Two Rings, One MCR, No Sleep: RHIC Early Commissioning

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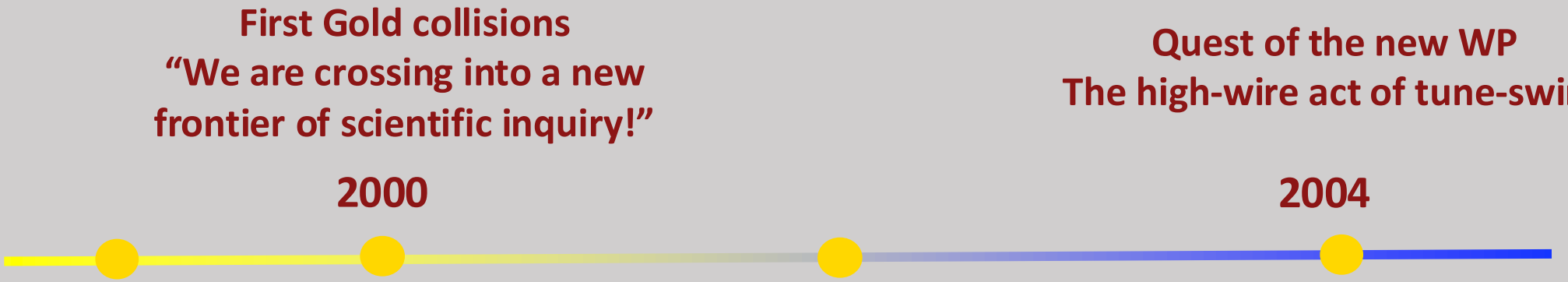
SLAC NATIONAL ACCELERATOR LABORATORY

