Seminář ATLAS – FZU AV ČR

28/3/2008

Uvádění pixelového detektoru experimentu ATLAS do provozu

Pavel Jež

FZU AVČR, v.v.i.
FJFI ČVUT

Pixelový detektor - status

- Hlavní rozcestník: https://twiki.cern.ch/twiki/bin/view/Atlas/PixelWiki

- Narozdíl od SCT a TRT není pixelový detektor stále zapojen (řada technických problémů – více info na pixel meetingu, každý čtvrtek od 16h v CERN)

  – Díky tomu se pixelový detektor neúčastní „milestone“ (MX) testů, kdy je (téměř) celý detektor zapojen
  – k dispozici data pouze z ROD simulací

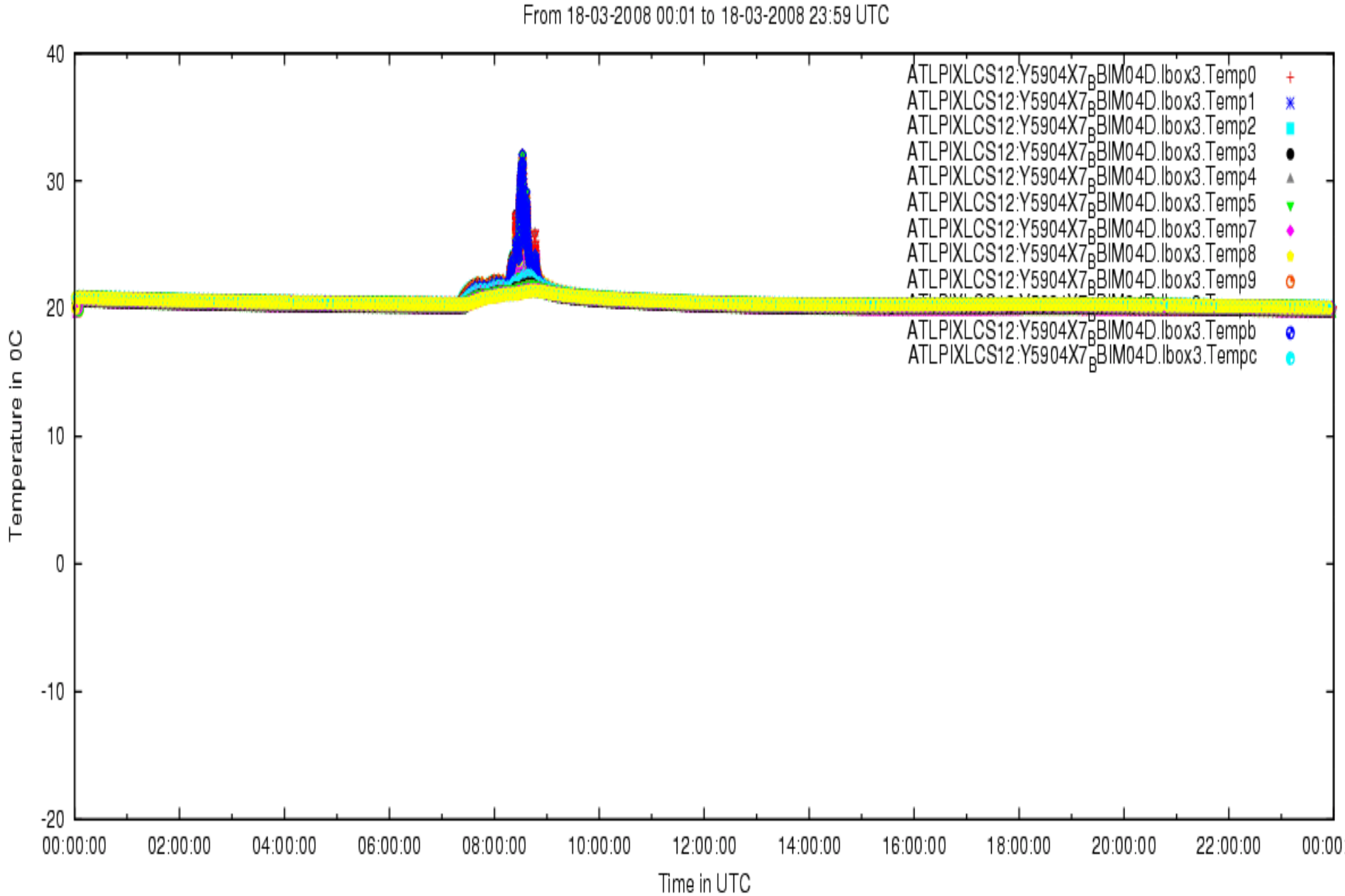
Pixelový detektor – status II

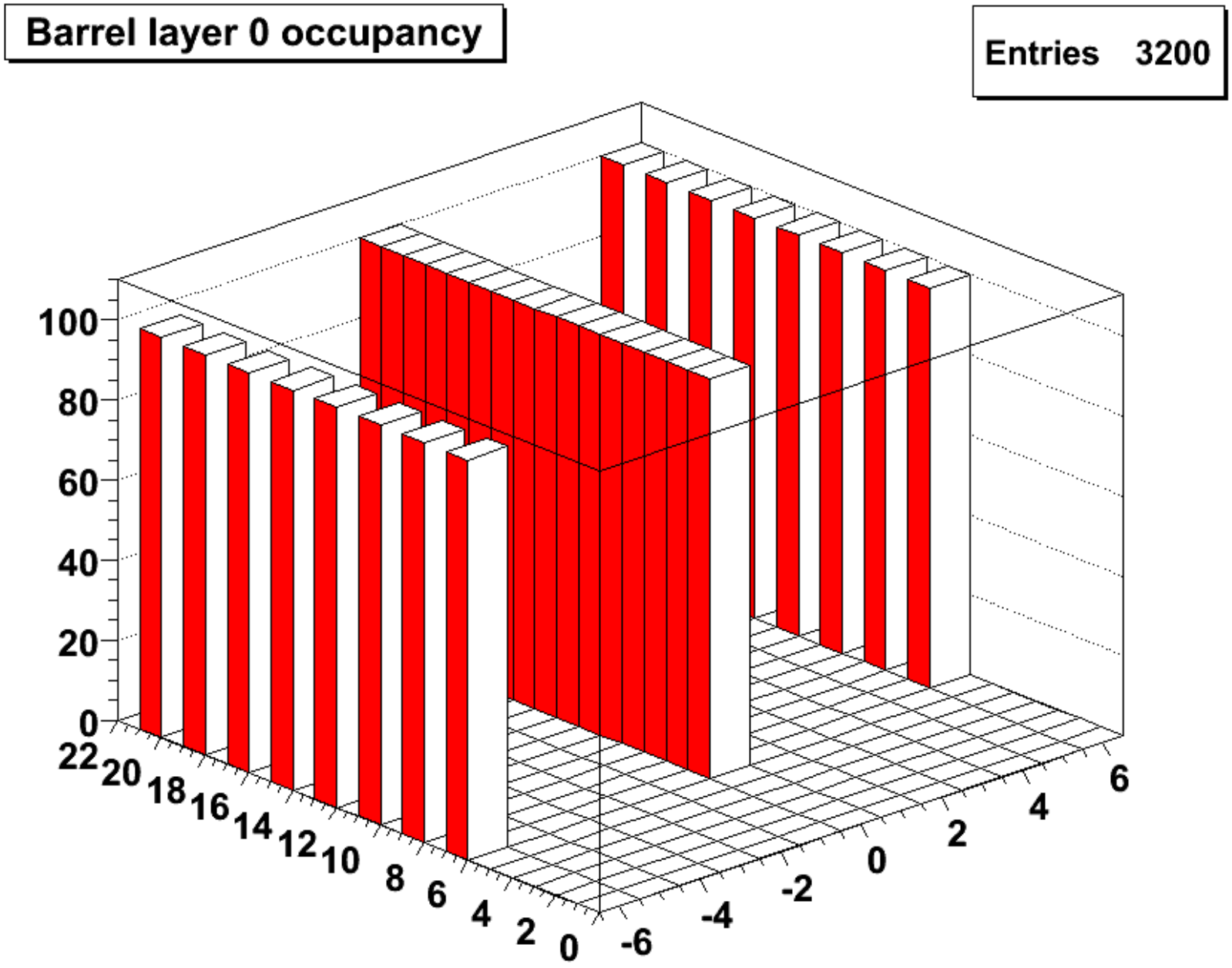
- Testuje a vyvíjí se monitorovací software
  - Není zřejmé, které veličiny je třeba sledovat

