Analysis of experimental data for selection Lambda-signal at the BM@N experiment

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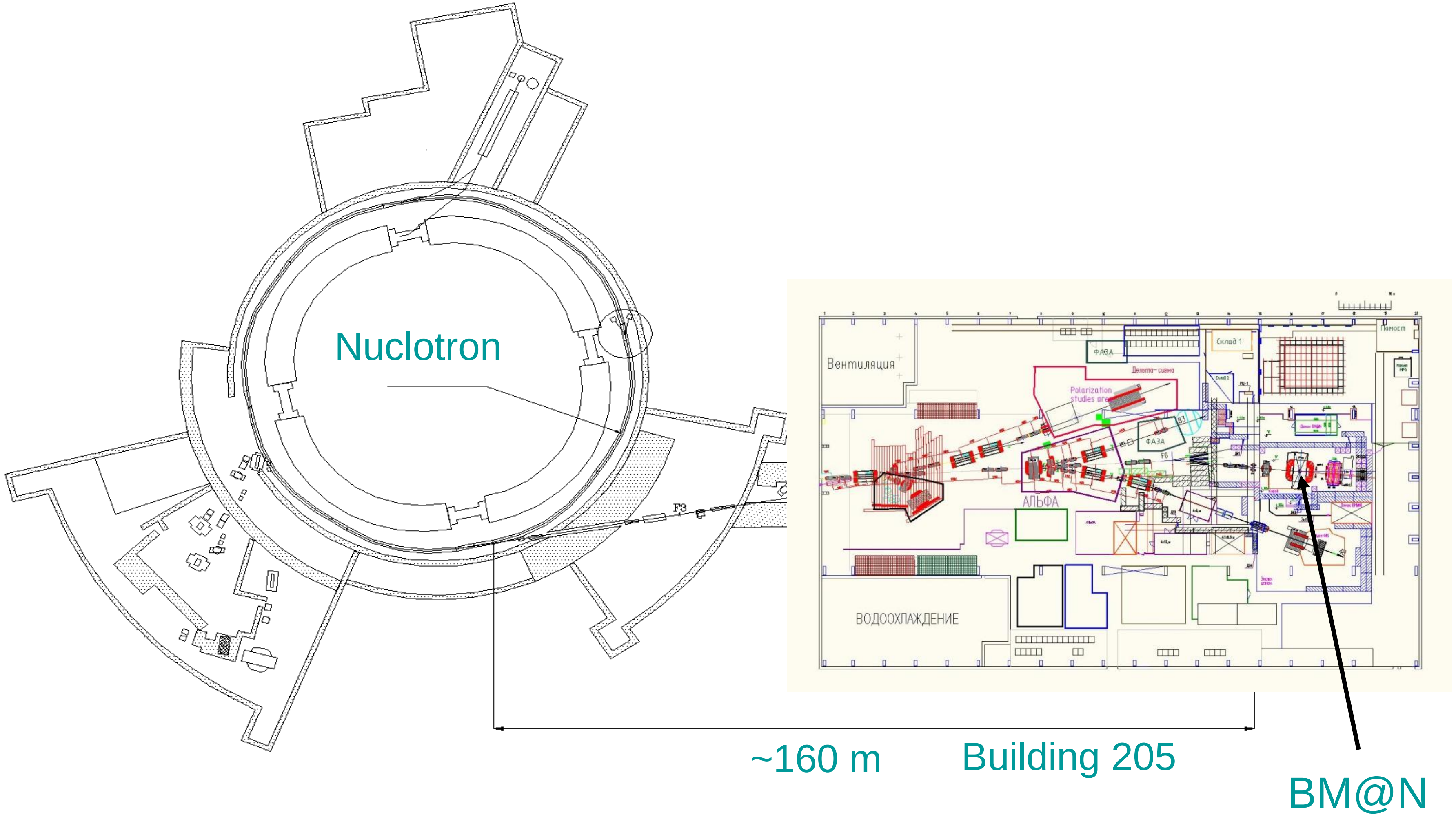
Outlines

- Aim of the project
- BM@N Set-up
- GEM detectors
- Analysis of Λ reconstruction
- Conclusion

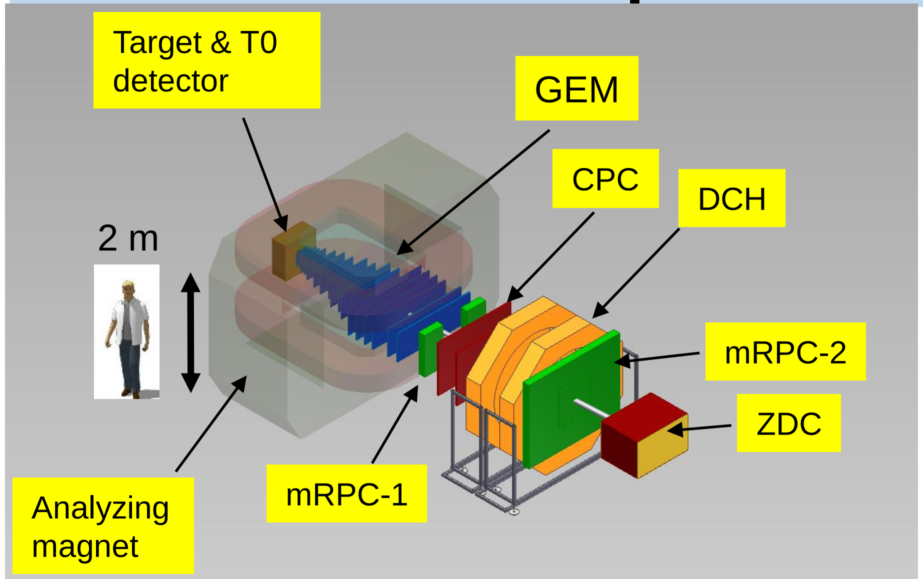
Aim of the project

- Study the structure of Baryonic matter at the Nuclotron (BM@N)
- Study the structure of Gas Electron Multipliers (GEM) located in BM@N
- Analysis of Λ reconstruction with experimental data

