

RHIC Budgets, Long-Term Run Plans and PAC Charge

Steve Vigdor

RHIC/AGS PAC Meeting

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BROOKHAVEN
NATIONAL LABORATORY

a passion for discovery



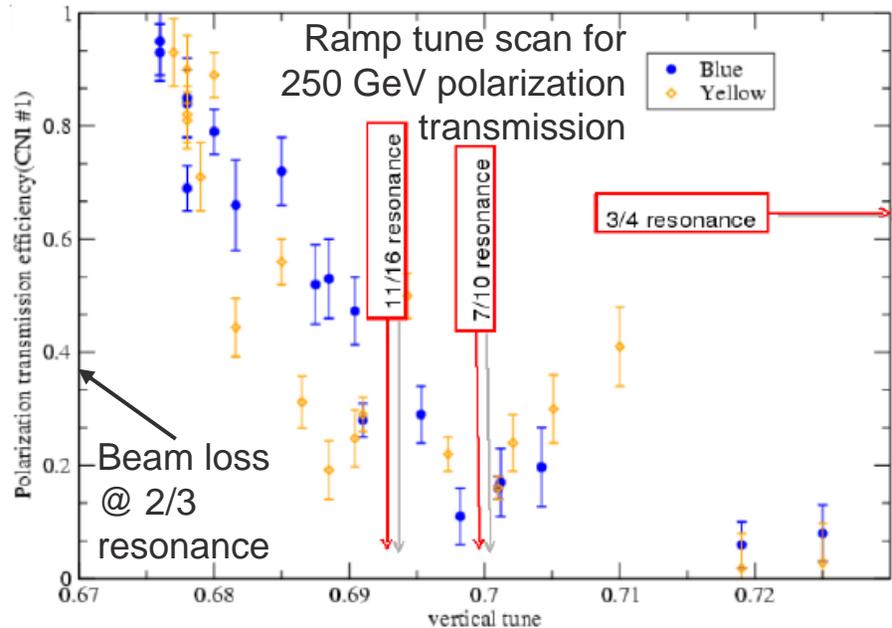
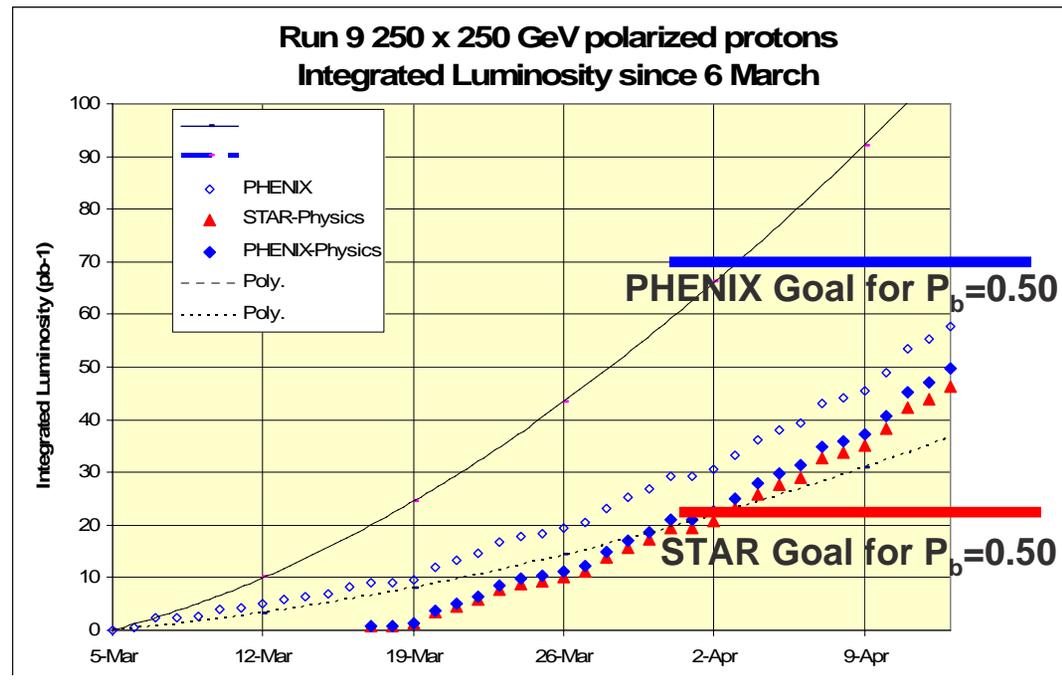
Recent RHIC Funding News

