Measuring Beam Size by Scraping with Collimator

Summary of MD1

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Game over, beam killed by a colimator move... Interlock on colimators seem to work.

Electronic Logbook: http://elogbook.cern.ch/
Overview Collimation SPS-MD1
⇒ beam current data from 19:20 to 8:09
Overview Collimation SPS-MD2

[Graphs and plots showing data measurements over time]
Overview Collimation SPS-MD2

\[ \Rightarrow \text{beam current data from 19:20 to 8:09} \]
Beam Based Alignment: Scraping

Multi-turn scraping slow w.r. to betatron frequency (both sides+x'!)
Neglect dispersion and coupling

\[ N(x) = \frac{1}{2\pi} \exp \left( \frac{-x^2 - x'^2}{2\sigma^2} \right) \]

\[ F(x) = \frac{1}{N_0} \int_{0}^{x-x_0} N(t) \, dt = 1 - \exp \left( \frac{-(x-x_0)^2}{2\sigma^2} \right) \]

(S. Redaelli)

Collimator scans to measure Tevatron emittance

Intensity and luminosity after beam scraping

H. Burkhardt, R. Schmidt

Tevatron beam study report
1.21.2003
A. Jenison et al
CERN-AB-2004-032 (ABP)
CERN-AB-Not-2004-004 (ABP)

Beam population during scraping

Th. Weiler, AB/ABP-LOC, CERN
Scraping
Scraping
Scraping

first scraping at 1:28
Scraping

first scraping at 1:28
Scraping

first scraping at 1:28

second scraping at 2:22
Scraping Beam Right Jaw

Gaussian fit:
mean = $-1474.70 \mu m$
$\sigma = 596.05 \mu m$
$x_c \approx -0.2 \text{mm}$
Scraping Beam Left Jaw

![Graphs showing beam current and position over time](image)

**Gaussian fit:**
- mean = 1998.41 μm
- sigma = 748.96 μm
- $x_c \approx 0.4$ mm
Scraping Beam Left Jaw

Gaussian fit:
mean = 1441.57 \mu m
sigma = 441.53 \mu m
$$x_c \approx 0.35 \, \text{mm}$$

$$x_c \approx 0.2 \, \text{mm measured by beam based alignment during MD}$$
Difference in Motor Speed

- Scraping in one go
- Scraping in 0.2 \( \mu m \ s^{-1} \) steps
## Summary MD1

<table>
<thead>
<tr>
<th>time</th>
<th>scraping jaw</th>
<th>beam center</th>
<th>beam size</th>
</tr>
</thead>
<tbody>
<tr>
<td>01:29:19</td>
<td>right</td>
<td>≈ -0.2 mm</td>
<td>596.05 μm</td>
</tr>
<tr>
<td>02:21:52</td>
<td>left</td>
<td>≈ 0.4 mm</td>
<td>748.96 μm</td>
</tr>
<tr>
<td>03:00:42</td>
<td>left</td>
<td>≈ 0.35 mm</td>
<td>441.53 μm</td>
</tr>
<tr>
<td>05:06:10</td>
<td>left</td>
<td>≈ 0.45 mm</td>
<td></td>
</tr>
<tr>
<td>05:30:07</td>
<td>right</td>
<td>≈ 0.05 mm</td>
<td></td>
</tr>
<tr>
<td>07:06:18</td>
<td>left</td>
<td>≈ 0.67 mm</td>
<td></td>
</tr>
</tbody>
</table>
Data Quality MD1

control software output: data is good to handle, in first MD there are some problems with signal polarity, acquisition rate $\approx 2.0 \text{ Hz}$

beam-loss monitor output: data OK for first MD, one file "BLM_2006-10-31-18-46.txt" contains two headers and some line breaks are not correct.

beam current data:
sdds file designed for data base issue? missing time-stamp in UNIX time as for other the files, therefore twice GMT time in header (Why?), lot of “0” at the end of data.

data handling would be easier if BLM data and controls data files start at same timing. BDCT is not straight forward to combine with the other data, different acquisition times
Data Quality MD2

- control software output: in second MD there where a few lines with “NAN” or “INF” position readings, acquisition rate $\approx 1.0$ Hz

- beam-loss monitor output: much more bad data in file, lines not complete and times-tap directly at the end of the data especially file “BLM_2006-11-07-15-47.txt” (under investigation).

Files with four header lines:
BLM_2006-11-07-13-01.txt
BLM_2006-11-07-17-36.txt
BLM_2006-11-07-23-40.txt
BLM_2006-11-08-02-59.txt
BLM_2006-11-08-03-04.txt
BLM_2006-11-08-03-47.txt
BLM_2006-11-08-09-09.txt