

EMERGENCE

great chain

neutrons protons



you

planets

stars

galaxies cosmos

quarks
fundamental
particles.

nuclei

atoms

molecules

cells

classical

physics

clusters →
BIG Bang
→ large
scale
structure

← "strings"

standard
model

quantum
mechanics

→ 1926

General
Relativity

fundamental fact
space \leftrightarrow time are connected,
special relativity } speed of light
general } c

$c = 3 \times 10^8$ m/s.
is a universal speed limit.

Einstein says: no information
no causality goes faster than c

part of the Standard Model
involves emergence in the
early universe.

— shortly after the Big
Bang

quarks
protons


cosmological
stuff.



"Reductionism"
— standard methodology
of science

explain a thing from its parts.

 down
the chain

 Emergence
up the chain.

Emergent property
→ something NOT just
the sum of the parts
— not obviously

(in principle
but not
in practice
reducible)

"weak emergence"

— Some properties are not
reducible in principle
even

"Strong Emergence"
"holistic" explanations

Whole → parts ?