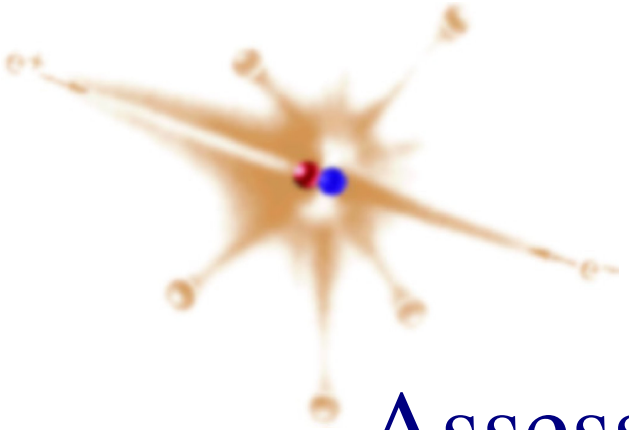
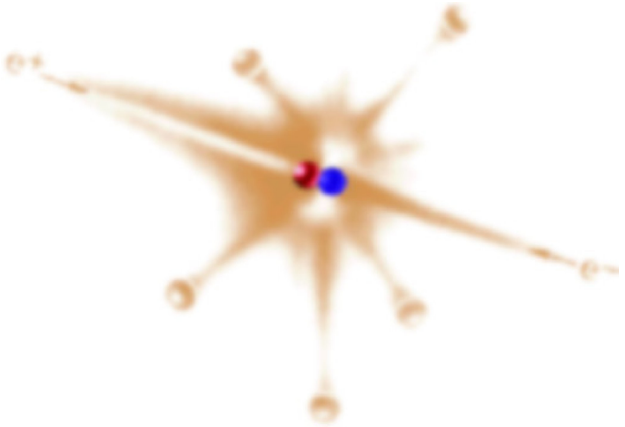


Assessment of BLM Thresholds in Collimation Regions for the LHC startup

By Till Böhlen & BLM-Team



Content

Introduction to Protection of Collimators

Approach & Work so far

Experiment @ SPS & Simulations

Simulations for LHC Setup (IR3&7)