RHIC Fest

Stanford University | U.S. DEPARTMENT OF ENERGY

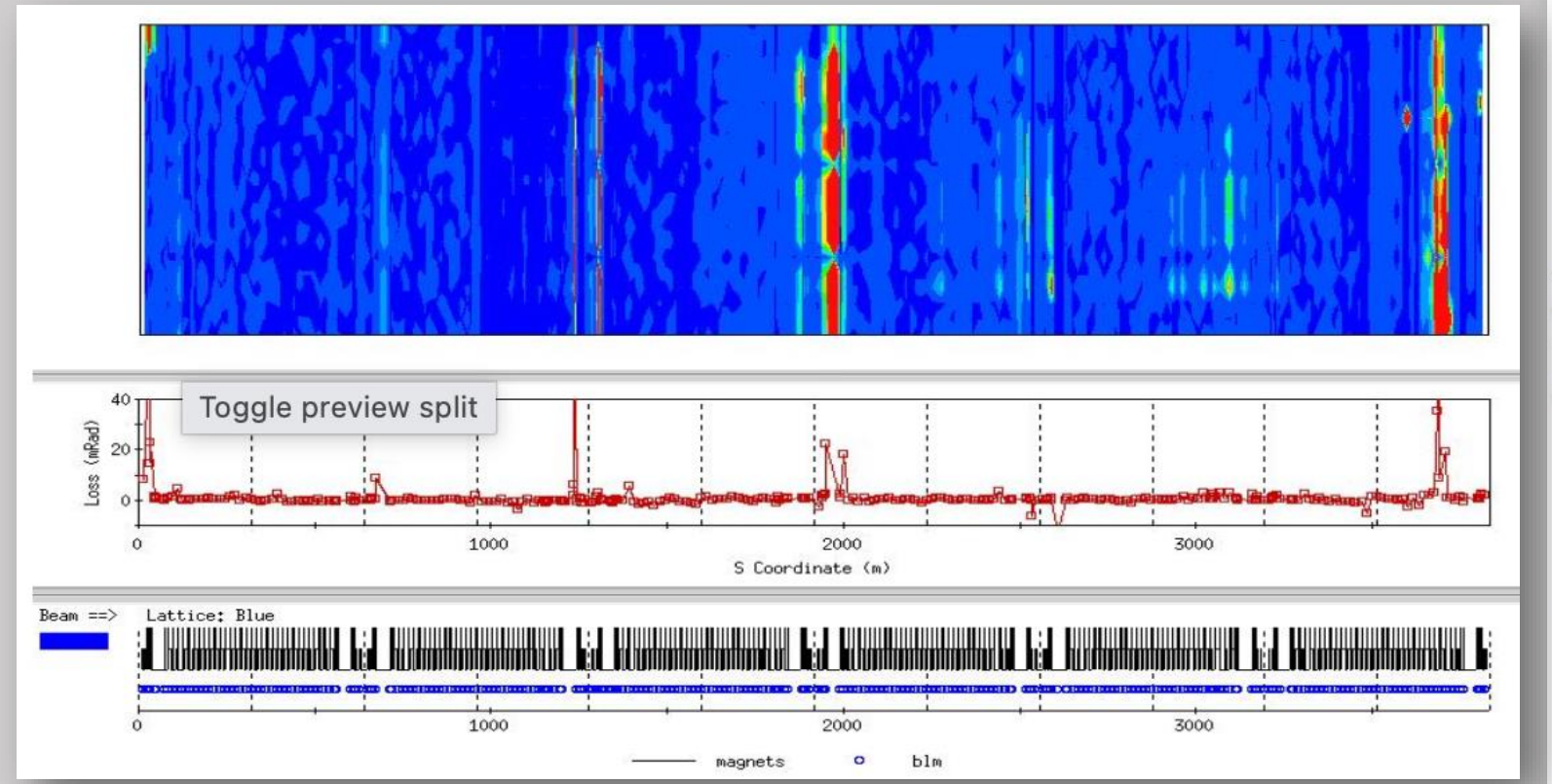
The Early Commissioning of RHIC



The start of commissioning: struggle to the circulating

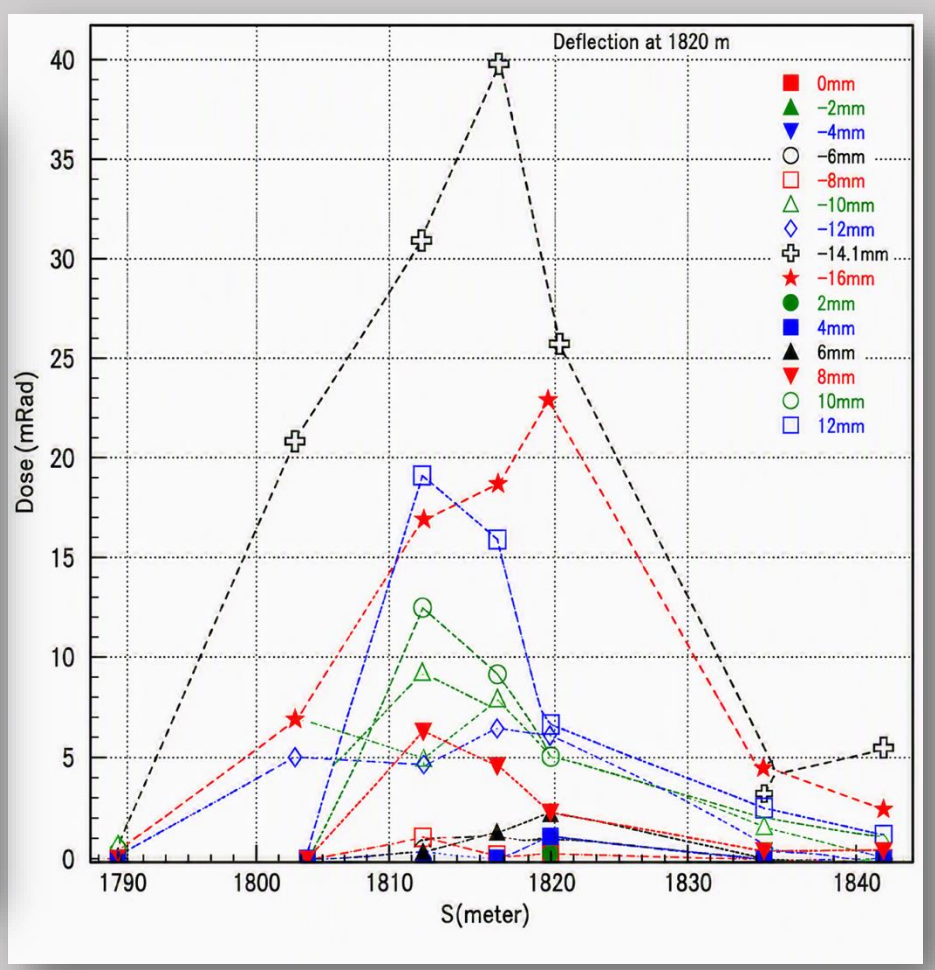
The hurdles we managed

Tuning the first turn with BLMs



The 1st turn loss map of blue ring

Locate the obstruction



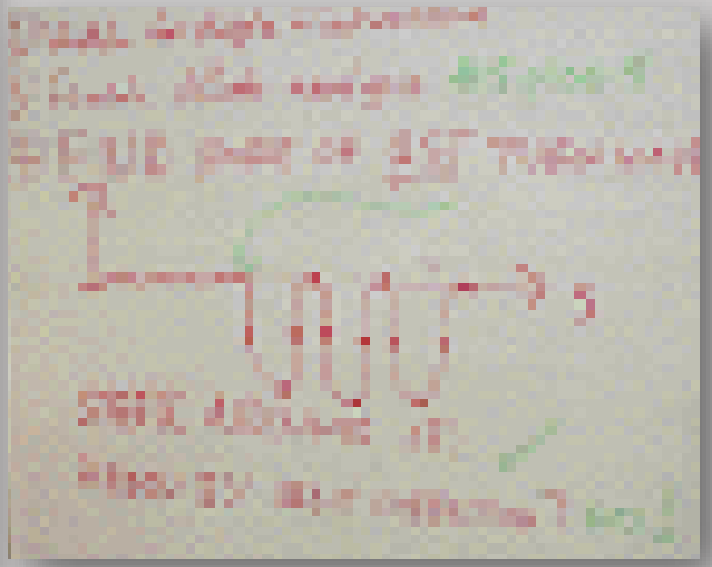
Loss pattern around Q6 of sector 11

P. Thompson, et al, AIP Conf. Proc. 546, 313–321 (2000)

