Loogbook and Analysis of the Third MD on BBLR 22/09/2002

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1 Aims

This is the first session where the BBLR set-up can be considered as finalized and operational. We should certainly verify this statement by checking the relationship between the orbit and tune shifts caused by the wire and compare with simulations to confirm the former analyses.

The experiment will be carried out at 55 GeV. It can be expected that the smaller emittance will overcome the vertical aperture problems detected in the second MD.

The second and principal aim is to detect the sudden increase of the beam diffusion at around 6 sigma as predicted by simulations and to quantify it. The main issue is how to observe this transition. It is likely that this and other MD sessions will be dedicated to searching how this phenomenon can be best put in evidence.

2 MD Plan

2.1 PS Beam Parameters

LHC beam with only 12 bunches. The total intensity should be around $3\,10^{11}$ protons.

2.2 SPS Set-up

The supercycle will be SC602, with a total duration of 21.6 s. The events distributed are those of P1.

- Injection Plateau: Measure and correct Q, Q' at the time of the damper excitation ($t \approx 250$). The goals are: $Q_x = .172$, $Q_y = .154$, $Q'/Q \approx$ a few 0.001.
- Flat Top: It is important to keep the optics constant during the plateau: correct the orbits (global and local at the BBLR), Q and Q'. Check that $\frac{\partial Q}{\partial J}$'s are not large.

2.3 Emittance Control

- Blow-up to the nominal LHC emittance on the Injection Plateau: For that purpose, a simultaneous increment by -11 units of the H octupole chain has been found efficient.
- Rectangular Distribution on Flat Top: This is an option that should be possible to enable or disable. The distribution should be roughly flat, with a non-negligible density at 10σ. At the wire scanner ($\beta_y = 28$ m), $10\sigma = 13$ mm.
- Parasitic Blow-up: Check that the measurement of the tune has no or little influence on the emittance.
- Horizontal emittance: Measure it (eventhough Frank's simulations show no effect due to the emittance in the other plane).

2.4 Spurious Tune Shifts

For the moment, the most direct way to measure the actual beam-wire separation at the BBLR is to measure the tune shift. The wire produces as well an orbit oscillation. It is important to check that this oscillation does not produce any significant tune shift due to feed-down effects around the machine.

Use MDV517 to create an orbit of 5mm peak and measure the tune shift.

2.5 Set-up Software

1. Launch the PMT and BCT logging and display:

```
/user/biswop/bin/hpux/cmonJPK
setenv DISPLAY termname:0
Select BA5 and BCT 3
All information is saved in /user/slops/data/bi_sps_colmon/JPK
```

2. Set-up the Q-meter for two measurements in the same cycle: start two applications, adjust the timing and select manually the kickers (they MUST be different).

3. Set-up an optional closed orbit correction for use only when the wire comes on.

2.6 Wire Excitation

Use the NEGATIVE polarity and 267 A. In this way the tunes will shift away from each-other, preventing an unwanted closest tune approach.

2.7 Experiment 1

The aim of this experiment is to blow-up the beam over the whole available mechanical aperture (the TIDV is the limit at 9.5σ) and observe with the wire scanner the expected cut in the transverse distribution when the wire is switched on.

- Beam-wire separation: Adjust the separation to 9.5σ. At the BBLR, this is 17.0 mm and at the BP517, it is 23.8 mm. The corresponding tune shifts should be: $\delta Q_x = .0045$, $\delta Q_y = -.0047$. remember that an uncertainty of 0.001 on the tune translates into an uncertainty of 1.5 mm on the beam-wire separation. Use both the tune shifts and the orbit measurement to improve the accuracy.

- Measurement: Measure the emittance before and after the wire goes on. If it changes, ensure it is not due to an orbit shift towards the aperture limit. If the change is 'genuine', measure the emittance versus time during the time the wire is on.

If no effect is detected, reduce the beam-wire separation.

2.8 Experiment 2

Using again a beam which occupies initially the whole mechanical aperture, run the collimator to cut the distribution at varying amplitudes: 3 to 7$\sigma$and observe the risetime of the losses on the close-by PMT's.

- Beam-Wire Separation: same as section 2.7.

- Measurement: Wire off, move in the collimator initially to 5σ from the local orbit for about 50 ms at time 16100. Retract then by $1/4\sigma$. Wire on, carry out the same experiment. If the closed orbit is changing, it is necessary to adjust the collimator accordingly.