Summary

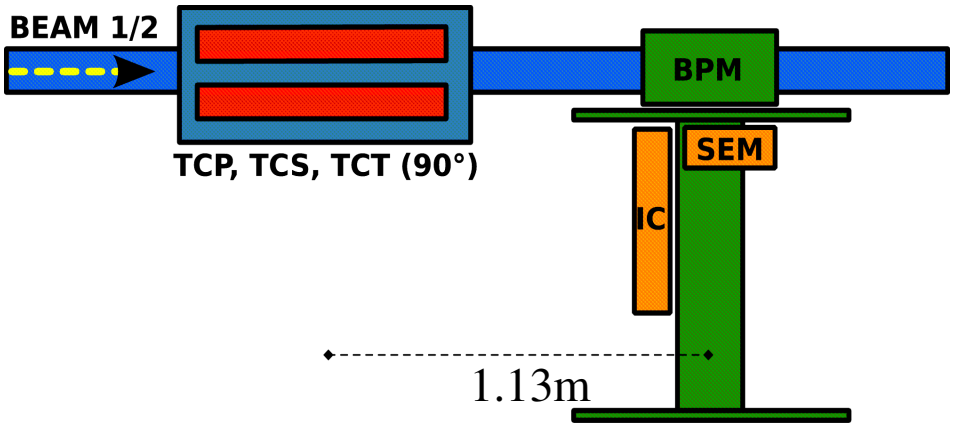
Collimator Types & Locations

Types of Collimators

	Active Jaw	Material
TCP	60cm	C-C
TCSG	100m	C-C
TCLA(TCT)	100m	W in Cu

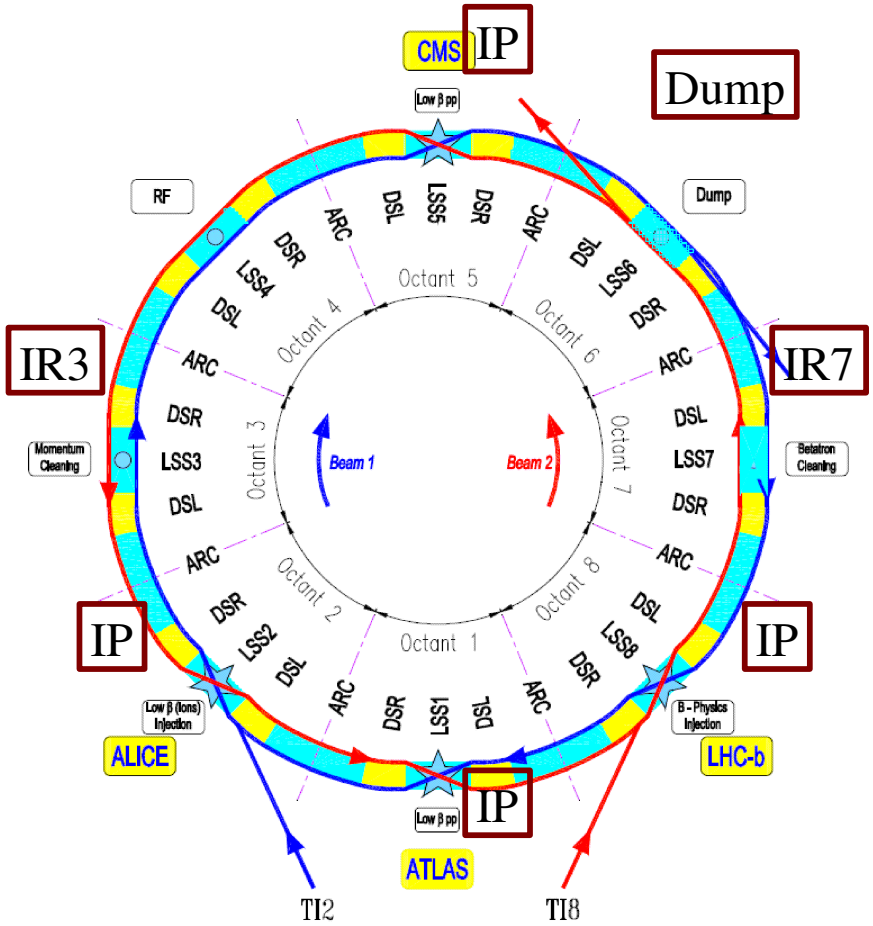
Additionally: TCSM, TCLI(C-C),TCLP(Cu), ...

Exemplary Setup



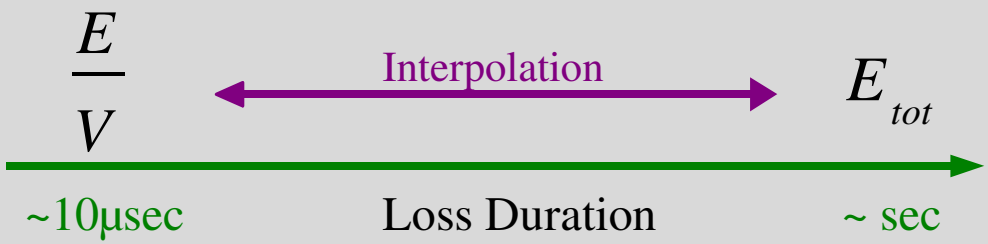
IR3 & 7

Locations



Task: Protecting Collimators

Damage & Quench Level



BLM thresholds can be set:

- for 12 loss durations
- for 32 beam energies

Collimator Damage Levels

Given by Collimation Group (R. Assmann):

	energy	steady state (t > 10s)	intermediate (10s > t > 1s)	transient (1s > t)
TCP:	7 TeV	90 kW	449 kW	?
	450GeV	87 kW	430 kW	1.1MW(only IR3)
TCSG:	7 TeV	9 kW	45kW	?
	450GeV	9 kW	43kW	110kW(only IR3)
TCLA:	7 TeV	45W	215 W	?
	450GeV	45W	225 W	550W (only IR3)

(preliminary numbers, still to be completed!)

Timeline

Past

IR7 Simulation
shower cross-talk matrices, heat in collimator jaws, ... (FLUKA,ANSYS)
M. Magistris, M. Leitner, M. Brugger et al., 2006

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

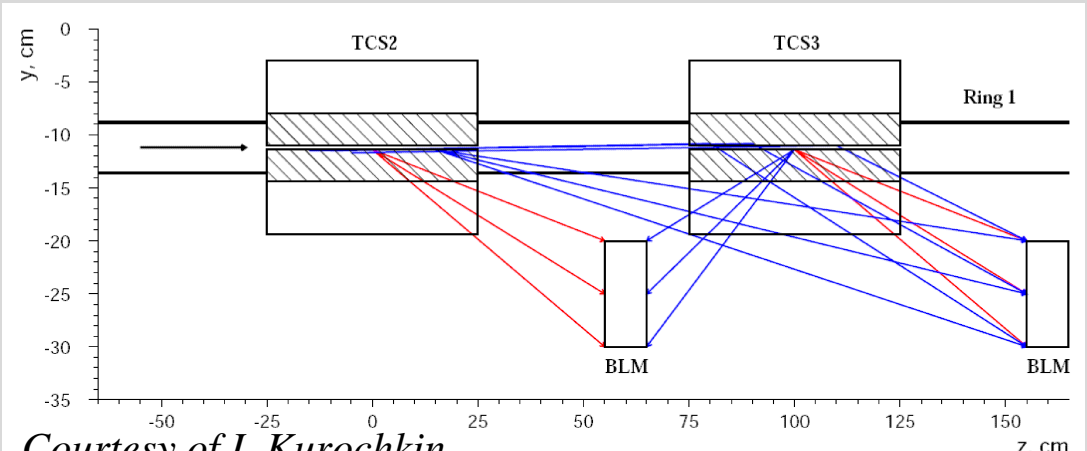
Present

Studying beam loss patterns
SPS, verification: exp. vs. sim.
LHC, relation: ED in jaws to Signal (FLUKA)
My work

Future

tbc ... FLUKA & BLM Team
updated simulations for current LHC layout
final shower cross-talks, ...

