

## **Charge to RHIC Collaborations: Future opportunities for p+p and p+A at RHIC**

The current RHIC run plan anticipates high luminosity Au+Au and p+p runs of RHIC in FY2021 and FY2022 utilizing the enhanced capabilities of sPHENIX and STAR anticipated for these years. The current physics focus of these runs is on hard probes, especially jet observables and Upsilon states. Depending on the available operating funds and presently unknown details of the future run schedule, there may be the opportunity to perform high luminosity p+Au (or other p+A) runs during this time.

C-AD currently anticipates the following peak luminosities: 200 pb<sup>-1</sup>/week for 500 GeV p+p and 300 nb<sup>-1</sup>/week for 200 GeV p+Au. The p+p luminosity assumes a bunch intensity of  $3 \times 10^{11}$  up from the present value of  $1.85 \times 10^{11}$ , and shorter bunches. The p+Au luminosity assumes bunch intensities of  $3.0 \times 10^{11}$  for protons and  $1.5 \times 10^9$  for Au. Since these numbers represent substantial increases over historically achieved luminosities, it may be prudent to assume somewhat lower numbers for estimates of required beam times.

In view of the prospect that the capability to investigate p+p, p+A, and A+A collisions at RHIC may be lost after the possible transition of the RHIC facility to a electron-ion collider, it is timely to consider the future physics opportunities for a polarized p+p and p+A program at RHIC from our present state of knowledge.

The question of the relative priority of extended p+A runs in the final years of RHIC is likely to come up in the context of the upcoming Long Range Plan process. In order to provide a framework for this discussion I am hereby asking the Collaborations to submit Physics Assessments of the scientific reach of such a program in the light of the anticipated capabilities of the RHIC detectors at the time of the final RHIC campaign.

Specifically, I would request that the assessment considers the following issues:

- The scientific motivation for high statistics p+p and p+A data based on our current knowledge, especially in the light of a future EIC physics program and with special consideration of the use of polarized protons;
- What will likely be accomplished during Runs 14-16;
- The compelling physics observables and their expected physics reach;
- The required integrated luminosities;
- The possible need for collision systems other than p+Au (e.g. p+C, p+Cu, d+Au).
- Detector requirements for a successful p+p/p+A program and the associated cost and schedule.

In particular, the document should address which compelling physics questions the p+p and p+A program at RHIC could address in the early part of the next decade in the context of the experiment upgrade plans, the existing and anticipated data from RHIC, LHC, and COMPASS, and a future EIC. The document should address the question to what extent polarized p+p and p+A collisions are complementary to the physics program of an EIC and not just an alternate and possibly less discriminating way of studying the same physics.

In order to be most useful as basis for the discussions in the context of the Long Range Plan process, I request that you submit your assessment no later than April 30, 2014. The two RHIC collaborations may consider the value of collaborating on the physics part of this charge and developing a joint Physics Assessment, followed by separate sections describing the hardware requirements and expected physics reach of each detector.

A handwritten signature in black ink, appearing to read "Berndt Mueller". The signature is fluid and cursive, with the first name being more prominent.

Berndt Mueller

ALD for Nuclear and Particle Physics

October 8, 2013