- Online monitoring – kontroluje především hardware detektoru, úzká souvislost s DCS (detector control system)
  - Histogramy (dočasně) ukládány v http://www.slac.stanford.edu/~behera/Pixel/DCS_Mon/
- Offline monitoring – slouží ke zjištění kvality dat proudících z detektoru
  - Samostatný balíček v Atheně

InnerDetector/InDetMonitoring/PixelMonitoring

Teplota pixeloveho modulu





Occupancy = number of hits during run

Pixel Offline Software

- Součást SW rámce Athena
  - soubor společných knihoven a nástrojů pro offline software na ATLAS (např. HEPVector...)
  - zároveň je to soubor veškerých algoritmů pro MC simulaci eventu i detektoru, rekonstrukci a fyzikální analýzu
  - balíčková struktura
  - všechny algoritmy v C++

CVS: http://atlas-sw.cern.ch/cgi-bin/viewcvs-atlas.cgi/offline/

LXR: http://alxr.usatlas.bnl.gov/ (s vyhledáváním)

ATHENA

- SW balíčky spravovány pomocí CMT (configuration management tool)
- Uživatel (vývojář) zvolí, s jakou verzí SW chce pracovat a připraví prostředí
  https://twiki.cern.ch/twiki/bin/view/Atlas/ReleaseRecipes
- stáhne zdrojový kód požadovaného balíčku z centrálního úložiště

```
cmt co <název balícku>
```

ATHENA

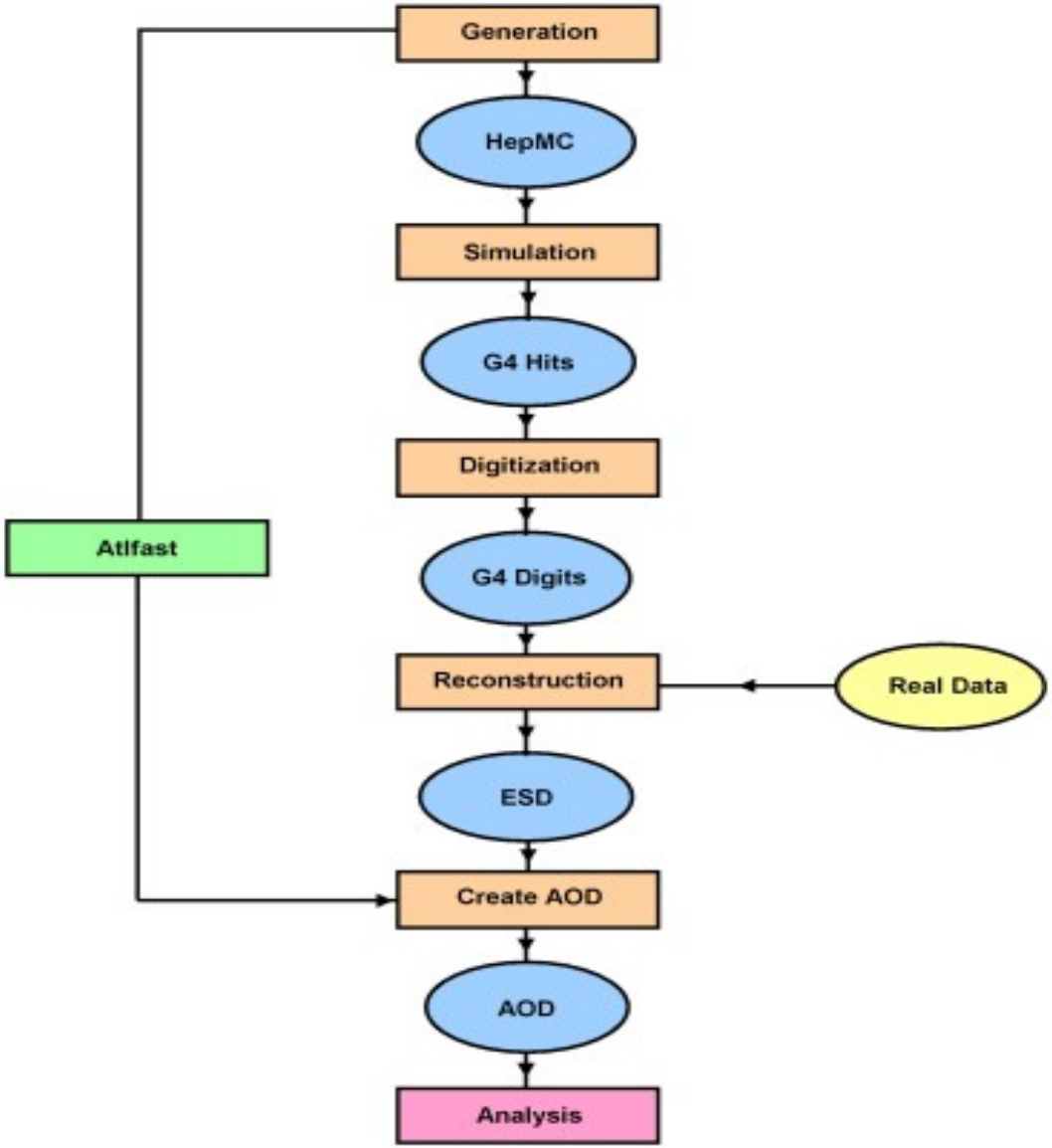
- všechny balíčky mají stejnou adresářovou strukturu:
  - *cmt* : slouží k propojení s ostatními balíčky (soubor `requirements`)
  - *<název balíčku>* : obsahuje hlavičkové soubory
  - *src* : obsahuje algoritmy v C++
  - *run* : zde se spouští jednotlivé joby
  - *share* : obsahuje příklady řídících skriptů (jobOptions), jimiž se volají jednotlivé algoritmy a předávájí parametry

ATHENA – kompilace a spuštění

- typické kroky po stažení baličku:

```
cd cmt
cmt config
source setup.sh
cd ../run
athena ../share/jobOptions.py
```

ATHENA – full chain



Cosmics in the Pit - motivation

- LHC will start commissioning with beams in 2008
- ATLAS will be completed sooner
  - Period with “nothing to do”
- Cosmic rays will be the first (and for some time the only) data for ATLAS
- We know the cosmic rays very well => they could be used for calibration and commissioning of the detector
- Need to have an idea how it will look like => Simulation of cosmic muons.