Shower Cross-Talk



Courtesy of I. Kurochkin

Our Approach

Outline

Studying the relation between energy deposition (ED) in jaws and signal of BLM detectors

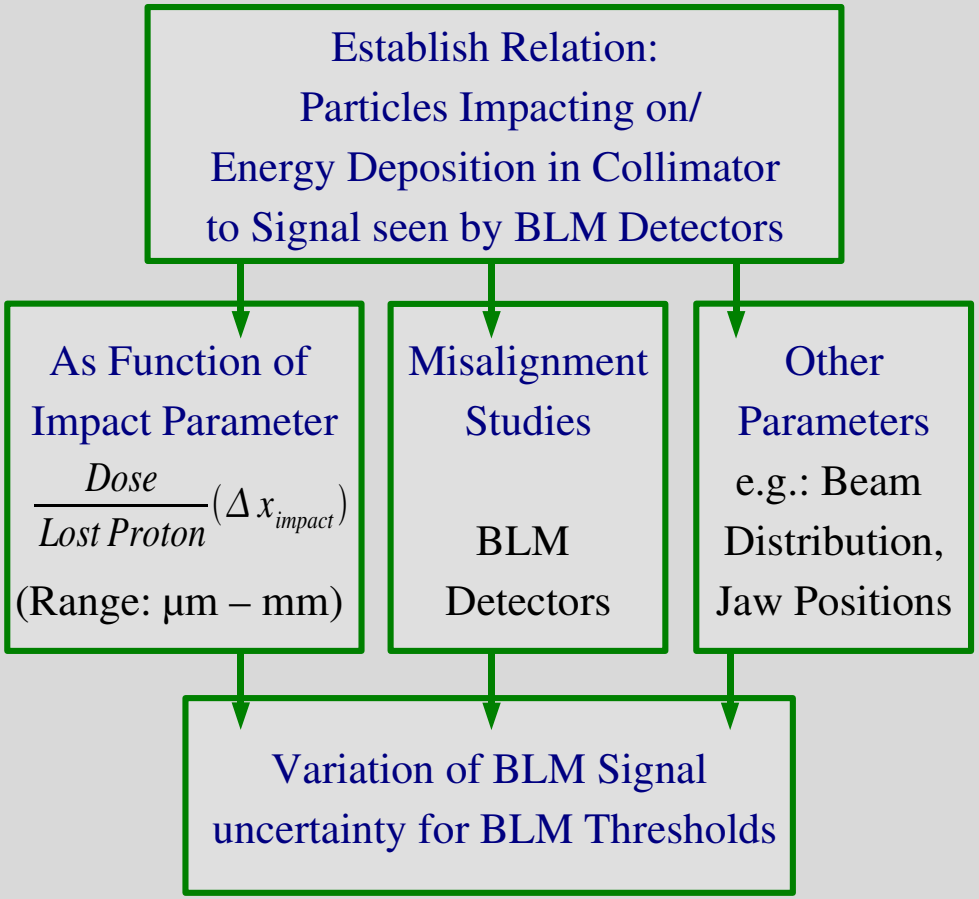
Focusing on collimation regions

- With LHC startup setup

Conservative approach

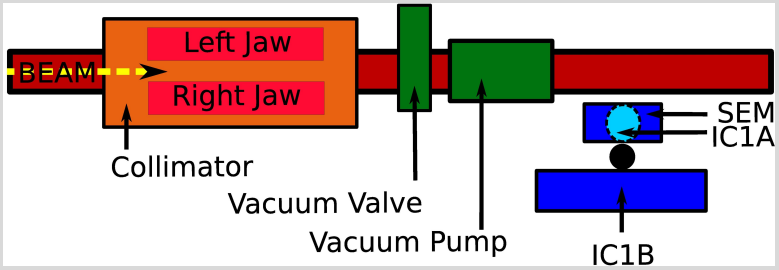
- Each collimator is protected by dedicated BLM pair (but shower cross-talks!)
- Security factor of about 10 for BLM thresholds
- Final revision: allows for efficient LHC operation? (i.e. low false dump-rate)

