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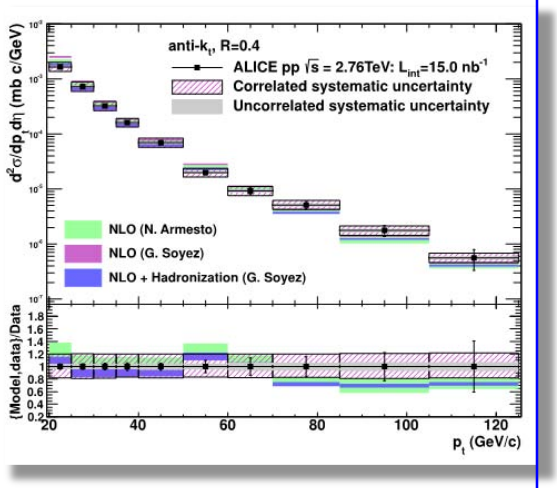
Nuclear Science Division Newsletter

In this issue: **July 2012**

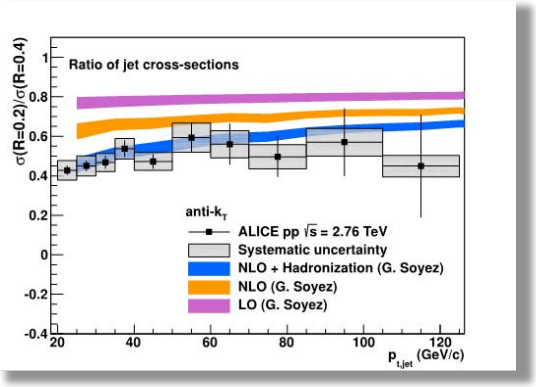
ALICE measures its first jets

Jets in high-energy collisions arise from the hard scattering of quarks and gluons from the incoming projectiles, producing a jet of particles at large angles to the beam direction. Jets have long been known to provide important probes of the Quark-Gluon Plasma (QGP) generated in high-energy heavy ion collisions, through their interactions with the QGP prior to breaking up ("fragmenting") into the particles observed in the detector. These interactions can be observed as the modification of the jet fragmentation pattern, known as "jet quenching".



The ALICE experiment, at CERN's Large Hadron Collider (LHC) is built to carry out a wide range of measurements of the QGP in the extremely complex environment of heavy ion collisions, in which many thousands of particles are generated in each event. The ALICE EMCal, which was constructed under US leadership, enables ALICE to carry out heavy ion jet measurements with high precision and, when coupled with ALICE's other capabilities, to study jet quenching in unique ways.

A major step in this program is close to completion with the first measurement of the inclusive jet production cross section in proton-proton collisions at center-of-mass collision energy 2.76 TeV. This energy is the same as that of PbPb collisions at the LHC, and this measurement provides an essential benchmark for upcoming jet measurements in PbPb collisions. It is however below the top LHC energy for proton-proton collisions. The data were collected in a two-day LHC run at this energy in March 2011.



The top figure compares the measured inclusive jet cross-section in proton-proton collisions at 2.76 TeV with several theoretical calculations. The agreement is good. The bottom figure shows the ratio of jet cross sections for two different jet "cone radii", which measures the internal distribution of energy in the jet, perpendicular to the jet axis. These measurements will play a crucial role in understanding the effects of jet quenching in other ALICE measurements currently underway.

National Research Council surveys Nuclear Physics

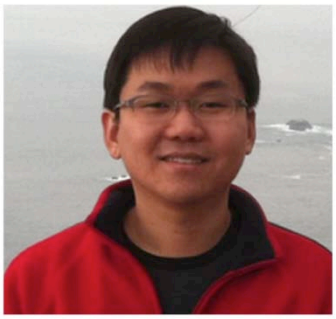
The National Research Council has released their '2010' decadal review of nuclear physics. This report, the fourth in a series (the last one came out in 1999) was put together by a 19-member committee chaired by NSDs Stuart Freedman. The committee was given two tasks: "What are the scientific rationale and objectives of nuclear physics?" and "Develop a long term strategy for US nuclear physics into 2020 in the global context."

The committee examined all aspects of the U.S. nuclear physics program, classified into 6 topics: the structure of atomic nuclei, nuclear astrophysics, the quark-gluon plasma, the quark structure of the nucleon, fundamental symmetries, and applications of nuclear physics. Three accomplishments stood out: the discovery of a near-perfect fluid in relativistic heavy ion collisions at RHIC, the precise determination of the electric and magnetic form factors of the proton and neutron at Jefferson Lab, and the final resolution of the solar neutrino problem, via the discovery and characterization of neutrino oscillations, a major accomplishment in neutrino physics and laboratory nuclear astrophysics.

