

# The RHIC Upgrade Plan

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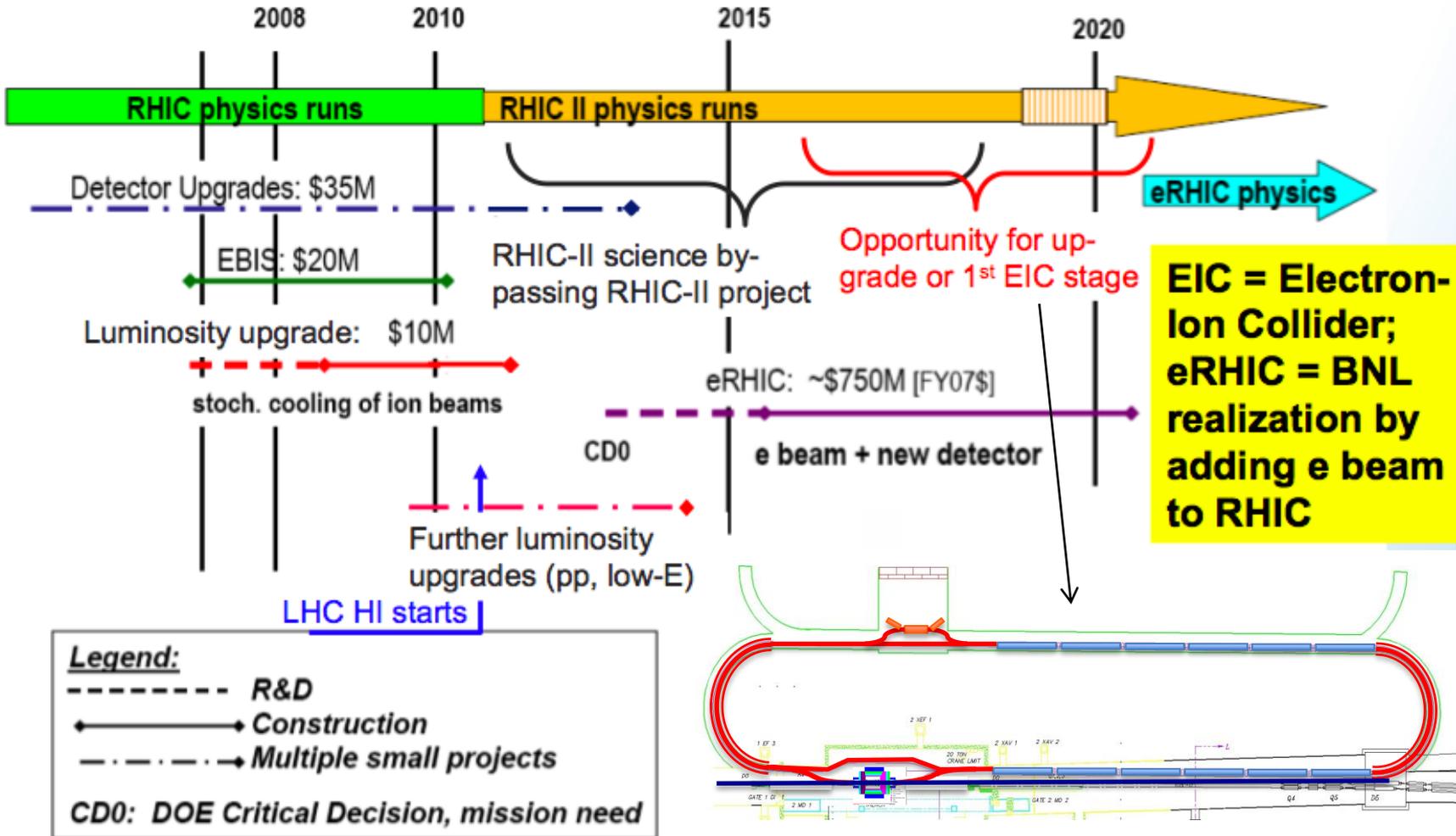
EBIS Pre-injector

Plans for luminosity upgrades

Low energy Au – Au collisions (Critical point search)

Electron-Ion Collider @ BNL (eRHIC and MeRHIC)

