

update on coherent tune shift in SPS collimator MD

- measured beam sizes, intensities (as last time)
- reduced resistivity from 14 to 10 $\mu\Omega\text{m}$
- re-evaluation of Burov-Lebedev prediction
- revised tune shift based on Piwinski
- Piwinski-based prediction including offset
- back-up slides on beam parameters

a quick reminder:

Potential for nonlinear resistive-wall impedance between two parallel plates was derived by Piwinski (DESY 94-068, Eq. (52)) and re-written by Bane, Irwin, and Raubenheimer (NLC ZDR p. 594).

$$V(x, y, x_0, y_0) = -\kappa f_R(\tau) \left[\frac{-x_- \sinh x_- + y_+ \sin y_+}{\cosh x_- + \cos y_+} + \frac{x_- \sinh x_- + y_- \sin y_-}{\cosh x_- - \cos y_-} \right]$$

$$y_+ = \frac{\pi}{2g}(y + y_0), \quad y_- = \frac{\pi}{2g}(y - y_0), \quad x_- = \frac{\pi}{2g}(x - x_0) \quad 2g: \text{full gap}$$

$$\kappa = \frac{1}{2} \frac{Nr_p}{\gamma \sigma_z} \frac{L}{g} \sqrt{\lambda \sigma_z} \quad f_R(\tau) = \frac{\sqrt{2}}{\pi} \int_0^\infty \frac{d\tau'}{\sqrt{\tau'}} e^{-\frac{(\tau+\tau')^2}{2}} \quad \langle f_R \rangle = 0.816$$

$$\lambda = \rho / (120\pi)$$

nonlinear kick to test particle:

$$\Delta y' = - \left\langle \frac{\partial V}{\partial y} \right\rangle$$

Piwinski formula applies if $\delta_s \ll \text{Min}(d_{\text{wall}}, d_{\text{bw}}, 1/(bk^2))$

revised calculation of coherent tune shift from nonlinear wake:

