Status of work
Energy deposition studies in LHC nominal luminosity Insertion Regions

Christine Hoa

Outline

- Introduction
- Modeling
  - Geometry lay out
  - Magnetic fields
- Simulation parameters
- Simulation results
- Next steps
- Conclusions

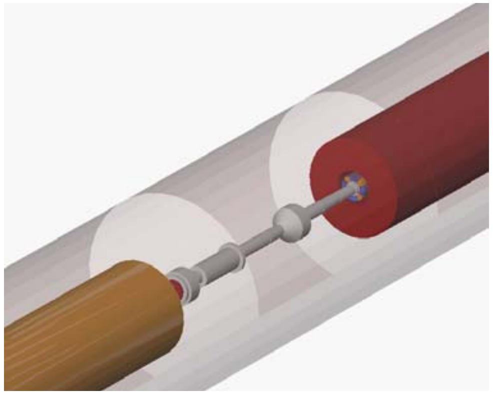
Introduction

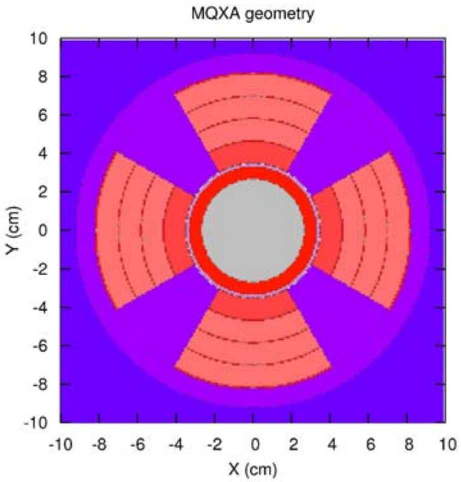
- **Validate** a reference energy deposition calculation for the insertion regions IR1 and IR5
  - Comparison with reference calculation performed by N. Mokhov

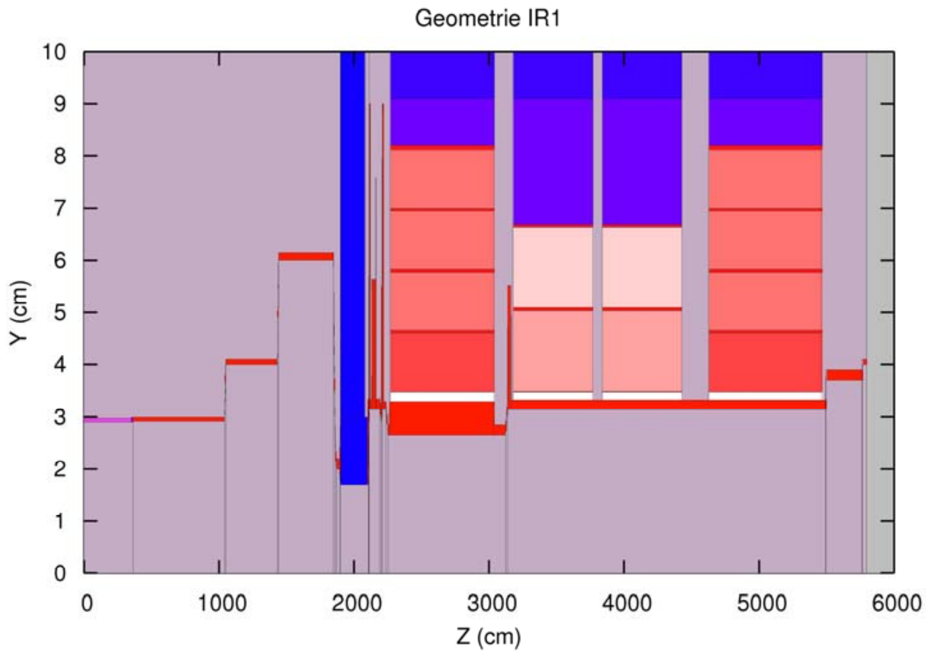
- **Develop competences in FLUKA** computation and energy deposition studies
  - Assess a general methodology
  - 'Objet oriented' modeling with generic routines and elements to be re-usable

