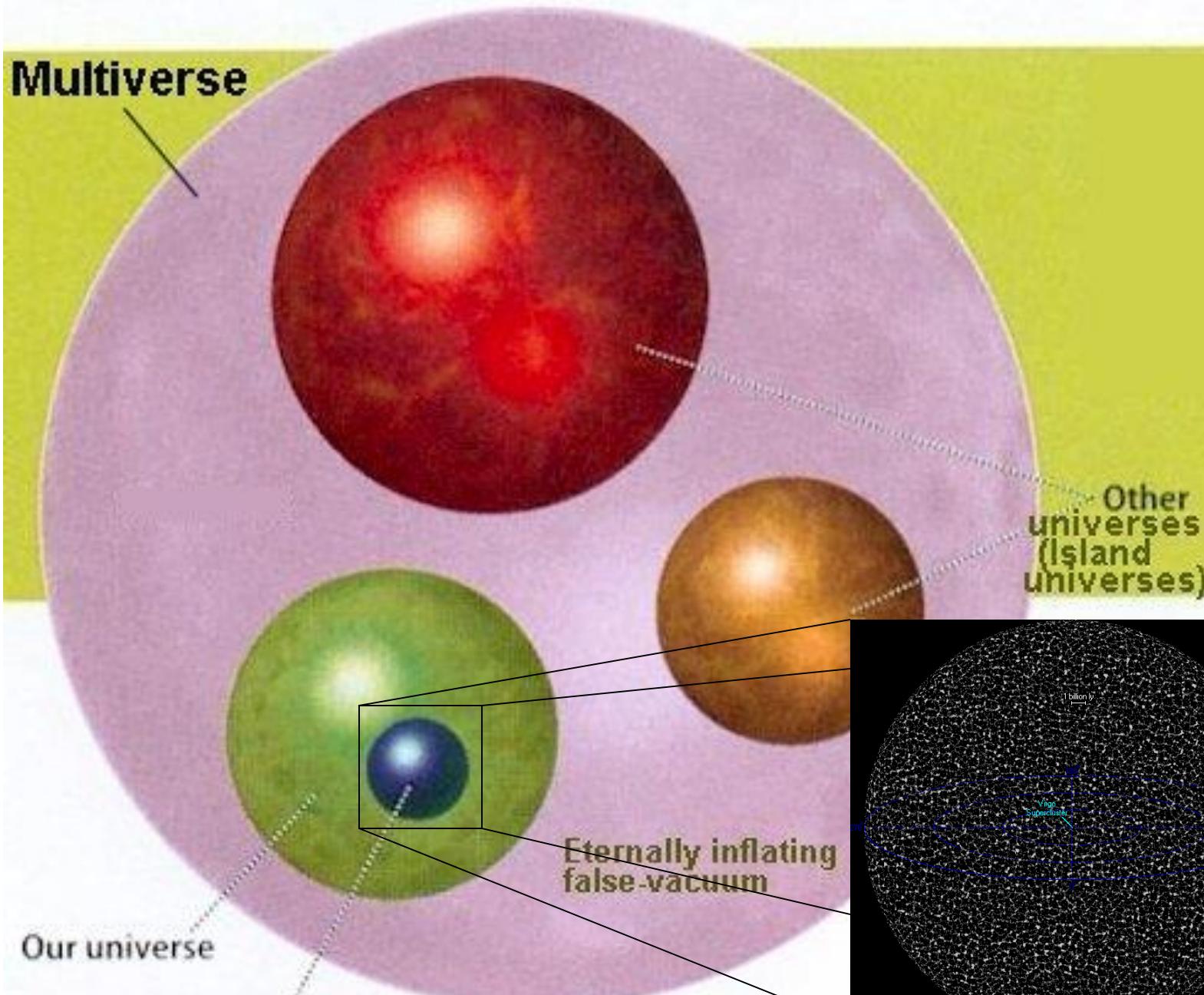


