

# Extraction line simulation using BDSIM

20mrad & 1.6mrad

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# Overview

1. What we are looking for ?
2. Brief introduction to BDSIM
3. Main difference, from the BDSIM point of view, between large and small crossing angle (the 20mrad and 1.6mrad case)
4. Power losses along the extraction
5. Conclusion and future for BDSIM

# What we are looking for ...

See the plenary session on MDI (Graham & Philip)

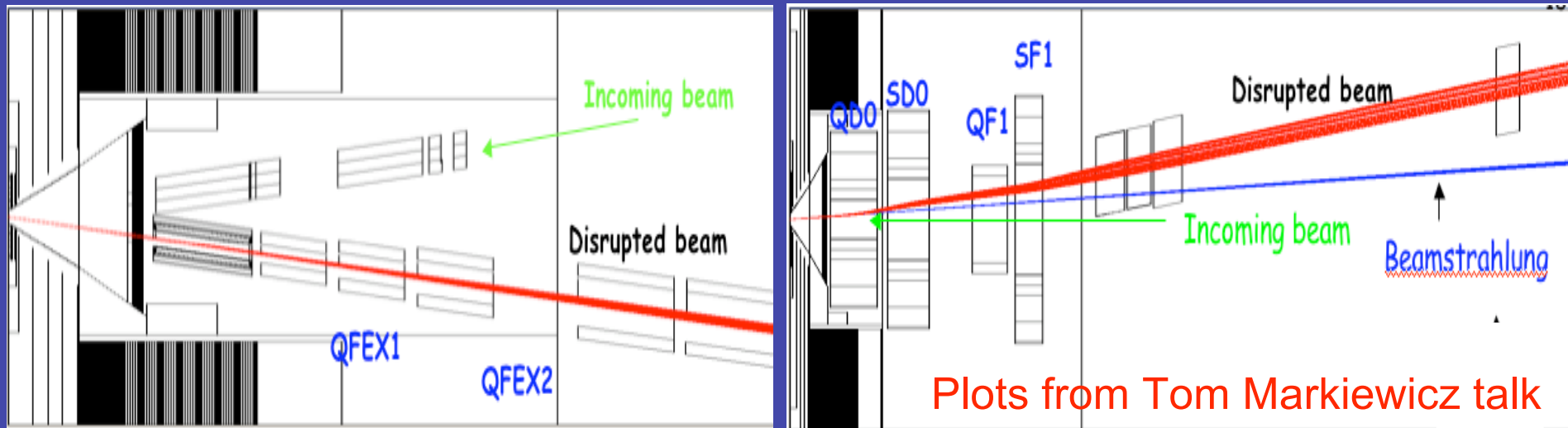
Need to extract the beam after collisions and transport it with minimal losses to the dump

Our primary goal:

→ evaluate the background this generates in the detector

1. Isolate the elements where the losses occur  
(possible damage on beam magnets:  
SC elements for example)
2. What are and how many particles are  
backscattered into the detector region