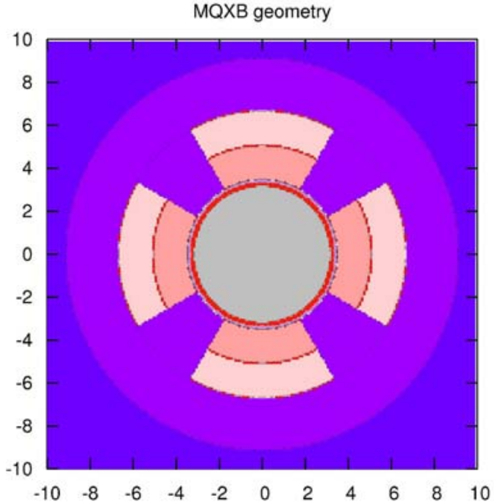
Geometry Layout

- **Insertion region IR1 Nominal LHC version 6.5**
- **Tools for Geometry implementation & visualization**
  - **Simplegeo**
  - **FLAIR**



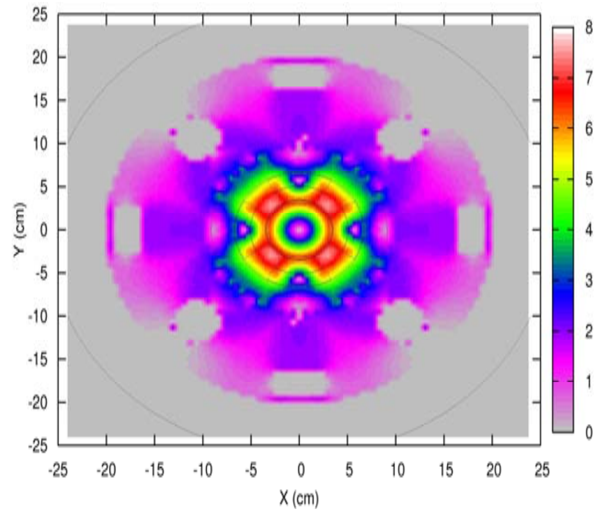




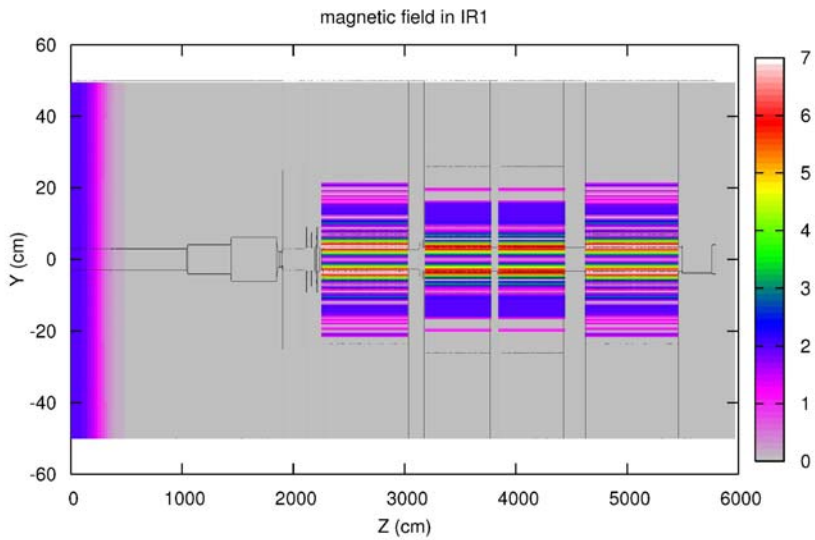


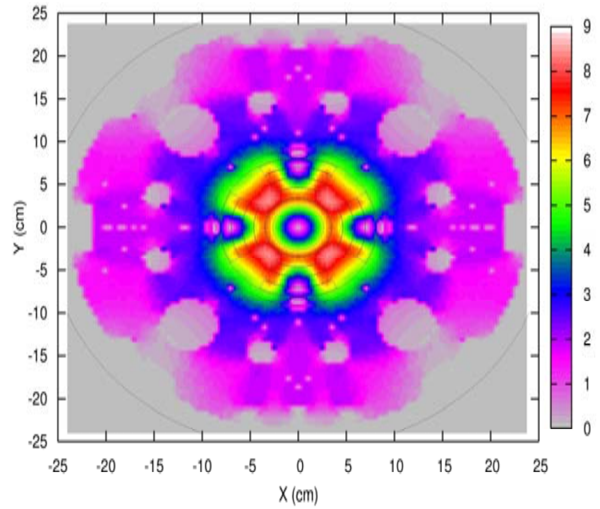
Magnetic fields

- **Quadrupoles MQXA and MQXB : Roxie Data**
  (in the courtesy of C. Vollinger)
  - 2D description, FDDF configuration for the debris particle



- **Solenoid Field in ATLAS 2 Tesla**
  - analytical description





Simulation parameters

Beam parameters

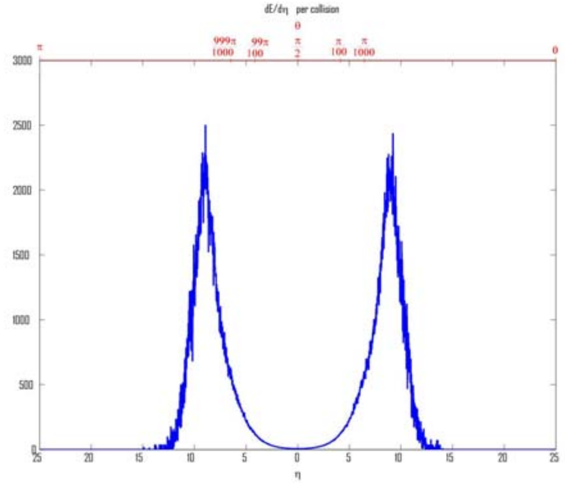
collision points	units	Nominal LHC
sigmax	µm	11.81
