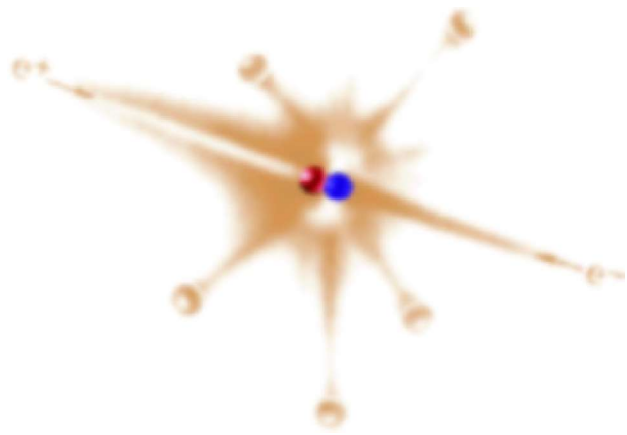


# Beam Loss Calibration Studies at the LHC Collimator in LSS5

Experiment and Simulation

BLM Team

Till Böhlen

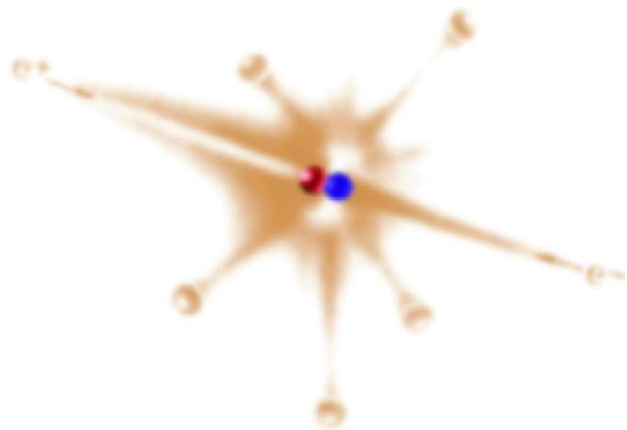


# Outline



Project Introduction  
Purpose, Aims & Related Work  
Experiment @ SPS  
Simulations  
Measurements, Data Analysis & Trouble  
Preliminary Results  
Planned MDs & Request

# Project



- Studying beam loss patterns at the LHC collimator
- Experiment located @ SPS LSS5
- Monitoring signals in BLMs close to collimator
- Simulations with FLUKA



# Some Related Works



Past

IR3 Simulation  
crosstalk matrices,  
transversal energy  
distribution (MARS, K2)  
I. Kurochkin, 2002-03

Beam Losses in  
the whole SPS, relative  
signal height (SixTrack)  
S. Redaelli et al.,  
2006

IR7 Simulation  
crosstalk matrices, heat in  
collimator jaws, ...  
(FLUKA, ANSYS)  
M. Magistris & M. Santana  
Leitner et al., 2006

Present

Exp. vs. Sim.  
a validation study,  
investigating a similar system  
My work

Future

tbc ... FLUKA & BLM Team  
Simulations for final LHC layout  
prediction of thresholds for BLMs



# Purpose & Aims

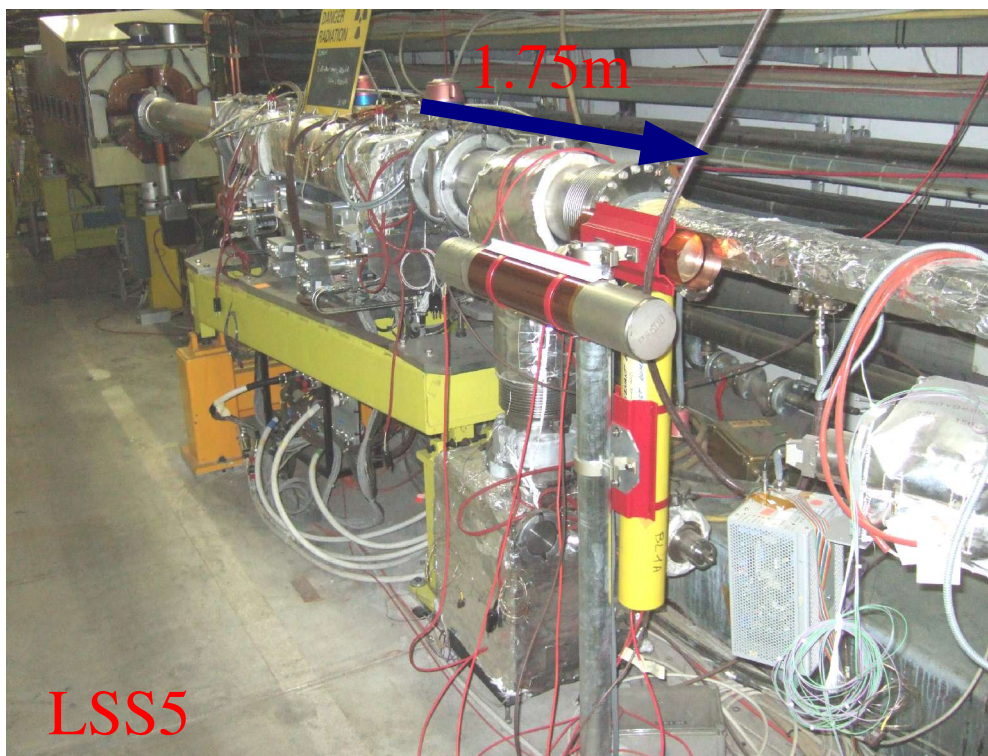
- Study behavior of a system similar to the LHC setup
  - Reference study for simulations for the LHC setup (Benchmark)
  - Establish correlation of energy deposition/particles impacting on the collimator and signal seen by the BLMs
- => Derive ratio: Threshold for collimator ~ Threshold of BLMs
- Influences of different collimator settings (impact parameter scan)
  - Misalignment studies => deviation of BLM signals
  - Test for the LHC BLM data acquisition system

