



«Study of Λ hyperon production in the BM@N experiment»

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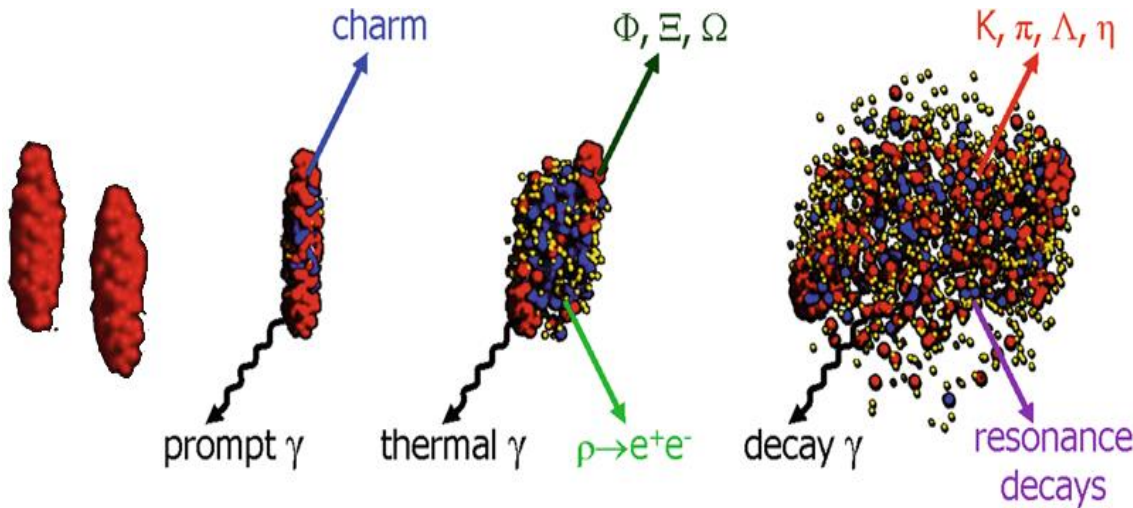


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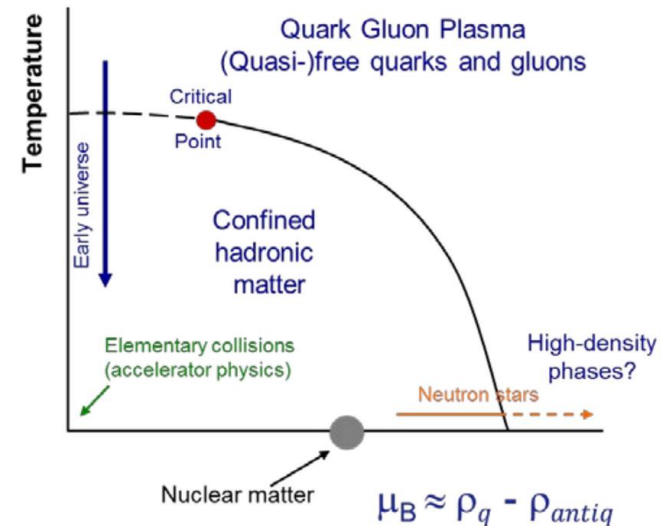
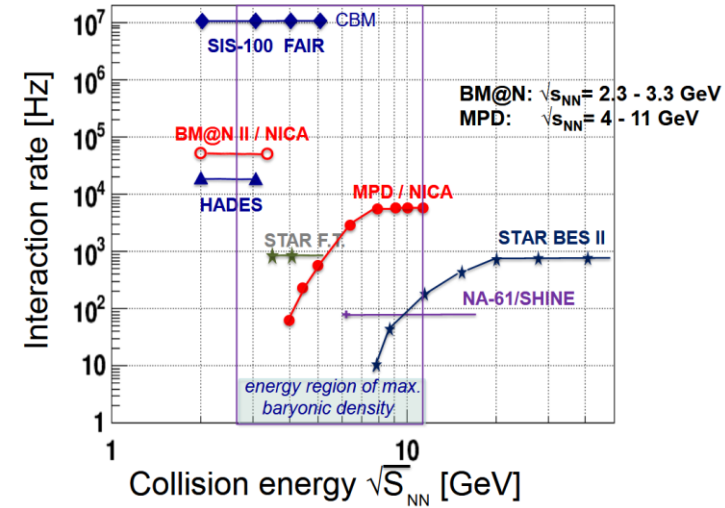
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JINR Young Scientists and Specialists
Association Workshop “Alushta - 2020”
26.09.2020 - 03.10.2020

