PWG5 (Heavy Flavour) summary

Alexander Zinchenko

Outline

1. Scope of activities

2. Inner Tracking System (ITS) TDR

3. Related Work Packages:

   1. ITS track reconstruction

   2. Exclusive D-meson decay selection

Scope of activities

1. Open charm studies: exclusive decays → Inner Tracking System (ITS) performance evaluation (synergy with ITS project) → dedicated track reconstruction methods ("Vector Finder")

2. Semi-leptonic decays and charmonia → lepton (electron) tagging (synergy with dilepton studies) → energy loss simulation and reconstruction in TPC for dE/dx PID

The two-stages construction scenario. Stage-1 (by 2022/2023)
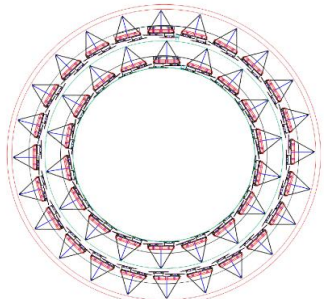
MPD - ITS

The Outer Barrel.

ALICE-ITS2 technology (42 Staves)

Sensor

100 um-thick MAPS

power bus
flexible printed circuit
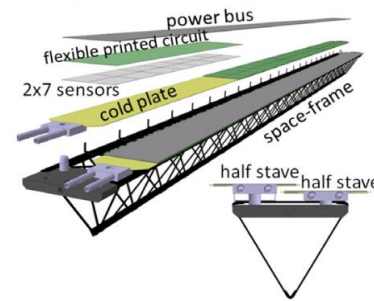2x7 sensors
cold plate
space-frame
half stave half stave

Layer 4: 18 Staves (36 Panels)
Layer 5: 24 Staves (48 Panels)
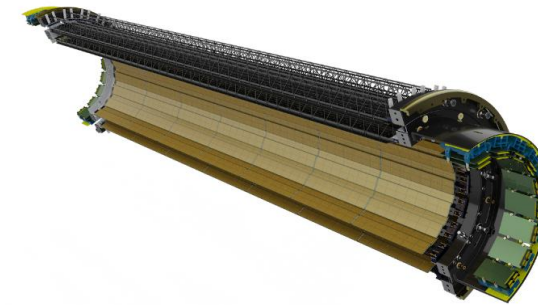
The Integration Mechanics.

(Beam pipe, TPC, FFD)
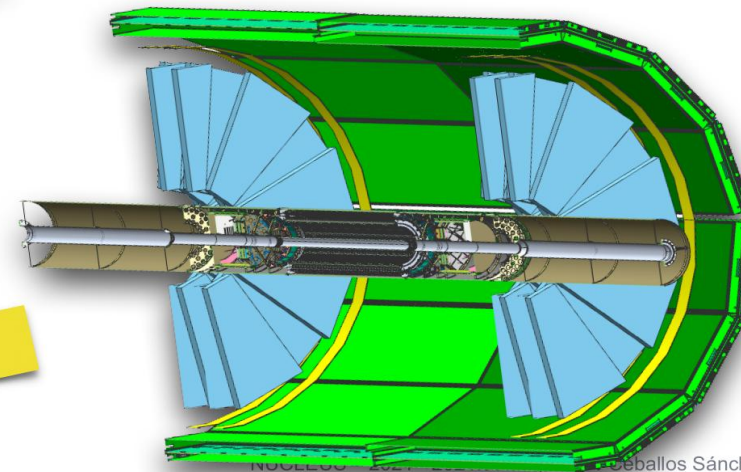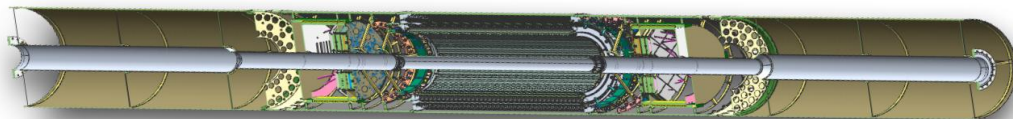
MPD Stage-I !!!