The start of commissioning: struggle to the circulating

The triumph orbit bump to steer the beam around the obstruction

What is drawn on the board?



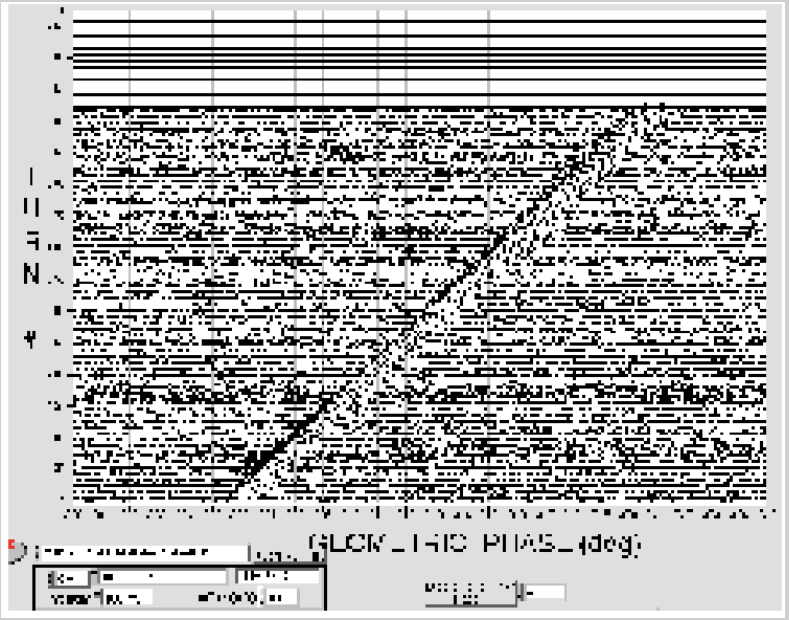
The start of commissioning: struggle to the circulating

A-crew perfected the match of injection and

D-crew instituted the local orbit bump

AI generated with public profile photos

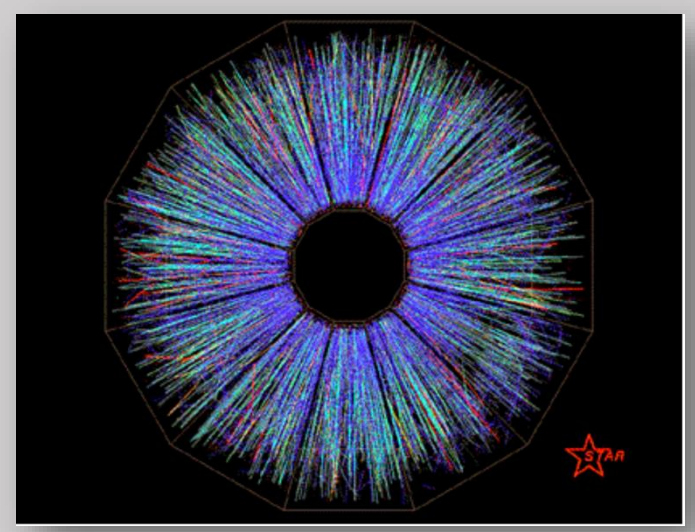
The first circulating in Blue Ring!