2.9 Experiment 3

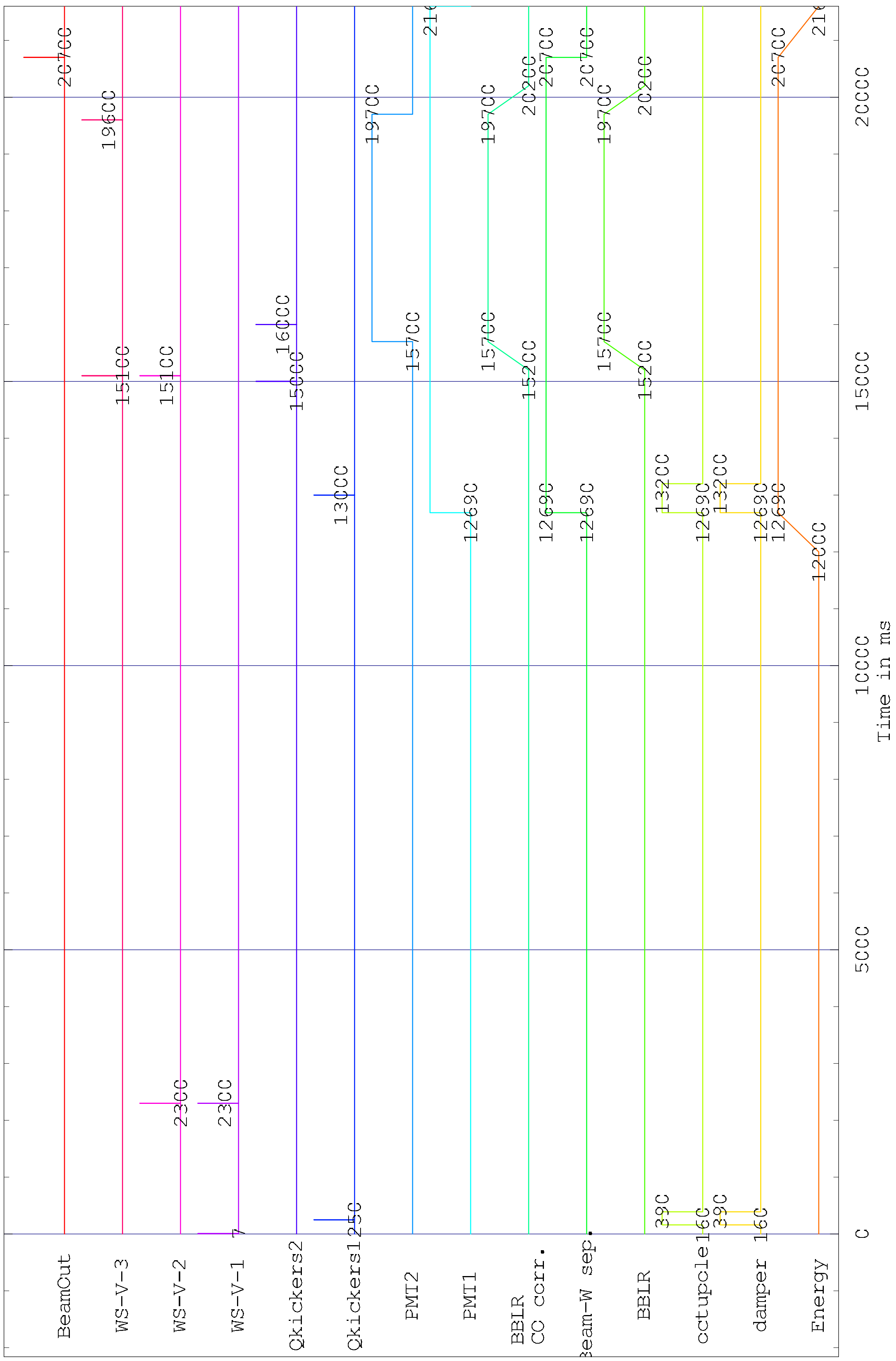
This experiment is a repeat of MD1 with the same ratio of the current over normalized emittance, but at a different energy. Using a beam with the nominal LHC emittance, the aim is to observe the losses as detected by the PMT versus beam-wire separation and wire current. Will the threshold observed in MD1 be confirmed?

3 Timing

The timing of all events and measurements is given on the timing diagram 1.

4 Efficiency

The MD was scheduled on Sunday 22/09/2002 from 21:00 to 7:00 am. The PS and SPS set-up took less than one hour. There was no down time. As in the previous MD, the emittance control required a large amount of time.


BeamCut
WS-V-3
WS-V-2
WS-V-1
Qkickers2
Qkickers1
PMT2
PMT1
BBLR
CC corr.
Beam-W sep.
BBLR
cctupcle
damper
Energy
C
5CCC
1CCCC
15CCC
2CCCC
Time in ms

5 Machine and Beam Set-Up

The MD is carried out on a special cycle SC602 which allows acceleration to 55 GeV. As usual, the standard LHC beam is reduced both in number of bunches and in intensity to 12 bunches representing a total charge of about 4 10^{11} protons.

The closed orbit was globally corrected to 1.3 mm rms (H) and 0.9 mm rms (V) at time 13000 (beginning of flat top). The local orbit at the BBLR was corrected to -0.18 mm interpolated at the BBLR (0.06 mm at time 16000). This was considered as satisfactory.

The tunes were measured with the Q meter at times 16000 (x) and 16020 (y) applying a 2 mm kick (Q meter setting: delay 10000, 30 dB). The tunes were $Q_x \approx 0.1862$ and $Q_y \approx 0.1383$.

The chromaticities were about $\xi_{x,y} \approx 0.05 - 0.10$, as determined by G. Arduini and J. Wenninger prior to the LRBB MD. We confirmed these chromaticities by measuring the tune shifts for $\Delta p/p = \pm 1.3 \times 10^{-3}$, and found $\xi_x \approx 0.10$ and $\xi_y \approx 0.07$.

The polarity of the wire was set to negative, in order to prevent a parasitic closest tune approach.