Cosmics with Pixels in Cavern

Aim:

- simulate cosmic rays in Pixel detector
- determine the rate of cosmic muons
- find and test optimal trigger
- reconstruct the data to find the efficiency of our software

- COMPARE WITH THE EXPERIMENT

Done:

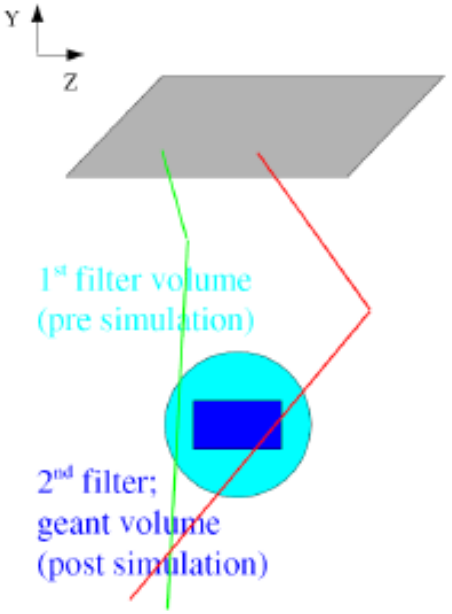
- ✓ simulate cosmic rays in Pixel detector:
  - ➢ 2 independent samples: Elsa+Jamie (cosmics for whole ATLAS)
    Pavel+Michal+Martin (focused on Pixels)
- ✓ determine the rate of cosmic muons
- reconstruct the data to find the efficiency of our software (partially done)

Cosmic muons simulation

Pavel Jez, Michal Marcisovsky, Martin Zeman

- Done in Geant 4 within Athena framework
- Release 13.0.10
- Simulation package: G4AtlasApps-00-02-15
- Cosmic muons generator: CosmicGenerator-00-00-24
  - Fixed bug with upwards heading muons
- New package: G4PixelCosmics-00-00-01
  - Based on G4UserAction
  - Available for testing at ~jez/public/Simulation/G4Extensions
  - Will be put into CVS and become part of nightlies

Filtering muons



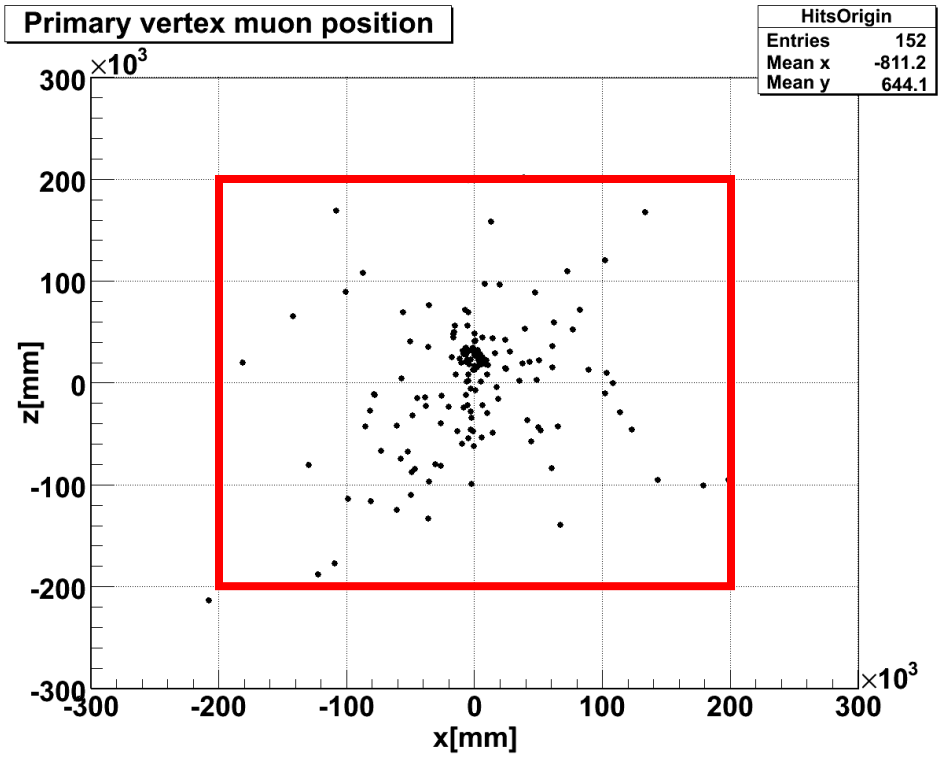
- Selection criteria:
  1. At the generator level:
     - Only muons heading to the 10 m sphere around the origin are accepted
     - Only muons with E > 1 GeV are accepted

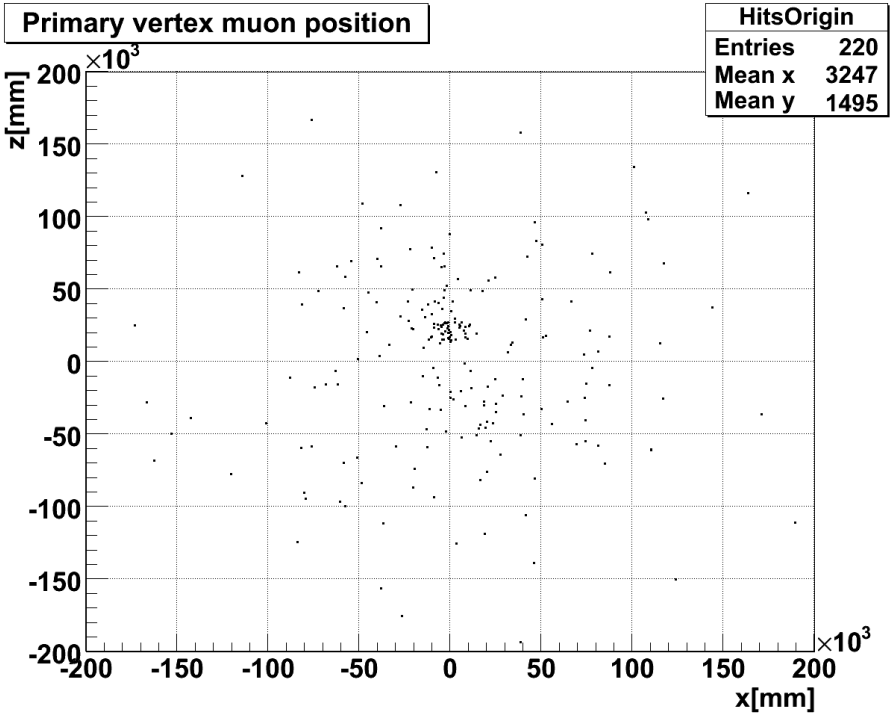
     ➢ Rules out 99.9 % of muons

     NB: Muons are generated ca. 10 m above a surface 600m x 600m over ATLAS cavern
  2. At the simulator/Geant 4 level:
     - Done by **stepping action**
     - At each step the action asks for the **name of the volume** it is in
     - If the name is **Pixel:siLog** or **Pixel:siBLayLog** (i.e. active detector) **and E > 100 MeV** , the track is tagged as having gone through pixel
     - Stepping action asks for position, momentum, primary vertex and momentum, type of particle and writes this information into a text file
     - Stepping action counts number of hits for each track and also writes it into a text file
     - Module, ladder and layer of the hit are stored as well