sigmay	µm	11.81
sigmaz	cm	5.34

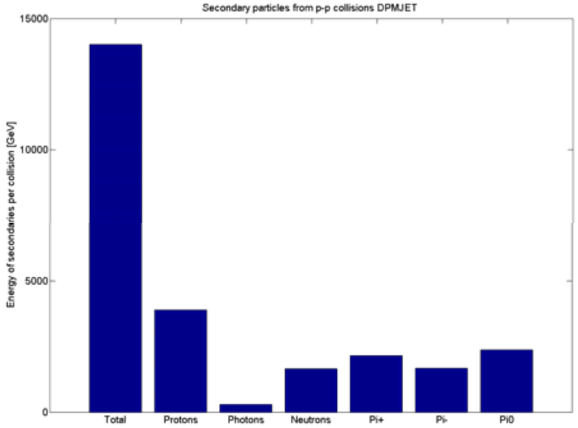
Beams	units	Nominal LHC
half crossing angle	µrad	142.5
crossing plane		vertical
px	GeV/c	0
py	GeV/c	9.975E-01
pz	GeV/c	7.000E+03

Nominal luminosity
10^{34} cm^{-2} s^{-1}

Cross section 80 mbarn

Event generator 14 TeV proton-proton collisions: DPMJET





C. Hoa

22nd March 2007

Simulation parameters

➢ Cut off thresholds

Number of primary particles	700
Average CPU time	36 s/pr
Cut off energy for e-/+e-	<10-3 GeV in TAS and QUADS
Cut off energy for photons	< 10-4 GeV in TAS and QUADS
Cut off energy for Hadrons/ Muons	<100 keV
Cut off for high energy neutrons	< 19.6 Mev
Cut off for low energy neutrons	thermal energies