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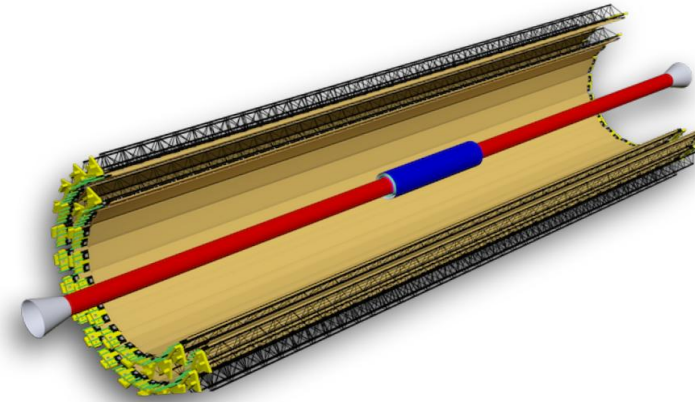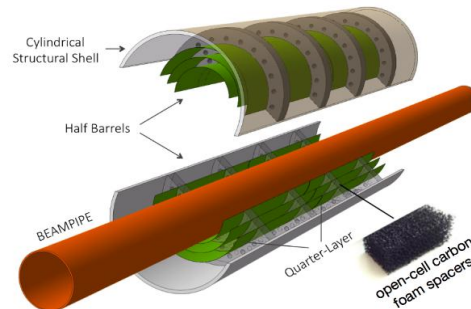## The two-stages construction scenario. Stage-2 (by 2025/2026)

MPD - ITS

The Inner Barrel.

Goal: Use double-size ALICE-ITS3-like sensors on a beam pipe of 40 mm in diameter
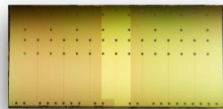
ALICE-ITS3 (Under R&D): 20 um-thick (!!!) by 280 mm-long bent MAPS

Silicon Genesis: 20 micron thick wafer

Cylindrical Structural Shell
Half Barrels
BEAMPIPE
Quarter-Layer
open-cell carbon foam spacers

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BackUp plan: Built an ALICE-ITS2-like IB
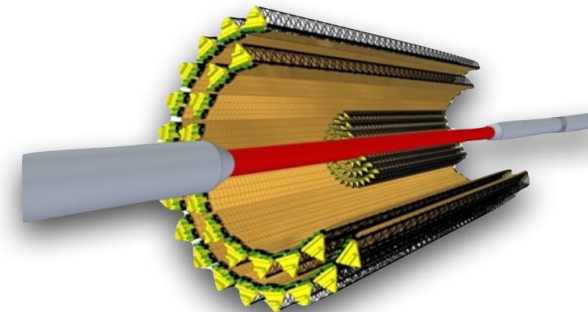
Sensor

50 um-thick MAPS

IBHIC

9 Sensors

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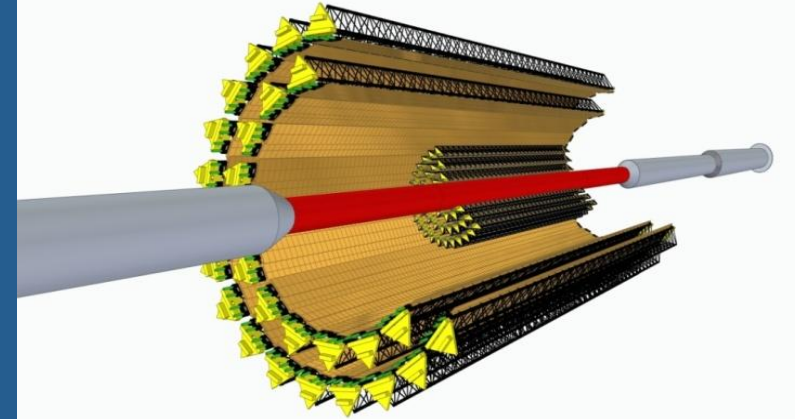
MPD Inner Tracking System based on MAPS

