Tracking of low momentum pions by using geane

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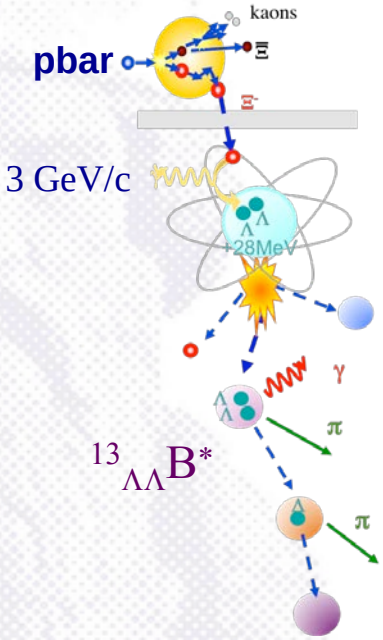
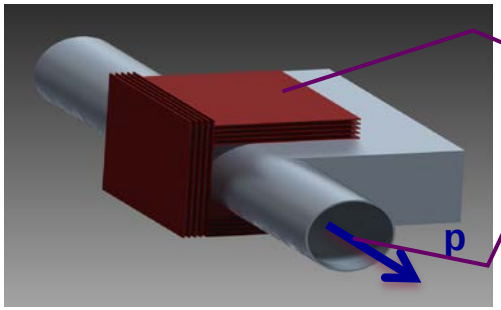
- Short Overview
- First considerations
- Tracking of low P particles with geane
- Summary and Outlook

ΛΛ- Hypernuclei at PANDA



pbar + $^{12}C \Rightarrow \Xi^- + \Xi bar$

Active secondary target



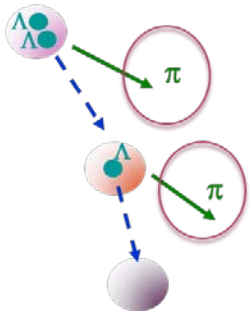
Secondary target
Si μ–Strip +
Be,B,C absorbers

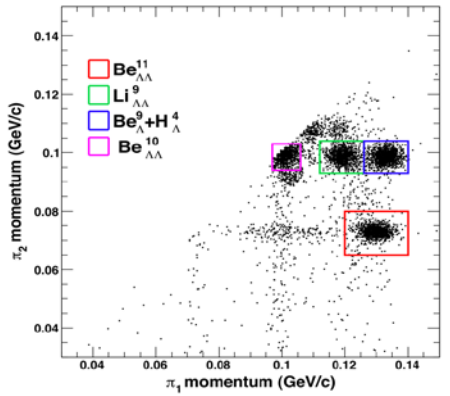
primary ^{12}C target

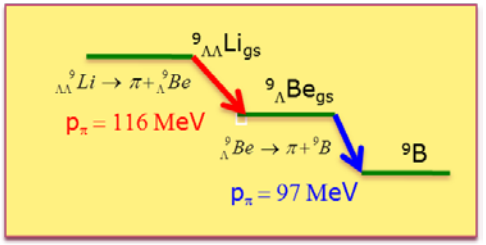
- **Weak decay of hypernuclei**:
  - Light nuclei -> mesonic decay 10%
  - Two-Body decay at rest

Double Lambda Hypernuclei :

  - Emission of two pions
    - Sequential decay
    - Low momentum ~ 60-130 MeV/c
    - Good Momentum resolution ~ 2%