Baryonic Matter at Nuclotron BM@N



BM@N Setup



BM@N advantage: large aperture magnet (~1 m gap between poles)

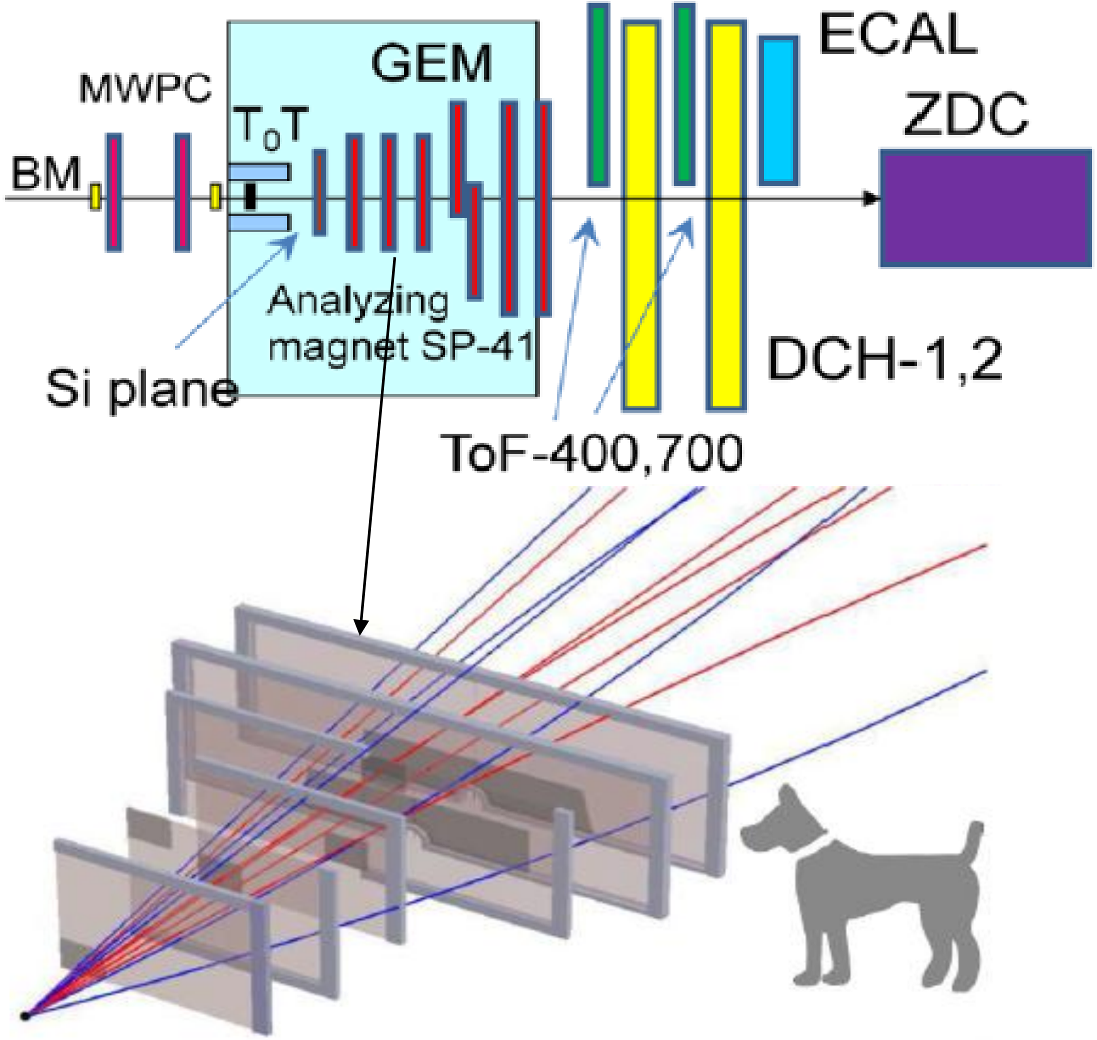
→ fill aperture with coordinate detectors which sustain high multiplicities of particles

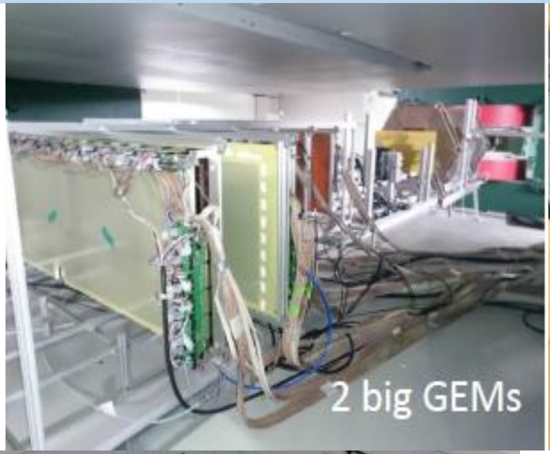
→ divide detectors for particle identification to “near to magnet” and “far from magnet” to measure particles with low as well as high momentum (p > 1-2 GeV/c)

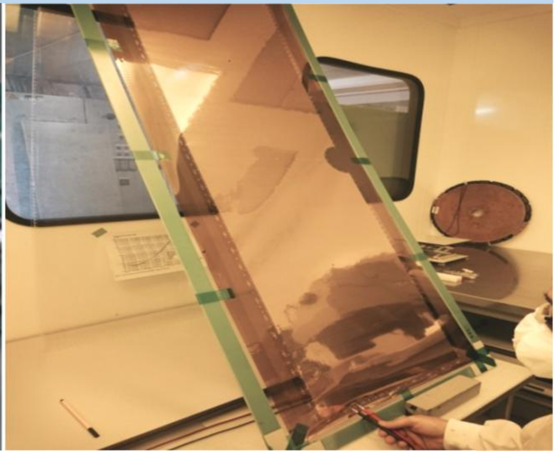
→ fill distance between magnet and “far” detectors with coordinate detectors

