

# Proposal for the BBLR SPS MD 2007

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## 1 Still to be done

### 1.1 other

- Get telephone numbers of all involved people.
- Check if flow switch is still on.
- mark steps in plan where 37GeV end scan should be possible. think about the impact of the tune compensation.
- Add an empty tunediagramm where LHC and SPS tunes are marked

### 1.2 Questions to Frank

- Wie sind sie bisher mit dem unterschiedlichem beta zwischen BBLR1 und BBLR2 umgegangen?
- results from 2004 MDs - crossing plane studies
- Beam-wire distance for 2004 compensation experiments.
- Koennen wir auch emittance durch injection mismatch anpassen? Filamentaion time?
- warum sind 267A (=4.4A pro LR) 60 LHC LR (erarte 60\*5=300)
- wirescanner: jeder scanner kann pro cycle nur 2 mal messen. wieviele davon gibt es? unterschiedliche devices koennen zu unterschiedlichen zeiten feuern.
- wie kontinuierlich/schnell/kontrolliert geht tuneanpassung.

- Was bedeute/wie wichtig etc sind die folgenden punkte aus einer alten MD note: start a repetitive monitoring of the machine losses. start a repetitive measurement of the beam lifetime. start the monitoring of the PMT's in BA5 in automatic mode. start the monitoring of the Bloss at the BBLR if not included in the machine losses by Lars. start the repetitive measurement of the beam position with the BBLR BPM. If Christian is around, a calibration without beam would be valuable to give the zero of the system. ensure someone is in BA5 to locally monitor the cooling water temperature.
- Was bedeutet das folgende: beam loss monitoring: Operation  $\downarrow$  New programs  $\downarrow$  SPS collimator monitors Set 'Extraction' to BA5 and select monitor 3 (BBLR). Settings used: Interval 430 (44 is 1 ms) and Start event 5000 (from the beginning of the supercycle; there appear to be a feature with the time scale: JJG informed). GlobLoss is the loss over the supercycle while PartLoss is the loss over the range selected.
- Was bedeutet das folgende: 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/bispscolmon/JPK`
- Was von folgendem hat sich bewaehrt: Measurement of the Diffusion Experiment at 26 GeV on P2 aimed at debugging the principle and the software.
  1. Method using a collimator Principle: The collimator is set at: closed orbit + (n+0.5 sigma). The scraper is used to cut the beam at n sigma. The rise of the background on the collimator is measured with a BMT Implementation: The motion of collimators being slow, this method probably requires the machine to be dedicated to this experiment. The best collimator BRC(Z)V51932 is just outside of the BBLR bump. It is equipped with a beam loss monitor and a PMT(4) logged by the program cmon. The scraper to be used is BSV51459 (outside the BBLR bump). The optics functions for SPS2003 have to be found.
  2. Method using a fast bump towards an aperture limit Principle: A fast bump is used to move the beam during the P2 cycle only towards an aperture limit monitored by a PMT. Otherwise the method is the same as the former one, using a scraper. Implementation: Unfortunately, the only monitored targets are the collimators in LSS5. A fast bump would disturb the beam-wire distance. I could not find another possibility.
  3. Method using a fast bump for scraping and aperture limit Principle: A fast bump is used to scrape the beam on an aperture limit and move it back by 0.5 sigma. The rise of the background is observed with a PMT. Implementation: same problem

as above: it does not seem possible not to interfere with the beam-wire distance. Jorg calculated that the beam motion would be 30 ms/mm with an overshoot. 4. Method using the BBLR as aperture limit Principle: The beam is moved slowly towards the BBLR until it grazes the wire as observed on the BBLR PMT(3).. This position will be interpreted as 9.5 sigma. The wire current is scaled to the LHC value, taking into account the beam-wire separation. The orbit perturbation is corrected. The scraper is used to cut the beam at n sigma and the rise of the background is observed with a PMT on this 9.5 sigma aperture limit. Implementation: doable directly in the control room. Method requiring the software upgrade (from 1 Aug.) Principle: The beam is scraped at n sigma and the scraper withdrawn by 0.5 sigma within 10's of ms. The rise of the background on the scraper is observed with a PMT. Implementation: Doable one the software is ready. The scraper to be used is BSC51459 equipped with a PMT(1). See figures

- We launched cmonJPK application. This program was found in */tmpmnt/nfs/bomlep/vol2/*

## 2 general

### 2.1 Telephone numbers

CCC	76677
Joerg Wenninger	164367
Gerard Burtin	160555
Frank Zimmermann	162051
Ulrich Dorda	+41 763 306 781

Table 1: To call a CERN GSM from outside CERN, dial +41 76 487 and the last 4 digits of the GSM number. For land lines: +41 22 76 .....