# Setup of the Experiment

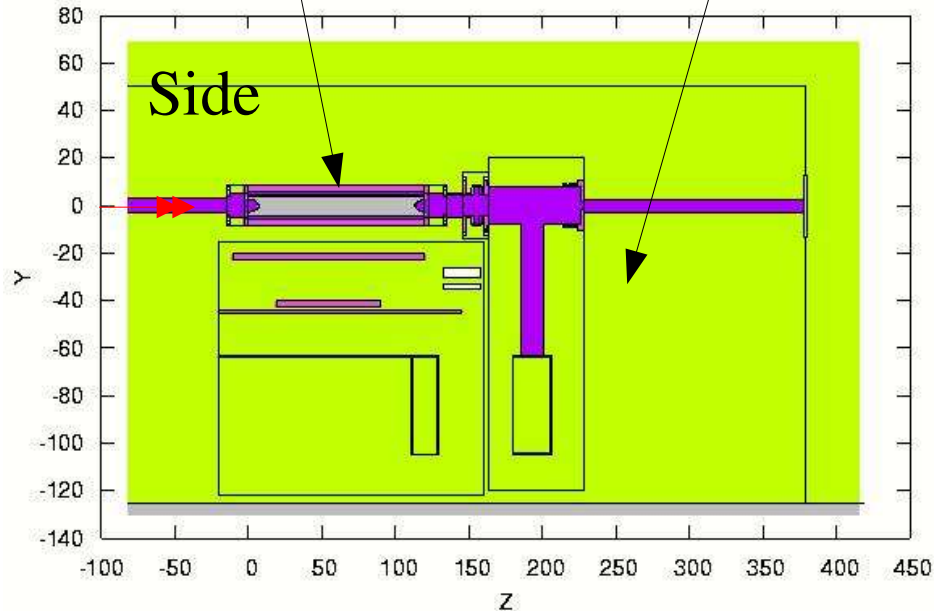
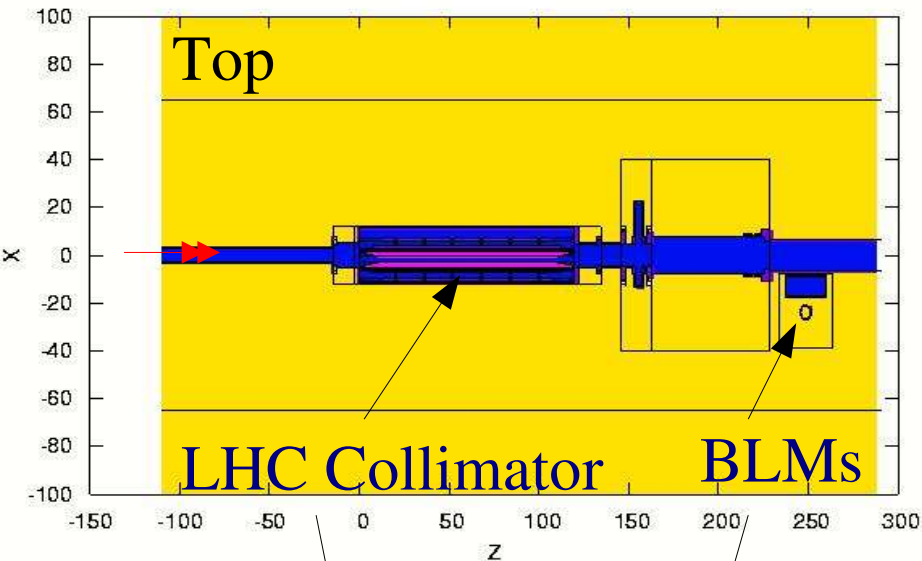


## Components:

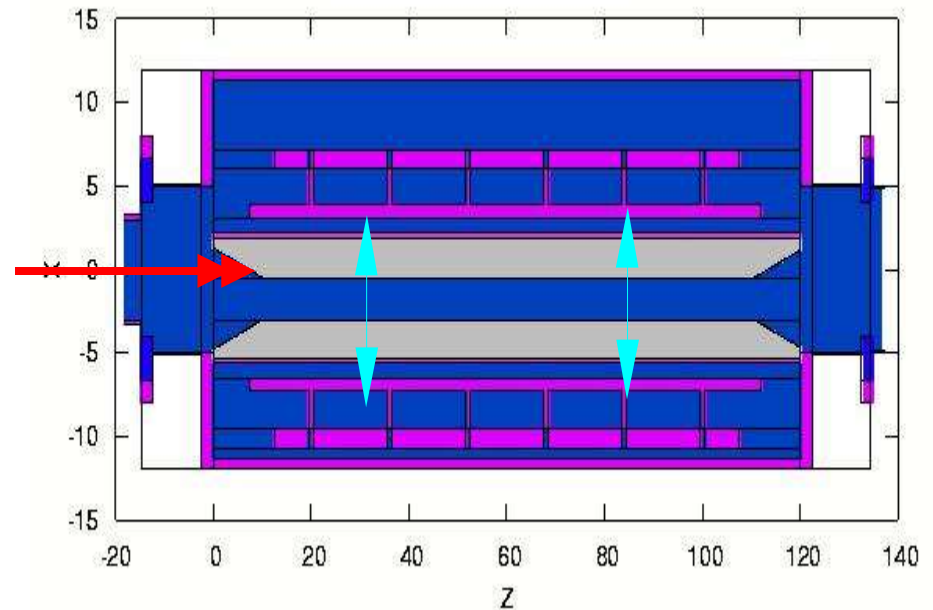
- LHC TCS Prototype
- 2 BLM Ionization Chambers
- BLM SEM



# Implementation in FLUKA



- Representative geometry  
=> low systematic errors due to simplification
- Allows for detailed study of the behavior of such a system
- Movable collimator jaws