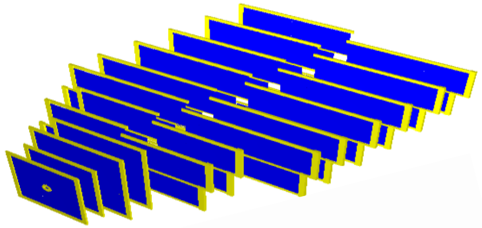
- Central tracker (GEM+Si) inside analyzing magnet to reconstruct AA interactions
- Outer tracker (DCH,CPC) behind magnet to link central tracks to ToF detectors
- ToF system based on mRPC and T0 detectors to identify hadrons and light nucleus
- ZDC calorimeter to measure centrality of AA collisions and form trigger
- Detectors to form T0, L1 centrality trigger and beam monitors
- Electromagnetic calorimeter for γ,e+ e-

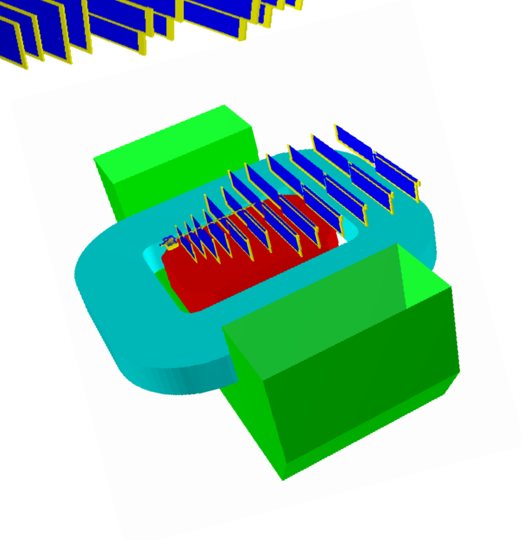
BM@N set-up in the deuteron run



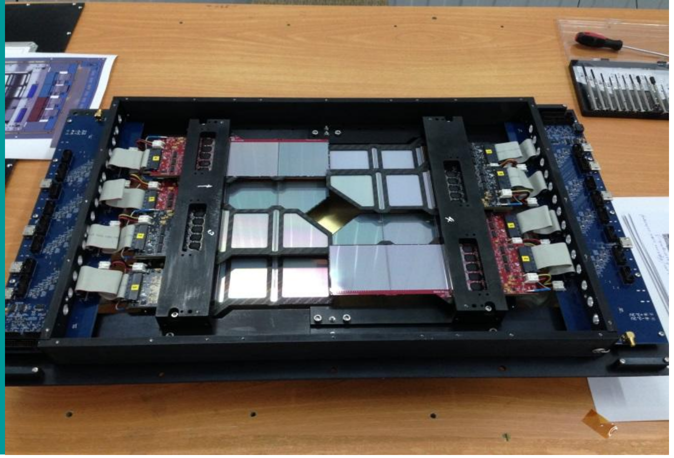




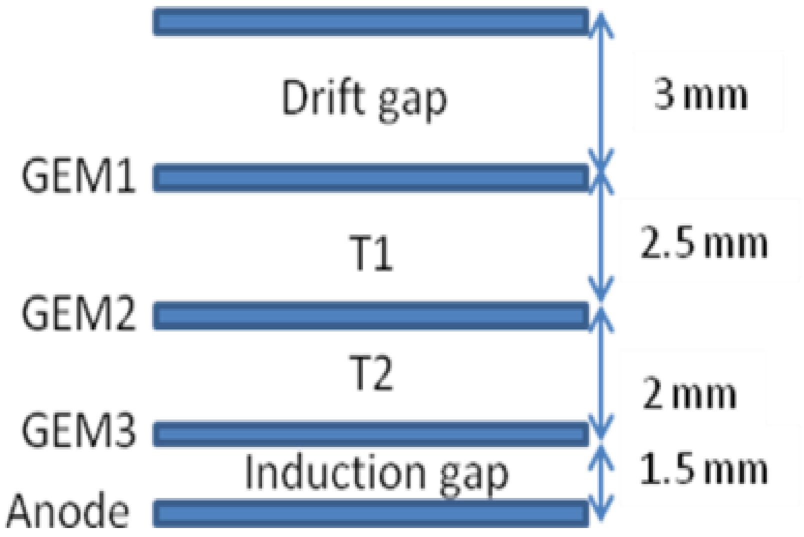


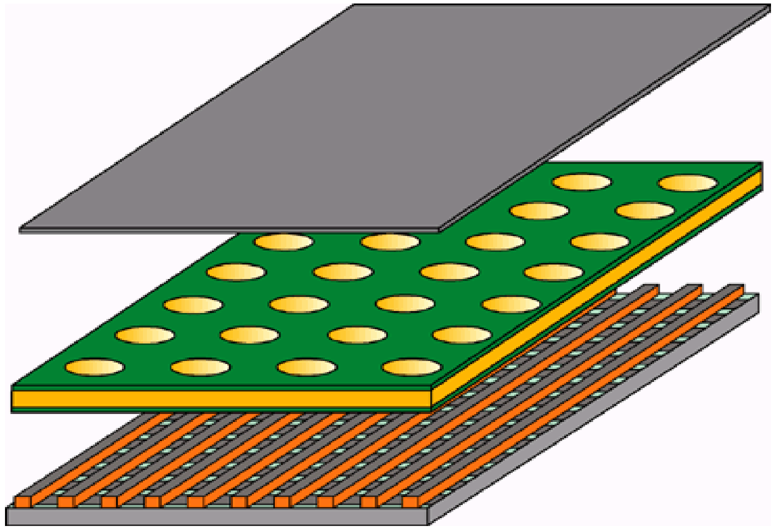


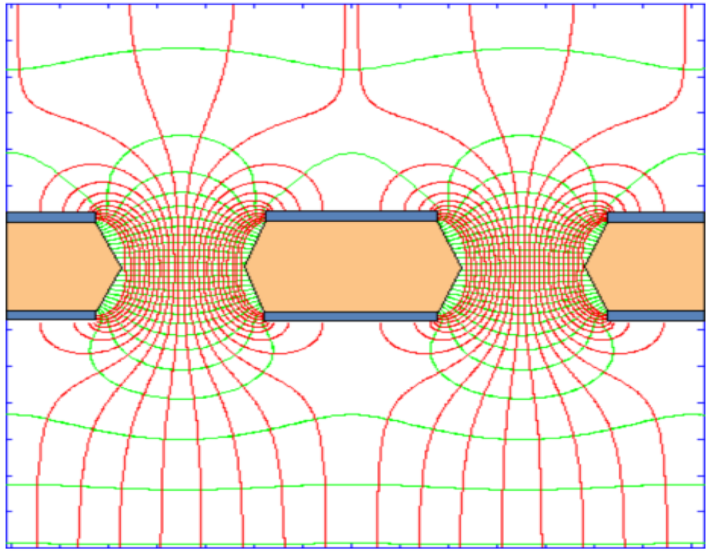
