

# Invisible Forces

## *Redux*

Jess H. Brewer

*Etymology:*

## **force (n.)**

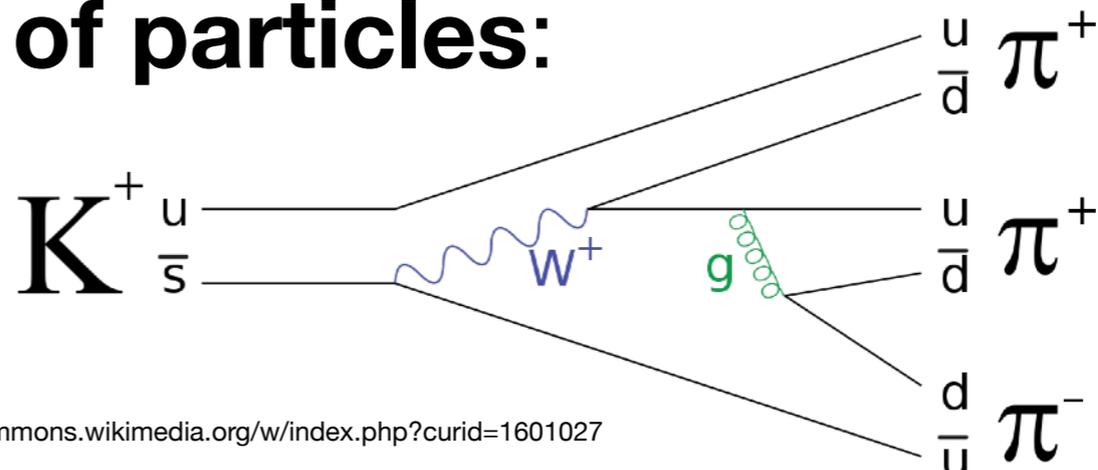
c. 1300, “physical strength,” from Old French *force* “force, strength; courage, fortitude; violence, power, compulsion” (12c.), from Vulgar Latin *\*fortia* (source also of Old Spanish *forzo*, Spanish *fuerza*, Italian *forza*), noun use of neuter plural of Latin *fortis* “strong, mighty; firm, steadfast; brave, bold” (see [fort](#)).

Meanings “power to convince the mind” and “power exerted against will or consent” are from mid-14c. Meaning “body of armed men, a military organization” first recorded late 14c. (also in Old French). **Physics sense is from 1660s; *force field* attested by 1920.**

Related: *Forces*.

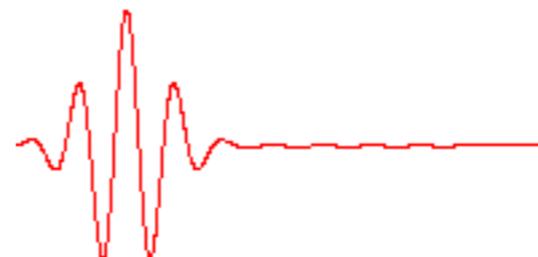
# Standard Model “forces”

\* *Mediated by exchange of particles:*

- Feynman Diagrams like 

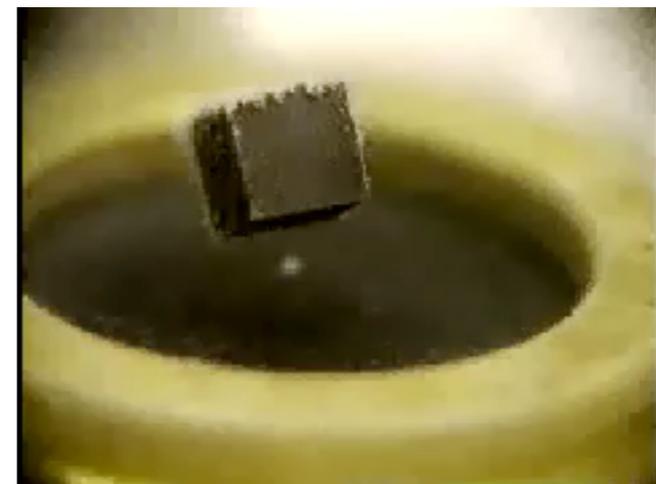
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- Too *Small* to see! (diameter  $\ll$  wavelength of light)
- **Blurry** Quantum Mechanical “Wavicles”!



# Familiar(?) Examples that still seem Magical

- After use in dry air, a *hairbrush* will pick up bits of *lint*.
- A *magnet* underneath a table can move an iron object around on top of the table.
- Magnetic levitation of (or *by*) a *superconductor*.



# Some “Visible” Forces

- Pushing against a person with your hand.
- The ground pushing up on your feet.
- A baseball being hit by a bat.
- A cue hitting a billiard ball.
- A boat floated by the displaced water.
- \* Each of these is governed by “*invisible*” ***electrostatic*** “*action at a distance*” on (sub-) *microscopic* scales.

# What *Makes* Forces “*Invisible*”?

1. Too *small* to see. (Subatomic Scales)
2. Too *blurry* to see. (Quantum Mechanics)
3. Too *fast* to see. (“Want to see it *again*?”)
4. Too *weird* to see. (The Uncanny)

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# **Invisible Forces** ***in other domains***

- ***“Power to convince the mind”***

Art, Music, Poetry, Literature...

- ***“Power exerted against will or consent”***

Abuses of Social Media, Bad Laws...

- ***“Body of armed men, a military organization”***

Proud Boys, Oathkeepers, others still unknown...