Measuring Beam Size by Scraping with Collimator

Summary of MD1

Th. Weiler

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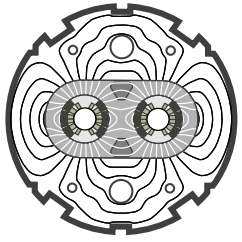
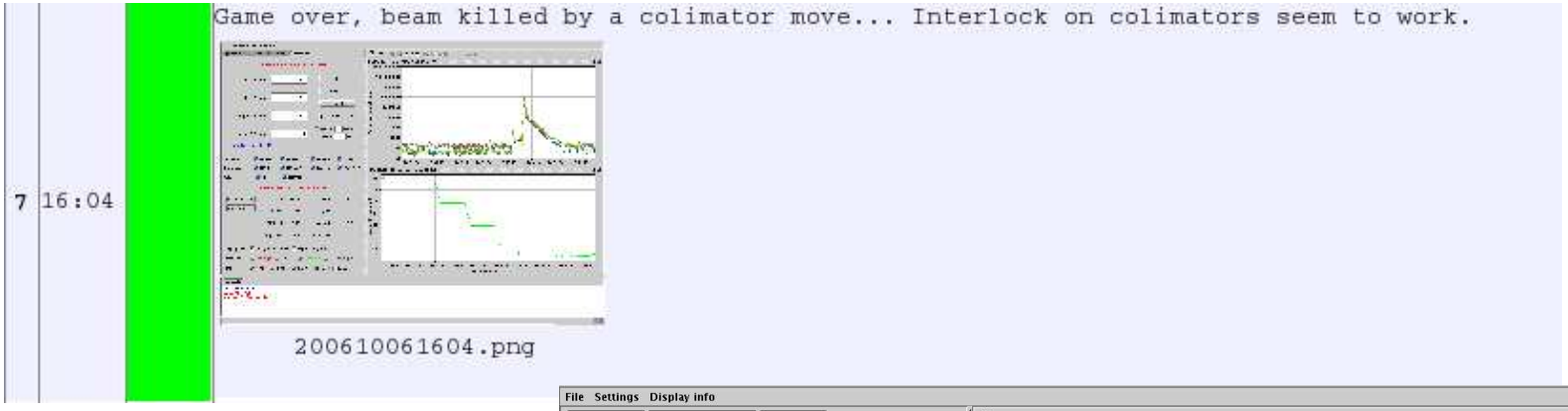
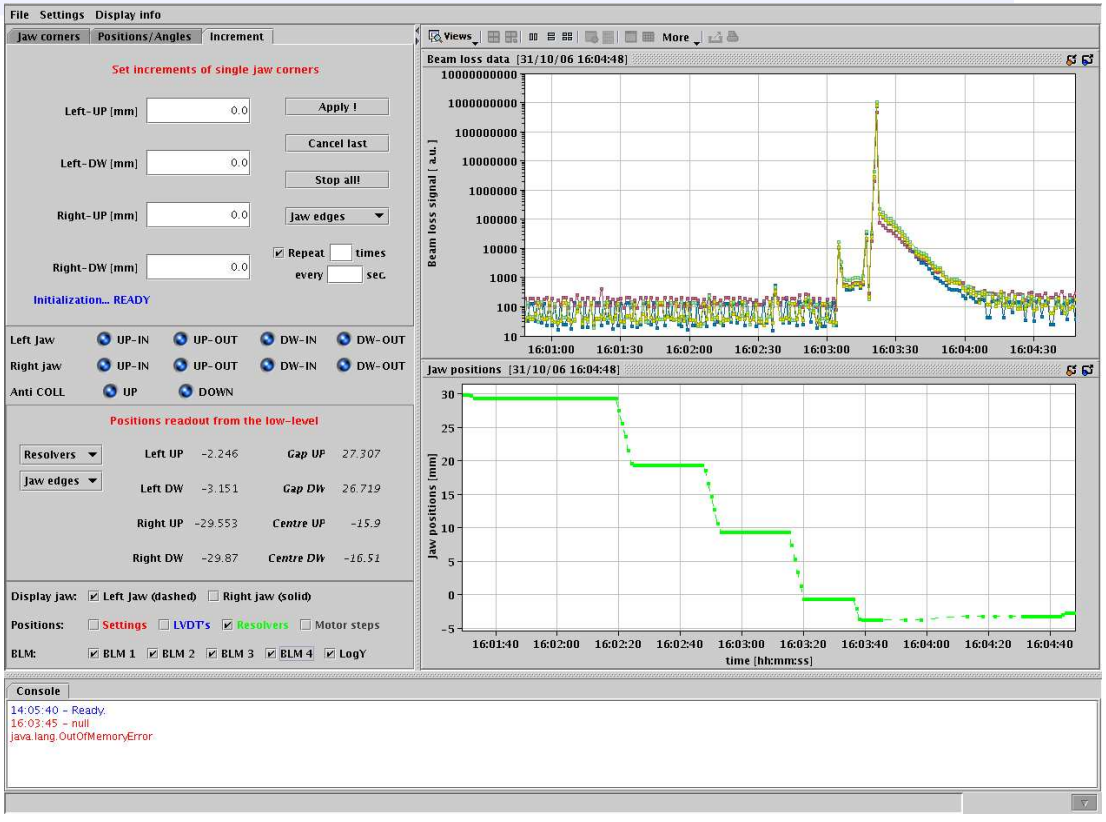