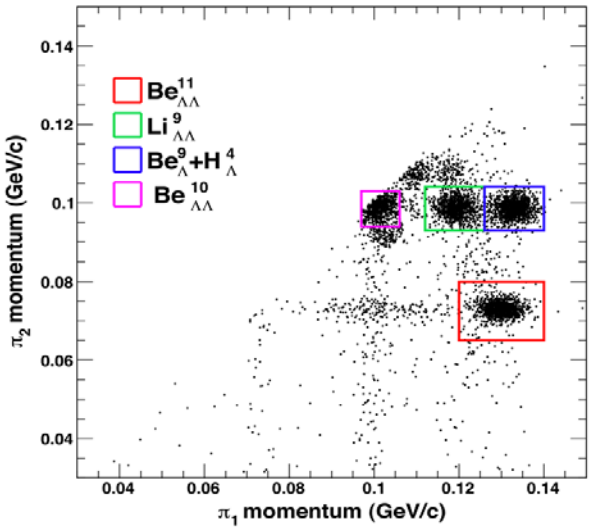






First considerations

- **First approach in Pandaroot** : *Panda Physics Book*
  - Genfit Package : LSLTrackRep
  - No effects due to energy loss and multiscattering



$$p\cos\lambda = 0.3\,z\,B\,R \qquad (\delta k)^2 = (\delta k_{\rm res})^2 + (\delta k_{\rm ms})^2$$

$$\delta k_{\rm res} = \frac{\epsilon}{L'^2}\sqrt{\frac{720}{N+4}} \qquad \delta k_{\rm ms} \approx \frac{(0.016)(\mathrm{GeV}/c)z}{Lp\beta\cos^2\lambda}\sqrt{\frac{L}{X_0}}$$

  - Realistic consideration of this problem is needed
  - Previous geometry:
    - Geane does not work properly : low P threshold, stopping of particles->compact geometry

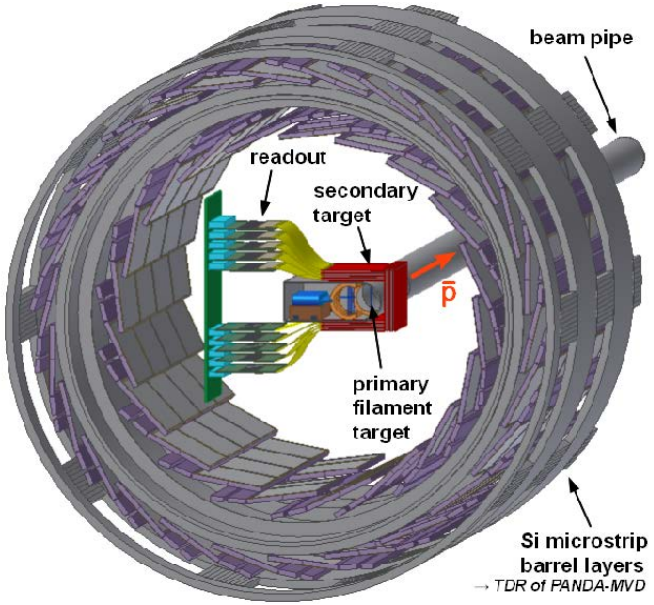
Implementation in Pandaroot

- **Tracking Proccedure**:
  - Raw Montecarlo : PndHypPoint
    trunc /hyp/ PndHyp.cxx/h

  - **Digitization**: MVD model
    - Realistic Hit Production
    - Ideal Hit Production
      trunc /hyp/hypTracking/PndHypIdealRecoTask.cxx
  - **Track finding**: GenFit
    - Ideal : TrackID -> PndHypDPatternRecoTask class
    - Real : riemann track finder / cellular automaton ?
  - **Track Representation**:
    - PndHypRecoHit (XY) / PndRecoHitSP (XYZ) space point
    - LSLTrackRep
    - GeaneTrackRep : modifications needed
    - Magnetic field : below 2 T
  - **Fitting** : Kalman filter + Geane ?

