A Fixed-Target Program for STAR: Extending the Low Energy Reach of the RHIC Beam Energy Scan Program  

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**MOTIVATION**

The RHIC Beam Energy Scan (BES) was proposed to search for the possible critical point and to study the nature of the phase transition between hadronic and quark-gluon phases of matter. Data from the NA49 experiment at CERN had suggested the onset of deconfinement at a collision energy of 7.7 GeV [1]. Though RHIC has not demonstrated sufficient luminosity to access collisions below 7.7 GeV in collider mode, interactions between beam nuclei and a stationary gold target will allow STAR to study Au+Au events at center-of-mass energies between 3.0 and 4.5 GeV during the BES phase II. A proof-of-principle study, using interactions between nuclei in the beam halo and the aluminum beam pipe data taking in years 2010 and 2011, has been investigated to demonstrate the feasibility of extracting physics from fixed-target interactions at center-of-mass energies below 7.7 GeV. Performance results from this proof-of-principle study will be presented. The gold target was installed for trigger tests during the 14.5 GeV Au+Au run in March of 2014. The first results of these gold target tests ($s_{NN} \approx 3.9$ GeV) are also presented.

**GOLD TARGET INSTALLATION (2014)**

The gold target installation (2014) was designed to allow STAR to study Au+Au collisions at a fixed beam energy below 3.9 GeV. The gold target is a 2 cm thick gold foil; the projectiles are ions from the halo of the “yellow beam.” The target is a gold foil; the projectiles are Au ions incident on the gold target. Figure 1 shows a cartoon of the phase diagram of QCD matter below the reported onset of deconfinement (CERN data taking year 2012). The Fixed Target Program has been investigated to demonstrate the feasibility of exploring the low energy region of the QCD phase diagram up to $s_{NN} \approx 720$ MeV. The fixed-target program will allow STAR to study Au+Au collisions at center-of-mass energies between 3.0 and 4.5 GeV.

**FIXED TARGET TRIGGER TESTS (2014)**

The Goals of the Beam Energy Scan Program:
1. Find the disappearance of QGP signatures  
2. Find evidence of a first-order phase transition  
3. Find the possible Critical Point

The fixed-target program will extend the search range for all of these features of the QCD phase diagram up to $s_{NN} \approx 720$ MeV.

**OUTLOOK**

We have successfully installed a gold target in the STAR detector. Preliminary data show that the fixed-target trigger is selecting fixed-target events and rejecting beam-beam collisions. With more events, we expect fruitful physics analyses can be done as per prior proof-of-principle studies conducted on fixed-target Au+Au events. This fixed-target program will enable STAR to make key measurements related to the phase diagram of QCD matter below the reported onset of deconfinement at $s_{NN} \approx 7.7$ GeV.

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**REFERENCES**