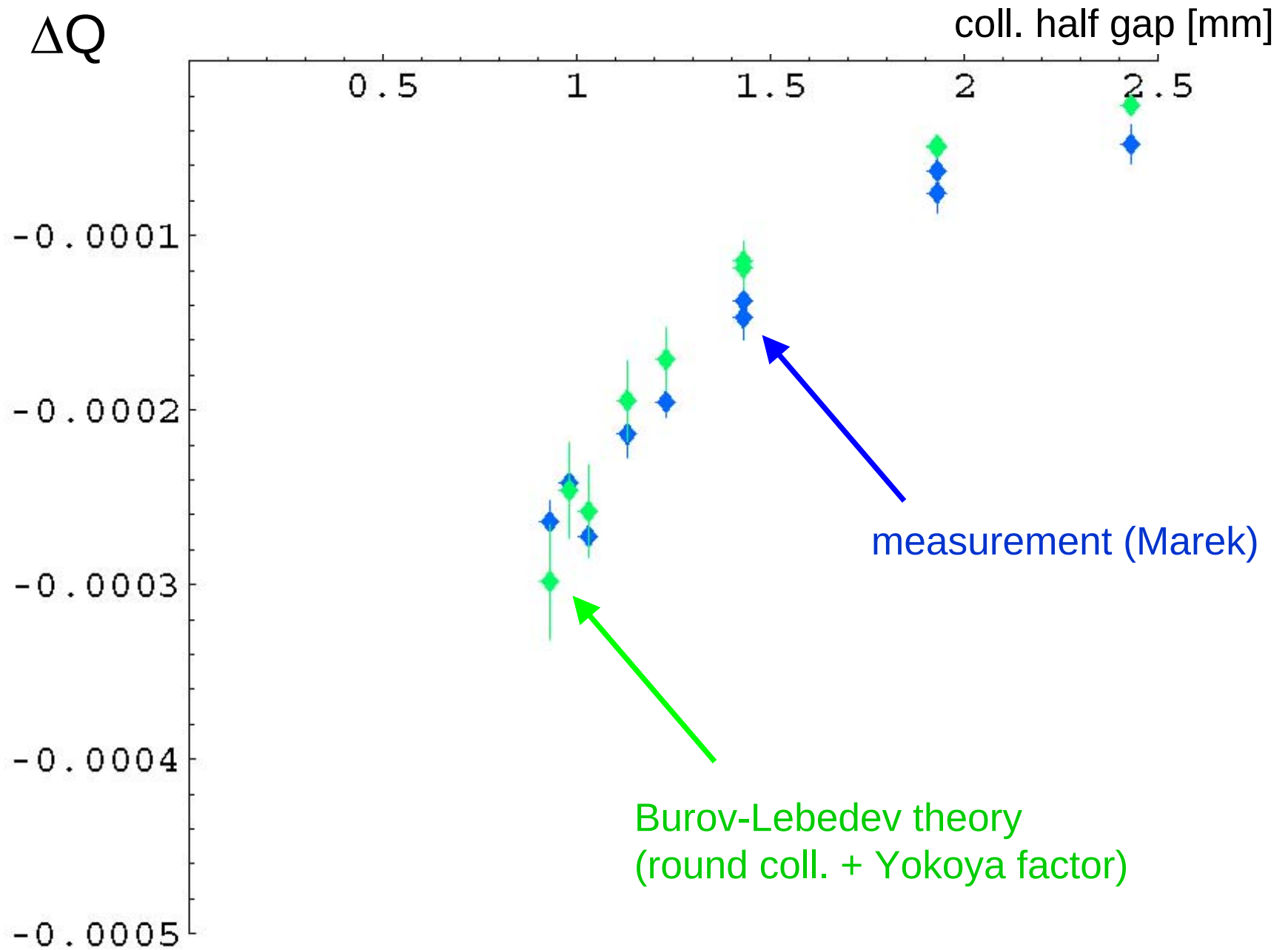
$$\Delta Q_{coh} = -\frac{\beta}{4\pi} \frac{1}{N} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \int_{-g+2y_{c0}}^g \int_{-g+2y_{c0}}^g \frac{\partial(\Delta y'(\tilde{x}, y = y_0 + \tilde{y}, x_0, y_0 + \tilde{y}_0))}{\partial y_0} \bigg|_{y_0=y_{c0}} \frac{e^{-\frac{\tilde{y}^2}{2\sigma_y^2}} e^{-\frac{\tilde{y}_0^2}{2\sigma_y^2}} e^{-\frac{x^2}{2\sigma_x^2}} e^{-\frac{x_0^2}{2\sigma_x^2}}}{(2\pi)^2 \sigma_x^2 \sigma_y^2} d\tilde{y}_0 d\tilde{y} dx dx_0$$