6 Control of the Emittance

The aim of the emittance control is to blow-up the vertical emittance to the normalized LHC value at injection, and, optionally, to obtain a quasi-rectangular distribution on the flat top. The horizontal emittance is naturally larger. Recent simulations show, in addition, that the diffusion in the vertical plane only depends on the vertical emittance [FZ]. For this session, it was intended to control the damper from the control room rather than from BA2.

Prior to this session, a short experiment took place to find the best parameters to blow-up the emittance. In the 2nd MD session, it had been observed that the filamentation by the sextupoles causes large beam losses. We rather used the octupoles. We found that an increment by -11 units of the horizontal octupole chain causes a blow-up from 1.3 to 2.8 10^{-6} without any significant loss. On the contrary, use of the vertical octupole chain causes losses.

6.1 Blow-up at injection

After an initial test with the damper, we employed injection oscillations and octupoles to blow up the beam at injection. The horizontal (?) octupoles were set to -6.97.

The tunes and octupoles were adjusted to produce a normalized emittance close to 3.75 μm (nominal LHC emittance).

Parameters:

Horizontal emittance...

Observations on the method...

6.2 Blow-up on the flat top

We used the damper to blow up the beam on the flat top (rf timing module 208, 12990-300-12690 ms, 1 DE delay = 7000 turns or 161 ms). The exciation started 161 ms after the beginning of the flat top. The damper was fed with a sine wave excitation at 200 Hz. A damper burst lasted 200 cycles corresponding to 5.2 ms, and was repeated 200 times ('window' parameter in the damper program) with a spacing of 250 turns (5.7 ms). Hence the beam was excited from 13121 to 14271 ms.

It was not possible to obtain the large rectangular distribution without heavy beam losses. A vertical aperture problem is suspected and discussed in the next section. The wire scanner BWSV 51995 showed a maximum profile full-width of 13–14 mm at $\beta_y = 28$ m ($\sigma_y \approx 1.3$ mm). This would correspond to a physical aperture of only about $\pm 5\sigma$. Wire scans were performed at times 15100 and 16900. We centered the beam using vertical correctors, but this only gained 1 mm in the full width. The aperture is about half the expected., or extrapolated from the 7σ aperture estimated in the previous MD at 26 GeV.

6.3 Comments on the strategy

The damper excites the beam at a fixed frequency. It was not possible to sweep the frequency with the available hardware. This option is actually implemented in the multi-Q measurement but its use appeared incompatible with our experiment. For the next session, we need automated frequency sweeping.

7 LogBook of the Measurements

The wire current was always 267 A.

7.1 Time table

Time	separation	Cycles	Comment
2:24	nominal 20.3mm ?	476..492	1mm rms, dQ=.0045,d= 20.3 mm looks large
2:52	-3.6?mm at wire	573..585	
3:20	-3.8mm	633..639	
	-	642	V Q-metter off
	-	672..676	BBLR off, CO corrected to that of 639
	-	693	CO + tunes corrected, no kcik
	-	708	BBLR ON, no Qmeter
	-	985..994	try scrape + observe loss rise: unsuccessful
5:58:10	nominal	1074..77	BBLR on, Qkicks on
6:00:40	bump -1mm at BBLR	1081..83	
6:02:50	bump -2mm at BBLR	1087..89	
6:05:00	bump -3mm at BBLR	1093..97	
6:07:53	bump -4mm at BBLR	1101..04	
6:11:06	bump -5mm at BBLR	1110..12	
6:16:09	bump -6mm at BBLR	1124..27	
6:20:28	bump -7mm at BBLR	1136..40	
	bump -7mm at BBLR	1166..84	BBLR on, Qkicks off, larger emittance?
	bump -6mm at BBLR	1216..23	
	bump -5mm at BBLR	1127..29	
	bump -4mm at BBLR	1239..41	
	bump -3mm at BBLR	1244..47	
7:00	bump -2mm at BBLR	1251..53	

Table 1: Logbook

7.2 Data recorded

The program /user/biswop/bin/hpux/cmonJPK logged on each cycle the losses as recorded on the PMT's and the high-sensitivity BCT. The data are in /user/slops/data/bi_sps_colmon/JPKMD. (sorry for the personnalization: it does not come from me!).

8 Overview of the experiments

Experiment 1 could be carried out completely, actually in more depth then foreseen. The beam separation was decreased in many steps. Due to the reduced aperture, we have to show whether we learn anything from the emittance measurement. The PMT data seem to contain interesting information.

Experiment 2 failed due to the hardware not adapted to the experiment (collimators not movable within a cycle) or not working correctly (scraper: too small time between beam out and beam in given its complicated motion).

There was no time left for experiment 3.

Various checks were carried out, which should reinforce the value of the data:

- vertical aperture scan,
- possible parasitic tune shift due to a vertical orbit oscillation,
- possible parasitic blow-up due to the Q-kickers,
- influence of the linear perturbations of the wire on the beam, without the non-linear part.

9 True Beam-Wire Distance

The actual distance between the beam and wire centers is a crucial parameter for a proper simulation of the conditions which will arise in LHC. It cannot presently be directly measured and is inferred in three different ways.