- *FY09 operating budget appropriation best in years -- would have supported 25 cryo-week run, but CR-induced late start ⇒ settle for 22 weeks.*
- *ARRA funds direct to RHIC > \$10M for timely completion of ongoing detector upgrades + accelerated timeline for accelerator improvement projects.*
- *Additional ARRA funds to BNL advance isotope production program @ BLIP and provide catchup on lab infrastructure improvement backlog (including RHIC complex).*
- *President's FY10 request is very encouraging: would permit 30-cryoweek run, C-AD staffing "bump", healthy R&D and capital equipment funding, start on new detector upgrade.*
- *ONP tells us not to expect budgets as strong in out-years.*
- *NYS supports BNL access to hydroelectric power ⇒ reduced power costs in renegotiated contract*

Milestones:

- *First 500 GeV pp collision run*
⇒ *1st W signals above bkgd?*
- *~10-week 200 GeV pp run* ⇒ *improve ΔG constraints*
- *1st plane transverse cooling installed, functionality tested*
- *RHIC spin flipper commissioned by end of run?*
- *1st real 9.2 GeV Au+Au collisions at end of Run 8*

Ongoing RHIC Run 9



Issues:

- *Polarization transmission to 250 GeV*
- *Detector rate limitations?*
- *Rate dependence of RHIC polarimeters*
- *No real improvement from Run 6 in pp luminosity and beam polarization*
- *Luminosity lifetime deterioration at reduced β^**

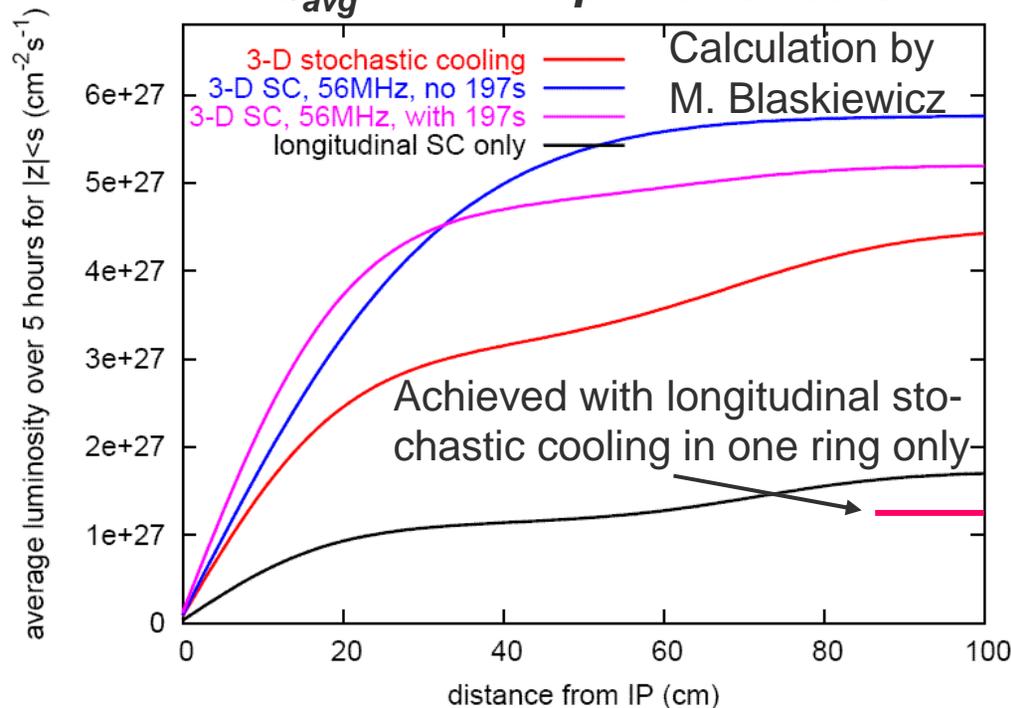
Progress Toward RHIC-II Science: Machine Upgrades