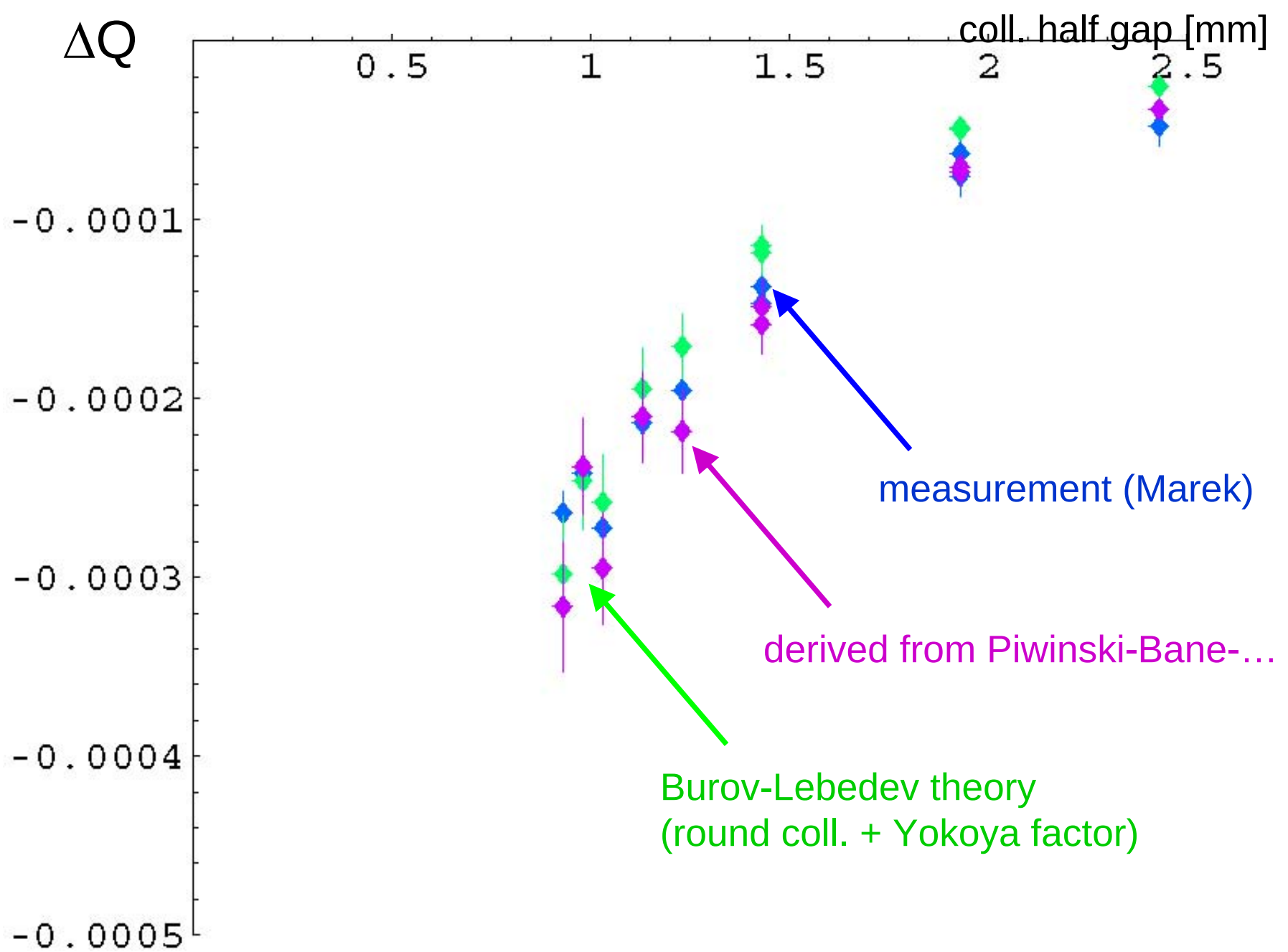
$$N \equiv \int_{-g+2y_{c0}}^g \int_{-g+2y_{c0}}^g \frac{e^{-\frac{\tilde{y}^2}{2\sigma_y^2}} e^{-\frac{\tilde{y}_0^2}{2\sigma_y^2}} e^{-\frac{x^2}{2\sigma_x^2}} e^{-\frac{x_0^2}{2\sigma_x^2}}}{(2\pi)^2 \sigma_x^2 \sigma_y^2} d\tilde{y}_0 d\tilde{y}$$

