Recommendations of the Nuclear and Particle Physics Program Advisory Committee

Brookhaven National Laboratory

September 10 – 11, 2020

1. Executive Summary

The Program Advisory Committee (PAC) convened remotely on September 10 – 11, 2020, to evaluate the STAR Beam Use Request for completion of the RHIC Beam Energy Scan II (BES-II) program in Run 21 and plans for data-taking in a Run 22 polarized proton run. The PAC was presented with the sPHENIX and STAR plans for data-taking in Runs 23 - 25, as well as the sPHENIX commissioning plans. The status of the Coherent electron Cooling (CeC) R&D program and a request for use of the RHIC beam for further investigation in Runs 21 and 22 were presented. A new request for data-taking in Run 24 by RHICf-II was also considered.

Progress in ongoing analysis efforts and publications from the STAR and PHENIX research programs was presented. Status reports on the STAR Forward Upgrade, the STAR isobar double-blind analysis, the PHENIX data analysis and plans for data preservation, and the sPHENIX detector project status were given.

The PAC thanks the collaborations for their preparation, presentations and cooperation in responding to questions. Input from the C-AD and BNL NP-HEP managements are acknowledged and were helpful in the PAC's considerations. We commend C-AD and STAR for the successful completion of the 2020 runs in the BES-II program, also recognizing the extra effort and hardship associated with the restrictions due to COVID. The performance of RHIC was again outstanding and exceeded expectations.

STAR is congratulated for the successful installation, operation and the performance of the iTPC, which positions STAR to be able to complete the BES-II Program. The PAC commends both the PHENIX and STAR collaborations for their outstanding scientific productivity and for delivering stimulating discoveries and high-impact publications, as well as their continued production of PhDs.

As stated in the 2015 NSAC Long Range Plan the construction and operation of sPHENIX and completion of the RHIC BES-II program are the highest priorities. The sPHENIX Collaboration is to be congratulated for its progress on the sPHENIX detector project, commissioning plan and its proposal for commissioning, data-taking and physics in Runs 2023 - 2025.

The PAC is pleased to see the continued success of STAR and the C-AD towards completing the BES-II program. The highest priority for BES-II is completion of the data-taking by STAR at $\sqrt{s_{NN}}$ = 7.7 GeV (100M events). C-AD has improved the RHIC beam performance at low energies to enable these data to be taken in 15 - 20 weeks during Run 21. Further incremental improvements in the luminosity by C-AD could allow other priorities to also be addressed in Run 21. STAR Fixed Target (FXT) measurements at $\sqrt{s_{NN}}$ = 3.0 GeV (300M events), $\sqrt{s_{NN}}$ = 9.2 GeV (50M events), $\sqrt{s_{NN}}$ = 11.5 GeV (50M events) and $\sqrt{s_{NN}}$ = 13.7 GeV(50M events) during a one week run are identified by STAR and the PAC as very important and the next highest priority for Run 21. The PAC considers as important to the overall RHIC scientific program and a third priority for STAR data-taking an exploratory 1 week O+O run at $\sqrt{s_{NN}}$ = 200 GeV (200M central). With slightly lower priority as of the time of its meeting given that internal early analyses of only 5% of the Run 19 BES-II data were available for consideration at that time, the PAC considers a 2.5 week Au+Au run at $\sqrt{s_{NN}}$ = 17.1 GeV (250M events) to supplement data in the BES-II program also important to the overall RHIC scientific program. The PAC encourages the STAR Collaboration to analyse with high priority a sufficiently large fraction of the BES-II data at 14.5 and 19.6 GeV in order to determine whether additional data taking at 17.1 GeV warrants a higher priority than the O+O run. A long (3 week) FXT run at $\sqrt{s_{NN}}$ = 3.0 GeV to collect 2B events can provide new measurements, and should be pursued if run time is available.

The PAC endorses for Run 22 the STAR proposal for data collection with transversely polarized p+p beams at $\sqrt{s}$ = 510 GeV, with the understanding that timely access to the IR for sPHENIX detector installation and commissioning has the highest priority. The STAR Forward Upgrade (fSTAR) provides a unique opportunity to address important spin physics questions. W production data from Run 22 and Run 17 along with Drell-Yan data that would be collected using fSTAR represent a unique opportunity to provide a definitive answer to the predicted Sivers function sign-change. The forward upgrade also extends coverage of the measurement of transversity to large *x*, allowing a better determination of the tensor charge.