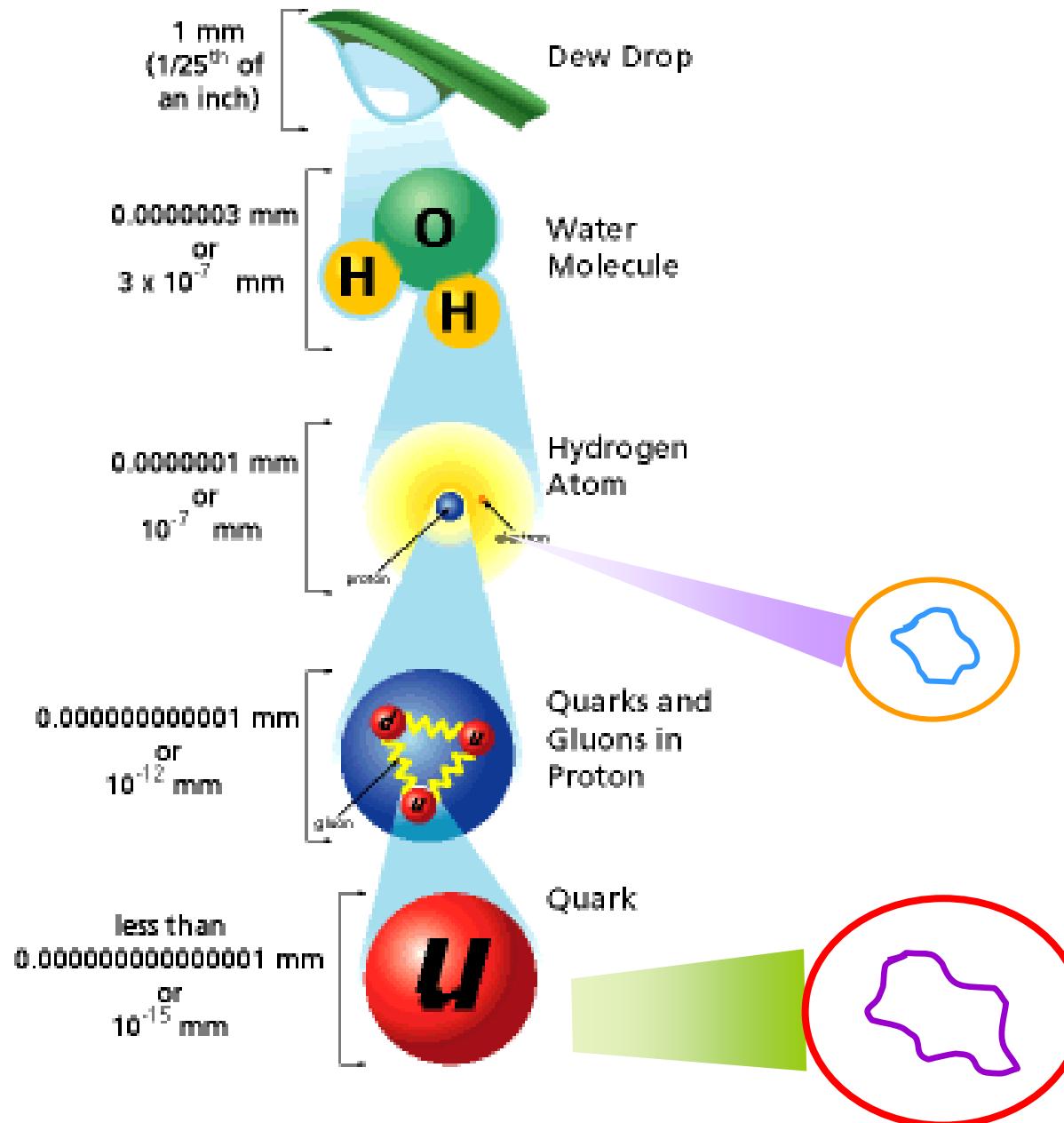
4 particles

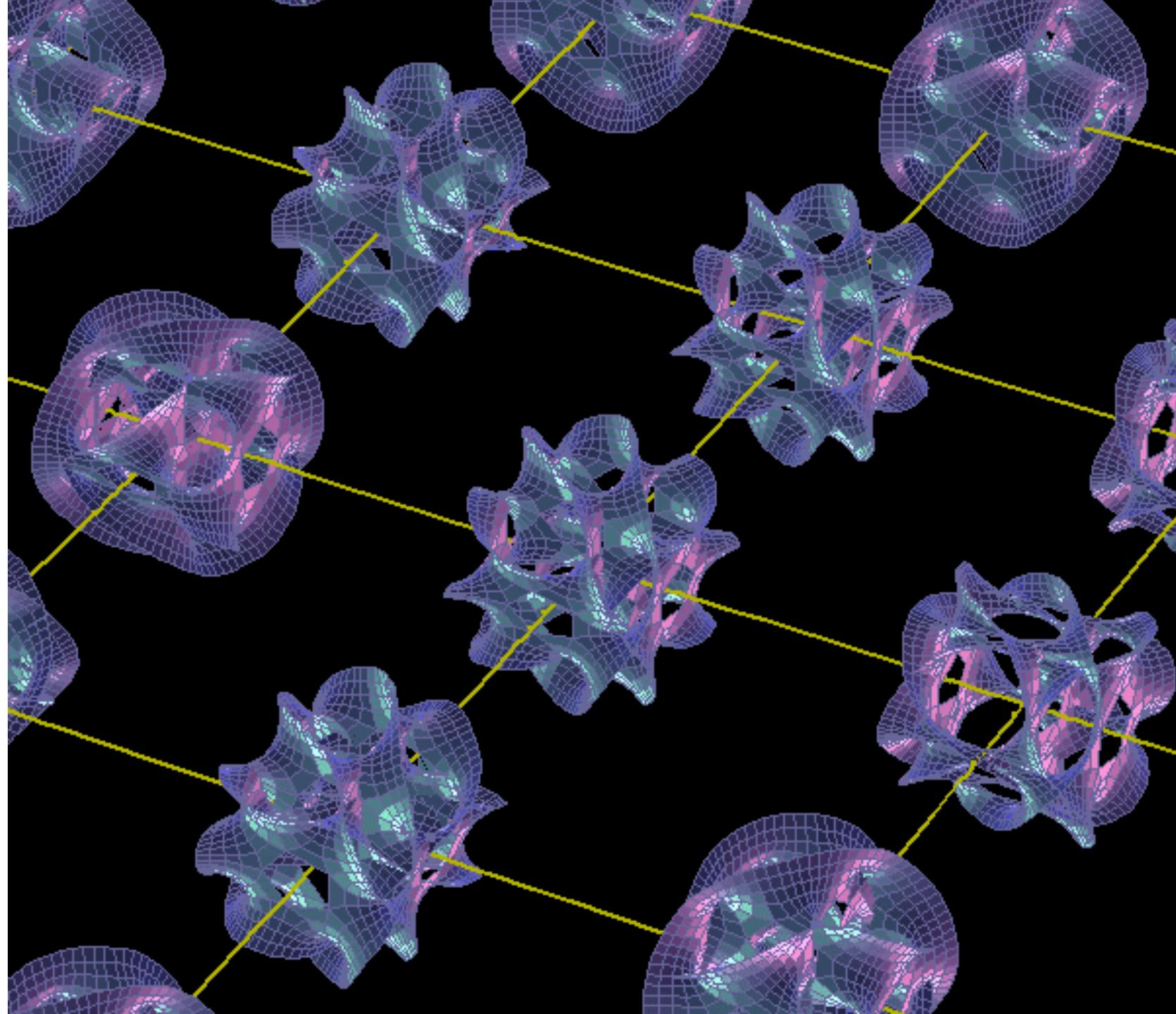
Second type of P.U. – different physics!