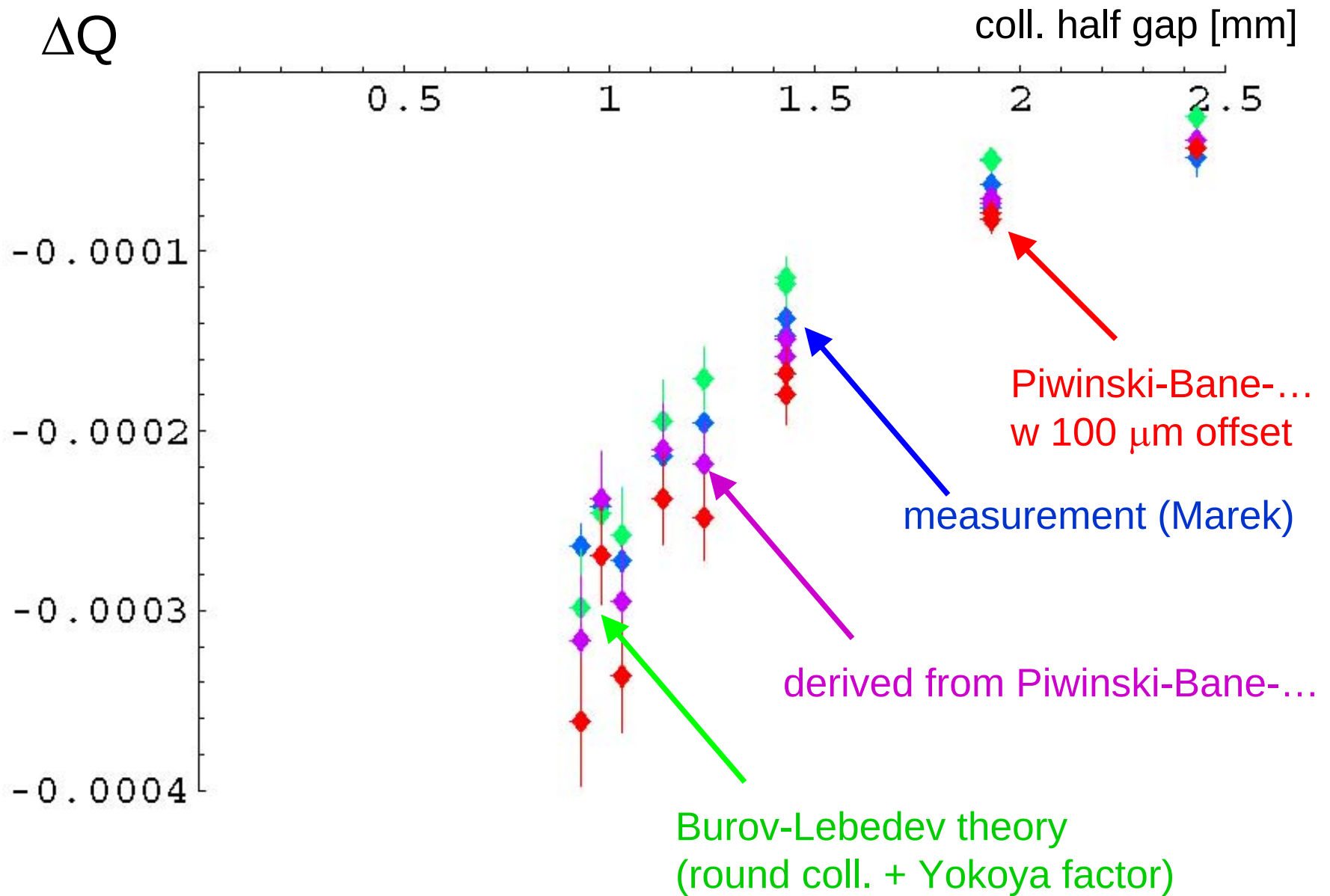
integration over $\tilde{y}_0$ was missing the last time; now 4 integrations
 – symmetric in drive and test particle coordinates