D^+_s reconstruction in central Au+Au at NICA energy

Particle	Mass [MeV/c^2]	Mean path cτ [mm]	Decay channel	BR	Multiplicity
D$^+$	1869.6	0.312	$\pi^+ + \pi^+ + K^-$	9.13%	10^{-2}
D^+_s	1968.5	0.150	$\pi^+ + K^+ + K^-$	5.50%	10^{-2}

Reconstruction of D^+_s is more complicated task compared to D$^+$ for three reasons:
1) due to the decay length is 2 times shorter,
2) due to the BR is 2 times less,
3) due to the decay channel, since the reconstruction efficiency of K tracks is lower than that of π tracks.
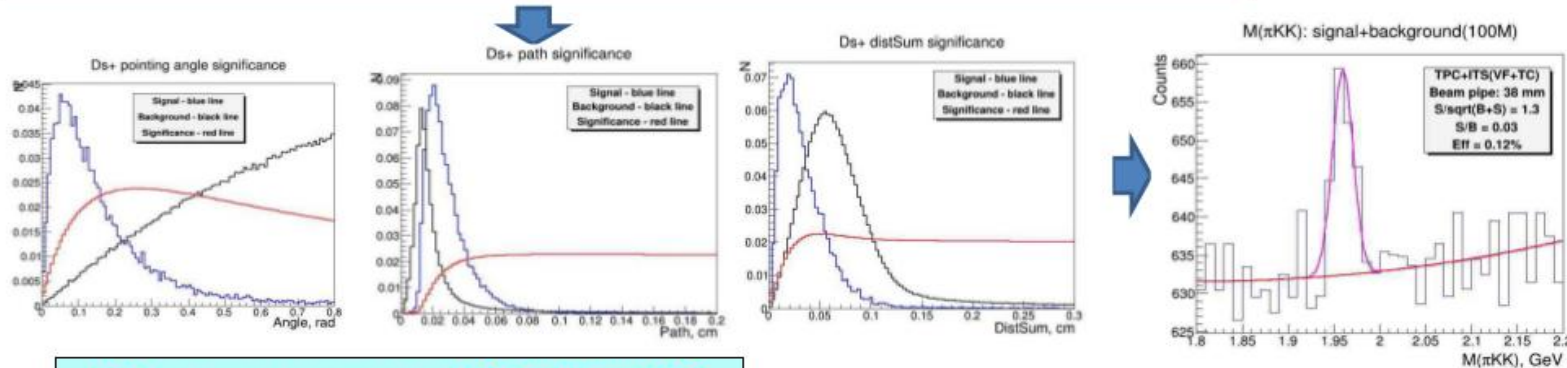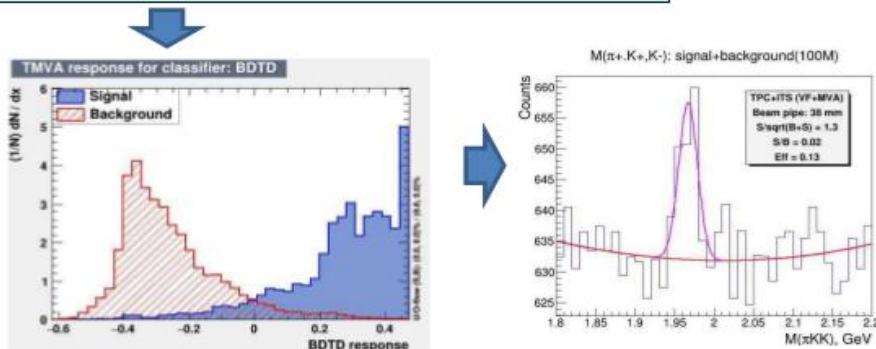
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D^+_s reconstruction using VF