9.1 Interpolation using near-by BPM's

The beam position at the BBLR is interpolated from the 2 nearest BPMs (BPV.517 and BPV.519). Due to the kick from the wire, the interpolation is systematically biased since the interpolation does not take this kick into account. This effect has been simulated with MAD for the conditions of the present MD. The position bias is shown in Figure 2. The interpolatated position always predicts a distance to the wire smaller than the true position by 0.2 to 0.5 mm.

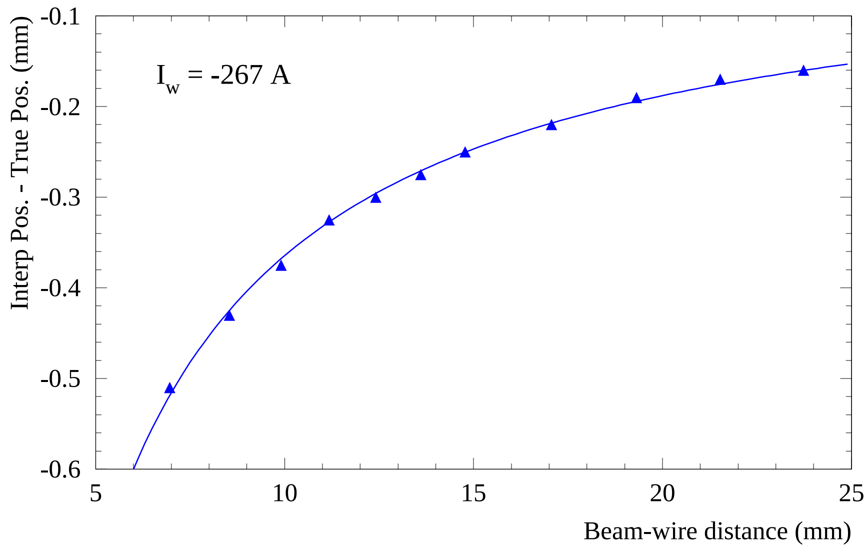


Figure 2: Simulated biais of the extrapolated beam position as a function of the true beam-wire distance for a wire current of -267 A at 55 GeV/c

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9.2 Fit of the Orbit Oscillation

The closed orbit distortions observed with the wire at -267 A have been analysed for different bump amplitudes using a virtual corrector at the centre of the BBLR. The orbit changes were analysed with the COCU correction package using a single kick at this virtual corrector. The model tunes were adjusted to the observed values. All monitors located inside the closed orbit bump were disabled for the correction to avoid any bias. Furthermore the resulting corrected orbits were inspected to locate bad BPMs. As a result 9 other BPMs were removed from the analysis. This resulted in corrected RMS orbits of better than 0.2 mm while the uncorrected orbit RMS values were in the range of 1.1 to 2.6 mm. The beam position change and the fitted closed orbit kick are given in table 5.

To compare observations with the expected dependence of the kicks on the wire distance, closed orbit distortions were calculated using MAD with same conditions (tunes, momentum and wire current) than during the MD. The simulations were performed with the nominal beam-wire separation. The resulting closed orbits were analysed using the procedure described in the previous paragraph to ensure an equal treatment. The measured and expected kicks are shown as a function of the wire distance in Figure 3. For the data, the interpolated position is corrected for the bias shown in Figure 2. For the simulation, the true position at the centre of the BBLR is used. Data and simulation agree rather well, with a possible small systematic shift of ≈ 0.5 mm between data and simulation. This small difference could also be due to small difference between the optics in the model and the machine.

wire current	bump [mm]	pos change [mm]	kick [μrad]
267 A	0	-1.3	-19.5
267 A	-1.0	-2.5	-21.3
267 A	-3.0	-5.0	-27.0
267 A	-6.0	-9.0	-37.9
267 A	-7.0	-10.5	-45.1

Table 2: Bump amplitude, extrapolated position change and the closed orbit kick due to the wire. The uncertainty on the kicks is ± 0.2 μrad.

