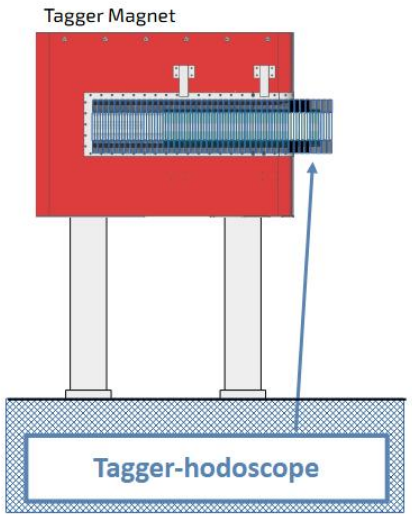
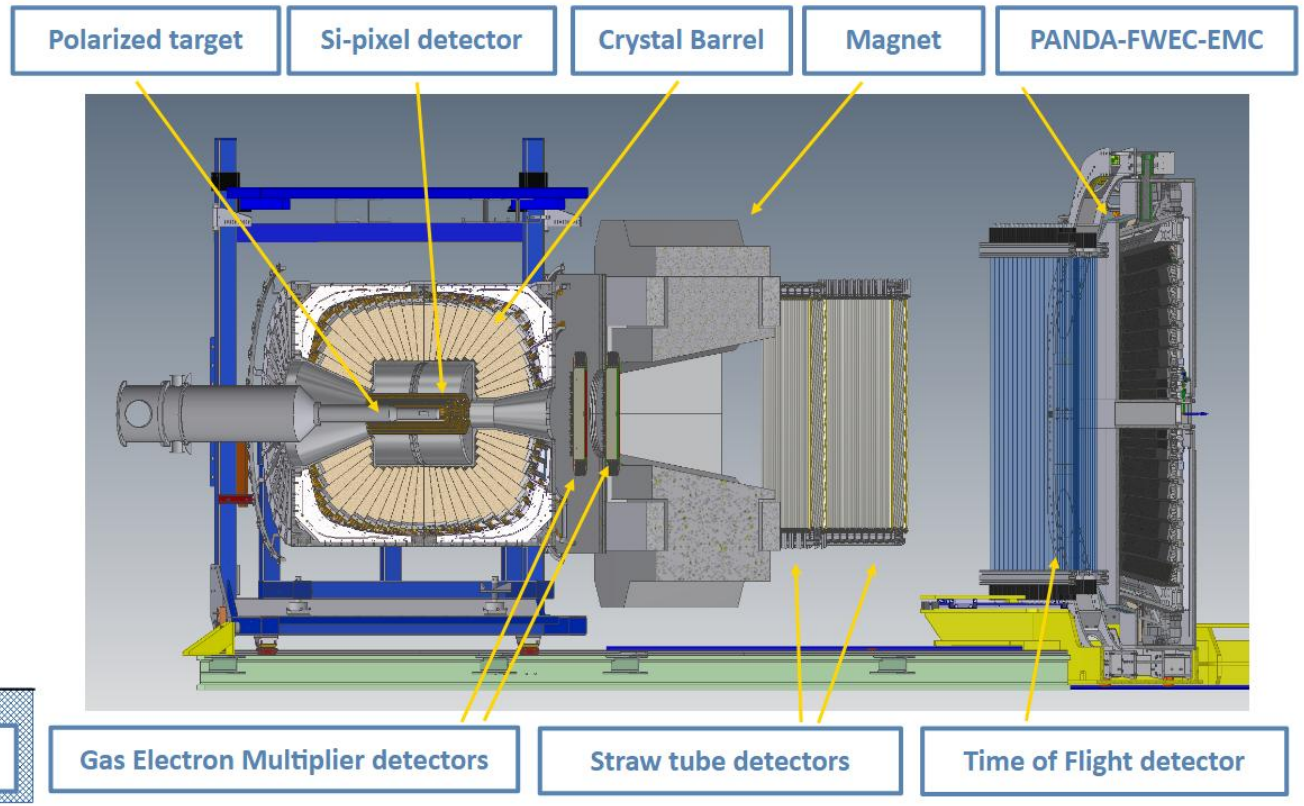
INSIGHT@ELSA

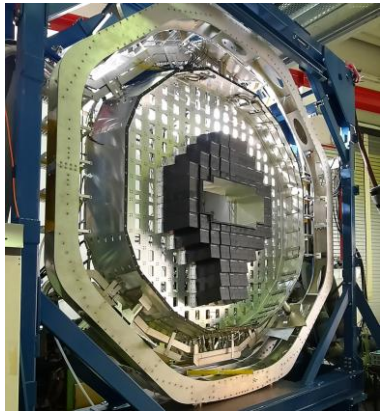
color meets flavor

@ELSA INSIGHT

Investigation of the strong interaction in the light flavor sector







at the FTD

Over almost the entire 4π-solid angle:

- ➡ **High resolution photon measurements**
- ➡ **Precise charged particle detection**

⇒ unique possiblilities!