TC: $dca(\pi, K) > 0.018$ cm, $angle(D^+_s) < 0.22$ rad & $dist(\pi K) < 0.04$ cm & $path(D^+_s) < 0.05$ cm
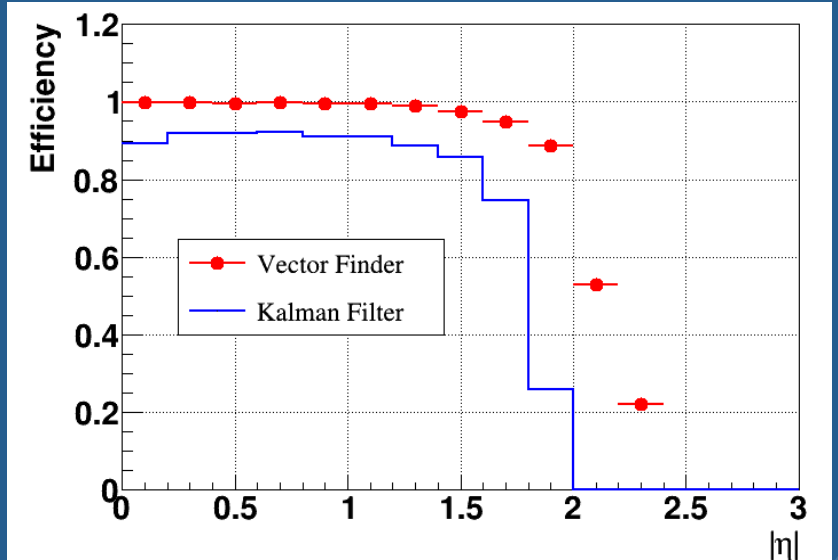
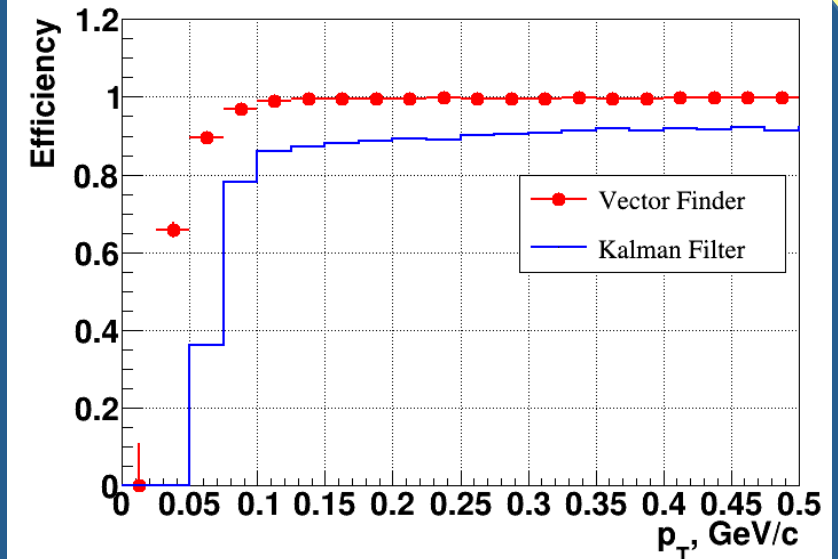$D^+_s \rightarrow K^- + K^+ + \pi^+$