Multiverse



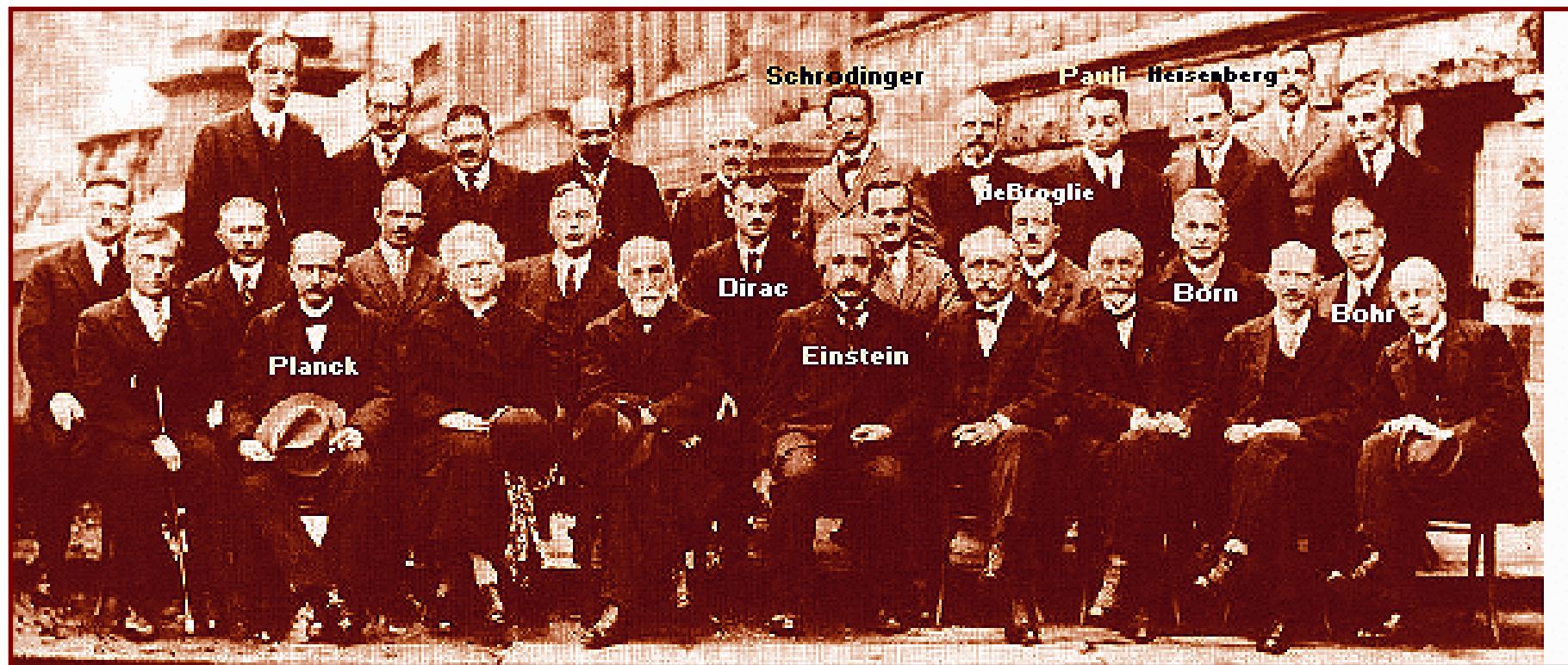




Quantum mechanics



Heisenberg 1925,



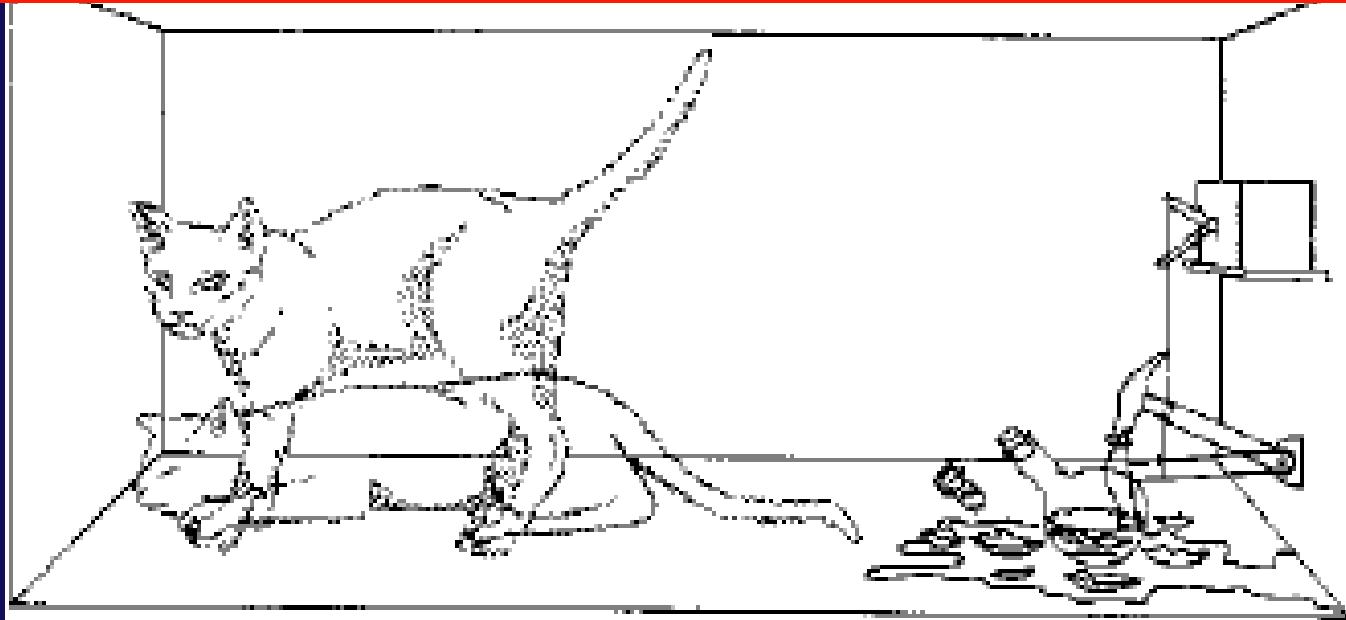
Conferenza di Solvay (1927)

Schrodinger's cat

- un paradosso della meccanica quantistica ovvero
- quando il "senso comune" non ci aiuta a risolvere i problemi !



Il gatto di Schrodinger



- Immaginiamo che esista un apparato contenente atomi di ^{13}N ed un rivelatore che rivela quando uno degli atomi è decaduto radiativamente
- Connesso al rivelatore vi è un relè connesso ad un martello che, all'atto del decadimento di un atomo, si attiva facendo cadere il martello che colpisce un'ampolla contenente del gas velenoso.
- Tutto l'apparato è posto in un contenitore insieme ad un gatto, ed aspettiamo 10 minuti
- Allo scadere esatto dei 10 min ci chiediamo: Il gatto è vivo o morto ?

MQ: Il gatto e' 50% vivo e 50% morto!

Il gatto di Schrodinger

Fintantochè non apriamo la scatola non possiamo conoscere quale delle due possibilità si è verificate

In gergo quantistico si dice che il sistema è collassato in uno stato. È l'interazione con l'osservatore (misura) che fa collassare il sistema in uno dei due stati.

Schrodinger's cat – a paradox

risveglio in
stessi !