# Large and small crossing angle 20 & 1.6 mrad design



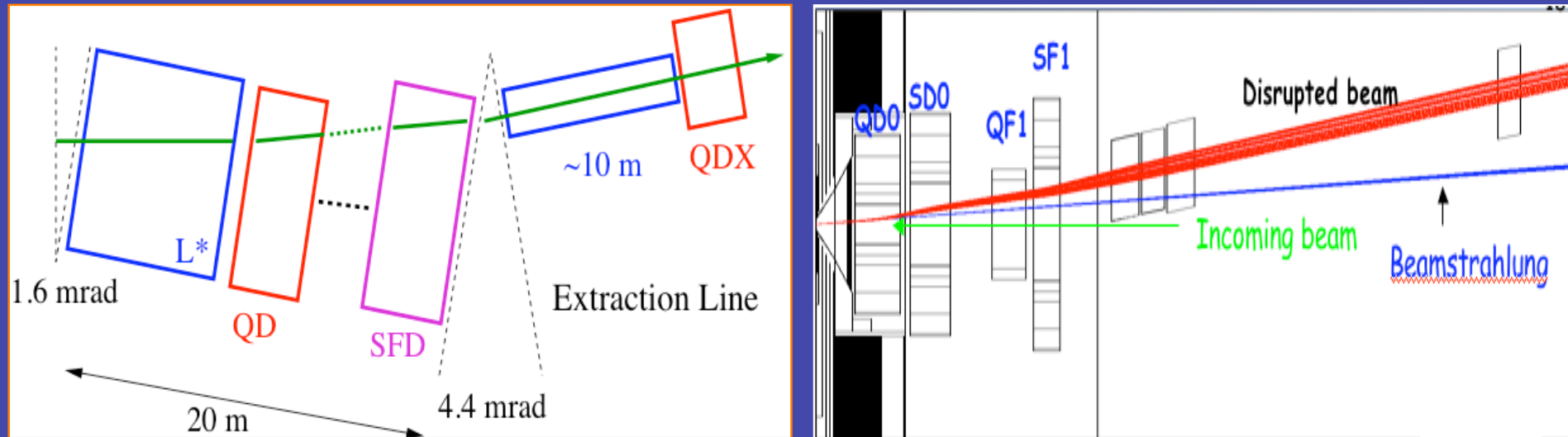
Separate magnets for incoming and outgoing beams in  
20mrad extraction

Length of the extraction line between IP and dump

→ ~ 350 m for 20mrad

→ ~ 680 m for 1.6mrad

# Large and small crossing angle 20 & 1.6 mrad design



Common Elements between incoming and outgoing for the first 20 m  
After, separate structure

Special coordinate transformation for the 1.6mrad

# Brief Introduction to BDSIM

Track particles through the BDS of a generic in LC including particle interactions and production of secondary in materials

BDSIM simulation based on Geant4

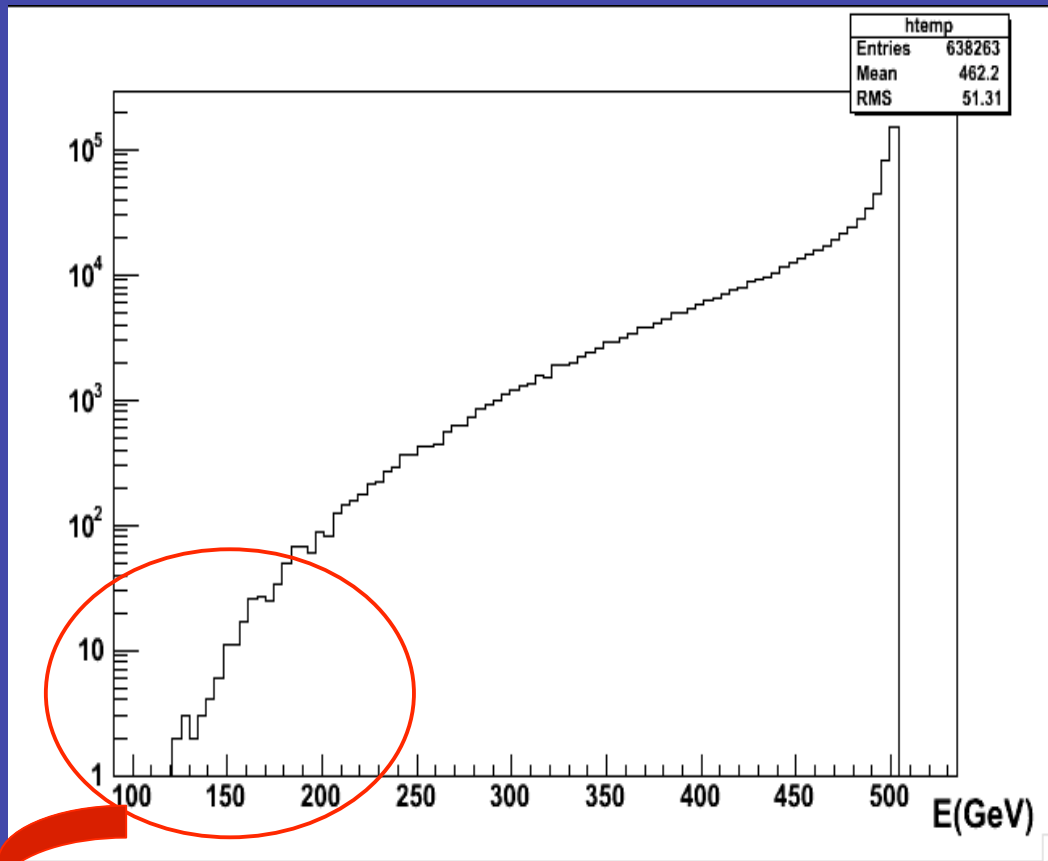
Up to now we have only taken care of the disrupted beam itself without emission of secondary

