

# THE MAGIC OF PHYSICS



2021

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# GUIDING QUESTION

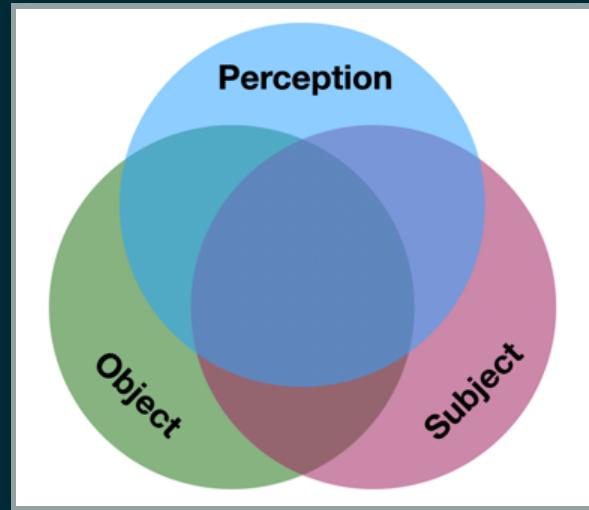
How real is reality?

- true nature of phenomena

Is the world the way we perceive it?

... strictly speaking!

# THE BIG PICTURE



Any perception requires all three

# OPPOSITES OF REAL

- dreams
- hallucinations
- projections
- deceptions

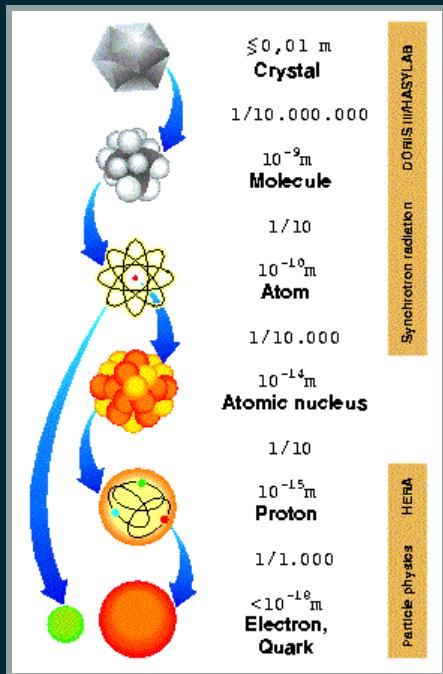


# WHAT MEANS 'REALITY'?

All we perceive, the way we perceive it

- size
- weight
- color / taste / smell ...
- solidity
- age
- consistency
  - lastingness
  - causality
  - nature = appearance
- independence
- objectivity
- individuality
- variety

# THE BRICKS OF THE CASTLE OF REALITY



Reality is not the way we perceive it

"nature  $\neq$  appearance"

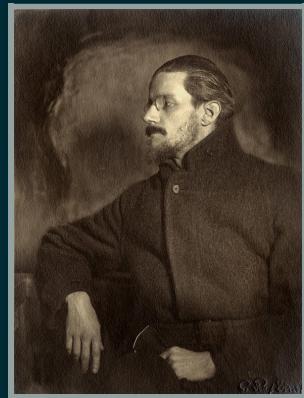
# VANISHING VARIETY

ALL objects consists of mainly

- electrons
- up and down quarks
- exchange particles = forces

# QUARK UND ELEKTRONEN

James Joyce 1882 - 1941



Finnegans Wake: "Three quarks for muster mark"

# THE GREAT MISUNDERSTANDING

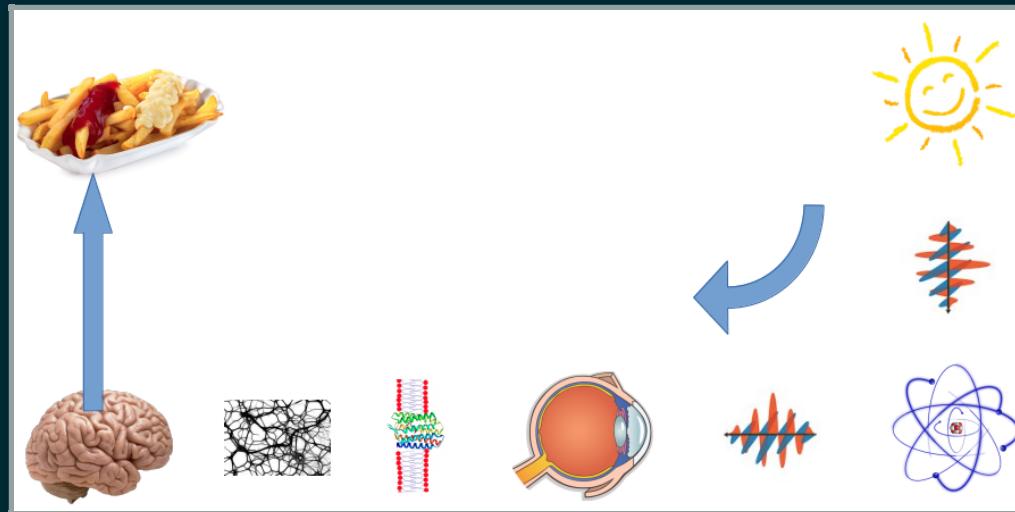
particles do **not have** mass, they **receive** it  
from interacting with the all-pervading Higgs field