The highest priority for Runs 23 - 25 is commissioning and data collection with the sPHENIX detector. In addition to carefully planned commissioning, sPHENIX should be able to begin data taking for their physics program with $\sqrt{s_{NN}}$ = 200 GeV Au+Au in Run 23. STAR running in Runs 23 and 24 is important, as recent STAR upgrades should provide important new physics. While Au+Au data-taking by STAR in Run 23 shall respect the beam schedule constraints imposed by sPHENIX commissioning, STAR should be able to

accumulate a significant legacy Au+Au data set at $\sqrt{s_{NN}}$ = 200 GeV that exceeds the statistics of all previous RHIC campaigns.

The PAC endorses the sPHENIX plan for p+p and p+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV in Run 24. Those data should provide essential reference data for their Au+Au program and calibration of the jet energy scale. They will also provide valuable data on the internal structure of protons and nuclei for reference for the future EIC program. The PAC commends sPHENIX for developing the continuous streaming readout option that will increase their data collection in Run-24 by orders of magnitude. This is particularly important and allows unique access to novel open heavy flavor measurements.

Furthermore, the p+p and p+Au runs in 2024 allow STAR, with its forward upgrade, to accomplish its cold-QCD program and provide opportunities for important cross-checks of earlier small-system studies. Comparison between the STAR $\sqrt{s}$ = 200 GeV p+p run in Run 24 and their Run 22 data at $\sqrt{s}$ = 510 GeV provides important information on the Q^2-evolution of transverse momentum dependent PDFs.

The success of sPHENIX and the qualitative increase in kinematic reach and discovery potential that are the promise of sPHENIX can only be realized with the high-statistics $\sqrt{s_{NN}}$ = 200 GeV Au+Au data collected in Run 25.

The scientific productivity of STAR continues on its very high level, with many interesting new results. Measurements of jet R_{cp}, improved and new results on global polarization, production of hypernuclei, heavy flavor and fluctuations have been obtained and published. The PAC is especially pleased to see the isobar analysis progressing well, and expected by the end of 2020.

PHENIX is to be commended for its continued productivity, especially for revealing a nucleus-dependent suppression of A_N of forward-rapidity hadrons in p+A collisions, and universal scaling of direct photon production over a broad range of collision systems, as well as the measurement of direct photon-hadron correlations that probe the jet-medium interactions. The PAC is also pleased to see that PHENIX is establishing a framework for data preservation.

2. Beam Use Requests and Proposals

2.1 Discussion and Recommendations for RHIC Run 21

Accumulating the required data at $\sqrt{s_{NN}}$ = 7.7 GeV (~100M events) needed to complete the BES-II program is the highest priority for Run 21; the scientific case for this has been made

in the 2015 NSAC Long Range Plan and in PAC reports from past years. As noted by the PAC last year, this highest priority among all the BES-II runs was left for Run 21 in order for the C-AD to have the time to optimize the required cooling of these low energy beams.

We commend C-AD for successfully improving the beam performance to enable the collection of the $\sqrt{s_{NN}}$ = 7.7 GeV data within 15-20 weeks. Given the strong scientific motivations for other elements of the proposed Run 21 program, presented below, we strongly encourage C-AD to explore any further incremental improvements of the luminosity that they can envision, as these would serve to provide a few more weeks of beam time for the priorities described below.

We concur with the STAR prioritization that the second priority for Run 21 is to undertake FXT measurements at 4 energies for 1 week in total. These are very important measurements and should be carried out if the beam time is available. Collecting 300M events in fixed target running at $\sqrt{s_{NN}}$ = 3 GeV, now with the iTPC and eTOF in place, will allow statistically significant measurements of the most important BES-II observables at this lowest energy. This is significant because the acceptance for fixed target measurements at this energy is similar to that for collider measurements at $\sqrt{s_{NN}}$ = 7.7 GeV, allowing quantitative comparison of the systematic effects in these measurements that differ between collider and fixed target collisions. STAR described other important measurements that will come from this data set in addition. Collecting 50M Au+Au events each in fixed target runs with $\sqrt{s_{NN}}$ = 9.2, 11.5, and 13.7 GeV will allow STAR to make measurements at the rapidities where the baryon density is expected to peak in these collisions, allowing STAR to complement and complete the mid-rapidity analyses already available from prior-year collider runs at these center-of-mass energies.

