

LHC COLLIMATION WORKING GROUP

9 May 2005

ENERGY DEPOSITION IN SC-LINK AND FIBERS OF THE MOMENTUM CLEANING INSERTION

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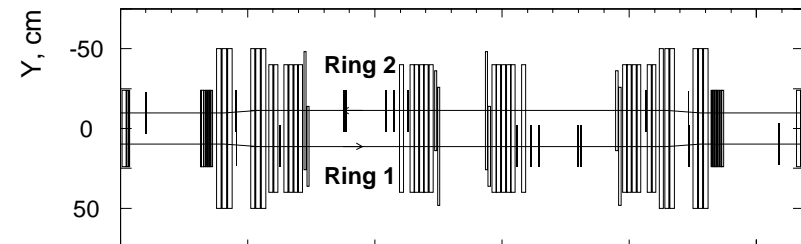
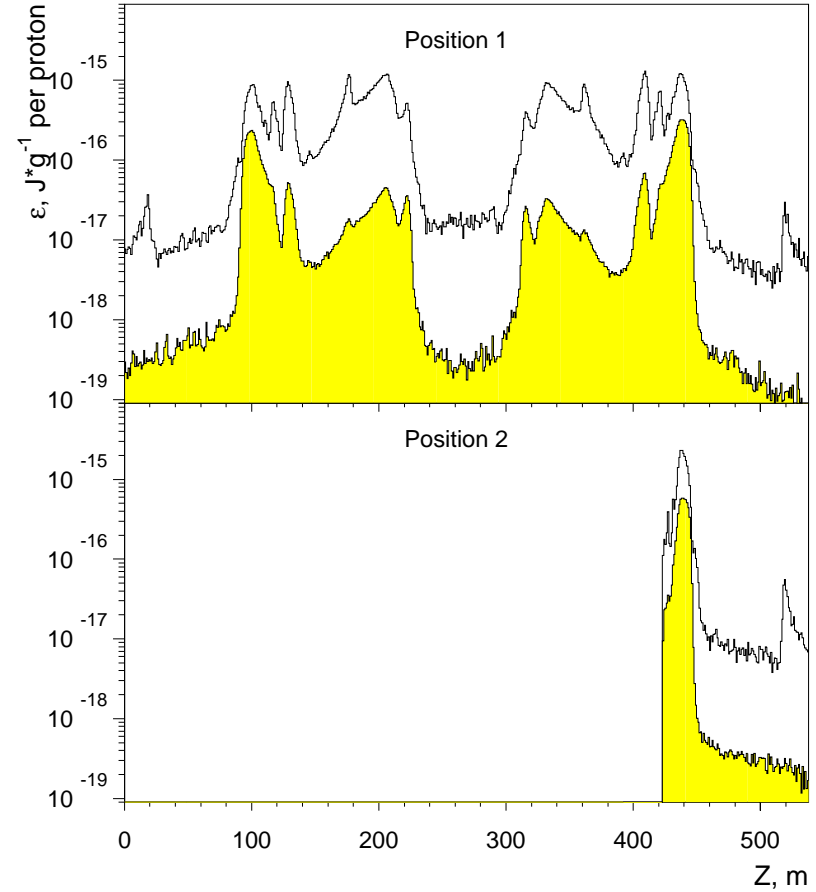
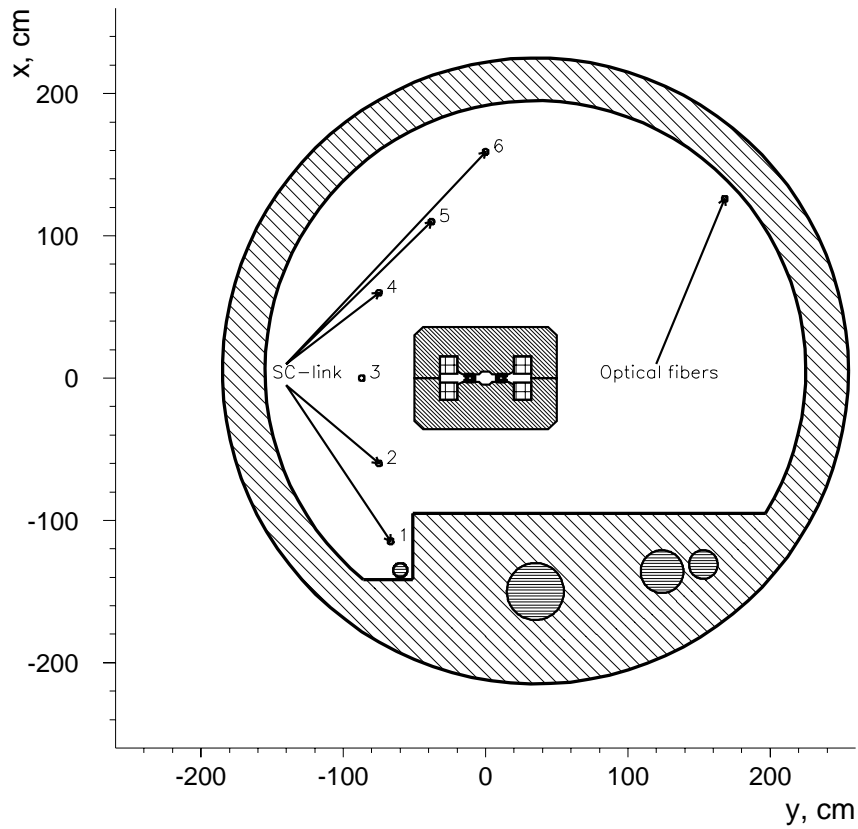
Simulation details