also introduced a suspected offset y_{c0}

note: for the SPS experiment we need to exchange x and y planes







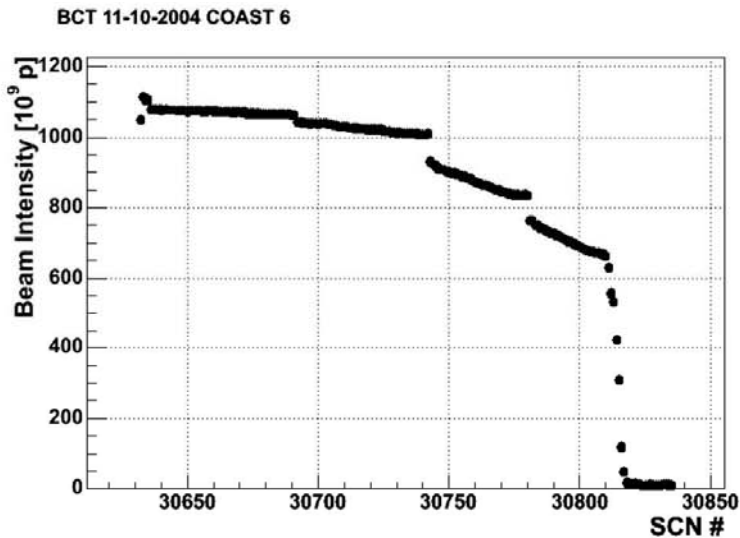
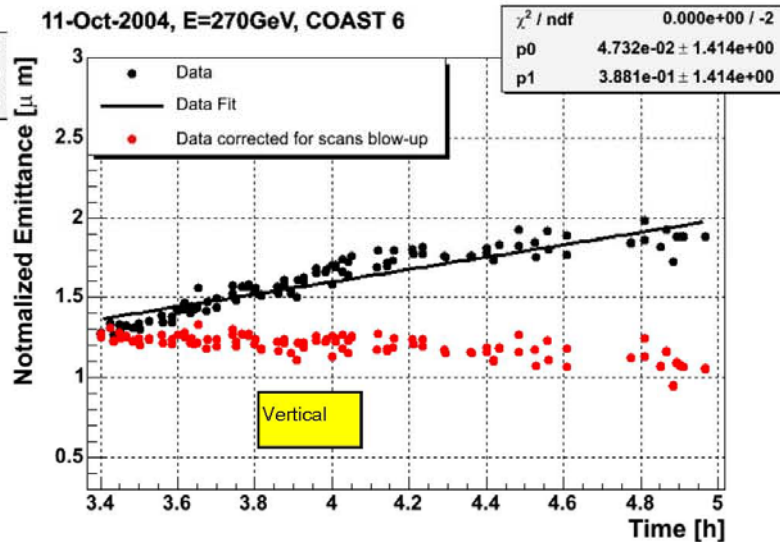
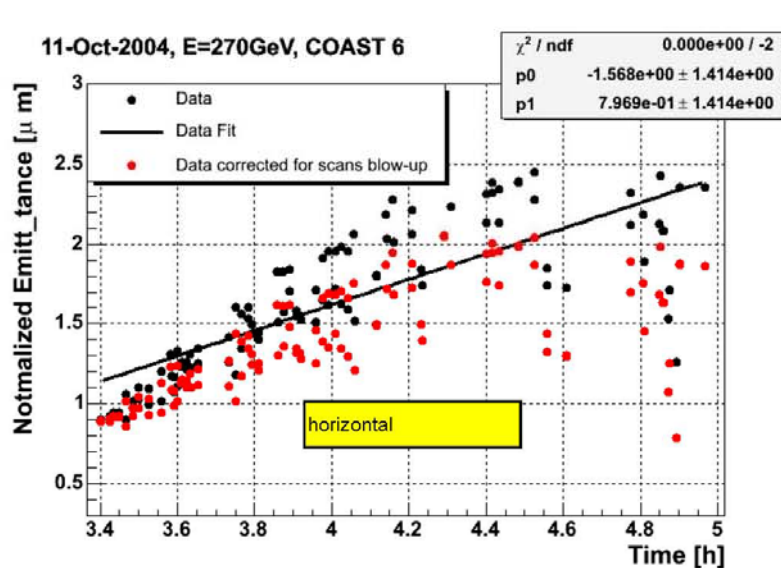
back-up slides

Re-analysis of SPS collimator MD

Thanks to G. Arduini, E. Metral, F. Roncarolo

time (readme)	time (Marek)	sc number	gap [mm] readme	gap [mm] Marek	err [mm]	dq [Hz]	err [Hz]	dQ [10 ⁻³]	dQ_err [10 ⁻³]
03:30	03:35:42	30650-30671	4.8 mm	4.86	0.05	2.07	0.47	0.0477	0.0108
03:41	03:45:28	30672-30690	3.8 mm	3.86	0.05	3.28	0.49	0.0756	0.0113
03:50-03:52	04:01:57	30690-30694	2.8 mm	2.86	0.05	5.96	0.64	0.1373	0.0147
04:14	04:21:49	30738-30778	2.1 mm (10% losses)	2.26	0.05	9.28	0.57	0.2138	0.0131
04:34-04:42	04:39:44	30779-30794	1.9 mm (15% losses)	1.96	0.05	10.49	0.50	0.2417	0.0115
05:25	05:29:56	30879-30897	3.8 mm	3.86	0.05	2.73	0.77	0.0629	0.0177
05:34	05:37:34	30898-30913	2.8 mm	2.86	0.05	6.38	0.549	0.1470	0.0126
05:42	05:45:51	30914-30929	2.4 mm (2% losses)	2.46	0.05	8.48	0.37	0.1954	0.0085
05:50	05:53:19	30930-30943	2.0 mm (6% losses)	2.06	0.05	11.82	0.53	0.2723	0.0122
05:57-06:12	06:04:37	30944-30973	1.8 mm (9% losses)	1.86	0.05	11.46	0.54	0.2640	0.0124

