

FARICH Performance Test in SpdRoot 4.1.7

Amaresh Datta (amaresh@jinr.ru)

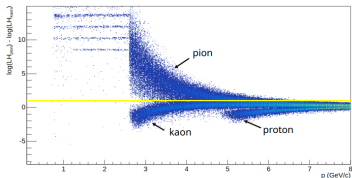
DLNP
Dubna, Russia

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New SpdRoot Version and FARICH

- On Jan 22, Igor mentioned development-4.1.7 version has been used in a test production
- Apart from bug fixes, two major new features in it were FARICH pid and convenient separation of DSSD/MAPS module (no more CustomIts)
- Artem Ivanov gave details of how to use FARICH in SpdRoot
- I tested the FARICH performance in data from test production (in /eos area)

Context



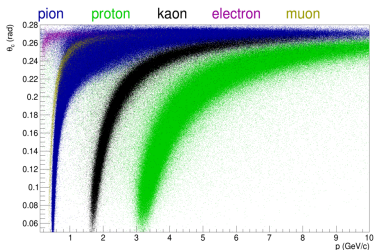
$$\text{PID}_{\text{pion}} = (\log(\text{LH}_{\text{pion}}) - \log(\text{LH}_{\text{kaon}})) > 1.1$$

Strict criteria

$$\text{PID}_{\text{pion}} = (\log(\text{LH}_{\text{pion}}) - \log(\text{LH}_{\text{kaon}})) > 1.1$$

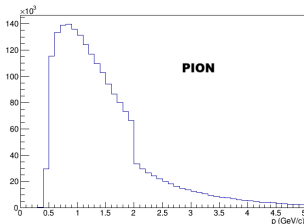
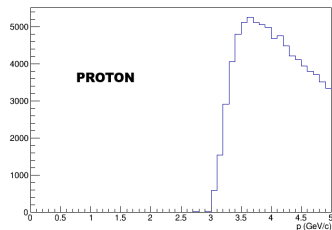
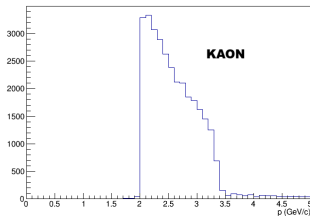
$$\text{PID}_{\text{kaon}} = \begin{aligned} &(\log(\text{LH}_{\text{kaon}}) - \log(\text{LH}_{\text{pion}})) > -0.2 \\ &(\log(\text{LH}_{\text{kaon}}) - \log(\text{LH}_{\text{proton}})) > 1.0 \end{aligned}$$

$$\text{PID}_{\text{kaon}} = \begin{aligned} &(\log(\text{LH}_{\text{proton}}) - \log(\text{LH}_{\text{kaon}})) > -0.5 \\ &(\log(\text{LH}_{\text{proton}}) - \log(\text{LH}_{\text{pion}})) > -0.5 \end{aligned}$$



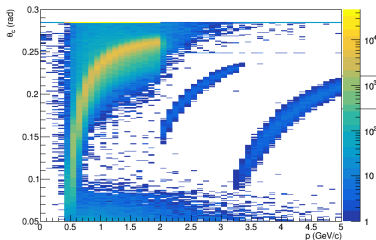
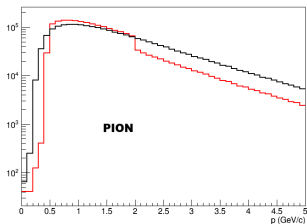
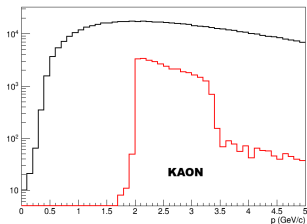
- Artem suggested log-likelihood formulae to use for PID (left) in collaboration meeting
- He also showed track θ_c distributions for different species (with true/MC pid) in test prod data
- He did not test how log-likelihood actually performs

Test of FARICH in development-4.1.7 - 1



- Clockwise from bottom left : pion, kaon and proton counts vs. momentum
- Plots show particles that were correctly identified (i.e. MC pid 211 and FARICH log-likelihood suggests pion for the pion plot)
- Notice how performance drops when next heavier particle threshold starts

Test of FARICH in development-4.1.7 - 2

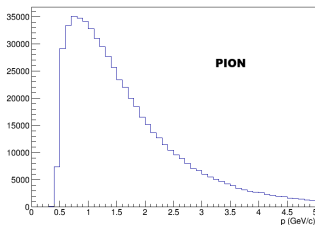
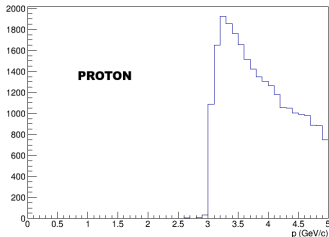
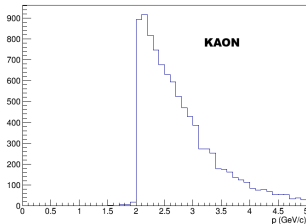


- Clockwise from bottom left : pion, kaon (tracks in endcap vs correct farich PID) and theta for corrected identified tracks
- I defined tracks reaching FARICH as (no of hits in EC > no of hits in barrel) - may be not a very good definition (i.e. pion plot)
- We clearly see something is wrong with the log-likelihoods

Bugs in FARICH Code

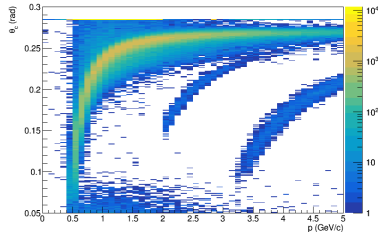
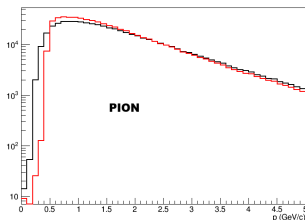
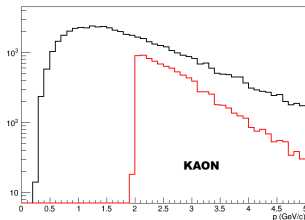
- Found a few bugs in reco/farich/SpdMCFarichParticleProducer.cxx
- Fixed and tested again

Bug Fix Test - 1



- Clockwise from bottom left : pion, kaon and proton counts vs. momentum
- Performance drops are gone
- After threshold, identification is more or less smooth

Bug Fix Test - 2



- Clockwise from bottom left : pion, kaon (tracks in endcap vs correct farich PID) and theta for corrected identified tracks
- More or less what we expect - **slight concern** : **missing kaons near threshold**

Summary

- FARICH log-likelihood had some problems in the 'development-4.1.7' version
- They are now fixed in the 'development' version in git and communicated to Artem - he will also take an overall look again at the relevant codes
- Also, I tested that simply using the largest log-likelihood as PID works perfectly fine - do not necessarily need the equations initially suggested