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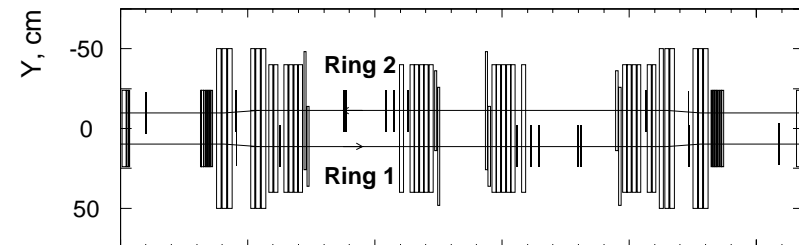
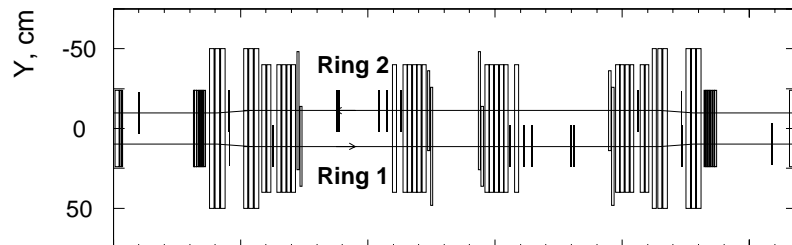
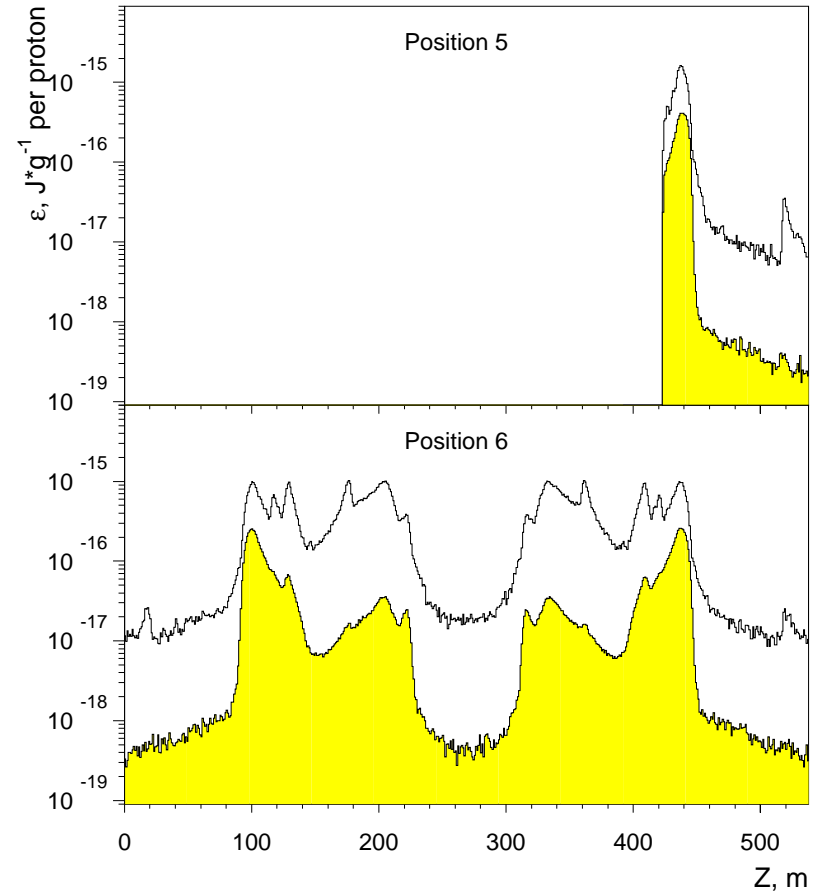
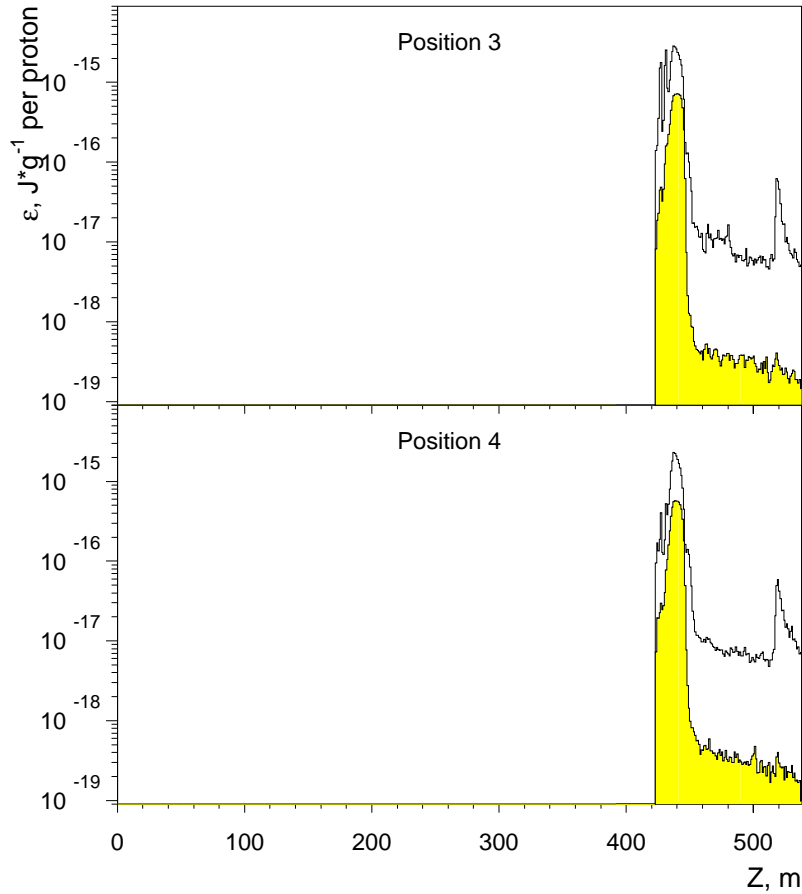
- **STRUCT** code is used to prepare a map of primary inelastic interactions in the collimator jaws (900000 protons)
- Hadron and electromagnetic cascades development is simulated using the Monte-Carlo code **MARS**.
- The geometry starts at the end of DS.3L and ends up at the entrance of the DS.3R.
- Dipole fields and quad gradients in the apertures of D3, D4, Q4, Q5, Q6 and Q7, magnetic lengths of their modules and the drift spaces between the module in a full accordance with the optics version 6.5.
- Active(TCL) and passive absorbers are included in considered model
- An individual cascade starts from the inelastic nuclear interaction of a proton inside one of the collimator jaws.

