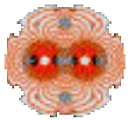
69th Meeting
of the
LHC Collimation Working Group

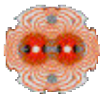


May 8th, 2006

FLUKA Simulations of TCDQ halo loads

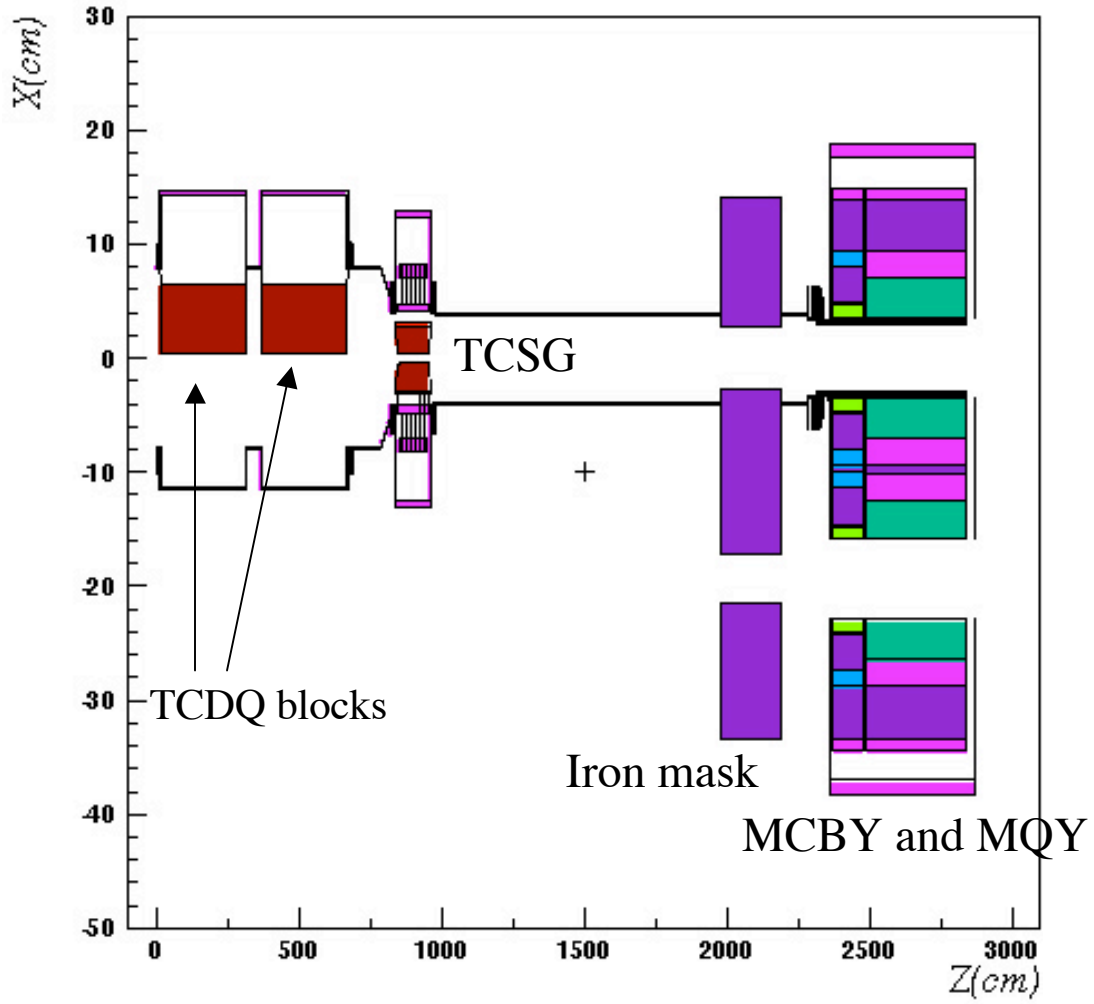
L. Sarchiapone, A. Ferrari, V. Vlachoudis