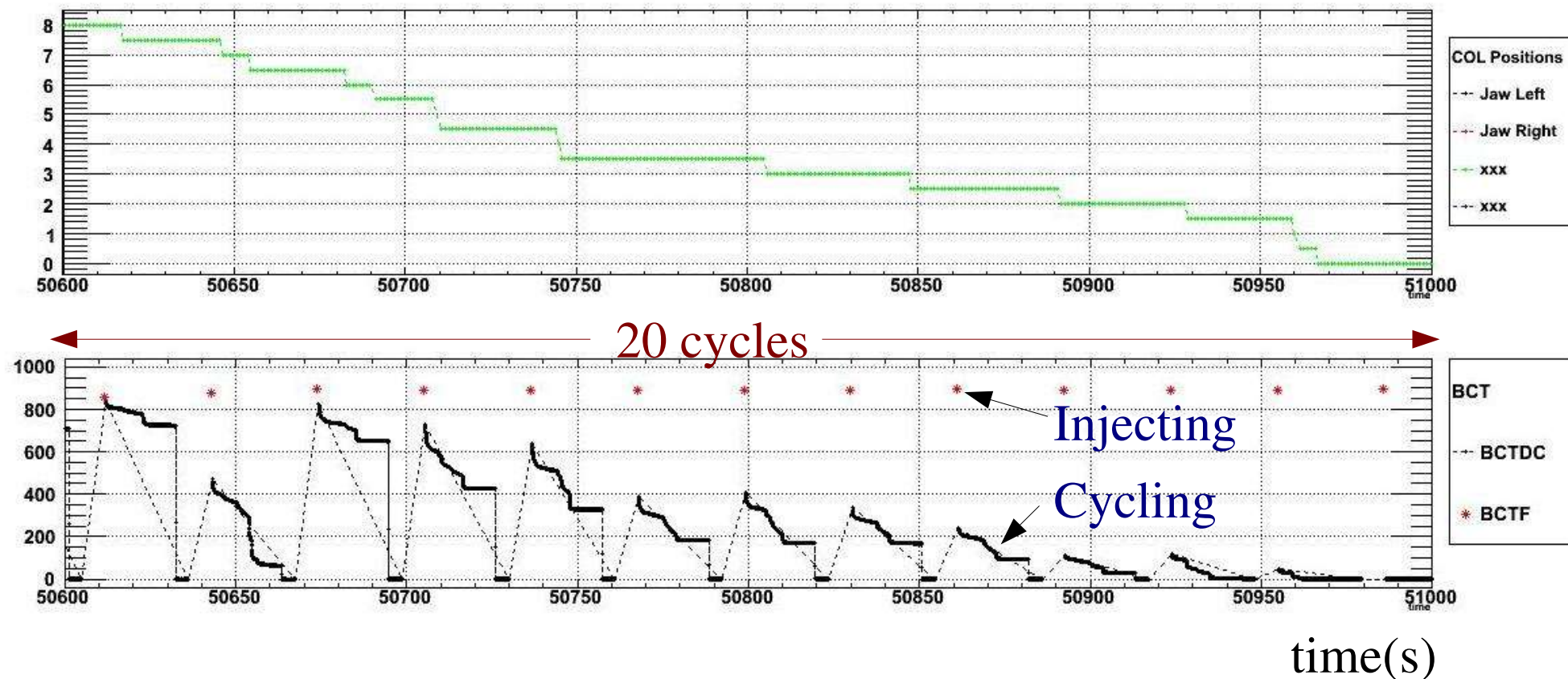
# Measurements (MD45, MD46)

08/11/07

12/11/07

- Until now: 2 Session à 1h
- $0.9 - 1.3 \times 10^{13}$  protons @ 26 GeV, Type: LHC25NS&FT, cycling beam
- Measurements done for varying collimator positions
- Acquisition of: beam current and BLM response

part. $\times 10^{10}$  | Collimator Jaw Pos.(mm)





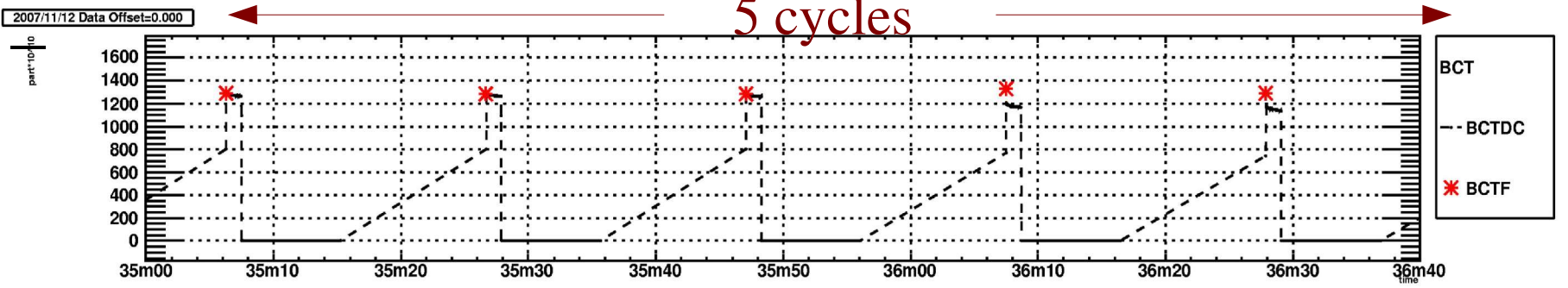
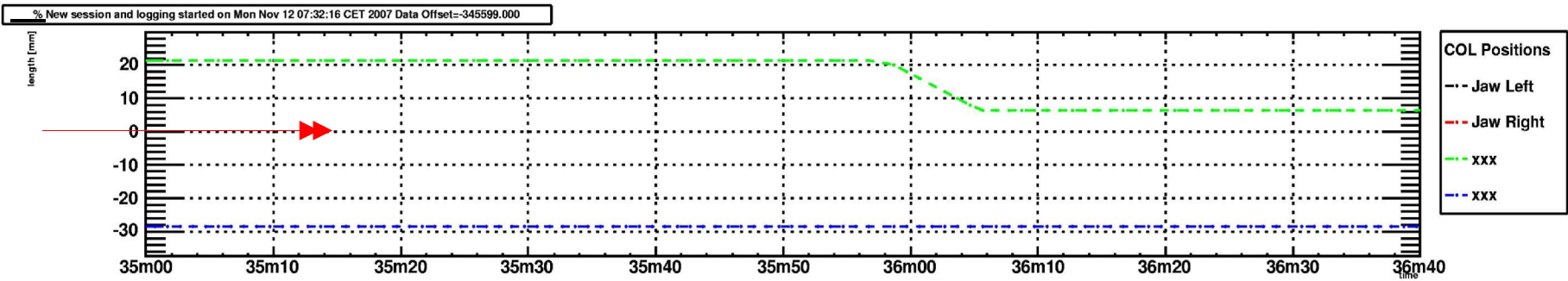
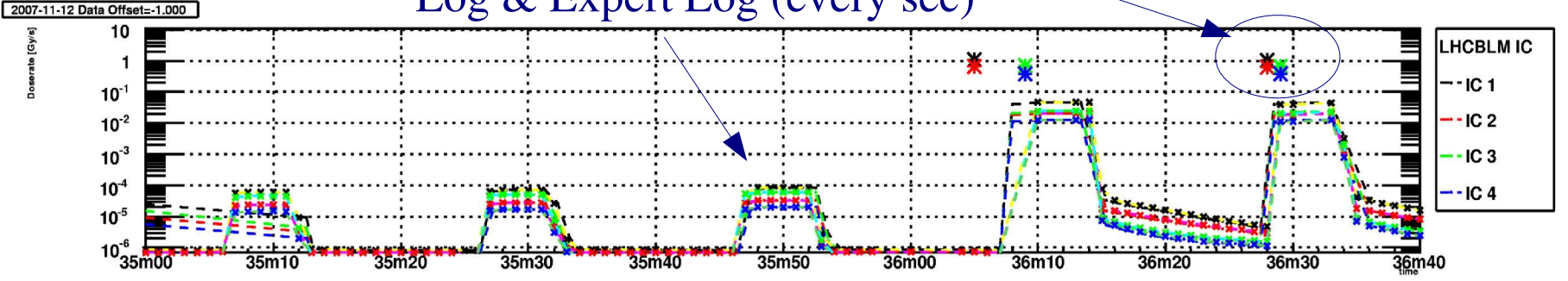


