Benchmarking of BDSIM and DIMAD for extraction line design

Preliminary Study of the Power Losses Along the extraction line

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Overview

1. Brief introduction of BDSIM
2. BDSIM/DIMAD comparison with different offset momentum particles
3. BDSIM/DIMAD comparison with disrupted beam
4. Power losses along the extraction line
5. Conclusion

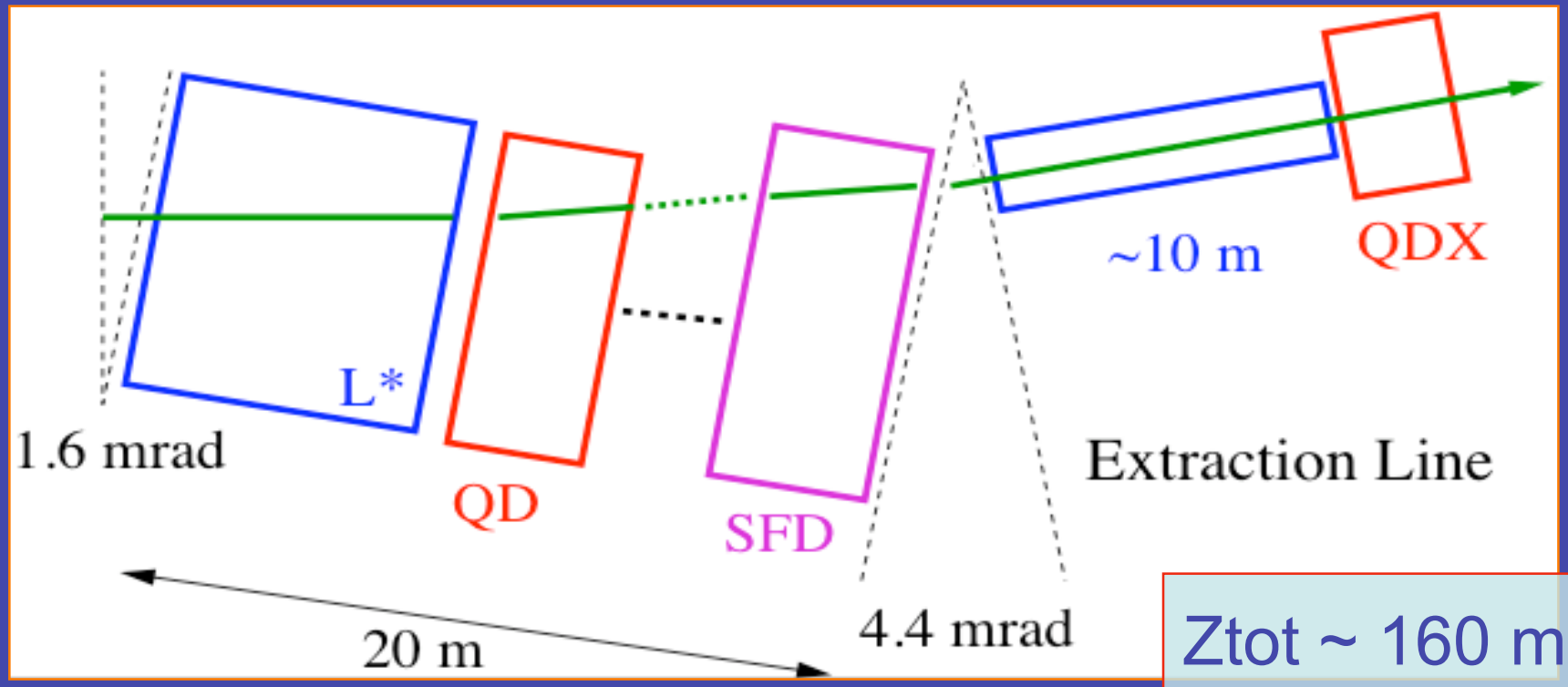
Brief BDSIM Introduction

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

- Geant IV based program originally developed by Grahame Blair
- Input program in the form of a MAD optics file
- SAMPLER element (dimensionless) give physical parameters at z : particles type, energy, position …
- WEDGE & OFFSET element to implement the crossing angle
- ROOT file(s) where each SAMPLER(S) appear(s)

In our case we are interested only in the tracking : the physical process is turned off (no synchrotron radiation)

Extraction line

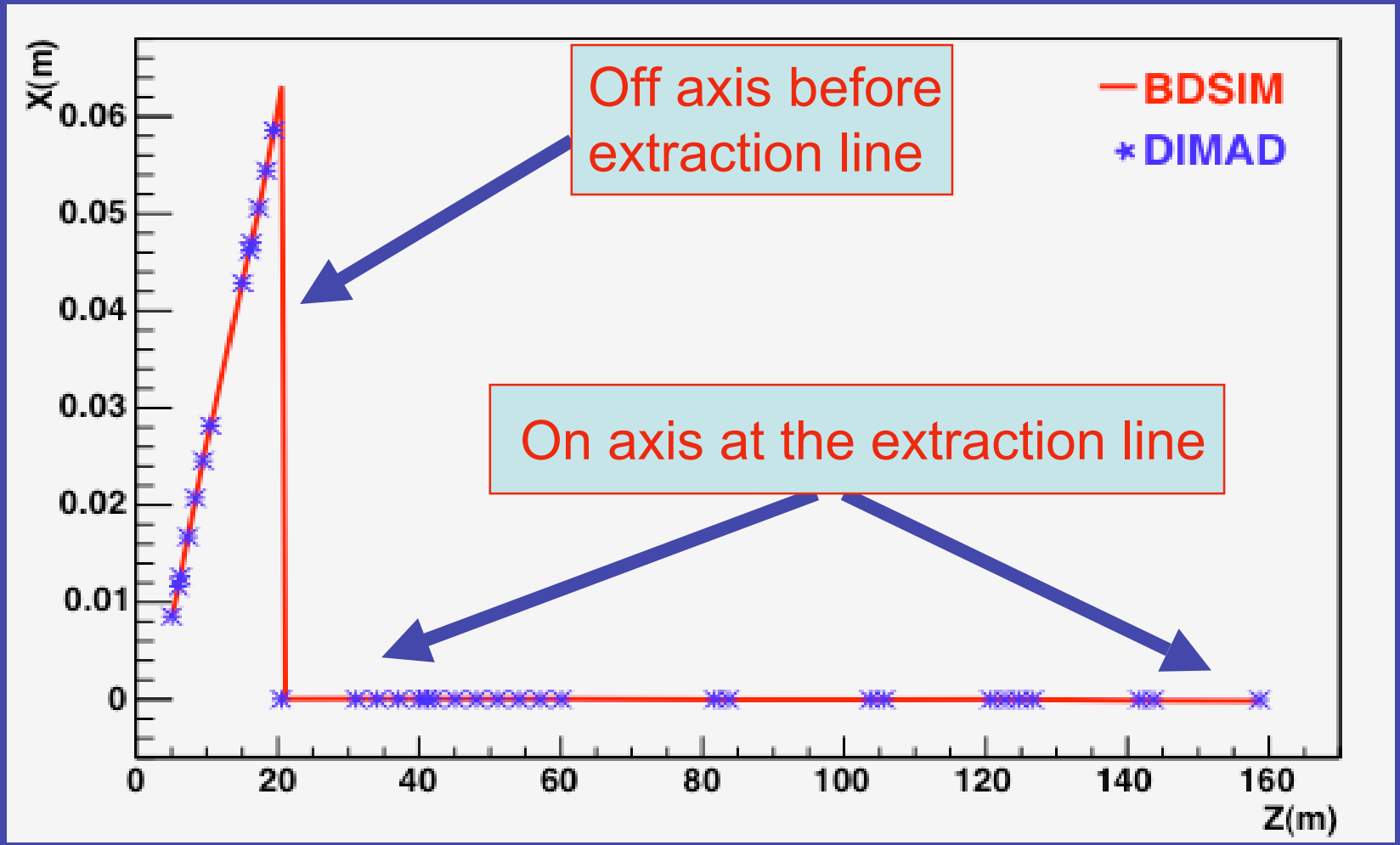


- Compared to entering particle :