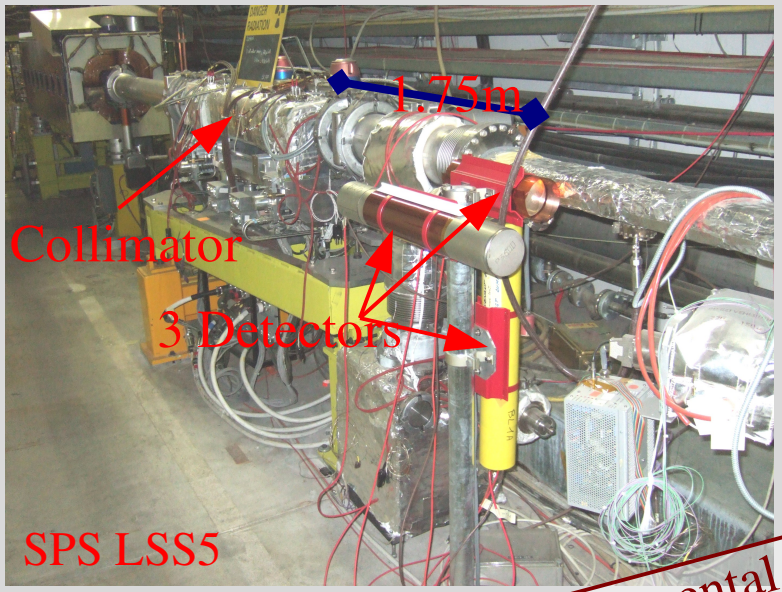
By Simulation



Losses at the LHC collimator in the SPS

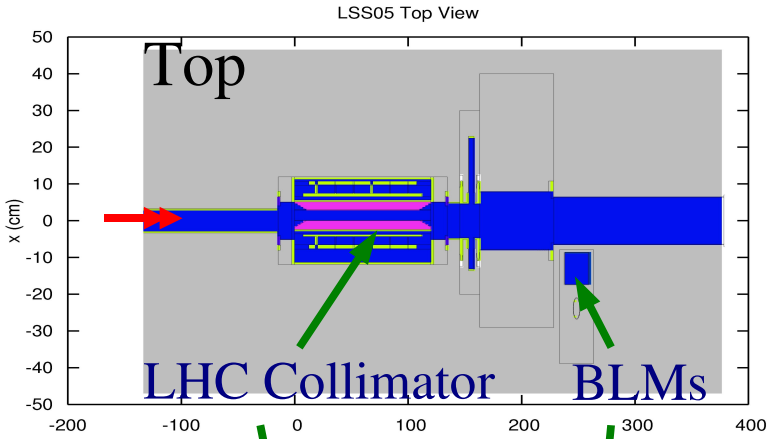
Experiment

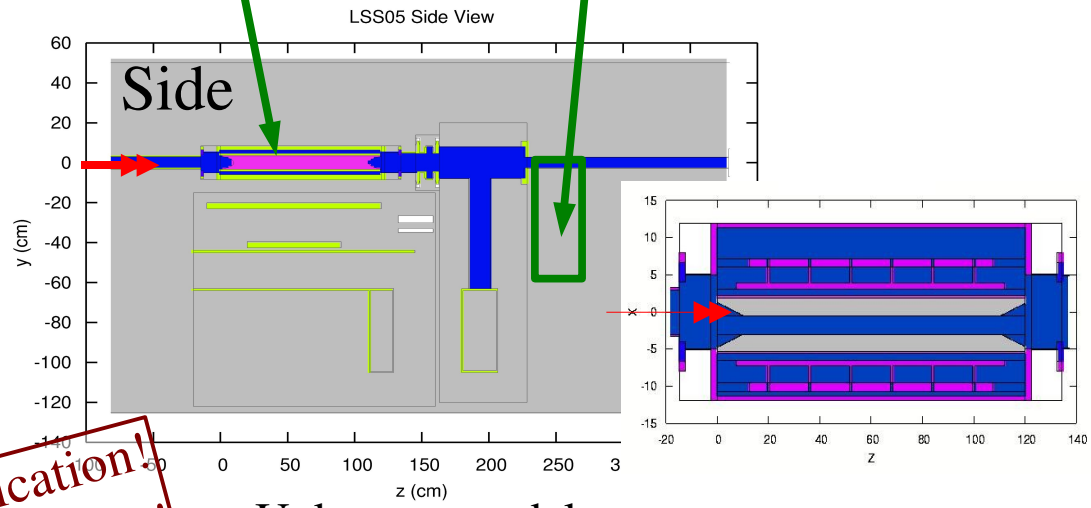




Experimental verification!
Assess Systematic Errors!