# Measurements (MD45, MD46)

Log & Expert Log (every sec)

Postmortem 1.7s

Part. x 10<sup>10</sup> | Jaw Pos. (mm) | Doserate (Gy/s)



time(s)

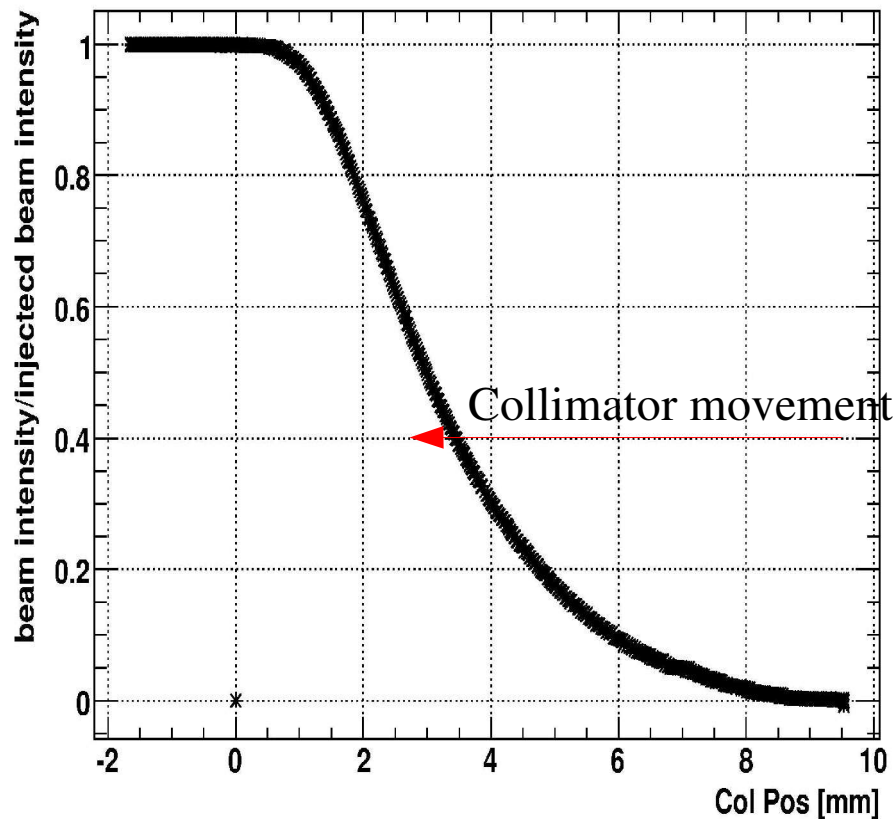


# Data Analysis

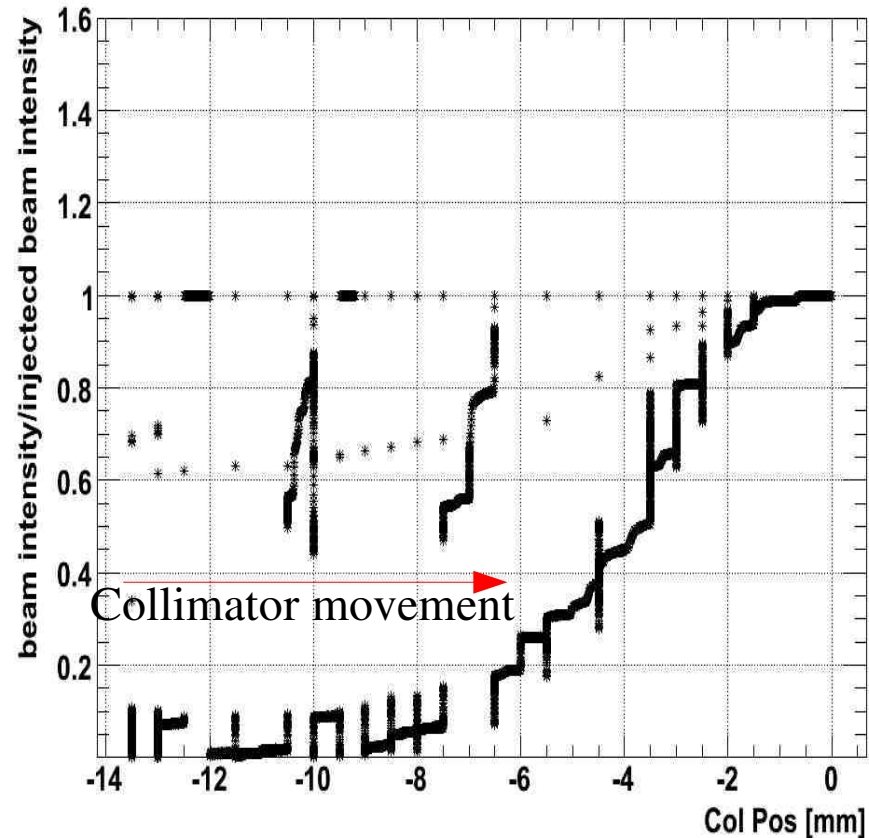


- Calibration of the impact parameter
- Fitted to Gaussian distribution to get beam size and position