Summary



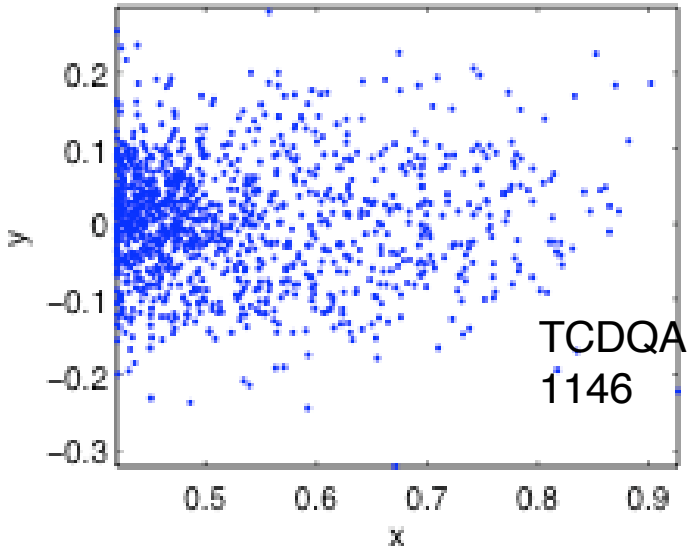
- Energy deposition on LHC dumping system elements, beam 2, Low β
- Peak energy and quench limits in quadrupole (MQY) and corrector dipole (MCBY)
- Magnetic field modulation in the MCBY