FLUKA Implementation





Focus on:
Collimator,
BLM Detectors,
Beam Tube

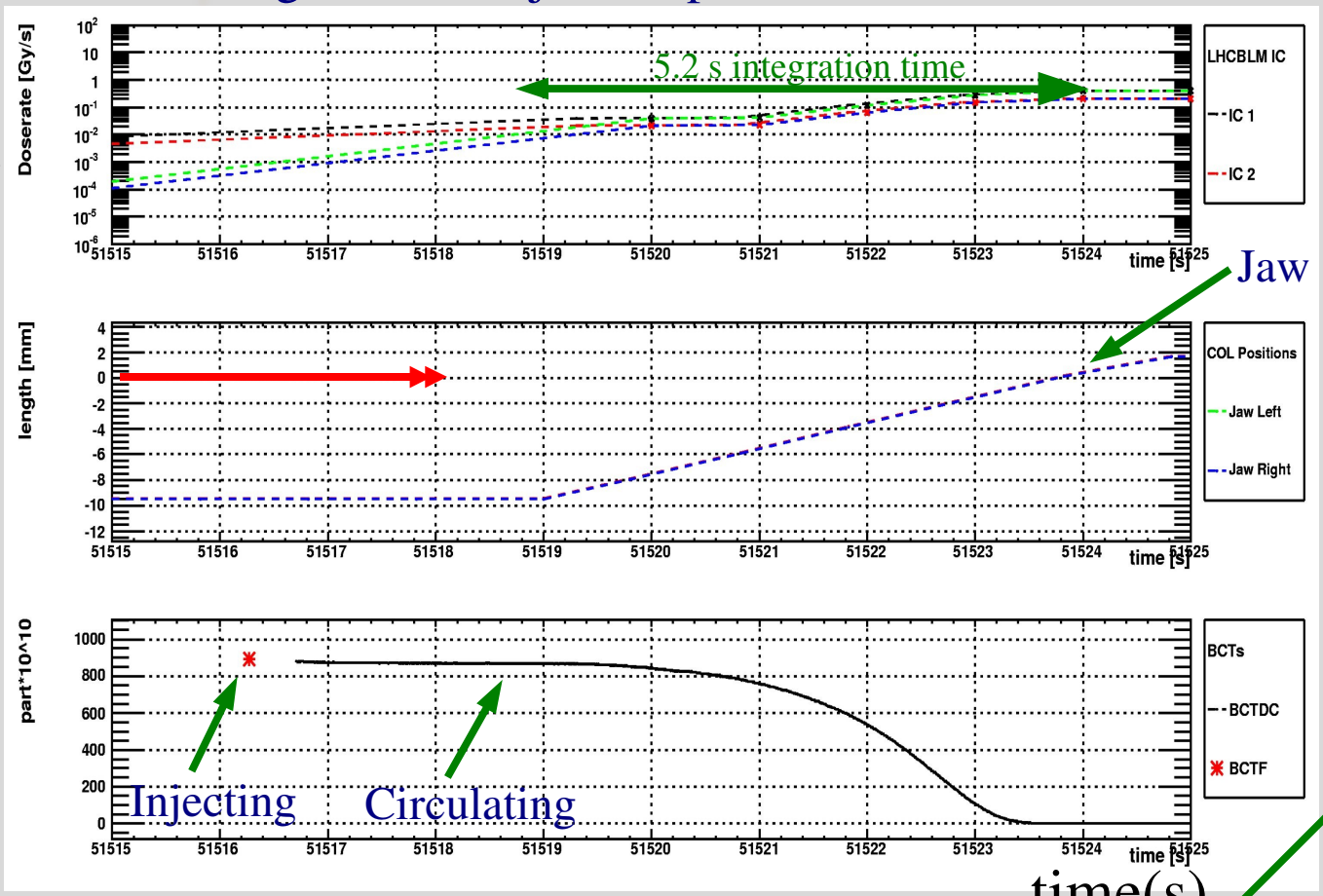
Unknown model parameters:

Errors: mostly 1-5%, all < 15%

Measurements in the SPS

Conditions: 0.9 - 1.3x10^13 protons @ 26 GeV

Total loss: killing beam at injection plateau with collimator



Jaw speed ~ 2mm/s

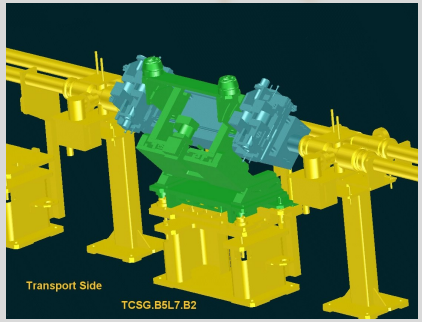
But: Just 2 experimental values!

BLM IC Response
(Data from BLM IC1A)

Exp.: L 3.24±0.25x10^{-13} Gy/Prot. (R 2.31±0.24x10^{-13}Gy/Prot.)

Sim.: L 3.30±0.17x10^{-13} Gy/Prot. (R 2.42±0.10x10^{-13}Gy/Prot.)