➤ EBIS on track for scheduled Q4 FY2010 completion; superconducting trap solenoid passed acceptance test 5/21/09

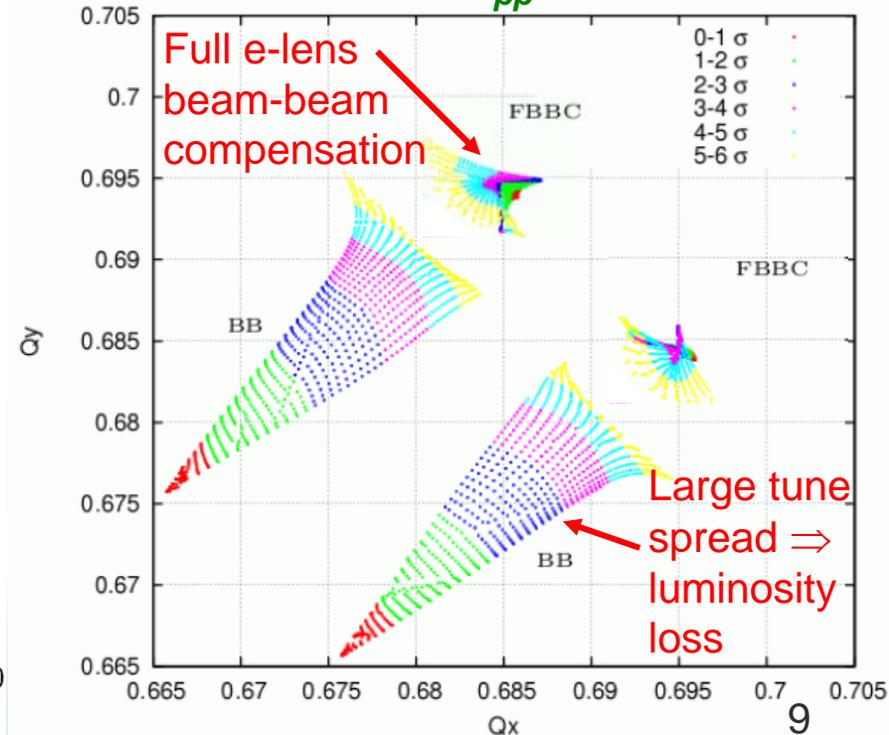
➤ FY09 ARRA (stimulus) funds for 2 additional planes transverse stochastic cooling + electron lenses to improve pp luminosity

2 planes transverse stochastic cooling + longitudinal cooling in each ring + 56 MHz SRF rebunching by 2012 run should ⇒ ~ order of magnitude enhancement in

\mathcal{L}_{avg} within exp't vertex cuts



Interaction with ~5 keV e^- beam to compensate pp head-on beam-beam tune spread ⇒ (?) factor ~2 in \mathcal{L}_{pp} after ~2013

