Responses to S&T Homework Questions

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a passion for discovery

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Q. 1) With the best understanding of the run plan for years 2010-14 laid out, show when each of the accelerator upgrade projects below will be ready (i.e., ready to produce improvements as per current plans) to support the physics program. Also indicate how each planned machine improvement supports the goals of the physics program (Vigdor 5-year run plan).

Year	Likely Beam Species	Science Goals	New Detector Sub-systems	New Machine Upgrades	Gain from Machine Upgrades	Comments
FY10	Au+Au at 200, 62.4 GeV + assorted lower E	Low-mass dilepton spectrum; early collision temp.; improved jet quenching studies (especially e^- from heavy quarks); begin energy scan for critical pt.	STAR TOF completed; PHENIX HBD for heavy ions	Blue ring longitudinal + yellow and blue vertical stochastic cooling; yellow longitudinal cooling (μwave link) upgrade	Factor >2 increase in average store luminosity for full-energy Au+Au	Need 4-8 weeks early in run to (re)commission all 4 stoch. cooling systems, demonstrate gain in lumi. lifetime
FY11	Sub-injection Au+Au; 500 GeV p+p; short 200 GeV U+U	Continue critical pt. search; gluon polarization at low x + antiquark pol'n from W production; 1st characterization of deformation effects in U+U centrality distrib'ns	PHENIX VTX; upgraded PHENIX trigger (t0) barrel	EBIS (tandem as backup); 9 MHz cavity; AGS tune jump quads (comm'd in Run 10); RHIC spin flipper	U beam capability; improved pp vertex distrib'n; improved pol'n from AGS; reduced syst. errors	9MHz requires upgrade to main PS + "bouncer" cavity for both rings + longitudinal damper or Landau cavity for each ring.

Year	Likely Beam Species	Science Goals	New Detector Sub-systems	New Machine Upgrades	Gain from Machine Upgrades	Comments
FY12	Au+Au at 200 GeV; 500 GeV p+p	RHIC-II heavy-ion goals: heavy flavor, γ-jet, quarkonium, multi-particle correlations; anti-quark polariza-tions in proton	PHENIX FVTX and μ trigger; STAR FGT + HFT prototype;	Yellow + blue horiz. stoch. cooling (in-stalled FY11); 56 MHz SRF; e-lenses; OPPIS sole-noid + "proton cannon"; RHIC collimator upgrade	Full RHIC-II heavy-ion luminosity + improved vertex & store length; improved pp lumino-sity + polar-ization	Electron lens commission-ing $\Rightarrow$ Run 12 gains possible; detailed collimator upgrade plans still to be developed
FY13	200 GeV p+p; further heavy-ion running to comple-ment earlier runs	Continue RHIC-II heavy-ion goals; transverse spin asymmetry for γ + jet (2015 spin milestone); pp reference data for new subsystems	PHENIX FOCAL?	Catchup for ambitious FY12 upgrades plan		N.B. "Proton cannon" increases pol. source current, to allow scraping to improve polarization
FY14	200 GeV Au+Au; low-E Au+ Au dictated by Run 10+ 11 results	Continue pursuit of γ + jet, energy scan and identified heavy flavor (DM10-12) milestones.	Full STAR HFT	RHIC low-E electron cool-ing; R&D ERL to RHIC for coherent e-cooling test	Factor of several increase in lowest-E Au+Au luminosity	Low-E cooling relies on Pelletron from FNAL in late 2011

Q. 2) What is the impact of ARRA funding with respect to advancing the AIP schedule -- i.e., how much sooner will horizontal stochastic cooling and electron lenses be delivered, in comparison to the pre-ARRA plans?

Horizontal stochastic cooling: 2 years earlier.
Electron lenses: 3 years earlier.

Q. 3) What are the plans for improving power supply reliability? How much operating funds are anticipated to be needed to address these reliability problems? When will these repairs be done?

Main items for the reliability improvements: new Uninterruptible Power Supplies (UPS) will be purchased for the RHIC main magnet power supplies; new Bi-polar 150 A supplies from new supplier will be purchased. Total cost: ?? -- evaluation in progress.

Q. 4) What are the plans for improving power supply regulation (i.e., glitches and ripple), and when will these improvements be in place? (Gulshan's advice: also include here plans to ameliorate the 10-Hz quad triplet vibrations.)

The autotransformers for the RHIC main power supplies will be replaced for Run 10, which will reduce the transition glitches between flattop and ramp supplies. Also new regulation algorithms will be implemented and tested this summer.

The 10 Hz beam oscillations due to the triplet vibrations will be corrected with a fast global orbit feedback system. The present BPM system can provide the fast position information with only minor changes. A test with four fast corrector magnets is planned for Run 10 and the full system with about 12 corrector magnets per ring will be installed for Run 11.