- for tracking in technical runs with deuteron and carbon beams in December 2016 and March 2017 used 5 detectors 66 x 41 cm^2 and 2 detectors 163 x 45 cm^2
- 2-coordinate Si detector with strip pitch of 95&103µm, full size of 25 x 25 cm^2 , 10240 strips
- Detector combined from 4 sub-detectors arranged around beam, each sub-detector consists of 4 Si modules of 6.3 x 6.3 cm^2
- One plane installed in front of GEM tracker and operated in March 2017

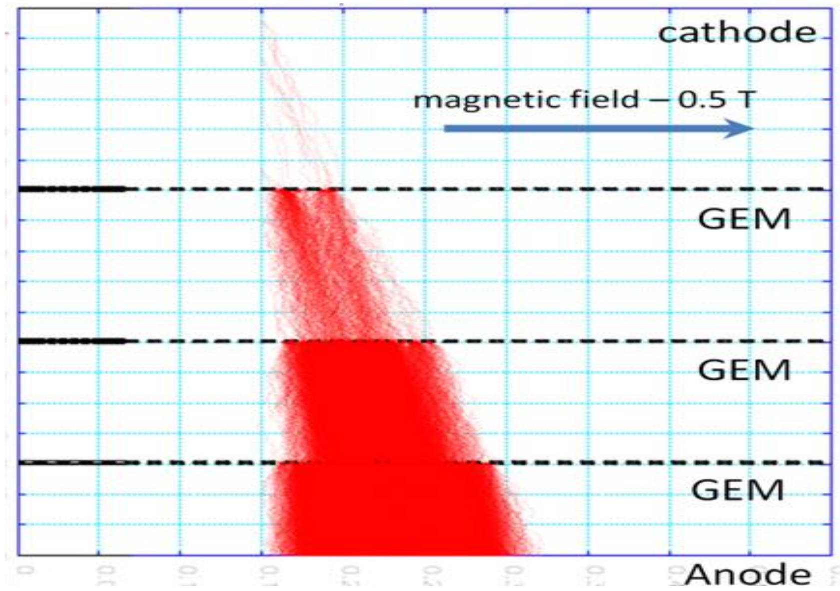


GEM Detectors operation







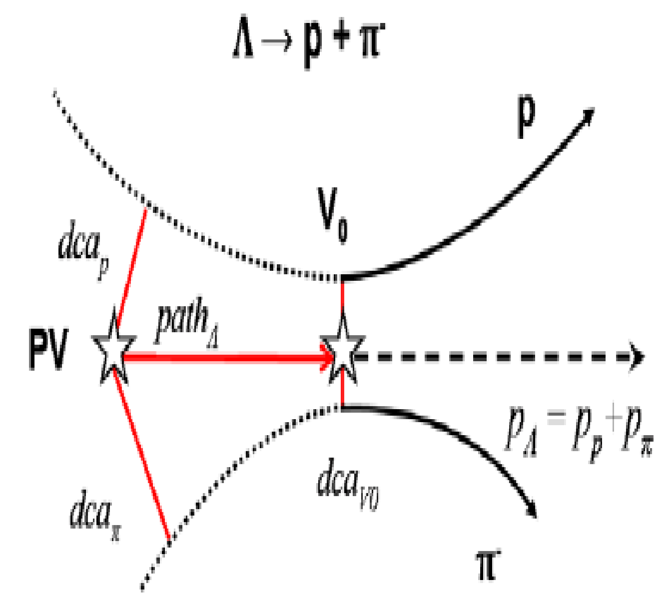


Analysis of Λ reconstruction with experimental data

- Used data set of d+C
- Reconstructed using their decay mode into two oppositely-charged tracks
- Signal topology: decay of a relatively long-lived particle into two tracks