SPS - Logbook

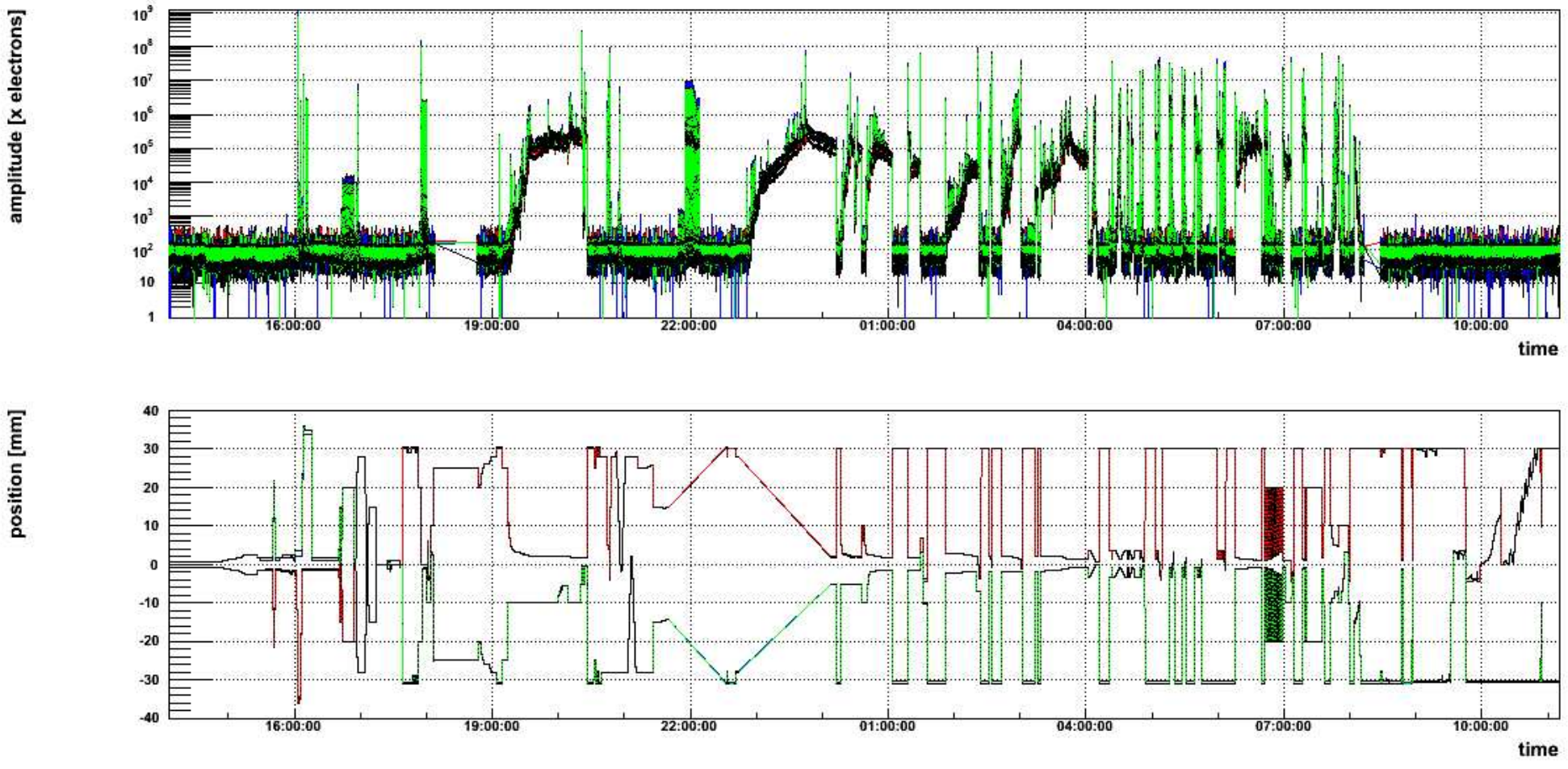


Electronic Logbook:

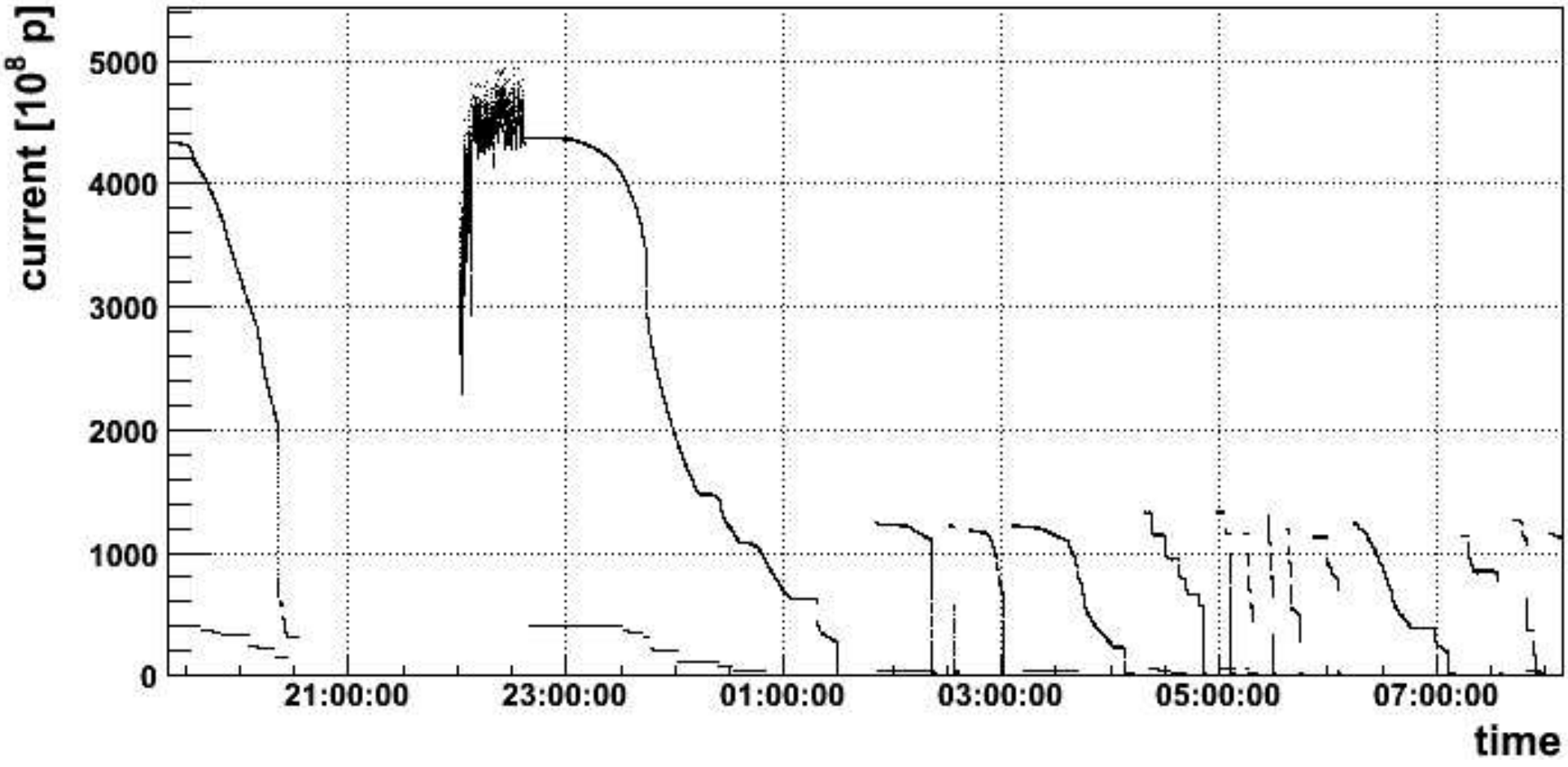
http://elogbook.cern.ch/



Overview Collimation SPS-MD1

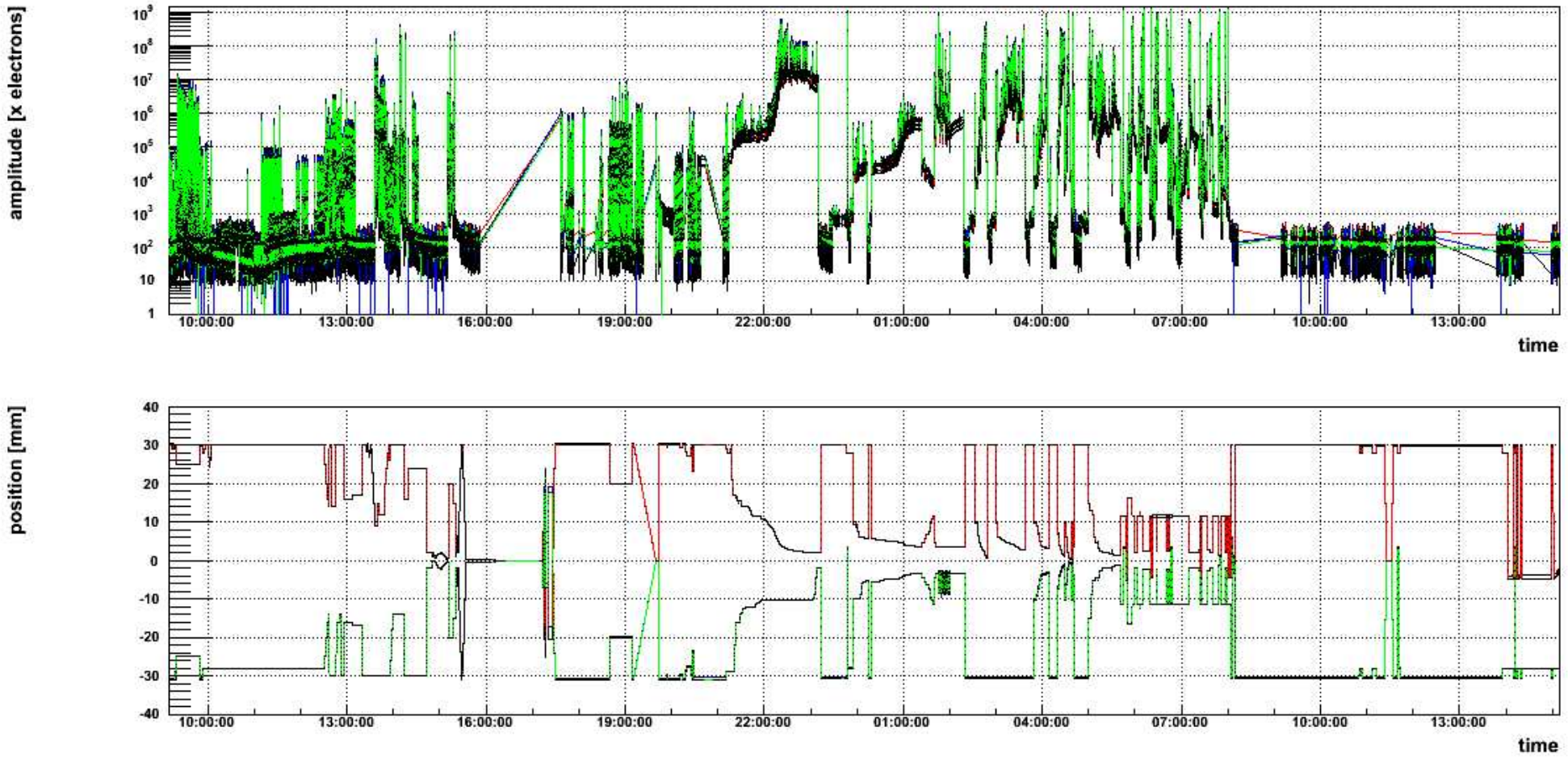


Overview Collimation SPS-MD1

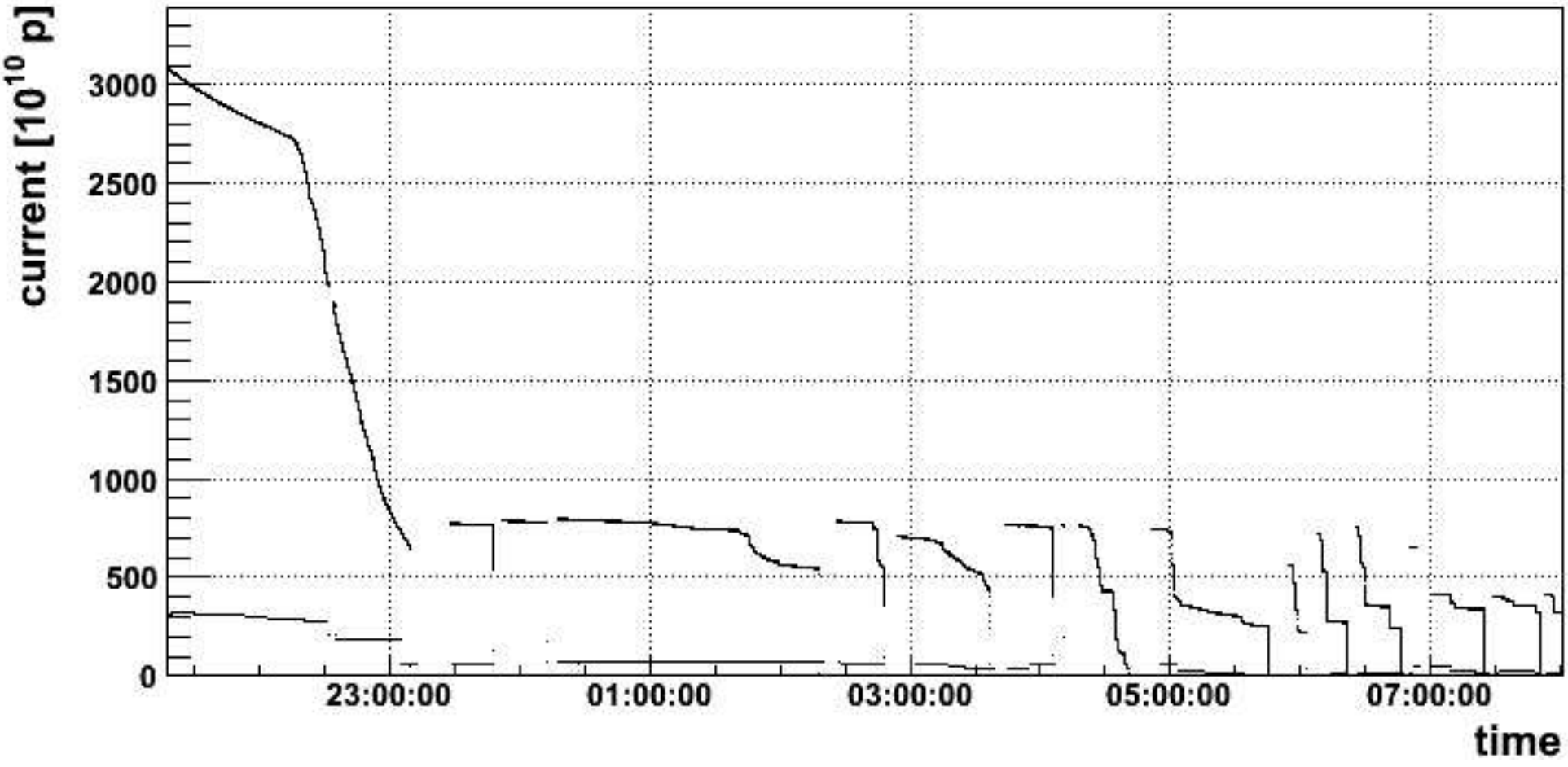


$\Rightarrow$ beam current data from 19:20 to 8:09

Overview Collimation SPS-MD2

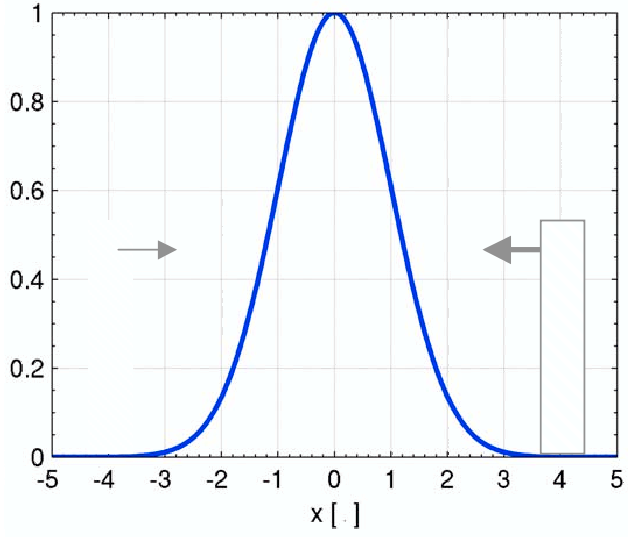


Overview Collimation SPS-MD2

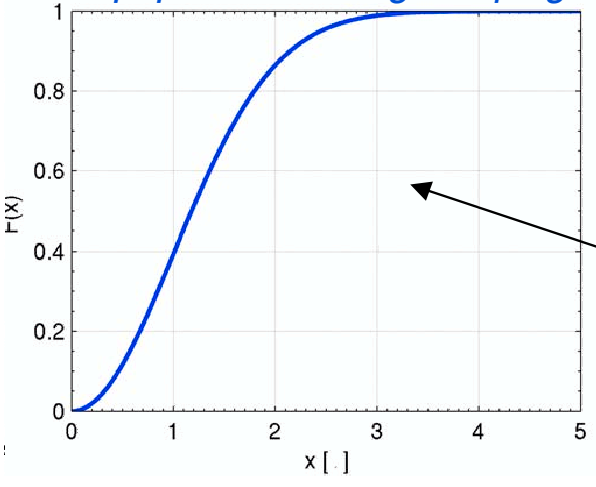


$\Rightarrow$ beam current data from 19:20 to 8:09

Beam Based Alignment: Scraping



Beam population during scraping



Fermilab

Tevatron beam study report
I.21.2003
A. Jansson *et al*

COLLIMATOR SCANS TO MEASURE TEVATRON EMITTANCE

CERN-AB-2004-032 (ABP)
CERN-AB-Note-2004-054 (ABP)