Since October 2005 new BDSIM version

- New input format very close to MAD format
- Histogram of the power losses by default
- All the optical elements being implemented
- Special coordinate transformation (for 1.6mrad)
- MAD style visualization (via ROOT dictionaries)

# Disrupted beam

1TeV Nominal 100 nm y offset



Huge Statistic 640k particles  
100nm maximize the energy losses

Beam parameters:

$$\sigma_x = 554nm$$

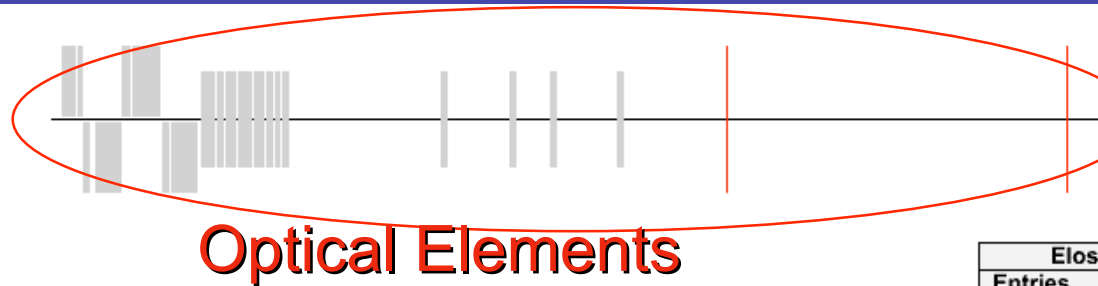
$$\sigma_y = 3.5nm$$

$$\delta = 7.6\%$$

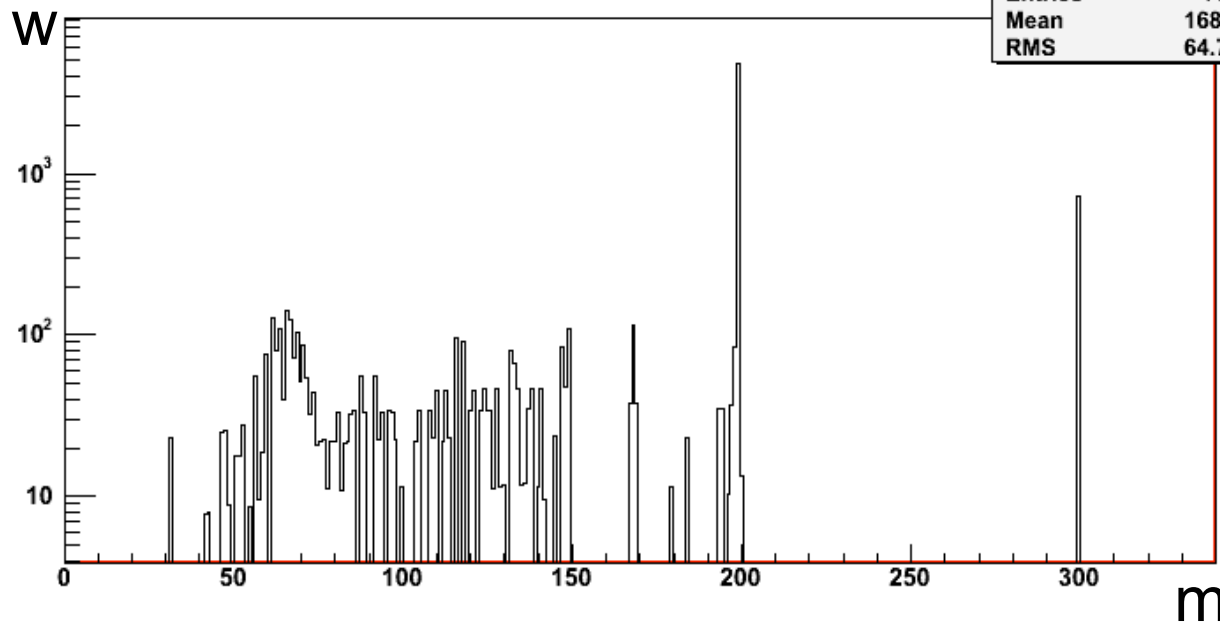
$$P=18.1 MW$$

Need to increase the statistics in the low energy tail

# Power Losses along the 20mrad



800 particles out of 640k are losses : 22 kW



Ecol1:  
BDSIM 5.48 kW  
Dimad 5.15 kW

→ Ecol2:  
BDSIM 0.84 kW  
Dimad 0.12 kW

# ZOOM on the 20mrad histogram

The screenshot shows a ROOT framework window titled "BDSIM ROOT Framework" with a menu bar (File, Edit, View, Options, Inspect, Classes, Help) and a toolbar. The main plot area displays a histogram of energy loss, with a red bar at approximately 32.6 m. A table titled "ElossHisto" provides summary statistics:

ElossHisto	
Entries	796
Mean	63.9
RMS	8.008

Below the histogram, a terminal window shows the following output:

```

dadoun, Mon Nov 14 11:45:51 CET 2005
BDSIM input file : 20mrad.gmad