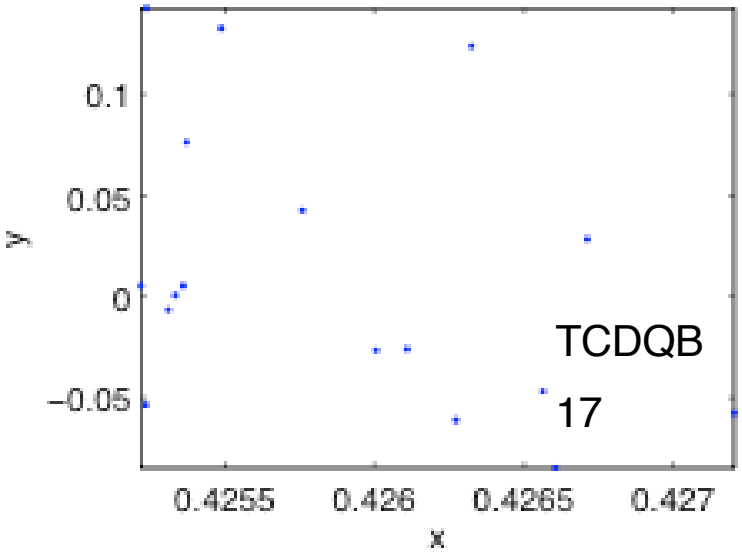
Geometry used for simulations

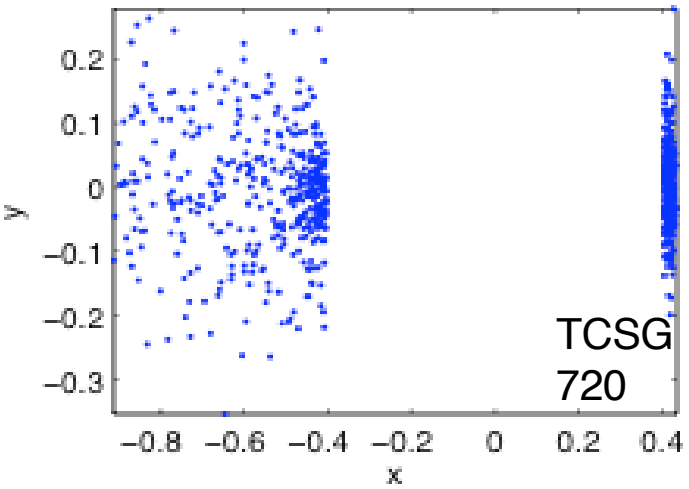


Input data, horizontal losses

Data provided by Thomas Weiler



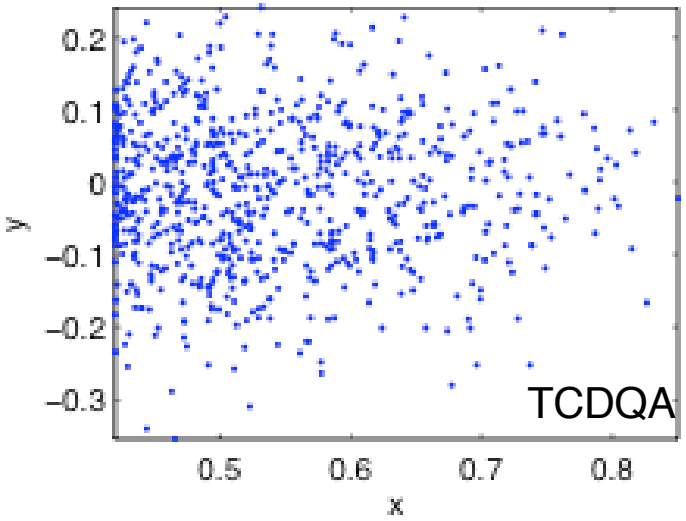


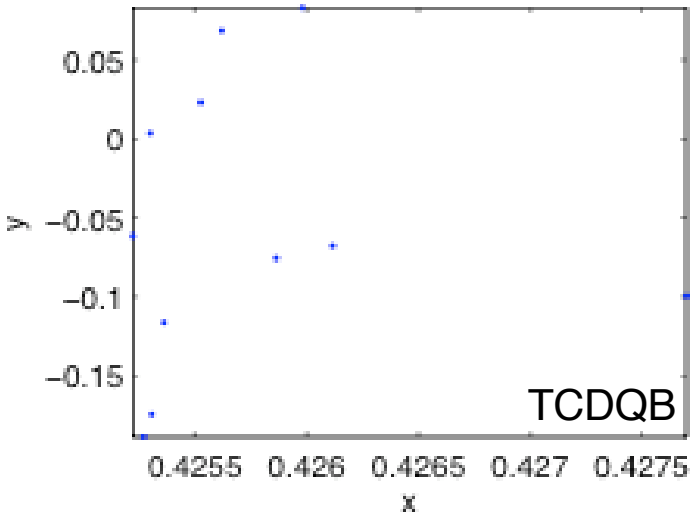


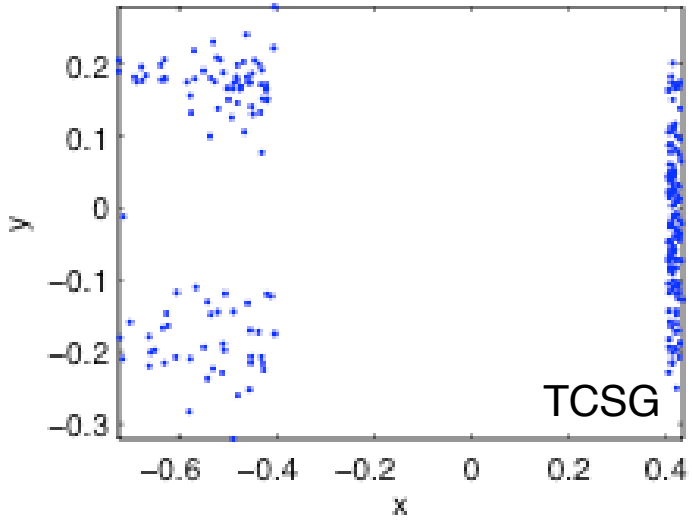
	# of protons lost
TCDQA	1146
TCDQB	17
TCSG	720
Total	1883