INTENSITY AND LUMINOSITY AFTER BEAM SCRAPING

H. Burkhardt, R. Schmidt

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

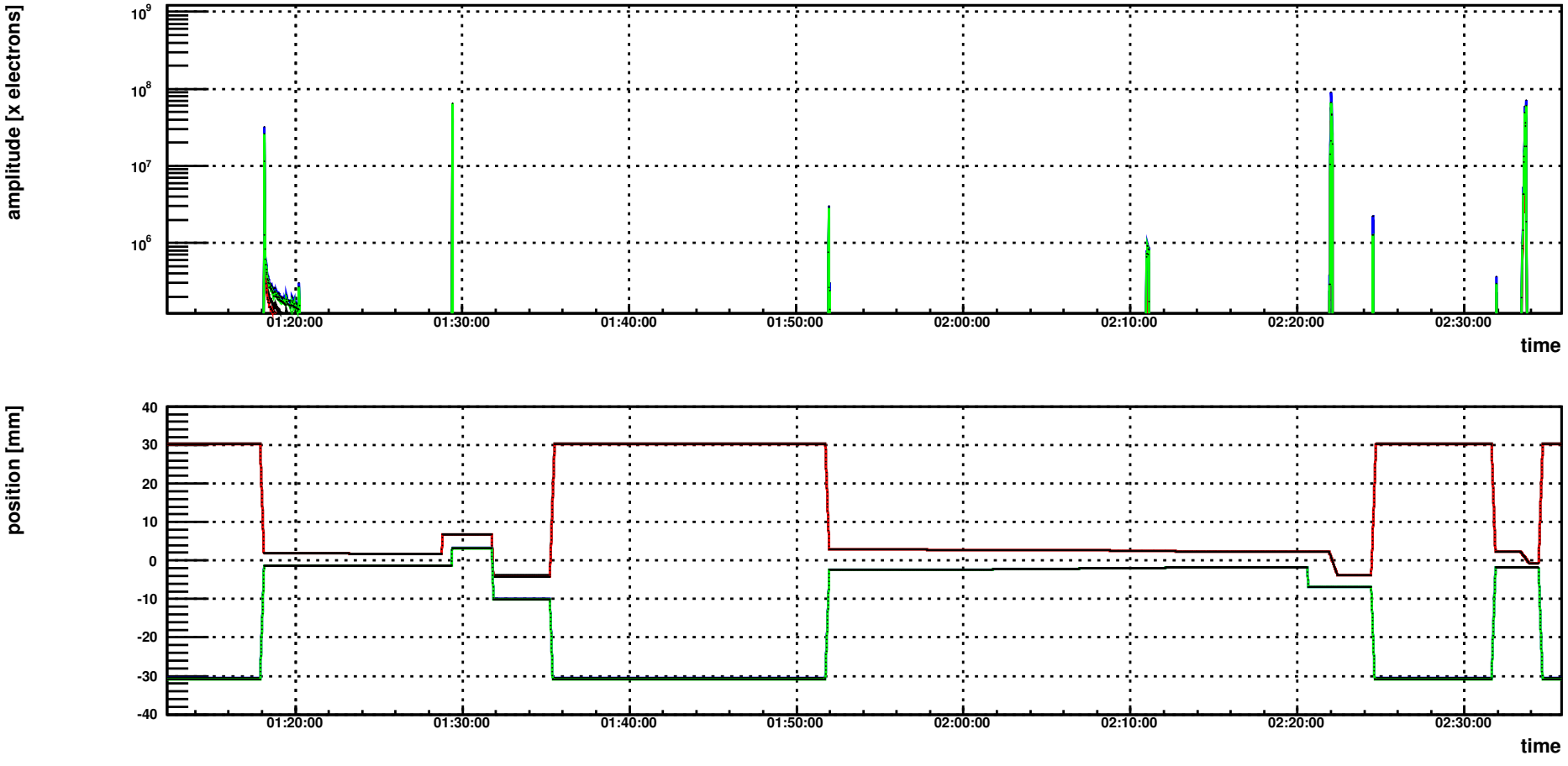
Multi-turn scraping slow w.r. to betatron frequency (both sides+x'!)

Neglect dispersion and coupling

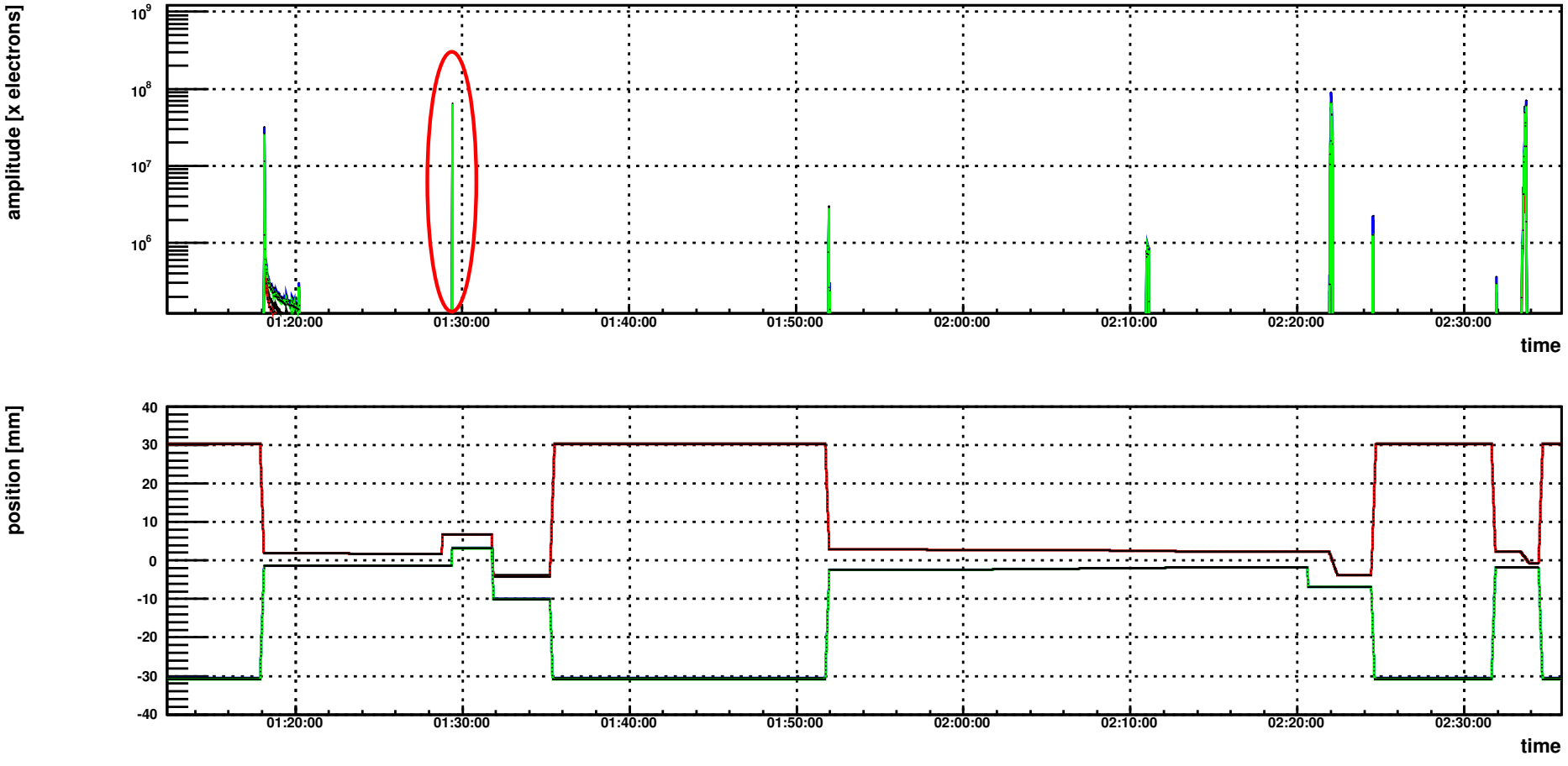
$$F(x) = \frac{1}{N_0} \int_0^{x-x_0} N(t)dt = 1 - \exp\left(\frac{-(x-x_0)^2}{2\sigma^2}\right)$$