Polarized beam and polarized target

Aim: Understanding the light quark baryon spectrum

Non-strange baryons:

Gain a complete picture of the N^*, Δ^*- baryon spectrum:

- **Polarized photoproduction off the polarized proton and neutron!**
  (unambigious PWA not possible without polarization obs. – especially scarce for neutron)
- **Multi-meson photoproduction**

Strange baryons: (Λ^*, Σ^*):

„… the field is starved for data“ (PDG‘2024)

Established resonances remained the same for more than 30 years!

Interesting exception: Two pole structure of the $\Lambda(1405)$

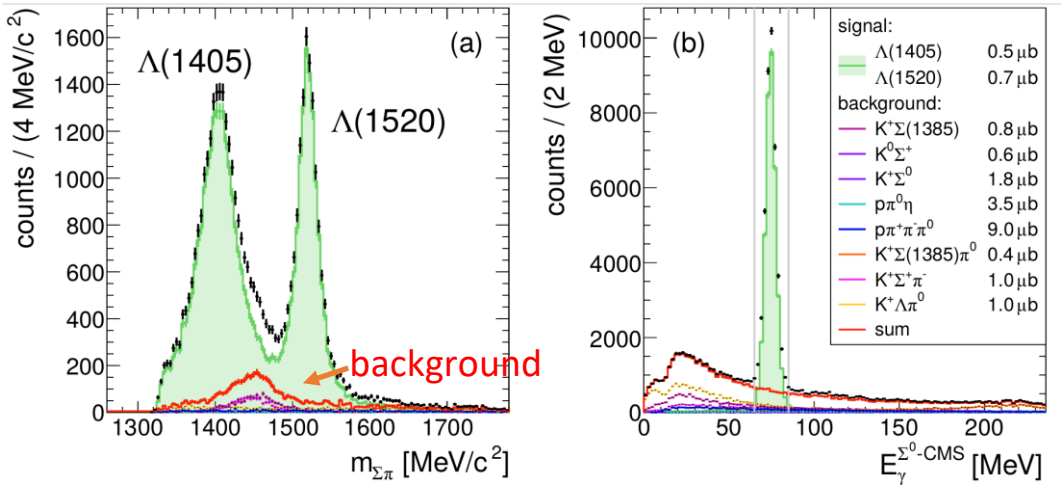
⇔ **Not even all states of the first excitation band known!**

- spectrum and properties of Λ^*, Σ^*

- multi-quark states? molecules? 2-pole structures?

e.g: $\gamma p \rightarrow K^+\Lambda^* \rightarrow K^+\Sigma^0\pi^0$, $\gamma p \rightarrow K^+\Sigma^* \rightarrow K^+\Lambda\pi^0$, ...

$\gamma p \rightarrow K^+\Lambda^* \rightarrow K^+\Sigma^0\pi^0 \rightarrow K^+\Lambda\gamma\pi^0$ (isospin selective)



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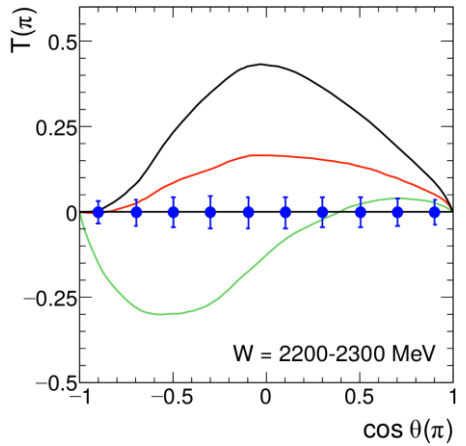

Sensitivity of polarization observables

(1600h + 200h of beamtime)

