Recommendations
Brookhaven National Laboratory
Nuclear and Particle Physics
Program Advisory Committee
June 15-16, 2009

1. Introduction

On June 15, 2009, the PAC heard background information on facility operation, experimental upgrades, possible signals of a QCD critical point as well as the PHENIX and STAR Beam Use Requests (BURs). Based on this input, we report our recommendations for Runs 10 and 11 with discussion of both heavy ion and polarized proton physics. We also comment on the status and prospects for machine and experimental upgrades, and conclude with comments about the preparation of future BURs. The recommendations of Section 2 are based on a total of 25 physics weeks, and involve a substantial period of running by only the STAR detector.

2. RHIC run plans

2.1 Executive summary

For Run 10 the PAC recommends the following (*in order of priority*). All are 'must-do' for the RHIC program. The first two, for heavy ions, depend on detector and accelerator configurations likely in place only for Run 10; the third looks forward to the next stage of spin physics.

1. 10 weeks of Au-Au collisions at $\sqrt{s_{NN}}$ = 200 GeV, to exploit the PHENIX Hadron Blind Detector (HBD). Since this is a unique dataset for the HBD, we consider it of very high importance that sufficient statistics be accumulated for a definitive measurement of the low-mass vector channel spectral function in central 200 GeV Au-Au collisions. This run will also allow STAR to make first use of its upgraded data acquisition system and newly installed time-of-flight detector (ToF) and advance the characterization of jet quenching.
2. 12 weeks for a beam energy scan (BES) with Au-Au collisions, beginning with 4 weeks of Au-Au collisions at $\sqrt{s_{NN}}$ = 62 GeV. This run should enable the collection of 400M events for a significant measurement of initial temperature via low mass, high p_T dielectron pairs, which also takes advantage of HBD

capabilities. This would be followed by 8 weeks at lower energies. One half week should be allocated for each of $\sqrt{s_{NN}}$ = 39 and 27 GeV collisions, which will be utilized by both PHENIX and STAR. The remaining 7 weeks should be devoted to the accumulation, by STAR, of significant statistics at energies at and below the top SPS energy, where PHENIX has stated it will not run. A run plan for this period that is consistent with PAC priorities, with estimated event totals for STAR, is as follows: 1 week at $\sqrt{s_{NN}}$ = 18 GeV (10 million events), 2 weeks at $\sqrt{s_{NN}}$ = 11 GeV (6 million events), 4 weeks at $\sqrt{s_{NN}}$ = 7.7 GeV (3.6 million events). The use of only one of the two major detectors during the latter period is justified by the strong attention given in the RHIC community to the potential for a landmark observation in this energy range.

3. 3 weeks of beam development for p-p running at $\sqrt{s}$ = 500 GeV to ensure luminosity and polarization goals for Run 11 are met. In the case where some, but not all, of the 3 weeks are required for this development, up to 1 week should be allocated to p-p running at $\sqrt{s}$ = 22.4 GeV. In the event the Laboratory determines that no dedicated p-p development is necessary, these 3 weeks should be added to the 8 weeks for a BES at 39 GeV and below (see above), in such a way that it preserves the running at the five different energies between $\sqrt{s_{NN}}$ = 7.7 and 39 GeV, but accumulates more statistics where they are deemed most important.

For Run 11 the PAC recommends the following (*not* in order of priority):

1. Seven weeks of Au-Au collisions at $\sqrt{s_{NN}}$ = 200 GeV, to exploit the new capabilities of the PHENIX VTX detector and to accumulate statistics for rare probes at the top energy.

2. A brief run with U beams, sufficient to accumulate 200 million collisions in both STAR and PHENIX, for initial exploration of this new RHIC physics program enabled by EBIS.

3. Ten weeks of p-p at $\sqrt{s}$ = 500 GeV, assuming the goals for luminosity and polarization are demonstrated before Run 11.

2.2 Discussion of heavy ion running

2.2.1 Run 10: Au-Au at $\sqrt{s_{NN}}$ = 200 GeV and 62 GeV

An extended Au-Au run at $\sqrt{s_{NN}}$ = 200 GeV in Run 10 will provide a unique opportunity for both experiments to make full use of recently completed and installed detector upgrades.

