

RHIC 4-year goals for heavy ions and polarized protons

Wolfram Fischer



BNL Collider-Accelerator Department
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Enhanced Luminosity Goals

(before e-cooling, about 2008)

- For Au-Au, average per store, 4 IRs

$$\mathbf{L = 8 \cdot 10^{26} \text{cm}^{-2}\text{s}^{-1}} \text{ at } 100\text{GeV/u}$$

4× design
2× achieved

- For $p\uparrow - p\uparrow$ average per store, 2 IRs

$$\mathbf{L = 6 \cdot 10^{31} \text{cm}^{-2}\text{s}^{-1}} \text{ at } 100\text{GeV}$$

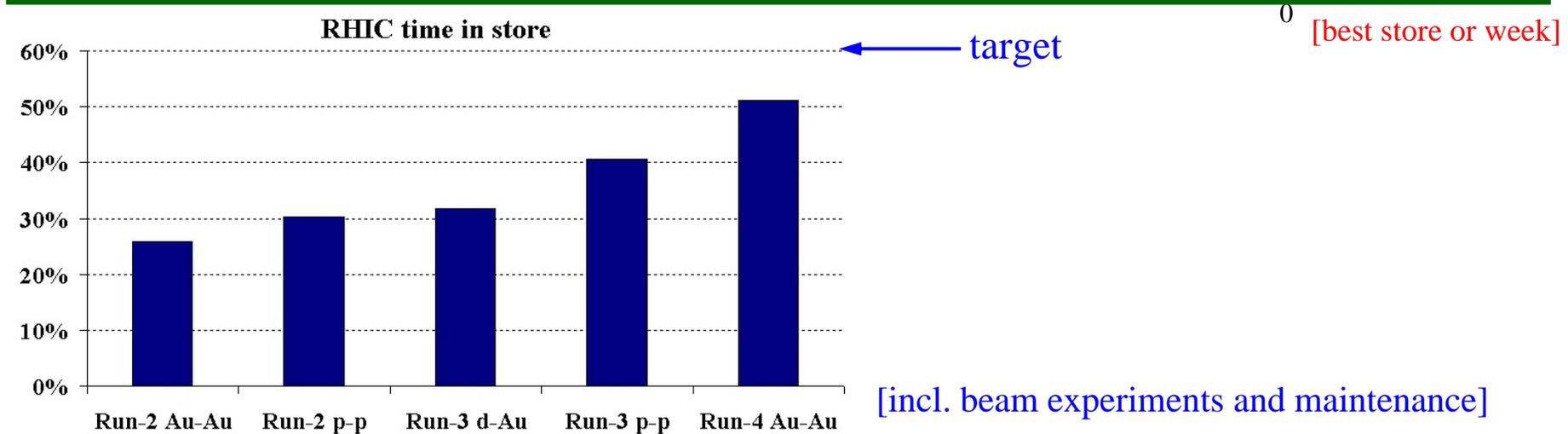
$$\mathbf{L = 1.5 \cdot 10^{32} \text{cm}^{-2}\text{s}^{-1}} \text{ at } 250\text{GeV}$$

with **70% polarization**

16× design
6× achieved

1× design
2× achieved

Mode	No of bunches	Ions/bunch [1 0 ⁹]	β^* [m]	Emittance [μm]	$\mathcal{L}_{\text{peak}}$ [$\text{cm}^{-2}\text{s}^{-1}$]	$\mathcal{L}_{\text{store ave}}$ [$\text{cm}^{-2}\text{s}^{-1}$]	L_{week}
Au-Au [Run-4]	45	1.1	1	15-40	15×10^{26}	5×10^{26}	$160 \mu\text{b}^{-1}$
d-Au [Run-3]	55	110/0.7	1	15	12×10^{28}	3×10^{28}	4.5 nb^{-1}
$p\uparrow -p\uparrow$ [Run-4]	55	70	1	20	6×10^{30}	4×10^{30}	0.9 pb^{-1}
Au-Au design	56	1	2	15-40	9×10^{26}	2×10^{26}	$50 \mu\text{b}^{-1}$
p-p design	56	100	2	20	5×10^{30}	4×10^{30}	1.2 pb^{-1}
$p\uparrow -p\uparrow$ design	112	200	1	20	80×10^{30}	65×10^3	20 pb^{-1}



Run-5 (starts in November 2005)