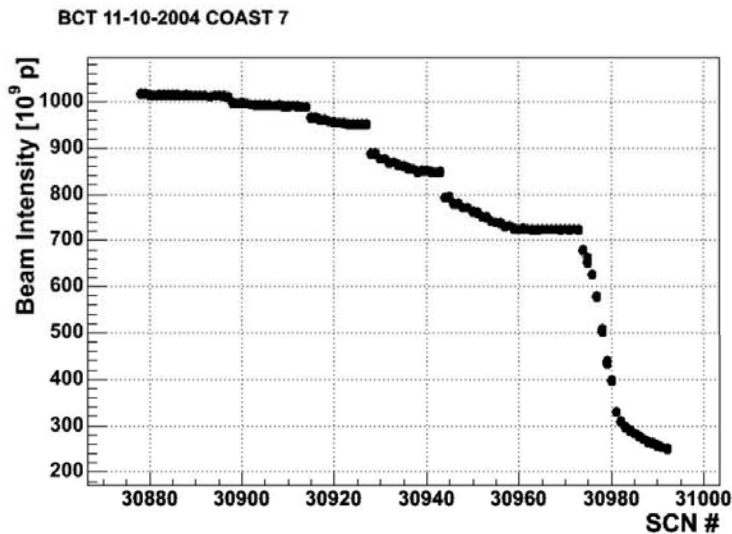
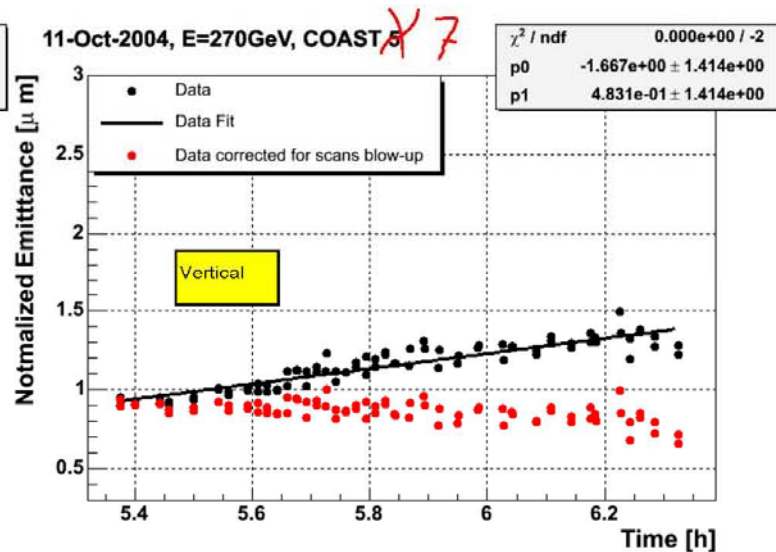
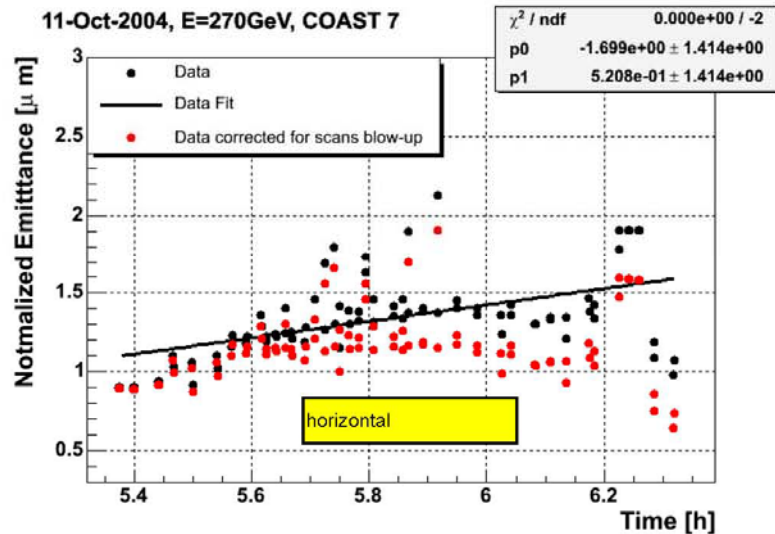
Coast 6 emittances and intensities