In the case of STAR, the upgrade of the data acquisition system, combined with improvements in the luminosity of the machine, will lead to a significant increase in the statistics STAR can accumulate at the top RHIC energy. In addition, this will be the first run for which the ToF detector will be available with full coverage, while reduced material in the detector will enable improved measurement of electron spectra. In this way, STAR is well positioned to make significant advances in characterizing jet quenching; in particular, a measurement of the single electron spectrum in a wider p_T range and with smaller systematic uncertainties will contribute to resolving the existing discrepancy between PHENIX and STAR. These data will address one of the main outstanding questions in the current understanding of jet quenching, namely, the extent to which heavy quark energy loss differs from that of light partons. More generally, the analysis of jet-like observables, including measurements of back-to-back correlations, will profit greatly from the improvements of detector and machine in Run 10.

For PHENIX, Run 10 presents the unique chance to reap the benefits of their significant investment in the Hadron Blind Detector (HBD), prior to its removal to allow installation of the silicon vertex detector. The HBD provides the capability to measure low-mass electron pairs with sufficient precision for a definitive characterization of the medium-modification of the spectral function in the vector meson channel. It is the measurement most directly related to chiral symmetry restoration in a quark-gluon plasma and thus represents an important milestone for a complete characterization of hot and dense QCD matter at a given center of mass energy. In addition, the HBD will provide unique measurements of thermal radiation by measuring low-mass (below that of the ρ meson) dileptons. This will allow for quantitative characterization of the initial temperature attained in the Au-Au collisions.

To arrive at a definitive statement about the ρ meson spectral function at $\sqrt{s_{NN}} = 200$ GeV, competitive in precision with the best measurements at the SPS, 8-10 weeks of running at nominal luminosity are needed. Given that this is a key measurement of any complete Au-Au physics program at the top RHIC energy, and given that this program cannot be completed in later runs when the HBD will be removed, we recommend that the resources necessary to achieve this goal be allocated with highest priority. The integrated luminosity needed for a definitive statement about thermal radiation is less stringent, and the suggested run plan should also provide the data for a determination of the initial (flow-shifted) temperature with an accuracy of about 20 MeV.

At lower energies, statistical requirements for a dilepton measurement of the vector meson spectral function appear very demanding. On the other hand, the integrated luminosity of ~ 4 weeks of Au-Au collisions at $\sqrt{s_{NN}} = 62$ GeV will be sufficient for a significant measurement of the thermal photon radiation at this lower center of mass energy. The measurement of the low-mass dilepton spectral function will not be as precise as that at 200 GeV, but should still provide important information about the beam energy dependence of the low-mass excess that is observed at the higher energy and that is not present in the NA60 measurement.

2.2.2 Run 10: Beam energy scan

Recommendation:

[4.0 weeks at $\sqrt{s_{NN}}$ = 62 GeV (already discussed above)]
0.5 weeks at $\sqrt{s_{NN}}$ = 39 GeV
0.5 weeks at $\sqrt{s_{NN}}$ = 27 GeV
1.0 week at $\sqrt{s_{NN}}$ = 18 GeV
2.0 weeks at $\sqrt{s_{NN}}$ = 11.5 GeV
4.0 weeks at $\sqrt{s_{NN}}$ = 7.7 GeV

For several years now, a beam energy scan (BES) has been on the future agenda for RHIC, with strong support from the PAC. It is motivated by two guiding ideas: (i) the search for the existence of a critical endpoint (CEP) between a first order phase transition at high baryon density (predicted by a number of QCD-based models) and a continuous cross-over transition at low net baryon density (predicted by Lattice QCD and consistent with existing experimental data from RHIC collisions at $\sqrt{s_{NN}}$ = 200 and 62 GeV); and (ii) the study of the beam energy dependence of various experimental signatures observed at top RHIC energies that are believed to signal the existence of a new phase, a strongly coupled quark-gluon plasma (QGP) with very low viscosity. If our current understanding is correct, these signatures should gradually or suddenly disappear at lower collision energies where none of the fireball matter created in the collision exists in the new phase. During Run 10, the PHENIX and STAR Collaborations have requested beams at several energies below $\sqrt{s_{NN}}$ = 62 GeV (the lowest center-of-mass energy per nucleon pair studied extensively so far), ranging from $\sqrt{s_{NN}}$ = 39 GeV to 5 GeV. At each of these energies, the beam time requests differ significantly between the two collaborations. These differences are driven by a combination of different detector capabilities and different measurement priorities held by the two collaborations.