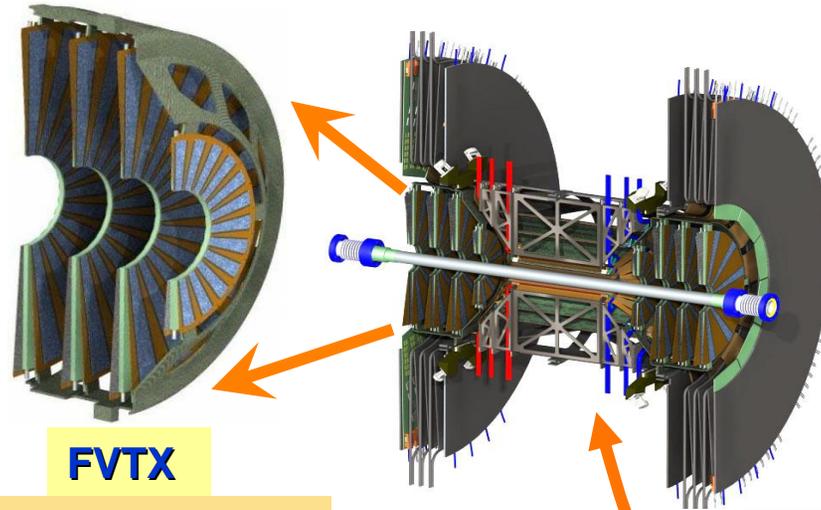


Progress Toward RHIC-II Science: Detector Upgrades

➤ FY09 ARRA funds ensure timely completion of PHENIX VTX & FVTX upgrades

➤ Awaiting updated plan, sharpened physics focus, for PHENIX FOCAL

➤ Successful HBD operation, μ trigger rescoping in FY09

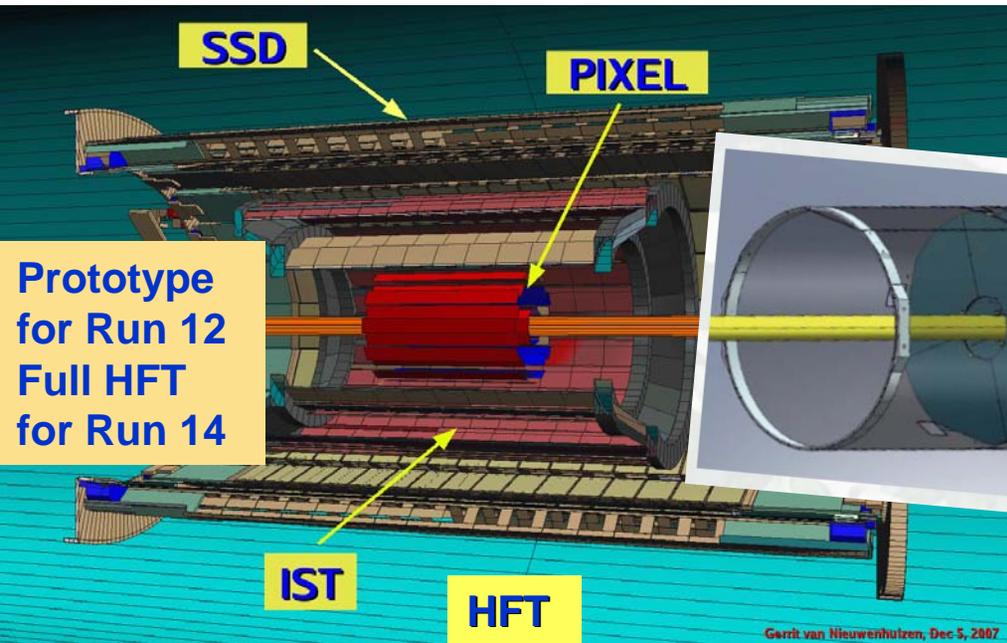


FVTX

Install for Run 12

VTX

Install for Run 11



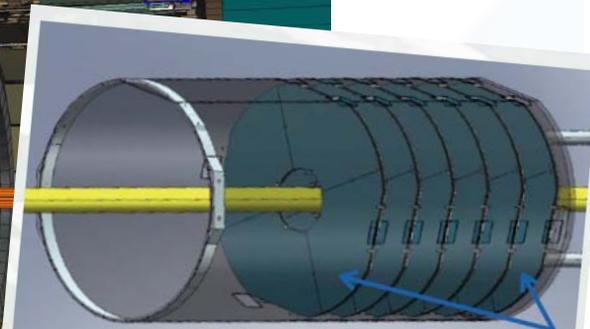
SSD

PIXEL

IST

HFT

Prototype for Run 12
Full HFT for Run 14



FGT

Install for Run 12

➤ STAR Heavy Flavor Tracker receives CD-0 in FY09; CD-1 review anticipated for Fall '09

➤ STAR Forward GEM Tracker launched as Cap. Equip. project

➤ Successful operation of DAQ1000 & $\frac{3}{4}$ TOF in Run 9

Tentative RHIC Run Plan Following 2008 PAC Recommendations

(assumes 6-month FY09 CR, 2-species runs in FY10-14 & best info on detector upgrade schedules)