Simulations for LHC Setup

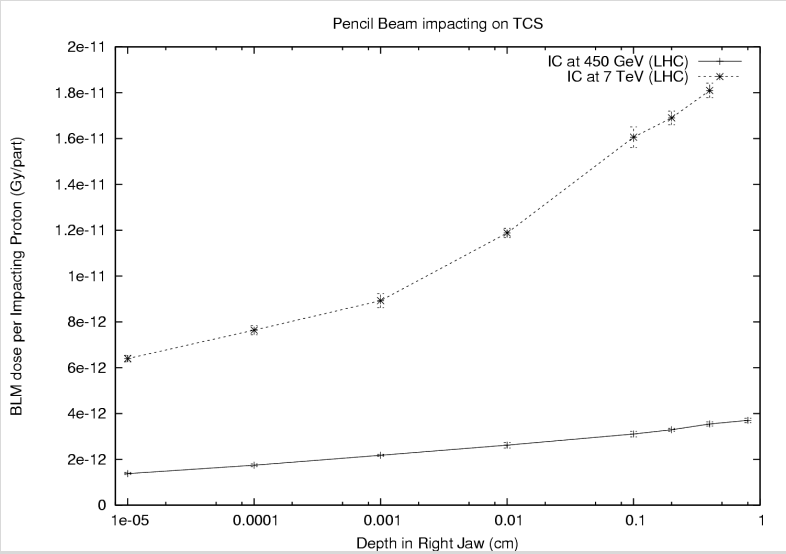


- Fluencies in detectors similar to SPS setup

  Computation of:
  - Detector response/primary on collimator
  - Detector response/total energy deposition (ED) in collimator jaw
  - Detector response/maximal ED in collimator jaw

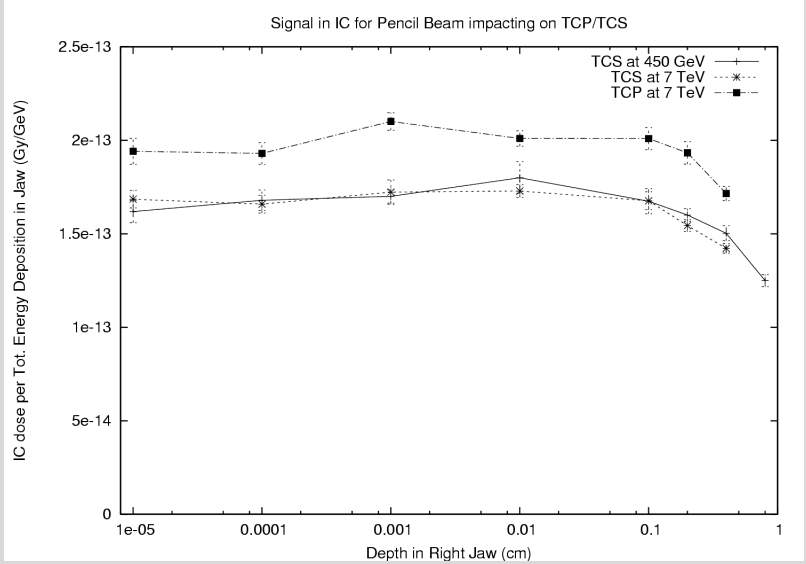
Preliminary Results

Dose per Proton (Gy/part)



Depth in right jaw (cm)

Dose per Tot. ED (Gy/GeV in Jaw)



Depth in right jaw (cm)

- Example for critical failure: IC signal/Max. ED = $1.94 \pm 0.13 \times 10^{-14}$ Gy*cm^3/GeV
- Detector response to total ED by ~50% lower for secondary shower compared to beam protons!

Summary

Implementation of experimental setup in SPS

- First comparisons between meas. and sim. => agreement within 5%
- More measurements hopefully in this month!
- Final determined discrepancy of meas.-model as systematic uncertainty for assessment of LHC BLM detector thresholds by simulations