In its BUR, STAR presented three quite different proposed runs as third priorities for Run 21, without providing a priority ordering. *The PAC considers the proposed 1 week O+O run at $\sqrt{s_{NN}}$ = 200 GeV (200M central events) and the proposed 2.5 week Au+Au run at $\sqrt{s_{NN}}$ = 17.1 GeV (250M events) both to be important to the RHIC scientific program*, for different reasons:

> The O+O run would be novel and exploratory, and offers the chance to shed new light on questions related to whether, and if so how, droplets of QGP can form in small-size collisions. Although an O+O run could also be considered in a future year, these questions are pressing and topical now.
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> A $\sqrt{s_{NN}}$ = 17.1 GeV run, if performed, would serve as the completion of the BES program, and cannot be considered after Run-21; the question is whether it is needed to achieve the scientific goals of the BES program. BES-I measurements of several

observables point towards a substantial change between $\sqrt{s_{NN}}$ = 14.6 GeV and $\sqrt{s_{NN}}$ = 19.6 GeV, and if this is so then a $\sqrt{s_{NN}}$ = 17.1 GeV run is strongly motivated, to focus in on what would then be the most interesting region of the energy scan.

The statistical uncertainties on the BES-I measurements (and the early internal results from 5% of the BES-II data that were shown at the meeting) are too large to make this conclusion definitive, but timely additional results from the BES-II data collected at these other energies could help to clarify the priority of such a run. At present, the PAC would rank the O+O run higher in priority. However, we strongly encourage the STAR Collaboration to analyse with high priority a sufficiently large fraction of the BES-II data at 14.5 and 19.6 GeV in order to help determine whether additional data taking at 17.1 GeV warrants a higher priority than the O+O run.

The third run among STAR's third priorities is a long (3 week) fixed target run to collect 2B events at $\sqrt{s_{NN}}$ = 3 GeV. The PAC ranks this as third priority among these three; if time is available for this, it should be pursued because it will allow exploration of 5th and 6th order proton cumulants at this energy, the centrality dependence of phi meson production, and a search for double-Lambda hypernuclei.

2.2 Discussion and Recommendations for RHIC Run 22

The PAC heard the presentation of the current status of the STAR Forward Upgrade (fSTAR). The PAC is pleased to learn that an Associated Laboratory Director's Review on the status of fSTAR, recommended by the PAC in May this year, was conducted in late August, just prior to the PAC meeting. Despite the severe challenge imposed by COVID, fSTAR is making good progress towards the goal of being ready for Run 22. However, the very tight installation schedule, especially for the forward silicon tracker, together with the uncertain future impact of COVID, are certainly a major concern. The PAC anticipates the fSTAR team to continue making good progress. The PAC also recommends continuing strong support by the BNL management to mitigate potential risk for a timely completion of fSTAR.

The PAC also heard the presentation of the Run 22 BUR dedicated to a transversely polarized pp run at 510 GeV with the coverage of forward rapidity region provided by the implementation of fSTAR. The STAR detector augmented by the forward upgrade offers a unique opportunity to address important questions in spin physics with transversely polarized pp at 510 GeV. In particular, the data of W production from Run 22 and Run 17, together with the Drell-Yan data to be collected with fSTAR, could allow RHIC to provide a definitive answer to the predicted sign-change of the Sivers function. The forward upgrade would also extend the coverage of the measurement of transversity to large *x*, allowing a

much improved determination of the tensor charge. The comparison between the Run 22 data at 510 GeV and proposed Run 24 data at 200 GeV would provide important information on the Q^2-evolution of the transverse momentum dependent PDFs.

The PAC recognizes that the Run 22 BUR of 510 GeV transverse pp run is very similar to Run 17, with the exception of the addition of the forward upgrade. To better evaluate the merit of an additional 510 GeV transverse pp run, it is imperative that STAR present results from Run 17 directly related to the main physics goals of Run 22 BUR. In particular, the PAC expects to hear the result of the W-boson single spin asymmetry measurements from Run 17 at the next meeting. In addition, STAR should show how Run 17 data can be used to extract Sivers effects from di-jet and flavor-tagged single-jet, and how well they can determine the proton's transversity distribution using the mid-rapidity data taken in Run 17. These results would be very important for evaluating STAR's request for additional running at 510 GeV in Run 22, and for evaluating the feasibility of extending such measurements to the forward region.

The PAC endorses the opportunity to collect important transversely polarized pp data at 510 GeV for Run 22. The readiness of fSTAR for Run 22 is essential. If any subsystem of the upgrade would not be ready, it is important to determine and present the impact at the next meeting on reaching the physics goals of Run 22.