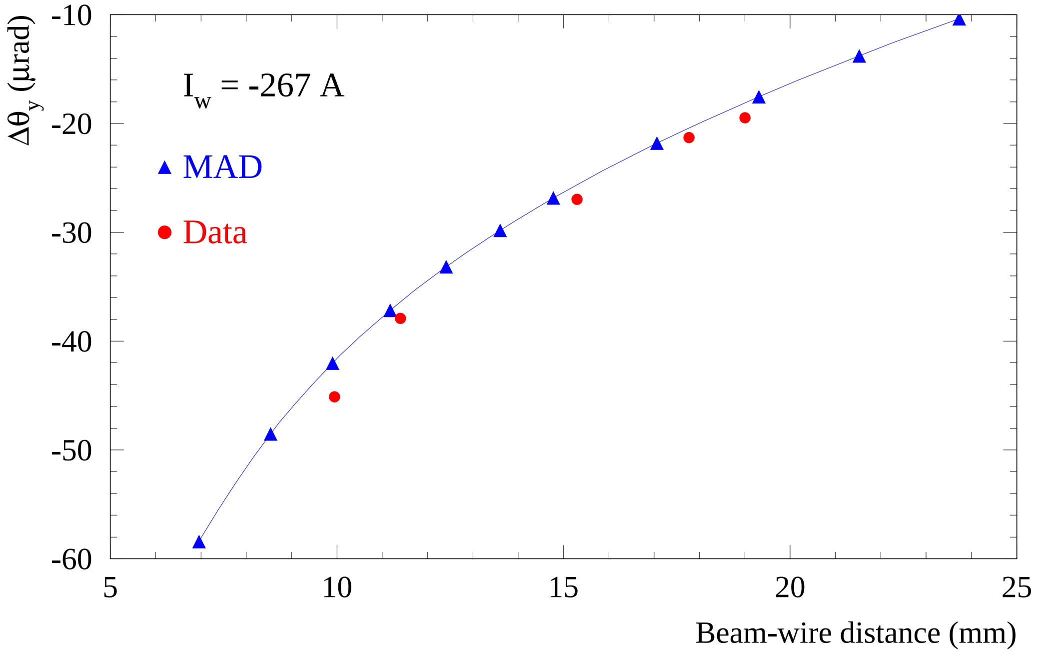

Figure 3: The observed closed orbit kick is compared to the expected kick (for a nominal wire position) as a function of the distance inferred from the beam position monitors and corrected for the bias evaluated from MAD.

9.3 Computation from the Tune Shifts

We first compared the tunes meaured at 15000 ms and 16200 ms without wire excitation. At 15000, we got $Q_x = 0.1871 \pm 0.0001$ and $Q_y = 0.1394 \pm 0.0007$, and at 16200: $Q_x = 0.1862 \pm 0.0001$ and $Q_y = 0.1391 \pm 0.0001$. In the horizontal plane, the tune changes by about 0.001; the vertical is about constant. We meaured the tunes with wire on at 16220 (x) and 16200 (y). Turning on the wire in the nominal position, caused an orbit change of 1.3 mm at the extrapolated BBLR position. An additional change of 1.2 mm in the same direction occurred when correcting the orbit.

Table 3 summarizes the tunes measured for different bump amplitudes at the wire, and it compares the inferred beam-wire distance with the distance expected from the extrapolated orbit position (in MD2, the expected number was taken from the applied bump amplitude, and did not include the self-consistent orbit response; the measured orbit change of course does). The same data is compared to the predictions from a MAD simulation in Figures 4 and 5.

Table 4 summarizes a measurement of orbit shift at the wire as a function of local bump amplitide. The result is also depicted in Fig. 6, together with results obtained in a previous MD at 26 GeV for opposite polarity and with beam-wire distances inferred from the tune shift.

We measured the unwanted effect of an orbit change (as induced by the wire) on the tune, by exciting the nearby corrector 517. Results are summarized in the table.

The tune variations vs. the rms orbit changes were fitted to

$$\Delta Q_x \approx 0.1863 + 3 \times 10^{-5} \Delta y_{\rm rms} + 6 \times 10^{-6} \left(\Delta y_{\rm rms}\right)^2 \quad (1)$$

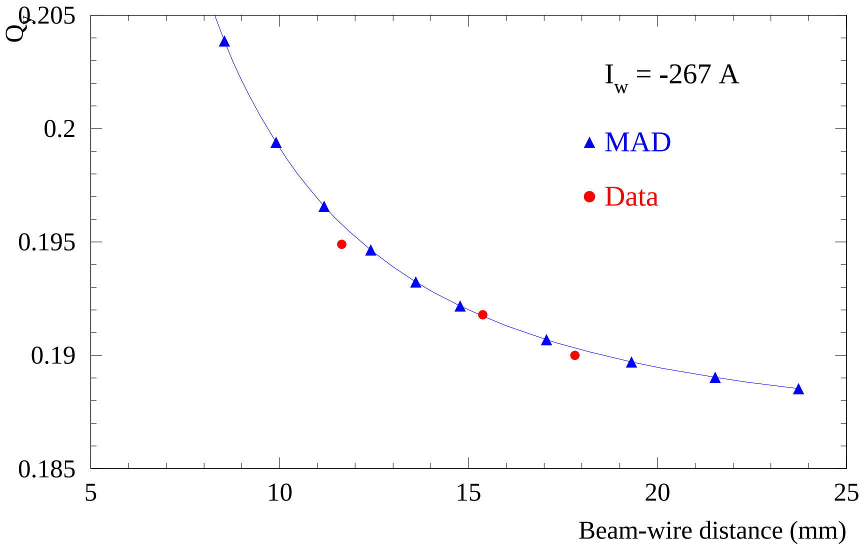

Figure 4: Observation and MAD prediction for dependence of the horizontal tune on the beam-wire distance. For the data, the measured distance is corrected for the expected bias due to the wire kick.