First Step: Geane (tracking param) modification

- Simulation :
  - 100 MeV/c π at primary vertex.
  - Ideal Hit Production
  - Ideal Track finding : GeaneTrackRep
  - Kalman fitting
- GEANE modifications:
  - Momentum threshold set to 50 MeV/c




```
//protect against low momentum:
 if(fabs(fState[0][0])>10){ GFException exc("GeaneTrackRep:  PROTECT
AGAINST LOW MOMENTA",__LINE__,__FILE__);  exc.setFatal(); throw exc; }
```

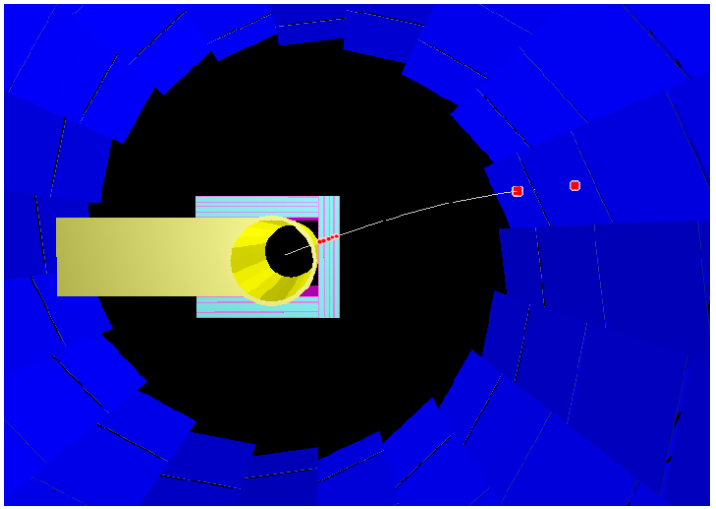
- Step size in material: media_pnd.geo

TGeoMedium(const char *name, Int_t numed, Int_t imat,Int_t isvol,Int_t ifield, Double_t fieldm, Double_t maxfd, Double_t stemax, Double_t deemax, Double_t epsil, Double_t stmin);

```
HYPdiamond      1  12.011  6.0  3.5
                1  1  20.  .001
               29. 0.5 0.0001 0.00001
```

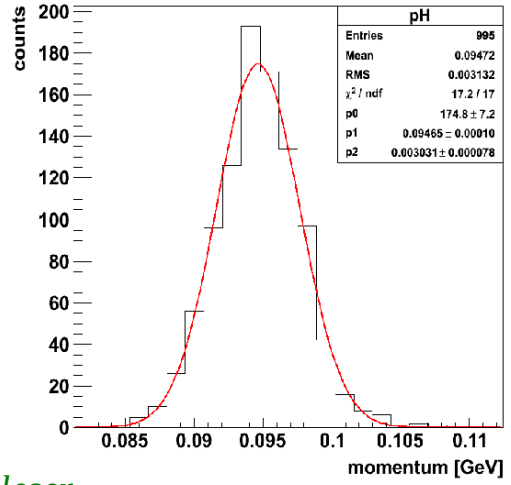
Optimization of parameters

- **Modifying the momentum threshold**:
  - It works only with one iteration
  - Otherwise error message:
    GFexception thrown with Excstring:
    geane propagation fails
  - Lia : particle stops in material
    ->error treatment has to be investigated



theta (40°), Phi (160 °)

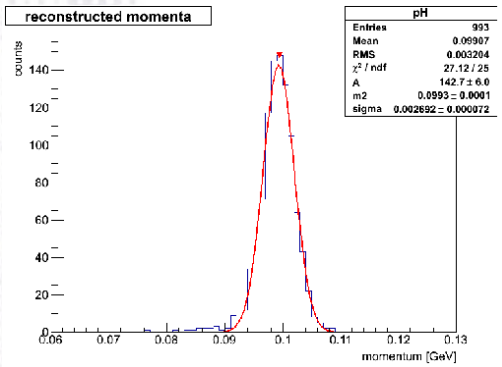
- **Modifying Material properties** :
  - Media_pnd.geo: it slows down the simulation
  - Not GFexcepcion due to propagation failure
  - Mean Value far from the MC value