- The PAC recommends continued strong support by the BNL management to mitigate potential risk for a timely completion of fSTAR.

- The PAC strongly recommends that STAR provide at the next PAC meeting results from the 510 GeV transverse pp Run 17 that are closely connected to the physics goals of Run 22, and essential for evaluation of the additional scientific value of Run 22.

- The PAC recommends that STAR provide at the next PAC meeting the integral luminosities required to collect the necessary data sets to accomplish each of their physics goals for the polarized pp program at 510 GeV.

2.3 Discussion and Recommendations for RHIC Runs 23 - 25

The commissioning of the sPHENIX detector, and data-taking with sPHENIX are highest priority for Runs 23 - 25.

The PAC recognizes the particular challenges that sPHENIX faces to complete its rich physics program within a three year time-period between the end of construction (2023) and transition of the laboratory to the EIC. In the absence of any contingency in the out years, the laboratory needs to give highest priority to sPHENIX needs in years 2023-2025. It is

essential that in preparation for Run 23 sPHENIX is provided timely access to the IR to start the detector commissioning on time. Successful commissioning and initial data taking in Run 23 will enable sPHENIX to achieve the milestones set out in the 2015 NSAC LRP during Runs 24 and 25.

STAR running in 2023 and 2024 is important. The recent STAR upgrades give access to important new physics in both soft and hard sectors. While 200 GeV Au+Au data-taking by STAR in Run-23 must respect any beam schedule constraints imposed by the commissioning of sPHENIX, it should nevertheless allow for accumulating a very large legacy data set at $\sqrt{s_{NN}}$ = 200 GeV that exceeds the statistics in all its previous campaigns. The STAR detector capabilities complement the sPHENIX program in both the soft and hard sectors. In the soft sector important measurements at forward rapidity will provide decisive input for elucidating the longitudinal structure of the initial conditions and three-dimensional dynamical evolution in heavy-ion collisions. In the hard sector the increased recorded luminosity and detector acceptance made possible by recent upgrades enable a strong jet program that not only allows important cross-checks with sPHENIX but also complements sPHENIX by its ability to correlate jet measurements with detailed soft event characteristics.

For sPHENIX, the p+p and p+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV in Run 24 provide not only crucial reference data for their Au+Au program and are essential for calibrating the jet energy scale, but they also yield valuable data on the internal structure of protons and nuclei that will provide reference measurements for the future EIC program.

We commend sPHENIX for developing the continuous streaming readout option for the detector, which increases the amount of data that can be collected in Run-24 by orders of magnitude. In particular in the sector of open heavy flavor, this technique will give access to a set of qualitatively novel measurements that would otherwise not be accessible. Given the tight timeline for completing the RHIC physics program before construction of the EIC begins, this is a tremendous and highly welcome achievement.

For STAR, the p+p and p+Au runs in 2024 not only allow the collaboration to accomplish its cold-QCD program but also provide opportunities for crucial cross-checks of earlier small-system studies and an important set of measurements that would complete the STAR transverse spin program at RHIC.

The qualitative advances in kinematic reach and discovery potential that are the promise of sPHENIX can only be realized with the high-statistics Au+Au run anticipated in 2025.

3. RHIC Data and Physics Analysis

3.1 STAR

STAR and C-AD should be congratulated for a successful Run 20. In spite of the COVID induced interruptions all the planned data and statistics were taken. We especially wish to express our gratitude to the local STAR group for filling in for the external collaborators who were unable to come to BNL in person. STAR is to be further commended for the successful operation of the iTPC, EPD, and eTOF upgraded detector systems. So far STAR is on track to take all the necessary data for the second phase of the RHIC BES program, and the PAC is looking forward to timely analysis of the data.

The scientific productivity of STAR continues on its very high level, and many interesting new results (such as the measurement of jet R_{cp}, improved and new results on global polarization, heavy flavor and fluctuations) have been obtained and published. STAR also presented some very interesting and encouraging results from the FXT runs on the production of hypernuclei. The PAC is especially pleased to see the isobar analysis progressing very well, and it is looking forward to the results, to be expected by the end of 2020.

STAR is making good progress on the Forward Upgrade and should be commended for gathering the funds necessary for enabling this effort.

3.2 PHENIX

PHENIX is to be congratulated on maintaining a high level of productivity since taking their last data in 2016. The A-dependent suppression of A_N of forward hadrons produced in p+A collisions is a seminal result, and the direct photon analysis over a broad range of collision systems is a tour de force. The correlation of direct photons and hadrons or jets represents a significant milestone for the community, as this analysis provides significant advantages to hadron-hadron correlations in that it better identifies the initial jet energy and direction. This progress is long awaited and opens a new era in the measurement, analysis, modeling and interpretation of jet-medium interactions.