MVA: $dca(\pi, K) > 0.02$ cm, BDT_response>0.25

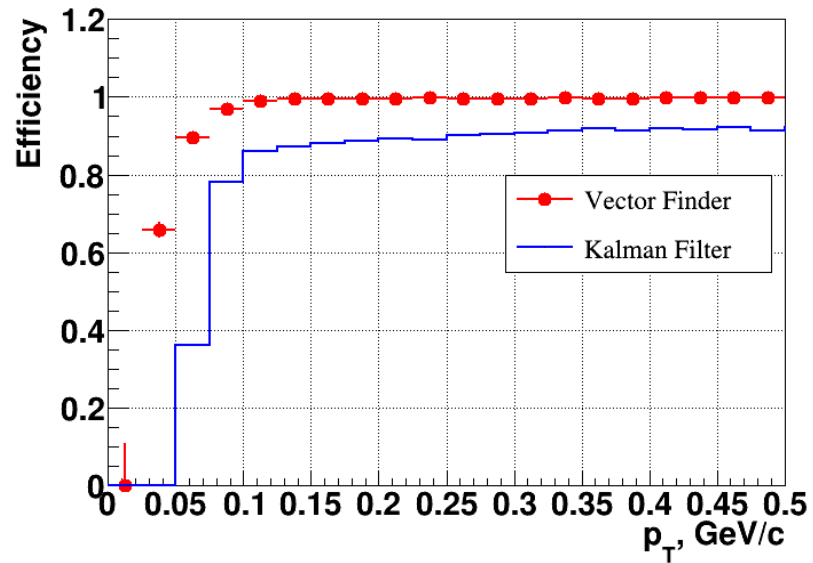| Particle	D^+_s	
Method	TC	MVA
Efficiency, %	0.12	0.13
Significance	1.3	1.3
S/B(2σ) ratio	0.03	0.02

VF mechanism opens up the feasibility of reconstruction D^+_s with an efficiency of 0.12 % by both TC and MVA methods at the same level of significance (1.3) with project ITS