# Long term future of RHIC



## RHIC Facility Upgrade Plans

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- EBIS (~ 2011) (low maintenance linac-based pre-injector; all species including U and polarized  $^3\text{He}$ )
- RHIC luminosity upgrade (~ 2012):  
 [Au-Au:  $40 \times 10^{26} \text{ cm}^{-2} \text{ s}^{-1}$  ( $\times 4$ ); 500 GeV p-p:  $1.5 \times 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$ ]
  - 0.5 m  $\beta^*$  for Au – Au and  $p\uparrow - p\uparrow$  operation
  - Stochastic cooling of Au beams and 56 MHz storage rf system in RHIC
- Further luminosity upgrade for  $p\uparrow - p\uparrow$  operation (~ 2014):  
 [500 GeV p-p:  $\sim 3 \times 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$ ]
  - 0.3 m  $\beta^*$  for 500 GeV  $p\uparrow - p\uparrow$  operation ( $\times 1.6$ )
  - Electron lens in RHIC for head-on beam-beam compensation ( $\times 2$ )
- Low energy ( $\sqrt{s}=5\dots30 \text{ GeV}$ ) Au-Au collisions for critical point search
  - $\sim 1\dots5 \text{ MeV}$  electron cooling of Au beams at injection (~ 2014)
- eRHIC: high luminosity ( $\geq 1 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$ ) eA and pol. ep collider using 4 GeV and later 10 - 20 GeV electron driver, based on an Energy Recovering Linac (ERL), and strong cooling of hadron beams (~ 2020)  
 Exploring gluons at extreme density!

# RHIC Physics Plan 2009 - 2014

Fiscal Year	Colliding Beam Species/Energy	Comments
2009	500 GeV p+p	4 physics weeks to commission collisions, work on polarization & luminosity, obtain first W production signal to meet 2011 RIKEN milestone; STAR DAQ1000 fully operational
	200 GeV p+p	10 physics weeks for 200 GeV ALL measurements
2010	200 GeV Au+Au	9-10 physics weeks with PHENIX HBD, STARDAQ1000 & TOF permits low-mass dilepton response map and 1 <sup>st</sup> HI collision test of transverse stochastic cooling
	Au+Au at assorted low E	1st energy scan for critical point search – energies and focus signals to be decided; commission PHENIX VTX (at least prototype)
2011	200 GeV U+U	<b>1<sup>st</sup> U+U run with EBIS</b> , to increase energy density coverage
	500 GeV p+p	1 <sup>st</sup> long 500 GeV p+p run, with PHENIX muon trigger and STARFGT upgrades <b>~ 100 pb<sup>-1</sup> recorded</b> for substantial statistics on W production and $\Delta G$ measurements
2012	?	
	200 GeV Au+Au	Long run with full stochastic cooling, PHENIX VTX and prototype STARHFT installed; focus on RHIC-II goals: heavy flavor, $\gamma$ -jet, quarkonium, multi-particle correlations
2013	500 GeV p+p	Reach ~ 300 pb <sup>-1</sup> to address 2013 DOE performance milestone on W production
	200 GeV Au+Au or 2 <sup>nd</sup> low-E scan	To be determined from 1 <sup>st</sup> low-E scan and 1 <sup>st</sup> upgraded luminosity runs, progress on low-E e-cooling, and on installation of PHENIX FVTX and full STARHFT
2014	200 GeV Au+Au or 2 <sup>nd</sup> 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 ( $\gamma$ -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 $\gamma$ -jet; reference data with new detector subsystems; test e-lenses for p+p beam-beam tune spread reduction

# Schedule of Upgrades and R&D Projects

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To be completed in FY2009 for Run 10:

- Blue and Yellow longitudinal/vertical stochastic cooling installation/upgrade
- AGS L10 cavity replacement/upgrade
- Remaining 3 IPMs upgraded
- Stripper in AGS J5
- AGS horizontal tune jump system completion
- RHIC 10 Hz orbit feedback test
- Spin flipper test (AC dipole 3-bump)

To be completed in FY2010 for Run 11:

- EBIS (CD4 date: 9/2011)
- 9 MHz rf system
- RHIC 10 Hz orbit feedback
- Blue spin flipper complete
- P<sub>1</sub> LEBT upgrade
- RHIC polarimetry upgrade (?)
- Polarized source upgrade (new solenoid) (maybe in FY2011?)
- Beam dump upgrade (?)
- Collimator upgrade (?)
- Gun-to-dump test and completion of ERL

## Schedule of Upgrades and R&D Projects (cont'd)

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To be completed in FY2011 for Run 12:

- 56 MHz superconducting rf system (maybe in FY2012?)
- Blue and Yellow horizontal stochastic cooling installation\*
- Electron lenses in blue and yellow ring\*
- ERL commissioning

To be completed in FY2012 for Run 13:

- Transverse damper for transition (?) [modeled on stochastic cooling?]

To be completed in FY2013 for Run 14:

- Low energy electron cooling in RHIC (?)
- Coherent electron cooling test using ERL (?)

\* ARRA projects