(S. Redaelli)

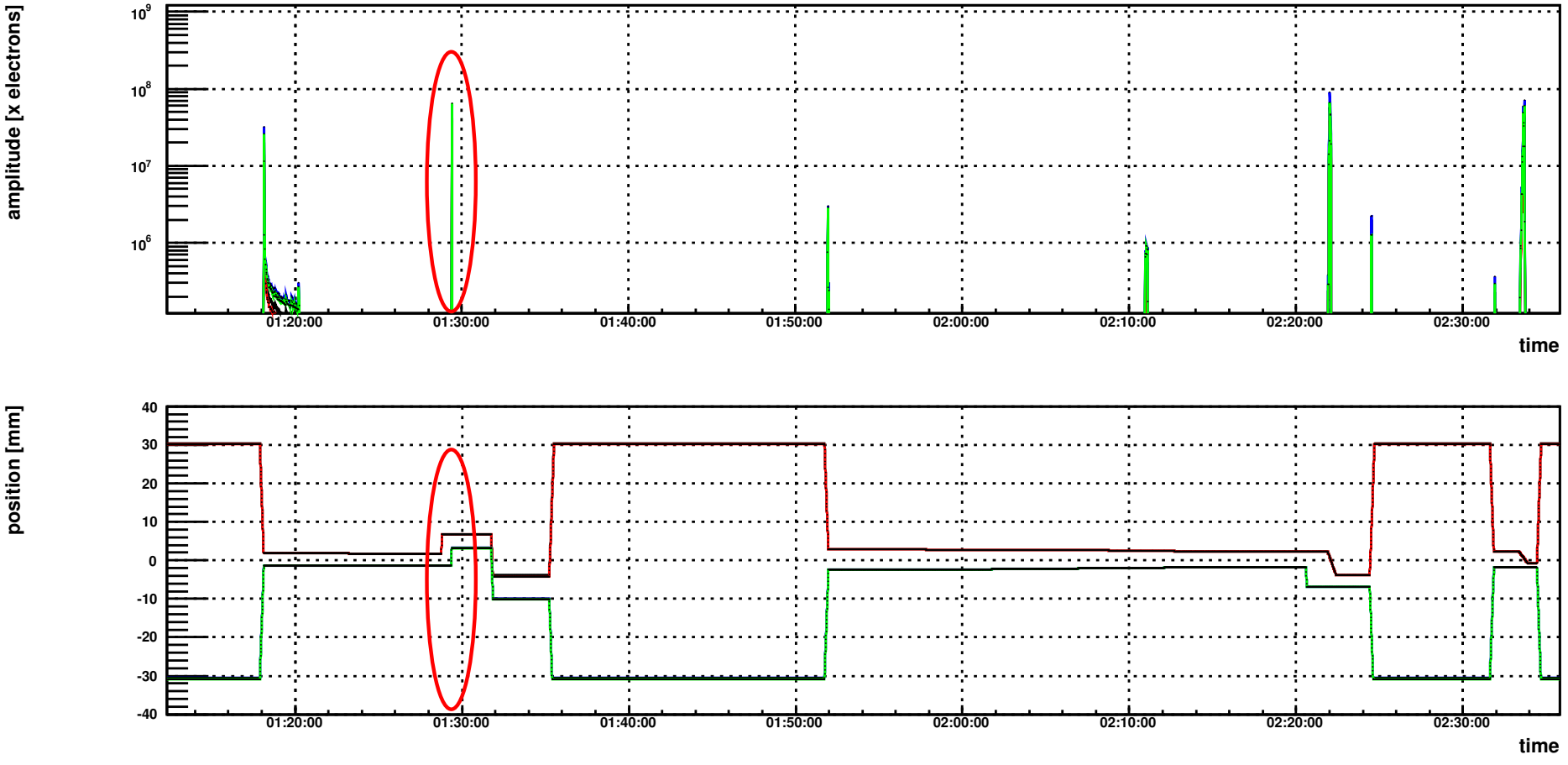
Scraping


amplitude [x electrons]
10^9
10^8
10^7
10^6
01:20:00
01:30:00
01:40:00
01:50:00
02:00:00
02:10:00
02:20:00
02:30:00
time
position [mm]
40
30
20
10
0
-10
-20
-30
-40
01:20:00
01:30:00
01:40:00
01:50:00
02:00:00
02:10:00
02:20:00
02:30:00
time