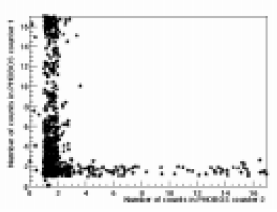
RHIC Begins the World's Highest Energy Heavy-Ion Collisions

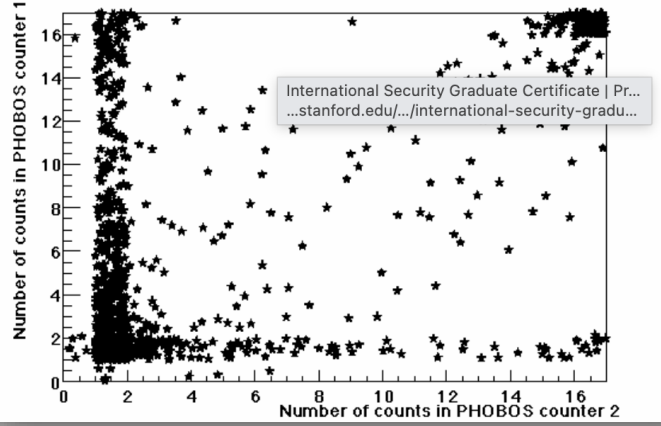
"We are crossing into a new frontier of scientific inquiry!"

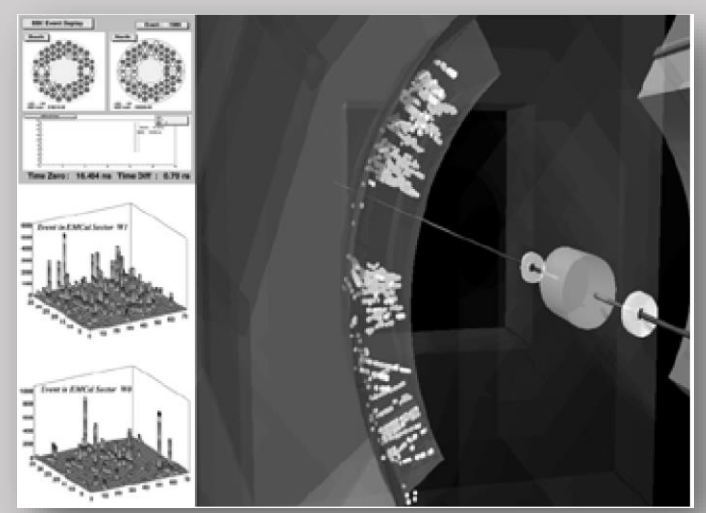
The 1st collision: Monday night, June 12, 2000, at exactly 9:00 PM EDT



These two plots are from PHOBOS, showing data taken in the early morning hours of June 13. The plot at right shows single gold beams interacting with material upstream of the detector. The plot below includes collision events, shown by the cluster of dots in the upper right corner. By the end of the day, PHOBOS had recorded over 1000 gold-on-







But getting there wasn't without struggles…

https://www.bnl.gov/bnlweb/pubaf/bulletin/files/2000/20000616.pdf

Beyond the First Collisions: Operational Hurdles

Besides the milestones of achieving first collisions, we also encountered and learned from the first set of beam-induced real magnet quenches

event	date	time	location (from mag voltage)	location (from loss monitor)	probable associated "operator" action
1	19Aug00	01.14.48	B3QFQ2	g3-lm1 b3-lm0	"ramp2inj" "operator" error
2	27Aug00	23.04.10	Y7QFQ3	(no data)	corrector saturation program problem (Fulvia's quench)
3	29Aug00	04.50.24	B11QFQ2	g11-lm1	access to ring: no dump, rf off, PASS. Abort to quad \phi_x=4.75
4	30Aug00	08.41.51	Y7QFQ3	y7-lm3.1 y7-lm4	corrector saturation program problem
5	3Sep00	00.15.47	B3QFQ3	b3-lm3	(? blue snake at full power ?)

L. Ahrens, C-A/AP/31

Beyond the First Collisions: Operational Hurdles

Lessons learned:

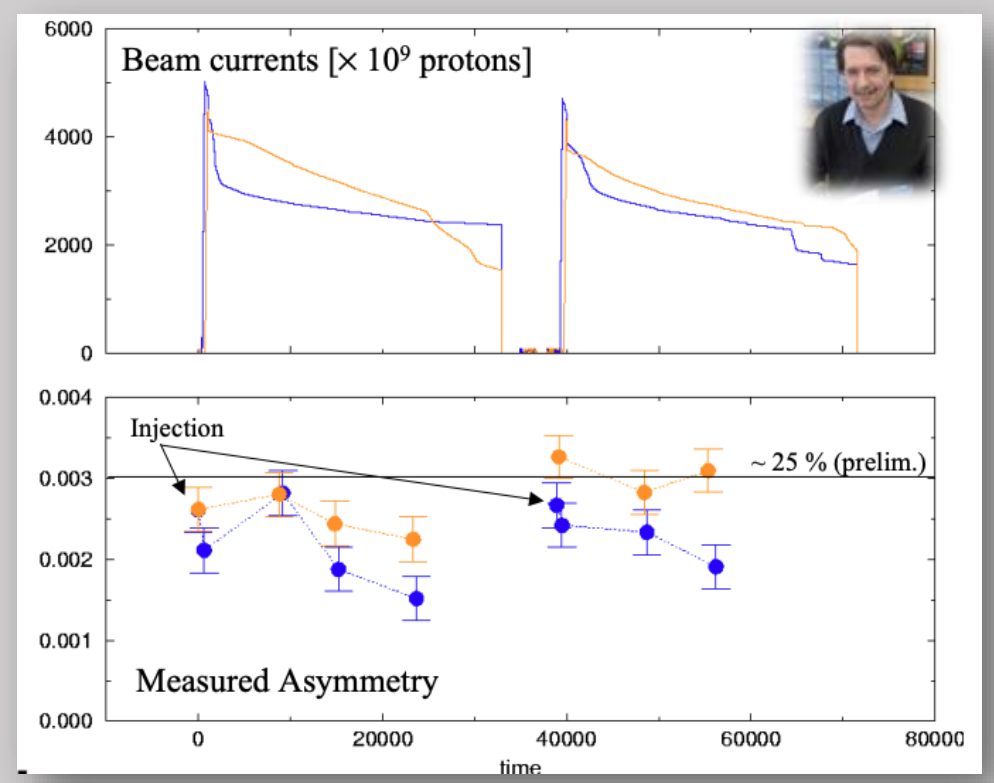
- **Protection against de-bunching**: Loss of all RF cavities must trigger an immediate pulling of the permit link.
- **Abort Gap Management**: Strict beam management inside the abort gap is required to maintain a safe operating margin.
- **BLM Threshold Optimization**: Beam Loss Monitor (BLM) thresholds must be carefully balanced to prevent frequent beam aborts while still protecting against magnet quenches.
- **Desired Diagnostics**: dedicated magnet quench flag, alongside closed-orbit and intensity logging for the final second before an event.

turn event	quench link pulled	intensity ions ($\times 10^{10}$) blue	intensity ions ($\times 10^{10}$) yellow	quench channel	quench/permit ado
1	blue	1.00	0.75	4b-qd1	4b-time.A
2	yellow	1.40	0.80	8b-ad2	8b-ps1
3	blue	1.90	0.00	12a-ad1	12a-ps1.A
4	yellow	1.10	1.10	8b-ad2	8b-ps1
5	blue	1.30	1.30	4b-ad1	4b-time.A