Selection Criteria

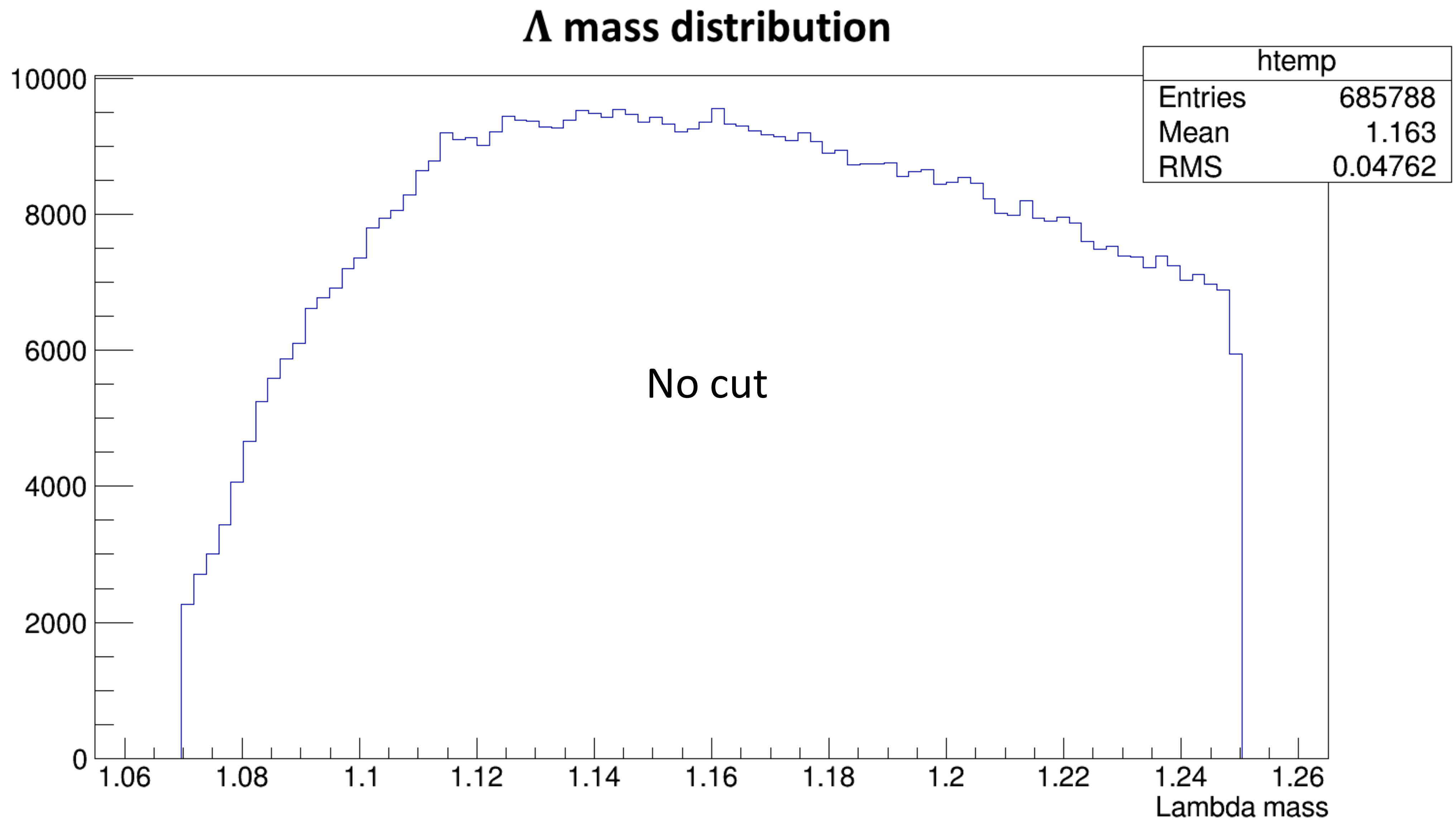
- Relatively large distance of the closest approach (DCA) to the Primary Vertex
- Small track-to-track separation in the decay vertex
- Relatively large decay length of mother particle



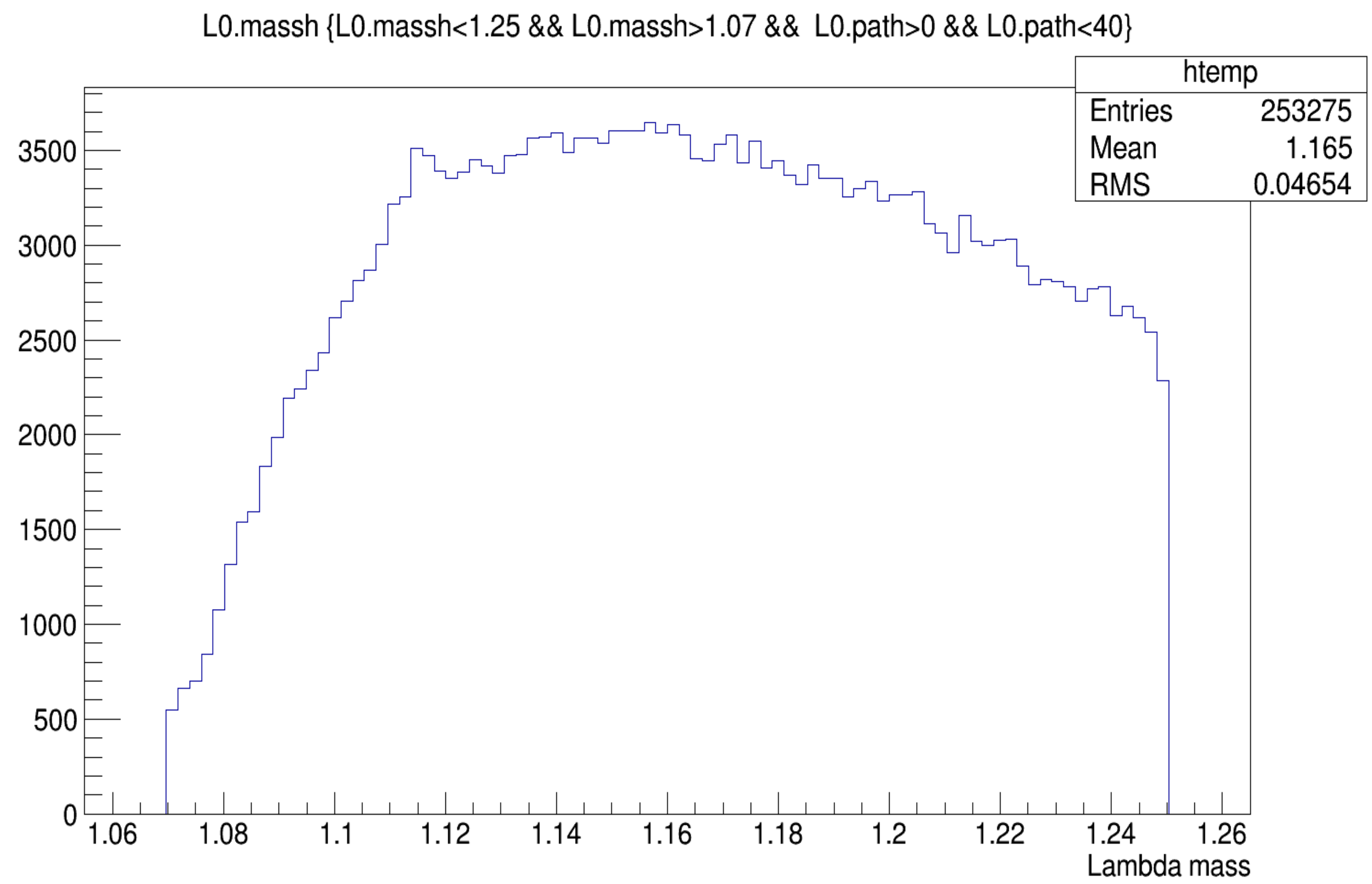
Event topology:

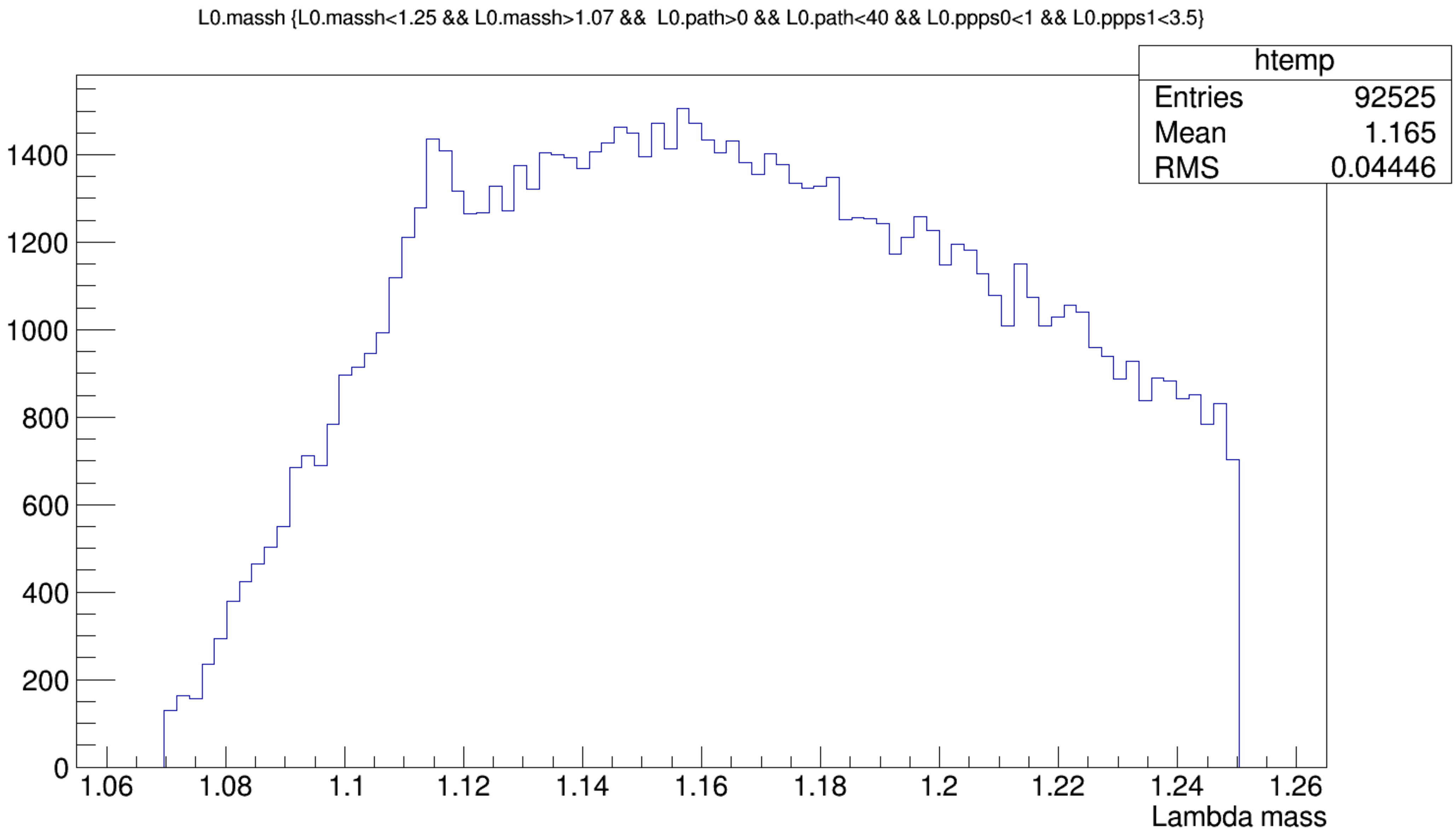
- ✓ PV – primary vertex
- ✓ V_0 – vertex of hyperon decay
- ✓ dca – distance of the closest approach
- ✓ path – decay length

