Stephen Pate

Major Research Project: Study of the internal structure of the nucleon via deep-inelastic processes in proton-proton and proton-deuteron interactions, and elastic processes in neutrino-proton interactions.

Present research grant: "Experimental Studies of the Quark-Gluon Structure of Nucleons and Nuclei," S.F. Pate, V. Papavassiliou; $1,260,000 over the period 4/1/2018 – 3/31/2021; US Department of Energy, Office of Science, Medium-Energy Nuclear Physics Program.

Research Personnel
Postdocs: Haiwang Yu (SpinQuest, Fermilab), Lu Ren (MicroBooNE, Fermilab)
Grad students: Jeongsu Bok (PHENIX, BNL), Chen Xu (PHENIX, BNL), Samantha Sword-Fehlberg (MicroBooNE, Fermilab), Forhad Hossain (SpinQuest, Fermilab)

The PHENIX experiment finished its very last data-taking run in 2016, completing 16 years of data collection on proton-proton, proton-nucleus, deuteron-nucleus, and nucleus-nucleus collisions. Our group has been involved in PHENIX for more than 20 years, working on the original construction of the detector in the late 1990s and also a more recent upgrade project in the period 2006-2012. We have focused on the observation of processes involving heavy quarks (charm and bottom quarks) in proton-proton and proton-nucleus collisions. In particular, the cross-section asymmetries in these heavy-quark processes, with respect to the spin-orientation of the protons in the collisions, are sensitive to the underlying proton spin structure. We have recently graduated the last of our PHENIX students.

The MicroBooNE Experiment at Fermilab observes interactions between accelerator-produced neutrinos with argon nuclei. MicroBooNE started taking data, observing interactions between neutrinos and argon nuclei, in October of 2015. Our group has been involved in a number of efforts, all in support of our goal of observing elastic neutral-current interactions between neutrinos and protons (from within the argon nucleus). Neutral-current interactions give us a window into the elastic form factors of the proton, especially the strange quark contribution to the axial form factor of the proton, which is crucial to an understanding of the spin structure of the proton.

The SpinQuest at Fermilab will observe the transverse single-spin asymmetry in Drell-Yan events for p+p and p+d interactions; the target proton or deuteron will be spin polarized. This measurement is sensitive to the role u-bar and d-bar quarks play in the spin structure of the proton.

Major research accomplishments (in the past year)
Jeongsu Bok has completed an analysis of the production of charged hadrons in proton-proton collisions at PHENIX; a manuscript has been submitted to Physical Review Letters, and Bok has graduated. Chen Xu has completed an analysis of the transverse single-spin asymmetry in the production of J/psi particles in proton-proton, proton-Al, and proton-Au collisions; this result has been published in Physical Review D, and Xu successfully defended his Ph.D. thesis. Samantha Sword-Fehlberg is in residence at Fermilab, working on short-range-correlations of nucleons in the argon nucleus. Haiwang Yu has led the simulation and data-reconstruction effort in SpinQuest. Forhad Hossain has taken a major role in the commissioning of the SpinQuest spectrometer at Fermilab, in advance of the first data-taking run in Fall 2019.

Service: Director of Physics Undergraduate Program; Tenure and Promotion Committee; Curriculum Committee; Engineering Physics Program Committee; Instructional Laboratory Committee (Chair); University Research Council (Chair-Elect); University Radiation Safety Committee (Chair).