Cosmics in the Pit - figures

Distribution of the primary vertices





"large" sample

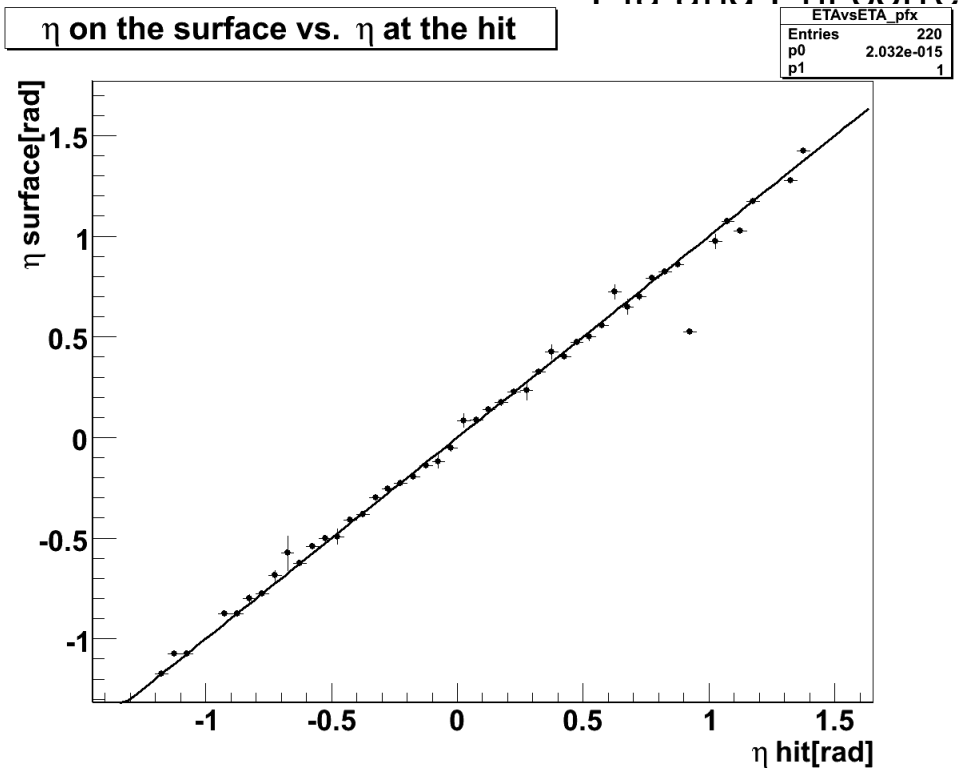
"standard" sample

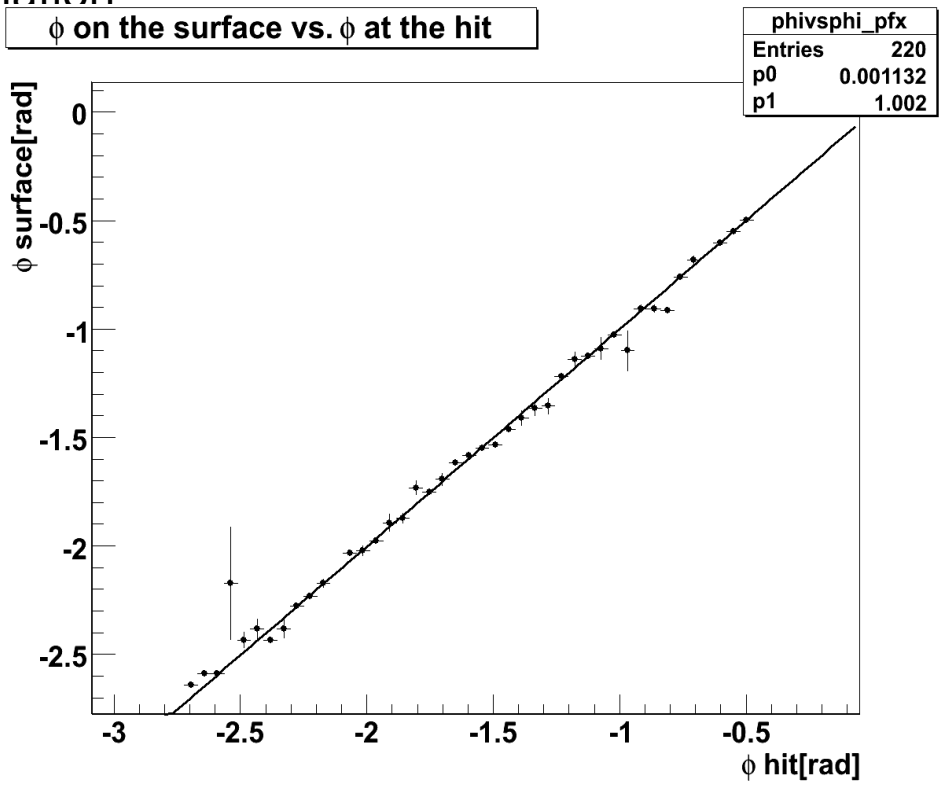
⇒ 400 m × 400 m is completely satisfactory

Pavel Jez, Michal Marcisovsky , Martin Zeman
Institute of Physics, Prague

Cosmics in the Pit - figures

Eta and Phi correlation





Fit: y = x + 2e-15

Fit: y = 1.002x + 0.001

⇒ practically identity ⇒ minimal scattering

Pavel Jez, Michal Marcisovsky , Martin Zeman
Institute of Physics, Prague

Cosmics in the Pit - status

- 4 types of simulated samples:
  - "standard" = surface 400 m × 400 m, optimizing sphere – 10 m radius
    - Good approximation to real situation
    - Rate in Pixels – **0.85 Hz**
  - "spec1" = surface 60 m × 60 m, optimizing sphere – 5 m radius
    - Focused on the low energy muon through shafts
    - Rate in Pixels – **0.38 Hz**
  - "spec2" = surface 400 m × 400 m, optimizing sphere – 40 m radius
    - Focused on the whole cavern
  - "large" = surface 600 m × 600 m, optimizing sphere – 10 m radius
    - Study of the large surface effect