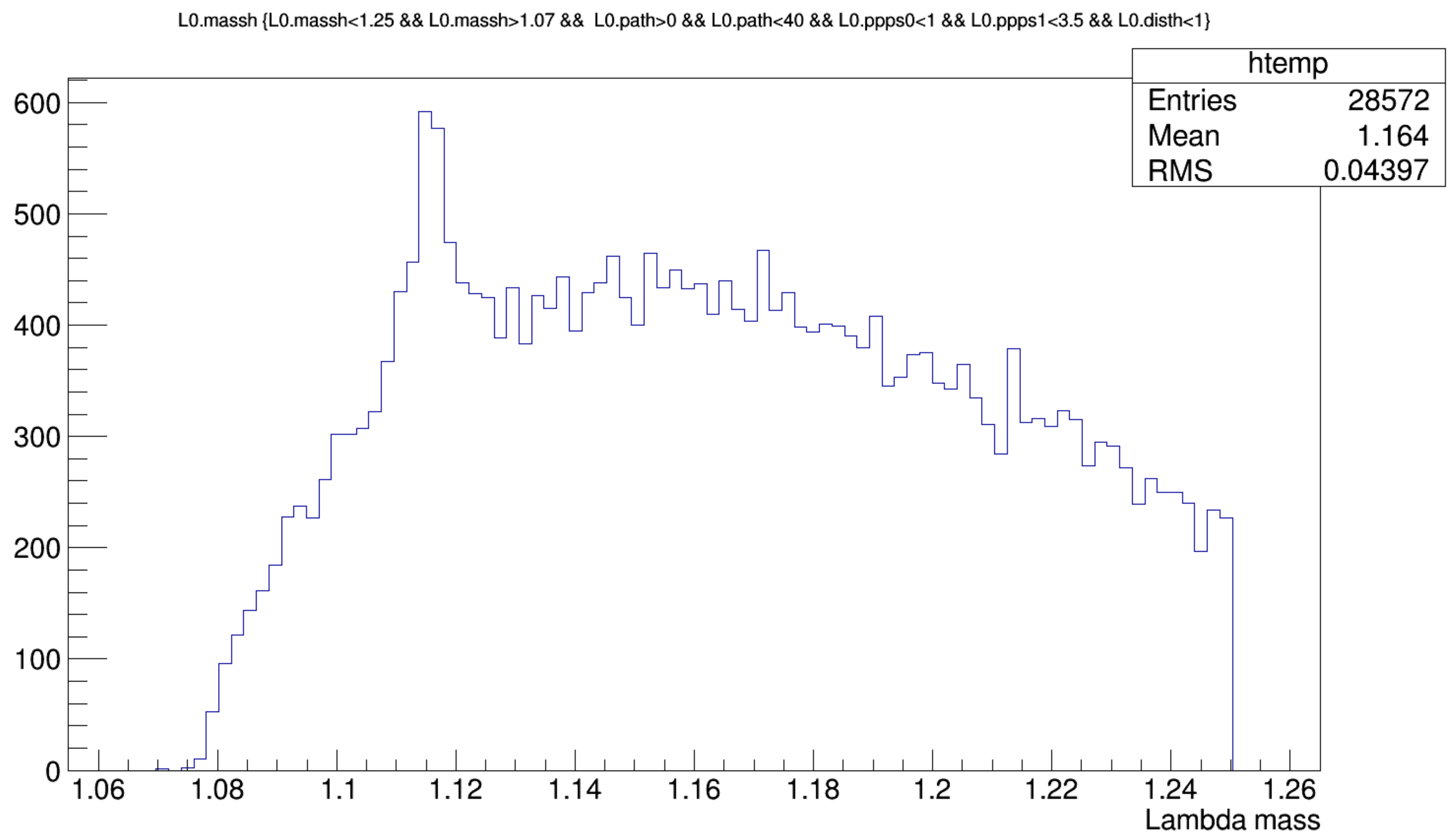
Results

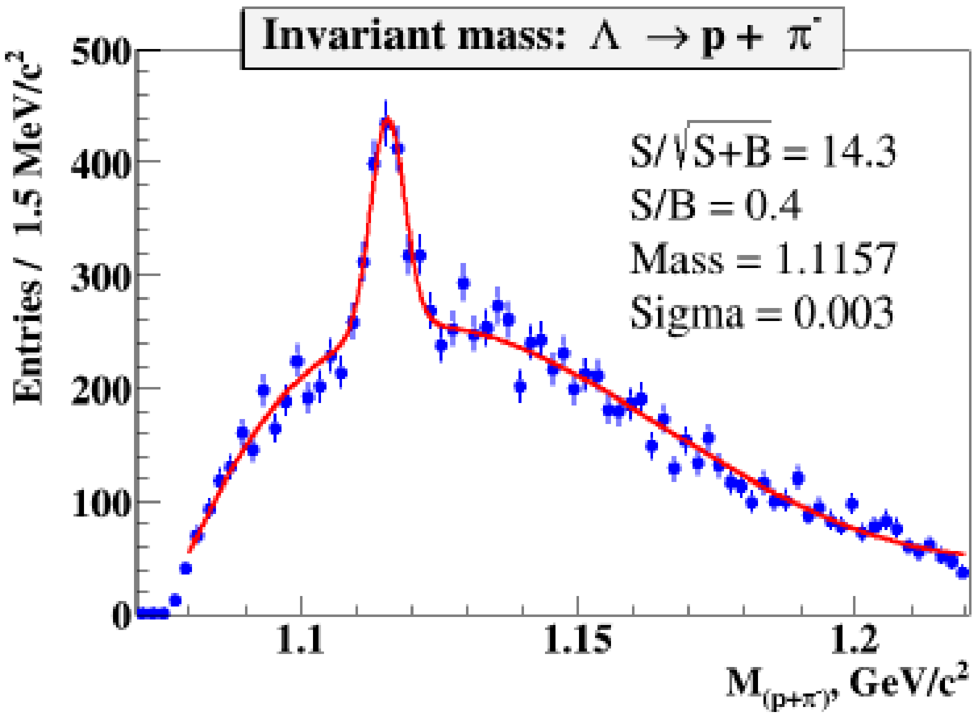


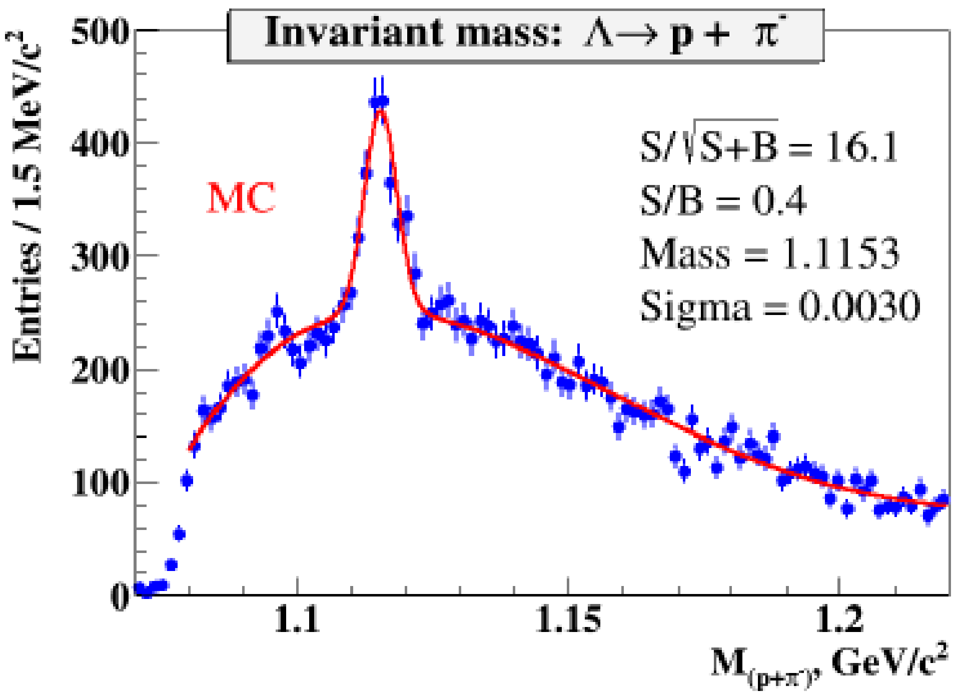
Λ mass distribution
htemp
Entries 685788
Mean 1.163
RMS 0.04762
No cut
10000
8000
6000
4000
2000
0
1.06
1.08
1.1
1.12
1.14
1.16
1.18
1.2
1.22
1.24
1.26
Lambda mass


L0.massh {L0.massh<1.25 && L0.massh>1.07 && L0.path>0 && L0.path<40}
htemp
Entries 253275
Mean 1.165
RMS 0.04654
3500
3000
2500
2000
1500
1000
500
0
1.06
1.08
1.1
1.12
1.14
1.16
1.18
1.2
1.22
1.24
1.26
Lambda mass


L0.massh {L0.massh<1.25 && L0.massh>1.07 && L0.path>0 && L0.path<40 && L0.ppps0<1 && L0.ppps1<3.5}
htemp
Entries 92525
Mean 1.165
RMS 0.04446
0
200
400
600
800
1000
1200
1400
1.06
1.08
1.1
1.12
1.14
1.16
1.18
1.2
1.22
1.24
1.26
Lambda mass


L0.massh {L0.massh<1.25 && L0.massh>1.07 && L0.path>0 && L0.path<40 && L0.ppps0<1 && L0.ppps1<3.5 && L0.disth<1}
htemp
Entries 28572
Mean 1.164
RMS 0.04397
600
500
400
300
200
100
0
1.06
1.08
1.1
1.12
1.14
1.16
1.18
1.2
1.22
1.24
1.26
Lambda mass


Invariant mass: Λ → p + π⁻
S/√S+B = 14.3
S/B = 0.4
Mass = 1.1157
Sigma = 0.003
Entries / 1.5 MeV/c²
M(p+π⁻), GeV/c²
0
100
200
300
400
500
1.1
1.15
1.2


Invariant mass: Λ→ p + π⁻
MC