## 3 Overview

### 3.1 Program

Initially both wires have to be set to position -20mm.

Do whenever parallel possible:

- Measure resonance driving terms.

- Add measurement at 37GeV after 26Gev tests.
- Impedance measurement - search for a tune change when the beam-wire distance is changed while the wire is not powered.
- Setup [4](#)
- Current scan 26GeV at  $9.5\sigma$  and  $5\sigma$ . [5.1](#)
- Current scan 37GeV at  $9.5\sigma$  and  $5\sigma$ .
- Tune scan at 26GeV [5.3](#)
- Compensation with different exciter distances. [5.4](#)
- Chromaticity scan
- Coarse tune scan at 37GeV
- Distance scan 26GeV at two power levels. [5.2](#)
- Current scan 37GeV
- Distance scan 37GeV
- Fill in Elias's quick feedback form.

## 3.2 Procedures

**Tail populations** Measuring tail populations by kicking to various amplitudes after wire excitation;

**37GeV end** In all cases of a 26GeV measurement, when the current is not used at full strength, ramp the current during the 37GeV part in order to identify equivalent points.

## 4 Setup

### 4.1 Data to log

- Beam profiles (wire scanner once at begin, once at end of studied energy level), emittance
- Beam loss monitors - all around the SPS and special devices at wire (PMT loss signals)

- Beam current (BCT)
- Tune
- Chromaticity
- Orbit
- 1000-turn data
- Wire current
- Wire position
- IPM or/and other luminiscence monitor

## 4.2 Sequence

In previous BBLR MDS it was concluded that it is best to switch on the BBLR before injection.

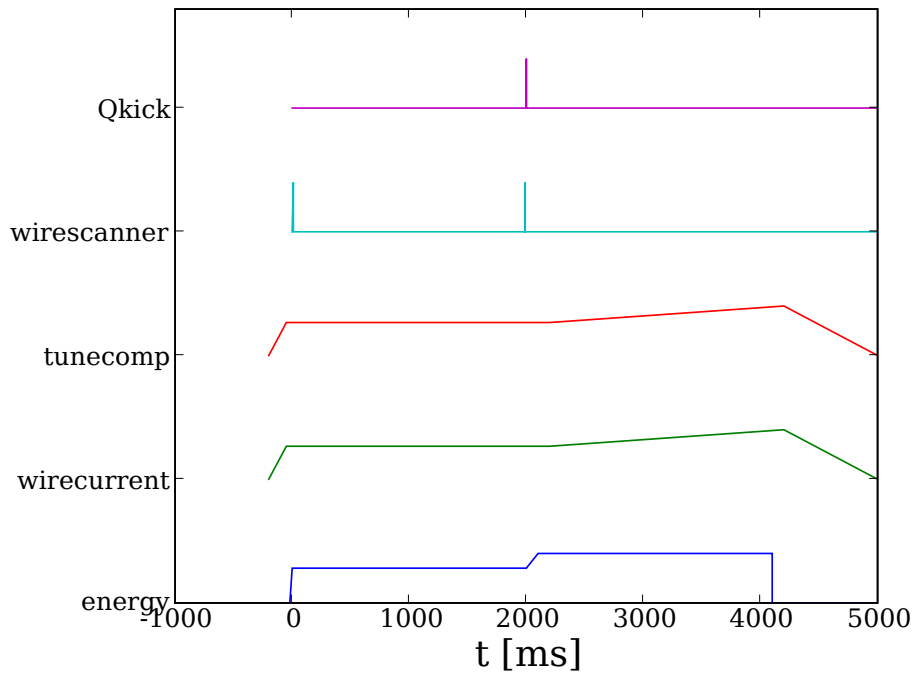


Figure 1: The sequence for experiments at 26GeV. In case the wire current was not at top during the 26GeV, the current in the wire (plus synchronously the orbit and tune compensation) is continuously raised after the energy-increase in order to identify the current value when losses are found again. This should be a ideal test for the energy scaling, which claims that only the effect on the beam-size matters. In this case the Q-meter kick is given at the end of the whole cycle.