Heavy-Ion Collision

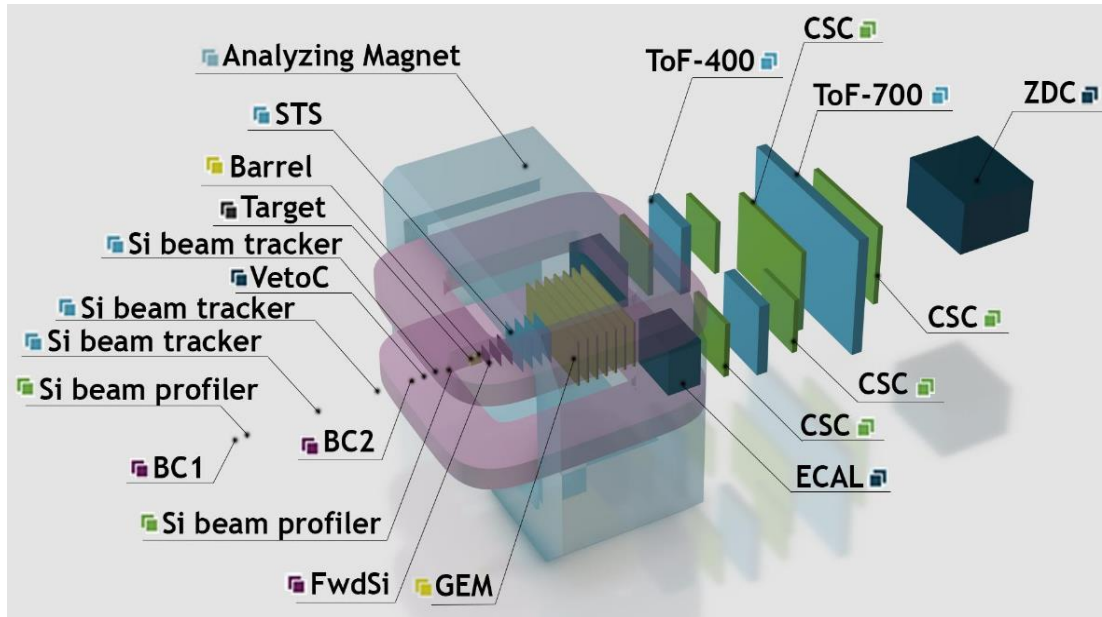


- At \sqrt{s} energies of 2 - 4.5 GeV, nucleon densities in a collision zone exceed the saturation density by the factor of 3-4.
- Heavy-ion collisions are a rich source of strangeness, and the coalescence of kaons with lambdas or of lambdas with nucleons will produce a vast variety of multi-strange hyperons or of light hypernuclei.