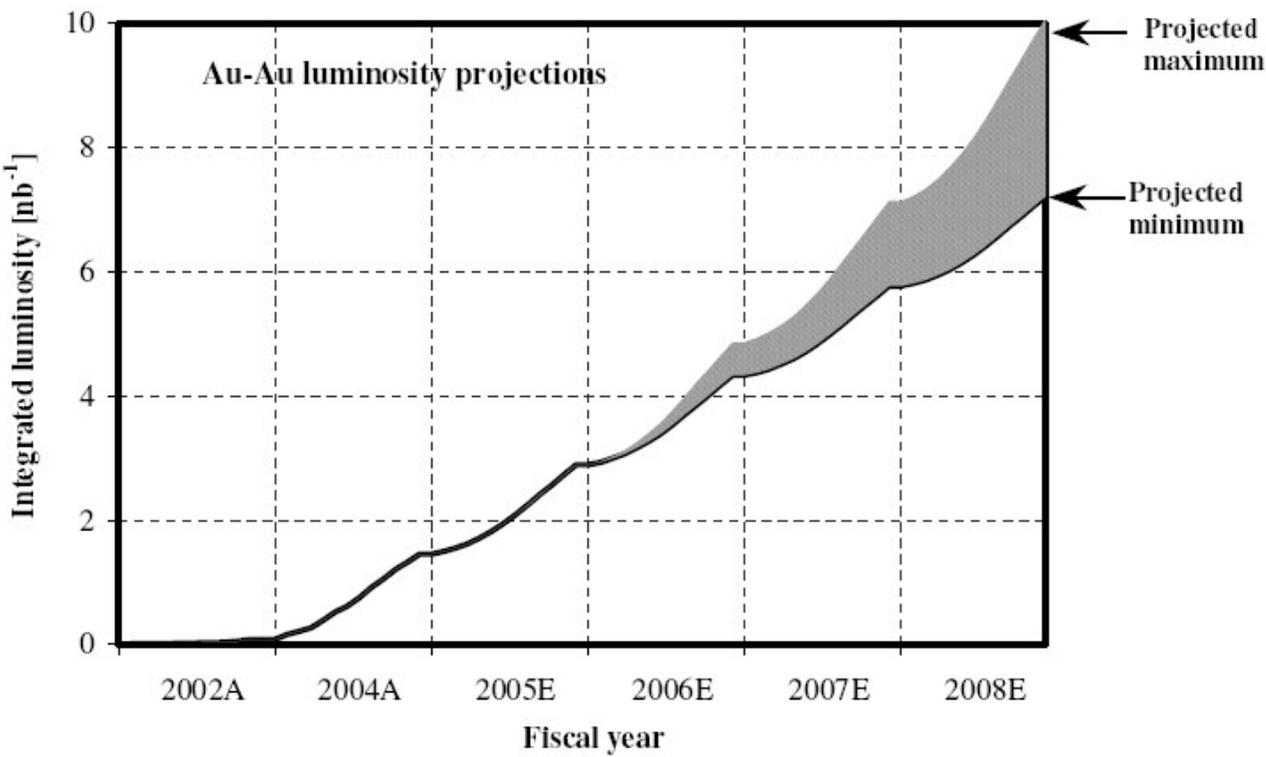
- Cu - Cu at 100 GeV/u
 - 4 weeks set-up / ramp-up
 - 7 weeks (?) for luminosity
 - 7 nb⁻¹ integrated luminosity delivered to Phenix/Star (assuming same charge per beam as with Au in Run-4)
- p↑ - p↑ at 100 GeV/u
 - 3 weeks set-up / ramp-up
 - 8 weeks (?) for luminosity
 - 8 pb⁻¹ integrated luminosity delivered to Phenix/Star, with 45% polarization at store (demonstrated performance of Run-4)

[T. Roser, W. Fischer, M. Bai, F. Pilat, “RHIC Collider Projections”, Last update August 16, 2005.]