dadoun:~$ cdpo: command not found
dadoun:/Volumes/DATA/Desktop/BDSIM/Utils dadoun$ cd power/
dadoun:/Volumes/DATA/Desktop/BDSIM/Utils/power dadoun$ ls
20mrad.gmad          Makefile~          ROBJC20mrad_0.root  cs25_dy80_hs.dat_0.root  power.C~
20mrad.root         ROBJC20mrad.root  ROBJC20mrad.root   output_0.root          power.o
20mrad.root         ROBJC20mrad.root  ROBJC20mrad.root   power                  power.C
Makefile            ROBJC20mrad_0.root  UINS
dadoun:/Volumes/DATA/Desktop/BDSIM/Utils/power dadoun$ vim power.C
dadoun:/Volumes/DATA/Desktop/BDSIM/Utils/power dadoun$

```

On the right, an "Optics Specs." window displays the following information:

**Opticals Elements specs.**  
Name: qdex3d Type :Quadrupole  
@ 32.576565 m with a length of 2.625449 m  
k1=0.000000, k2=-0.009993  
k3=0.000000, k4=-1.849137

Below the optics specs, a "display" window shows the following output:

```

* http://root.cern.ch
*
*
*
*****
***
FreeType Engine v2.1.3 used to render True
Type fonts.
Compiled for macosx with thread support.
CINT/ROOT C/C++ Interpreter version 5.15.1
38, May 23 2004
Type ? for help. Commands must be C++ stat
ements.
Enclose multiple statements between { }.
root [0]
Processing histoPOWER.C("20mrad.gmad", "ROB
JC20mrad_0.root")...
0
total length 339.999
Axis max: 339.999 m
(int)0
root [1]