➢Gain in CPU time factor of 2.5

➢Optimization of CPU time with Biasing methods

- ➢Leading Particle Biasing methods
  - e+/e-, photons
  - hadrons
- ➢Gain in CPU time factor of 2.8

→TOTAL gain in CPU time with a factor of 7

Simulation results

- Dynamic heat loads in Quadrupoles and TAS

$$Power(W) = Power(eV/primary) * e(eV) * L(cm^{-2}s^{-1}) * A(barn) * 10^{-24}$$

1.609e-19 10^34 80e-3

			reference cases	
	Power deposition (W)	**statistical errors (%)**	N. Mokhov [1]	F. Broggi [2]
Insertions	IR1		IR5	IR1
TAS	144.8	5.8	184	139
Q1	37.3	7.1	37.6	27
Q2	28.6	11.1	29.6	45
Q3	26.6	12.3	27.4	28
Q4	44.6	8.9	32.8	23
TOTAL QUADS	137.1	9.9	127.4	123.0

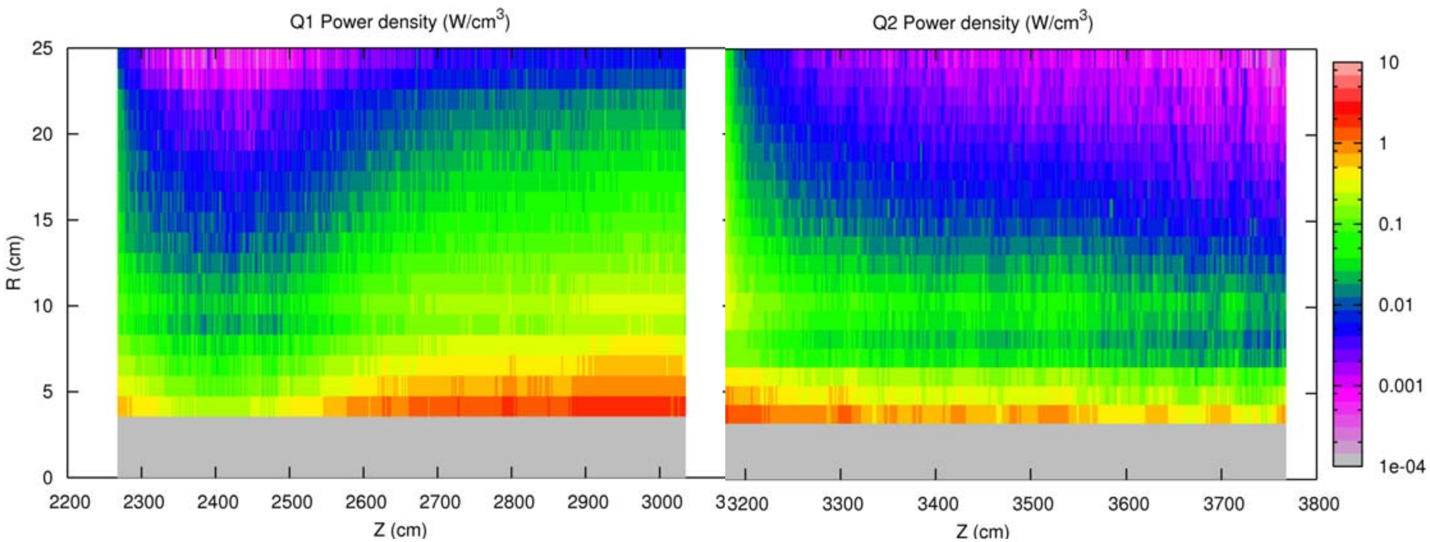
[1] LHC Project report 633, Apr03

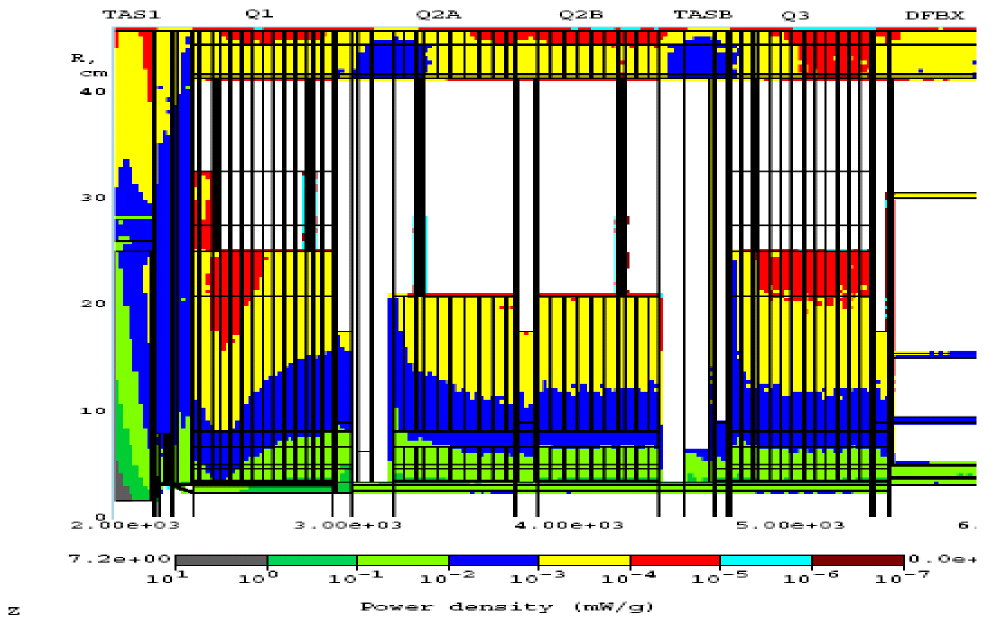
[2] NED presentation, Feb06