Beam Lost Scraping with Collimator Jaw



Beam Lost in Left Collimator Jaw MD45



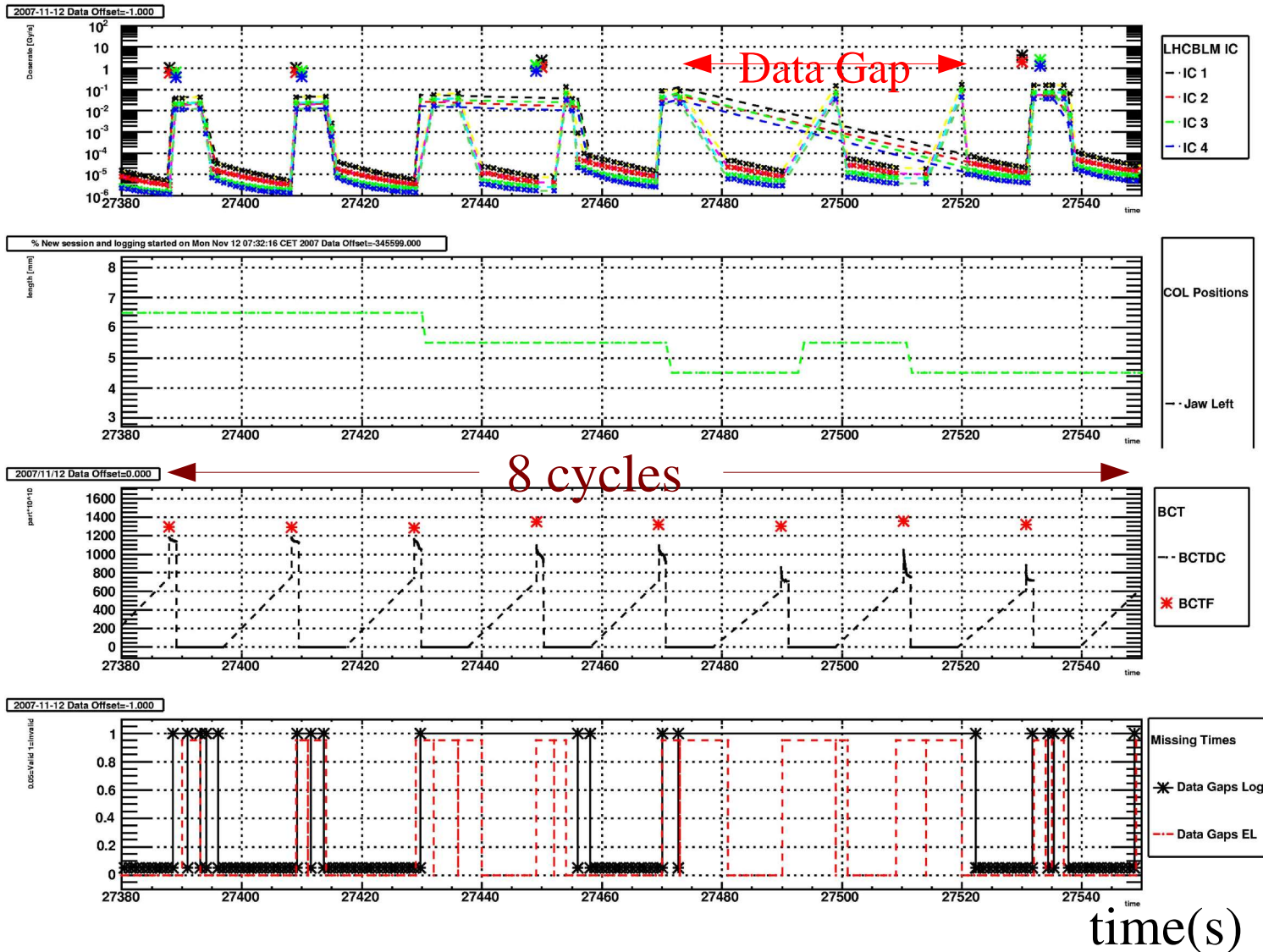
Collimator Offset:  $\sim 1.5$  &  $\sim 3.5$  mm (precision: 0.5)

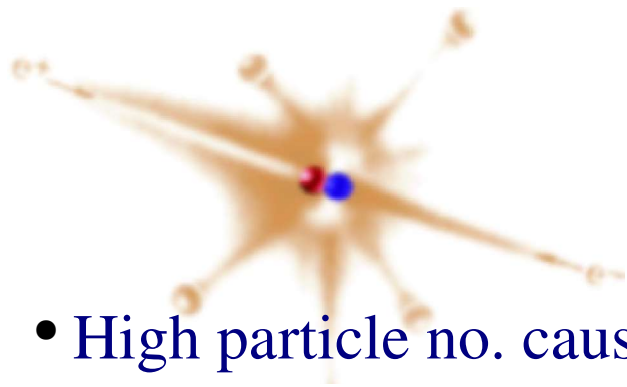


# Trouble

- Missing BLM data (single threaded front-end CPU => only one data set at a time, MD was dedicated to triggering)

Missing | Part.x10^10 | Jaw Pos.(mm) | Doserate(Gy/s)  
Data |



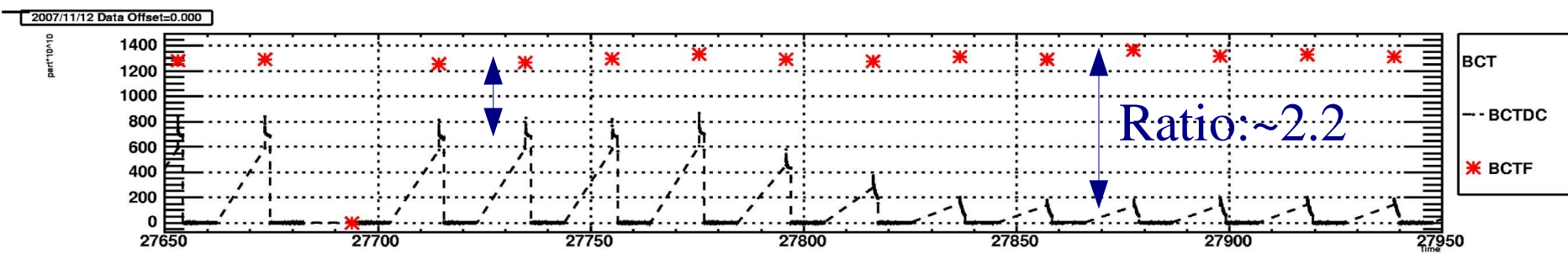
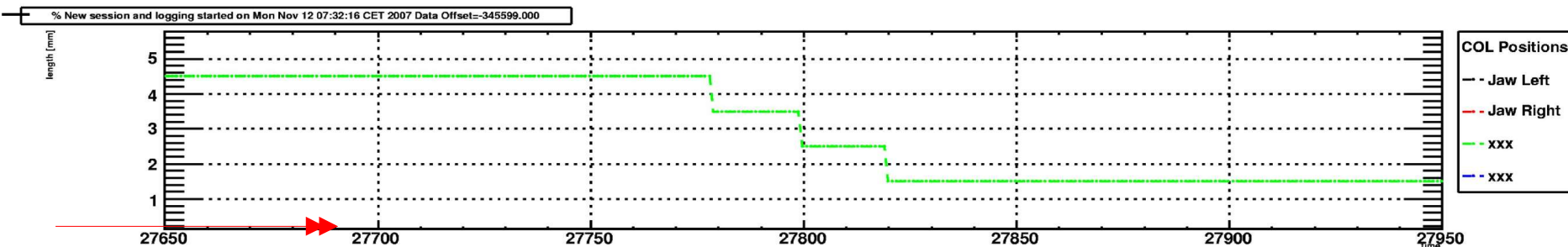
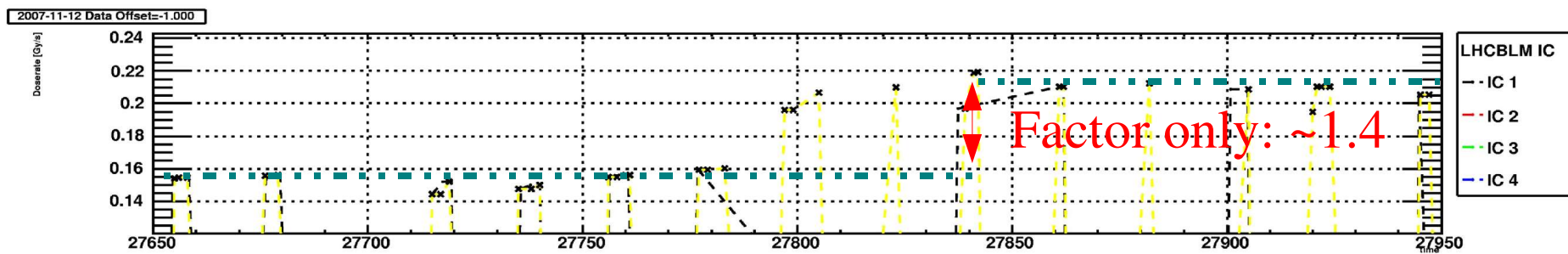