```

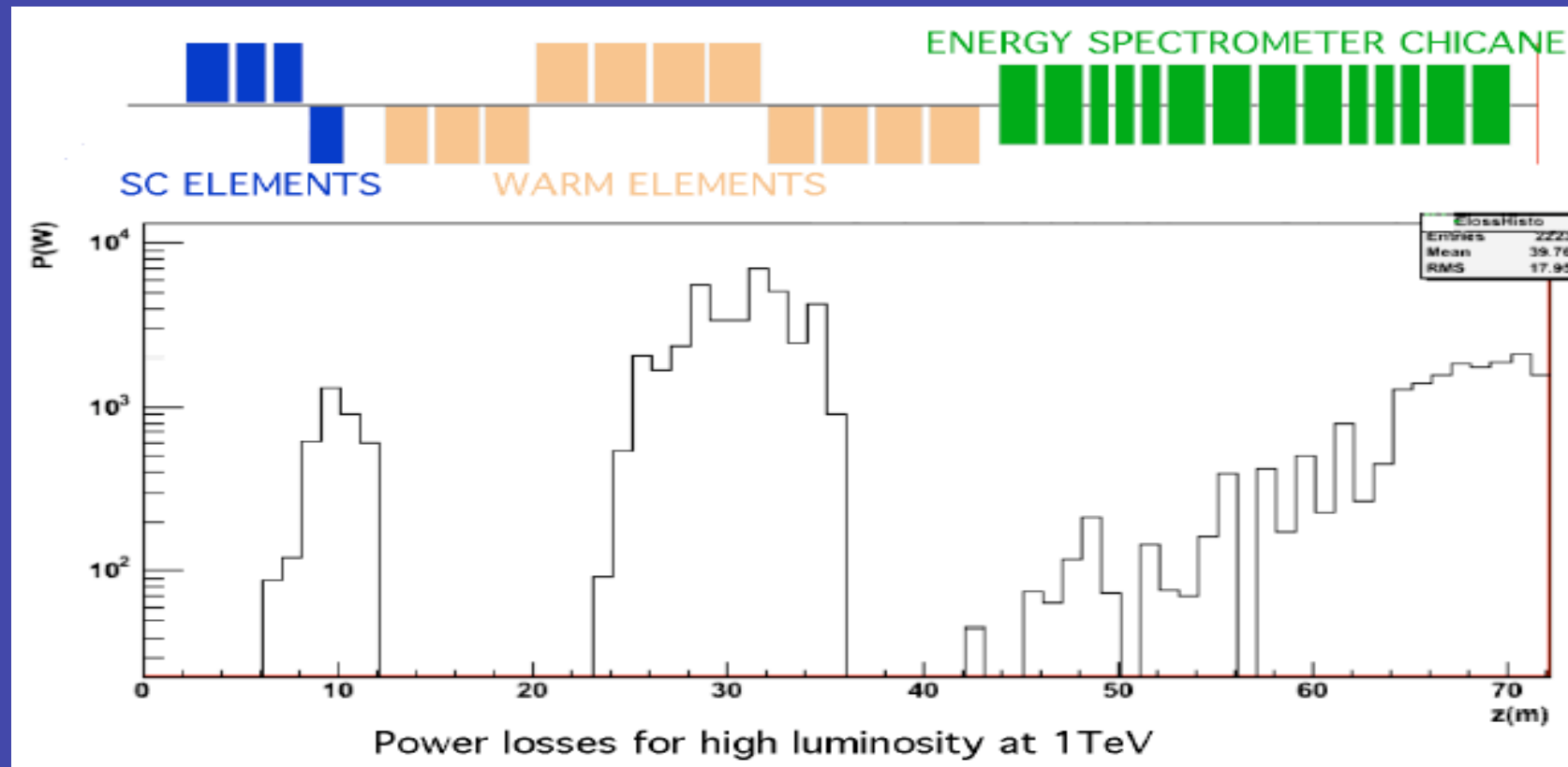
MAD display event

Papers

No loss until 30m

# Power Losses along the 20mrad

High luminosity beam parameters



Power losses even in the beginning of the extraction

# Table of the power losses

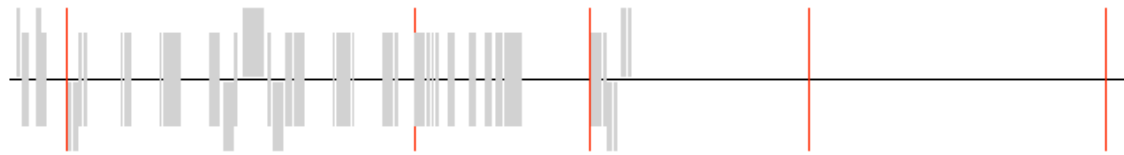
## 20mrad Extraction Line

Disrupted beam loss on collimators and max loss density in the magnets.  
Both collimators using round aperture:  $R_{COL1} = 88\text{mm}$ ,  $R_{COL2} = 132\text{mm}$ .