- **Fairly good agreement with reference cases**

Simulation results

- Longitudinal power distribution





N. Mokhov [1]

Simulation results

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- **Simulation results**
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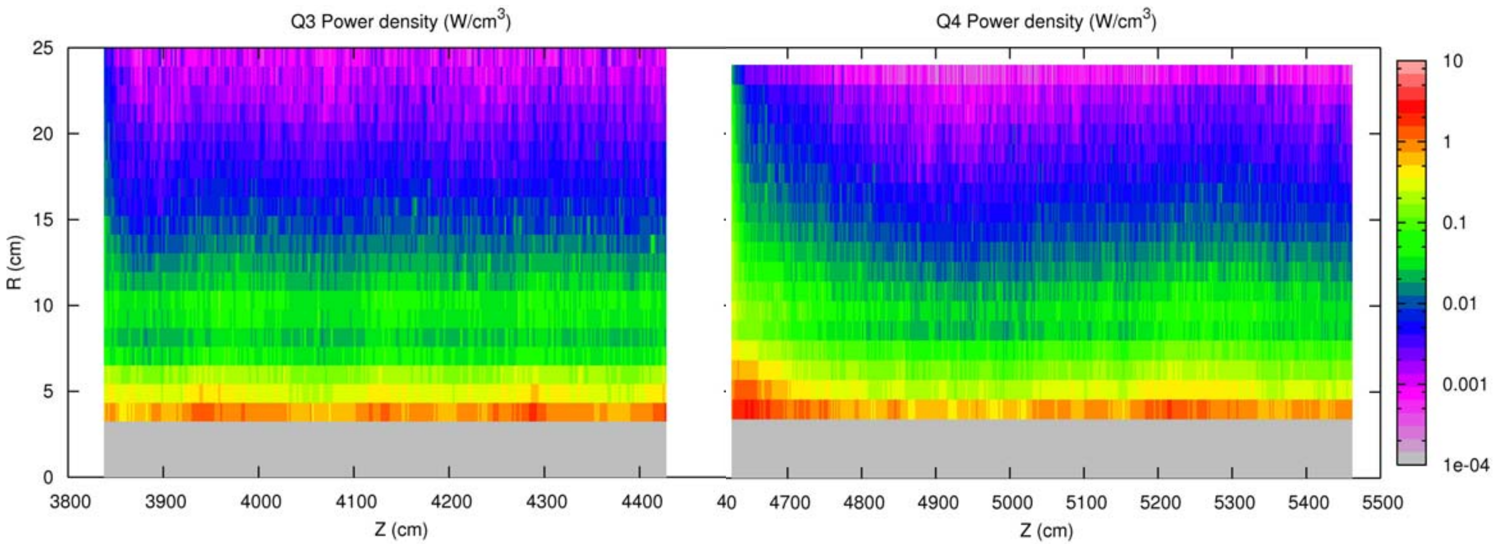
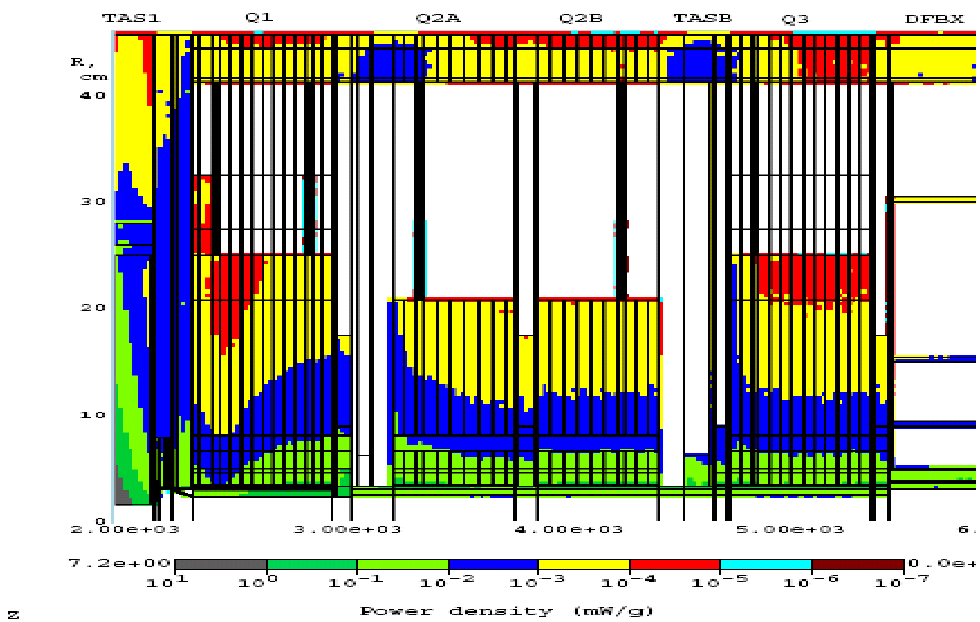
Longitudinal power distribution