# More Trouble



- High particle no. caused saturation of BLMs at small impact parameters

Part.  $\times 10^{10}$  | Jaw Pos.(mm) | Doserate(Gy/s)



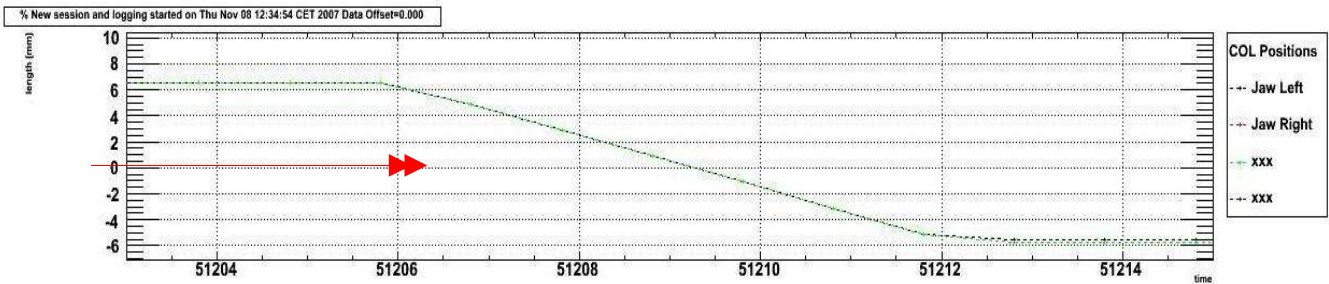
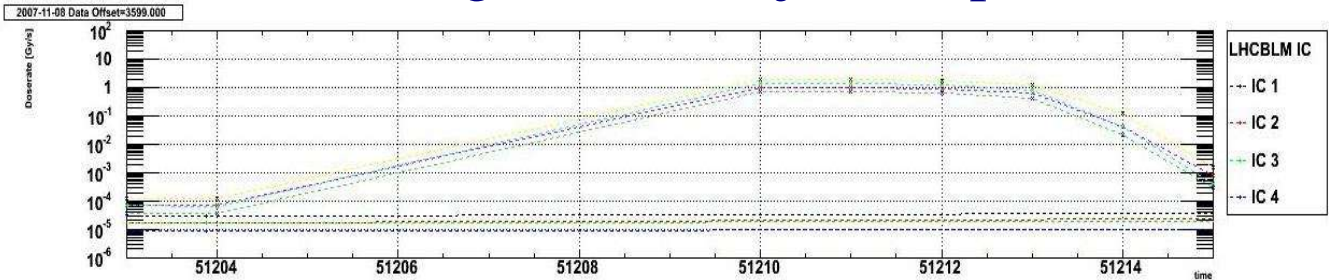
time(s)

- More measurements for statistics needed

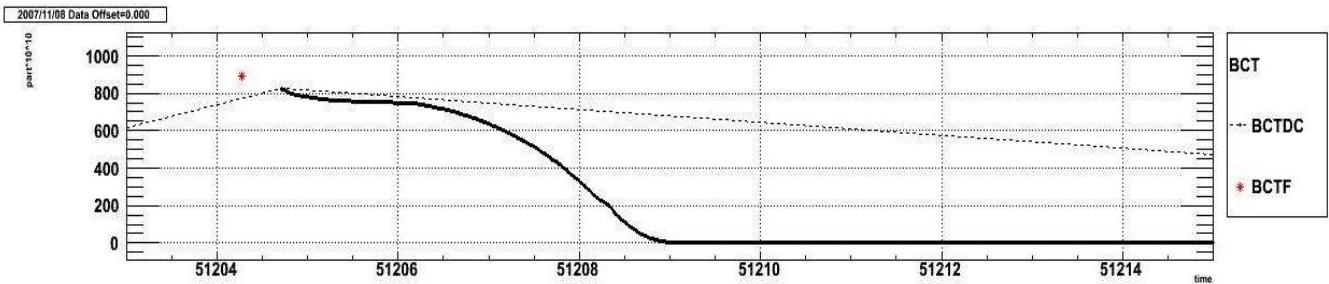


# Preliminary Results

- Total loss: killing beam at injection plateau with collimator



Jaw speed ~ 4mm/s



But: Just 2 experimental values!