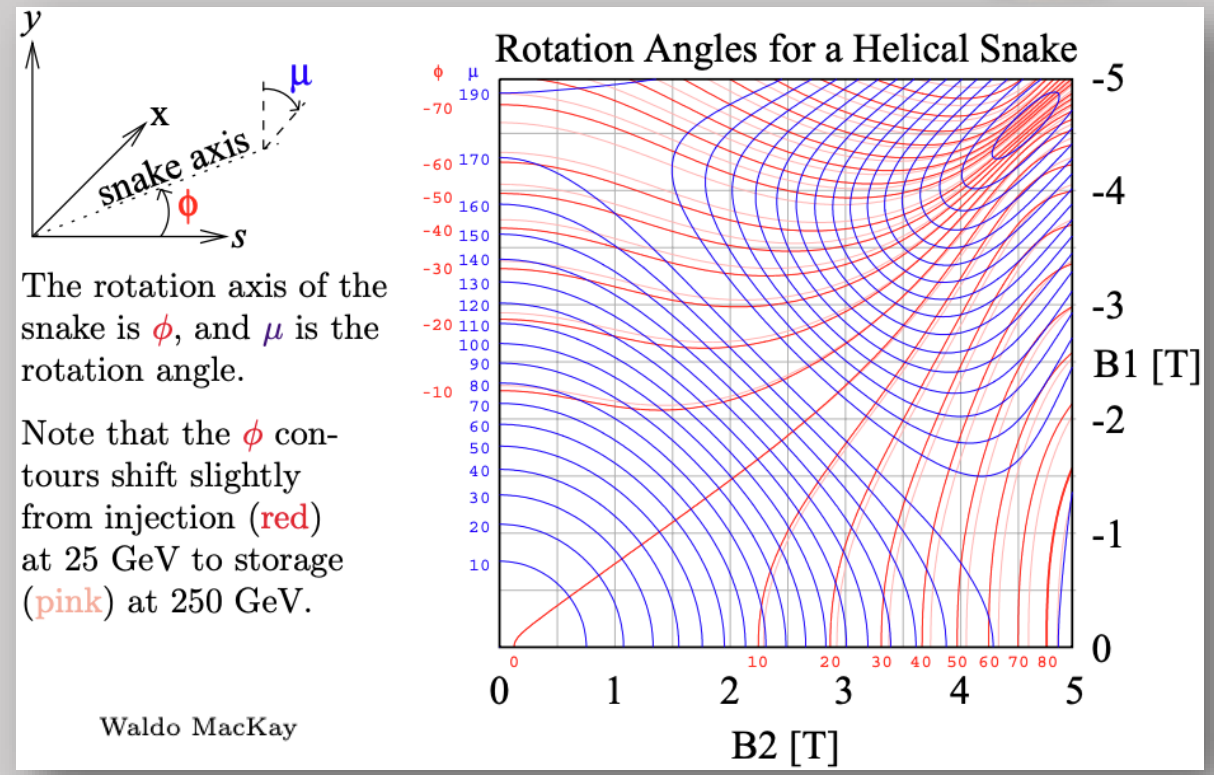
L. Ahrens, C-A/AP/31

The Start of Spin Era

The first pp collision

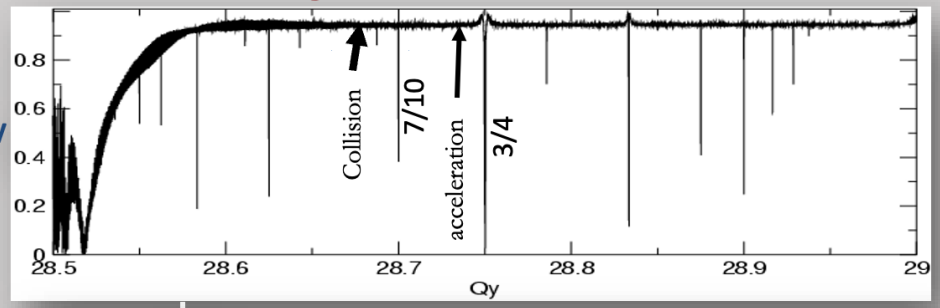


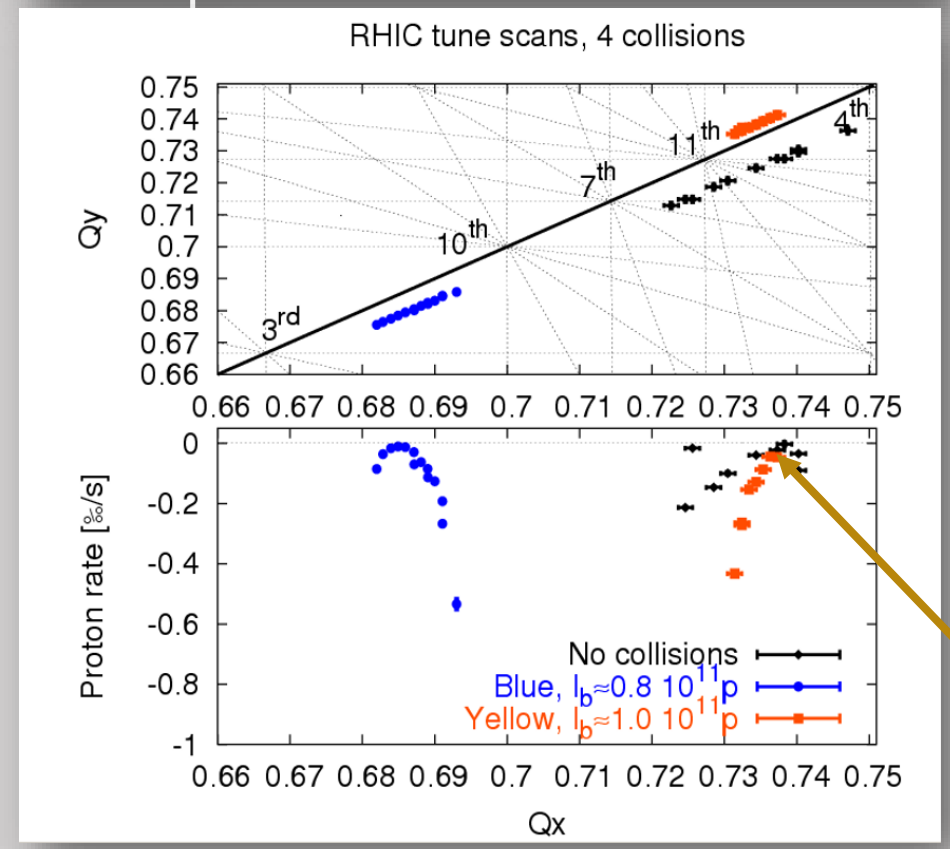
The delicacy of RHIC Helical Snakes



The polarized proton: duck-down to avoid depolarization!