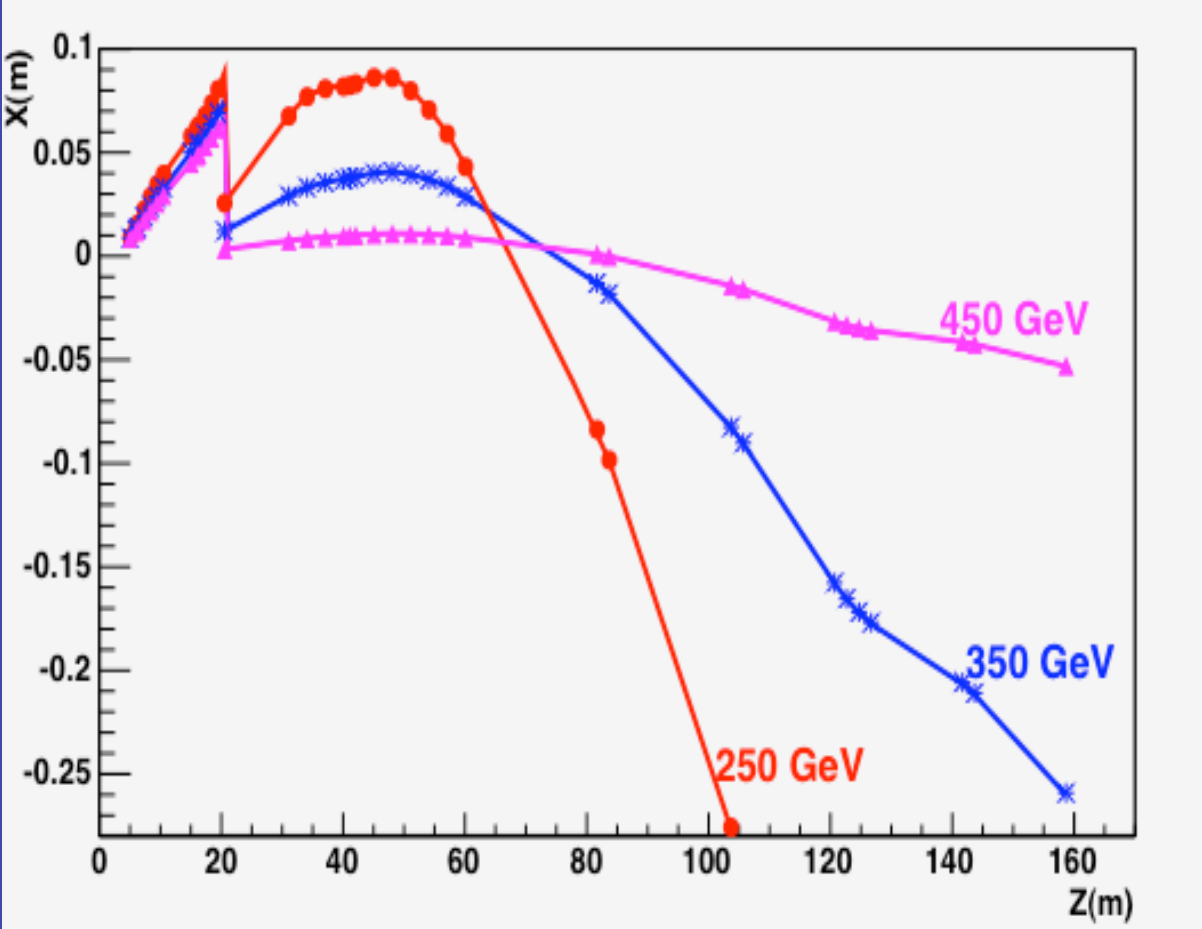
The extraction line is deviated 4.4 mrad , X = 6.3 cm

- Using 41 SAMPLERS at the end of each optics elements

Nominal 500 GeV energy

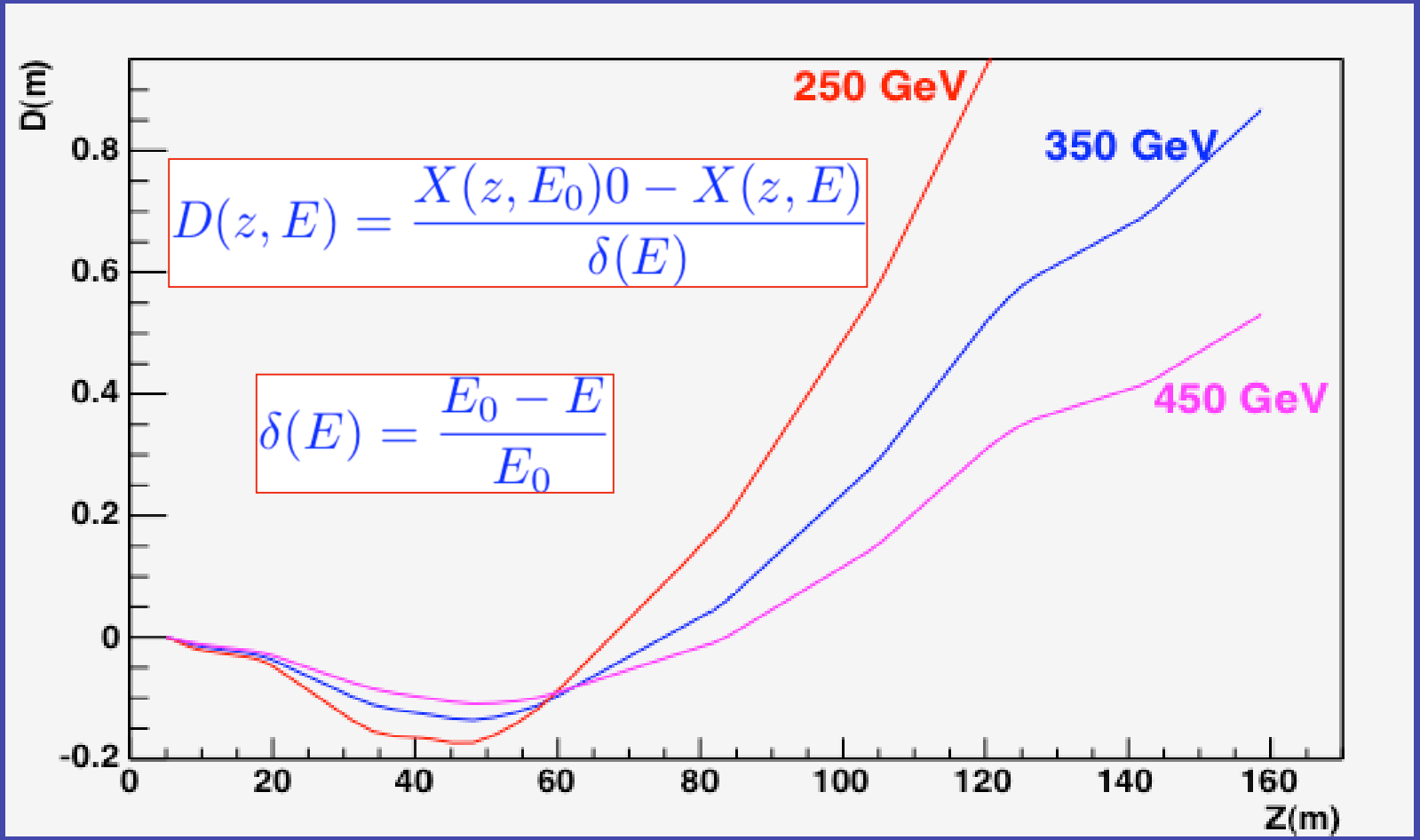


Offset momentum BDSIM and DIMAD



- Even for large offset momentum good agreement between BDSIM and DIMAD
- Large excursion appears very soon in the optics line for energy below 250 GeV