Lines =PWA-solutions indistinguishable based on differential cross sections only

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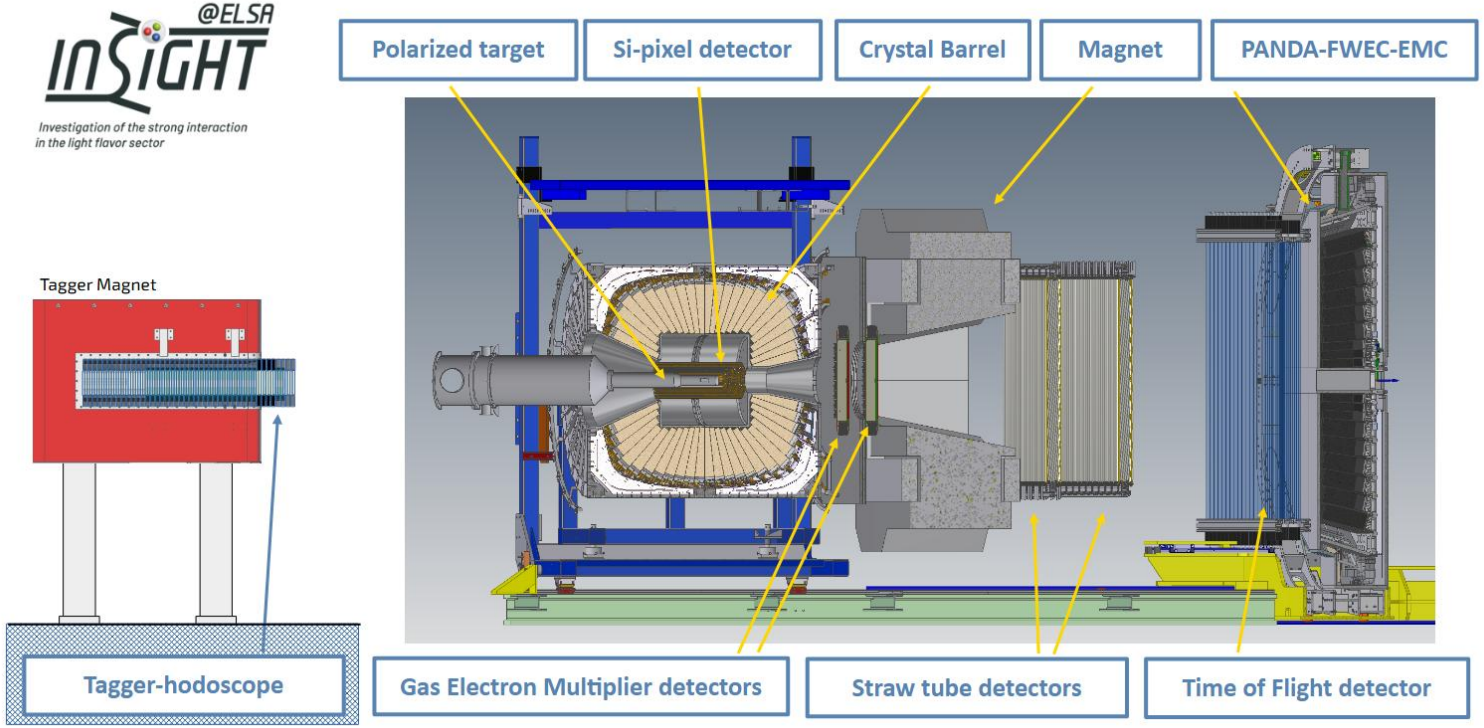


color meets flavor : **Providing data not only**

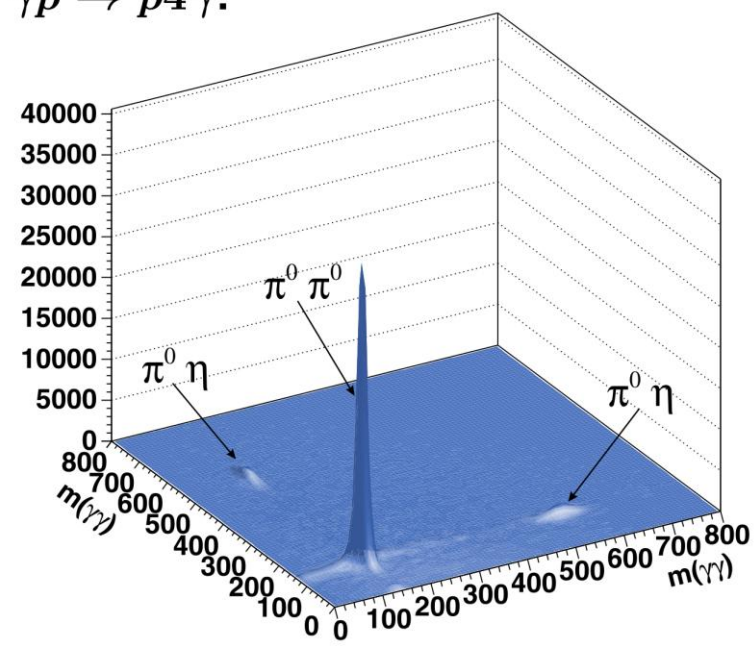
for RA1
but also as input for RA2 (BSM- searches)