Input data, vertical losses

Data provided by Thomas Weiler





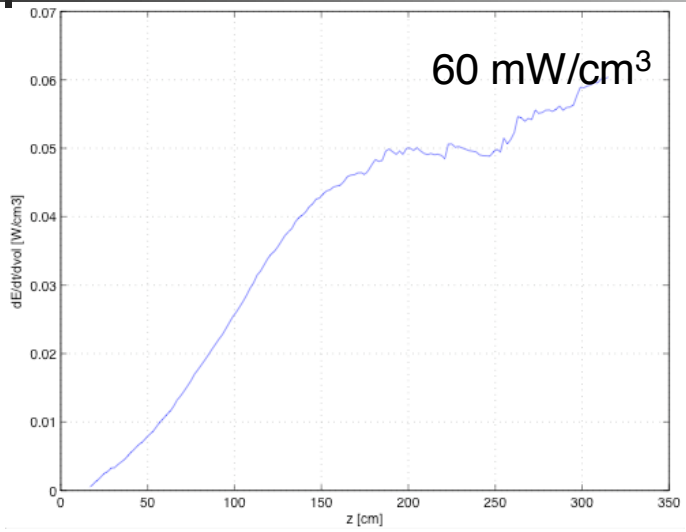


	# of protons lost
TCDQA	757
TCDQB	11
TCSG	229
Total	997

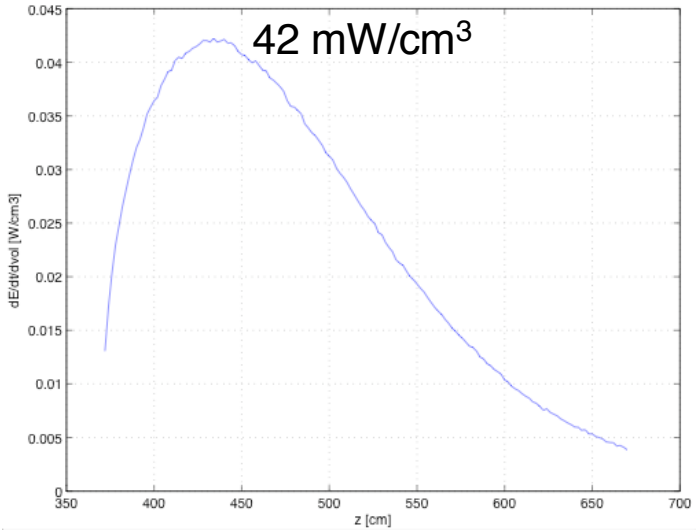
FLUKA parameters and Normalization factors

- 20,000 p^+ followed in 4 runs
- Magnetic field **on**, in MCBY and MQY (sensitivity to the MCBY mag. field has been studied)
- Cartesian binning chosen for each element, with $\Delta x=\Delta y=$ 1mm and $\Delta z=$ 2cm.
- Results in GeV/cm^3/p converted to W/cm^3
- 5.11 10^6 particles absorbed in SixTrack simulations,
- Beam life time of **0.2 h** at nominal LHC intensity assumed
- Results scaled to **1.65 10^8 p/s** lost on TCDQ/TCS

