APR15-2015-000539

Abstract for an Invited Paper
for the APR15 Meeting of
the American Physical Society

Quarkonia production in p+A collisions - what have we learned?

ANTHONY FRAWLEY, Florida State University

It has been known for many years that gluon distribution functions in nuclei are modified from those in a proton. The modification should affect the yields of hard probes produced in high energy p+A collisions, since they are produced in hard scattering processes between partons in the proton and the nuclear target. This phenomenon is interesting in itself, and also because it affects the initial state in high energy heavy ion collisions, where a quark gluon plasma (QGP) is formed. Knowledge of the initial state modification in heavy ion collisions is needed before one can try to understand the effects of the QGP on the production of hard probes. The modification of the yield from a hard process that involves a gluon in a nuclear target depends on the fraction of the momentum carried by the gluon, and the momentum transferred in the interaction. For low values of the momentum fraction, the yield is reduced (referred to as shadowing). For large values of the momentum fraction it is enhanced (referred to as anti-shadowing). The modification becomes smaller as the scale of the momentum transfer increases. From simple kinematic considerations, the modification must depend on the rapidity of the detected hard probe and the collision energy. The production of charm and bottom quarks is sensitive to the gluon distributions in the projectile and target. It occurs at a scale (set by the masses of the charm and bottom quarks) that is reasonably low - and so the modification is expected to be significant. Thus a comparison of charmonium or bottomonium production between p+p and p+A collisions should reflect the gluon modification in the target nucleus. There are, however, other processes besides modification of the parton distributions that contribute to quarkonia production in a nuclear target and these need to be understood. They include breakup of the forming quarkonia by collisions with nucleons in the target, and parton energy loss in the cold nucleus. There is also recent evidence of collective flow effects in high energy p+A collisions, suggesting that a small quark gluon plasma may be formed. There is now a large body of data on heavy quarkonia production in p+A collisions at energies ranging from $\sqrt{s_{NN}} = 17$ GeV to 5 TeV and covering a wide range of rapidities. I will review this data set and discuss what we have learned from it about the issues outlined above.