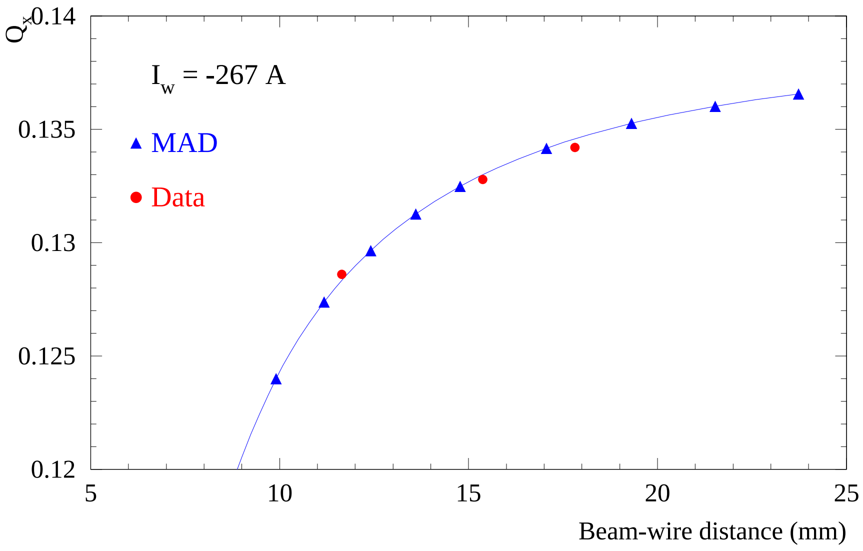

Figure 5: Observation and MAD prediction for dependence of the vertical tune on the beam-wire distance. For the data, the measured distance is corrected for the expected bias due to the wire kick.

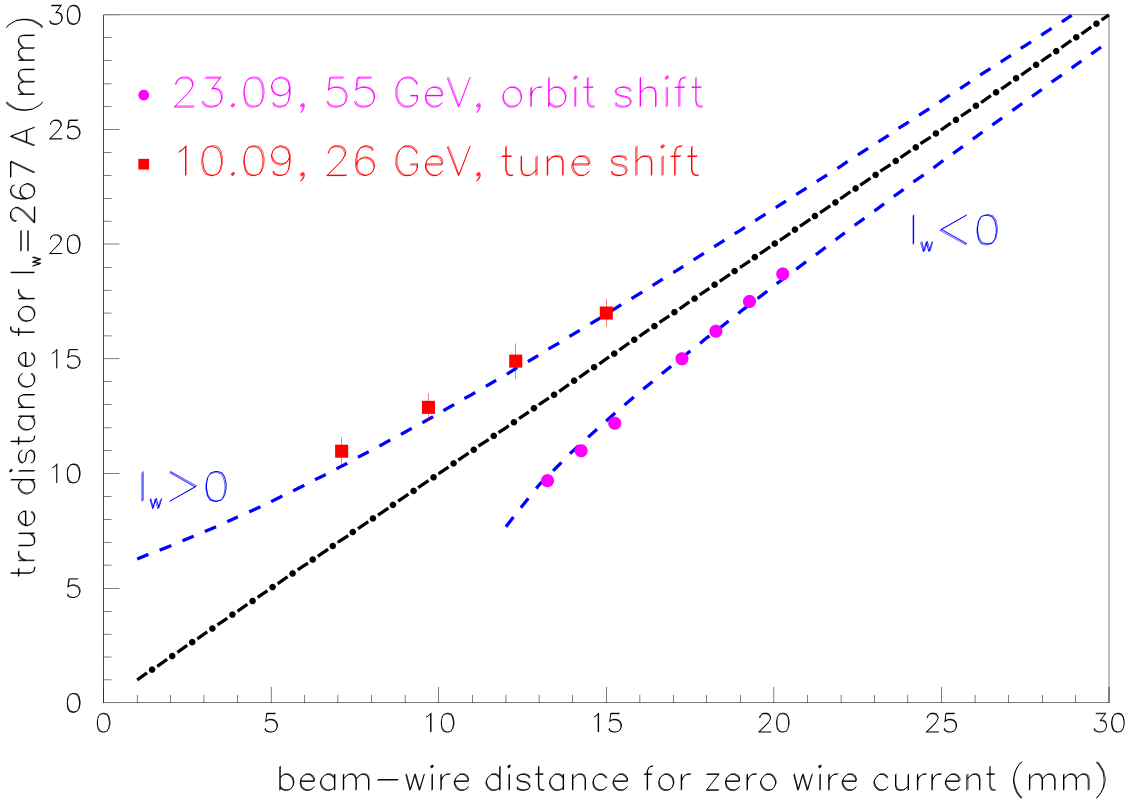

Figure 6: The actual distance between wire and beam for $I_w = 267$ A as a function of the same distance without wire excitation. The dashed line is the theoretical prediction (see MD note 2), the upper plotting symbols refer to the four tune shift measurements after 17:30 in MD2 at 26 GeV; the lower symbols refer to the local orbit shift measured in the present MD after 5:46 at 55 GeV/c. Note that for the 1st MD the first point (15.0 mm on the horizontal axis) was chosen as a reference and set to the predicted value of 17.0 mm. For the 2nd MD all numbers are measured.

time	wire current	bump [mm]	extr. pos. [mm]	Q_x	Q_y	distance [mm] from BPMs	inferred from ΔQ
2:19	0	0	-0.18	0.862 ± 0.0001	0.1391 ± 0.0001	20.09	N/A
2:41	267 A	-1.2	-2.5	0.1900 ± 0.0001	0.1342 ± 0.0001	17.8	17.5 ± 0.1
	267 A	-3	-4.97	0.1918 ± 0.0001	0.1328 ± 0.0004	15.3	15.0 ± 0.1
	267 A	-6	-8.78	0.1949 ± 0.0001	0.1286 ± 0.0001	11.5	11.7 ± 0.0

Table 3: Tune shifts and the inferred beam-wire distance. The rms beam size at the wire is 1.8 mm.

