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ABSTRACT

Simulation Additions for the Proposed Hall A Moller Experiment. ALEXANDER BROWN (Virginia Polytechnic Institute and State University, Blacksburg, VA 24060) MARK DALTON (Thomas Jefferson National Accelerator Facility, Newport News, VA).

Hall A of Jefferson Lab currently plans to use a 150 cm beam target of liquid hydrogen (LH_2) in its upcoming Moller Scattering experiment. In order to study the proposed experiment and fine-tune the equipment specifics needed, a simulation was created using the package GEANT4. Initially, the simulation being used to help in the project's planning used target geometry of a single floating cylinder of LH_2. The purpose of this project was to study the effect that aluminum windows on the front and back ends of the target will have on the expected results. To do this, cross section and asymmetry calculations for different interactions in aluminum were added to the program, along with geometry adjustments for the aluminum ends. When the simulation is run with the newly added scattering information occurring in the aluminum windows, the resulting data will be taken into consideration for future figure of merit calculations.

ABSTRACT

Hadron mass corrections in polarized semi-inclusive deep inelastic scattering. STEVEN CASPER (Carnegie Mellon University, Pittsburgh, PA) WALLY MELNITCHOUK (Thomas Jefferson National Accelerator Facility, Newport News, VA).

We derive mass corrections for semi-inclusive deep inelastic scattering of leptons from nucleons using a collinear factorization framework which incorporates the initial state mass of the target nucleon and the final state mass of the produced hadron. The formalism is constructed specifically to ensure that physical kinematic thresholds for the semi-inclusive process are explicitly respected. We calculate a leading-order cross section from the contraction of a lepton tensor and a hadron tensor, and we find it is a function of mass-dependent scaling variables. Comparison with the cross section without mass corrections shows significant deviation in the kinematic regions of facilities such as Jefferson Lab. The mass corrections will be important to efforts at extracting polarized parton distribution functions from semi-inclusive processes at intermediate energies.

ABSTRACT

Nuclear Effects in the Proton-Deuteron Drell-Yan Reaction. PETER EHLERS (University of Minnesota – Morris, Morris, MN 56267) WALLY MELNITCHOUK (Thomas Jefferson National Accelerator Facility, Newport News, VA).

Scattering experiments using a deuteron target, composed of one proton and one neutron, are currently the simplest way of studying the internal structure of the neutron. The internal structure can be revealed by examining scattering cross sections for certain reactions using deuteron targets. One such reaction is the Drell-Yan process, where a quark and an antiquark for different hadrons annihilate and produce a lepton-antilepton pair. One can express the proton-deuteron (pD) cross section in terms of the proton-nucleon cross sections as well as the momentum distribution of the nucleons in the deuteron, called the smearing function. For this project, an expression for the smearing function of the

pD cross section in the Drell-Yan process was obtained while making as few approximations as possible. The results from this project will allow more accurate computation of the pD Drell-Yan cross section, which is especially necessary for lower energy collisions.

ABSTRACT

Beam Diagnostics of the Compton Scattering Chamber in Jefferson Lab's Hall C. ADAM FAULKNER (State University of New York at Albany, Albany, NY) JOHN MUSSON (Thomas Jefferson National Accelerator Facility, Newport News, VA).

Upcoming experimental runs in Hall C will utilize Compton scattering, involving the installation of a rectangular beam enclosure. Cylindrical stripline Beam Position Monitors (BPMs) are not appropriate due to their form factor; therefore to facilitate measurement of position, button-style BPMs are being considered. Button experience is limited at Jefferson Lab, so preliminary measurements are needed to characterize the field response and guide the development of appropriate algorithms for the Analog-to-Digital receiver systems. $\vec{E}$-field mapping is performed using a Goubau Line, which employs a travelling wave to mimic the electron beam, helping to avoid problems associated with vacuum systems. Potential algorithms include look-up-tables, as well as a potential third order power series fit. In addition, the use of neural networks specifically the multi-layer Perceptron will be examined. The analysis of the field response suggests the buttons are accurate to 10 mm, and will be successful in beam diagnostics for Hall C.