N. Mokhov [1]

Simulation results

Introduction

Modeling

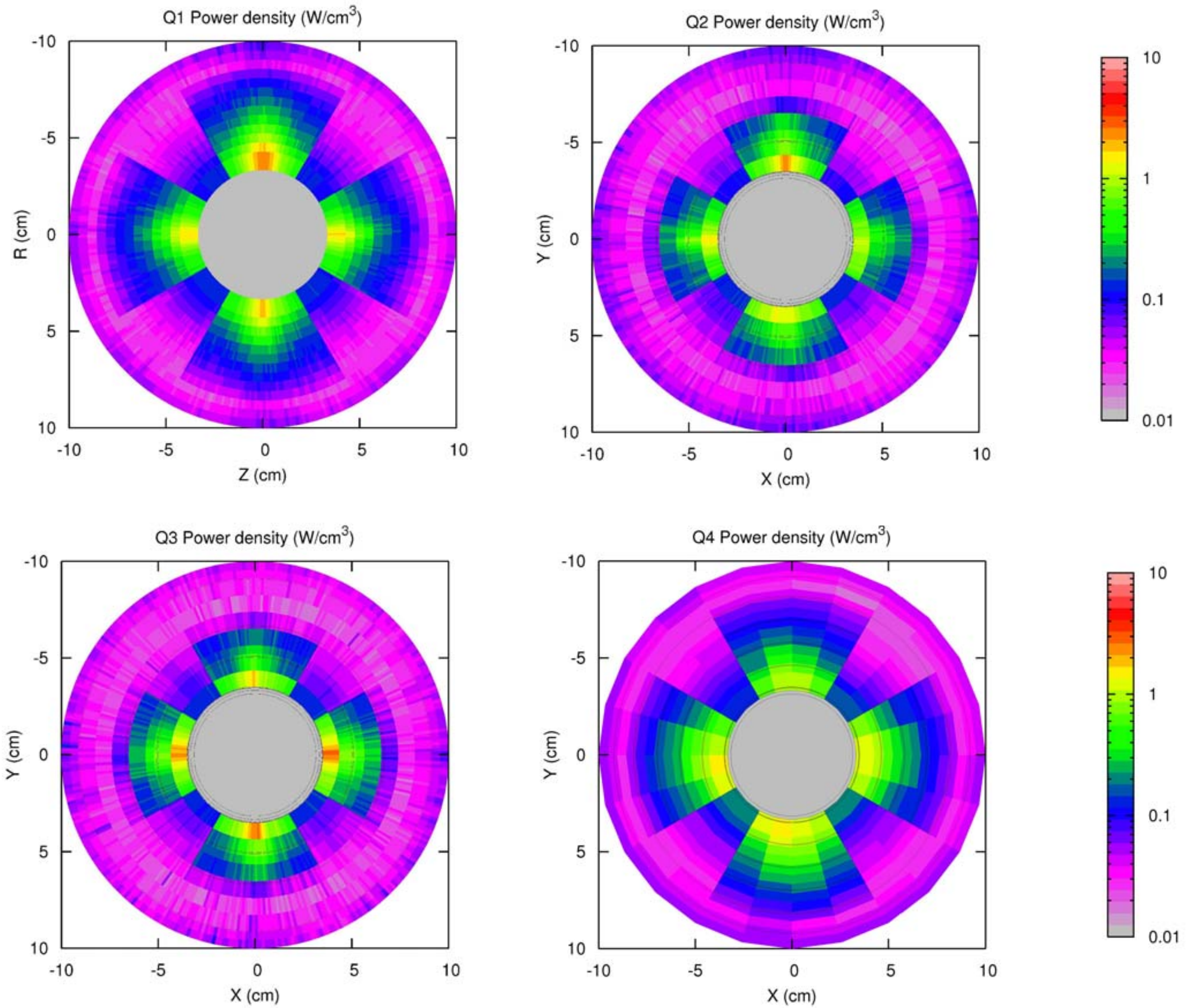
Simulation parameters

Simulation results

Next steps

Conclusions

- Radial power distribution



Next steps

- **Geometry improvements**
  - Beam screens
  - Correctors
- **Magnetic fields**
  - Checking of the tracking on a reference proton (comparison with MAD) in progress
  - ATLAS Solenoid mapping
- **Beam parameters**
  - Vertical/horizontal plane for the crossing angle
  - Implement the divergence of the beam
- **Detailed analysis**
  - Peak energy deposition
  - Particle fluxes

Conclusions

- **Encouraging** first results
  - Good agreement of the dynamic heat loads
  - Similar Energy deposition maps

- **Still many tasks ahead…**
  - Refinement of the modeling for IR1 in progress
  - Detailed analysis to be performed
  - IR5 …

Acknowledgments

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