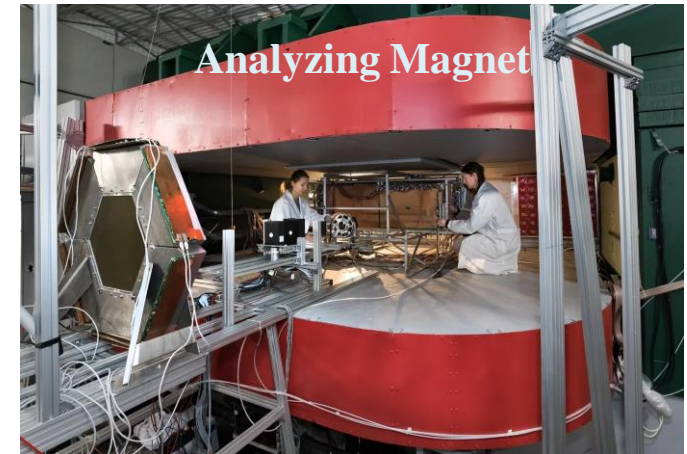
Baryonic Matter at Nuclotron

Full detector setup for year 2021



November 2017

Technical work before the 7th run



Drift Chamber



- **BM@N** is the first experiment with a fixed target at the NICA.
- It is designed to study nuclear-nuclear collisions at high densities.
- The Nuclotron provides heavy ion beams with energies ranging from 2.3 to 4.5 GeV

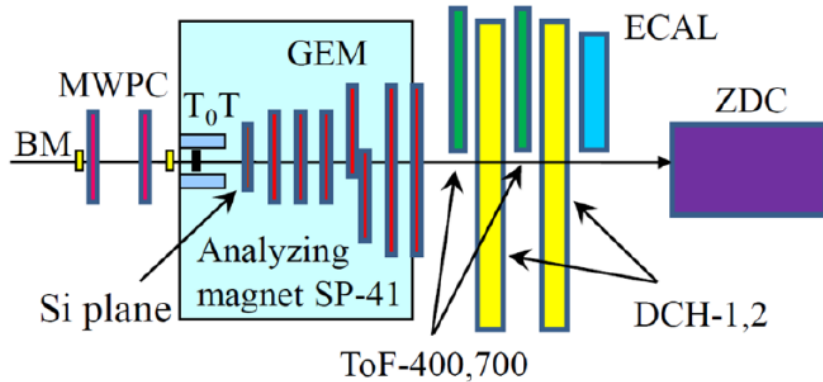
Beam parameters and setup at different stages of BM@N experiment



	Run 5	Run 6	Run 7	Run 8	
Year	2016	2017 spring	2018 spring	fall 2021	2022
Beam	d(↑)	C	Ar,Kr, C(SRC)	Kr,Xe	up to Au
Max.inten sity, Hz	0.5M	0.5M	0.5M	0.5M	0.5M
Trigger rate, Hz	5k	5k	10k	10k	10k
Central tracker status	6 GEM half planes	6 GEM half planes	6 GEM half planes + 3 forward Si planes	7 GEM full planes + forward Si planes	7 GEM full planes + forward Si + 2 large STS planes
Experiment al status	technical run	technical run	technical run+physics	physics run	stage1 physics

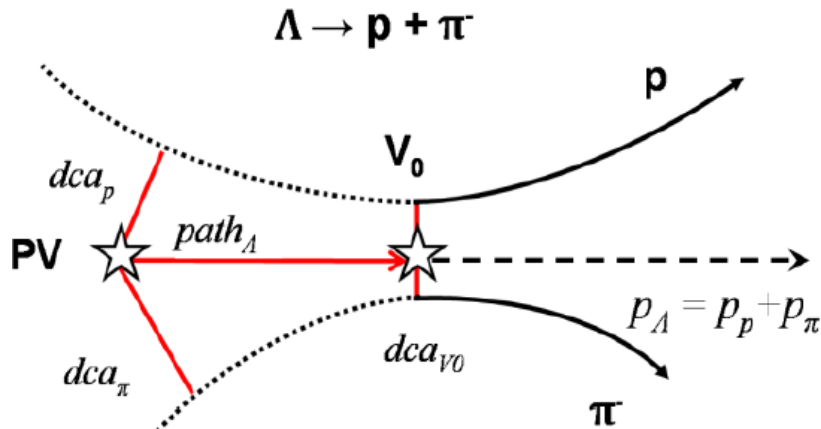
Carbon - nucleus interaction

BM@N setup in carbon run



Program in carbon run:

- Test / calibrate ToF, T0+Trigger barrel detector, full ZDC, part of ECAL
- Trace beam through detectors, align detectors, measure beam momentum in mag. field of 0.3– 0.85 T
- Measure inelastic reactions $C + \text{target} \rightarrow X$ with carbon beam energies of 3.5 - 4.5 GeV/n on targets C, Al, Cu, Pb



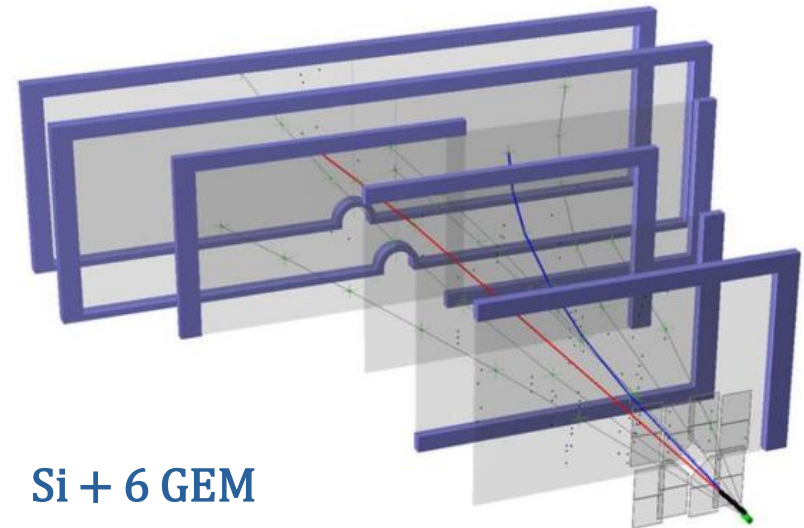
Event topology:

PV – primary vertex

V₀ – vertex of hyperon decay

dca – distance of the closest approach

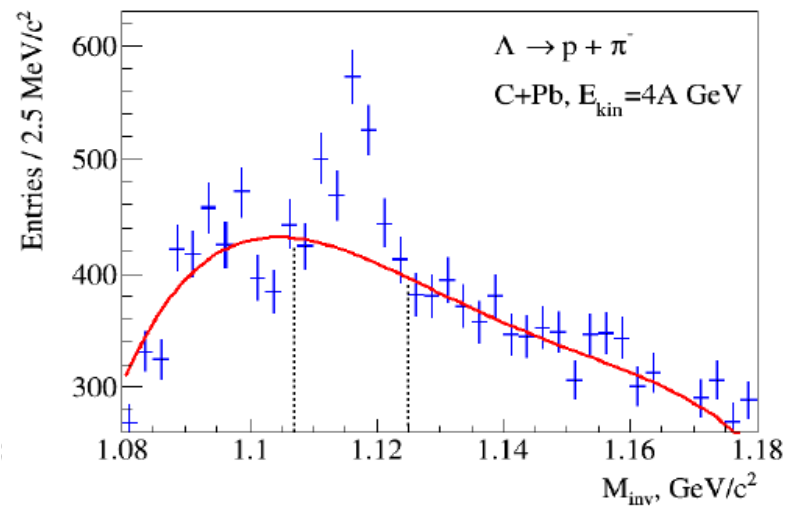
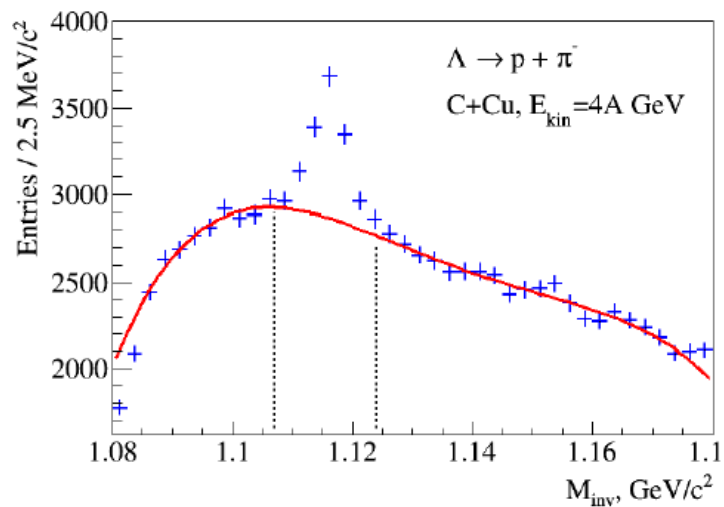
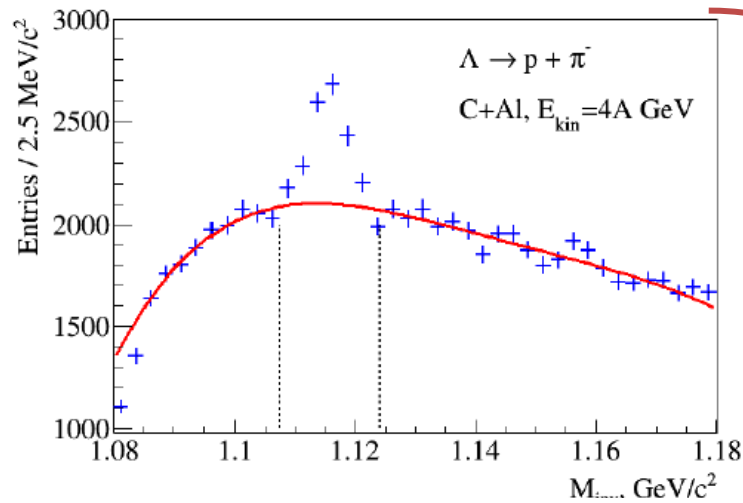
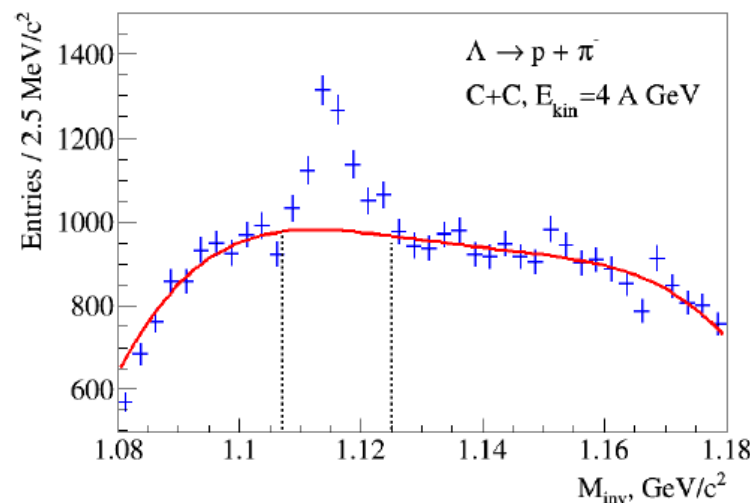
path – decay length



Si + 6 GEM

Λ decay reconstruction in Central tracker in C+C interaction

Λ in C+C, Al, Cu, Pb interactions(4A GeV)



First results on mass signal

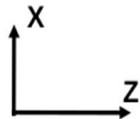
Received by BM@N group in 2019

The background is fitted by the 4th degree Legendre polynomial and subtracted from the histogram content in the Λ signal mass range indicated by the vertical lines.