Energy deposition density in SC-link

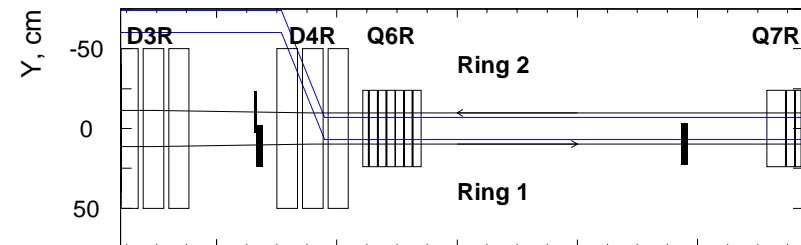
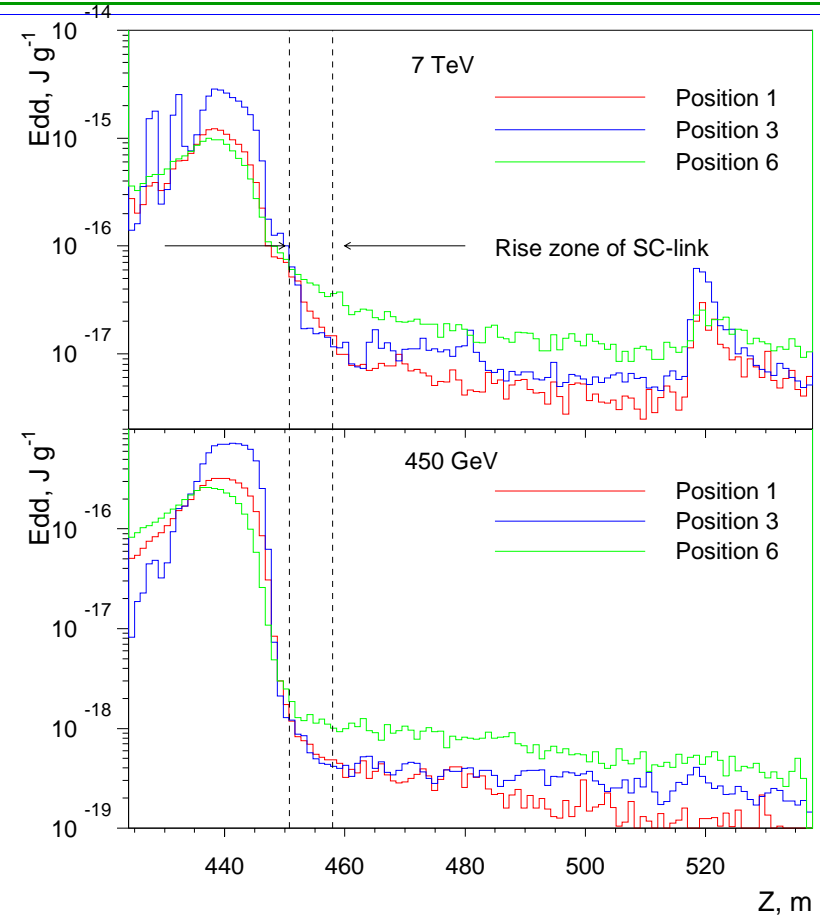
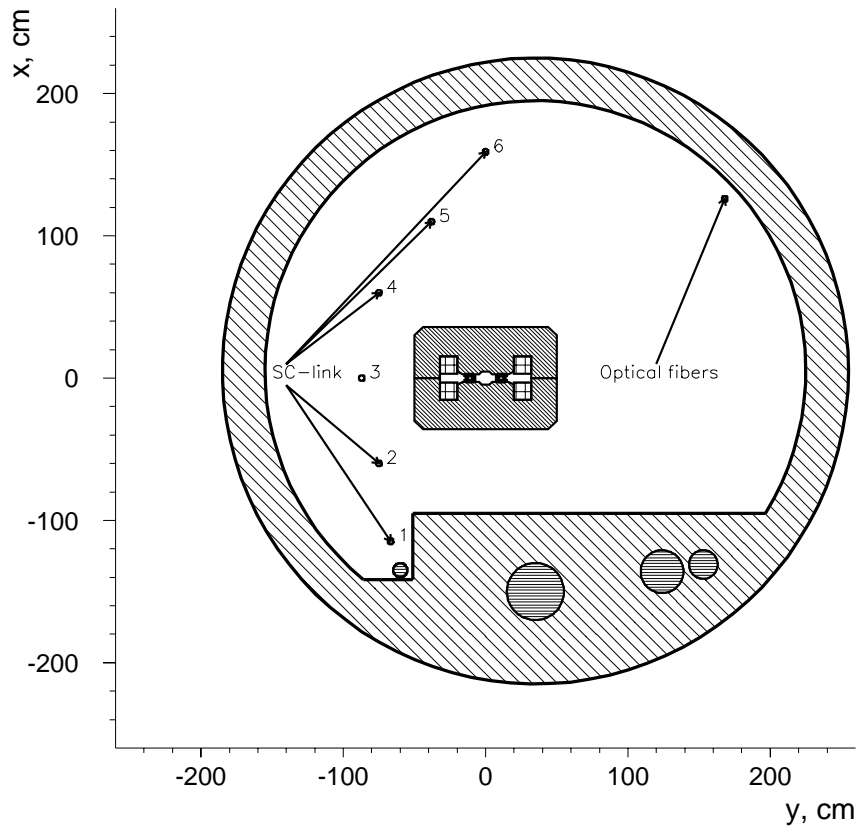
SC-link position in tunnel