Higgs and that god

# SENSUAL QUALITIES

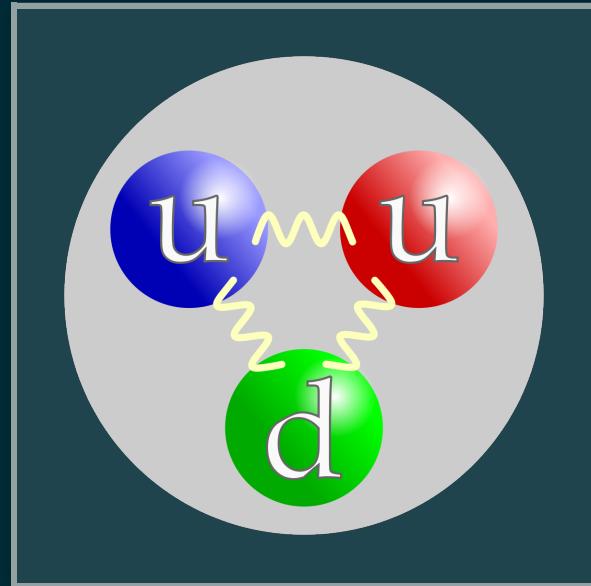
- color / taste / smell



any perception is a product of our brain!

# TOGETHER FOREVER

Quarks simply cannot exist alone!



# PERFECT EQUALITY

Absolutely no differences in the microcosmos!



Thus there is no such thing as age!

# QUARK UND ELEKTRONEN

- size
- weight
- color / taste / smell
- age
- individuality
- independence

...

# GOOD BYE 'REALITY'

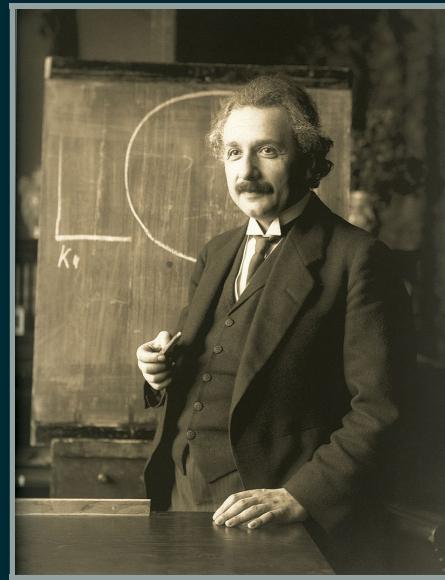
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# THE MAGIC