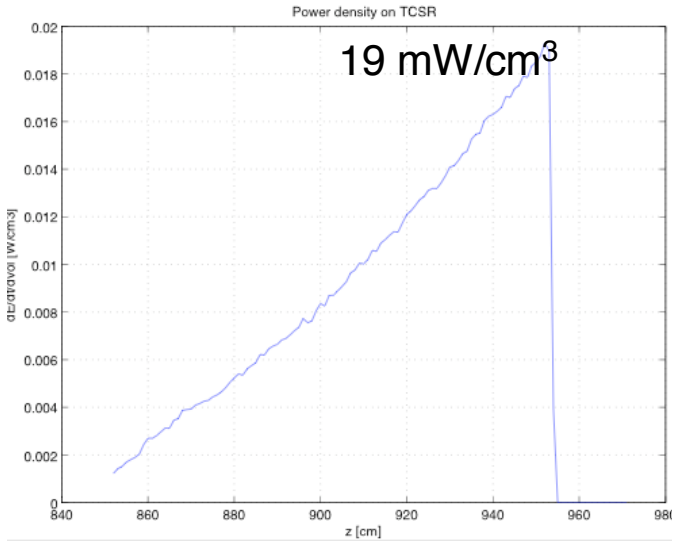
Power density profiles on TCDQ/TCS



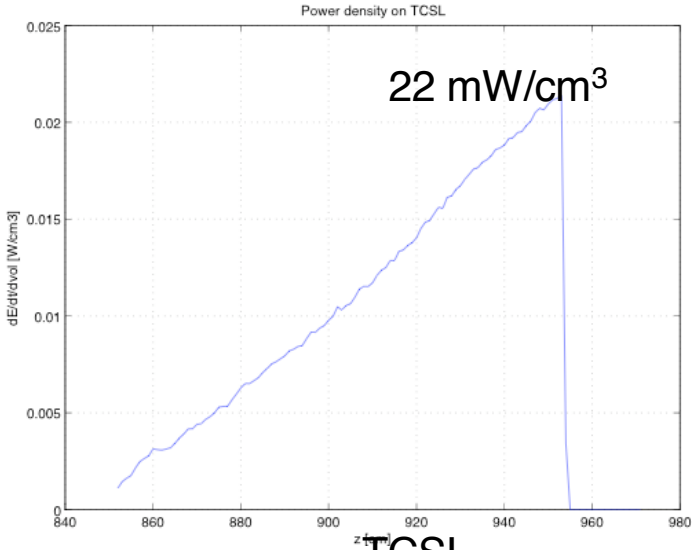
TCDQ1



TCDQ2

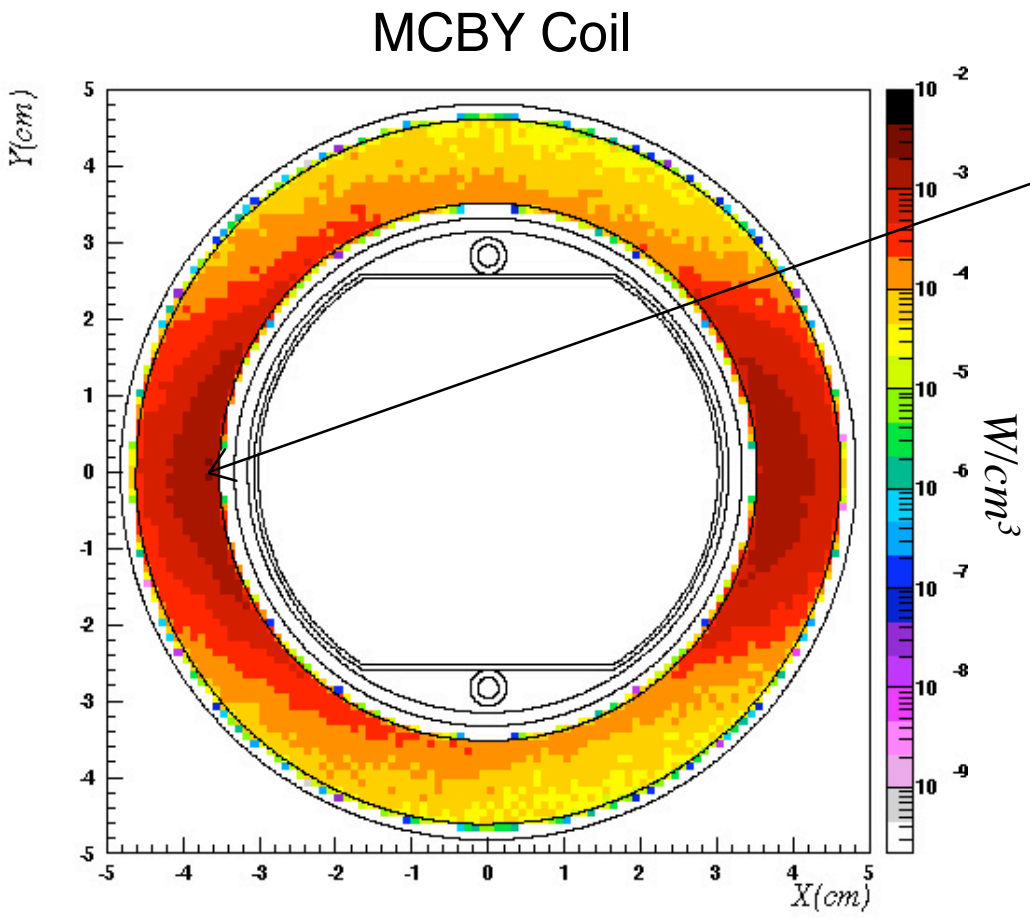


TCSR



TCSL

Power density on MCBY



Localised deposition:
2.3 mW/cm^3

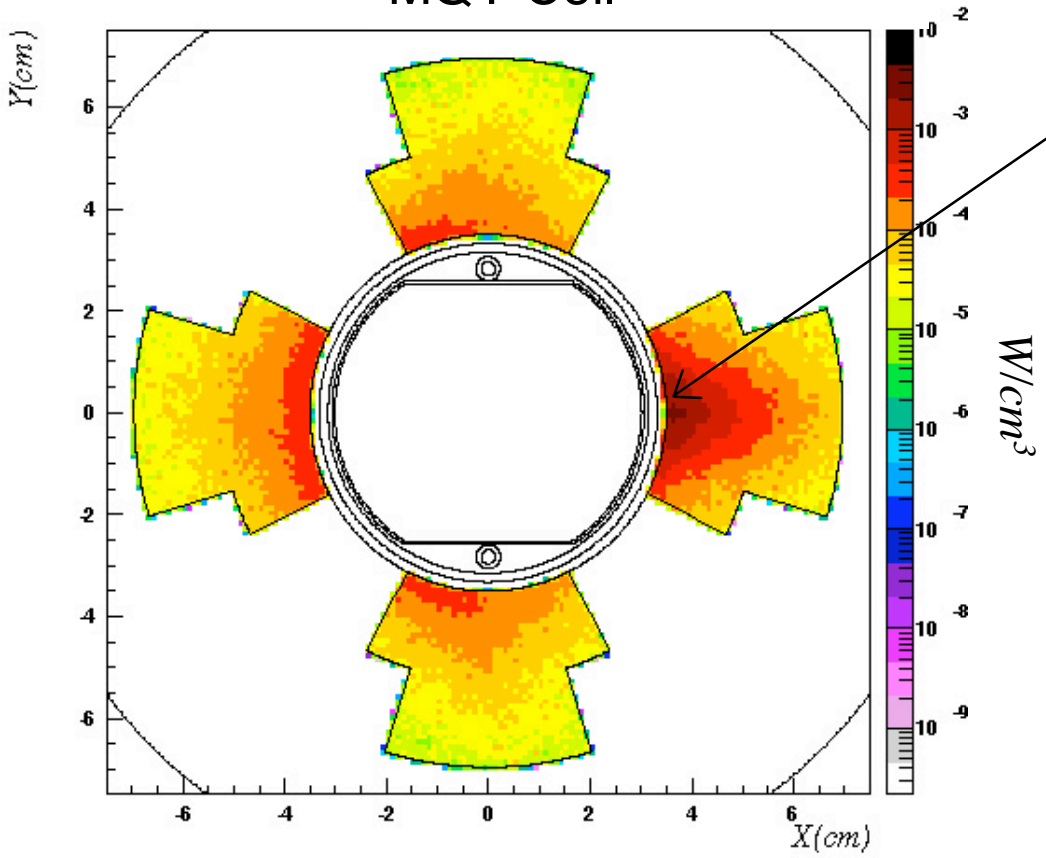
Quench: 5 mW/cm^3

Total power deposition in the MCBY coil: ~ 2.5 W

Quench --> 20 W

Power density on MQY

MQY Coil



Localised deposition:
3.1 mW/cm^3

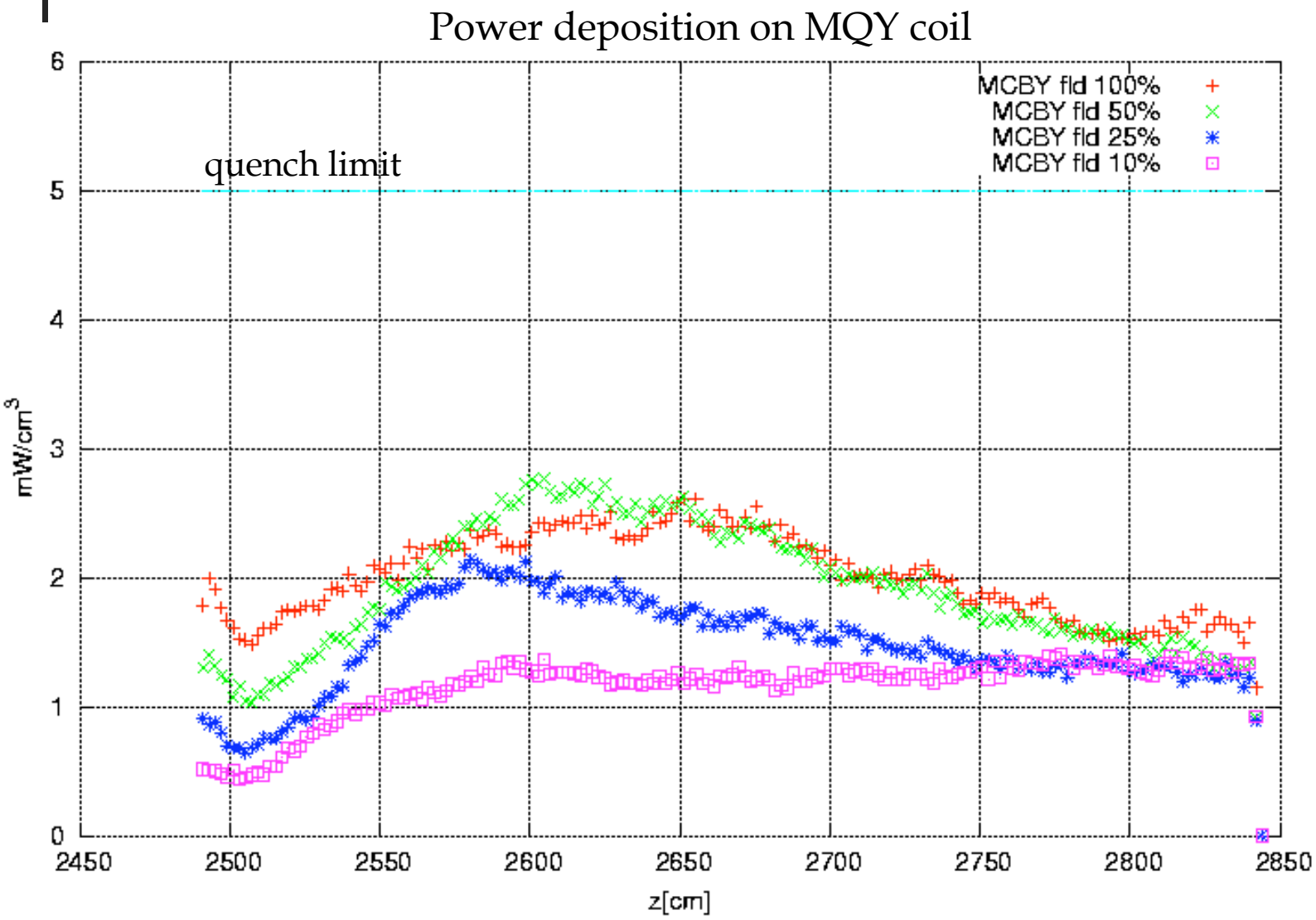
Quench: 5 mW/cm^3

Total power deposition in the MQY coil: ~ 9.5 W

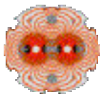
Quench --> 20 W

MCBY field 100% --> ~2 T

Sensitivity to MCBY field



Energy deposition H/V losses



Horizontal

	TCDQA	TCDQB	TCSL	TCSR	MASK	COIL MCBY	IRON MCBY	COIL MQY	STEEL MQY