The PAC was pleased to see that the calibration of the 2016 data is being finished after the VTX sustained damage in 2016, and encourages BNL to ensure that PHENIX is assigned the necessary resources to complete data production as soon as possible.

The PAC commends the progress PHENIX has made toward data preservation and looks forward to seeing a working version of the web portal at the next PAC meeting. It is preferable that both PHENIX and STAR establish consistent expectations, policies and methods for the entire RHIC effort.

3.3 STAR and PHENIX

Some of the recent highlights of the RHIC program are the PHENIX measurements of elliptic and triangular flow in p/d/^{3}He+Au collisions published in Nature Physics. Taken together they yield strong support for the hypothesis that the collective behavior observed in small collision systems is due to hydrodynamic flow driven by the initial collision geometry. However, preliminary results from STAR presented at Quark Matter 2019 exhibited a factor of 3-4 discrepancy with PHENIX in the measurements of v_3 in p/d+Au collisions, in two of the six measurements. While the STAR interpretation of their preliminary results still favors the hydrodynamic flow hypothesis, the precise role of the initial geometry is disputed. Resolving this discrepancy is of highest priority for the RHIC small-systems program which, owing to the versatility of the machine, has unique data sets. In May, the PAC heard reports on additional checks performed since Quark Matter 2019 and recommended that a task force be formed to address the issues. It is possible that the discrepancy is due to the fact that the measurements in STAR and PHENIX are done with different techniques and with detectors covering different kinematic ranges, and therefore the differences reflect physics rather than unaccounted experimental uncertainty. A measurement utilizing the newly installed STAR EPD detector could remove this ambiguity.

As the RHIC program is coming to a close, preserving the data for future analysis becomes a top priority. The data preservation efforts in PHENIX have begun, guided by a BNL-internal task force. Laboratory management should ensure that these efforts follow best practices, by bringing in additional expertise from outside the RHIC community. This might involve the National Nuclear Data Center or initiatives from outside BNL.

- The PAC recommends that BNL organize the data preservation efforts in coordination with PHENIX and STAR and that the lab seeks additional guidance from experts on long-term data preservation from outside the RHIC community. A presentation on the progress of these efforts should be presented at the next PAC meeting.

- The PAC strongly recommends that the Task Force recommended at the May PAC Meeting be convened as soon as possible to resolve the PHENIX/STAR discrepancies in their v_3 in p/d+Au measurements, and if resolution is not achieved, consideration should be given to resolving it experimentally.

4. sPHENIX

The PAC commends the sPHENIX Collaboration on excellent progress on many fronts. The collaboration continues to grow with the addition of international and U.S. research groups. Advances in tracking, TPC distortion correction and calibration have been impressive. The collaboration plans to start a Mock Data Challenge in late 2020.

sPHENIX was designed as a state-of-the-art jet detector at RHIC to explore the properties of the QGP at very short scales, and its scientific program was endorsed by the 2015 NSAC Long Range Plan for Nuclear Science. The PAC considers the completion of the sPHENIX scientific program as the highest priority of the RHIC program after the completion of BES-II and before the transition to the EIC facility.

sPHENIX has grown to be a collaboration with 80 institutional groups and over 300 participants. The number of participant collaborators is expected to grow to be nearly 500 by 2023 when the commissioning and physics data-taking start.

Over the past years the sPHENIX Collaboration has dramatically improved the track reconstruction speed by a factor of over 200. The sPHENIX track reconstruction CPU time is approaching the goal of 5 s/event for Au+Au minimum bias event embedded in 100 kHz pile-up events and work on further optimization and tuning continues. The PAC commends the sPHENIX Collaboration for this important achievement.

The sPHENIX Collaboration has established a calibration task force to address the TPC distortion correction and the jet energy scale calibration. These are technical challenges that are essential to the success of the sPHENIX scientific program.

The PAC encourages the sPHENIX Collaboration to continue the exploration of the connection to the future EIC. The Cold QCD physics is an important component of the sPHENIX program. The collaboration has formed a broad consortium including outside members from the electron-scattering physics community to prepare a response to the call of Expression of Interest (EoI) from the EIC Project.