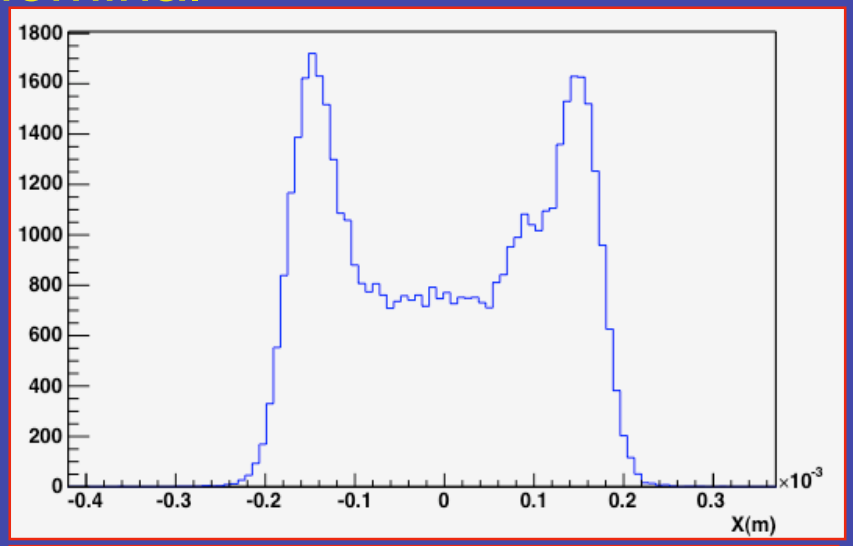
Dispersion function

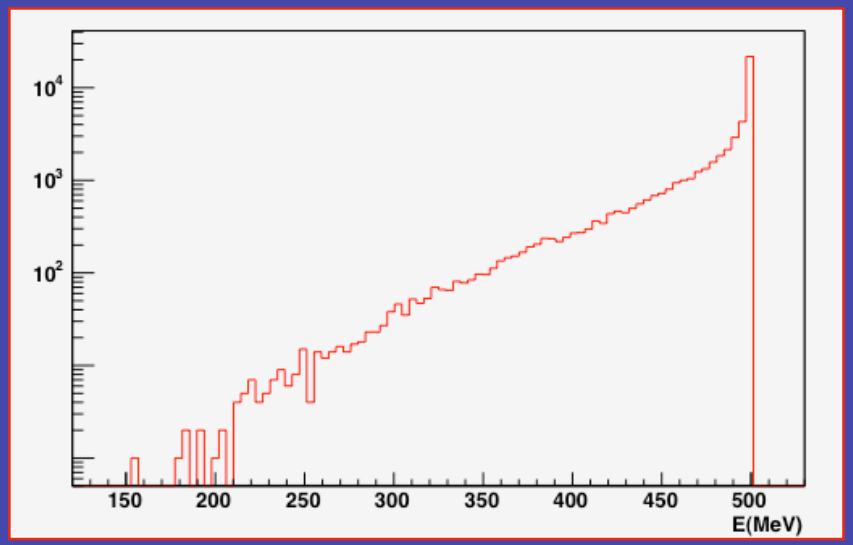


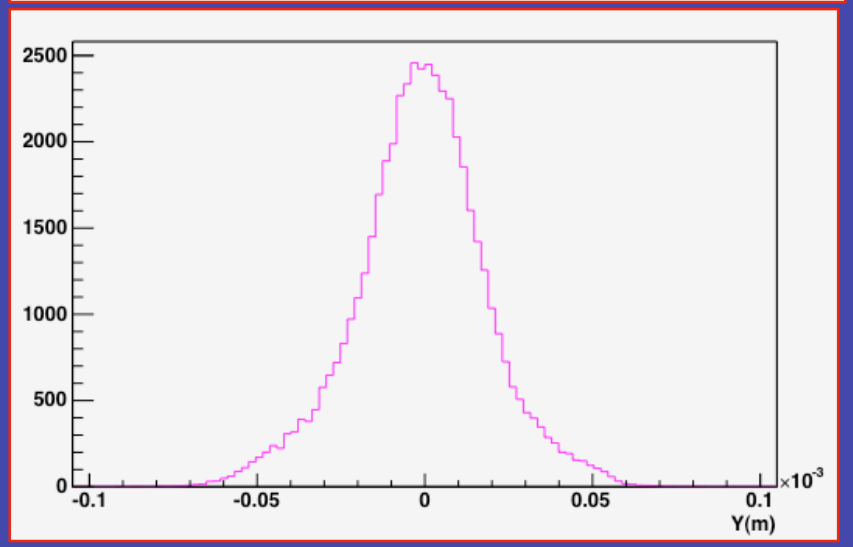
Disrupted Beam

- Beam parameters: ILC 1TeV nominal
- Guinea-Pig simulation
- 50k Macro Particles
- 5% below 250 GeV
- Beam Power ~ 21 MW