$J/cm^3/p$	$3.7\ 10^{-10}$	$2.6\ 10^{-10}$	$1.3\ 10^{-10}$	$1.2\ 10^{-10}$	$7.9\ 10^{-11}$	$1.4\ 10^{-11}$	$2.7\ 10^{-12}$	$1.9\ 10^{-11}$	$4.9\ 10^{-12}$
W/cm^3	0.0604	0.0422	0.0214	0.0193	0.0131	0.0023	$4.45\ 10^{-4}$	0.0031	$8.1\ 10^{-4}$

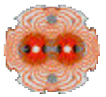
Norm. per $1.65\ 10^8$ p/s

Vertical

	TCDQA	TCDQB	TCSL	TCSR	MASK	COIL MCBY	IRON MCBY	COIL MQY	STEEL MQY
$J/cm^3/p$	$3.7\ 10^{-10}$	$2.2\ 10^{-10}$	$1.2\ 10^{-10}$	$8.7\ 10^{-11}$	$7.0\ 10^{-11}$	$1.1\ 10^{-11}$	$2.3\ 10^{-12}$	$1.6\ 10^{-11}$	$4.7\ 10^{-12}$
W/cm^3	0.0326	0.0194	0.0106	0.0077	0.0062	$9.7\ 10^{-4}$	$2.03\ 10^{-5}$	0.0014	$4.1\ 10^{-4}$

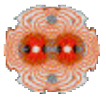
Norm. per $8.81\ 10^7$ p/s

Comparison with previous results at different conditions



	Thermal load on MQY coil [mW/cm^3]	
Load condition	*Beam 1*	*Beam 2*
No beam cleaning	15	???
Nominal cleaning	0.03	3.1

Conclusions



- At the assumed loss rate of 1.65 10^8 p/s on TCDQ/TCSG the maximum power deposition on TCDQ (diluter) and TCSG (secondary collimator) is 60 mW/cm^3 and 22 mW/cm^3 respectively.
- The power deposited on the quadrupole MQY and the sensitivity to the magnetic field in the corrector dipole MCBY have been studied with the following result:
  - The power deposited on MQY with the a MCBY magnetic field of ~2 T (100%) is 3.1 mW/cm^3, < factor 2 under the quench limit (5 mW/cm^3);
  - Reducing the field intensity to 10%, the safety factor rises up to 4.
- The energy deposition doesn't change using as input the horizontal or vertical loss maps (results presented for "horizontal simulations" are also available for vertical).