Is the weak force a force?

Abstract

In our previous paper, we explored the epistemological foundation of quantum chromodynamics: what concepts and models are we using, and what does Occam's Razor Principle has to say about that? In this paper we do the same for the weak force. We think the force concept should not be applied to the analysis of decay or disintegration processes. The idea of W and/or Z bosons *mediating* the weak force makes even less sense. W/Z bosons should be thought of as debris: transient or resonant matter. We suggest the whole idea of bosons mediating forces resembles 19th century *aether* theory: we don't need it. The implication is clear: if that's the case, then we also don't need gauge theory and/or quantum field theory.

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Is the weak force a force? A force holds stuff together – or keeps things apart. Something that makes things fall apart, cannot be a force, right? But if it is not some *force* that makes things fall apart, then what is it? What causes decay?

John Wheeler's concept of mass without mass implies that – ultimately – all matter is energy, and the mass of some particle is just the equivalent energy of the oscillation. But what is the oscillation? What is oscillating? Some *charge*. We do *not* think of an electron in free space as some dimensionless object: instead we think of a *naked* charge – just a charge with no inertia – spinning around at the velocity of light. We can then interpret the Compton radius of the electron as the effective diameter of the motion of the charge.

Let us recall the basics of that interpretation. We thought of the speed of light – the *c* in Einstein's mass-energy equivalence relation ($E = m \cdot c^2$) – as some tangential velocity. A tangential velocity will always equal the radius times the angular frequency of the rotational motion: $c = a \cdot \omega$. We then used the Planck-Einstein relation ($E = h \cdot f = \hbar \cdot \omega$) to substitute ω for $\omega = E/\hbar = m \cdot c^2/\hbar$) to find the Compton radius:

$$c = a \cdot \omega \Leftrightarrow a = \frac{c}{\omega} = \frac{c \cdot \hbar}{\mathrm{m} \cdot c^2} = \frac{\hbar}{\mathrm{m} \cdot c} = \frac{\lambda_C}{2\pi} \approx 0.386 \times 10^{-12}\ \mathrm{m}$$

The novel idea here is that one rotation – one *cycle* of the electron in its *Zitterbewegung* – packs the electron's energy ($E = m_e \cdot c^2$) as well as Planck's quantum of action ($S = h$). The idea of an oscillation packing some amount of physical action may not be very familiar but it is just the same as saying we have some angular momentum in the motion.

An electron is a spin-1/2 particle, however. How do we explain that? We introduced the concept of the *effective* mass of the pointlike charge: it acquires mass *because* of its velocity—because of its *kinetic* energy. We wrote that mass as m_γ, and we showed $m_\gamma = m/2$: the *effective* mass of the pointlike charge – as it whizzes around the center of the two-dimensional oscillation that makes up our electron – is half of the (rest) mass of the electron.[1] Where's the other half of the mass? That's in the potential energy of the oscillator. It's all quite deep and mysterious but we can't dwell on that here (we do so in our other papers).

The point to note here is that an electron – in free space or in an electron orbital – is stable. When we say the electron in an electron orbital is stable, we should be precise: it's the orbital – or the atom itself – that is stable. What makes it stable? The Planck-Einstein relation: $E = h \cdot f = \hbar \cdot \omega$, *exactly*.

[1] See: Jean Louis Van Belle, *The Electron as a Harmonic Electromagnetic Oscillator*, 31 May 2019 (http://vixra.org/pdf/1905.0521v3.pdf)

Indeed, the 2019 re-definition of SI units *defines* Planck's constant as being equal to h = $6.62607015 \times 10^{-34}$ J·s, *exactly*.[2] Hence, Planck's constant is an exact value, and we may think of a stable particle (think of an electron, a proton or a photon) as respecting the E = h·*f* = ħ·ω equation *exactly*.

We think *non*-stable particles do *not* respect this equation *exactly*. We like to think of them as *transients*: oscillations that die out. Of course, that triggers the obvious question: where does the energy go? The *metaphor* of a transient oscillation has its limits. In fact, it's seriously limited: the particle decay processes that are being studied in particle accelerators and colliders resemble car crashes: the term *disintegration* – as opposed to decay – is a more apt description.