PP working point development 2004





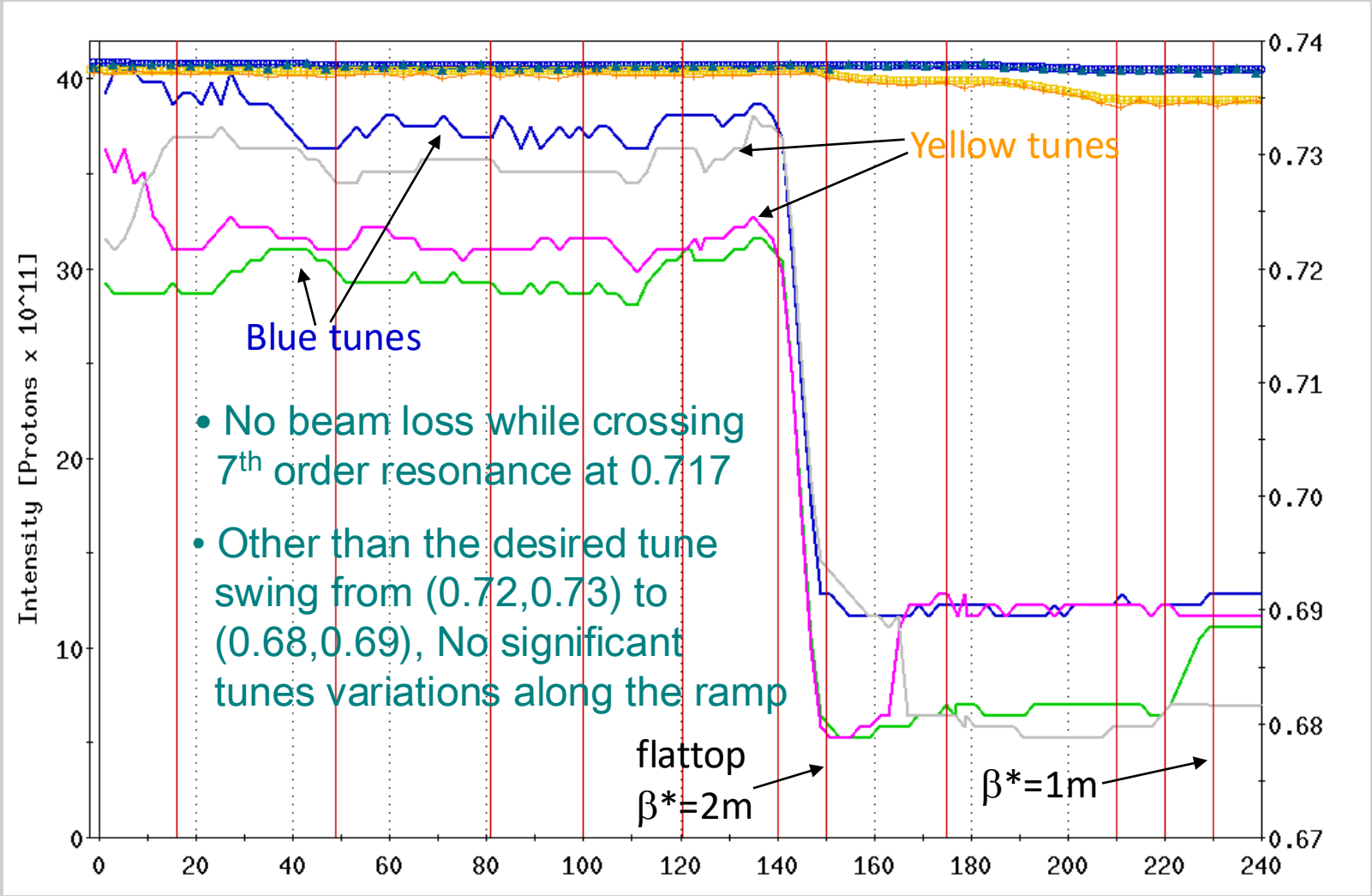
mode	Wokring point At store	Working point ramp	β*	Colli-sions	$P_{injection}$ [%]	P_{store} [%]	$P_{store}/P_{injecttion}$ [%]
I	0.739,0.738 0.735,0.734	0.735,0.72 0.735, 0.72	1	4	41.1±2.5 38.9±5.0	29.2±4.2 23.9±3.9	0.71 0.61
II	0.73,0.72 0.72,0.73	0.735,0.72 0.72, 0.73	2	0	41.7±3 40.1±2.1	32.0±5.7 27.1±4.5	0.77 0.67
III	0.73,0.72 0.72,0.73	0.735,0.72 0.72,0.73	2	2	43.5±5.0 42.8±7.9	37.6±2.7 34.1±3.8	0.87 0.80
IV	0.69,0.68 0.68,0.69	0.735,0.72 0.72,0.73	1	4	48.7±5 50.0±4.5	43.2±2.4 40.1±3.3	0.88 0.80

Clearly shows the benefit of store working point below 7/10 resonance

good for Beam lifetime, but bad for polarization

The polarized proton: duck-down to avoid depolarization!