Q. 5) What is the strategy for scheduling machine studies?

We have 2 types of machine studies:

1. Machine development - usually during day shift on Mon, Thu, Fri (STAR would not like any interruption on Tue. because of shift training, Wed. is APEX/maintenance). Machine development is strictly for immediate run improvements. Time allocated is discussed with the experiments, and scheduled on Mon. Machine development stops when all avenues for run improvements are exhausted or allocated time is used up.

2. APEX (=accelerator physics experiments) - on Wed. for 12 h (including end effects). APEX studies are proposal-driven, reviewed and prioritized by a committee of accelerator physicists, and scheduled by the APEX coordinator. APEX studies can have an immediate impact on the run or an anticipated longer-term impact on the machine or the accelerator field in general. In times of need APEX studies have been focused on short-term gains for the run.

Q. 6) Please provide the following documents for each active MIE project (I interpret this to include the large capital equipment projects): Project Execution Plan; quarterly reports for FY09; requirements documents if they exist.

The following documents are now posted on
www.bnl.gov/npp/RHICst09_notes.asp

VTX: Management plan; Q1 and Q2 FY09 reports; other VTX background info
FVTX: Management plan; Q1 and Q2 FY09 reports; other FVTX background info
TOF: Management plan; Q1 and Q2 FY09 reports
mu trigger: NSF MRI proposal; Q1 and Q2 FY09 reports; other mu trigger background info
FGT: Conceptual Design Report; Initial Packet; Q1 and Q2 FY09 reports
EBIS: Project Execution Plan; Monthly FY09 reports for 10/08, 11/08, 12/08, 1/09, 2/09, 3/09, 4/09, 5/09

Backup Slides

Progress Toward RHIC-Related DOE Performance Milestones

Heavy ion

Year	#	Milestone
2014	DM9 (new)	Perform calculations including viscous hydrodynamics to quantify, or place an upper limit on, the viscosity of the nearly perfect fluid discovered at RHIC.
2014	DM10 (new)	Measure jet and photon production and their correlations in A≈200 ion+ion collisions at energies from medium RHIC energies to the highest achievable energies at LHC.
2015	DM11 (new)	Measure bulk properties, particle spectra, correlations and fluctuations in Au + Au collisions at √sNN between 5 and 60 GeV to search for evidence of a critical point in the QCD matter phase diagram.
2016	DM12 (new)	Measure production rates, high pT spectra, and correlations in heavy-ion collisions at √sNN = 200 GeV for identified hadrons with heavy flavor valence quarks to constrain the mechanism for parton energy loss in the quark-gluon plasma.
2018	DM13 (new)	Measure real and virtual thermal photon production in p + p, d + Au and Au + Au collisions at energies up to √sNN = 200 GeV.

- ***Progress on earlier Dense Matter milestones was rated Excellent in 2009 NSAC report***
- ***Envisioned RHIC program for next ~5 years, with luminosity and detector upgrades, should keep us on track for above new milestones if operating budgets remain decent***
- ***Energy scan for DM11 should also allow search for disappearance of charge correlation possibly related to CPV vacuum fluctuations***

Progress Toward RHIC Spin-Related Milestones

spin

Year	#	Milestone
2013	HP8	Measure flavor-identified q and $\bar{q}$ contributions to the spin of the proton via the longitudinal-spin asymmetry of W production.
2013	HP12 (update of HP1, met in 2008)	Utilize polarized proton collisions at center of mass energies of 200 and 500 GeV, in combination with global QCD analyses, to determine if gluons have appreciable polarization over any range of momentum fraction between 1 and 30% of the momentum of a polarized proton.
2015	HP13 (new)	Test unique QCD predictions for relations between single-transverse spin phenomena in p-p scattering and those observed in deep-inelastic lepton scattering.

- ***HP8 requires two long 500 GeV pp runs by 2013, with improved beam polarization and luminosity, PHENIX μ Trigger and STAR FGT installed for at least the 2nd such run***
- ***Anticipate more favorable RHIC dynamic aperture, hence luminosity limits, at 500 than at 200 GeV. Can test stability of near-2/3 tune for improved pol'n transmission, after power supply improvements, with Au beams in Run 10.***
- ***Do we need more 200 GeV? HP12 sensitivity to $\Delta G(x < 0.1)$ can be obtained via di-jet or di-hadron correlations at 500 GeV, but $x > 0.1$ is best probed at 200 GeV -- did we get enough 200 GeV di-jet data in Run 9?***
- ***HP13 requires a long transverse spin run for direct γ by 2014, but can probably be accomplished with present beam performance***