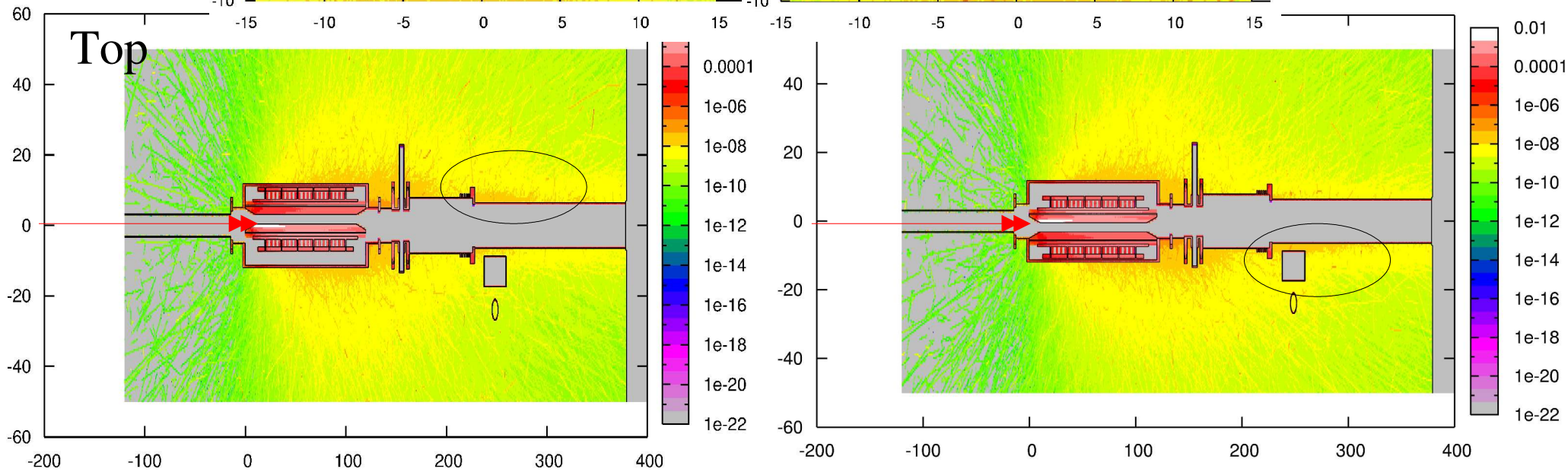
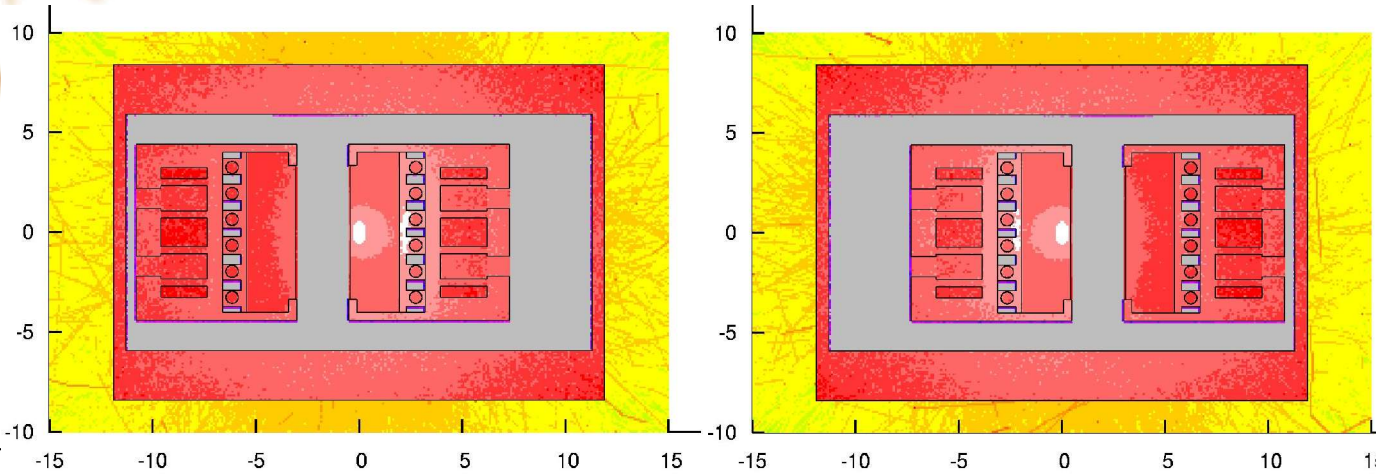
BLM IC Response

- Exp.: L  $3.24 \pm 0.25 \times 10^{-13}$  Gy/Prot. (R  $2.31 \pm 0.24$  Gy/Prot.)
- Sim.: L  $5.03 \pm 0.56 \times 10^{-13}$  Gy/Prot. (R  $3.61 \pm 0.41$  Gy/Prot.)

# Preliminary Results

Right jaw in

Left jaw in



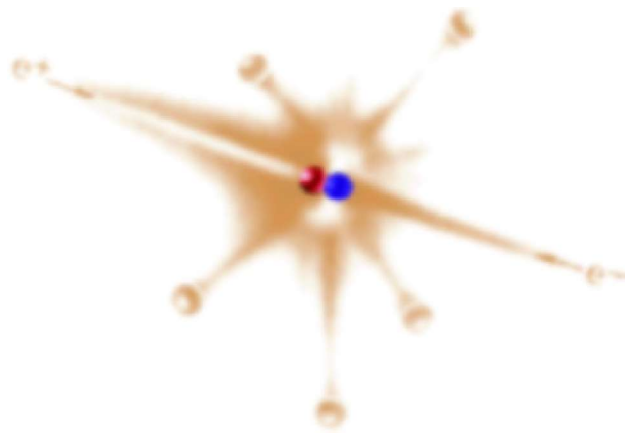
• IC signal ratio Right/Left Sim:  $0.717 \pm 0.116$  Exp:  $0.712 \pm 0.093$



# Plans for further MDs

- Lower beam intensity  $\sim 5 \times 10^9$  to  $1 \times 10^{11}$   
(no saturation @ full impact)
- Better statistics: several cycles for each collimator position
- Complete BLM data (ongoing software update (*Fesa 2.10*)=> prioritization possible)
- Data acquisition with one turn passing (direct extraction) to eliminate error sources

=> Request: Would require 2 MDs à 2-4hrs (May-June 2008)



# Request



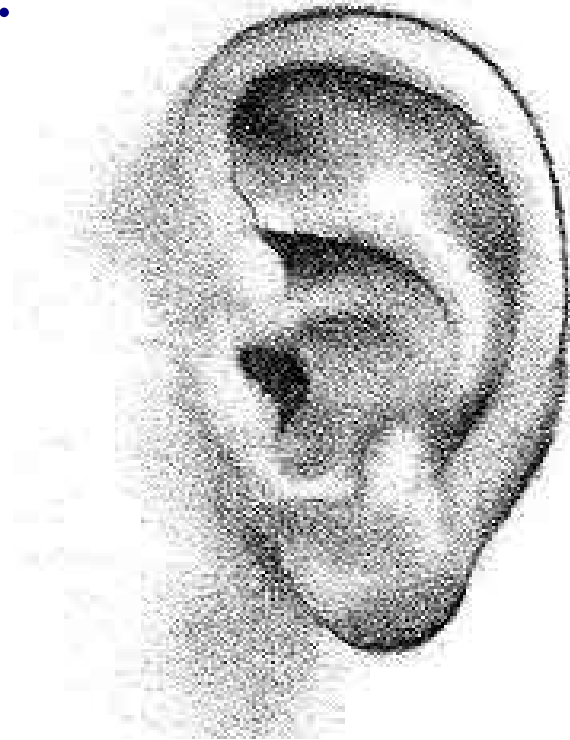
To Collimation Group:

- Damage limits in collimator for
  - fast losses and steady state losses
  - all collimator types: TCP, TCS & Absorbers
  - including energy dependency



A starburst graphic with a central blue and red dot and several orange lines radiating outwards, each ending in a small orange circle.