The PAC finds that meaningful experimental insights into the existence and possible location of the CEP in the QCD phase diagram require measurements that are either qualitatively novel (such as the observation of non-monotonic beam energy dependences in fluctuation and correlation signatures, associated with behavior near a critical end point) or that provide statistically very significant, and systematically well-controlled, results that substantially strengthen or invalidate existing experimental indications from data collected in earlier SPS experiments. In arriving at its recommendations for the BES, the PAC has given priority to careful measurements of the energy dependence of fluctuation and correlation observables associated with the CEP search, over systematic 'disappearance measurements' for signatures that require large integrated luminosity (such as high-p_T single particle suppression).

The total beam time of 8 weeks allocated to $\sqrt{s_{NN}}$ between 7.7 and 39 GeV is substantially less than that requested by either experiment. This was done to balance our two main heavy ion priorities: good measurements of the low mass dielectron spectrum at at least two energies ($\sqrt{s_{NN}}$ = 200 and 62 GeV), and meaningful measurements of CEP signatures at several energies, including at least three energies in the region between

$\sqrt{s_{NN}}$ = 7.7 and 27 GeV. The suggested BES allocation was guided by the principle of ensuring that the largest possible fraction of the requested numbers of events can be collected for key fluctuation and correlation observables for the full range of energies. We anticipate that improvements in run efficiencies not accounted for in the STAR BUR may allow, at some energies, accumulation of event statistics approaching those requested by STAR. The PAC believes strongly that these results be well understood prior to consideration of future running at low energies.

2.2.3 Run 11: Au-Au and U-U collisions at $\sqrt{s_{NN}}$ = 200 GeV

Run 11 provides new opportunities for full energy heavy ion running, following the installation of the PHENIX Silicon Vertex Barrel (VTX detector), a partial implementation of stochastic cooling, and the possibility of uranium beams from EBIS. Assuming the VTX detector is available on schedule and performing well, there is high priority for a significant (~7 week) Au-Au run at $\sqrt{s_{NN}}$ = 200 GeV. It will allow separate measurements of the charm and bottom nuclear modification factors (R_{AA}) with much greater significance, and provide the first elliptic flow data for charm and bottom hadrons, via single displaced vertex electrons. In addition, the extended running and increased luminosity will add important statistical weight to many other rare probe channels for STAR and PHENIX, including jets, dijets, quarkonia (including at high p_T), multi-particle correlations and other observables.

We also recommend a brief run for $\sqrt{s_{NN}}$ = 200 GeV U-U collisions. For this first commissioning run of EBIS, CAD projects that there may be only 1/3 of the design luminosity available in Run 11, with full luminosity available in Run 12. The main interest is in the small fraction of the inelastic cross section where the two elongated uranium nuclei are oriented to have complete overlap, resulting, for tip-on-tip collisions, in large energy deposition (potentially a 50% increase in energy density over the most central, most energetic Au-Au), or, for side-on-side collisions, in strong elliptic flow with fully central collisions. The measurements of other collision geometries have ambiguities that may render their interpretation more difficult. Thus, it is viewed that a U-U only program in Run 11 is not a reasonable substitute for Au-Au collisions. Rather, a short (1 week) physics run with U-U collisions should be allocated with high priority, for the experiments to directly evaluate the utility of – and the practical aspects of extracting the desired physics from – collisions between large, deformed nuclei. In addition, prior to the next PAC meeting, it is critical for both collaborations to simulate the event categorization methods and the fraction of the total inelastic cross section available for different observables.

2.3 Discussion of spin program running

The RHIC spin program is in an exciting and challenging transition period. Data obtained from $\sqrt{s}$ = 200 GeV p-p running have been scrutinized by the theoretical community, yielding critical new information on the gluon polarization in the proton. Data have also been collected with transverse beam polarization, resulting in several measurements related to the Sivers function and the coupling of spin and transverse motion in the proton. With these successes in hand, the spin program is now moving to 500 GeV center-of-mass energy, where benchmark spin measurements will be possible. Most notably, $\sqrt{s}$ = 500 GeV opens a long-anticipated channel: the measurement of the single-spin asymmetry A_L for W production and the resulting information on the polarization of quarks and antiquarks in the proton.