Fiscal Year	Colliding Beam Species/Energy	Comments
2009	500 GeV p+p	~5-6 physics weeks to commission collisions, work on polarization & luminosity, obtain first W prod'n signal to meet 2011 RIKEN milestone; STAR DAQ1000 fully operational
2010	200 GeV p+p	10-12 physics weeks to complete 200 GeV A_{LL} measurements – could be moved to Run 9 if FY09 Omnibus Funding Bill supports 21 cryoweeks
	200 GeV Au+Au	9-10 physics weeks with PHENIX HBD, STAR DAQ1000 & TOF permits low-mass dilepton response map and 1 st HI collision test of transverse stochastic cooling (one ring)
2011	Au+Au at assorted low E	1 st energy scan for critical point search, using top-off mode for luminosity improvement – energies and focus signals to be decided; commission PHENIX VTX (at least prototype)
	200 GeV U+U	1 st U+U run with EBIS, to increase energy density coverage
2012	500 GeV p+p	1 st long 500 GeV p+p run, with PHENIX muon trigger and STAR FGT upgrades, to reach ~100 pb ⁻¹ recorded for substantial statistics on W production and ΔG measurements
	200 GeV Au+Au	Long run with full stochastic cooling, PHENIX VTX and prototype STAR HFT installed; focus on RHIC-II goals: heavy flavor, γ -jet, quarkonium, multi-particle correlations
2013	500 GeV p+p	Reach ~300 pb ⁻¹ to address 2013 DOE performance milestone on W production
	200 GeV Au+Au or 2 nd low-E scan	To be determined from 1 st low-E scan and 1 st upgraded luminosity runs, progress on low-E e-cooling, and on installation of PHENIX FVTX and full STAR HFT
2014	200 GeV Au+Au or 2 nd low-E scan	Run option not chosen for 2013 run – low-E scan addresses 2015 DOE milestone on critical point, full-E run addresses 2014 (γ -jet) and 2016 (identified heavy flavor) milestones. Proof of principle test of coherent electron cooling.
	200 GeV p+p	Address 2015 DOE performance milestone on transverse SSA for γ -jet; reference data with new detector subsystems; test e-lenses for p+p beam-beam tune spread reduction

Run Plan, Detector & Luminosity Upgrades Address All New RHIC-Related Performance Milestones

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)	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
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 $A \approx 200$ 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 $\sqrt{s_{NN}}$ 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 p_T spectra, and correlations in heavy-ion collisions at $\sqrt{s_{NN}} = 200$ 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 $\sqrt{s_{NN}} = 200$ GeV.

spin

Heavy ion

N.B. Some will be missed if budgets do not permit 2 species/year runs in FY10-14, but FY09 and President's FY10 budgets encouraging!

Excerpts from Letters to PHENIX & STAR re PAC:

What I would like you both to focus on in your BUR presentations to PAC are your collaboration's **preferences for beam species, energies, and physics goals for Runs 10 and 11**, in light of whatever we will be able to achieve in Run 9.

I imagine a major topic of discussion at PAC will focus on the **optimal strategy for a low-energy scan and search for QCD critical point and/or onset of deconfinement**.

I would, however, also like you to address in your PAC presentations how your collaboration is **preparing to make optimal use of the anticipated luminosity increases**.

Be prepared to summarize briefly your plans and issues for **accommodating the higher luminosity in DAQ and trigger rate capabilities and offline data analysis capabilities, together with any relevant detector subsystem issues at higher luminosity**. In particular, STAR should present the preliminary findings from the study of high luminosity effects on TPC performance, which was “ordered” by the 2008 RHIC S&T Review (and which will have to be presented in full at the July 2009 S&T Review).

PAC should provide advice on priorities for 25- and 30-cryoweek Runs 10 and 11, plus feedback on collaboration readiness to handle enhanced luminosity.

Open Session Bldg. 510 (Physics) Large Seminar Room

9:00 – 9:15 **S. Vigdor:** Charge to PAC; overview of long-term run planning and budgets

9:15 – 10:00 **W. Fischer:** Run 9 machine performance + progress on RHIC upgrades + projections for Run 10 and 11 performance (30' + 15' for questions)

10:00 – 10:15 Coffee Break

10:15 – 10:45 **T. Ludlam:** Status report on detector upgrades (20' + 10')

10:45 – 11:30 **D. Kharzeev:** Theory perspective on search for P- and CP-violating vacuum fluctuations (30' + 15')

11:30 – 12:15 **K. Rajagopal:** Theory perspective on search for QCD critical point (30' + 15')