Thanks for ...



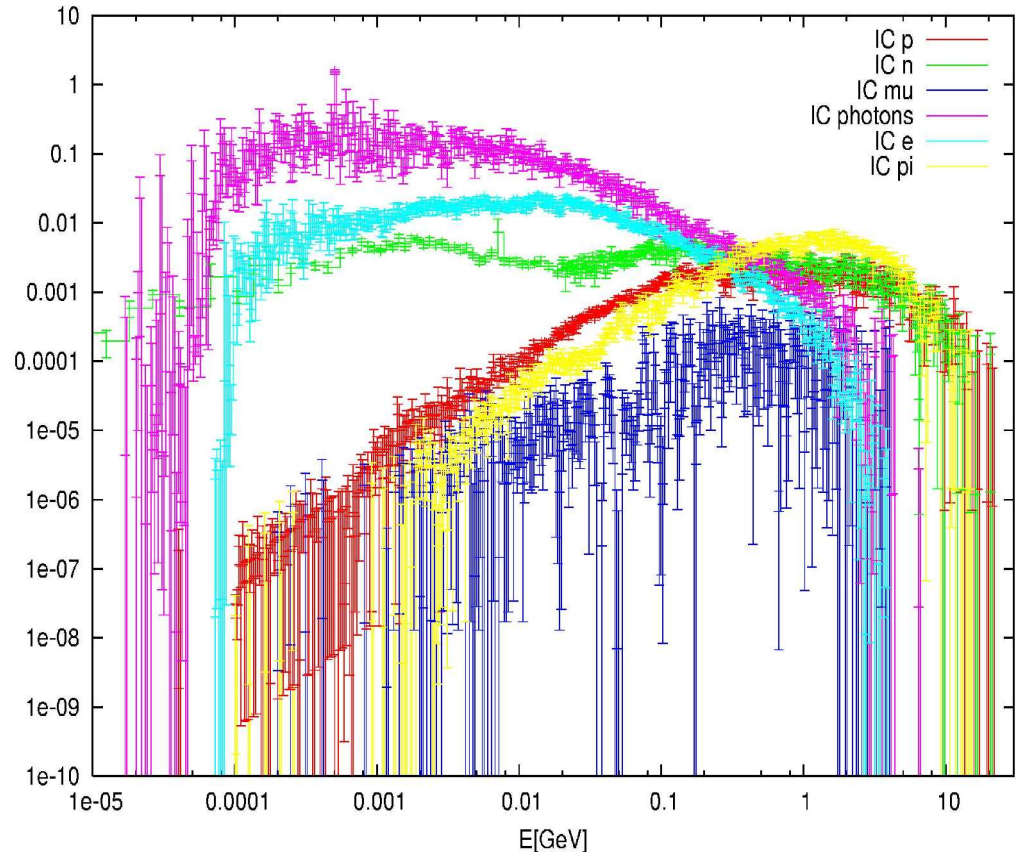
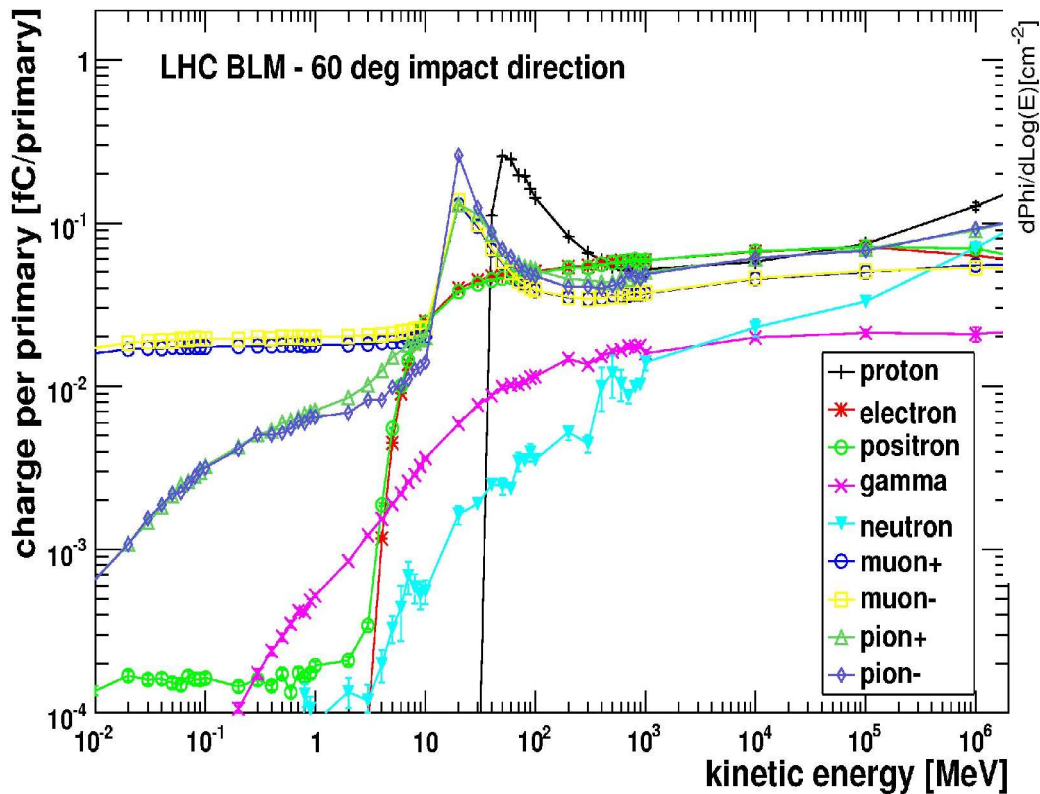
Comments and suggestions welcome!

... and thanks to the BLM Team!



# Response Curves (Add.)

## BLI1A Lethargy BLMIC1ATrFluLeth



Response Curve of LHC BLM IC, by M. Stockner