Ongoing implementation and computation for LHC setup by BLM & FLUKA team

- Assessing BLM detector threshold values based on damage limits for collimators

Conservative approach for assessment of BLM thresholds

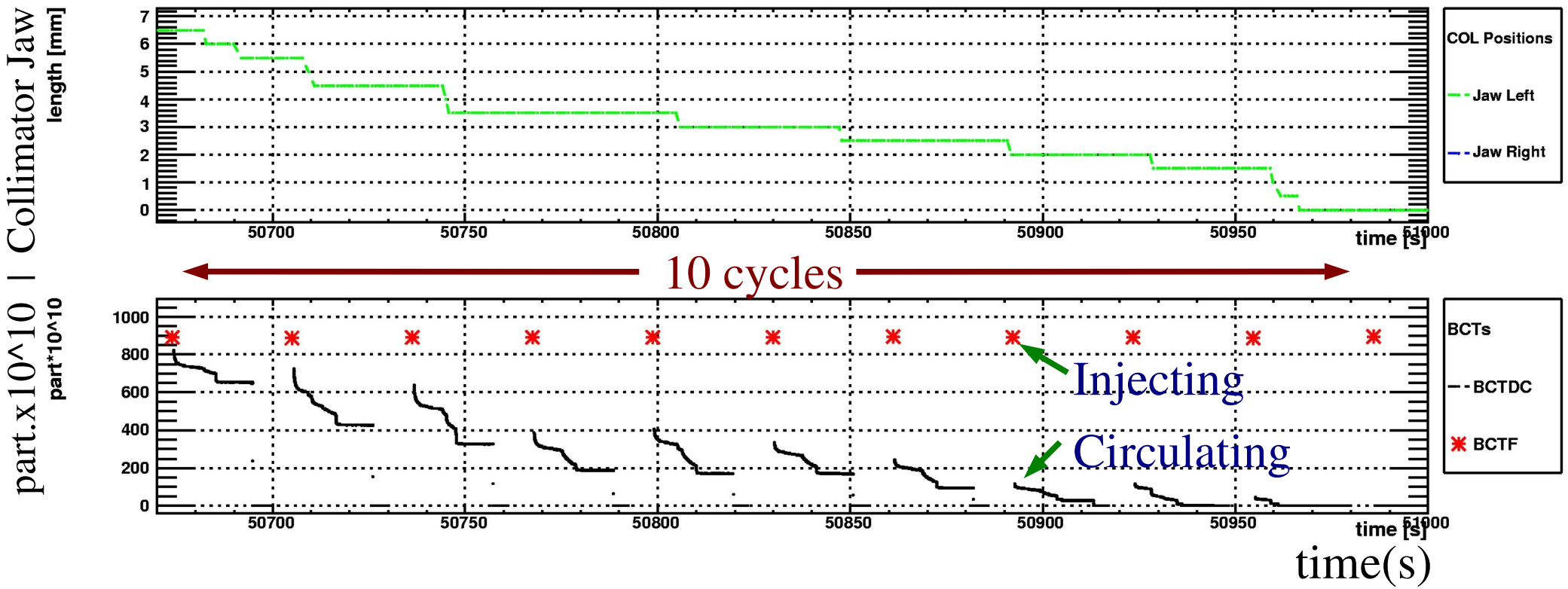
- Not considering shower cross-talks
- Security margin of 10

Thanks for attentive ...

Comments and questions welcome!

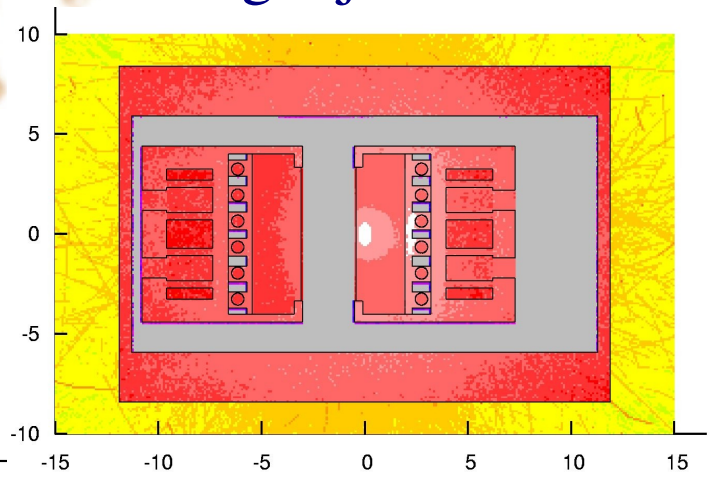
Measurement Conditions (Add.)

- Until now: 2 Session à 1h 08/11/07 12/11/07
- 0.9 - 1.3x10^13 protons @ 26 GeV, Type: LHC25NS&FT, cycling mode
- Measurements done for varying collimator positions
- Acquisition of: beam current and BLM detector response
- Wire scanner meas. for beam width => beam width at collimator

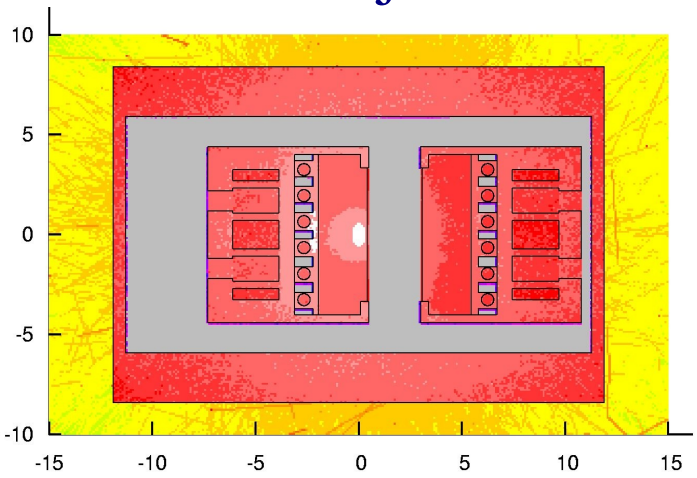


Preliminary Results (Add.)

