

# RHIC present status and plans

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In Run-11 the peak performance in 250 GeV polarized proton operation has significantly increased for both luminosity and polarization, although at a reduced time in store. The RHIC Run-11 is summarized and the main polarized proton upgrades for the next years are presented. d-Au and p-Au operation, a possible energy upgrade, and  $^3\text{He}$  operation are discussed.

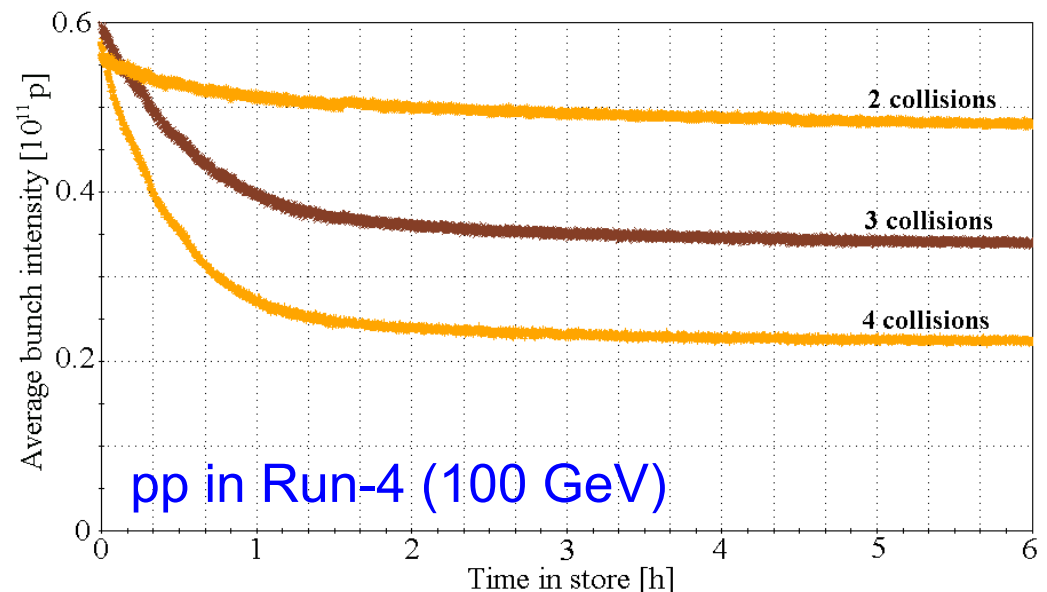
# Future operation of $A_n$ DY

- Can reduce  $\beta^*$  at IP2  
have run with  $\beta^* = 2.0$  m previously for BRAHMS  
 $\beta^* = 1.5$  m probably ok, needs to be tested
- Longer stores  
10h instead of 8h in Run-11 (depends on luminosity lifetime and store-to-store time)
- Collide earlier in store when conditions are met  
needs coordination with polarization measurement, PHENIX and STAR
- Electron lenses (see later) if  $A_n$ DY runs beyond Run-13  
increases max beam-beam tune spread, currently  $\Delta Q_{\text{max,bb}} \approx 0.015$   
can be used for to increase  $\xi \sim N_b/\epsilon$  and/or number of collisions

Run-11 luminosity at  $A_n$ DY:  
max  $\sim 0.3 \text{ pb}^{-1}/\text{store}$

With improvements:  
 $\sim 3x$  increase,  
 $\sim 10 \text{ pb}^{-1}/\text{week}$

[all preliminary]



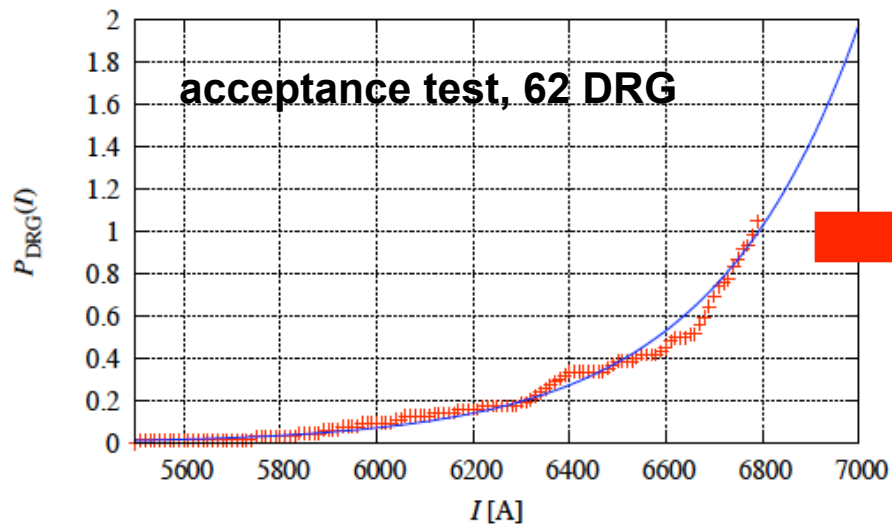
## Asymmetric collisions (p-Au)

- p-Au was considered in RHIC design (D. Trbojevic), no operation yet  
100.8 GeV p on 100.0 GeV/nucleon Au ( $\gamma_p = \gamma_{Au} = 107.4$ )
- **Need to translate DX magnets horizontally by 4.33 cm**  
p are bent stronger than Au<sup>79+</sup>
- For energy scan need to match Lorentz factor  $\gamma$  of both beams