Energy deposition density in SC-link



Energy deposition density in SC-link





Some estimations: top energy

- $R_{loss} = 4.3 \cdot 10^{11}$ p/s (0.2 h)
- $R_{loss} = 0.8 \cdot 10^{11}$ p/s (1.0 h)
- Maximal Power dissipated in SC-link (position 1)

τ , h	0.2	1.0	10.0	30.0	100.0
PDD, $\text{mW} \cdot \text{cm}^{-3}$	4.2	0.8	0.08	0.03	0.008

- Power dissipated in SC-link (position 6, beginning of rise)

τ , h	0.2	1.0	10.0	30.0	100.0
PDD, $\text{mW} \cdot \text{cm}^{-3}$	0.35	0.06	0.006	0.002	0.0006

- Power dissipated in SC-link (position 6, end of rise)

τ , h	0.2	1.0	10.0	30.0	100.0
PDD, $\text{mW} \cdot \text{cm}^{-3}$	0.14	0.03	0.003	0.001	0.0003



Some estimations: injection

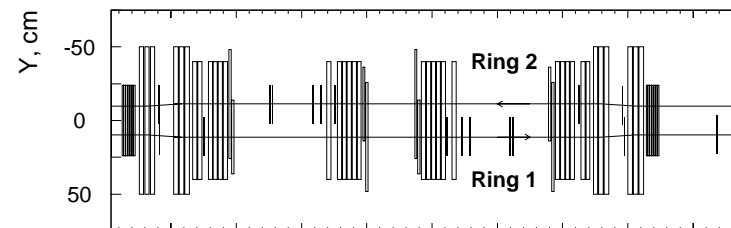
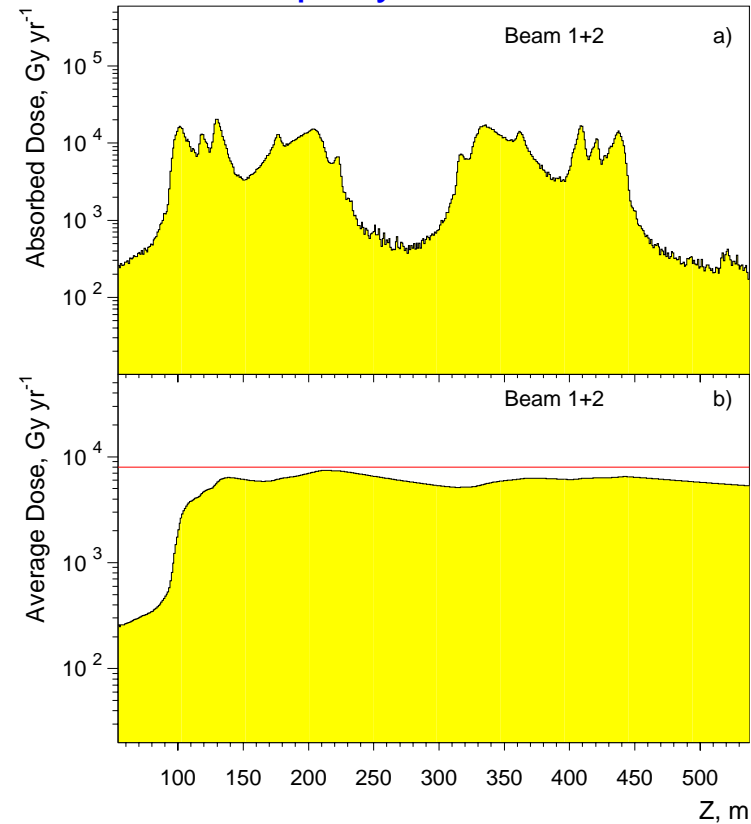
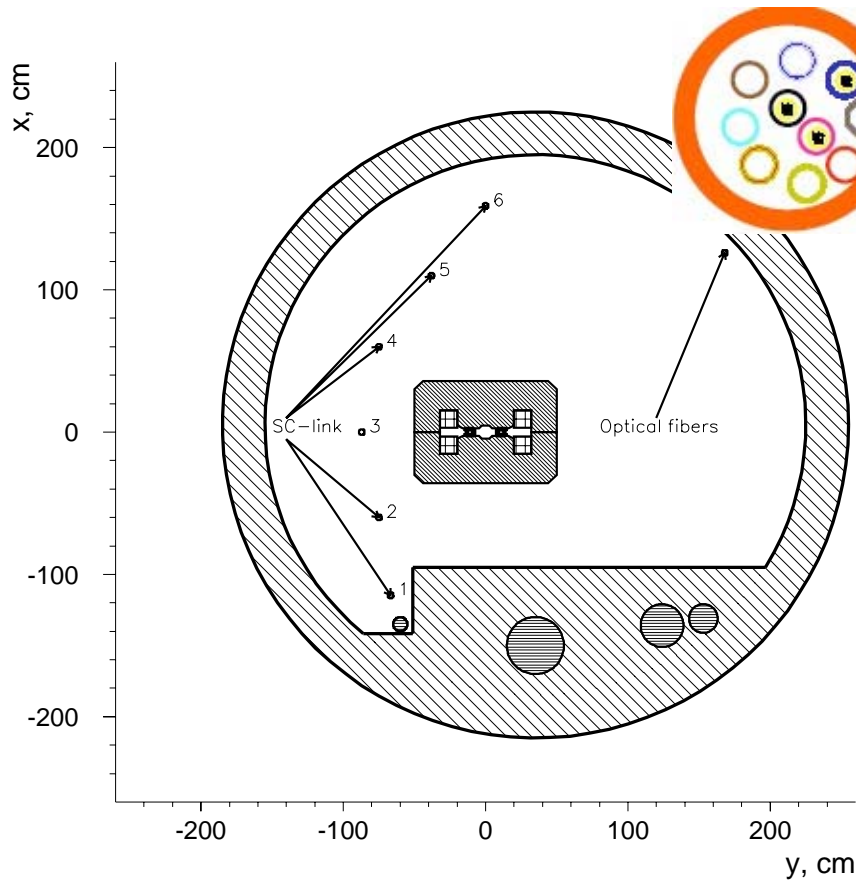
- 5 % of injected protons will lie outside their RF bucket at the beginning of the ramp of acceleration
- $N_b = 1.15 \cdot 10^{11}$ protons per bunch
- $n_b = 2808$ bunches
- for $T \sim 1$ s, $R_{loss} = 1.6 \cdot 10^{13}$ p

Position	1	6 (beginning of rise)	6 (end of rise)
EDD, $\text{mJ} \cdot \text{cm}^{-3}$	43.0	0.38	0.13

Absorbed dose to fibers

\emptyset 40 mm duct with 10 x \emptyset 7 mm tubes,
10 x 24 = 240 optical fibers

Absorbed dose is normalized to 10^{16} inelastic
proton interactions per year





Summary

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- Peaks of PDD in SC-link reach values of $4.2 \text{ mW}\cdot\text{cm}^{-3}$ (position 1) at top energy
- PDD don't exceed values of $0.35 \text{ mW}\cdot\text{cm}^{-3}$ (position 6) in the rise zone of SC-link
- In the case of injection EDD reach values of $43 \text{ mJ}\cdot\text{cm}^{-3}$ (position 1), in the rise zone maximal EDD is less on two orders than peaks in position 1
- High level of average dose to fibers along IR3 (about 8 KGy per year assuming that 10^{16} protons per year will be lost in each ring).