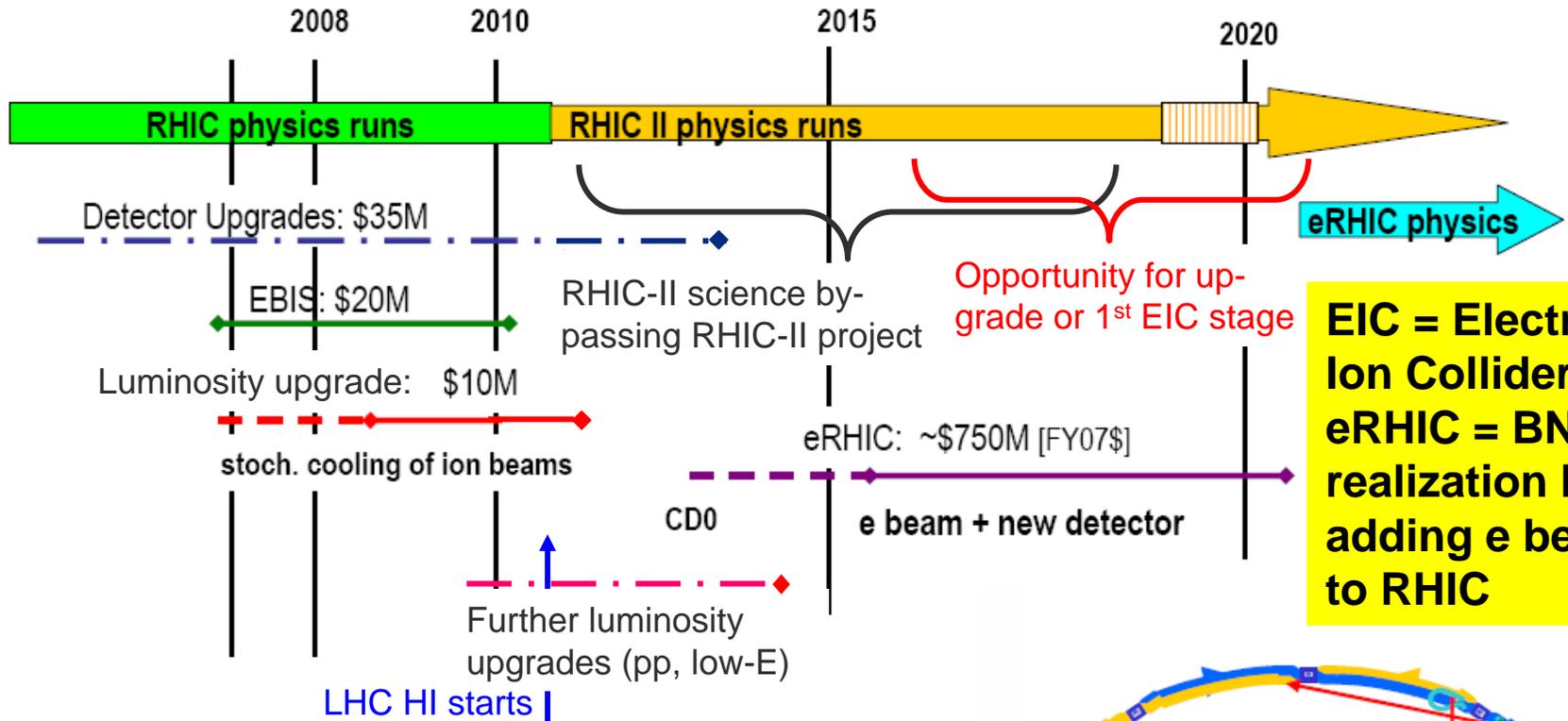
Open Session Bldg. 510 (Physics) Large Seminar Room

14:00 – 15:00 **J. Dunlop:** STAR Beam Use Proposal + recent accomplishments + plans to handle upgraded luminosity (40' + 20')

15:00 – 16:00 **B. Jacak:** PHENIX Beam Use Proposal + recent accomplishments + plans to handle upgraded luminosity (40' + 20')

Backup Slide

A Long Term (Evolving) Strategic View for RHIC



EIC = Electron-Ion Collider; eRHIC = BNL realization by adding e beam to RHIC

Legend:

- R&D
- ◀-----▶ Construction
- .-.-.-.-> Multiple small projects

CD0: DOE Critical Decision, mission need