- total transformability
- no separation

# THE MAGICIAN

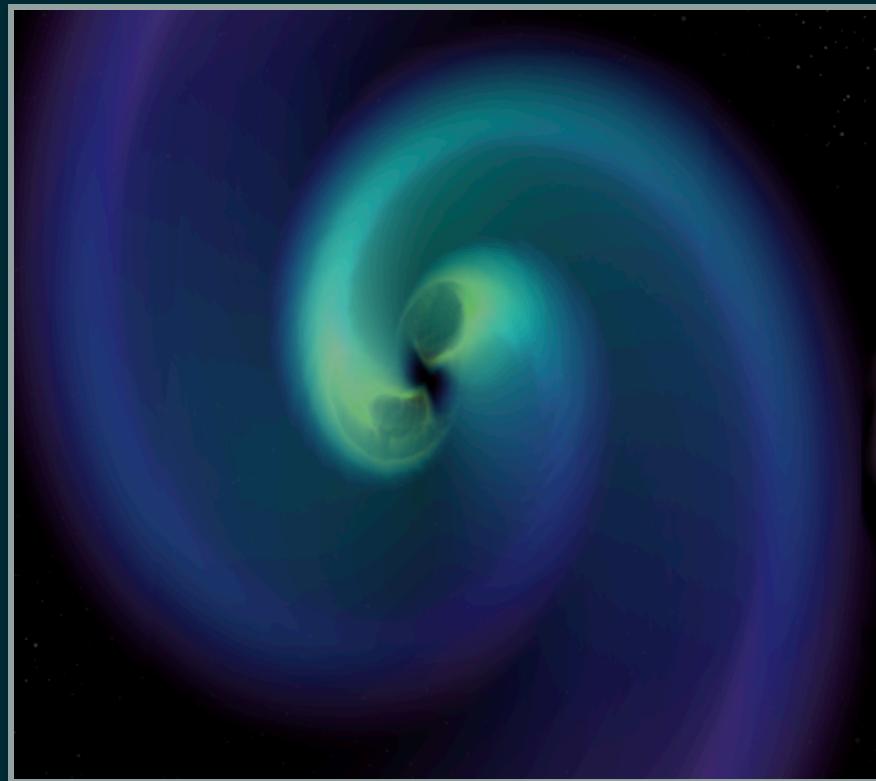
Albert Einstein 1879 - 1955



# THE FORMULA OF MAGIC

$$E = m \cdot c^2$$

# LARGE INSANE SCALE TRANSFORMATIONS

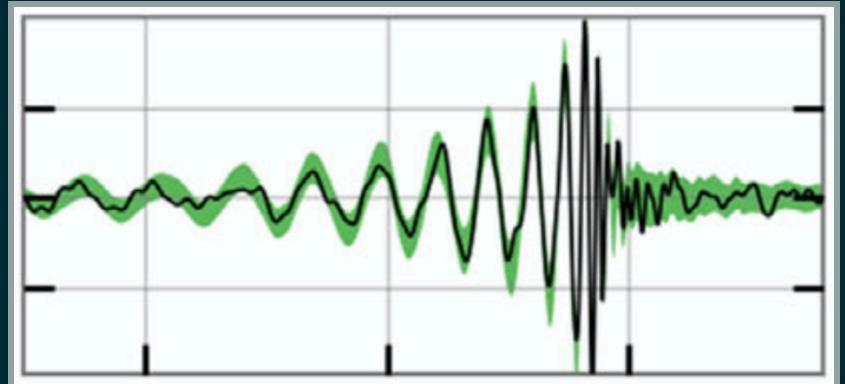
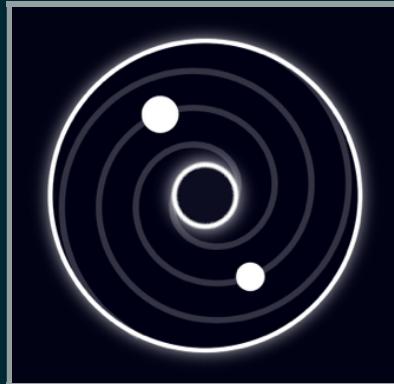


# INSANE PRECISION



Ligo

# INSANE SIZES



- $35 \& 30 \times m_{sun}$ , 1 bil. years ago
- $3 \times m_{sun}$  disappeared
- $1 \text{ mio} \times m_{earth}$  transformed into gravitational waves
- 2 kg in biggest explosion on earth

