*Day-One Physics*

**I.** $Au + Au$ at $\sqrt{s} = 200$ collisions: 1X10$^6$ minimum biased good events will provide the following measurements and possible physics:

1. The 'cross section' $d\sigma/dN_{charge}$ (and possibly $d\sigma/dE_T$) and $dN_{charge}/d\eta$ (and possibly $dE_T/d\eta$) as a function of the trigger cross section (impact parameter) $\sigma_{trig}$. The statistical error for the top trigger cross section cut, $\sigma_{trig}/\sigma_{geom} \leq 5\%$, should be less than 10%. This number is obtained from the event generators like HIJING and RQMD which are believed to predict a lower bound of the charge particle multiplicities at the RHIC energy. Systematic errors should be extracted from the MDC2 data.

   ***Physics**: The multiplicity (and/or transverse energy $E_T$) measurements should provide*

   - *collision geometry;*
   - *the value of multiplicity is related to the entropy production;*
   - *with further model analysis, one can extract an experimental effective energy density $\epsilon_e$. Both 'entropy' and 'energy density' results can be compared with the results measured at AGS and SPS.*

2. The event anisotropy ($flow$) measurements: $v_i, i = 1, 2, ..$ will be measured as a function of rapidity (within the acceptance), and transverse momentum $p_T$ for charged hadrons (no pid), pions and protons.

   ***Physics**:*

   - *The information on the reaction plane can be obtained from the $v_i$ measurement. Any later physics analysis for non-central collisions, for example, the mean transverse momentum $\langle p_T \rangle$, the HBT size parameters ($R_i, i = out, side, long$), should have certain dependence on the reaction plane;*
   - *The event anisotropy parameters, $v_i, i = 1, 2, ..$, especially the $v_2$ may provide the information at the stage when the density is the highest during the history of the collision.*

3. Charged particle ($\pi^{\pm}, K^{\pm}, p^{\pm}$, $\Phi$, and possibly deuteron) transverse momentum and rapidity distributions at relatively low $p_T$ region ($\leq$ 1 GeV). The statistical error for the transverse momentum distributions is negligible due to high multiplicity. But the errors in net proton distribution $p - \bar{p}$ is non-trivial and more studies are needed.

   ***Physics**:*

   - *The net proton distribution $N_p = p - \bar{p}$ distribution as a function of rapidity is the combination of energy loss (at early stage) and particle production during the collisions. Take into account of the information from $\Lambda$ measurements, one can determine the net baryon distributions at the RHIC energy. The centrality dependence of $N_p$ should be included in the study;*

- *The $\pi^{\pm}, K^{\pm}, p^{\pm}$, and deuteron transverse momentum distributions will provide information on possible collective flow which may be related to pressure, in the language of hydrodynamics. There is no doubt that the pressure is one of most important parameters in determing the formation of the new form of matter;*
- *Within the same event class, the ratios among different particles can be extracted. These ratios will provide information on the chemical properties of the system.*

4. In terms of model calculations, we already have (or get them very soon) most of the above mentioned distributions from event generators HIJING, RQMD, VENUS, and VNI. What do we need urgently is to process these through the STAR detectors and get the relevant acceptance, efficiency, momentum resolution, background parameters. Reliable simulation tools are needed in this case. After MDC2, we hope to have some of the parameters from few models. We would like to stress here that we need to do it through all possible models in order to understand the systematics. One another important issue is the detector calibration.

**II.** In order to reach a similar statistical accuracy, one needs about 5 - 6X$10^6$ minimum biased events for light ion Si + Si collisions.

**III.** With the above statistics (1X$10^6$ Au+Au and 5X$10^6$ Si+Si) the systematic errors will be the dominant factor. If we accumulate only 1-5X$10^4$ events, most of the above physics still can be done except the event anisotropy. More events, about 0.5X$10^6$, are needed in order to determine the reaction plane and its resolution. In any case, the statistical error will be similar to the systematic ones, and number of bins in rapidity and transverse momentum may have to be reduced. More simulations in this direction are needed in the next few month.