Scraping

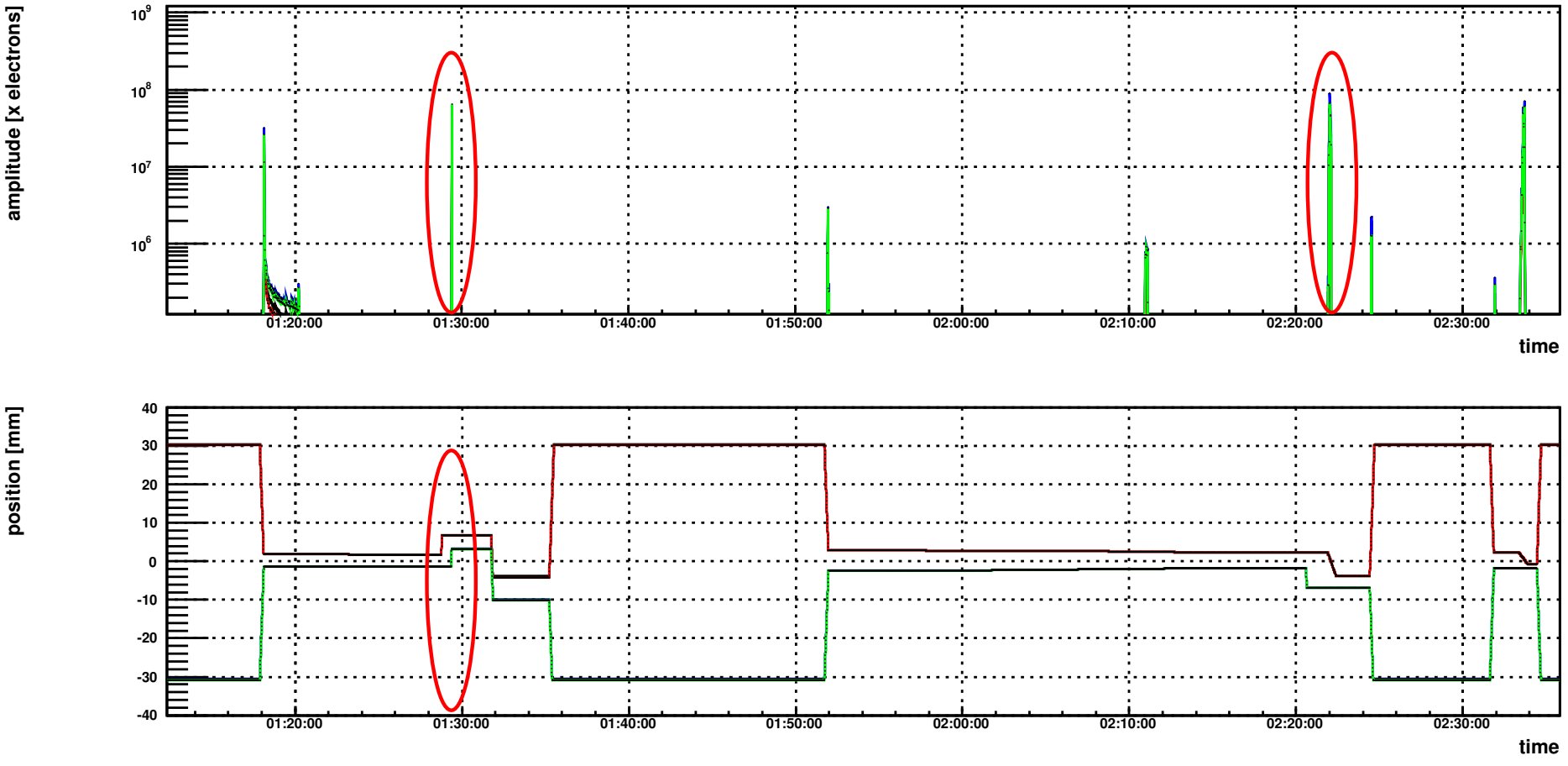

amplitude [x electrons]
10^9
10^8
10^7
10^6
01:20:00
01:30:00
01:40:00
01:50:00
02:00:00
02:10:00
02:20:00
02:30:00
time
position [mm]
40
30
20
10
0
-10
-20
-30
-40
01:20:00
01:30:00
01:40:00
01:50:00
02:00:00
02:10:00
02:20:00
02:30:00
time