DRAFT

Federico Roncarolo

Coast 7 emittances and intensities



DRAFT

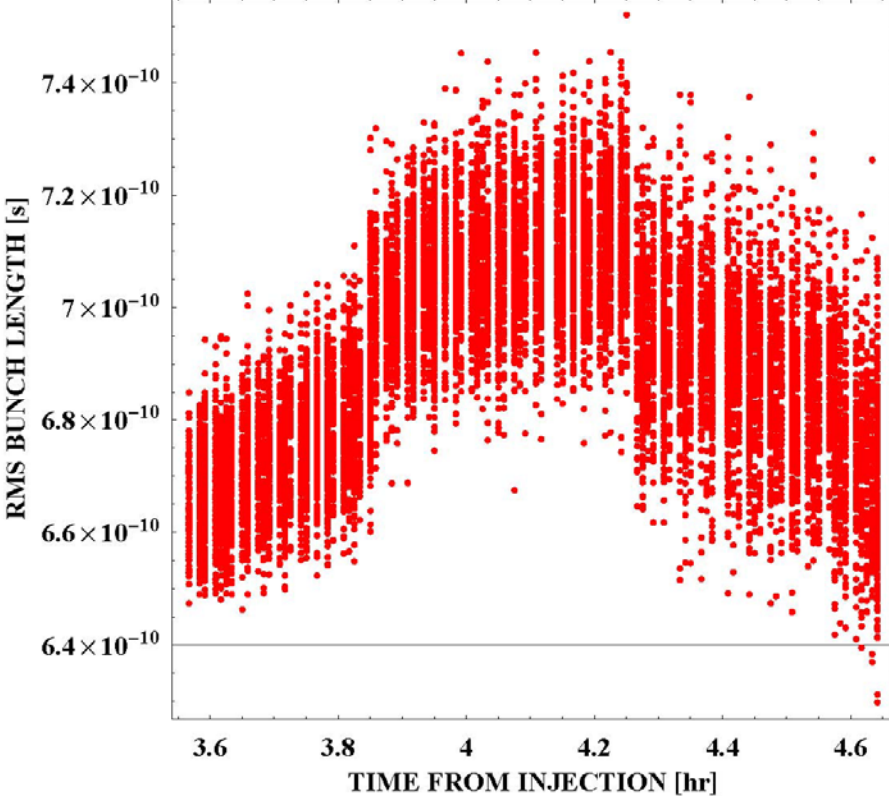
Federico Roncarolo

emittances from F. Roncarolo

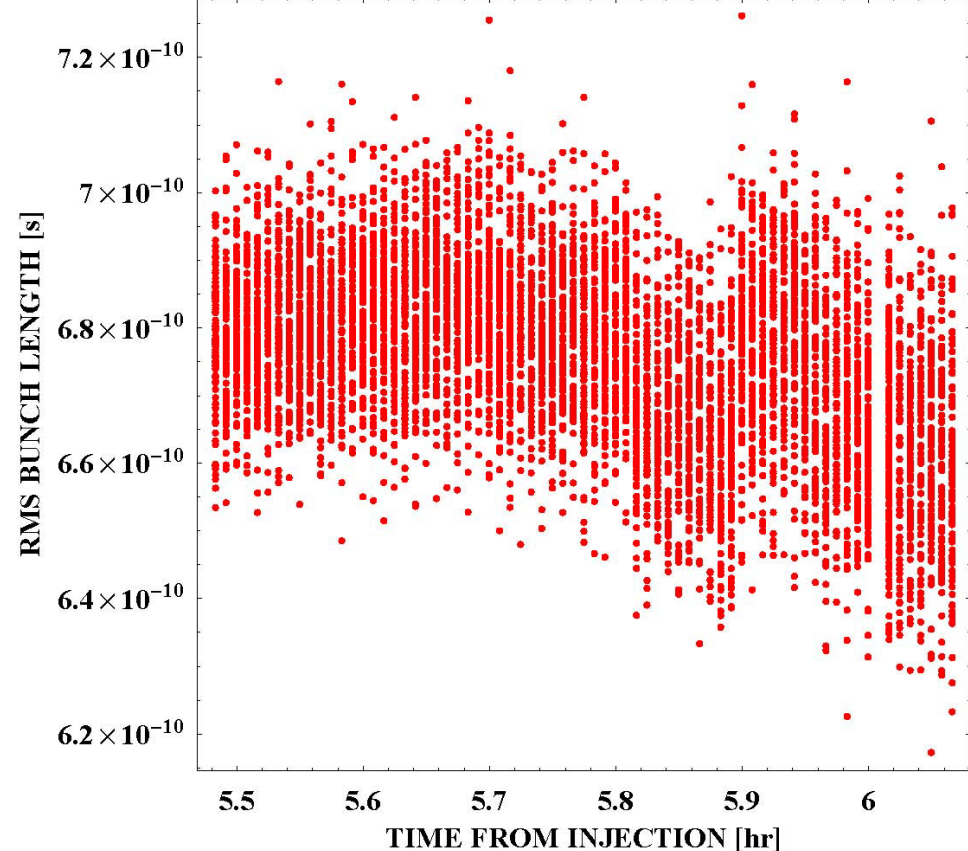
time (readme)	time (Marek)	sc number	EmitXN [micron]	EmitX_err [micron]	EmitYn [micron]	EmitY_err [micron]
03:30	03:35:42	30650- 30671	1.0	0.1	1.3	0.1
03:41	03:45:28	30672- 30690	1.25	0.1	1.4	0.1
03:50-03:52	04:01:57	30690- 30694	1.5	0.1	1.5	0.1
04:14	04:21:49	30738- 30778	2.0	0.3	1.7	0.1
04:34-04:42	04:39:44	30779- 30794	2.3	0.2	1.8	0.1
05:25	05:29:56	30879- 30897	1.0	0.1	0.9	0.1
05:34	05:37:34	30898- 30913	1.1	0.1	1.0	0.1
05:42	05:45:51	30914- 30929	1.2	0.1	1.1	0.1
05:50	05:53:19	30930- 30943	1.3	0.3	1.2	0.1
05:57- 06:12	06:04:37	30944- 30973	1.3	0.2	1.25	0.1

intensity data obtained with the help of G. Arduini and E. Metral

time (readme)	time (Marek)	sc number	intensity [1e9]	intensity error-std [1e9]	intensity error-sys [1e9]
03:30	03:35:42	30650-30671	95.72	0.20	9.6