Performance: Photon-Measurements and vertex resolutions

- **Photons from measurements:**

Crystal Barrel:

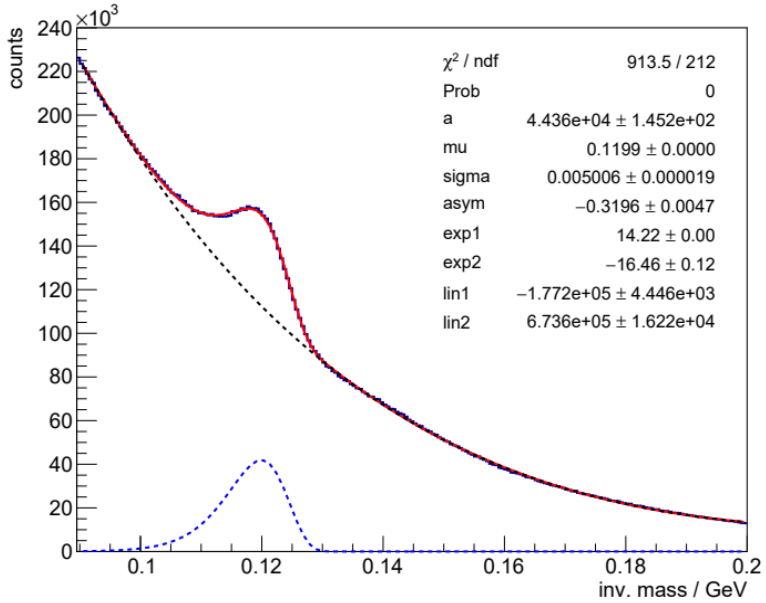
$\gamma p \rightarrow p4\gamma$:



$\sigma(\pi^0) \approx 7$ MeV

+ excellent signal to background ratio

PANDA-FWEC @COSY testbeam



$\sigma(\pi^0) \approx 5$ MeV

+ further improvements to be expected

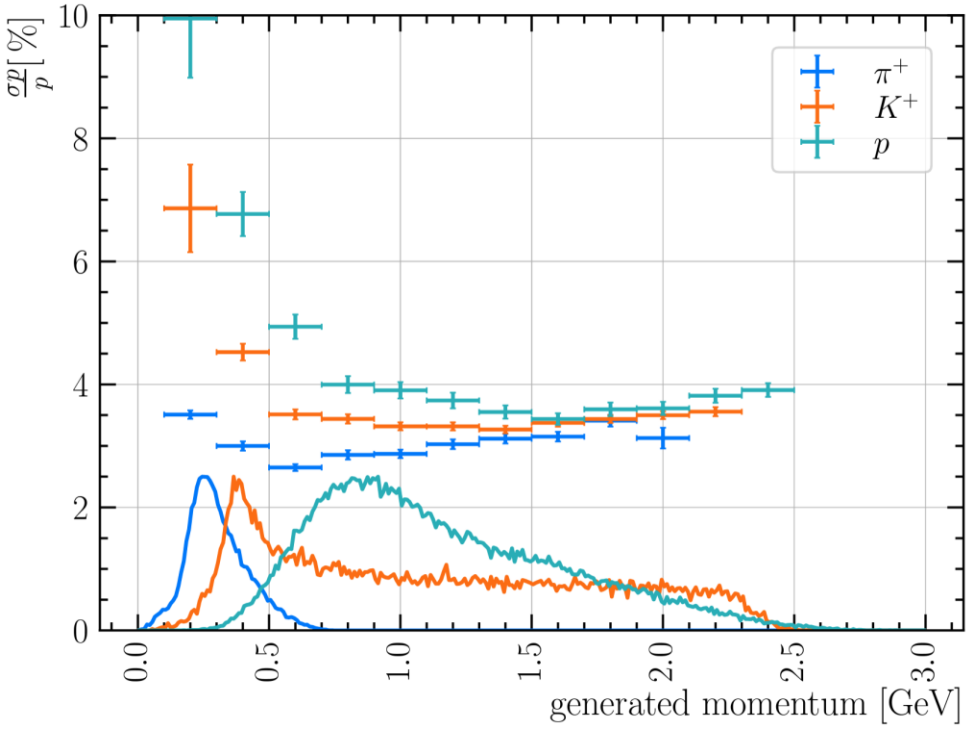
Pixel detector: Measurement of charged particle trajectories in the central region