The top priority from last year's PAC recommendations was a 10-11 week spin run in 2009, with a portion of the time allocated to first exploratory p-p data at $\sqrt{s}$ = 500 GeV (Run 9 is in progress at the time of writing this report). Good data have been collected with longitudinally polarized p-p at both 200 GeV and 500 GeV, but it is clear that the data-taking goals of Run 9 will not be met. At 200 GeV, the beam polarization has been good (55%), but the collected luminosity will be less than anticipated (30-40% of the Run 9 goal is projected). The first 500 GeV run has successfully delivered the planned luminosity of 10 pb^{-1}, providing crucial information on beam performance, detector performance, and rates for the future spin program. It is expected that these data will be sufficient to achieve the RIKEN 2011 milestone of successful observation of W production at RHIC. The transfer of beam polarization to the higher energy, however, has been problematic: only 35% has been achieved compared with a design polarization of 60%.

The partial success of Run 9 constitutes both a milestone and a challenge for the spin program. The PAC's discussion of the spin program was rather brief this year because of the clear priority of the heavy-ion program in Run 10. The discussions at next year's PAC meeting will again be more 'spin-intensive', in preparation for the machine's planned return to polarized production running in Run 11. Our recommendations this year all concern preparation for Run 11 and the spin program's transition to $\sqrt{s}$ = 500 GeV.

2.3.1. Beam polarization at $\sqrt{s}$ = 500 GeV

Our highest priority recommendation for the spin program is improvement of the beam polarization at $\sqrt{s}$ = 500 GeV.

Compared with the design goal of 60% beam polarization, the 35% achieved in Run 9 represents a reduction in figure-of-merit by a factor of 9 (3) for double-spin (single-spin) asymmetries. The impact of such a reduction is obviously severe. The PAC heard a number of suggestions for addressing this technical problem, including proposed machine tests in Run 9 and/or Run 10. We leave it to the experts in C-AD to develop the optimal strategy to increase the polarization, but we stress the importance of resolving this issue *before* Run 11. Ideas for studies that can already be performed in Run 9 should clearly be investigated with utmost urgency. However, our first recommendation is:

If the low polarization problem is not resolved this year, dedicated beam time for machine development, as required to meet the polarization goal of 60%, should be allocated in Run 10, to the extent that the key physics goals of the heavy ion program are not unduly impacted (hence its overall #3 priority for Run 10). *Our specific* *recommendation is for up to 3 weeks of proton beam time in Run 10 dedicated to polarization development.*

2.3.2. Returning to $\sqrt{s} = 200$ GeV

The PHENIX and STAR BURs include plans for 10-14 weeks of polarized running in 2011. The PHENIX request is for $\sqrt{s}$ = 500 GeV running only, while the STAR request is split between 200 and 500 GeV. The STAR BUR also states that studies to make optimal use of this time are still in progress.

The PAC has determined that the best course for the spin program is to concentrate on collecting $\sqrt{s}$ = 500 GeV data in Run 11, but there is clearly not yet enough information to make a detailed schedule. Our second recommendation is to clarify the issue:

Assuming the anticipated polarization and luminosity goals for $\sqrt{s}$ = 500 GeV are met in time for Run 11, what, if any, are the pressing observables that would require a return to 200 GeV? BURs submitted to the 2010 PAC should quantitatively address the need for any further spin data at 200 GeV center-of-mass energy.

For longitudinal polarization observables, the answer to this question is likely to be impacted by the data collected at both energies in Run 9.

The move to $\sqrt{s}$ = 500 GeV will open up a new and exciting era in spin physics with access to the parity-violating asymmetry A_L in W production, lower x values for the gluon polarization, and higher luminosities. There may be some reasons to return to 200 GeV, but they will need to be clearly supported and articulated. Double-spin asymmetries with dijet or photon-jet production at higher x may be helpful, for example, to address the possibility of a node in the gluon helicity distribution. Further, the asymmetries are, in general, larger at the lower center-of-mass energy. However, it should be kept in mind that the theory relating A_{LL} measurements at 200 and 500 GeV is relatively well understood within perturbative QCD. Data taken at these different energies can, in principle, be combined. Thus, 200 GeV data need not be considered as “baseline” for later runs at 500 GeV, but as complementary information on parton distributions. Recent advances in global fits to polarized parton distributions show that the technology for a unified analysis is already in place. On the transverse-spin side, STAR’s planned measurement of the Sivers photon-jet asymmetry and its expected sign-change – a DOE milestone – has been simulated at 200 GeV, but it is unclear whether this energy is required, or merely convenient. The energy dependence of this A_N is not fully understood, but the effects are unlikely to scale as an inverse power of the energy, because momentum transfer also plays an important role in the Sivers effect and related analyses. We also note that, if a strong case for collecting further 200 GeV data exists, scheduling should be coordinated with the heavy ion program, which will need to return to p-p at the lower energy once the new detectors are in place.