$$\sigma_x \sim 100\sigma_y$$



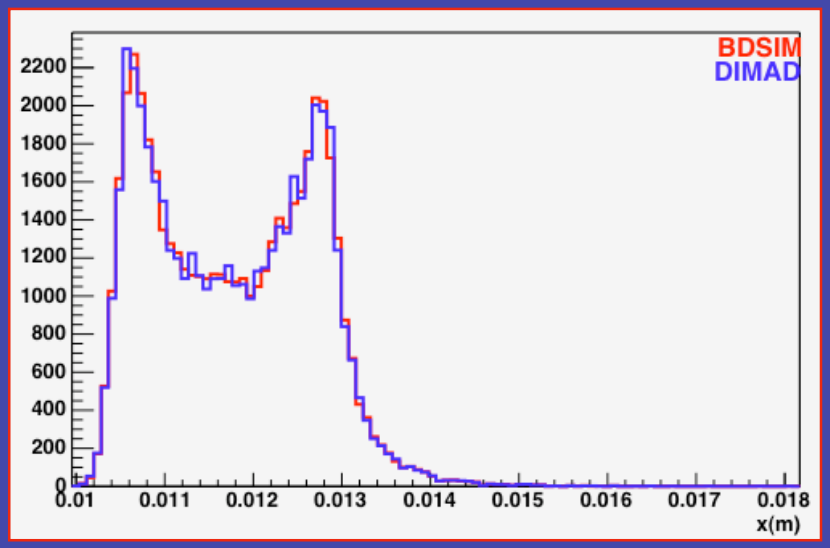


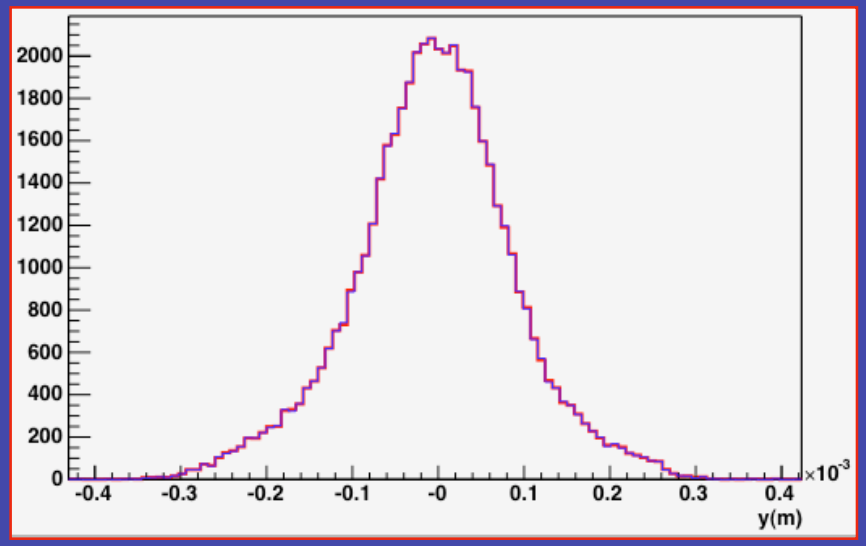


BDSIM/DIMAD
Disrupted beam at the exit of the 1st QD

BDSIM running on PPC 1.67 GHz with 1Gb RAM :

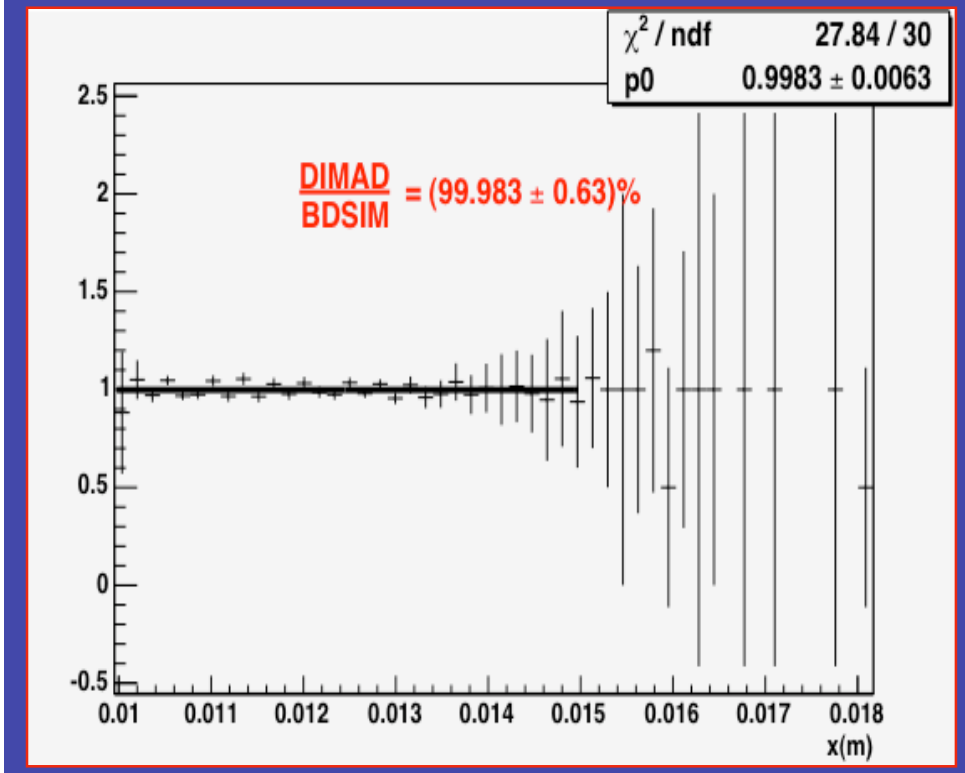
- → 20 mins to track 50k particles in all the 160 m optic line
- → 80 Mb ROOT file

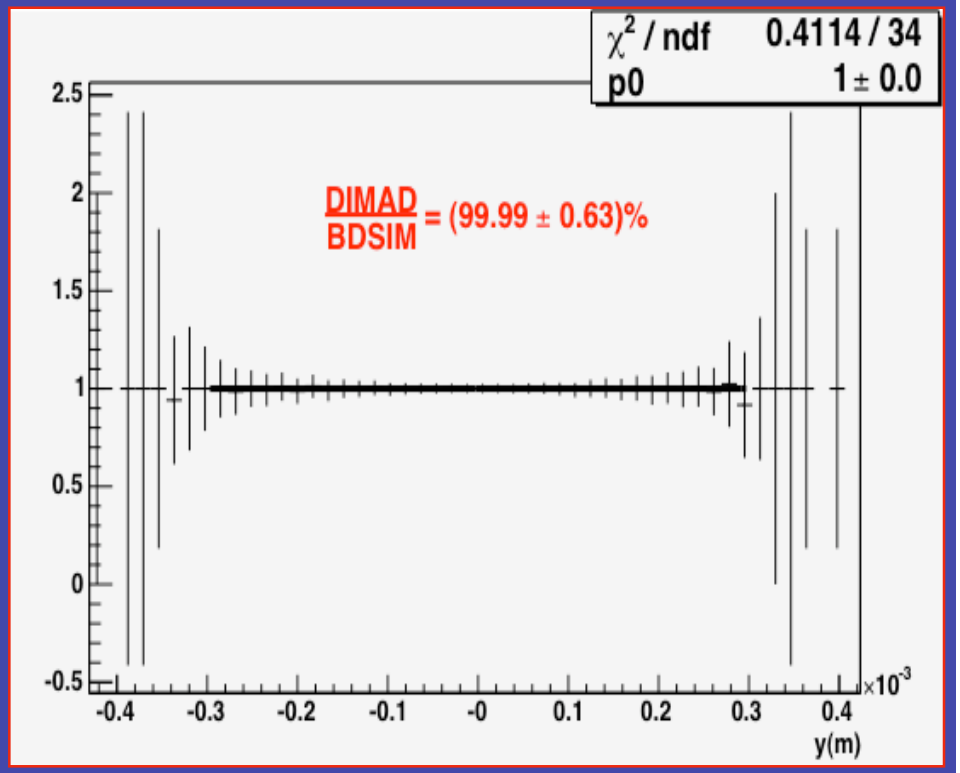




A first look shows a very good fit between BDSIM and DIMAD
Must to be quantitative …