- Vertex resolution (simulations with polarized target):
  - $\Delta z, \Delta r \approx 150 - 500\mu m$ (energy and angle dependent)

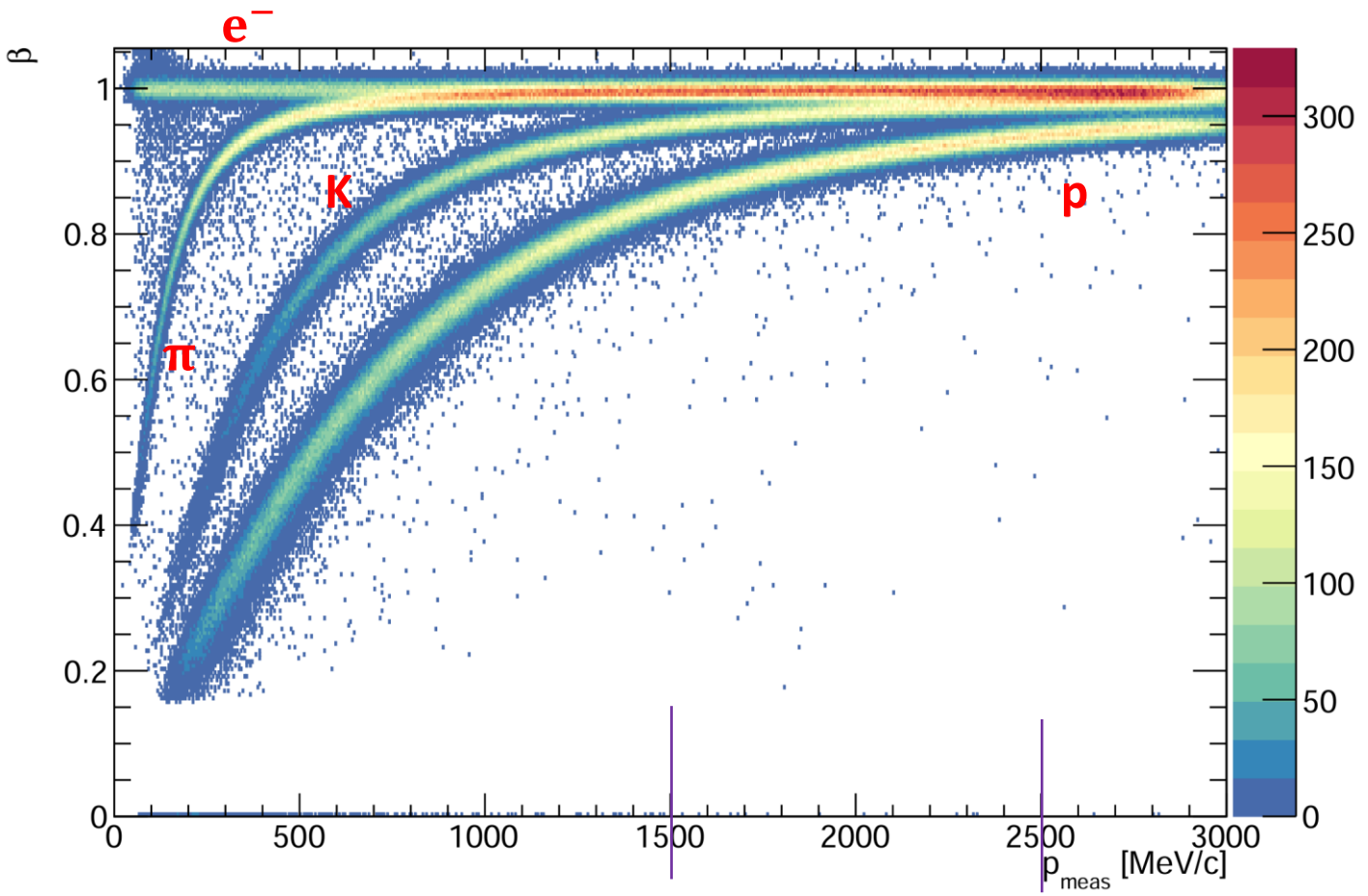
Forward tracking - Simulations

Simulating tracking:

$$\gamma p \rightarrow K^+\Lambda^* \rightarrow K^+\Sigma^0\pi^0 \rightarrow K^+\, p\pi^-\gamma\pi^0$$