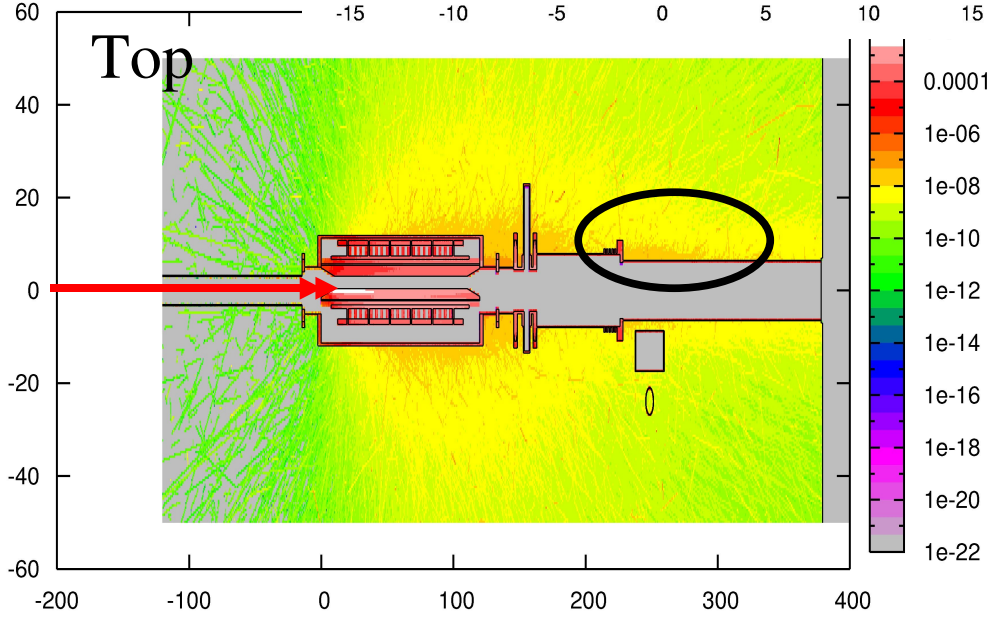
Right jaw in

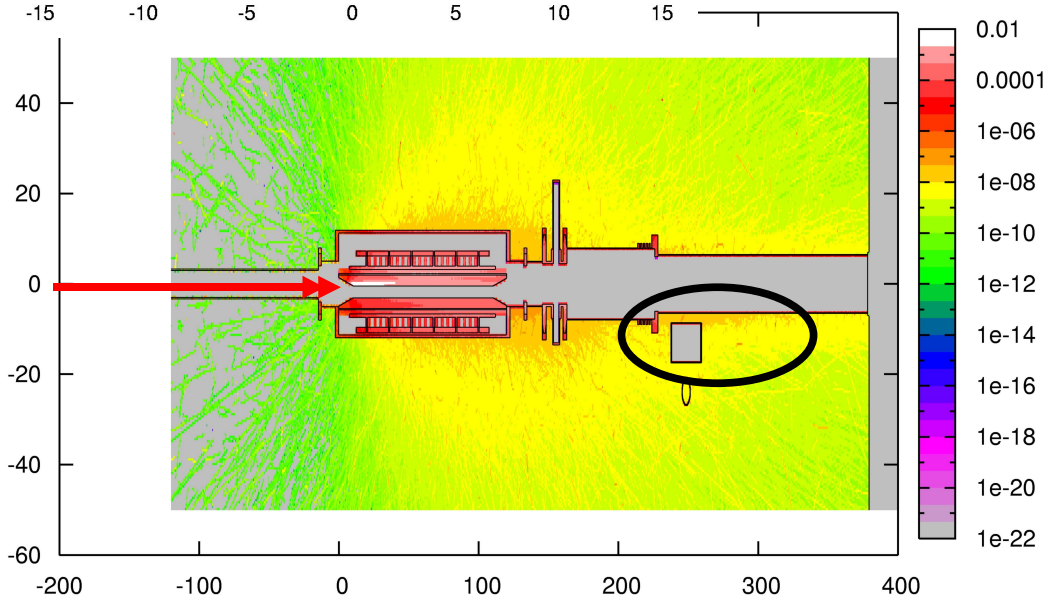


Left jaw in



Top





- IC signal ratio Right/Left Sim: 0.73±0.05 Exp: 0.71±0.09