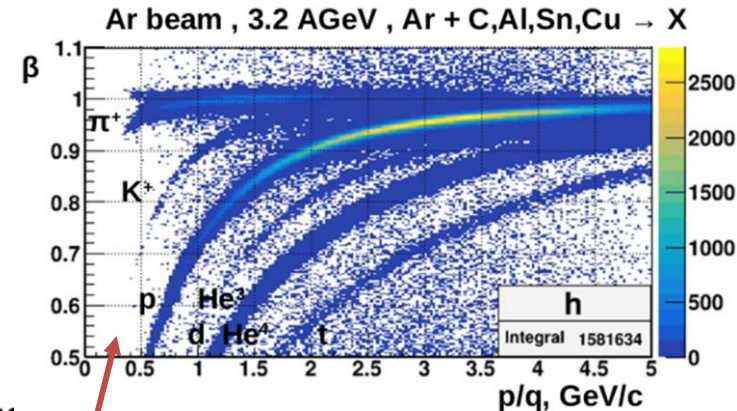
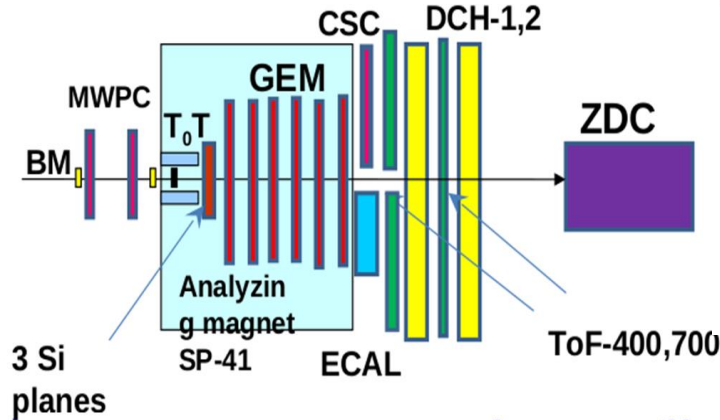
Ar - nucleus interaction

Detector setup for argon run (Data were taken in March 2018)

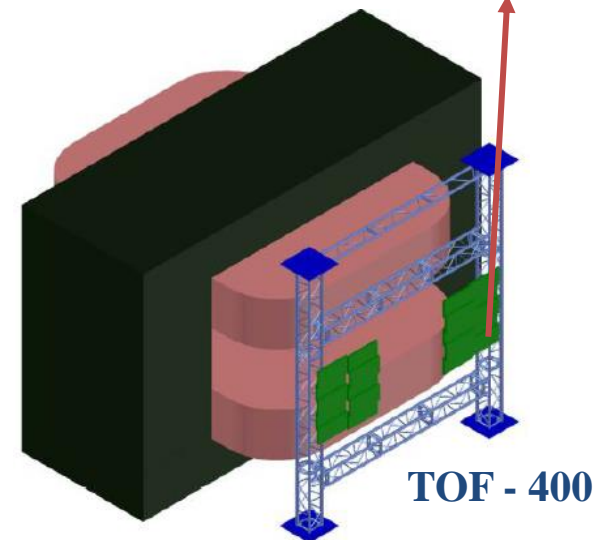
Ar beam, $T_0 = 3.2$ GeV/n



Kr beam, $T_0 = 2.4$ (2.9) GeV/n



β vs p/q plot bands for π^+ , K^+ , p , He_3 , d/He_4 , t are clearly visible.