Simulating different particles separately:



GEMs @82 and 100cm, Δ=18cm, σ = 50μm

STRAWS @ 208, 213, 253, 258 cm, Δ=45cm, σ = 140μm
(recent change to 6 instead of 4 double layers)

TOF @ 360cm , σ = 100 ps

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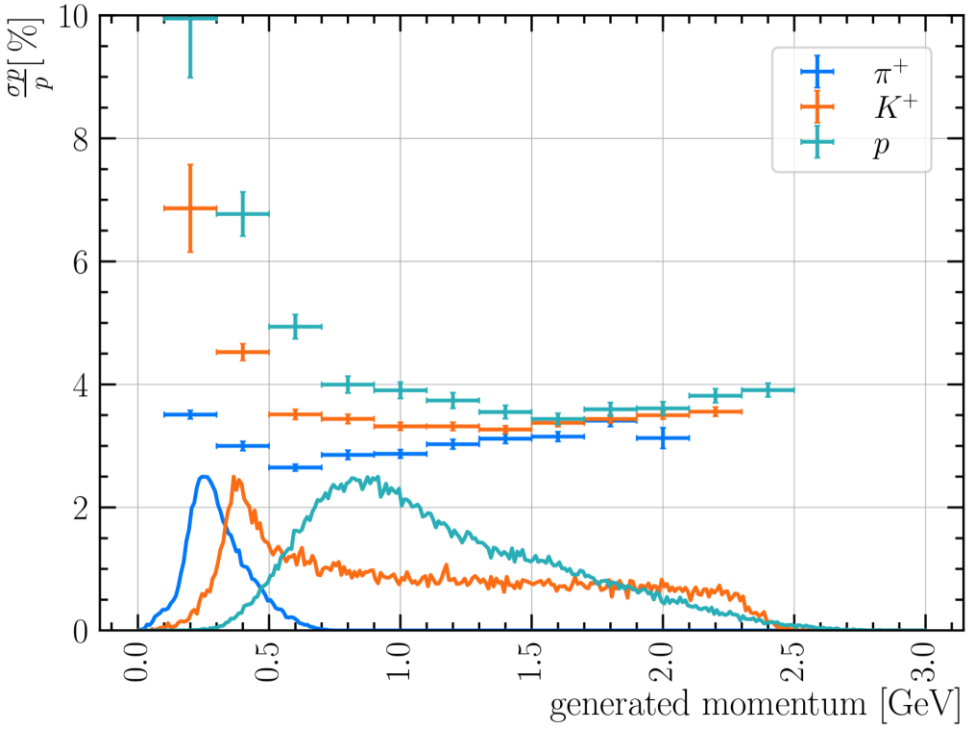
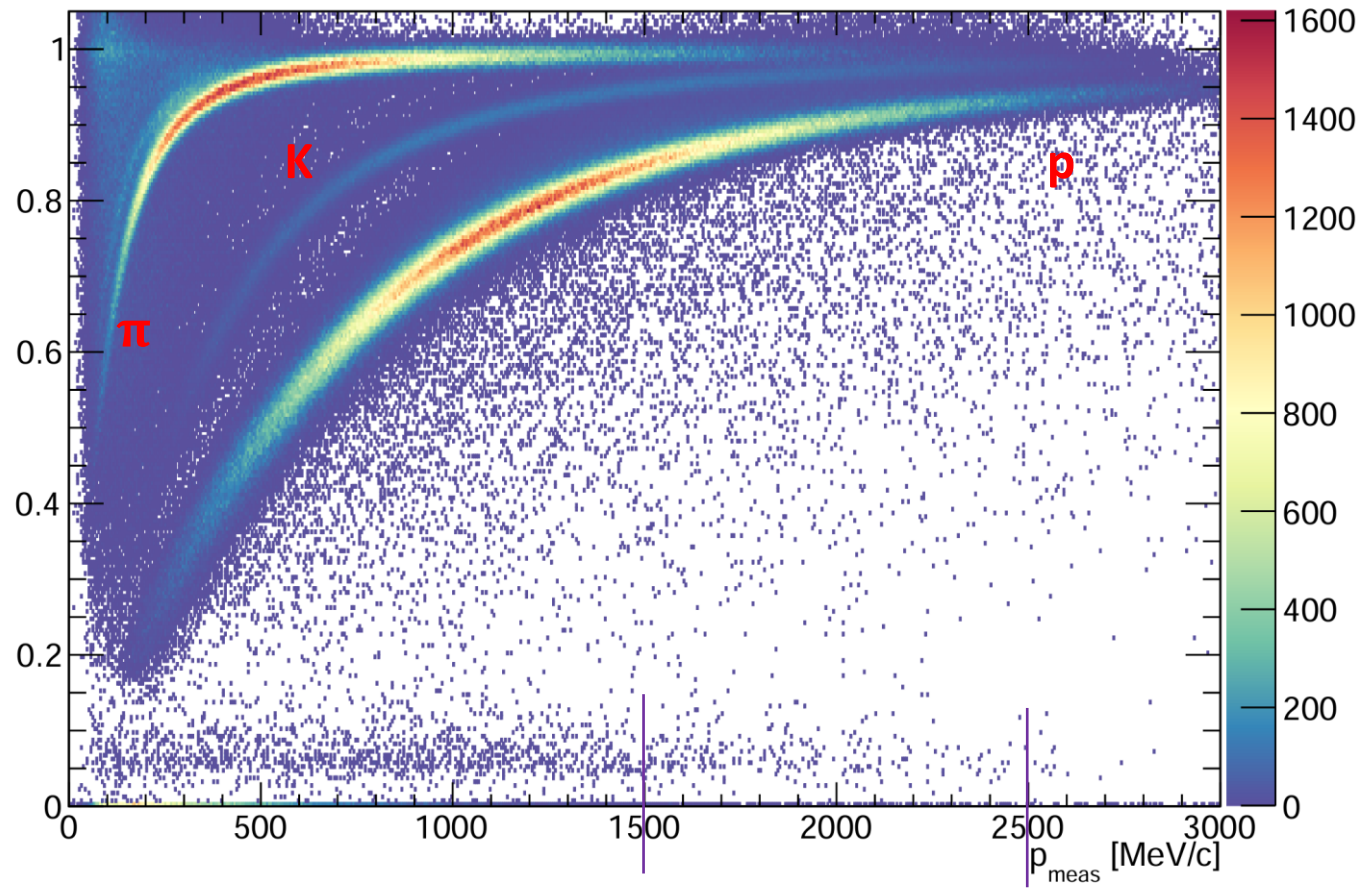


