Global Variables Summary and Plans

PHENIX Global Variables Physics Working Group
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1 Overview

Global event parameters in RHIC collisions are of interest because there is a large latitude in extrapolations from fixed target CERN energy to RHIC energy. Commonly used event generators tuned on SPS data differ by as much as factors of 2 in such basic predictions as charged particle multiplicity ($dN_{ch}/d\eta$) and transverse energy (E_t). In particular, the predictions of the shapes, widths and normalizations of the spectra differ in calculations by the popular event generators such as VNI, RQMD, HIJING, and HIJET. Further, there is a variation in the results of hydrodynamic models as well, because the models begin from assumptions about the exact initial features of the formed fireball (cf., e.g., recent HYLANDER-C calculations); these assumptions can only be validated by comparing to actual measurements.

The basic measurements will be available almost immediately after RHIC turn-on and consist of E_t and $dN_{ch}/d\eta$ distributions; these can be tagged on spectator neutron multiplicity in each beam direction to investigate their behavior with respect to event centrality. These measurements complement one another and should logically be incorporated in a single publication.

The shapes and normalization of the $dN_{ch}/d\eta$ spectra will immediately indicate which cascade codes have to be considered as the appropriate choices for further physics discussions. This ability to constrain the models early on will be important not just for understanding the global aspects of the interactions, but also to provide a relevant framework for predictions of other physics quantities of interest to PHENIX, *e.g.* charmonium suppression, jet quenching, *etc.*

The simultaneous measurement of $dN_{ch}/d\eta$ and E_t spectra will reflect essential information on the global features of the formation of the Au-Au fireballs, *e.g.* stopping and transparency. In addition, E_t measurements will provide strong constraints on the transverse expansion of the fireball, while $dN_{ch}/d\eta$ spectra are sensitive to the longitudinal expansion of the system. Thus, the combined spectra will provide limitations to hydrodynamical models, in particular regarding their assumptions on the build-up of flow, which is directly related to the effective softness of the equation of state of nuclear matter at these extremely high energy densities.

Our Group's plan for publication is to think in terms of a single publication incorporating the above measurements and their correlations. However, depending on how rapidly data and analysis take shape, we may subsequently decide to break out a smaller subset of topics.

2 Relationship between our Physics program and schedule

By and large we see no part of our measurements which is sacrificed by various PHENIX staging scenarios. Nevertheless we identified a few concerns that will affect our readiness to make the needed measurements.

- $dN_{ch}/d\eta$– Although the MVD will be ready from the start, it should be kept in mind that the detector will not be installed around the beampipe until background/radiation levels are acceptable. We don't know when this will happen. In the mean time calibration of the $dN_{ch}/d\eta$ measurement must be worked out in detail; methods and cross-checks are being studied. We also need to understand whether BBC can contribute to the $dN_{ch}/d\eta$ measurement.

- E_t– Some fraction of solid angle will be covered by EMCAL even for the engineering run. Work needs to be done to calibrate detector response relative to "generated" E_t. One aspect is to better understand "non-vertex Background" in which our recent simulation studies do not fully differentiate decays (which is just a "response issue") from secondary scatters (which can mix different regions of η).

- **Spectator Neutron Measurement**– although the ZDC detector hardware and electronic readout should be ready well in advance of the run, we see a real vacuum in the preparation of software. We strongly recommend that this system be adopted by BBC since the whole ZDC (6 channels) occupies 3/4 of one BBC front end electronics card.

- **Other**– Central Rapidity Proton Multiplicity, $\langle p_t \rangle$ of π^o and $\langle p_t \rangle$ of charged particles are global event properties which are closely related to the above measurements. We would like to work closely with the "hadron" group to plan early measurements for a subsequent publication.