03:41	03:45:28	30672-30690	94.91	0.25	9.5
03:50-03:52	04:01:57	30690-30694	93.58	0.95	9.4
04:14	04:21:49	30738-30778	77.15	4.77	7.7
04:34-04:42	04:39:44	30779-30794	64.37	3.08	6.4
05:25	05:29:56	30879-30897	91.47	0.17	9.1
05:34	05:37:34	30898-30913	89.63	0.55	9.0
05:42	05:45:51	30914-30929	85.54	2.47	8.6
05:50	05:53:19	30930-30943	77.10	1.32	7.7
05:57-06:12	06:04:37	30944-30973	66.16	2.94	6.62



Fitted rms bunch length during Coast 6.
 Average bunch length is 0.691 ns +/- 0.019 ns.
 From 3.5 h to 3.683 h, the gap was 4.86 mm,
 from 3.683 h to 3.833 h it was 3.86 mm, from
 3.833 h to 4.0387 h it was 2.86 mm, from
 4.233 h to 4.567 it was 2.26 mm, and from
 4.567 h to 4.7 h 1.96 mm.
 The rf tripped at 3.867 h.



Fitted rms bunch length during Coast 7.
 Average bunch length: 0.675 ns +/- 0.014 ns.
 From 5.83 h to 5.95 h, the gap was 2.06 mm,
 from 5.95 to 6.22 h it was 1.86 mm.
 At 5.9 h there was a trip of TRX2.

bunch-length data obtained with the help of G. Arduini

data from Marek with x and y error bars