time	wire current	bump [mm]	extr. pos. [mm]	distance [mm] 'expected'	from BPMs
5:46	267	0	-1.27	20.27	19.0
	267 A	-1.0	-2.49	19.27	17.78
	267 A	-2.0	-3.77	18.27	16.50
	267 A	-3.0	-4.95	17.27	15.32
	267 A	-5.0	-7.47	15.27	12.80
	267 A	-6.0	-8.92	14.27	11.35
	267 A	-7.0	-10.24	13.27	10.03

Table 4: Bump amplitude, extrapolated position, and the inferred beam-wire distance. The rms beam size at the wire is 1.8 mm.

$$\Delta Q_y \quad \approx \quad 0.1385 + 2 \times 10^{-5} \Delta y_{\rm rms} - 4 \times 10^{-5} \left(\Delta y_{\rm rms}\right)^2 \qquad (2)$$

with an R^2 of 0.61 and 0.87, respectively.

I suggest to give a ξ^2 and not a regression coefficient which does not mean much. JW

10 Available vertical aperture

This was already addressed in Section 2.3. The aperture inferred from orbit bumps and from the sharp-edge beam profile after excitation indicate an aperture of $\pm 5\sigma$. Either calculating the physical aperture or extrapolating earlier data taken at 26 GeV, we had expected at least twice this value.

On September $26^t h$ the vertical aperture of the SPS was checked by C. Aramatea and J. Wenninger at 26 GeV using the LHC beam on SC540, the normal LHC cycle to 450 GeV. The beam emittance was blown up by inserting screens into the beam in the TT10 injection line (up to 9 screens were inserted) and by kicking the beam with the Q-meter kicker. Wire scanner BWSV51995 was used to measure the beam profiles ($\beta_v = 28$ m). It appeared clearly that the available aperture was limited to 14 mm (full width), compared to the expected aperture of $\sim$ 22 mm which is given the the TIDV beam dump block. This aperture corresponds to $\pm 5\sigma$ at 55 GeV for a nominal LHC emittance of $\epsilon^* = 3.7$ μm. The measurement therefore confirms the observations made during the MD. Furthermore the pattern of beam losses recorded on the ring loss monitors showed a clear and very large peak at position 519, with a decay of the losses over cells 521 and 523, implying that the aperture limitation is just downstream of the BBLR.

11 Emittance versus beam-wire separation

A few emittances measured before and after wire excitation are listed in Table 5. For a nominal bump amplitude of 7 mm, the emittance shrinks during the flat top.

kick	Q_x	Q_y	rms orbit change
0	0.1862 ± 0.0001	0.1386 ± 0.0005	N/A
20 μrad	0.1863 ± 0.0000	0.1383 ± 0.0001	1.8 mm
40 μrad	0.1865 ± 0.0002	0.1379 ± 0.0004	3.6 mm
60 μrad	0.1866 ± 0.0002	0.1373 ± 0.0001	5.5 mm
80 μrad	0.1868 ± 0.0000	0.1366 ± 0.0007	7.3 mm
-80 μrad	0.1864 ± 0.0002	0.1362 ± 0.0001	7.3 mm

wire current	bump [mm]	extr. pos. [mm]	emittance 'in'	emittance 'out'
267 A	0.0 mm	-1.27 mm	2.581	2.832
			2.828	2.640
267 A	-6.0 mm	-8.92 mm	3.11	2.862
			2.688	2.847
			3.588	3.516
			3.284	3.342
267 A	-7.0 mm	-10.24 mm	3.46	2.756
			3.59	2.893

Table 5: Emittances measured at times 15100 and 19600 for various bump amplitudes.

12 Beam losses versus beam-wire separation

Both the local beam losses in 517 and the global current losses are measured. The first ones are measured with a PMT placed just after the BBLR. The second uses the high-resolution BCT.

The quality of the data is high. All measurements were done twice and one three times. All the points are on the figures, all showing good consistency. When the BBLR is off, the losses are much lower. Cutting the integration interval into slices shows they are steady. When the BBLR is on, the losses first show a bump when the beam is kicked by the Qmeters with a long memory (0.5 s?). Then the losses become close to steady. I did the analysis partly 'manually'. I plan to write some software to ease the analysis and produce figures of loss patterns for the records.

For the analysis, the PMT losses shown are normalized to the average beam current in the cycle and expressed in Hz. The BCT losses are interpreted in average lifetime over the integration window (2 to 4 s). On figures 7 and 8, the losses are plotted versus the actual beam-wire separation. The beam-wire separation is the self-consistent value whenever the

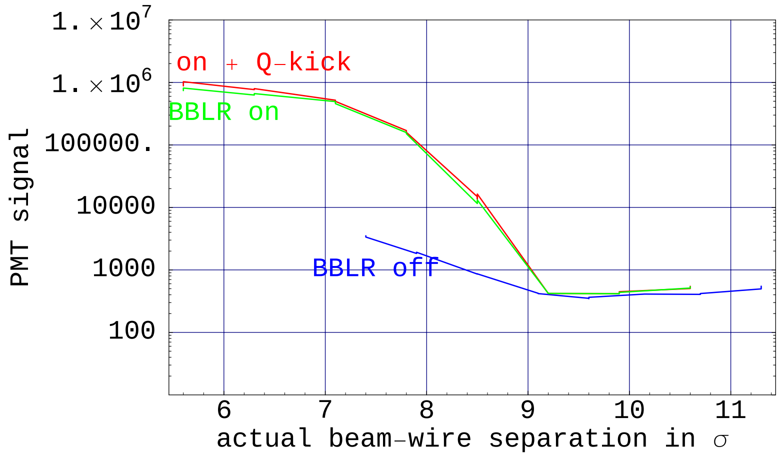

Figure 7: PMT losses versus beam-wire separation

BBLR is on. It is taken from table 4.