The role in Run 11 of the pp2pp experiment, aimed at studies of diffractive processes and central glueball production, and described in the STAR BUR, should be considered in the context of results from its Run 9 data-taking (scheduled for the very end of the current run period).

2.3.3. $\sqrt{s}$ = 500 GeV in Run 11

As described above, it is too early to make detailed decisions about the spin schedule for Run 11. The PAC has determined that, given the present information, and assuming the low beam polarization problem can be resolved in time, a spin run at $\sqrt{s}$ = 500 GeV should remain the top priority for Run 11. We maintain this priority from last year's PAC despite the fact that the forward upgrades at STAR and PHENIX are delayed and will not be complete by Run 11. Our reasons are as follows:

- The PHENIX Muon Trigger upgrade will be sufficiently complete by Run 11 to make a good measurement of the forward and backward asymmetry $A_L(W)$. If the current schedule holds, only RPC1 will be missing, which should not have a major impact on the measurement.
- It is now clear that STAR's Forward GEM Tracker (FGT) will not be ready for Run 11, which means that charge-separation of forward and backward going electrons/positrons will be limited at best. Nevertheless, STAR can measure $A_L(W)$ at mid-rapidity. Though not sensitive to the antiquark polarization, this is an essential "baseline" measurement for the *W*-production program, and one which will not be generated in Run 9 as originally hoped. The mid-rapidity asymmetry is, instead, mostly sensitive to the rather well known *u* quark polarization. A successful comparison with theory is a necessary first step in interpreting the future *W* production measurements in terms of antiquark polarization.
- Both experiments can collect valuable data on the gluon polarization at low *x*, from the double-spin asymmetries for π^0 production at PHENIX and for dijet and inclusive-jet production at STAR.
- STAR can explore the transverse single spin asymmetry A_N for π^0 (and other mesons) and inclusive jet production at high energy. The energy dependence is very interesting theoretically, and will provide valuable guidance on what prospects lie ahead for the transverse spin program at 500 GeV. As no transverse spin data is expected from Run 9, transverse running at 500 GeV with STAR in Run 11 would be particularly valuable.

The PAC looks forward to revisiting these questions next year.

2.4 Equipment development and use of luminosity upgrades

2.4.1 PHENIX

The PAC congratulates the PHENIX Collaboration on the demonstration of the functionality of PHENIX's Hadron-Blind Detector (HBD). PHENIX has demonstrated resolution of all the problems that plagued this complex device during the Run 7 engineering period. The HBD will make critical improvements (of roughly an order of magnitude at full collision energy) in the effective statistics of dielectron measurements in the low mass region. The conflict of the HBD (and also the Reaction Plane Detector) with the VTX and FVTX upgrade projects is unfortunate, unavoidable, and limits the future of the HBD to the end of Run 10. The compelling physics delivered by this upgrade for both $\sqrt{s_{NN}}$ = 200 and 62 GeV running have led to the high priority placed on these programs in the PAC's considerations for Run 10.

The PAC is also encouraged by the progress in the VTX and W-trigger systems, both of which are on track to be fully implemented and ready for data in Run 11. Noise issues in the strip-pixel readout systems for the VTX have been addressed beyond the design specification level during the past year, and have put the project back on track for installation for Run 11. The presence of this device makes it possible to measure the displaced vertices of open heavy quark decays and thereby distinguish the energy loss and flow of charm quarks from those of bottom quarks. This capability generates the urgency for additional full-energy heavy ion data in Run 11. Unfortunate funding profiles have delayed the FVTX completion and installation until Run 12, and this device had little influence on the decisions for Runs 10 and 11.

The move to $\sqrt{s}$ = 500 GeV proton collisions not only probes the spin structure of the proton at lower *x*, but, as discussed above, also opens the possibility of measuring the large asymmetry anticipated for W production. The new W-trigger system (partly and successfully tested in Run 9) expands the PHENIX W-trigger from the central arm (high momentum electrons) into the muon arms and thereby greatly expands the aperture for this measurement. The W-trigger system consists of electronics upgrades to the existing tracking detectors and the addition of RPC panels to the muon systems. PHENIX has completed full north arm, and partial south arm, installation of the new electronics. Also, two full-sized panels were added and successfully read out. The availability of this trigger for Run 11 strengthens the case for running the machine at $\sqrt{s}$ = 500 GeV.