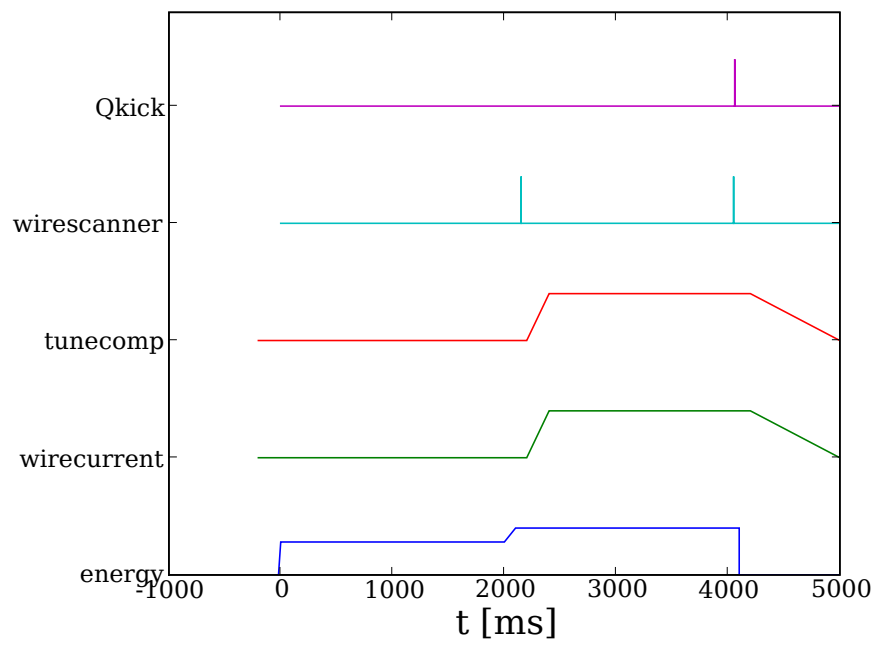


Figure 2: Sequence for 37GeV



### 4.3 Setup procedure

- Start automatic logging of all parameter given above.
- Measure tune with kick
- Set up automatic regular “multi-Q application” measurement. How often depending on the impact on the beam.
- Measure chromaticity and detuning with amplitude (maximize decoherence time); set to an established level.
- Measure and correct coupling if necessary
- Center the beam H + V in the BBLR, minimize any oscillation in this area. Unload as much as possible the vertical orbit correctors, which will be needed for the bump.
- Retract collimators.
- Check feedback status (turn off?)
- Measure the beam profile with the wire scanner to get a reference profile. Take several shots to get an idea of the fluctuations.
- Power the BBLR 1 to highest level to test it. Check if tune and orbit change as expected (almost nothing).
- Power the BBLR 2 to highest level to test it. Check if tune and orbit change as expected (almost nothing).
- Check that all parameters are logged correctly.
- Test orbit bump to -10mm. Power BBLR1. Check if tune and orbit change as expected.
- Test orbit bump to -10mm. Power BBLR2. Check if tune and orbit change as expected.
- Kick the beam increasingly strong to find “unperturbed” DA.
- Activate orbit bump to -10mm. Kick the beam increasingly strong to find “unperturbed” DA.

## 5 Program

### 5.1 Current scan 26GeV at $9.5\sigma$ and $5\sigma$

#### 5.1.1 Motivation

A quick current scan of the impact of the wire and the compensation efficiency. In order to save time this can also be done without tune compensation (but with orbit compensation). This is a valuable information for benchmarking simulations and should - together with the distance scan - allow to identify equivalence points in the trade off distance versus current. The lacking tune compensation can be reproduced in simulations and the fact that resonances are crossed might even bring another interesting feature -how strong is their impact in simulation vs. experiment.