Fiscal year		2004A	2008E
No of bunches	...	45	112
Ions/bunch, initial	10^9	1.1	1.1
Average store luminosity	$10^{26} \text{ cm}^{-2} \text{ s}^{-1}$	4.0	9.0
Time in store	%	53	60
Maximum luminosity/week	μb^{-1}	160	327

- Assume**
- 12 weeks production in every year
 - 8 weeks of linear luminosity increase
 - 4 experiments
 - completion of improvements

2x increase



To reach enhanced luminosity goals
in heavy ion operation

→ Need to double bunch number

currently limited by dynamic pressure rises

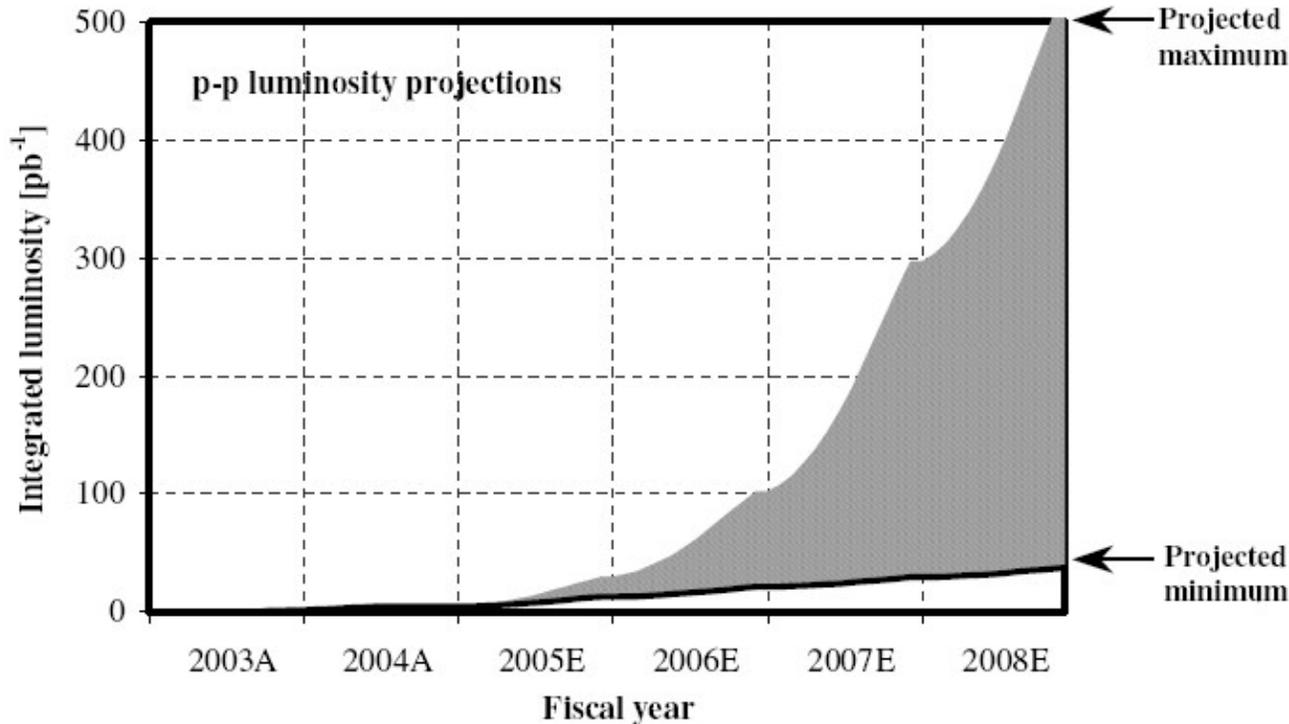
→ Up to an additional 50% possible
with stochastic cooling

prevents debunching, which dominates
the bunched beam lifetime

Fiscal year		2004A	2008E
No of bunches	...	56	112
Ions/bunch, initial	10^{11}	0.7	2.0
Average store luminosity	$10^{30} \text{ cm}^{-2}\text{s}^{-1}$	4	72
Time in store	...	38	60
Maximum luminosity/week	pb^{-1}	0.9	26.0
RHIC store polarization, average	%	40	70
Maximum LP^4 /week	nb^{-1}	24	6230

Assume

- 12 weeks production in every year
- 8 weeks of linear luminosity increase
- only 2 experiments
- completion of improvements



250× increase !
 9× from Polarization
 18× from Luminosity
 (another 2.5× for 250GeV)

To reach enhanced luminosity goals in polarized proton operation

- Need to double polarization
currently limited by AGS, source
- Need to maintain polarization from 100 to 250 GeV
limited by orbit control in RHIC
- Need to triple bunch intensity
will be limited by beam-beam interaction
- Need to double bunch number
currently limited by dynamic pressure rises