$\gamma p \rightarrow K^+\Lambda^* \rightarrow K^+\Sigma^0\pi^0 \rightarrow K^+\, p\pi^-\gamma\pi^0$ with background and pol. target



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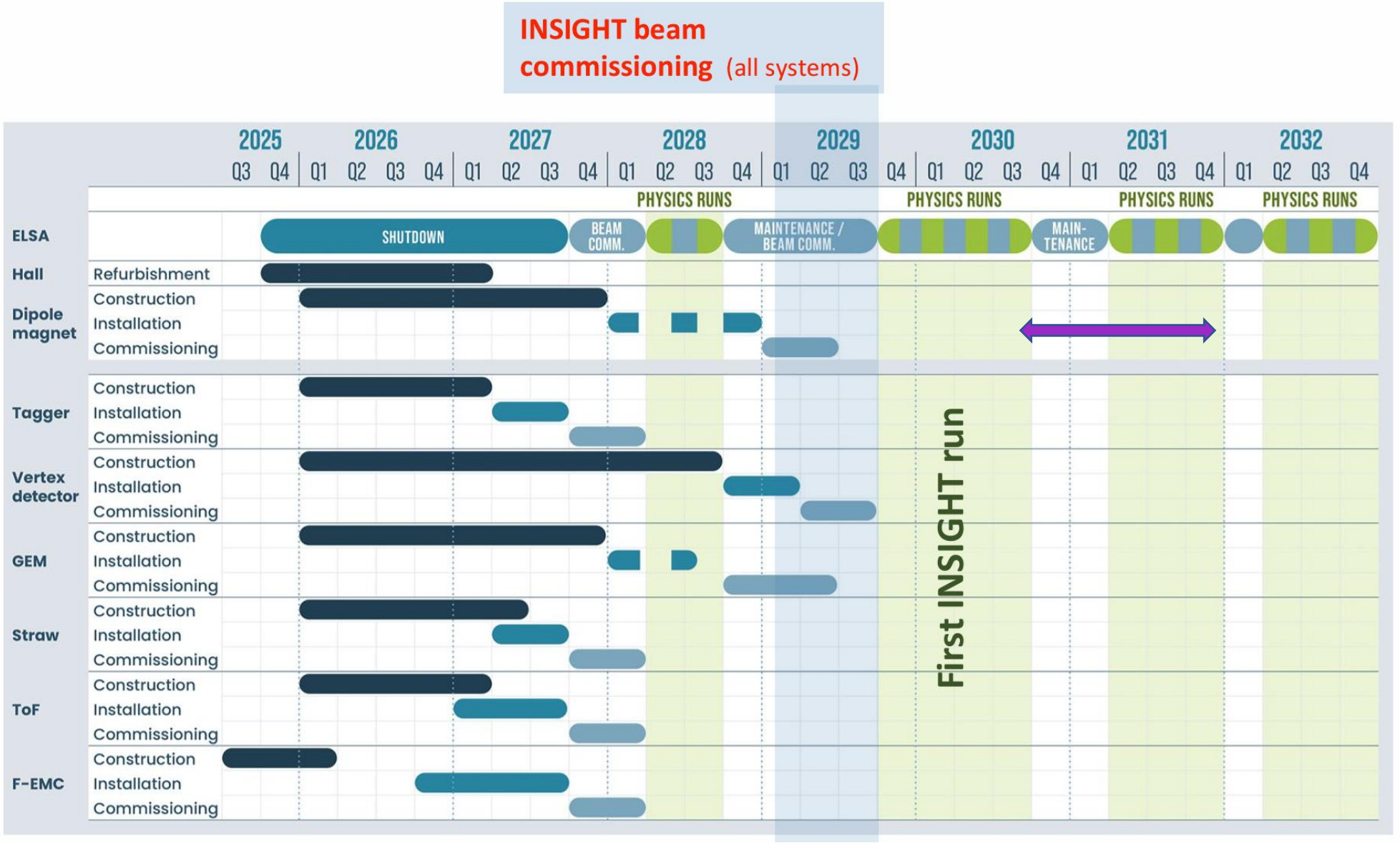
Very tight time schedule



Not much time for data analysis before next application

…. and a new detector system which needs to be understood ….

Hardware-Costs

	2026	2027	2028	2029	2030	2031	2032
Funding Category	**Totals per year in k€**						
Staff (total of Table 4.5.2) [b]	688	917	940	445	456	467	479
Direct project costs (excl. staff)	78	155	155	138	138	138	138
Total Instrumentation (< 150 k€) [c]	**1410**	**1130**	**610**	**50**	**0**	0	0
Tagger	**305**	**50**	0	0	0	0	0
scintillator, SiPMs	105	0	0	0	0	0	0
FEE, readout	135	50	0	0	0	0	0
infrastructure	65	0	0	0	0	0	0
Pixel detector	**100**	**280**	**280**	0	0	0	0
sensors,	50	180	180	0	0	0	0
mechanics, infrastructure	50	100	100	0	0	0	0
GEM	**50**	**270**	**120**	0	0	0	0
GEM foils, mechanics	50	70	70	0	0	0	0
FEE	0	150	50	0	0	0	0
infrastructure	0	50	0	0	0	0	0
Straws	**160**	**260**	0	0	0	0	0
material, mechanics	50	50	0	0	0	0	0
readout	60	130	0	0	0	0	0
infrastructure	50	80	0	0	0	0	0
ToF	**560**	**200**	0	0	0	0	0
scintillator, mechanics	140	0	0	0	0	0	0
PMTs, readout	420	60	0	0	0	0	0
infrastructure	0	140	0	0	0	0	0
F-EMC	**50**	0	0	0	0	0	0
DAQ	0	**70**	**210**	**50**	0	0	0
ELSA Hall / infrastructure	**185**	0	0	0	0	0	0
Total Instrumentation (≥ 150 k€)	**200**	**200**	**300**	0	0	0	0
Magnet (incl. power supply)	**200**	**200**	**300**	0	0	0	0