

RHIC BEAM-BEAM STUDIES IN RUN 2003

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RHIC Beam Experiments Workshop
BNL
26 September 2002

1. Introduction
2. Measurements of Run 2001
3. Measurements for Run 2003
4. Summary

Beam-Beam in Hadron Colliders

	ISR	SPS	Tevatron	HERAp	RHIC	RHIC	RHIC*
			Run I		Au 2001	p 2001	p 2002
Bunches per beam	coasting	3	6	174	55	55	110
Experiments	6	2	2	2	4	4	4
Parasitic interactions		4	10	—	—	—	—
ξ / IP	0.0010	0.0093	0.0075	0.0007	0.0015	0.0022	0.0037
Total bb tune spread, max	0.008	0.028	0.024	0.001	0.006	0.009	0.015

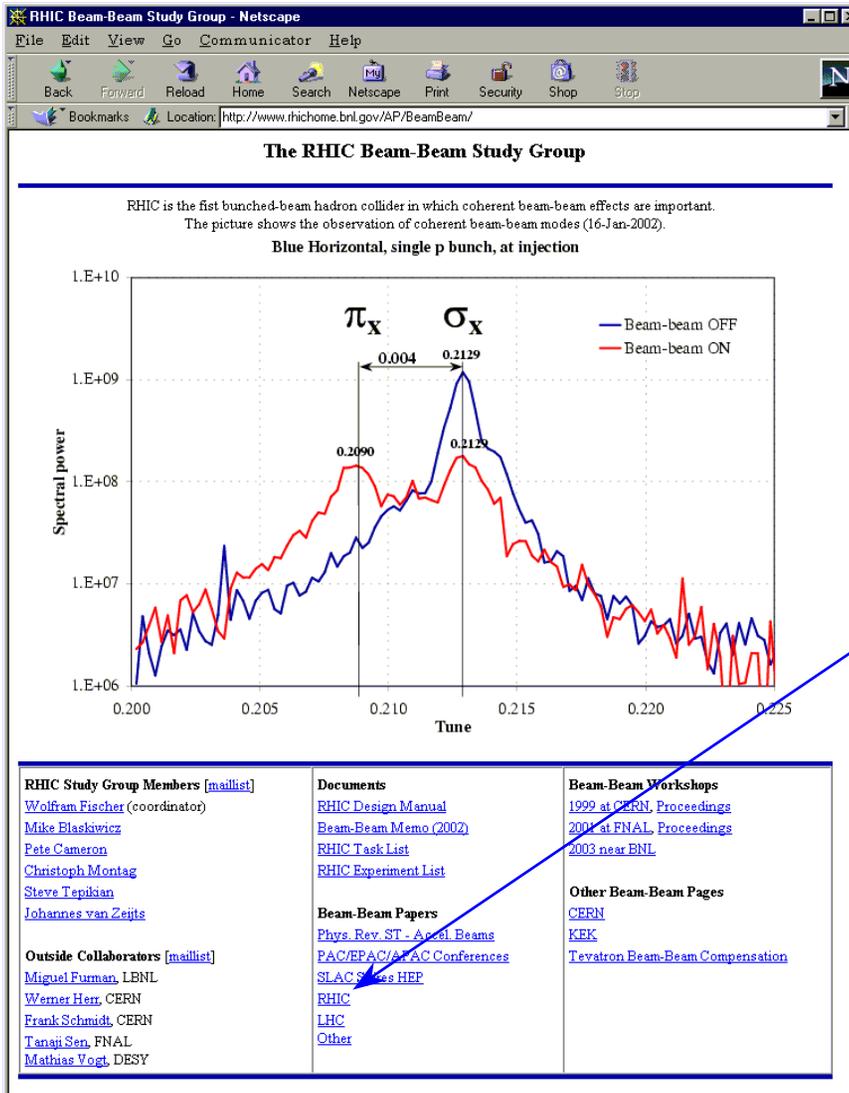
* Numbers for **next run** assuming $\varepsilon_N=20\mu\text{m}$ and $N_b=10^{11}$

Sources: W. Schnell PAC75, W. Herr, V. Shiltsev, C. Montag

- Total tune spread from beam-beam in proton operation with $\varepsilon_N=20\mu\text{m}$ and $N_b=2\cdot 10^{11}$ will be as large as the maximum achieved in any past hadron collider
- Unlike past hadron colliders (weak-strong except ISR), RHIC will operate in a strong-strong regime

Introduction

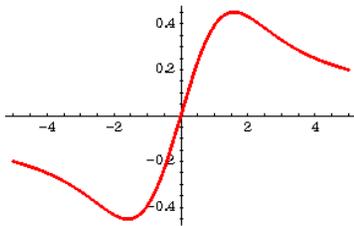
New web page to keep track of activities