PP 2004

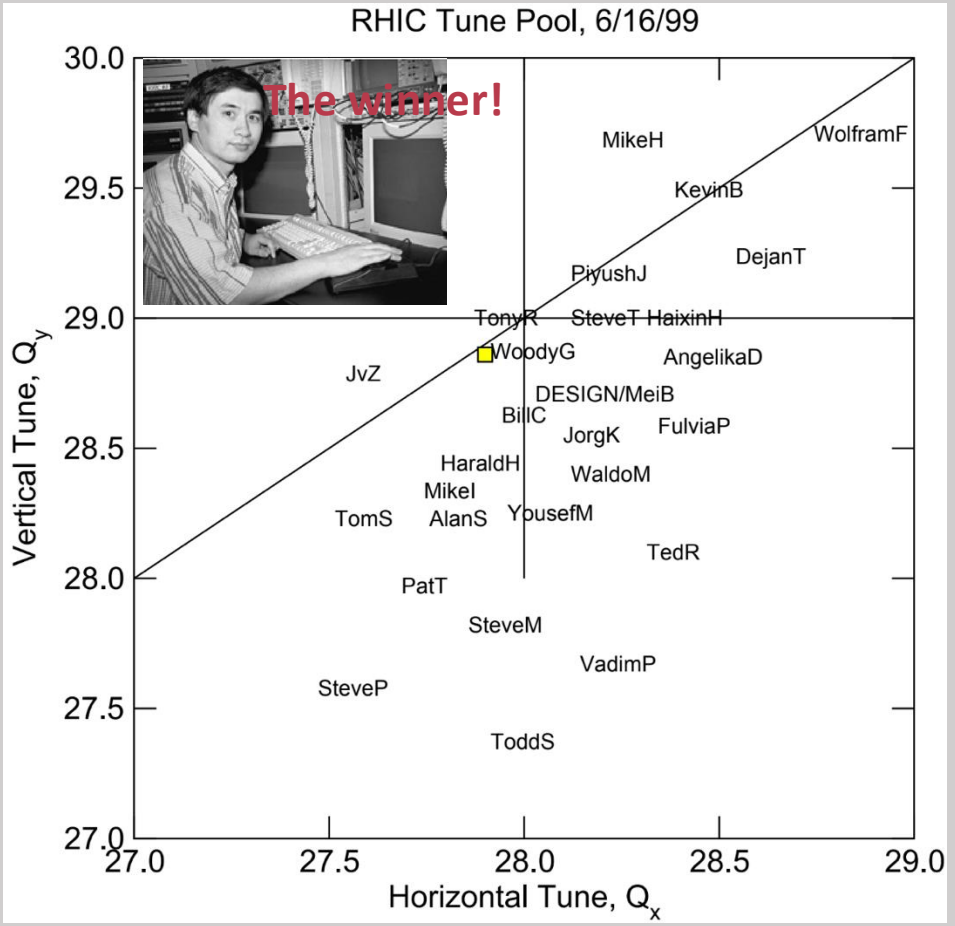


Those memorable moments

One of the many tense and exciting moments in MCR!

AI generated

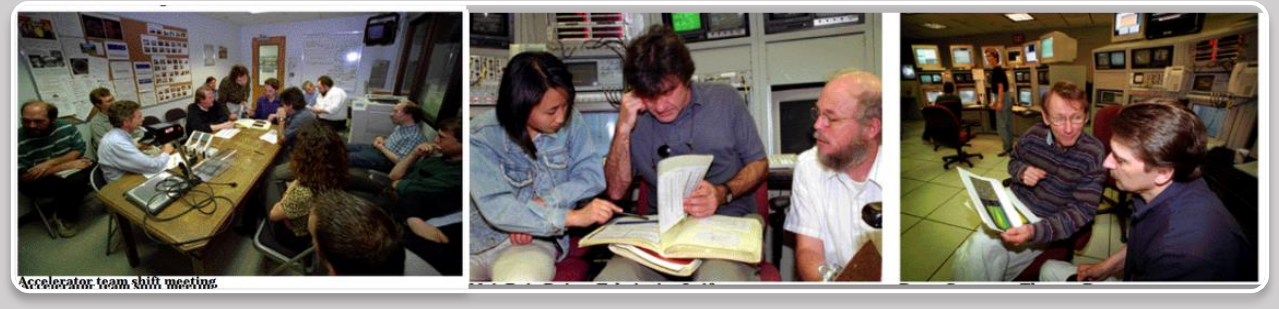
Place the right bet!



The amazing team


Accelerator team shift meeting


Michael Herbst


Accelerator team shift meeting