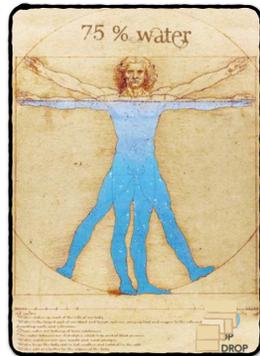


The glue in you and everything you love

Raúl Briceño & Arjun Gambhir

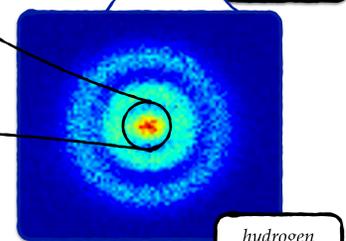
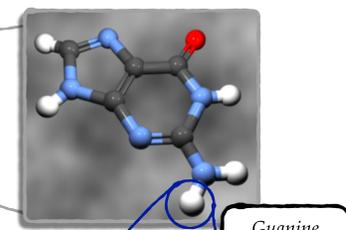
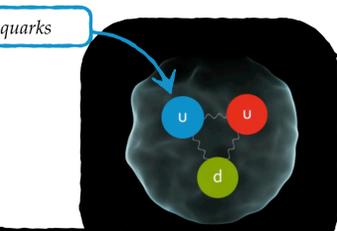
Yes, we all know that...



...but did you know that you're actually 85-90% glue?

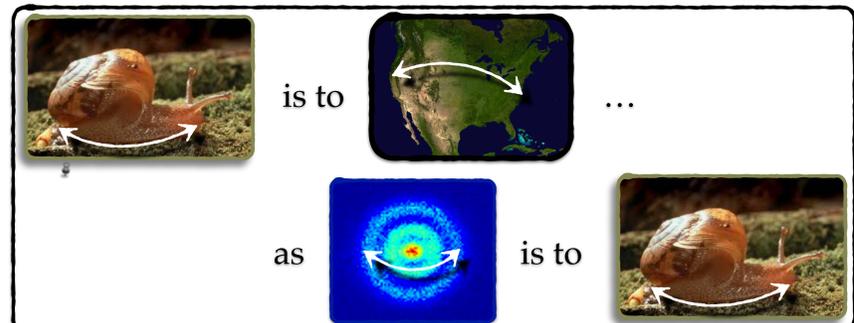
The big picture:

To understand this, let's dive deep inside the stuff we are made out of



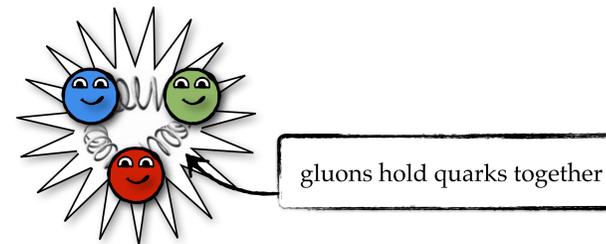
zoom factor of ~100,000!

proton:
 • hydrogen atom's nucleus
 • the lightest of all nuclei
 • carries 99.95% of hydrogen's weight



Peering inside the proton?

The proton is made of three quarks and the gluons that hold them together:

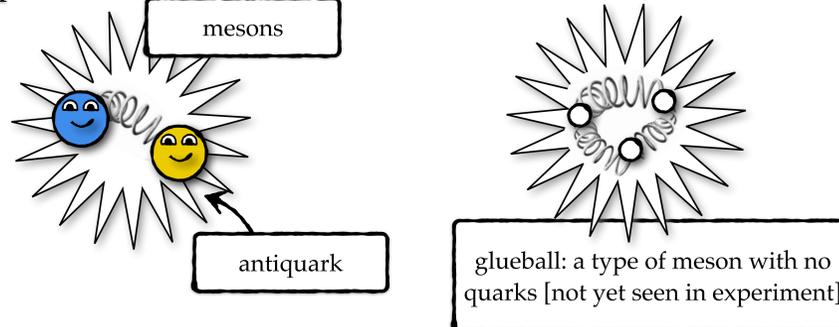


The theory that describes quarks and gluons is known as "quantum chromodynamics" (QCD):

$$\mathcal{L}_{\text{QCD}} = \bar{\psi}_f (i \not{D} - m_f) \psi_f - \frac{1}{4} \text{tr} (GG)$$

This simple equation should describe everything made of quarks and gluons, like the proton, DNA, your brain, planets, stars, etc.

Also, it should describe more exotic matter seen in experiments:

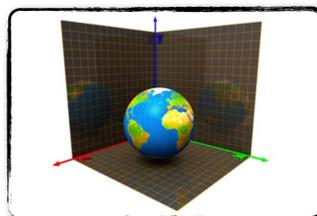


All attempts to solve this equation with pen and paper math, have failed!

Want a Nobel Prize in Physics?

Simulating Nature:

Input fundamental equations of nature

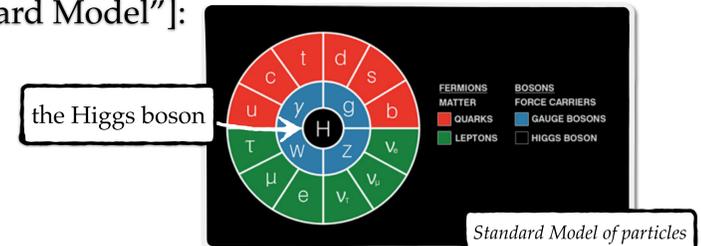


Virginia's biggest and fastest supercomputer

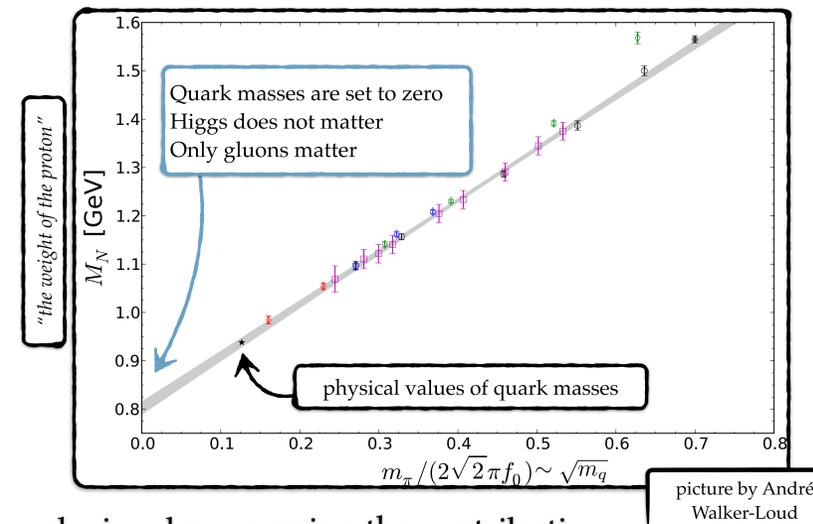
Emergence of natural phenomena

The Higgs vs. glue?

Remember the Higgs boson? Discovered in the LHC at CERN [2013], it is responsible for giving mass to itself and the other subatomic particles [those that appear in the "Standard Model"]:



Naively, one would think that the Higgs is responsible for our mass, but our simulations have shown that the Higgs only contributes at most to 15% of our weight.



In conclusion, by removing the contribution of the Higgs, the mass of the proton remains largely unchanged. The mass is then simply due to the gluons keeping the proton together.

Since we are made of protons and neutrons, which carry essentially all of our weight, then...

"Yes, gluons are to blame!"

One of the many scientific goals of JLab is to find more explicit evidence of the glue content of the proton and observe the manifestation of glue in more exotic matter.