The PAC endorses the plans of the sPHENIX Collaboration to initiate a Mock Data Challenge (MDC). This is timely and it is important to have in place a software project with appropriate project structure, responsibility and review processes associated with a project. The goals and milestones of the MDC project should be defined to enable the collaboration to assess the software readiness for the start-up of the sPHENIX detector. The MDC project

will be essential to shape up the sPHENIX software towards the commissioning of the detector in 2023.

The PAC commends the sPHENIX Project Management and Construction Teams for impressive progress in spite of the COVID pandemic. The construction of all major detector components continues at a pace consistent with the schedule of installation and commissioning in 2022 shutdown. The construction of EMC blocks is on a tight schedule and there is little contingency in the installation schedule with the current RHIC schedule.

The sPHENIX MIE Project including TPC, EMCal, HCal, Electronics, DAQ/Trigger, MBD and Project Management all performed well in terms of cost and schedule. All FY20 milestones were met. The MVTX project (non-MIE) is also progressing well towards an early completion of Feb. 2022. The Building 1008 Upgrade Project is proceeding as planned. COVID mitigation plans are being implemented and institutions with construction responsibilities are mostly back on track operating with low personnel density.

The annual BNL sPHENIX review went well and there were no technical recommendations. The sPHENIX Project Management raised a concern that the proposed RHIC plan for Run 2022 and the expected start of the sPHENIX commissioning run in Feb. 2023 leaves little schedule contingency for the sPHENIX detector installation. The PAC urges the C-AD and the sPHENIX management to prepare as well an alternative backup plan before Run 2022 should the schedule contingency for the sPHENIX detector installation become necessary.

The PAC supports the sPHENIX project management proposal to use the contingency funds to find ways to ensure meeting the construction schedule. The PAC considers the timely startup of sPHENIX physics data-taking as the highest priority of the RHIC program after completion of BES-II. The PAC recommends the sPHENIX and RHIC managements to work together to meet the schedule requirements of the sPHENIX project.

5. CeC

The PAC was disappointed to hear that the CeC data-taking in 2020 would be unable to demonstrate the imprint that the ion beam leaves on the electron beam -- the criteria stated by last-year's PAC for further CeC data-taking. The PAC was left unsatisfied with the presentation by CeC at the PAC meeting. However, we understand that the needs of the EIC project may require two weeks of dedicated CeC operation in Runs 21 and 22.

6. RHICf-II

The PAC considered the RHICf-II presentation (in effect an Expression of Interest). It finds that RHICf-II could provide capabilities beyond the STAR Forward Upgrade and allow

measurements focused on different kinematic domains (lower p_T and larger rapidity) where different physics could dominate. However, the PAC was concerned that, at least at this stage, the proposal has not yet been coordinated with either STAR or sPHENIX, given that it plans to rely on the resources of one of these experiments.

The PAC recommends that RHICf approach STAR or sPHENIX management and determine how RHICf-II could best be integrated, as was previously done with RHICf-I and STAR. The PAC does not see a scenario in which dedicated high-beta running would be justifiable given the tight overall schedule, and recommends planning running in a parasitic mode and at nominal beta* and polarization parameters appropriate for STAR and sPHENIX.

7. PAC Recommendations

STAR

- The PAC strongly encourages the STAR Collaboration to analyse with high priority a sufficiently large fraction of the BES-II data at 14.5 and 19.6 GeV in order to determine whether additional data taking at 17.1 GeV warrants a higher priority than the O+O run.

- The PAC strongly recommends that STAR provide at the next PAC meeting results from the 510 GeV transverse pp Run 17 that are closely connected to the physics goals of Run 22, and essential for evaluation of the additional scientific value of Run 22.

- The PAC recommends that STAR provide at the next PAC meeting the integral luminosities required to collect the necessary data sets to accomplish each of their physics goals for the polarized pp program at 510 GeV.

BNL Laboratory Management

- The PAC recommends continued strong support by the BNL management to mitigate potential risk for a timely completion of fSTAR.

- The PAC recommends that BNL organize the data preservation efforts in coordination with PHENIX and STAR and that the lab seeks guidance from experts on long-term data preservation from outside the RHIC community. A presentation on the progress of these efforts should be presented at the next PAC meeting.

- The PAC strongly recommends that the Task Force recommended at the May PAC Meeting be convened as soon as possible to resolve the PHENIX/STAR discrepancies

in their v_3 in p/d+Au measurements; if resolution is not achieved, consideration should be given to resolving it experimentally.

8. BNL Nuclear and Particle Physics Program Advisory

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