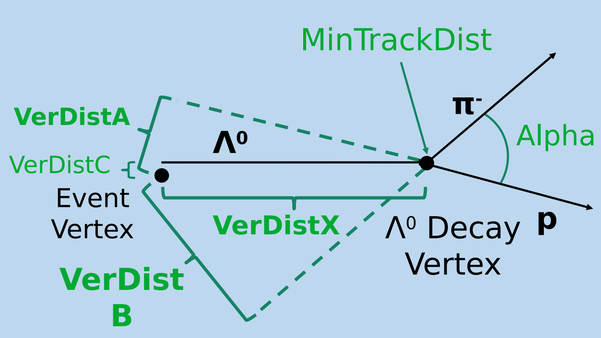
Reconstruction of Λ hyperons in an inhomogeneous magnetic field with a Kalman Filter based tracking algorithm

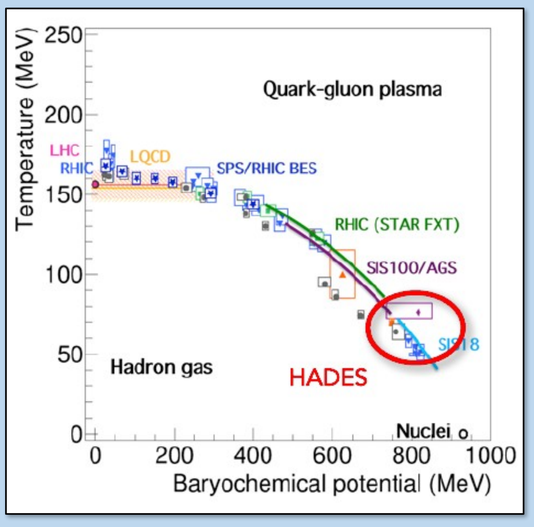
M. Parschau for the HADES-Collaboration
Institut für Kernphysik – Goethe-University, Frankfurt am Main, Germany

Motivation

- High baryochemical potential at freeze out
- Weakly decaying strange particles (Λ^0, K, Ξ^- , ...)
- Identification via decay topology quantities:



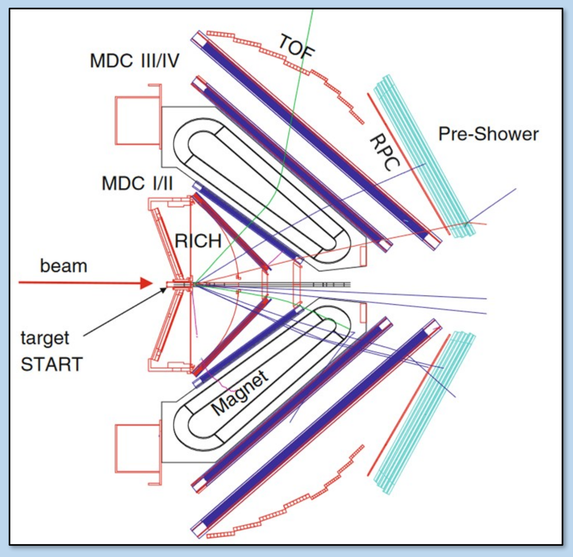
$\Lambda^0 \rightarrow p + \pi^-$ decay topology



- Particle covariance matrices calculated event-by-event have never been applied for reconstruction before

HADES

- **Fixed target** experiment at **GSI Helmholtzzentrum** für Schwerionenforschung in Darmstadt, Germany
- High acceptance for detection of **leptons** and **hadrons**
- Tracking with **M**ini **D**rift **C**hambers (MDC)



Schematic setup of HADES

KF Particle Package

- Software package for **fast reconstruction** of short lived particles

  https://github.com/sgorbuno/KFParticle.git &

  https://doi.org/10.21248/gups.71330

- Significant performance improvement due to consistent use of **SIMD data types**
- Enhanced **reconstruction** performance in contrast to classical vector ansatz due to application of **covariance matrices**

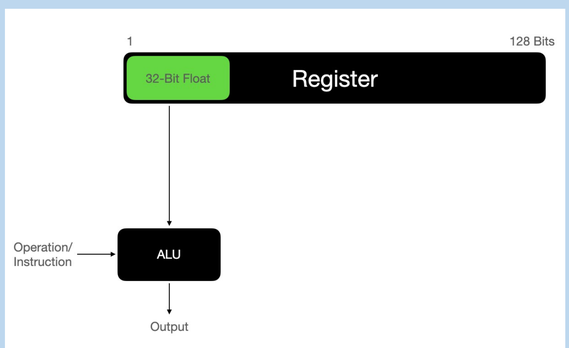


Illustration of the SISD workflow

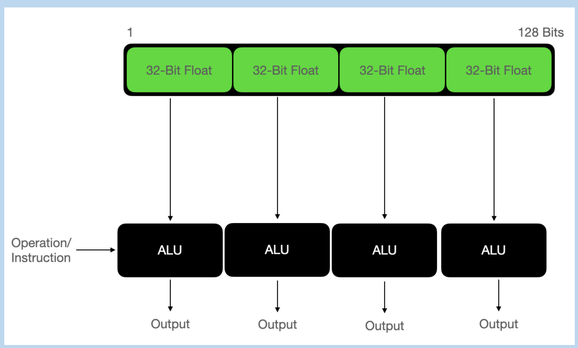
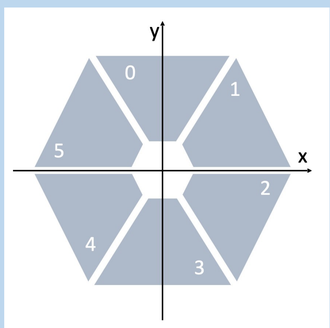