ABSTRACT

Non-linear Multidimensional Optimization for use in Wire Scanner Fitting. ALYSSA HENDERSON (University of Virginia, Charlottesville, VA 22903) ALICIA HOFLER and BALŠA TERZIĆ (Thomas Jefferson National Accelerator Facility, Newport News, VA 23606).

To ensure experiment efficiency and quality from the Continuous Electron Beam Accelerator, beam energy, size, and position must be measured. Wire scanners are inserted into the beamline to produce measurements which can obtain beam properties. Extracting physical information from wire scanner measurements begins by fitting Gaussian curves to the data. This study focuses on optimizing and automating this curve-fitting procedure. We use a hybrid approach combining the efficiency of Newton Conjugate Gradient (NCG) method with the global convergence of three nature-inspired (NI) optimization approaches, which ensures the quality, robustness, and automation of curve-fitting. Given an initial data-derived guess, each finds a solution with the same chi-square-- a measurement of the data-to-fit agreement. The procedure begins with NCG and escalates to a NI method only if NCG fails, thereby ensuring a successful fit. This method allows for the most optimal signal fit and can be easily applied to similar problems.

ABSTRACT

Optimization of Spin-Polarization of Helium-3 Target Cell by Thermal Convection Processes. STACY E. KARTHAS (University of New Hampshire, Durham, NH 03824) PATRICIA SOLVIGNON (Thomas Jefferson National Accelerator Facility, Newport News, VA).

Spin-polarized Helium-3 (^3He) cells have been used in many experiments at Jefferson Lab as effective neutron targets to get access to the neutron properties. To reduce the polarization gradient within the cell we studied the new convection system and its effects on adiabatic fast passage (AFP) polarization loss that results from measuring the polarization of Magnetic Resonance (NMR). A Kapton flexible heater was used to induce convection within the cell. By methods of NMR polarimetry, the convection speed and AFP loss was found for multiple heater powers. It was found that an appropriate gas velocity of 6.05 cm/min was easily achievable with an absolute AFP loss below one percent in both the pumping and target chambers. These results indicate that this heater will be able to be used to induce convection in the new cell with small AFP losses.

ABSTRACT

Formulism for R, the Longitudinal to Transverse Momenta Ratio, Within the Quark Parton Model.

DANIEL KOCH (San Jose State University, San Jose, CA) WALLY MELNITCHOUK (Thomas Jefferson National Accelerator Facility, Newport News, VA).

When nucleons are struck by a beam of electrons, the scattering process is a combination of the beam's energy as well as the primordial motion of the quarks within the nucleon. Until recently, it has been assumed that at high Q^2, the transverse moment k_T of the parton was negligible. However, new experiments at low Q^2 suggest that k_T dependence may indeed play a significant role. The exact k_T dependence based on theoretical grounds is still unknown, and is the major objective of this project. We examined previously laid theoretical groundwork for R (R = σL/σT) and improved them. In particular, we updated several of their formulas using modern techniques and distribution functions. If our theoretical models match well with the data, it will prove that k_T dependence can no longer be ignored. At low Q^2, this primordial transverse momentum will need to be more accurately studied.

ABSTRACT

Evaluating the Field Emission Characteristics of Al and Cu Electrodes for DC High Voltage Photo-Electron Guns. *RHYS TAUS (Loyola Marymount University, Los Angeles, CA 90045) MATTHEW POELKER (Thomas Jefferson National Accelerator Facility, Newport News, VA).*

High current photoguns require high power laser light, but only a small portion of the laser light illuminating the photocathode produces electron beam. Most of the laser light (~ 65%) simply serves to heat the photocathode, which leads to evaporation of the chemicals required to create the negative electron affinity condition necessary for photoemission. Photocathode cooling techniques have been employed to address this problem, but active cooling of the photocathode is complicated because the cooling apparatus must float at high voltage. This work evaluates the field emission characteristics of cathode electrodes manufactured from materials with high thermal conductivity: aluminum and copper. These electrodes could serve as effective heat sinks, to passively cool the photocathode that resides within such a structure. However, literature suggests "soft" materials like aluminum and copper are ill suited for photogun applications, due to excessive field emission when biased at high voltage. This work provides an evaluation of aluminum and copper electrodes inside a high voltage field emission test stand, before and after coating with titanium nitride (TiN), a coating that enhances surface hardness.