N. Maltsev @ Nucleus 2021 (Equivalent statistics ~100M Au+Au)
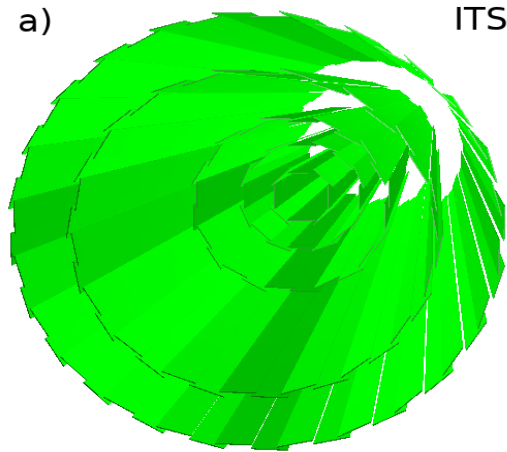
D. Zinchenko
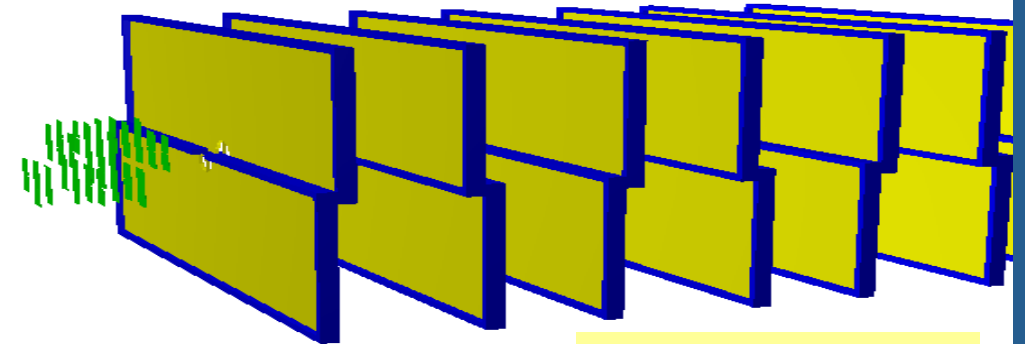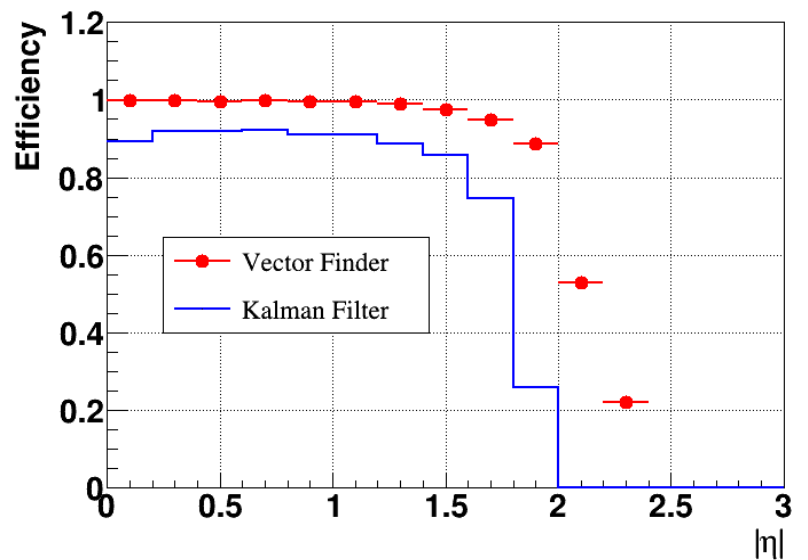