Non-stable particles

Let us look at a few examples so we have a better feeling of what we are trying to talk about. Let's think of *pions*, for example. We should distinguish charged pions (the π^+ and π^- particles) from the neutral pion (π^0). They don't have a lot in common—except for their energy, which is of the same order of magnitude. However, the mean lifetime of the π^+ and π^- particles is much more measurable: about 26×10^{-9} seconds. In contrast, the mean lifetime of the π^0 particle is measured as something like 84×10^{-18} seconds. The difference between nanoseconds (10^{-9} seconds) and attoseconds (10^{-18} seconds) is 10 to the power 9, so that's a *billion*. The disintegration process is also *very* different:

1. The π^+ and π^- particles decay into a *muon* (positive or negative) and a *muon neutrino*.
2. The π^0 particle just leaves two photons.[3]

Muons are unstable as well, but their mean lifetime is measured in *micro*-seconds (10^{-6} seconds). Guess what? They decay into an electron or a positron (depending on their charge) and neutrinos. Let's write it down:

$$\pi^+ \rightarrow \mu^+ + \nu_\mu \ \rightarrow e^+ + \nu_e + \nu_\mu$$

Just change the signs for the π^- decay.[4] What about the energy equation? The energy of charged pions is about 139.57 MeV. That's a sizable chunk of money—at the nuclear level, that is. To put that number into perspective: it's about 15% of the energy of the proton.

What are pions anyway? According to the Standard Model of physics, the pion should be thought of as a particle that *mediates* the interaction between a pair of nucleons. In other words, they are supposed to mediate the strong force. I think that's nonsense.

Let me repeat that: I think the idea of some particle *mediating* a force is nonsense. It's like the 19th-century *aether* theory: we don't need it. Pions are just debris: it's part of the stuff that's flying around after the car crashed. To be precise, we get pions when protons – also known as hydrogen nuclei 😉 – crash into something else. That is illustrated below: they are part of the debris in cosmic rays. We can also create them artificially in colliders: the first artificial production of pions involved bombarding

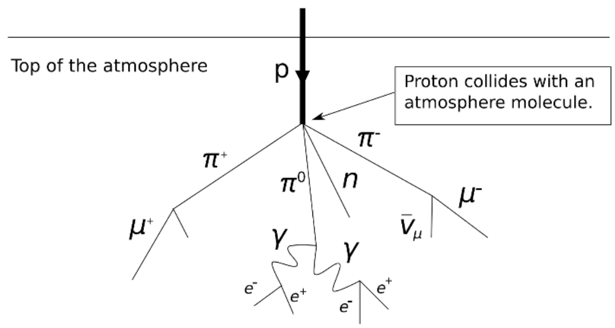
[2] The NIST defines the unit as $J \cdot Hz^{-1}$, which confirms our interpretation of Planck's constant as a fundamental cycle. Note that the *reduced* Planck constant ($\hbar = h/2\pi = 1.054\ 571\ 817... \times 10^{-34}$ J·s) has an infinite number of digits but zero uncertainty. That is because π is an irrational number.

[3] We will quality this statement in a minute.

[4] The second step in the decay makes abstraction of the muon neutrino that was produced in the first step of the decay process.

carbon atoms with high-speed alpha particles. Don't think of them as virtual particles: they are real. Don't think of them as mediating some force. That's nonsense. They're just unstable: they fall apart. The weak force is not a force.