Although the components of the DAQ and trigger systems upgrades were clear in the PHENIX BUR and presentation, the precise time line and how it couples to the present schedule of RHIC luminosity upgrades was unclear. For example, does the system have 'matched bottlenecks' so that improvement is only possible after full installation, or can a staged implementation lead to incremental progress? For the DAQ, a run-by-run list of milestones in terms of hardware, firmware, and throughput goals would be useful in evaluating present plans and future progress. For the trigger, a similar table delineating the expected rejections required for each physics signal as a function of time and luminosity would be equally valuable to the PAC.

2.4.2 STAR

We congratulate STAR on the successful completion of the DAQ1000 project and the installation of 3/4 of the Time-of-Flight detector. These provide STAR with the necessary high rate and particle identification (PID) capabilities for RHIC II luminosity in future runs. At the same time, the upgrades provide necessary PID and more flexibility for the beam energy scan (BES) in the search for the critical endpoint. The STAR Photon Multiplicity Detector (PMD) and Forward TPC (FTPC) are slow detectors (maximum

~100 Hz), and not compatible with the high rates. In addition, the FTPC and its supports cannot coexist with the upgrades to the Heavy-Flavor tracker (HFT) and the Forward GEM Tracker (FGT). However, the PMD and FTPC are important for the beam energy scan and are to be used as reaction plane detectors and in long-range correlation and charged-neutral analyses. These provide significant constraints on the schedule for the BES. STAR trigger upgrades that will both accommodate the expected increase in luminosity and provide additional trigger flexibility are in progress. STAR and BNL management should ensure sufficient resources are in place for timely completion of these essential upgrades.

The STAR FGT is crucial in identifying the charge of the $W^{\pm}$ for the spin program at $\sqrt{s}$ = 500 GeV. STAR anticipates installation of the FGT in summer 2011 for first operation during Run 12. Since the HFT and FGT are integral parts of the STAR inner tracker with different time lines, a clearer integration plan will help the PAC assess the constraints. Given the potential p-p luminosity limits at 200 GeV projected from Run 9, the PAC has requested a clarification from the STAR collaboration on whether the transverse spin program is still viable, and whether the same program (gamma-jet) can be done by the Forward Meson Spectrometer at 500 GeV.

2.4.3 RHIC

The PAC is pleased that RHIC has successfully secured additional funding to accelerate and improve the stochastic cooling upgrades making RHIC-II luminosity available by Run 12. Furthermore, steady progress on the EBIS ion source promises first U-U collisions in RHIC for Run 11.

As may be expected for the first significant p-p running at $\sqrt{s}$ = 500 GeV, the machine performance, while sufficient in luminosity, showed a significant loss in polarization. The present understanding is that the fractional tune (~2/3) presented too narrow a window between resonances for high polarization transmission to full energy. A suggested, but not yet tested, strategy would be to run at near integer tune. This would likely alleviate the polarization loss, but reintroduce 10 Hz oscillations that must be addressed by other means. The PAC places a high overall priority on 500 GeV running for Run 11, and therefore strongly encourages any and all efforts, including tests during the current Run 9, and others as discussed above, that can resolve the polarization loss problem in advance of the anticipated spin running in Run 11 and beyond.

3. Future BURs

The PAC requests that future Beam Use Requests (BURs)

1. are submitted 6 weeks in advance of the PAC meeting to allow time for the committee to adequately review the documents and to submit to the proponents questions and requests for additional information, and

2. contain a more detailed discussion and quantitative evaluation of the impact of proposed measurements than was presented in either of this year's requests. Improved constraints on, or uncertainties in, quantities of underlying physics importance (i.e. those quantities that are driving the proposed measurements) should be presented. Examples from this year's requests are measurement of the invariant mass spectrum of lepton pairs, and the energy scan to constrain the location of the QCD critical endpoint (CEP). In the case of the former, for example, a quantitative discussion of the constraints for the vector channel spectral function and the initial fireball temperature expected from the proposed measurements would have enabled a more informed discussion of beam time allocation options by the PAC. Similarly, in the latter case, a presentation of the anticipated level of significance with which planned measurements can discover or exclude non-monotonic energy dependences in observables thought to be associated with the existence of the CEP would have made evaluation of the proposals more efficient and effective. In situations where proposed measurements would enhance a pre-existing data set, the anticipated improvements should be clearly presented in the BUR, including estimates of anticipated statistical and systematic uncertainties. The PAC believes it is important that all collaborations submitting BURs to the PAC place special emphasis on this component of proposal preparation, and include such analyses in all future BURs.