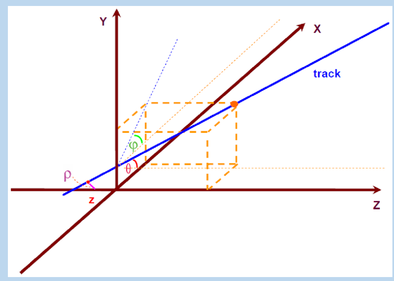
Illustration of the SIMD workflow

Sim Data Integration

- Sim data Ag+Ag at 1.58 GeV
- **~93x10⁶ events** enriched with one Lambda/event
- **Interface** to transform HADES data from **specific coordinate systems** into lab. system with 6-d state vector
- Preselection with **topology quantities**

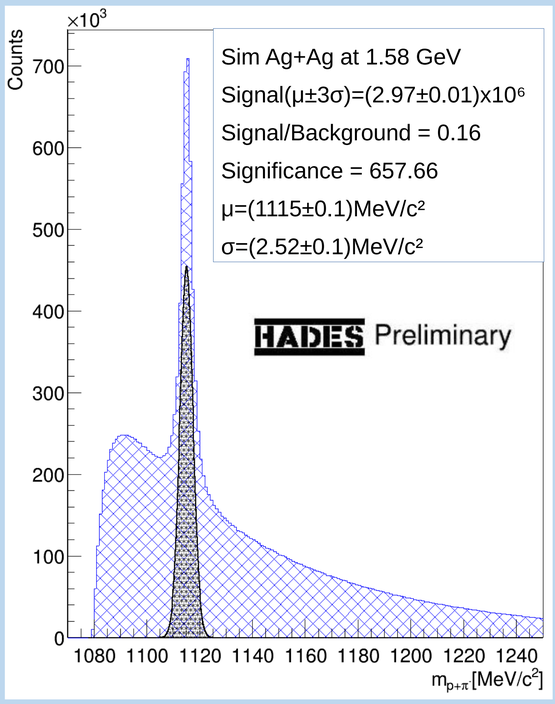


HADES sector coordinate system

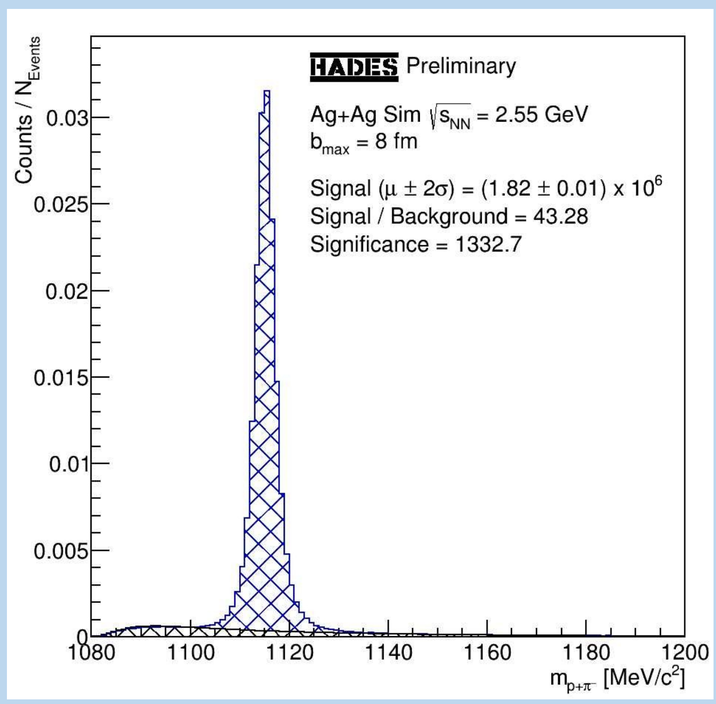


HADES track parametrisation

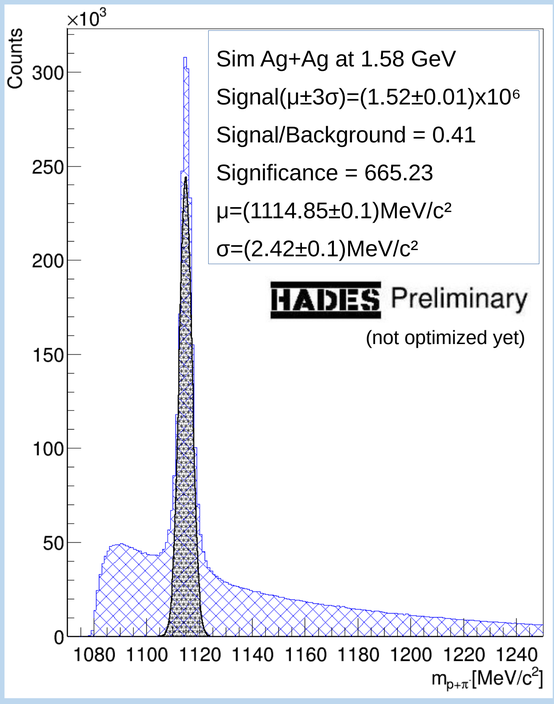
Results



Classical vector Ansatz with topology cuts



MVA Ansatz (DOI: 10.21248/gups.68651)



KF Particle Ansatz

Further optimization:

- Add **full material budget** to Kalman Filter procedure to gain more realistic errors
- Parameter **optimization** of the KF Particle package
- Apply the fully optimized ansatz to **measured Ag+Ag data**

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Contact:
Mirco Parschau
M.Parschau@gsi.de