Scraping



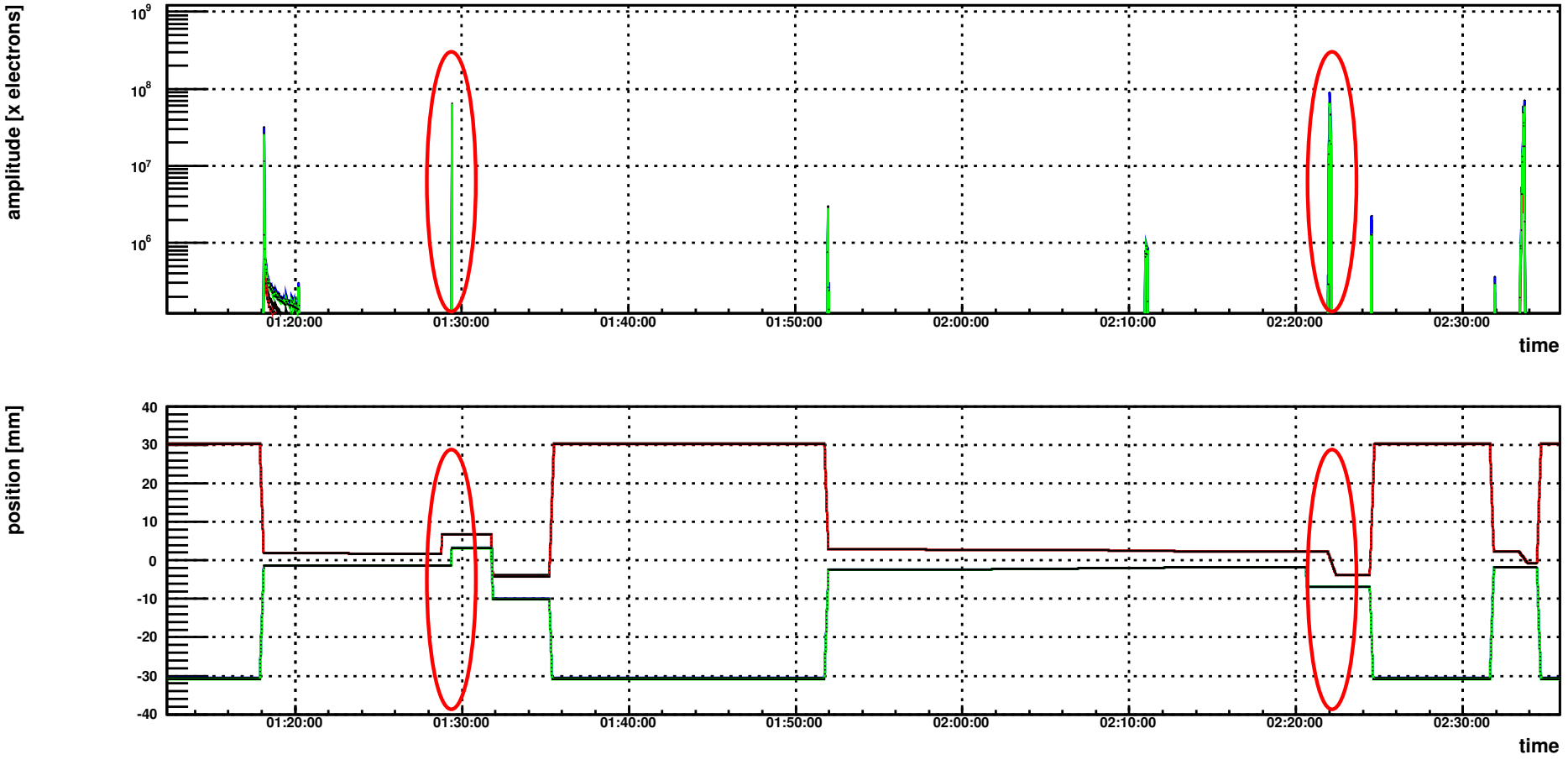
first scraping at 1:28

Scraping



first scraping at 1:28

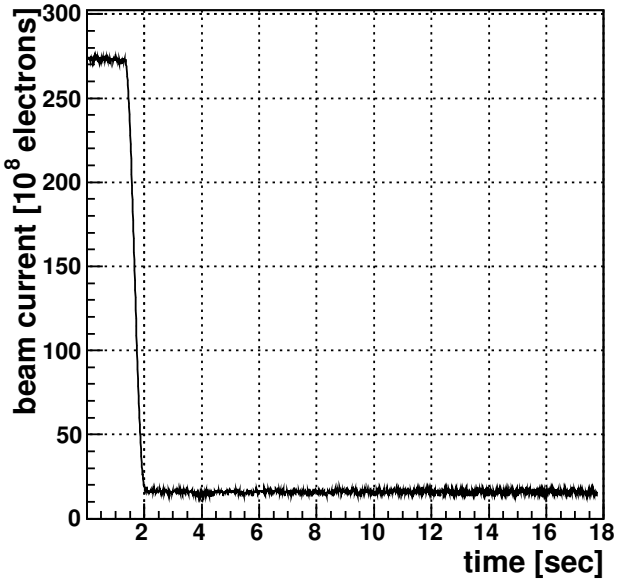
Scraping

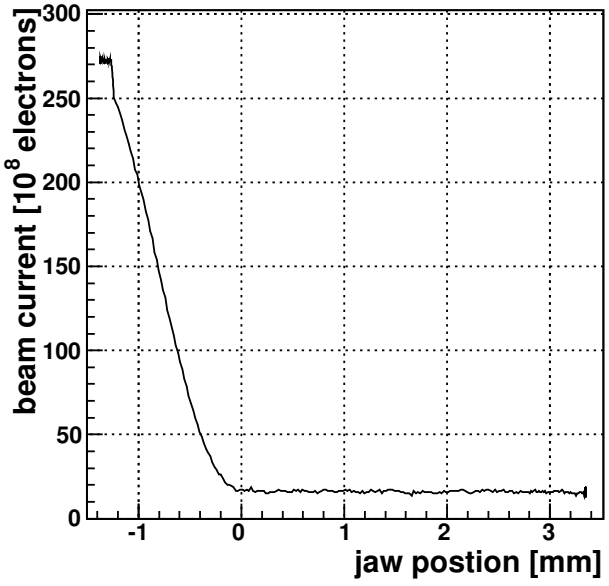


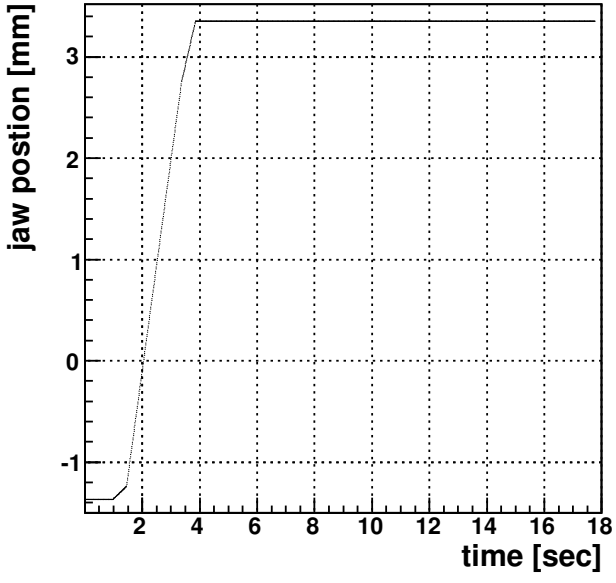
first scraping at 1:28

second scraping at 2:22

Scraping Beam Right Jaw







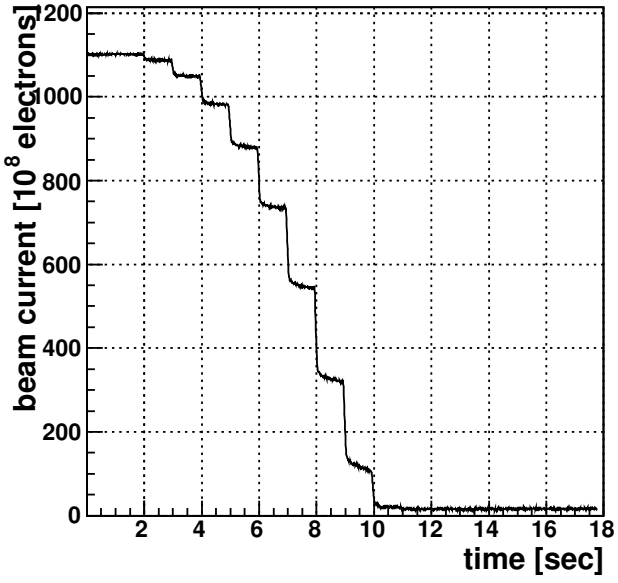
Gaussian fit:

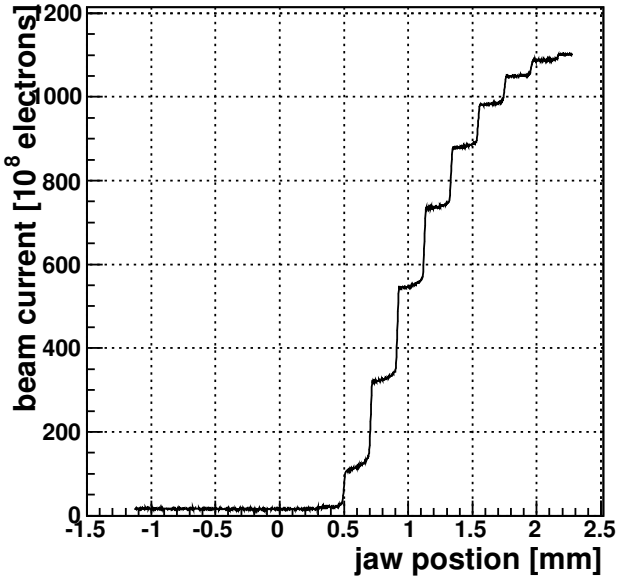
mean $= -1474.70\,\mu$m

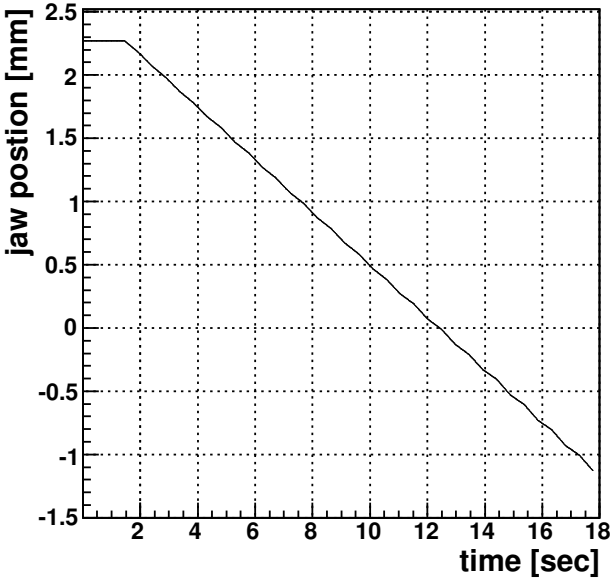
sigma $= 596.05\,\mu$m

$x_c \approx -0.2\,$mm

Scraping Beam Left Jaw







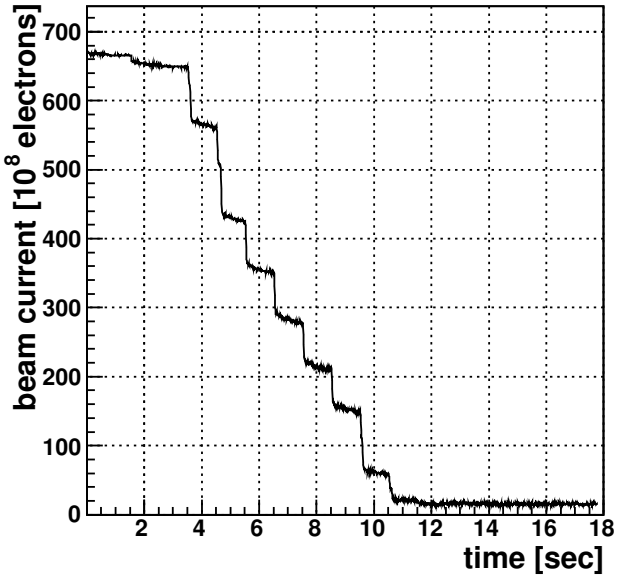
Gaussian fit:

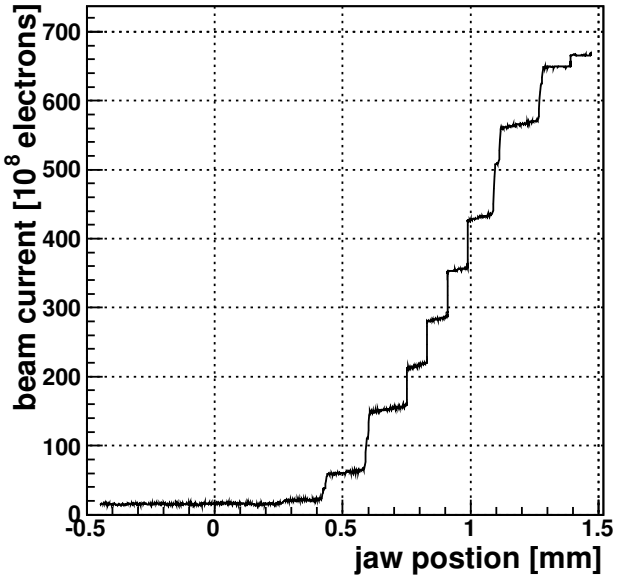
mean $= 1998.41\,\mu$m

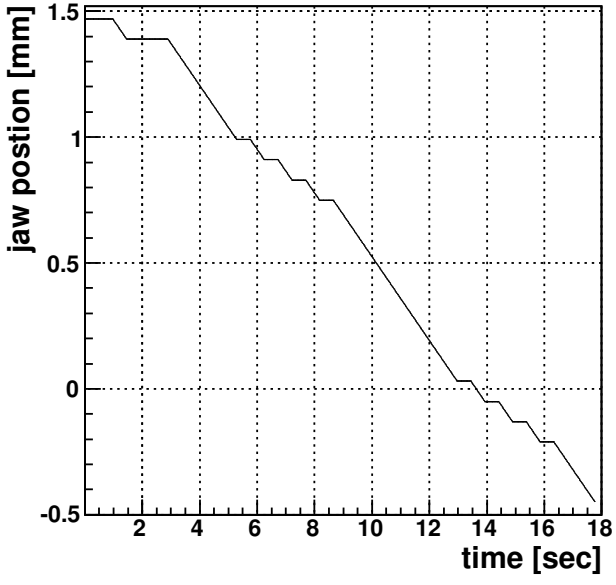
sigma $= 748.96\,\mu$m

$x_c \approx 0.4$ mm

Scraping Beam Left Jaw







Gaussian fit:

