Dbrane models for our world

D-branes provide more tools to tinker with. With them we can build models that bear some resemblance to our world. Specifically, branes include constructs that look a whole lot like quantum field theory, the foundation of particle physics.

A bit of review. Strings are oriented. Open strings have an intrinsic "direction." One end of the string is the "source" of that orientation. For convenience, we label it $+$. The other end we label $-$. There's a method to our madness, of course. As we'll see in the next chapter, the ends behave like charges.

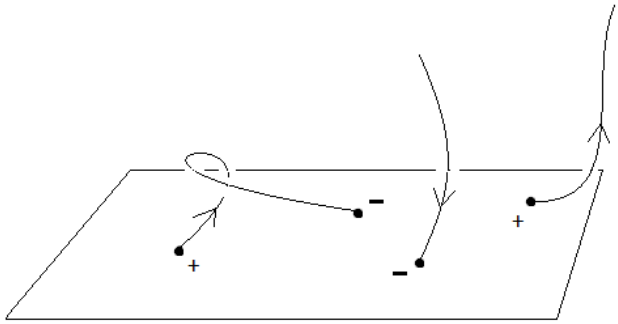

Figure 22.1. A photon (left), electron, and positron all anchored to a D2 brane.

Closed strings also are oriented, R or L, clockwise or counter-clockwise. We'll focus on open strings here, but we will find analogous physics in closed strings wound on a torus.

We build our models on 2-branes. An open string with both ends stuck on the brane behaves like a photon.

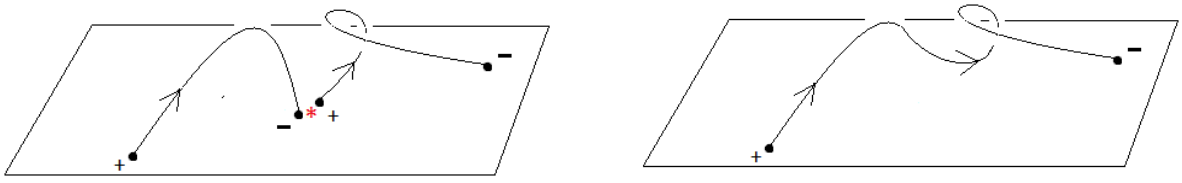

Figure 22.2. Two photons (left) interact, producing another photon (right).

Rules are when the $+$ end of one photon bumps into the $-$ end of another, the ends join and lift off the brane. We're still left with a photon – and a nice model for boson behavior. Photons like to associate with other photons. The more photons the merrier.

A string with only its $-$ end stuck to the brane behaves like an electron. Vice versa, a string with $+$ on the brane is a positron. $+$ meets $-$ and the ends lift off the brane, disappearing from the brane world, just like when a positron annihilates an electron. And when the $+$ end of

a photon meets an electron, the result is a string with − end stuck to the brane, still an electron, but displaced from its original trajectory.

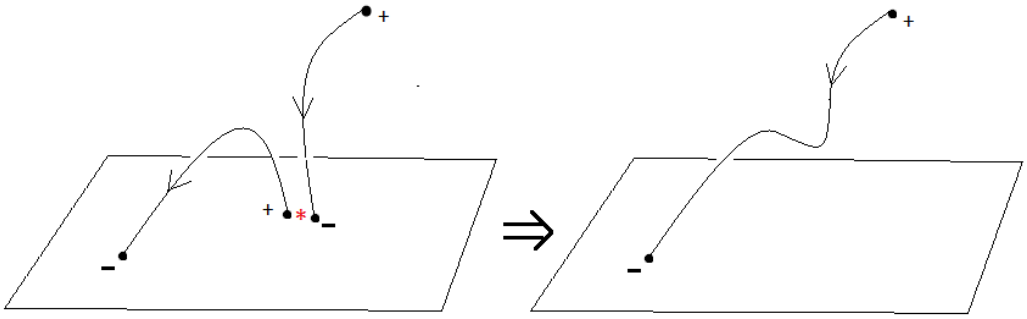

Figure 22.3. Interaction between a photon and an electron.

These pictures provide a model for QED, the interactions between photons and electrically charged particles.

There's more. Supposed we build a world on three 2-branes. Label the branes R, G, and B. (You see where this is headed.) Same ideas as before: some strings have both ends stuck to branes, and others have just one end attached. If it's the + end on the brane, we assign that end the label (R, G, or B) of the brane. Negative end on the brane we assign the "anti-" label. We assume that the strings can pass through a brane; it's just the ends that interact with the brane.

What have we here? Suppose a (R, anti-G) string bumps into a (G, anti-B). Voila! We get (R, anti-B), like interacting gluons. Or if a B string bumps into a (G, anti-B) we get a G string. Quantum chromodynamics on the branes! This brane world models the interactions of quarks and gluons.

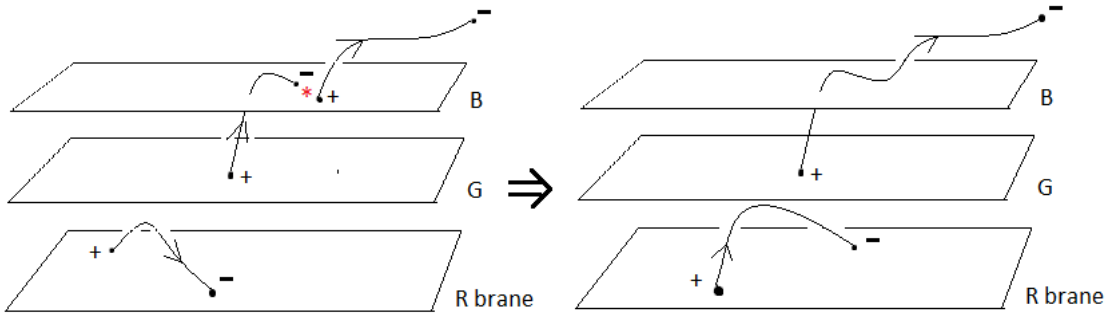

Figure 22.4. An (R, anti-R) gluon, below. Above, a (G, anti-B) gluon transforms a B quark into a G quark.

Fun stuff! But how can we assume the string ends behave like charges? We need to substantiate that claim.

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