#### 5.1.2 Procedure

Do the following for  $d = 9.5\sigma$  and  $d = 5\sigma$ .

- Make sure all parameter are logged.
- Activate the “37GeV-end”
- Orbit bump to d
- Although the alteration might be more work-load for orbit correction, it is better to have the un- and compensated case next to each other. With increasing current I, step size= 20A (adjust if needed)
  - Power BBLR1 & measure
  - Power both BBLR & measure.

### 5.2 Distance scan 26GeV at two power levels

For the same reasons as given in 5.1, a distance scan is interesting (again, a tune compensation is not mandatory)

Do the following for  $I = I_{max}$  and  $I = I_{max}/2$ :

- Power BBLR1 and move beam to d
- Power both BBLR
- decrease d and redo all

### 5.3 Tune scan at 26GeV

For a distance where we observed significant losses before, make a  $Q_y$  tune scan around LHC tunes ( $Q_y$  from 0.32 to 0.27 in steps of 0.003).

If we observed no significant changes from cycle to cycle, we propose the following strategy in order to minimize the effort for tune and orbit corrections

- scan tunes. No BBLR, but orbit already bumped
- Reverify performance at start tune with no wire
- scan tune. Both BBLRs
- Reverify performance at start tune with no wire
- scan tune 1 BBLR

If there is enough time, redo at another separation.

### 5.4 Compensation with different exciter distances

#### 5.5 Motivation

In LHC the long-range beam-beam interactions will take place at various different normalized beam beam separations. the following experiment should allow to measure the impact of this differences and validate the compensation performance in this case.

#### 5.6 Procedure

In this case the fixed BBLR is to be seen as the compensator. The two parts of the movable wire are powered in common, but can be moved separately.

For top excitation

- move beam to a distance of significant beam loss
- Power on movable wire at full strength a the same distance as the fixed one - measure
- Power both BBLRs and measure
- in a loop do:
  - Retract one part of the movable wire

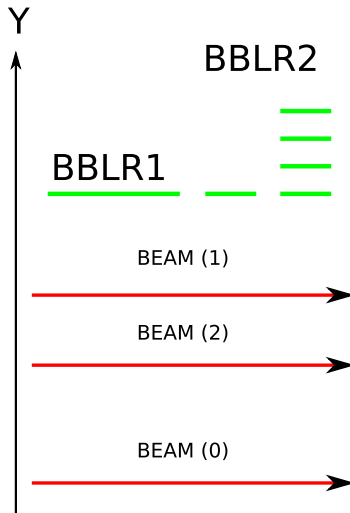


Figure 3: The beam at two different positions and one of the movable wires moved

- Power movable wire only
- Power both BBLR

## 5.7 Measure resonance driving terms

ROGELIO

- Take reference with no BBLR
- 2 currents
- 2 different distances
- compensated and uncompensated

## 5.8 Chromaticity scan

### 5.9 Motivation

Quick RHIC experiments have shown a strong impact of the chromaticity on the effect of the wire. This needs to be confirmed and the compensation tested for different cases.

### 5.10 Procedure

No tune/orbit compensation should be necessary

- Power BBLR1 at full strength.
- Set Chromaticity to 0
- Move beam to a distance where no beam loss is found
- Increase Chromaticity in steps to see impact
- Redo with both BBLRs

### 5.11 Coarse tune scan at 37GeV

Same as in [5.3](#) but at 37GeV. In order to save time, do in more coarse steps.

## 6 Other

### 6.1 Backup MD ideas

- Move wires to different increasingly positions and measure impact. How much do we need to reduce the current on the first closer one to be equivalent to the case where both are at the same distance.

- beam lifetime vs. beam-wire distance for different tunes to see (understand) whether different power laws found at SPS <sup>(5)</sup>, Tevatron<sup>(3)</sup> and RHIC <sup>(2)</sup> and <sup>(4)</sup> are tune related.

## 6.2 Analysation ideas

- Analyze Beam profiles using the Abel transformation

## 6.3 Ideas for further MDs

- If we manage to connect the other BBLRs to the top with coaxial cable in order to measure the induces signal. Can we use this signals also to excite the beam = noise studies.