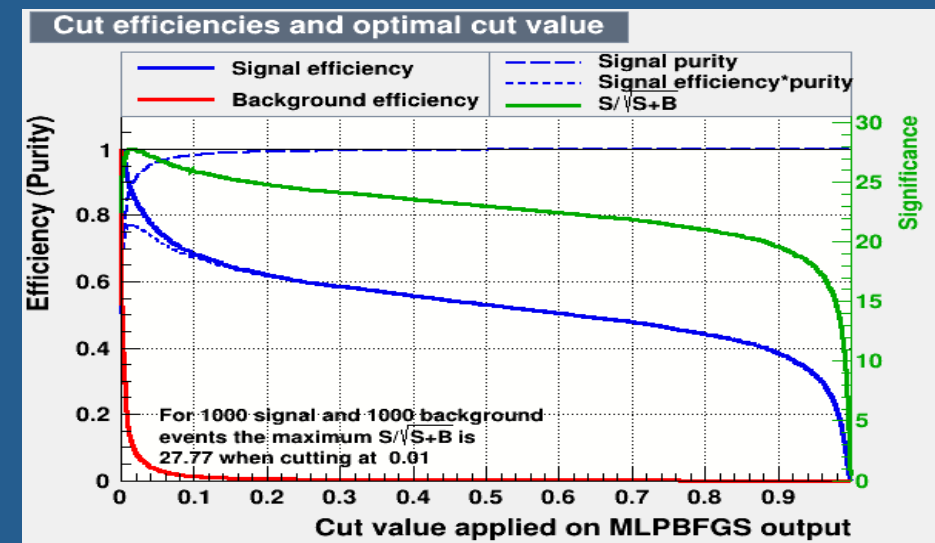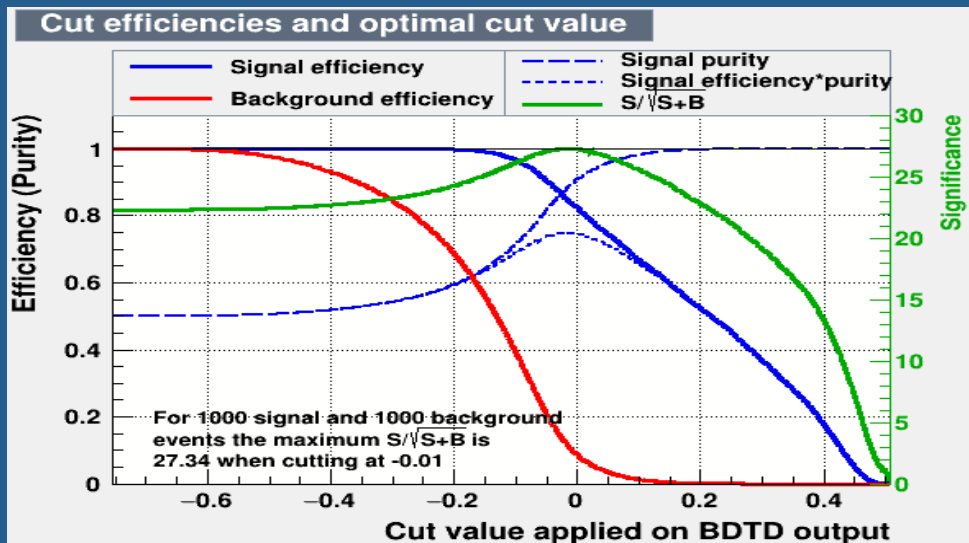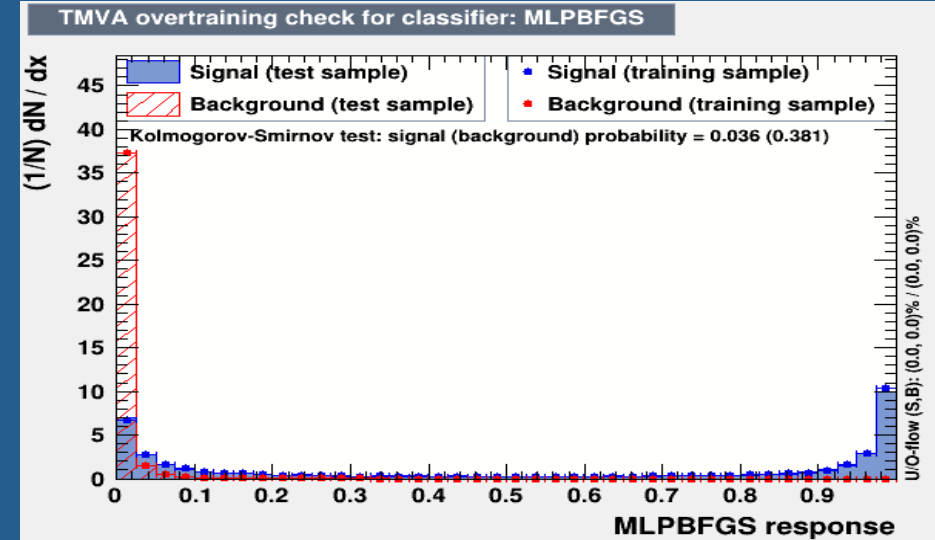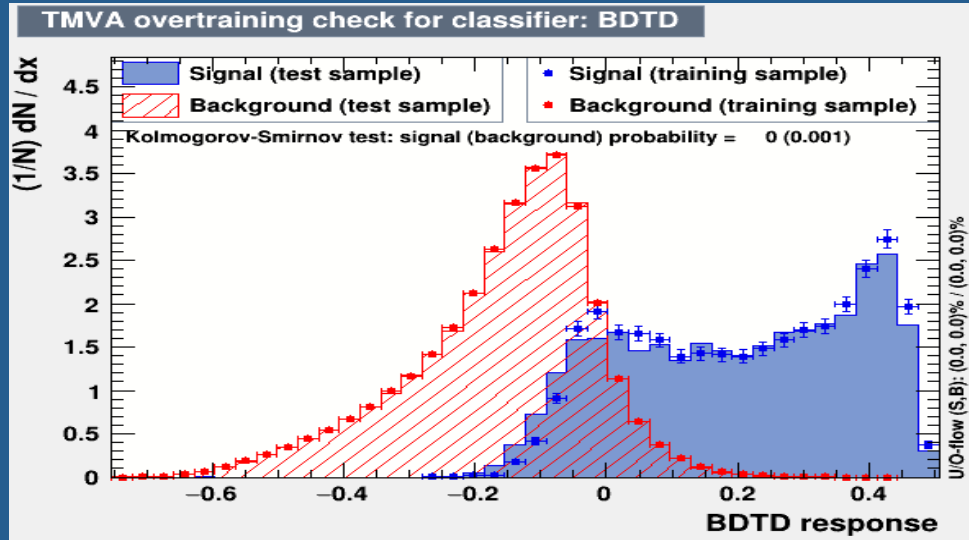BM@N tracker