S/√S+B = 16.1
S/B = 0.4
Mass = 1.1153
Sigma = 0.0030
Entries / 1.5 MeV/c²
M(p+π⁻), GeV/c²
0
100
200
300
400
500
1.1
1.15
1.2

Conclusion

- BM@N purpose is to investigate properties of nuclear matter under extreme density and temperature
- GEM detectors combine high precision track measurements with time-of-flight for particle identification
- Signal of Λ-hyperon is reconstructed in proton-pion invariant mass spectrum

thank you
danke
рахмат
謝謝
ngiyabonga
teşekkür ederim
spas
Баярлалаа
mersi
kia ora
barka
welalin
tack
mahalo
tapadh leat
спасибо
faafetai lava
vinaka
blagodaram
dank je
misaotra
matondo
paldies
grazzi
gracias
спасибі
kiitos
dankie
dhanyavad
nanni
nandri
mauruuru
hvala
bedankt
bayarlalaa
gràçie
köszönöm
dankon
ačiū
akun
хвала
asante
manana
obrigada
tenki
murakoze
enkosi
dziękuję
djiere dieuf
tau
mochchakkeram
mamnun
дякую
chokrane
chnorakaloutioun
gratias ago
gràcies
sulpáy
taiku
go raibh maith agat
sobodi
děkuji
obrigado
sagolun
sukriya
kop khun krap
arigatô
takk
dakujem
trugarez
mèsi
ありがとう
tanemirt
grazie
didi madloba
najis tuke
terima kasih
rahmet
kam sah hamnida
rahmat
diolch
dhanyavadagalu
shukriya
mercé
мерси
ευχαριστώ
তোমাকে ধন্যবাদ
감사합니다
xièxie
merci