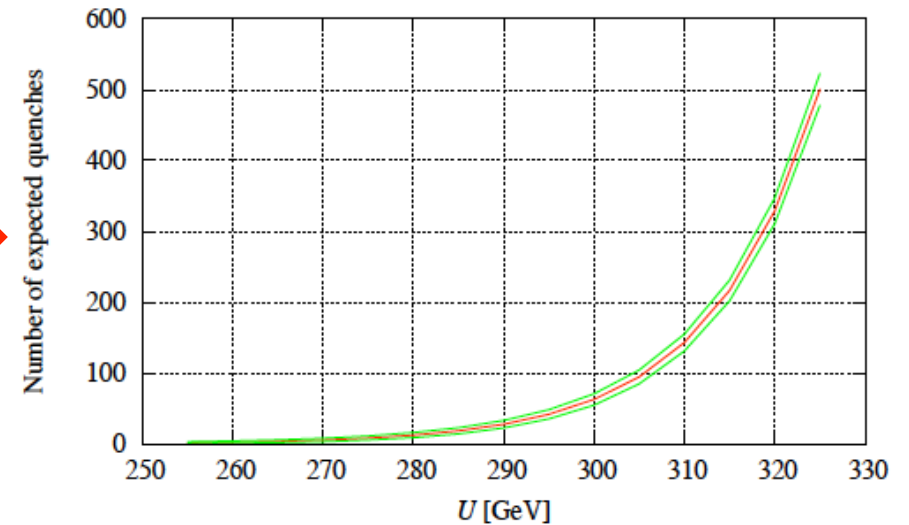
Parameter	unit	p-Au		p-Au	
No of bunches	...	111	111	111	111
Ions/bunch, initial	$10^9$	100	1.0	200	1.2
Average beam current/ring	mA	139	110	278	132
Stored energy per beam	MJ			0.36	0.42
$\beta^*$	m	0.85		0.60	
Hour glass factor	...	1.00		0.91	
Beam-beam parameter $\xi/IP$	$10^{-3}$	4.3	1.7	5.2	3.5
Peak luminosity	$10^{28} \text{ cm}^{-2} \text{ s}^{-1}$	30		95	
Average / peak luminosity	%	60		60	
Average store luminosity	$10^{28} \text{ cm}^{-2} \text{ s}^{-1}$	18		57	
Time in store	%	55		55	
Maximum luminosity/week	$\text{nb}^{-1}$			189	
Minimum luminosity/week	$\text{nb}^{-1}$	60			

# Energy upgrade – W. MacKay, C-A/AP/422

observed quenches in arc dipoles



estimated # of training quenches



## Conclusion:

- 10% increase to 275 GeV (+45% in  $\sigma_W$ ) feasible with current magnets  
about 20 DX, 10 other training quenches, more cooling at some current leads
- Requires some hardware upgrades (dump kicker, power supplies)
- Effect on polarization still needs study
- Energies >275 GeV require too many training quenches  
hundreds of arc dipole training quenches alone for 325 GeV

# Polarized $^3\text{He}$

[Summary W. MacKay, CAD MAC-05, 09/15/2010]

- ✎ Deuterons not good in RHIC — perhaps in a figure-8 ring.
  
- ⋈  $\text{He}^3$  looks promising: no real show stoppers.
  - Source:  $^3\text{He}^{+2}$  OPPIS source — proposal: Milner/Zelenski  
See Anatoli Zelenski's presentation.
  - $|G\gamma|_{\text{max}}$  is higher for  $\text{He}^3$ :
    - More and Stronger resonances in all rings.
  - $^3\text{He}$  polarimeters need to be developed.
  - AGS cold snake may be sufficient at lower field.  
AGS warm snake (fixed field) might be too strong ( $\sim 14\%$ ).
  - AGS injection and extraction spin-matching: not too bad.
    - Booster to AGS may need matching (depends on AGS snakes).
  - RHIC snakes and rotators will work with lower fields.
  - Lower injection rigidity for RHIC should be OK.
    - Injection orbit excursions reduced.

# Summary – RHIC performance

- Run-11  $p^{\wedge}p^{\wedge}$  results:

$$P > 46\%, L_{\text{peak}} = 150 \times 10^{30} \text{cm}^{-2} \text{s}^{-1}, L_{\text{avg}} = 85 \times 10^{30} \text{cm}^{-2} \text{s}^{-1}$$

(all new records for peak performance, and all within Run-11 projections)

Integrated luminosity below expectation due to down time

$A_n$  DY tested, ran with relatively small impact on STAR/PHENIX

- Main hardware upgrades for  $p^{\wedge}p^{\wedge}$  (commissioning planned for Run-13)

Polarized source:  $P +5\%$ , intensity +order of magnitude

Electron lenses : up to 2x more luminosity with source upgrade

- Asymmetric collisions (d-Au and p-Au)

Expect up 2x more luminosity for future d-Au operation rel. to Run-8

p-Au possible with change of DX location ( $\gamma_p = \gamma_{\text{Au}} = 107.4$ )

- Limited energy upgrade possible, 10% to 275 GeV protons

Effect on polarization still needs study, requires hardware upgrades

- Polarized  $^3\text{He}$  (p- $^3\text{He}$ ,  $^3\text{He}$ - $^3\text{He}$ )

Polarized  $^3\text{He}$  source R&D has started (with MIT, using EBIS)

Acceleration and storage in RHIC should be possible

$^3\text{He}$  polarimetry at high (esp. absolute) needs R&D