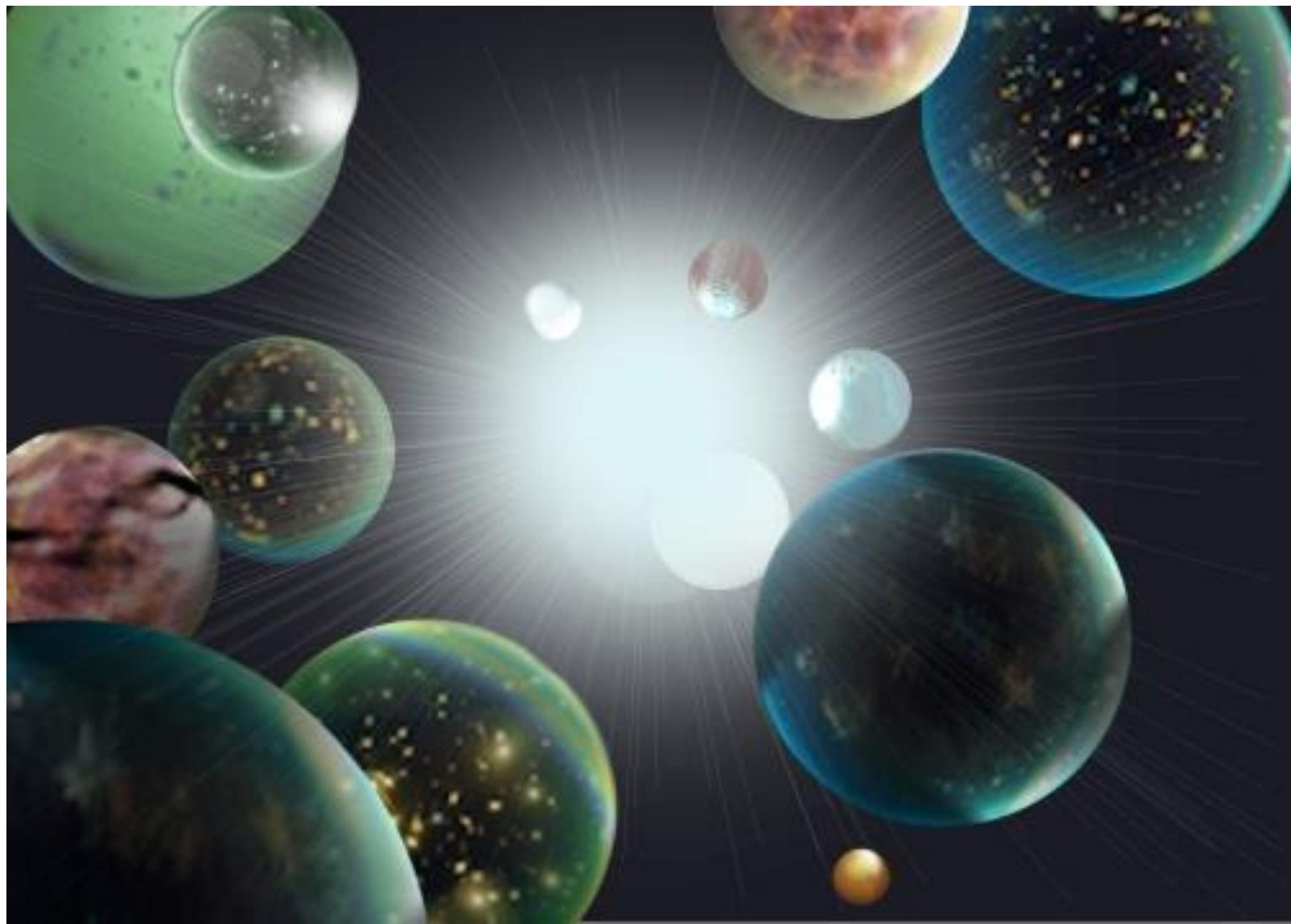


Tutta una serie di interpretazioni
della meccanica quantistica:

- De Broglie - Bohm
- Many-World Interpretations
- Collapsus della funzione d'onda

-





Universe – a SIMULATION?