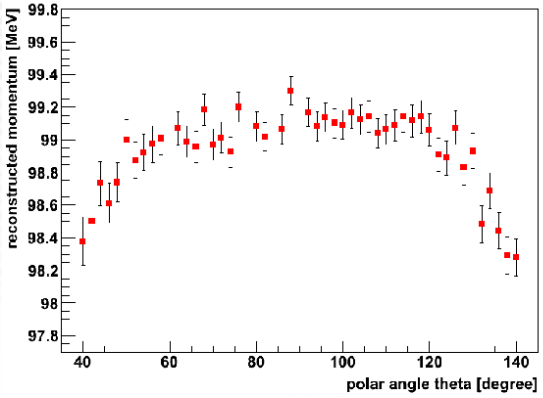


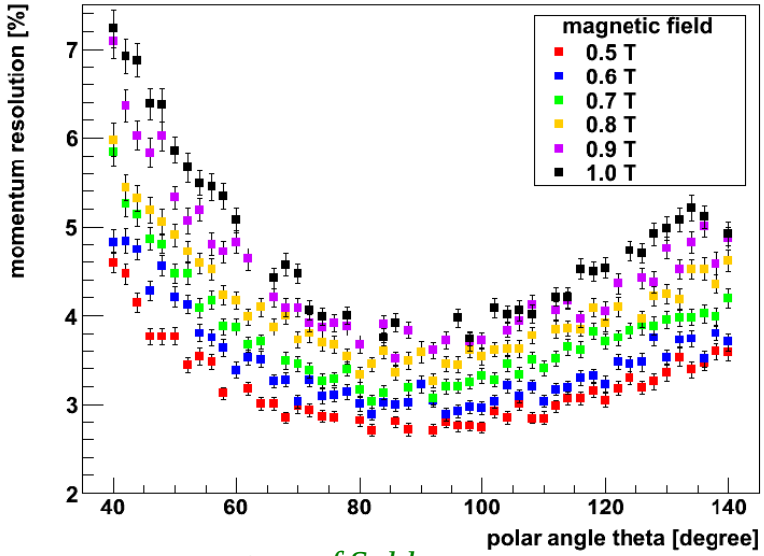
cortesy of S. bleser

Optimization of parameters

- **Modifying EPSIL param (Lia‘s Talk evo. Meeting)** :
  - Better stability of the fitting proccedure
  - Mean Value comparable to MC value
  - Strong dependence on angle distribution(no fixed value)







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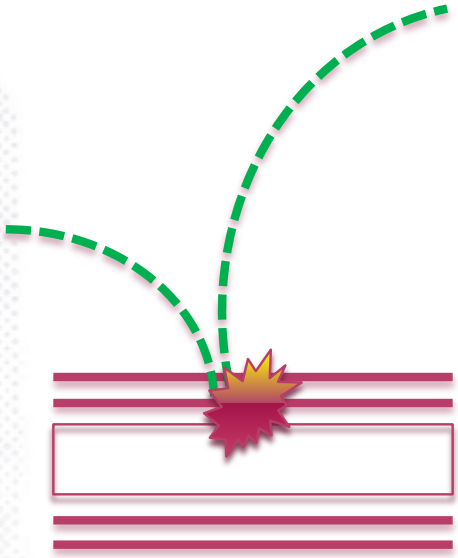
Decay Vertex reconstruction

- **Decay vertex as cut parameter for trigger purposes**:
  - Hypernuclei decay at rest
  - Event topology can be used : mononergetic pions -> good signature
  - Pion track candidates combined by using RhoCandidates Objects.
  - Vertex Reconstruction determined via VertexFitter (Rho Package)



Summary and Outlook

- First considerations regarding the tracking of low momentum pions using geane for the study of hypernuclei at PANDA has been done
- Further investigations regarding the propagation errors have to be accordingly performed.
- In addition tracking params of the material has to be modified.
- Further activities: analysis tools using RhoCandidates, Vertex Fitter.
- Simple modifications have shown that GEANE is nevertheless a powerful tool to track low energy particles, as it has been previuosly done for other experiments for example FINUDA.