

Stony Brook University The Graduate School

Doctoral Defense Announcement

Abstract

Probing the Nucleus with d+Au Collisions at RHIC

By

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The Relativistic Heavy Ion Collider (RHIC) was built to produce and study Quark Gluon Plasma (QGP) the phase of matter thought to exist under conditions sufficiently hot and dense to create a medium in which the degrees of freedom are quarks and gluons rather than color neutral hadrons. Already in its early years of running the data from RHIC provided tantalizing evidence of QGP signatures in Au+Au collisions at $\sqrt{s_{NN}}=200\text{GeV}$. A crucial part of understanding the putative QGP in Au+Au collisions is to have both a well understood reference as well as a robust control experiment. Proton-proton collisions at the same $\sqrt{s_{NN}}$ serve as the baseline for heavy ion collisions at RHIC. For the control experiment, RHIC's ability to collide asymmetric beams is utilized and d+Au collisions are used. Unlike p+p collisions, in the d+Au system there is a nuclear medium present - the heavy Au nucleus - and so we may study this system to distinguish initial state cold nuclear matter effects from final state effects that occur in the hot dense medium of Au+Au collisions.

Beyond its use as a control experiment, the d+Au collision system presents the opportunity for important study of nuclear and nucleonic structure, it is after all necessary for our colored parton theory to operate in the nucleus as well as in a QGP. Deuteron - gold collisions at RHIC are a powerful tool for shedding light on cold nuclear matter effects.

This thesis describes two analyses of d+Au collisions measured by the PHENIX experiment at RHIC. The first is a measurement of the midrapidity yield of unidentified charged hadrons in the 2003 RHIC run. This is used as a key baseline for understanding particle production in Au+Au collisions as well as a detailed look at the Cronin effect. The second analysis measures rapidity separated two-particle production where one of the particles is at either forward or backward rapidity and the other at midrapidity. These measurements probe different x regions of the Au nucleus and there investigate shadowing, anti-shadowing and other cold nuclear matter effects.

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