Cosmic muons rates

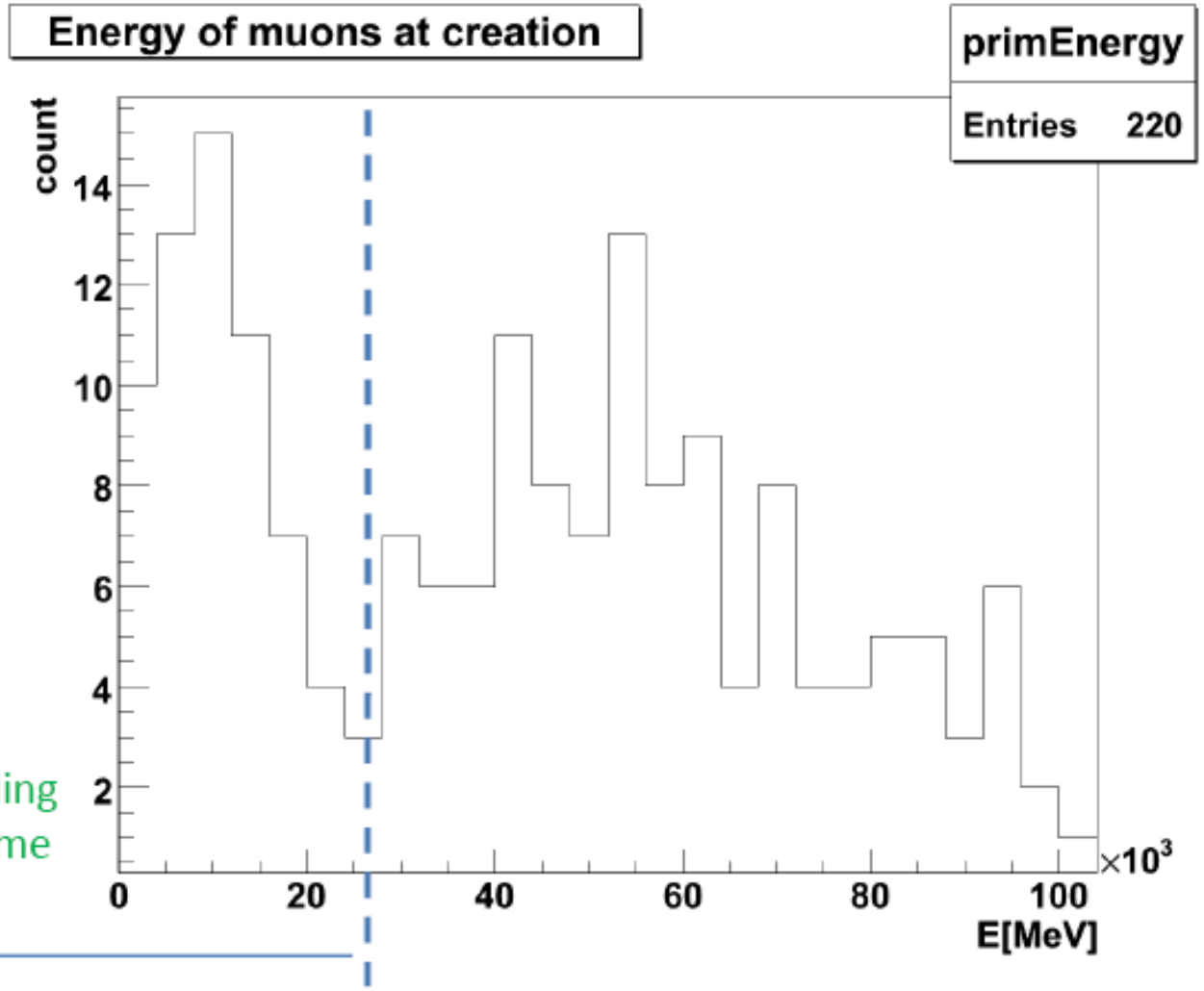
standard sample

Generated	Accepted	>=1 pixel hit	Time	Rate
6 907 433 412	11 575 728	220	259.6 s	**0.85 Hz**

For reference: Result by Beate, Max and Tobi for the cosmic muon rate in Pixel detector is 0.89 +-0.36 Hz.

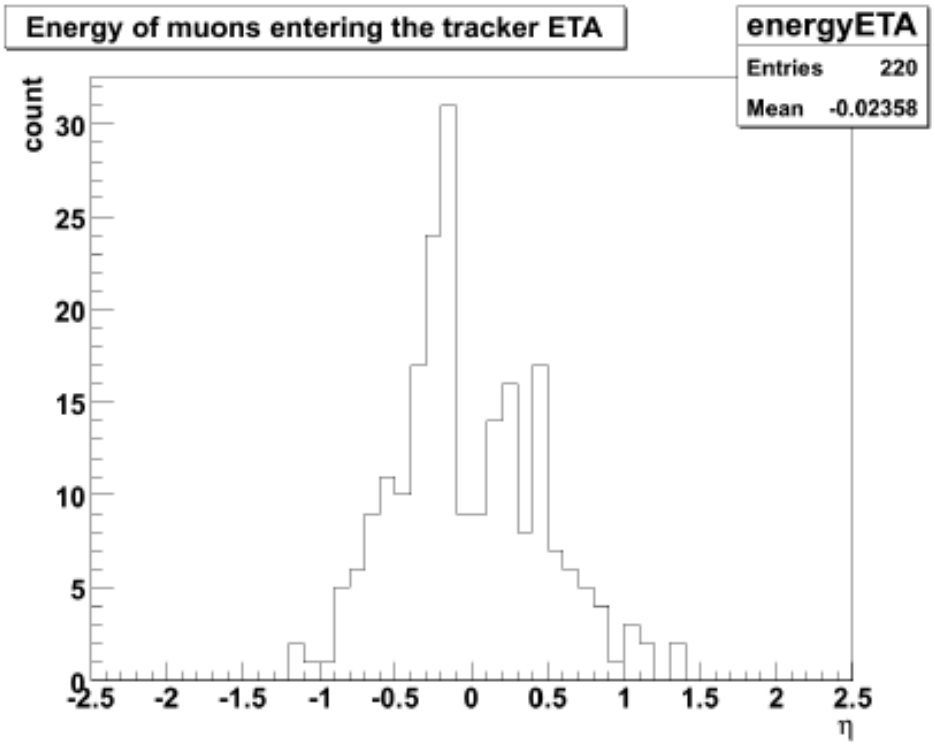
Barrel hits (71 %)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**>=3**
Number	3	22	20	10	8	20	21	79
Rate [Hz]	0.03	0.21	0.19	0.10	0.08	0.19	0.20	0.3
Endcap Hits (29%)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**>=3**
Number	32	22	5	2	0	1	0	8
Rate [Hz]	0.14	0.12	0.02	0	0.02	0	0	0.02

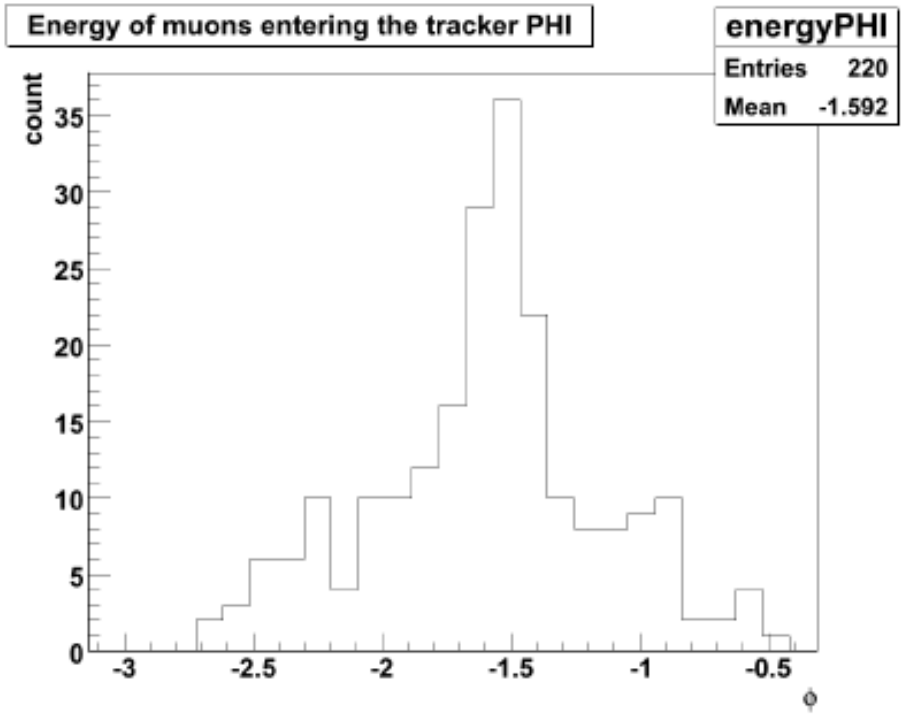
Cosmic muons distribution
Energy on the surface