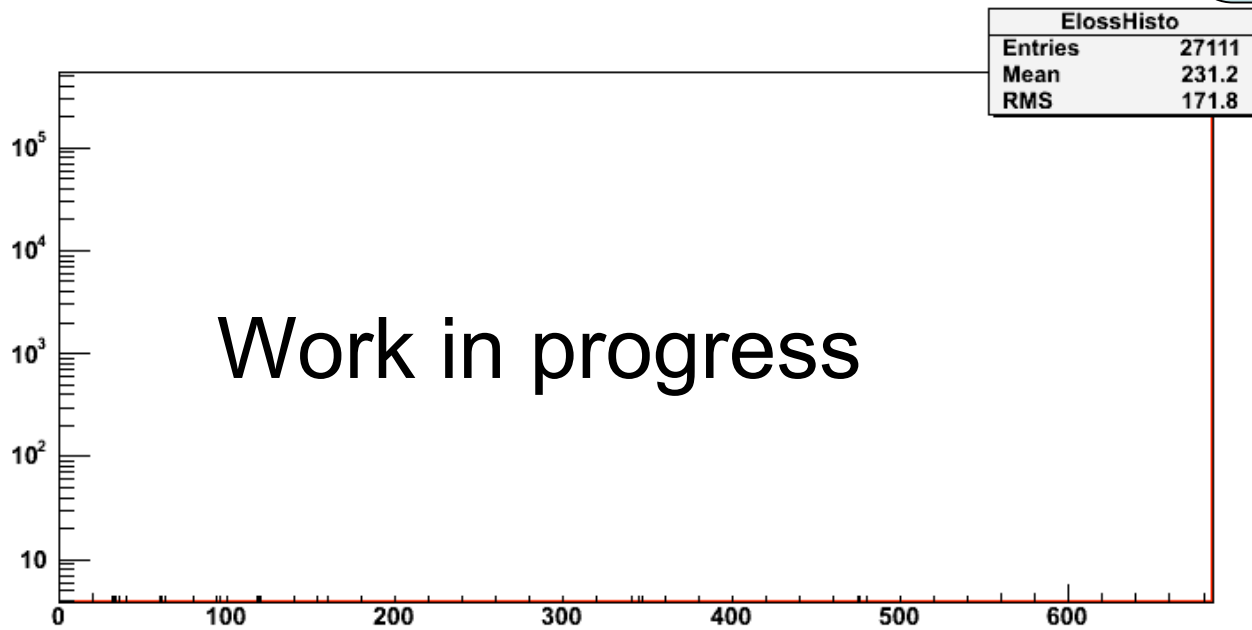
Tracked in BDSIM using  $7e4$  particles (except 1TeV Nom. Dy100 - 640K particles)

$E_{cm}$ [TeV]	Vertical Offset [nm]	E-Loss [kW]		Max E-Loss density in Magnets [W/m]		
		Col1	Col2	SC Quads	Warm Quads	Bends
0.5 Nominal	0	0	0	0	0	0
	200	0	0	0	0	0
0.5 High Lumi	0	46.4	75.5	0	58	52
	120	174.1	179.7	0	95	265
1.0 Nominal	0	0.86	0	0	0	0
	100	5.48	0.84	0	10	139
1.0 High Lumi	0	49.7	56.7	1284	6205	2162
	80	122.3	67.7	1125	7250	5725

# Power Losses along the 1.6mrad



? particles out of 640k  
are losses : ? kW



Work in progress

Recently (yesterday)

Found a disagreement  
Between Dimad/BDSIM

→ But we are  
able to fix it ...

# Summary and prospects

- Good understanding of DIMAD and BDSIM comparison on power losses is essential before estimating backgrounds
- Increase the statistics in the low energy tail
- Power losses due to the radiative Bhabha
- More systematic studies needed for all beam parameters
- Track the behavior of the secondary particles
- Customize the existing neutron propagation in GeantIV (CPU time !)
- Run BDSIM onto DATA GRID