RHIC Beam-Beam Reports

7. M. Vogt, J.A. Ellison, W. Fischer, and T. Sen, "[Simulations of Coherent Beam-Beam Modes at RHIC](#)", proceedings of the 2002 European Particle Accelerator Conference, Paris (2002).
6. W. Fischer, L. Ahrens, M. Bai, M. Blaskiewicz, P. Cameron, R. Michnoff, F. Pilat, V. Pitsyn, T. Sen, S. Tepikian, D. Trbojevic, M. Vogt, and J. van Zeijts, "[Observation of Coherent Beam-Beam Modes in RHIC](#)", BNL C-A/AP/75 (2002).
5. W. Fischer, P. Cameron, S. Peggs, and T. Satogata, "[Tune Modulation from Beam-Beam Interaction and Unequal Radio Frequencies in RHIC](#)", BNL C-A/AP/72 (2002).
4. W. Fischer and S. Peggs, "[RHIC as a Test Bench for Beam-Beam Studies](#)", proceedings of the Beam-Beam Workshop at Fermilab, BNL C-A/AP/61 (2001).
3. T. Satogata and S. Peggs, "[Hadron Beam-Beam Diffusion in 2.5-D](#)", proceedings of the LHC Beam-Beam Workshop at CERN 1999, BNL RHIC/AP/170 (1999).
2. S. Peggs, "[Beam-Beam Collisions and Crossing Angles in RHIC](#)", proceedings of the LHC Beam-Beam Workshop at CERN 1999, BNL RHIC/AP/169 (1999).
1. S. Peggs, "[Parasitic Beam-Beam Collisions and Crossing Angles in RHIC](#)", BNL RHIC/AP/66 (1995).

Beam-Beam Workshop 2003



Beam-Beam Workshop 2003

in conjunction with [HALO'03](#)

May 19-23, 2003 (following [PAC'03](#))

[Gurney's Inn, Montauk, Long Island, New York](#)

Beam-Beam Workshop planned for 2003 in conjunction with HALO'03 (organized by J. Wei)

- week after PAC03
- at Gurney's Inn, Montauk
- 1st announcement made

[1st Announcement HALO'03](#)

[Beam-Beam Workshop 1999 at CERN](#)

[Beam-Beam Workshop 2001 at FNAL](#)

A workshop on beam-beam effects in ring colliders will be held near Brookhaven National Lab from May 19 to 23th, 2003 in conjunction with the 29th Advanced ICFA Beam Dynamics Workshop HALO'03.

A single registration fee allows participants to attend both workshops. The workshop follows directly the PAC'03 conference in Portland, Oregon.

The workshop will review progress in the understanding of beam-beam effects in hadron and lepton colliders. The organization parallel to the HALO'03 workshop offers the unique opportunity to discuss the role of beam-beam effects in halo formation, as well as means to detect and remove halos.

Workshop topics to be discussed include:

- Weak-strong effects
- Strong-strong effects
- Simulation techniques
- Theoretical models
- Beam-beam compensation techniques
- Beam-beam machine experiments

Workshop proceedings will be published.

Program committee:

Y. Cai, SLAC
M. Furman, LBL
W. Herr, CERN
M. Minty, DESY
T. Sen, FNAL
K. Yokoya, KEK
R. Talman, Cornell
W. Fischer, BNL

Local organizing committee:

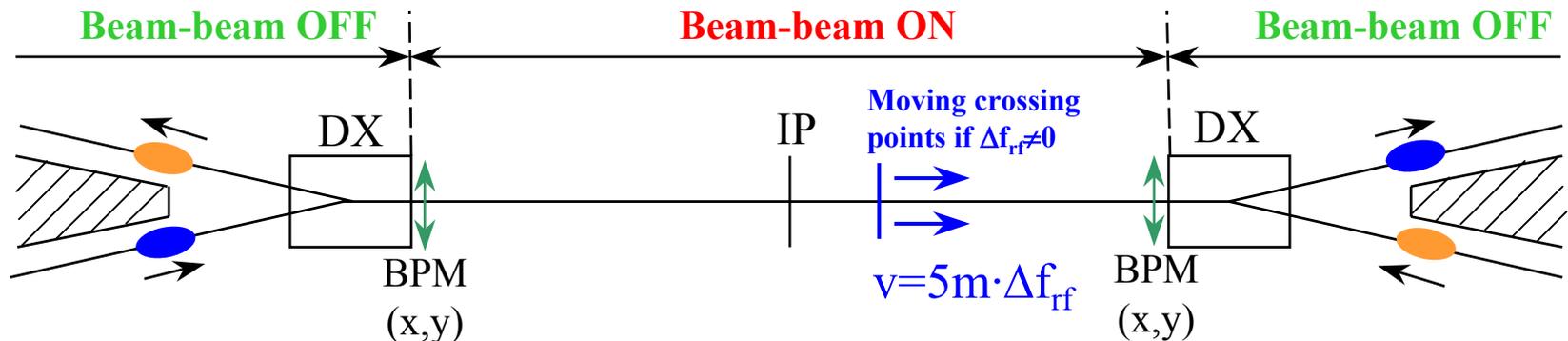
[F. Pilat](#)
[W. Fischer](#)
[M. Campbell](#)