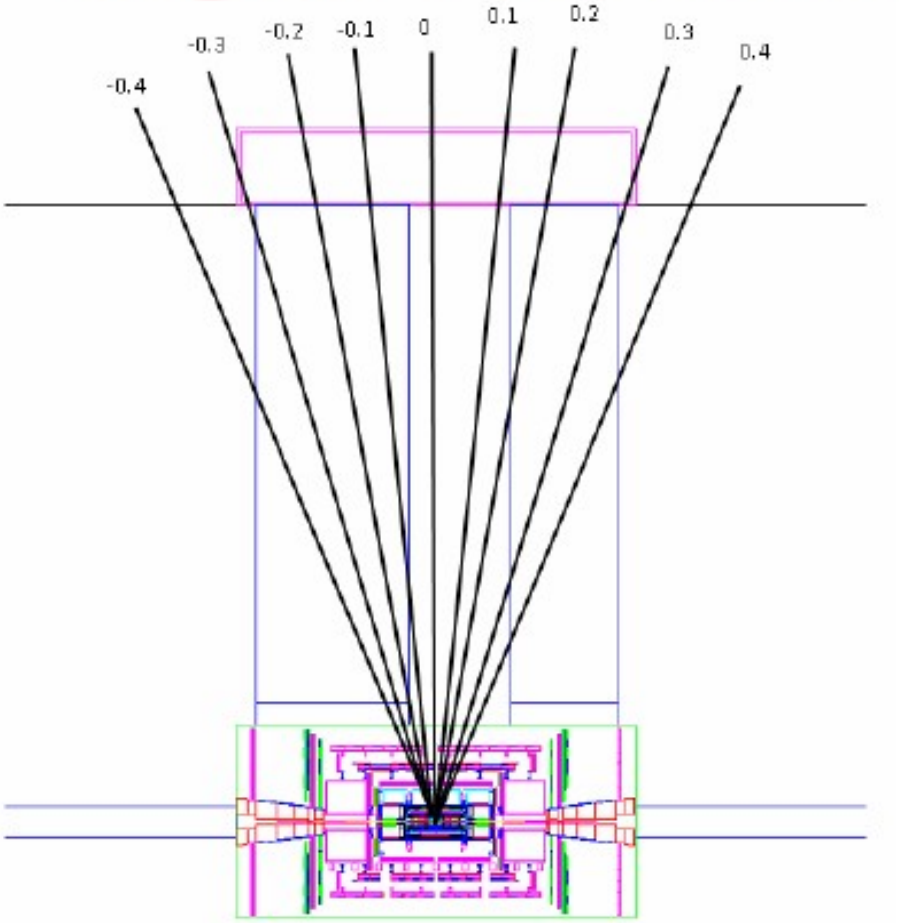
Low energy muons, spending most of the time in shafts