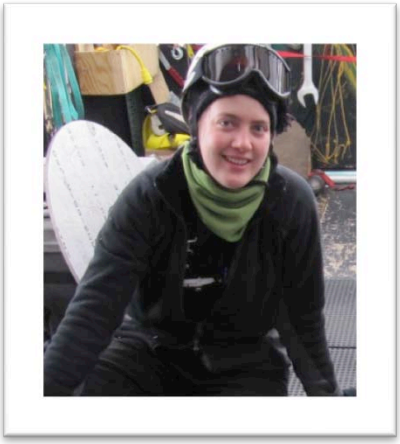
Most attention focused on the 2nd question, about the U.S. nuclear physics program over the next decade. The 2007 long range plan provided clear, albeit somewhat dated community guidance. The committee offered several findings, conclusions and recommendation. Existing facilities are critical: *"Exploiting strategic investments should be an essential component of the U.S. nuclear science program in the coming decade. Another highlights FRIB: The Department of Energy … should, in conjunction with the State of Michigan … work toward the timely completion of the Facility for Rare Isotope Beams and the initiation of its physics program."* Underground science was also recognized, *"The DOE, NSF and other funding agencies…should develop and implement a targeted program of underground science, including important experiments on whether neutrinos differ from antineutrinos, what is dark matter, and nuclear reactions of astrophysical importance. Such a program would be substantially enabled by the realization of a deep underground laboratory in the United States."* The committee felt that another proposed project, an electron-ion collider, should be evaluated carefully during the next nuclear science long-range plan. Computing was recognized with a recommendation that the theoretical community develop a plan that will provide access to forefront computing resources, leading to the use of exascale computing capability. The dual role (education and research) played by universities was emphasized, as was the importance of balancing small, medium and large-scale facilities. *"The committee concluded that it is critical to maintain a balance between funding of major facilities operations and the needs of university based programs."* The committee recognized the importance of competitiveness and innovation, recommending that the sponsoring agencies strive to develop flexible and streamlined procedures, including those tailored for smaller scale projects.

During the course of the committees work it became clear that the funding profile for nuclear physics was not following the guidance originally given to the committee. The difficult task of responding to the shortfall and prioritizing the current program components has been charged to a newly formed subcommittee of NSAC. Although obtaining adequate funding to take advantages of all present opportunities may prove to be challenging, the NRC decadal survey clearly shows that nuclear physics is positioned to make important contributions to the scientific vitality of the Nation.

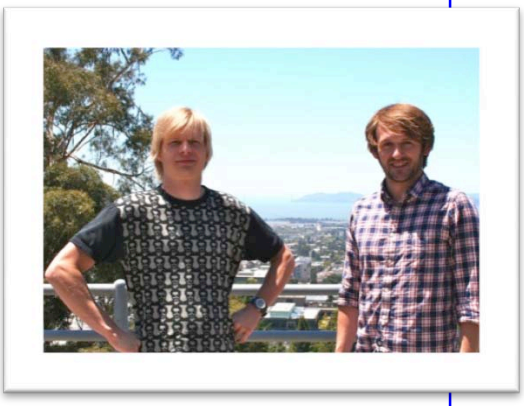
NSD Fragments



NSD postdoc **Len Eun** has won the 2012 RHIC & AGS thesis award for his dissertation, *"Transverse Single Spin Asymmetries and Cross-Sections for forward π^0 and η Mesons at Large x_F in $\sqrt{s}$= 200 GeV p↑+p Collisions at STAR."* His work was cited for revealing "the existence of a remarkably large single beam-spin asymmetry in the production of η mesons at forward rapidity. The asymmetry is, with good probability, larger than for π^0 mesons, which has contributed significantly to the renewed interest in transverse spin phenomena in hard interactions. Len received his PhD from Penn State in August, 2011, and he is continuing his work with STAR in the RNC group. Congratulations Len!



Freija Descamps has joined the Nuclear Science Division, where she will work on SNO+, initially on PMT calibration and calibration sources. Freija received her PhD from the university of Gent, in Belgium, where she studied acoustic detection of neutrinos. Most recently, she spent 2011 at the South Pole Station, where she served as a winter-over for IceCube.



Juho-Antti Rissanen (left) **Andreas Wiens** (right) and have joined the NSD nuclear structure program, where they are working with GRETINA. Andreas is working on optimizing the performance of GRETINA, while Juho works with GRETINA, and also experiments with heavy elements using the BGS separator. Before coming to Berkeley, Wiens was at the University of Cologne, where he worked on the European AGATA spectrometer, developing new approaches to enhance energy resolution in segmented germanium detectors. Rissanen worked at the University of Jyväskylä, Finland, where he studied neutron rich nuclei around A=110, using a Penning-trap-assisted spectroscopy method.

Newsletter Notes

Please send any comments, including story suggestions to Spencer Klein at: srklein@lbl.gov.

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