Beam-beam experiments in Run 2001

- Operational observations
 - Beam and luminosity lifetimes
 - Triplet vibrations (C. Montag)
- Beam-beam tune shifts
- Tune modulation on ramp
- Coherent mode observation

Tune Modulation During Ramp

- Blue and Yellow rings independent (except DX):
 - Independent control of transition jump
 - Need to accommodate different species
- Rf frequencies were not synchronized initially
 - Can lead to tune modulation with beam-beam tune shift



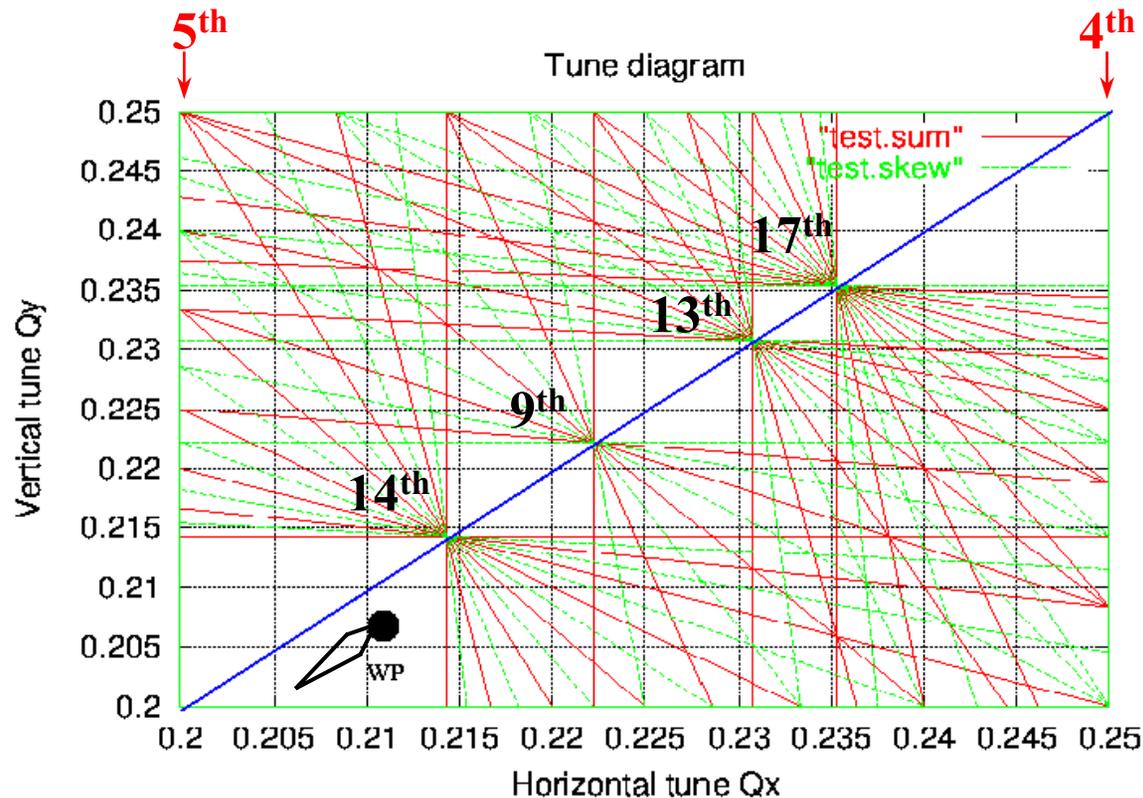
Experiments for Run 2003

1. Working point scan with beam-beam interaction
 - Observe beam lifetime
 - Observe background and halo formation
2. Emittance growth with 1-sigma offsets
 - Emittance measurement with IPM
 - Emittance measurement with bb tune shift
 - Emittance measurement with $I(t)/L(t)$
3. Beam-beam tune shift with long/short bunches and large crossing angles

Experiments for Run 2003

4. Coherent modes generation and suppression
 - Tune scans
 - Variation in intensity ratio of the two beams
5. Measurement of beam-beam resonance driving terms
6. Variation of phase advance between two collisions with constant tunes
 - Needs working tune feedback
 - Observation of beam lifetime
 - Measurement of resonance driving terms

Working Point in RHIC



- Operation between 0.2 and 0.25 in both planes
- 0.2 less dangerous than 0.25, especially vertically
- Typically $\Delta Q_{\min} \sim 0.01$
- May need to move to other tune when beam-beam tune spread increases further (\rightarrow possibly large investment in time)
- No systematic tune scans during last run, mostly tuning for lifetime during stores

- Beam-beam is one of the most limiting effects of colliding beam storage rings, will be the RHIC limit in proton operation
- RHIC is presently the best-suited machine to study strong-strong phenomena
- Beam-beam studies should benefit machine operation and general beam-beam knowledge