Cosmic muons distribution
angular distribution



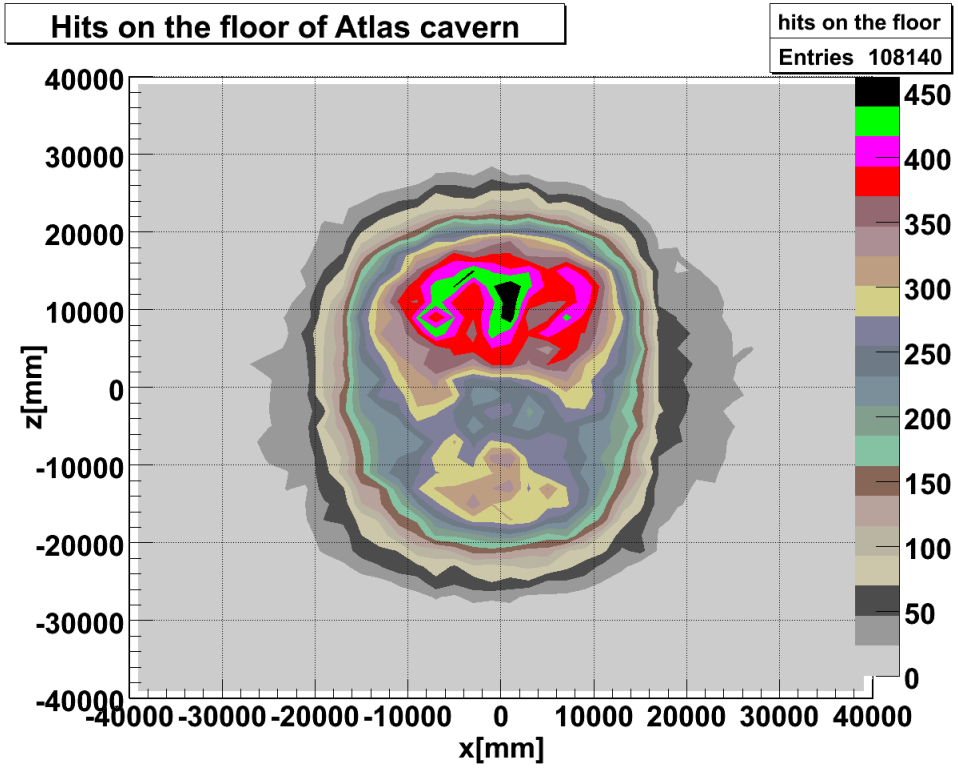


Cosmic muons distribution
angular distribution

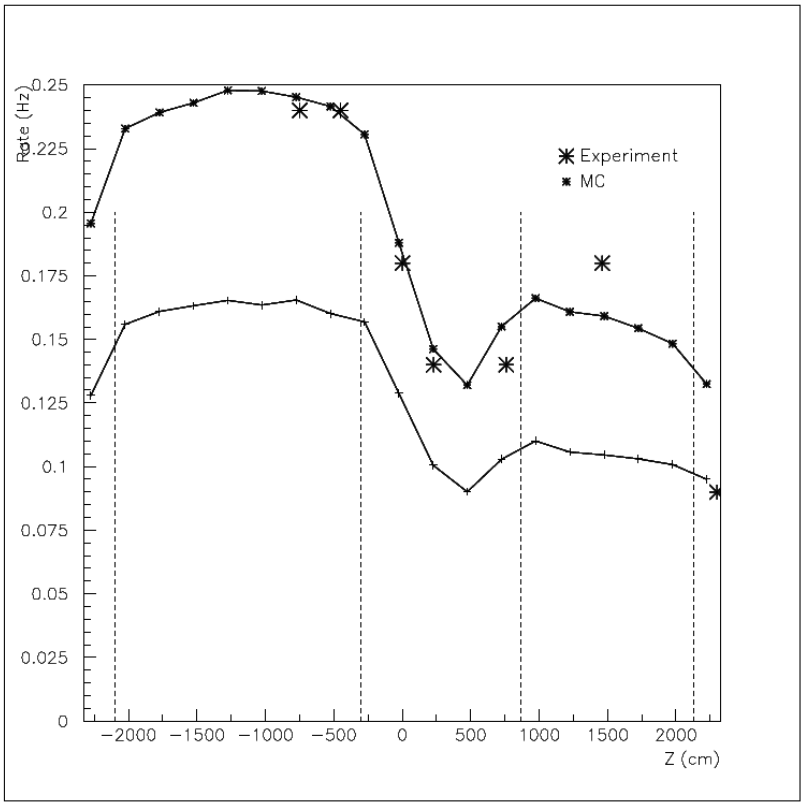


Cosmics in the Pit - figures

Cavern floor hits



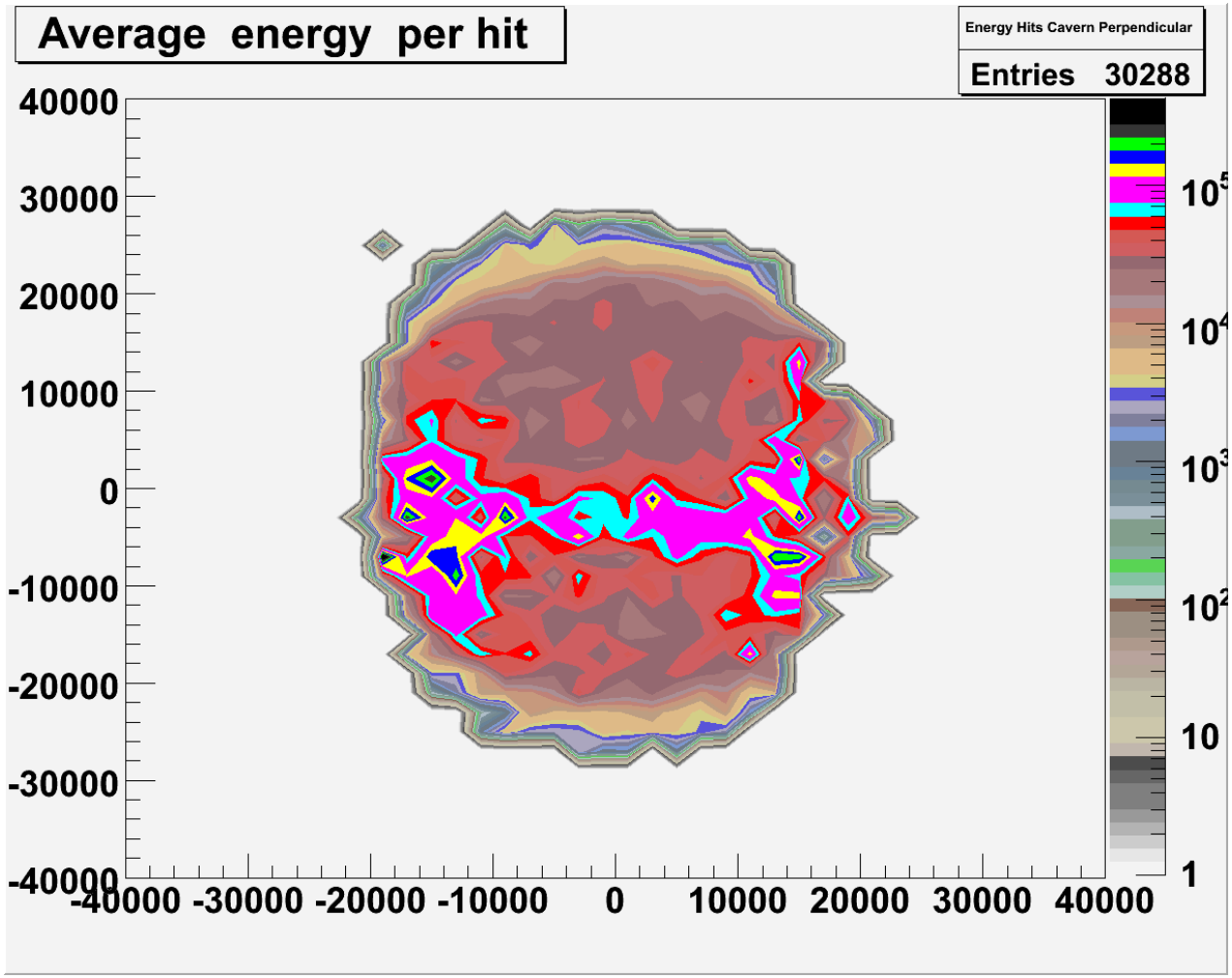
simulation



Measurement + old simulation

Pavel Jez, Michal Marcisovsky , Martin Zeman
Institute of Physics, Prague

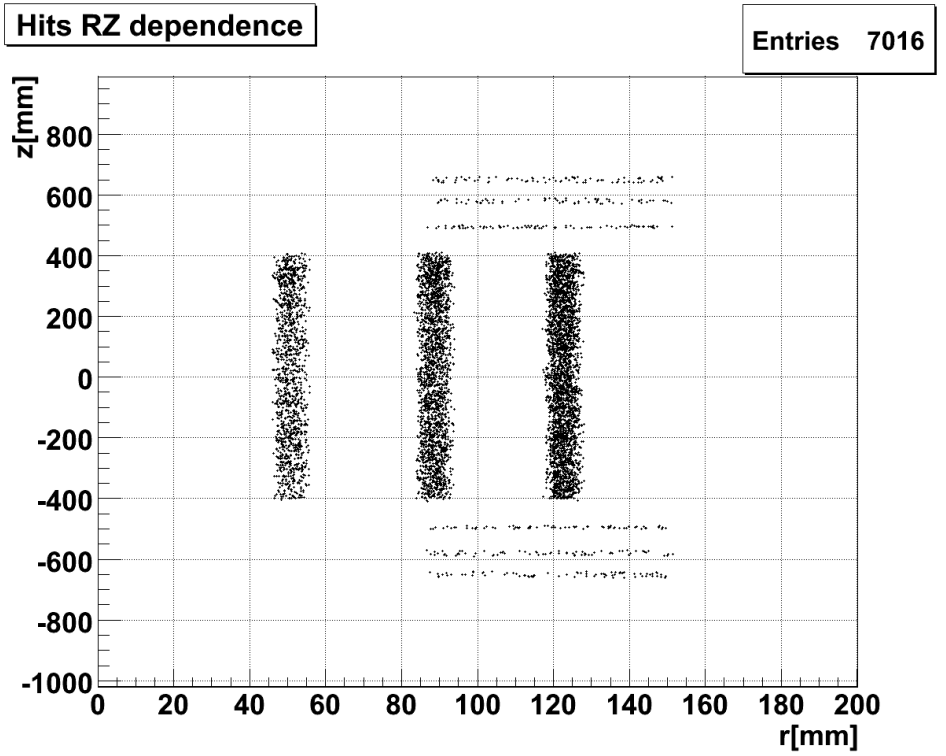
Cosmics in the Pit - figures



Cosmics in the Pit - figures

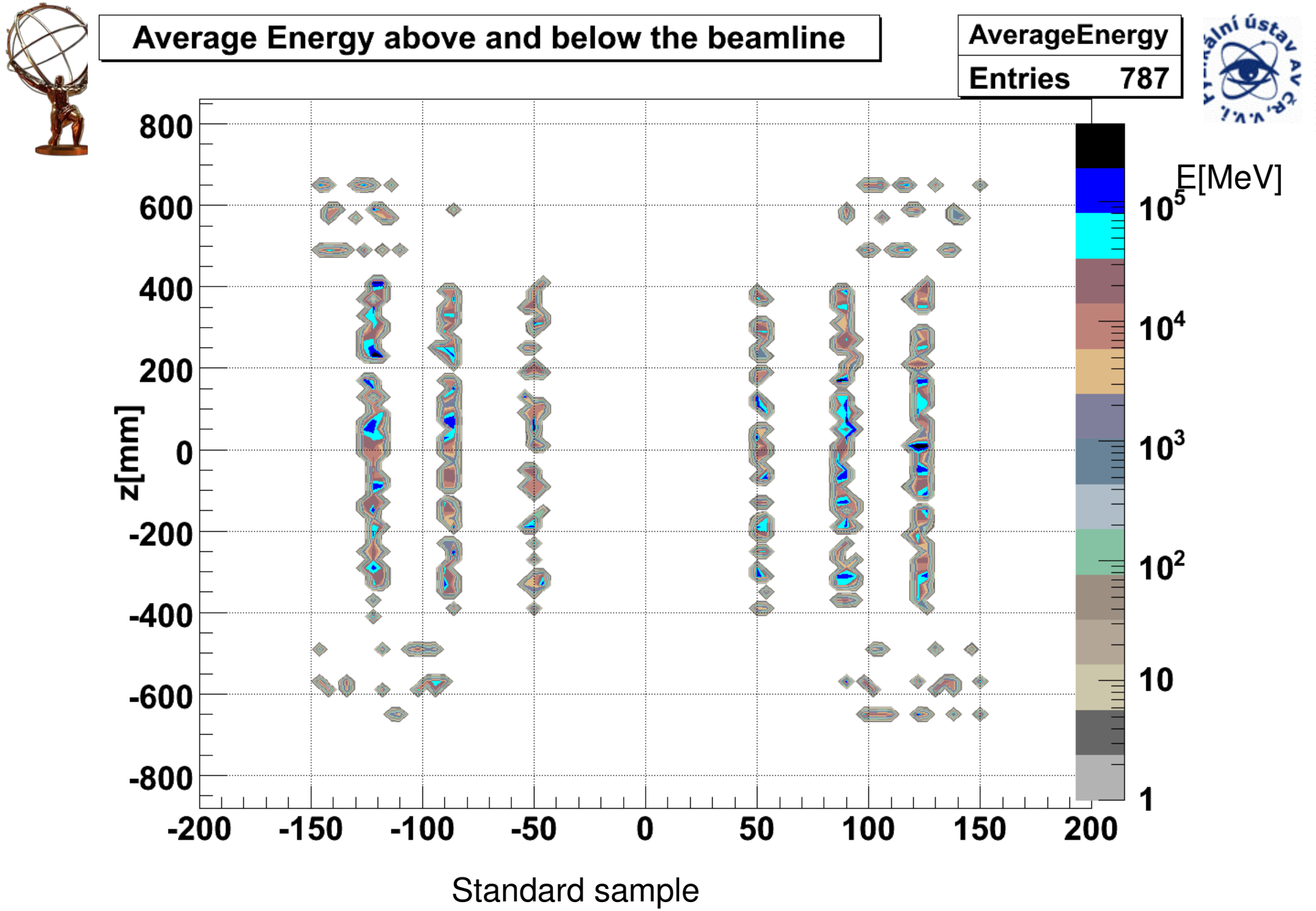
Hits in the Pixel detector

Standard sample



