Why is this Important?

There are four fundamental interactions in the nature. The most powerful is the *strong* interaction. This holds the quarks together in the proton and neutron, as well as holding the protons and neutrons together in the nucleus of an atom. Understanding the strong force is vital to our understanding of the universe.

The strong force interacts with the *color* charged particles such as quarks and gluons. This behavior is modeled by the theory of *Quantum Chromodynamics* (QCD). By testing the predictions of QCD, we are testing our understanding of the strong force.

The strong force has a remarkable property called *confinement*. Confinement says particles must always bind together into combinations that have no color. This means quarks can not exist by themselves. Quarks **must** be attached to other quarks. In experiments, only particles with no net color can be seen (such as protons, neutrons, pions, ...,). As a result, the most basic tests of QCD we can do involve the simplest quark combinations, such as pions.

At the lowest possible energies, the π^o is the only *strongly* interacting particle. It plays a special role as a tool for investigating the most fundamental predictions of QCD in the very low energy limit. A high precision measurement of the π^o lifetime will directly test the QCD prediction, helping us to test our understanding of the strong force. The lifetime of the π^o is dominanted by the chiral anomaly and contains information about the number of colors inherent in the strong force. Understanding the π^o lifetime provides a crucial step towards constructing a systematic link between quarks/gluons in QCD and the observable particles in the *hadronic* (strong) world. This lies at the heart of contemporary nuclear science and has a deep impact on particle physics, astrophysics and cosmology.