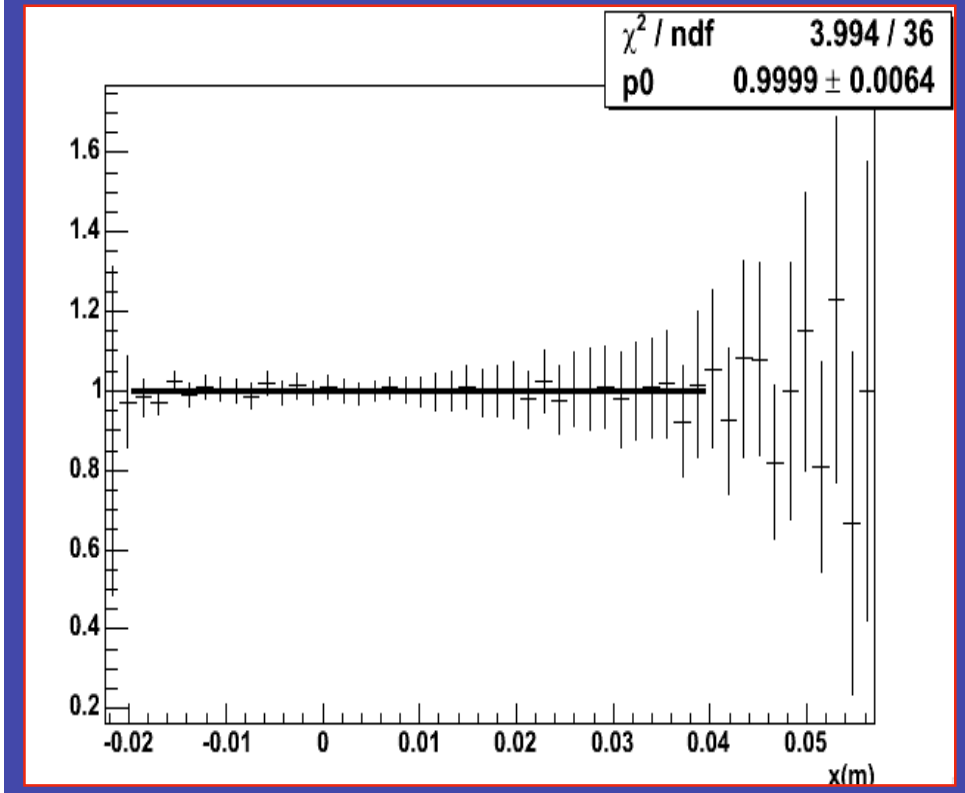
BDSIM/DIMAD

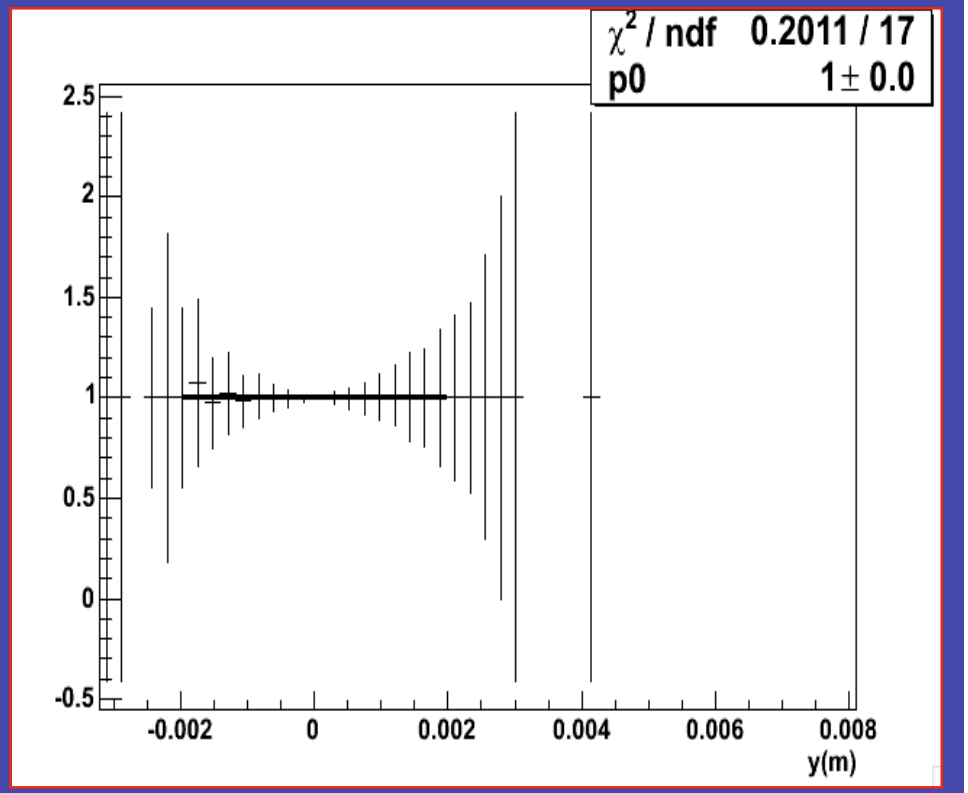




Ok for the first element and after ? …

BDSIM/DIMAD @ QFX3D (Z ~ 60 m)