Figure 1: Pions in cosmic rays



What about W^+, W^- and Z bosons? They're the same: they're unstable debris. In fact, there is no evidence for them whatsoever. Of course, the academics will cry wolf here: W^+, W^- and Z bosons are supposed to have been 'discovered' in the proton-antiproton collider at CERN.[5]

But where is the wolf? Do these experiments actually *confirm* quarks, gluons and W/Z bosons exist? They don't. These experiments only produce some *signal* that is 'consistent' with the hypothesis. A signal. Consistency. No proof. In fact, physicists owe an explanation to the general public: what does it mean when they say this or that particle *exists* if it can only travel as a quasi-free particle at a distance of the order of 10^{-15} *centi*meter. That's *a hundredth* of a femtometer (10^{-15} m). In case you don't know the femto-universe very well[6], you should probably remind yourself of the scattering radius of a proton, which is something tween 0.84 and 0.9 fm. Even when traveling at the speed of light, the equivalent *lifetime* of a particle traveling over a distance of, say, 3 fm is 10^{-23} seconds. That's smaller than anything we can measure. It then decays into other products.

That's not a particle: that's a resonance, or an excited state of something.[7] Whatever it is, it is surely *not* something you'd associate with the usual *definition* of a particle.

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[5] The first of these experiments go back to the late 1970s and the early 1980s and are associated with the PETRA accelerator in Hamburg, the Positron-Electron Project (PEP) at the Stanford National Accelerator Laboratory (SLAC), and the Super Proton-Antiproton Synchrotron at CERN. We encourage the reader to *google* and think about these experiments. What do these experiments try to find or measure? And how do they do it?

[6] I will readily admit that I don't, but I will also not hesitate to say that any of the physicists who write about it do. Why? Because you can't 'see' or 'measure' anything with precision in the femto-universe. Hence, your guess about what's going on there – as an amateur physicist – is as good as that of the academic physicist.

[7] A *resonance* in particle physics is effectively defined as a 'particle' whose lifetime is of the order of 10^{-23} seconds. Traveling at the speed of light, these 'particles' can, effectively, only travel about 10^{-15} m (which is about the diameter of a proton), before decaying. Distances of this magnitude cannot be measured in bubble chambers or in whatever other device for detecting subatomic particles, and the lifetime of a resonance is, effectively, analogous to the time an electron stays in an excited state, which is calculated using the Uncertainty Principle: $\Delta E \cdot \Delta T = h \Leftrightarrow \Delta T = \Delta E/h$. See: http://webhome.phy.duke.edu/~kolena/modern/dudley.html.

Transients versus resonances

So what can we say? Nothing much. All we can say is that, after some time, most stuff falls apart. Except protons and electrons—as far as we know, at least. And photons go on forever too. All other stuff falls apart: we're talking mesons and baryons, basically. Stuff that consists of two and three quarks respectively according to the quantum-mechanical canon. To be precise, baryons (think of neutrons, for example) consist of three colors (or three anti-colors), while mesons (think of pions) consist of a color and an anti-color.

What about flavors? Wikipedia defines a flavor as a *type* or a *species* of an elementary particle. That's useless: a different type of an elementary particle is a different elementary particle. That's just logic. If quarks change color all of the time, then they don't have a color charge. Full stop. Gluons are a superfluous concept, and particles that change another particle into some other particle – W^+, W^- and Z bosons – are canonical nonsense. No one has been able to prove they actually *exist*.

In reality, we have a very limited number of permanent fixtures (electrons, protons and photons), hundreds of *transients* (particles that fall apart) and thousands of resonances (excited states of the transient and non-transient stuff). What's the difference between them?

Stable particles respect the $E = h \cdot f = \hbar \cdot \omega$ relation—and they do so *exactly*. For non-stable particles – transients – that relation is slightly off, and so they die. They die by falling apart in more stable configurations, until we are left with stable particles only.

As for resonances, they are just that: some excited state of a stable or a non-stable particle.

Conclusions

In our previous paper, we explored the epistemological foundation of quantum chromodynamics: what concepts and models are we using, and what does Occam's Razor Principle has to say about that? In this paper we do the same for the weak force. We think the force concept should not be applied to the analysis of decay or disintegration processes. The idea of W and/or Z bosons *mediating* the weak force makes even less sense. W/Z bosons should be thought of as debris: transient or resonant matter. We suggest the whole idea of bosons mediating forces resembles 19th century *aether* theory: we don't need it. The implication is clear: if that's the case, then we also don't need gauge theory and/or quantum field theory.