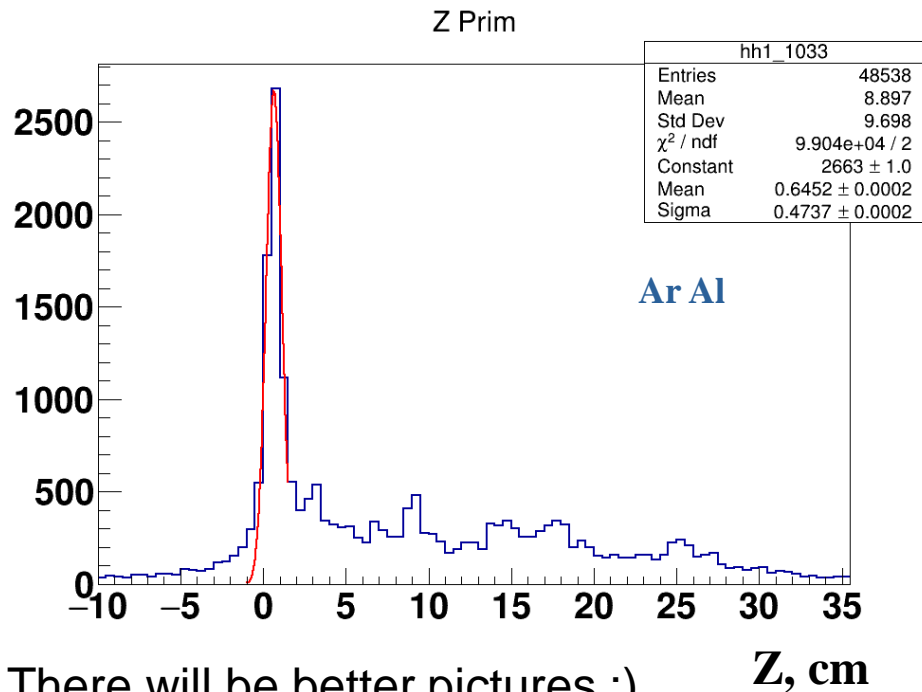


Run 7:

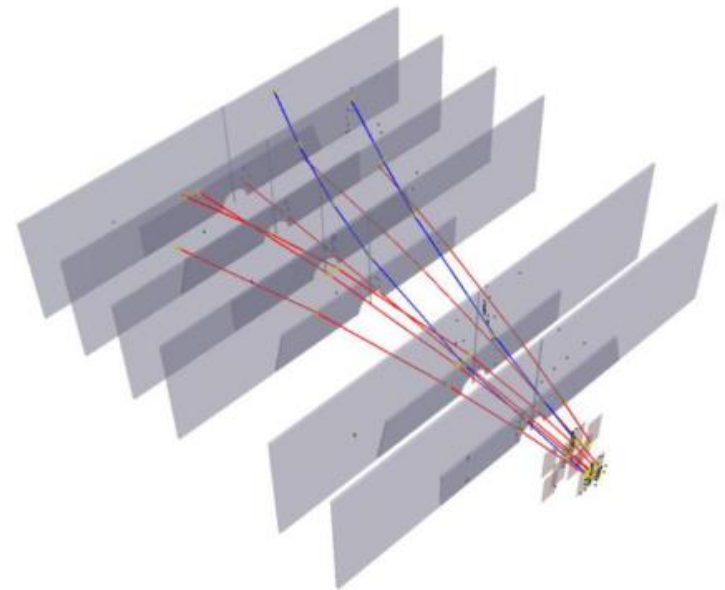
Inelastic reactions Ar (Kr) + target \rightarrow X on targets C, Al, Cu, Sn, Pb

- Hyperon production measured in central tracker (Si + GEM)
- Charged particles and nuclear fragments identified with ToF

Reconstruction of the primary vertex of the Λ hyperon in the run7



There will be better pictures :)



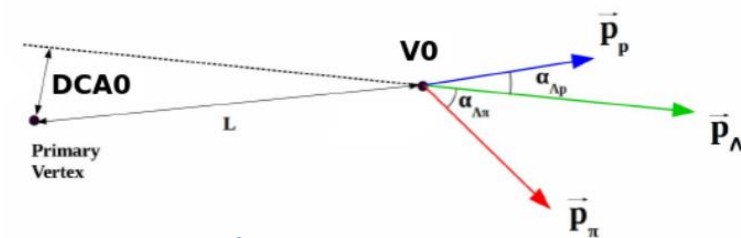
Central tracker in 7 run

Ar (Kr) + target \rightarrow X on targets C, Al, Cu, Sn, Pb

3 forward silicon strip planes and 6 GEM detectors

Summary:

- Data analysis for an argon run involves the application and expansion of carbon run methods for the reconstruction of the lambda hyperon.
- Work is underway to reconstruct the primary vertex of the lambda hyperon from its decay products in the $\Lambda \rightarrow p + \pi^-$ reaction for an argon run



Λ^0 decay scheme

Thank you for attention!