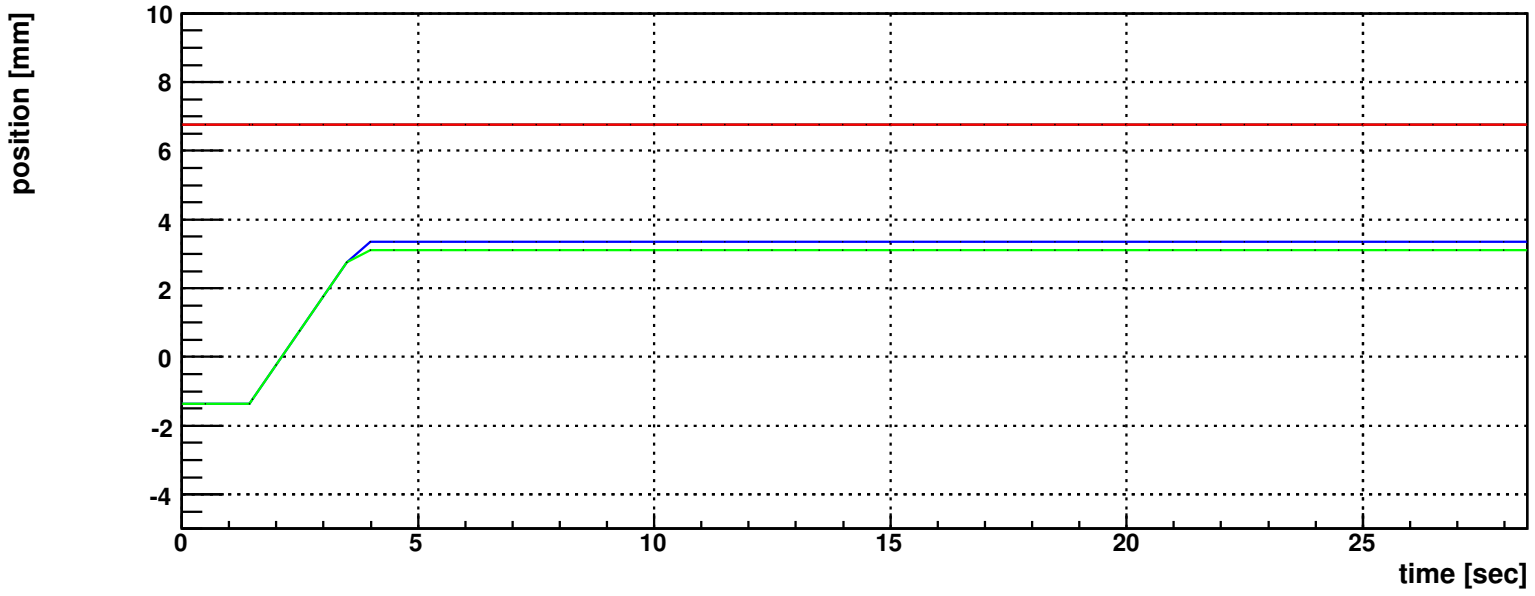
mean $= 1441.57\,\mu$m

sigma $= 441.53\,\mu$m

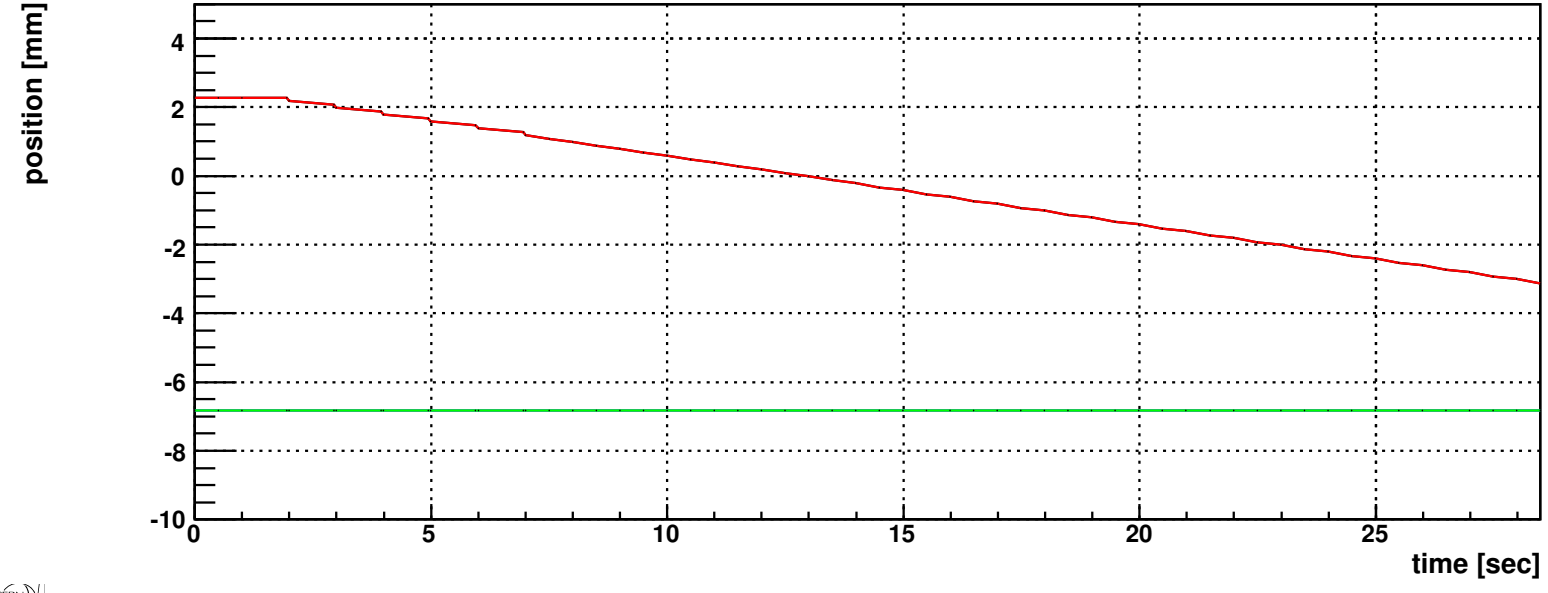
$x_c \approx 0.35$ mm

$x_c \approx 0.2$ mm measured by
beam based alignment during MD

Difference in Motor Speed



scraping in one go



scraping in $0.2\,\mu\mathrm{m\,s^{-1}}$ steps

Summary MD1

time	scraping jaw	beam center	beam size
01:29:19	right	≈ -0.2 mm	$596.05\,\mu$m
02:21:52	left	≈ 0.4 mm	$748.96\,\mu$m
03:00:42	left	≈ 0.35 mm	$441.53\,\mu$m
05:06:10	left	≈ 0.45 mm	—
05:30:07	right	≈ 0.05 mm	—
07:06:18	left	≈ 0.67 mm	—

Data Quality MD1

- control software output: data is good to handle, in first MD there are some problems with signal polarity, **acquisition rate** ≈ 2.0 **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** ≈ 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