The beam losses depending on the beam-wire separation could arise from several sources:

- the losses induced by the strong diffusion due to the simulated beam-beam effect. The particle losses proper are expected to reach first the aperture limit whereever it is and produce a halo that can be detected in 517.
- the classical losses produced by a cut of the transverse beam distribution by an aperture limit. The BBLR producing a vertical orbit distortion, the cut would be a function of the beam-wire distance. In the absence of diffusion, the losses would behave close to an Erf function (If I remember well, Frank, you told me this is not quite true?).
- losses produced by machine resonances crossed due to the linear tune shift produced by the BBLR acting as a quadrupole.

Figure 7 shows that an increase of the losses occurs for a beam-wire distance of 9.2σwhether the BBLR is on or off. Since, in the latter case, there is no orbit perturbation outside the bump, this shows that the loss occurs inside the bump.

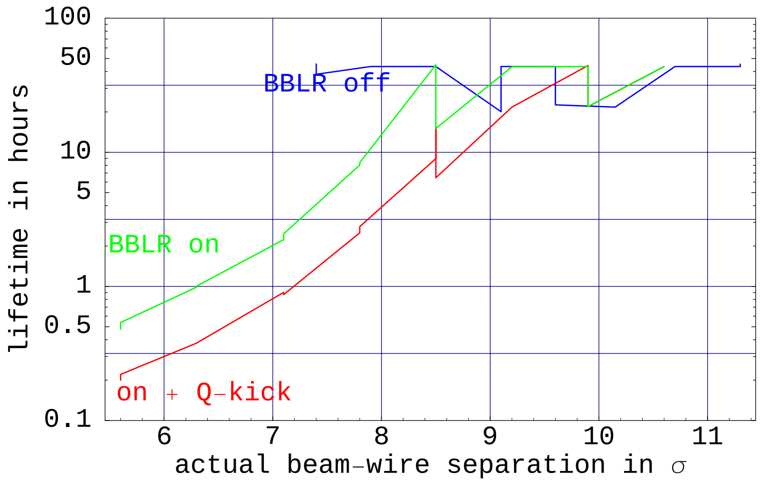

Figure 8: Current losses versus beam-wire separation

However the physical aperture is measured to be only 5σwithout bump. The aperture limit is thus most likely not at the BBLR.

An important issue is the understanding of this aperture limit to estimate what is the maximum particle amplitude. Does the emittance measurement say anything?

Indeed, if particles at 5σor less are cut, the effect we are after would appear weaker.

On the other hand, if the lifetimes (diffusion) are acceptable, this could be the easiest and free way of fixing the problem: collimating at 4 or 5σinstead of 6 to 7σ!!

The dependence of the losses vs separation is far from the steady increase of the Erf-function in beam tails. Do you agree that it seems to exclude a pure geometrical aperture limit without diffusion.

There is more data to be analysed: same experiment with Qkickers off; one beam separation where the CO and tune shift due to the BBLR were corrected.

13 PROVISIONAL Conclusions TO START THE DISCUSSION

13.1 this experiment

The linear perturbations produced by the BBLR are consistent with 1.2m * 267 A. The separation computed from either the interpolated closed orbit or from the tune shifts agree very well; however the tune shift due to the orbit perturbation over the whole machine is not so small and requires a correction ¡¡¡ TRUE?

If we accept the data of the loss monitors and if the physical aperture is 7σas in LHC, then the beam separation for LHC is just on the safe side and should allow a beam lifetime of about 20 hours.

An error of 10% on the estimate of the actual beam-wire separation reverses this conclusion. The lifetime is reduced to 4 hours, which is both unacceptable for physics and defined as the warning level for the quench prevention(quench level is a lifetime of 1 hour).

If the aperture limitation is less than 7σbut larger than 4σ, we then measure an effect which is weakened with respect to the simulations. However, the global lifetime from the BCT is compatible with baseline parameters, i.e. a tighter collimation would alleviate the problem.

13.2 what is required for the next experiments

To decrease the number of possible interpretations of beam losses, a measurement of the diffusion rate at amplitudes less than the geometrical aperture is necessary. We need to be able to retract the collimator within an SPS cycle. After enquiries, this should be possible next year. The collimator could be retracted on a time event. The speed would be about 1 mm in 70 ms. Is that fast enough? In parallel, it does not seem impossible to modify the scraper controls.

Again to minimize mis-interpretations, I wonder whether we should not install an orbit corrector at the BBLR. This would allow to keep the orbit constant both outside and inside the BBLR bump. Do you think it is worth pushing, in the ligth of our present results?

For software upgrades, I sent a long list to JJ Gras. We can discuss that later.

Thanks to...

W. Hofle