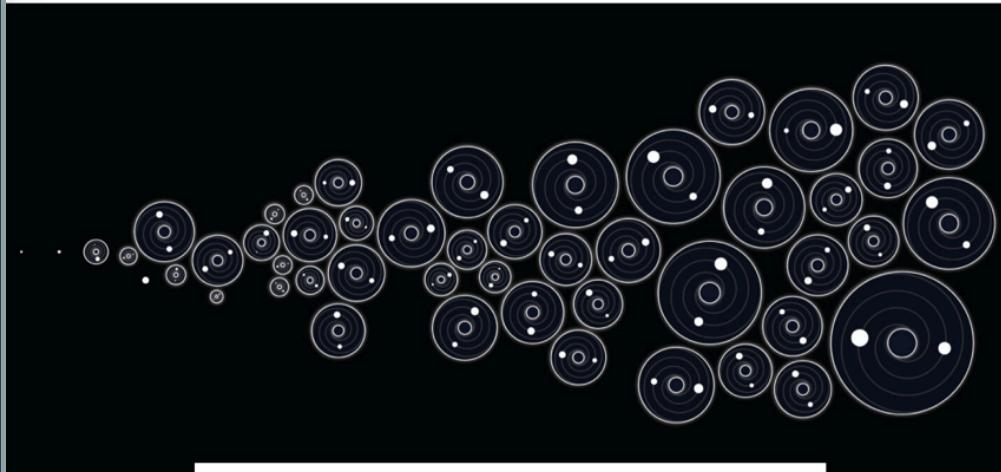




# A SCIENTIFIC SINGULARITY?

**ScienceNews**  
INDEPENDENT JOURNALISM SINCE 1921

ALL TOPICS   LIFE   HUMANS   EARTH   SPACE   PHYSICS   CORONAVIRUS



**PHYSICS**

## Explore every gravitational wave event spotted so far

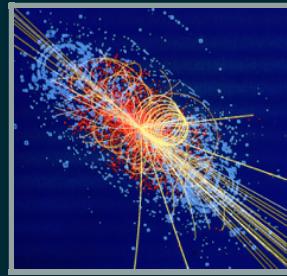
Fifty events reveal the similarities and differences in these cosmic smashups

Gravitational waves, produced when behemoths like black holes and neutron stars spiral inward and merge, have been spotted 50 times (each event represented with a large circle above).

NADIEH BREMER/  
VISUALCINNAMON.COM

# MOTION TO MASS

Elastic  $e^-$ ,  $e^+$  scattering events at CERN



IN:

- $e^-$ ,  $e^+$

OUT:

- $e^-$ ,  $e^+$
- particle jets

# THE ILLUSION OF SEPARATION

Albert Einstein: "God doesn't throw dice"

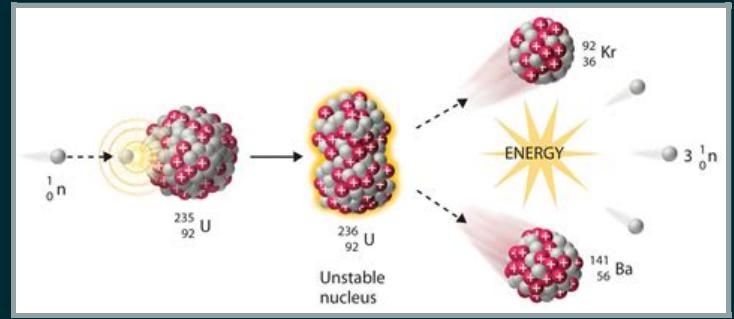
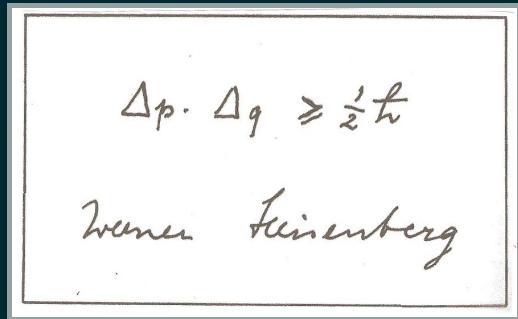


He was wrong ... but opened the door to true magic in physics.

# HOW DO PARTICLES INTERACT?

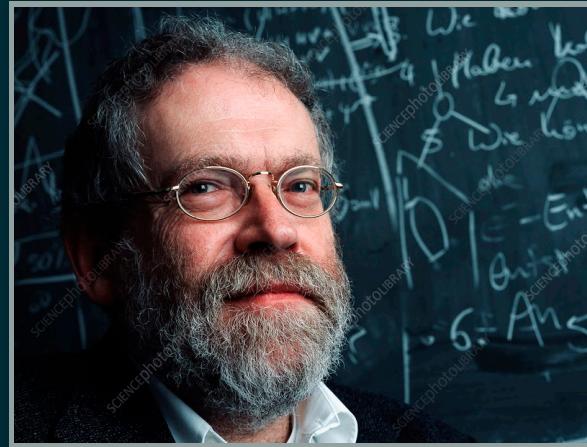
Exchange of particles causes force

# THE EPR GEDANKENEXPERIMENT



IF quantummechanics is right,  
THEN there would be an instantaneous 'ghost'  
interaction  
THUS quantum mechanics must be wrong ...

# ENTANGLED PARTICLES



Anton Zeilinger

The successor of the big magician

# THE REAL GHOST INTERACTION

Zeilinger: first some 100 meters, latest between 2 canary islands.

Chinese: 2000km via satellites

# THE COSMIC JOKE

- zoom in
  - *reality* fades
  - *magic* appears
- zoom out
  - *magic* hides
  - *reality* unfolds
- do it again

# DUAL REALITY

- the nature of all appearances
  - nothing truly exists
- however, things appear
  - by complex interplay things appear as real

# SAME INSIGHT



without giant devices

# MERRY CHRISTMAS!

# SOURCES OF IMAGES

- slide 5: desy.de
- slide 6, : wikipedia.org
- slide : ligo.org
- slide : sciencenews.org
- slide : cern.ch