SOCIETY OF PHYSICS STUDENTS
An organization of the American Institute of Physics

Marsh W. White Award Proposal

Project Proposal Title	Jazz Gluon Fusion
Name of School	Abilene Christian University
SPS Chapter Number	0006
Total Amount Requested	$500

Abstract

We use atom smashers to explore the structure of protons and we find a surprisingly complex world full of antimatter and quantum mechanics. We propose to partner with Derek Brown, our former jazz director turned professional musician, to produce a YouTube video explaining protons with jazz.

Proposal Statement

Overview of Proposed Project/Activity/Event

Background and Motivation

ACU specializes in nuclear physics research. Our faculty and students are involved in several projects designed to use the country's highest energy particle accelerators ("atom smashers") to make detailed measurements of proton structure. One experiment currently taking data is the SeaQuest spectrometer in Fermilab, near Chicago. The primary goal is look for extremely rare cases of quarks in the beam protons annihiling with anti-quarks in the target, and using these data to measure properties of antimatter found inside all everyday matter.

Many people learn in high school or college physics classes that protons are made of three quarks: two up quarks and one down quark. However, the reality is far more complex and mysterious. These are only the *valence* quarks (in analogy to valence electrons in atoms) and they only carry a small fraction of the proton's mass, energy, and momentum. These quarks are connected with gluons which may, at any time, split into a new quark-antiquark pair forming the quark sea. Unlike photons, gluons can actually interact with other gluons to form complex structures. These sea quarks and gluons also carry angular momentum as they orbit inside the proton.

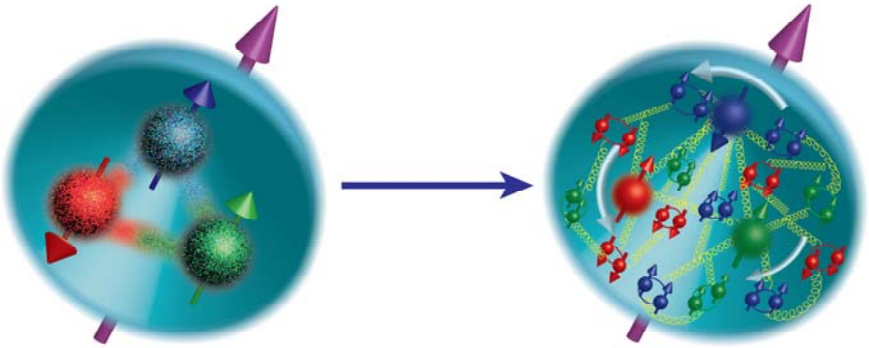

Illustration of our understanding of proton structure. The left shows the simple model of the 1980's where the proton consists only of 3 quarks. The right shows a current picture including gluons, sea quarks, and orbital momentum. (Figure from A. Accardi, et al, arXiv:1212.1701 [nucl-ex])

Besides Fermilab, our university has another interesting connection in the Chicago area. ACU's former director of Jazz now works in Chicago as a professional musician and can be found online at www.derekbrownsax.com. Derek Brown has developed an original style he calls beatbox sax. His first album is ranked in Billboard's Top 25 Jazz Albums in November (http://www.billboard.com/charts/jazz-albums/2016-11-05) and his YouTube videos often receive more than 100,000 hits (https://www.youtube.com/user/beatboxsax). He visited our experiment at Fermilab this summer and agreed to work on a collaborative project with us.

Brief Description

We propose to make a YouTube video using his unique talents to explain our nuclear physics research. After a short introduction of Fermilab and the SeaQuest experiment, he illustrates the old model of the proton by playing three simple notes for the 3 quarks. As we explain the interactions taking place inside the proton, he adds new elements to his 3 note pattern. While the explanation grows in complexity, he keeps adding new beatbox techniques to the music. What starts simply develops into something awesome.

Goals of the Project

We hope to produce a popular YouTube video, so there is virtually no limit to the number of people that can be reached. The combined marketing of AIP, our university, Beatbox sax followers, and Fermilab give an incredible platform to tell our story.

Intended Audience

We hope to spark interest from both communities of people interested in science and people who love jazz.

How Proposed Activity Promotes Interest in Physics

This proposal seeks to reach a new audience in a unique way. Structure of matter is relevant to everyone since we can explain what the frontier of science says about the protons in your own body. Showing the incredible facilities of the particle accelerator, the detectors, and the computer infrastructure to the general public will spark more interest in modern physics research and make people more curious about the world around them.

Because of these two connections, the ACU SPS chapter has a unique opportunity for outreach. The Marsh White Award would give us a way to connect new worlds.

Plan for Carrying Out Proposed Project/Activity/Event

The coordination will be handled by SPS chapter advisor Dr. Michael Daugherity to make sure the preparation, filming, editing, and marketing takes place. Once the video is uploaded to YouTube, we will share it across many social media platforms and from many institutions. SPS members will be involved in every phase of the project. Several current SPS members were involved in making a series of videos about spacetime diagrams in conjunction with LIGO (https://www.youtube.com/watch?v=7By2Fox_5ic) and have gained expertise in filming and video editing. We will have two faculty and 4 or 5 SPS members back at Fermilab next summer if any final pieces remain.

Project/Activity/Event Timeline

If this proposal is approved, then we will immediately start working with Derek Brown's travel schedule to find a time to record the video. If the scheduling is impossible, then instead of filming together he can film his piece separately and send it to us electronically for editing. We will have a script by February and a schedule for filming. We are planning one trip to Fermilab to take shifts on the experiment some time in the spring and plan to have 6 or 7 arrive in mid-May for summer research. After the filming is done the editing will take less than a week and the video can be shared immediately.

Activity Evaluation Plan

The simplest way of evaluating the video is to track the number of views on YouTube. We can also have SPS members interact in the comments.

Budget Justification

The budget is quite simple. We will borrow video equipment and editing software for free from the university. The bulk of the budget, $400, will be for Derek Brown's time and effort. The remaining $100 will be for production costs including props or meals, and to pay SPS members for their work in video editing.