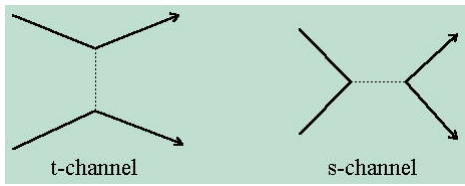
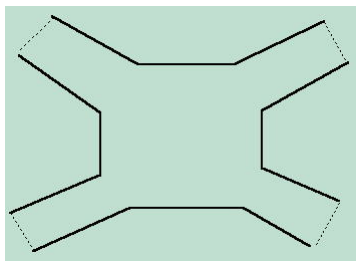
Duality and strings





S and t channel look the same if you stretch a string between the quarks

When two particles come together, interact and scatter off each other they could have done one of two things. It could be that they exchanged an intermediate particle, like an electron and positron exchanging a photon. Or, it could be that they join to form a new particle which then reverts back to the original two, like an electron and positron which annihilate briefly and are then recreated from a photon. These two scattering modes are known as the t-channel and s-channel respectively. For strong interactions it was found experimentally that these two amplitudes were approximately the same. There might be a principle which meant that the two channels were somehow really the same thing. Could there be an underlying interaction which possessed such duality exactly?

When these question were asked, the evidence of quarks as constituents of the proton and neutron was becoming more convincing, but nobody could understand why they were never seen on their own. They seemed to be bound together inside the hadrons. According to string theory "bound" was just the right word. The quarks were always attached to the end of strings which resisted them being pulled apart. When stretched too far it would break but a new quark anti-quark pair formed from the energy released would take hold of the lose ends. The process could also reverse when strings join together. In space-time the strings sweep out a surface or world sheet. The scattering of two mesons would now be described by a process in which two strings joined momentarily and then broke. When the world sheet is drawn the explanation for duality suddenly becomes clear. The same picture can be interpreted as either a t-channel or s-channel scattering mode.