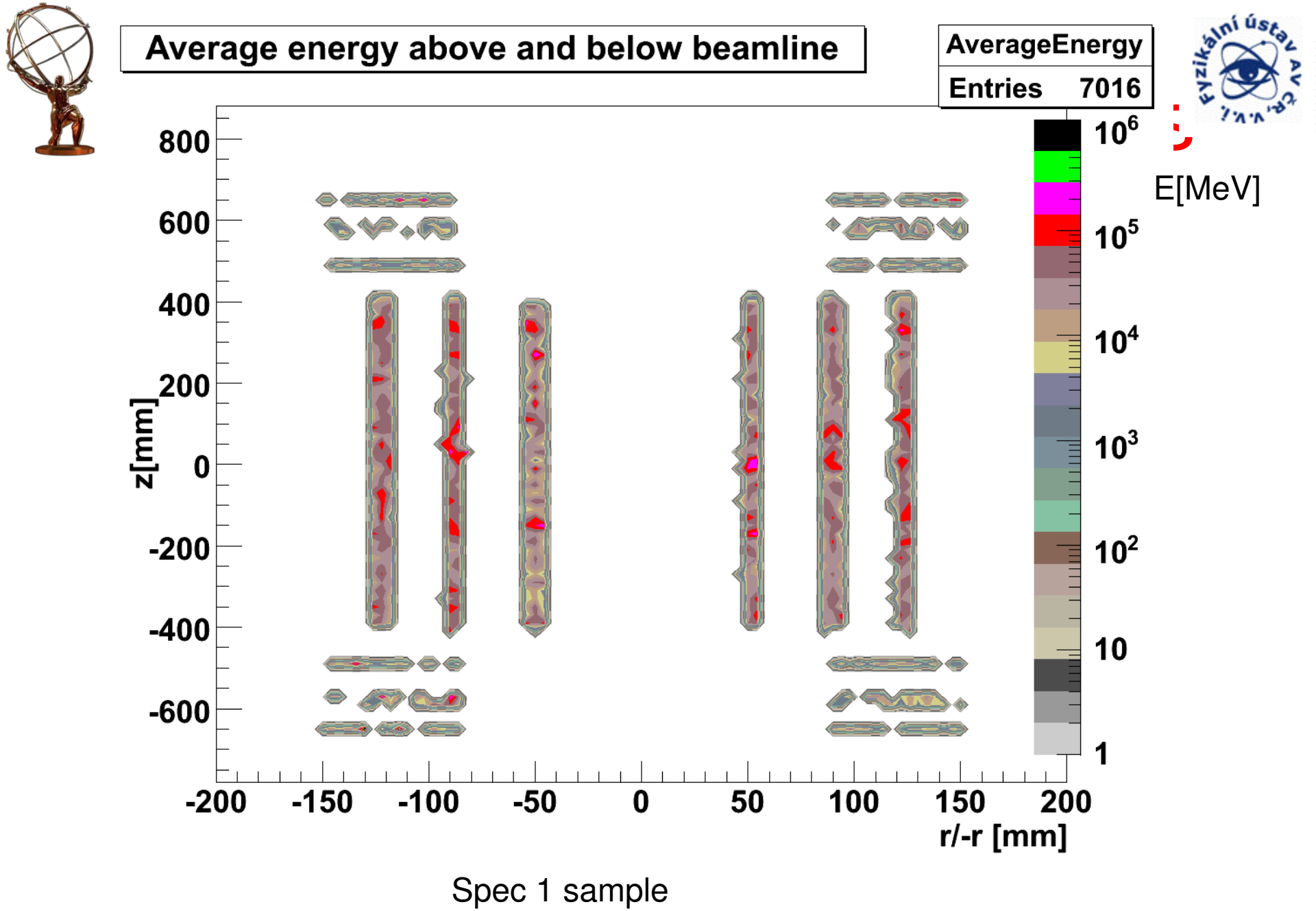
Spec1 sample

Pavel Jez, Michal Marcisovsky , Martin Zeman
Institute of Physics, Prague



Standard sample

Pavel Jez, Michal Marcisovsky , Martin Zeman
Institute of Physics, Prague



Spec 1 sample

Pavel Jez, Michal Marcisovsky , Martin Zeman
Institute of Physics, Prague

Simulace kosmiky - závěr

- cross-check oficiálních výsledků
- potvrzení toho, že simulace funguje kvalitativně správně
- možnost porovnání s experimentálními daty pro SCT a TRT (ne Pixel. Stále není zřejmé, zda vůbec nějaká data budou)
- vynikající cvičení na použití Atheny a Geant4