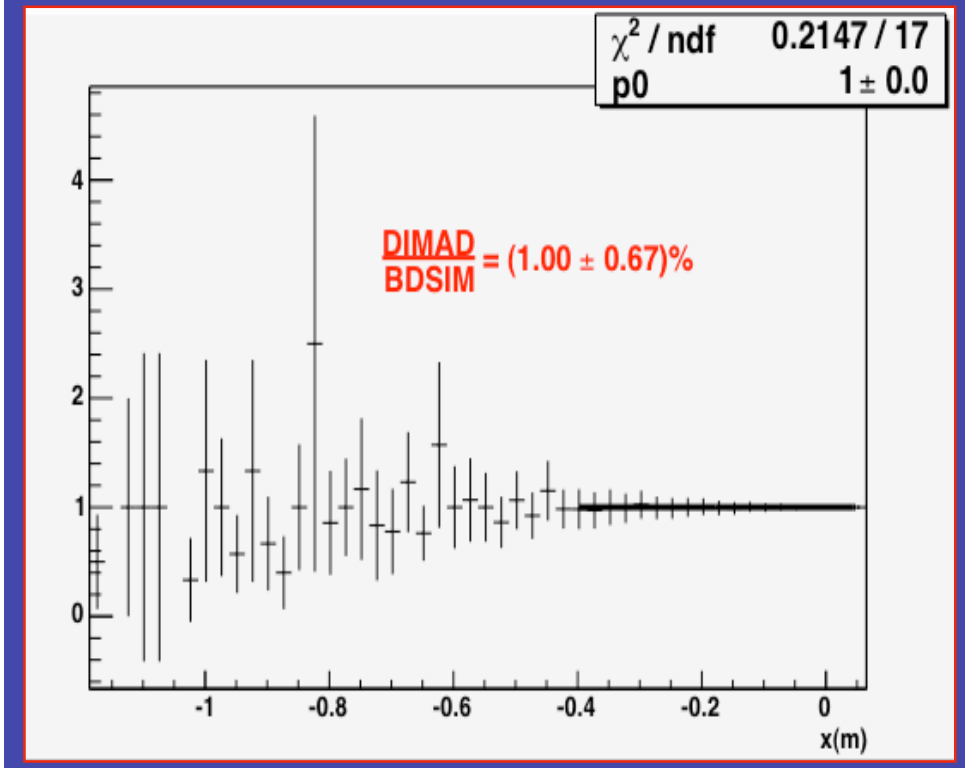


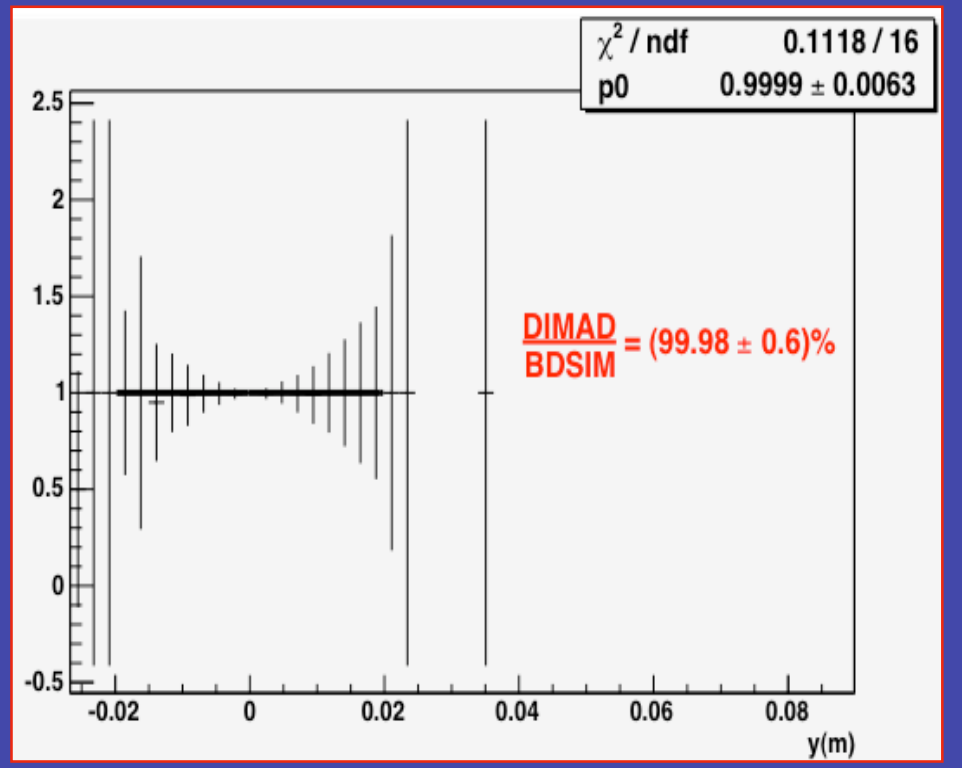


It's still perfect …

BDSIM/DIMAD @ BDCHI4 (Z ~ 160 m)

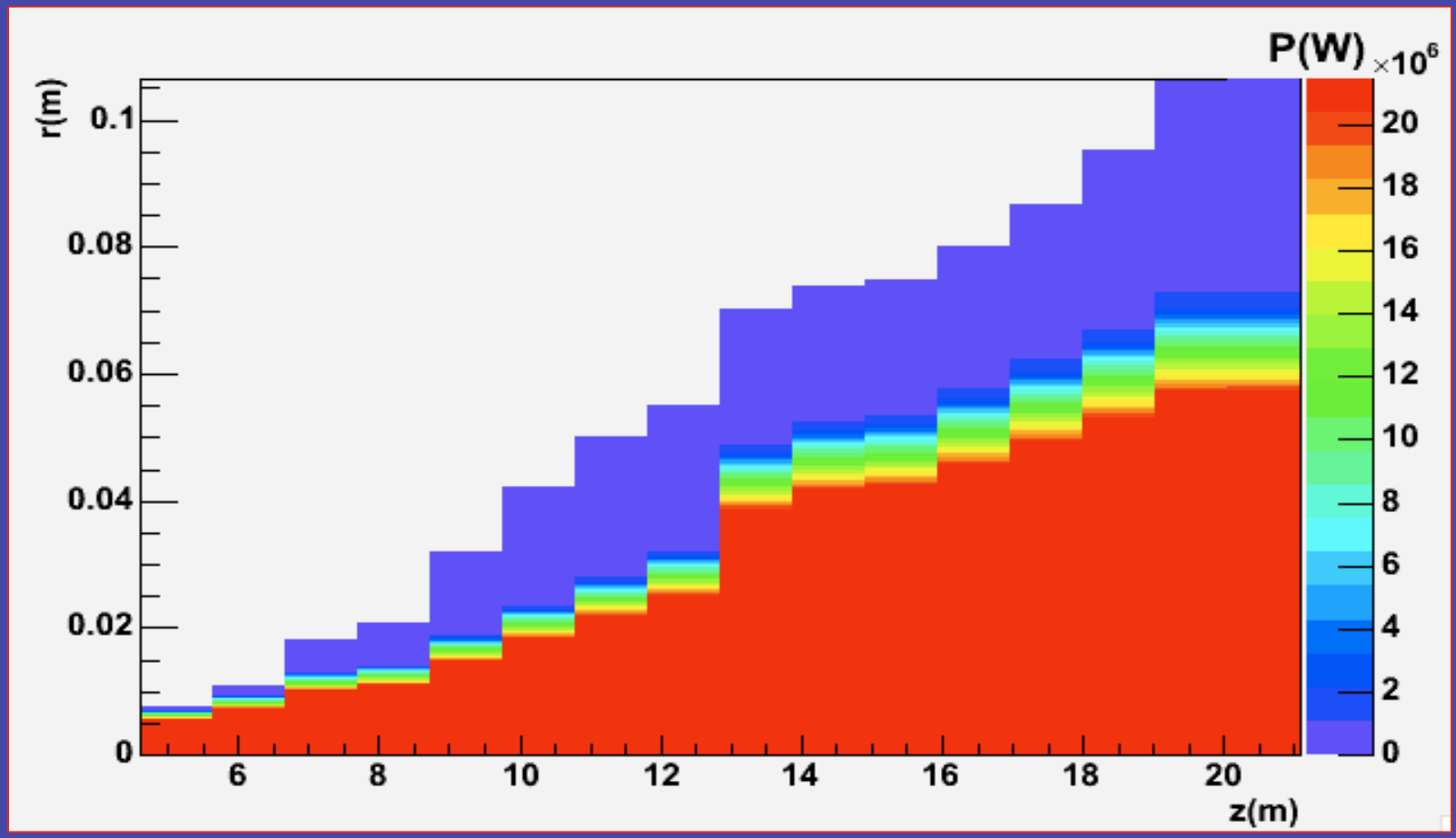
… Perfect fit between both softwares





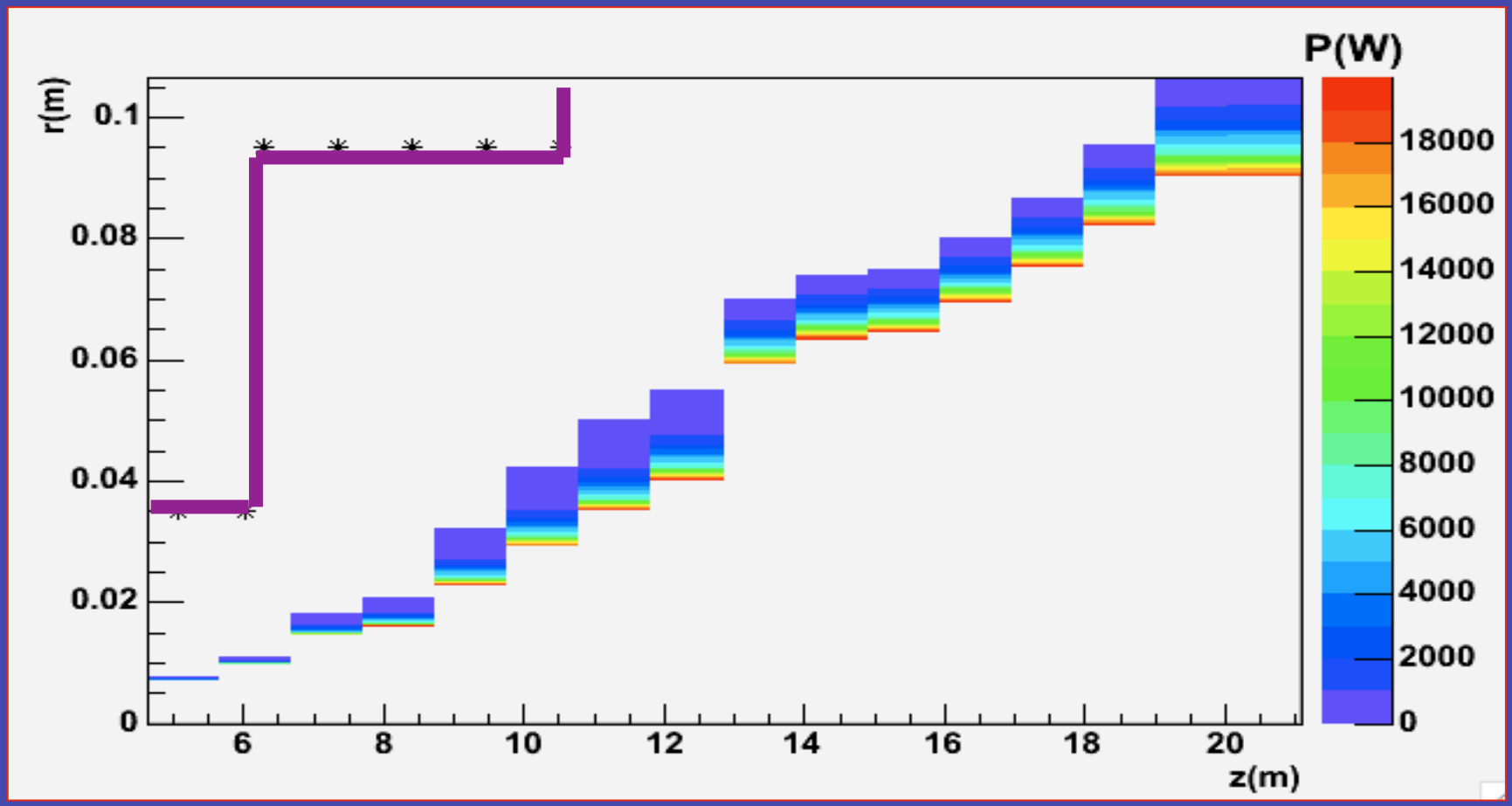
Total Power before extraction line

for a given radius



We see off axis components before the extraction line

Power below 20 kW

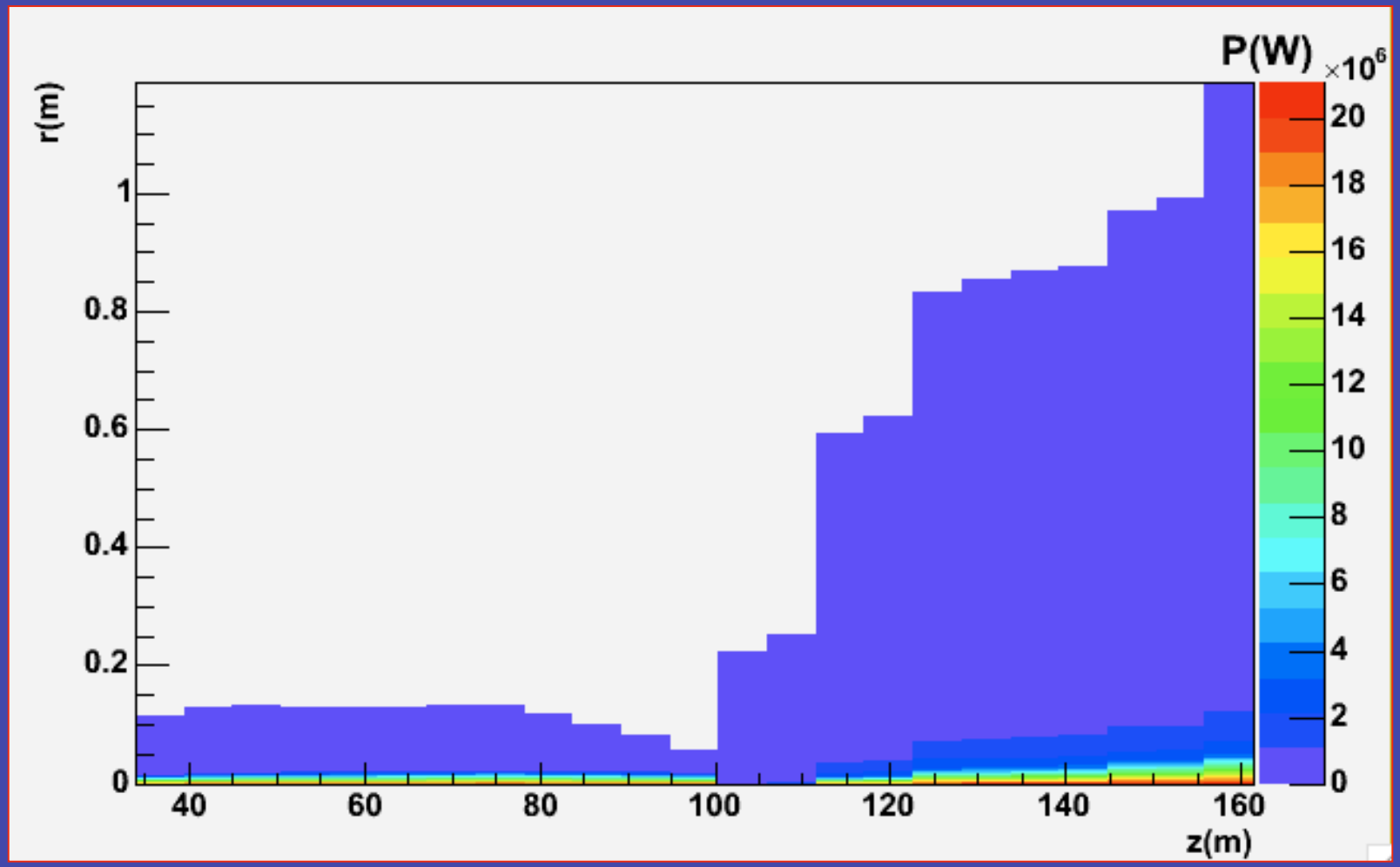


All particles are included in the apertures of each optics elements

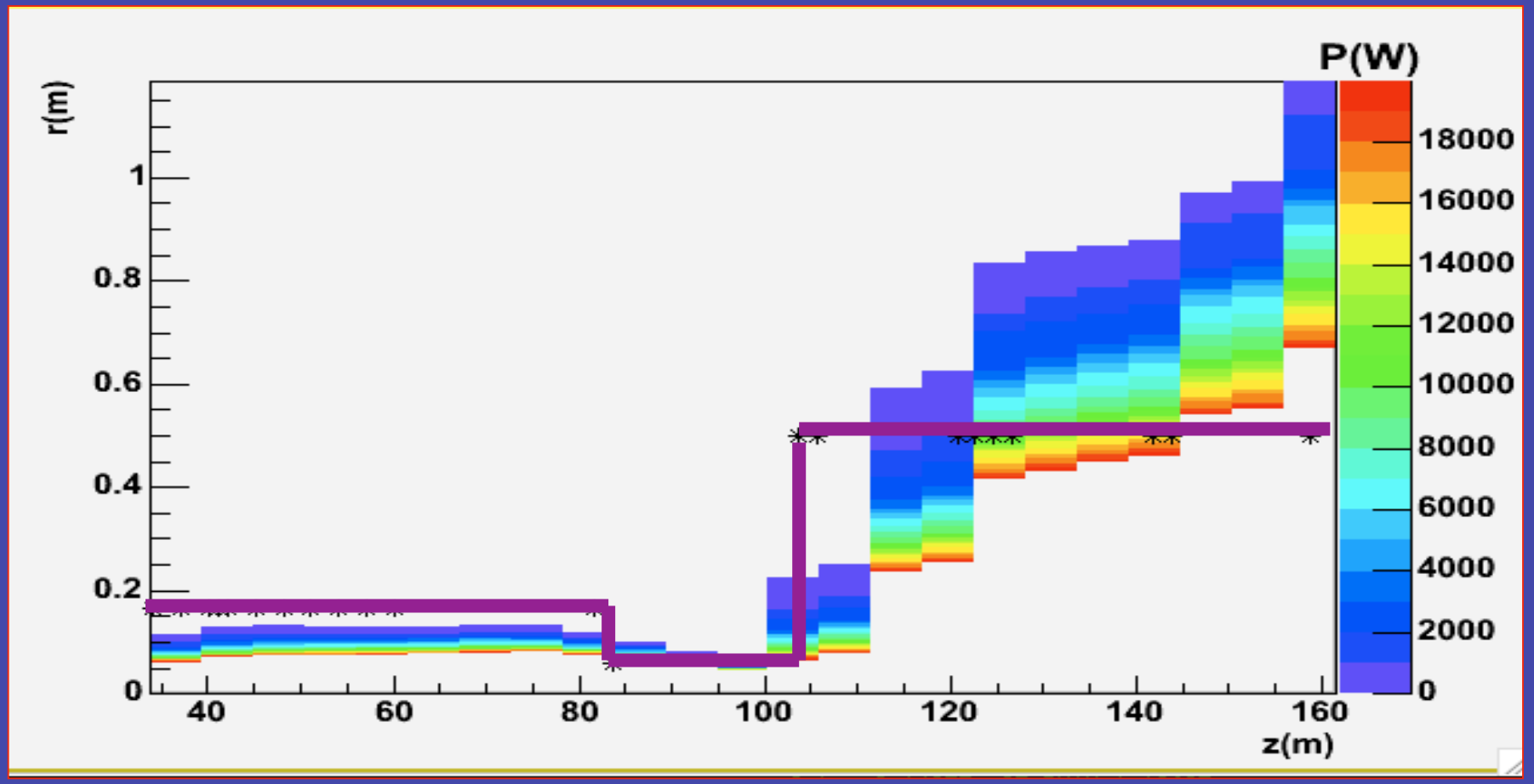
→ no losses : insufficient statistics …

Total Power before extraction line

for a given radius

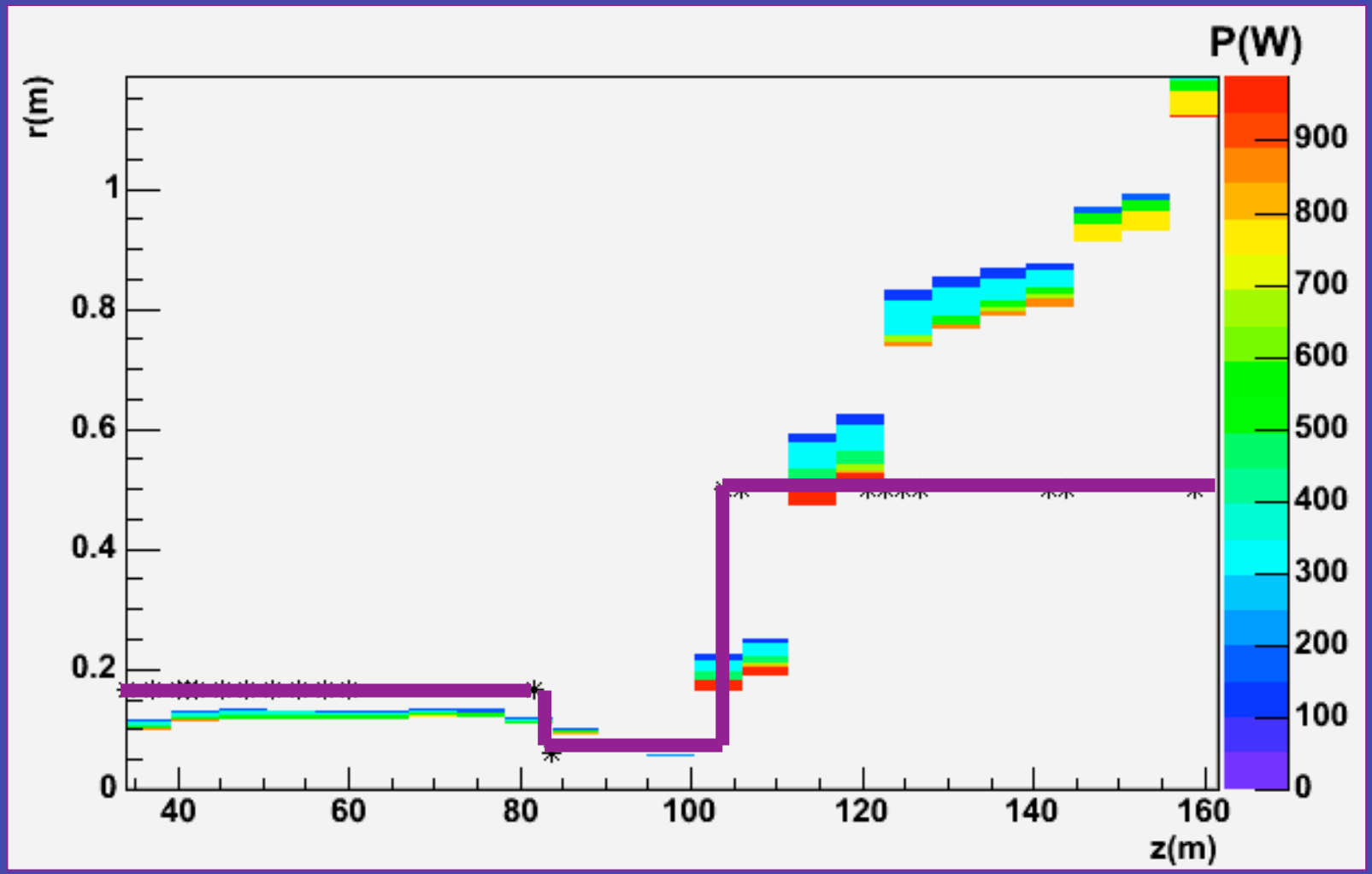


Power below 20 kW



After Z ~ 80 m start losing particles

Power below 1kW



Conclusion

⇒ Good agreement between BDSIM & DIMAD

¿ What's next ?

- Simulation of the full extraction line
- Increase the statistics
- Isolate the losses along the extraction line
- Turn on the physical process in BDSIM
- Track the behaviors of secondary particles such as synchrotron radiation, neutron …
- Provide ROOT file program to have a MAD like visualization (where the optics elements appears)

Particles energies density evolution