p+p @ 25 GeV Pythia8 (Equivalent statistics ~1B events)
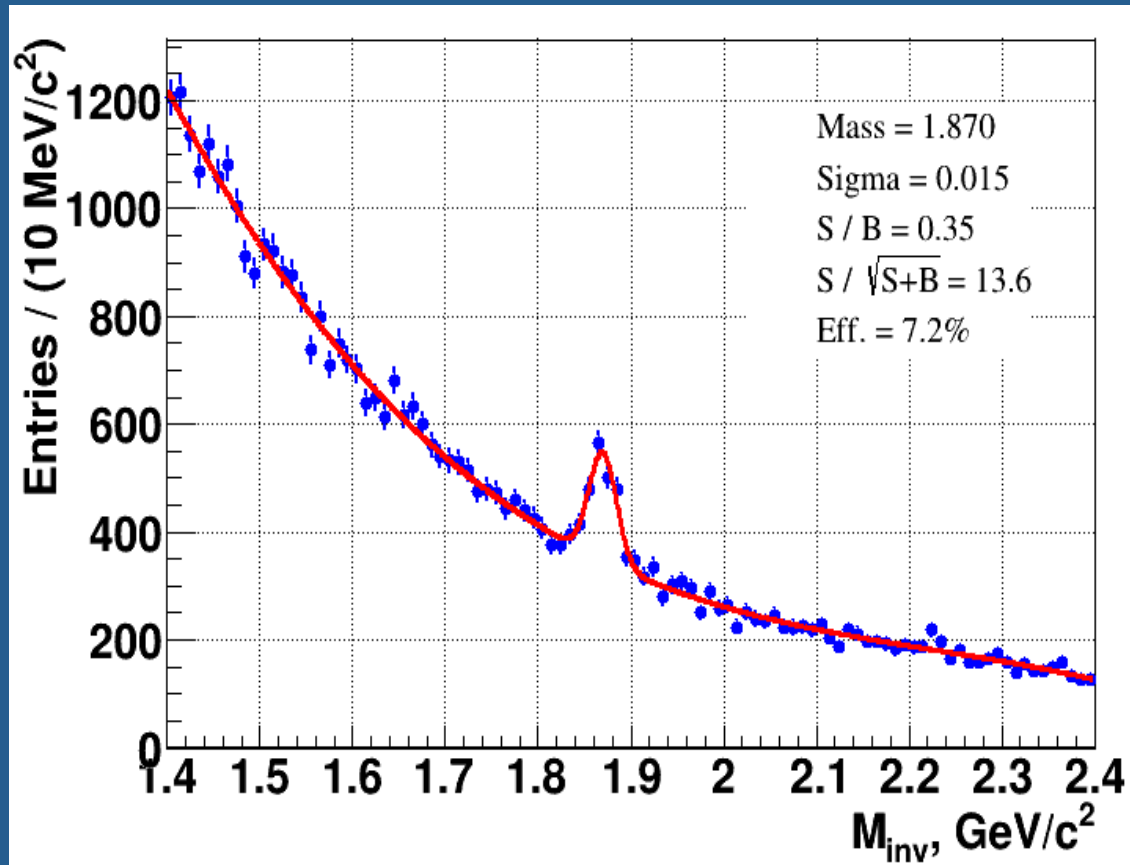Thanks to V.Kondratev for sharing his experience with TMVA package usage
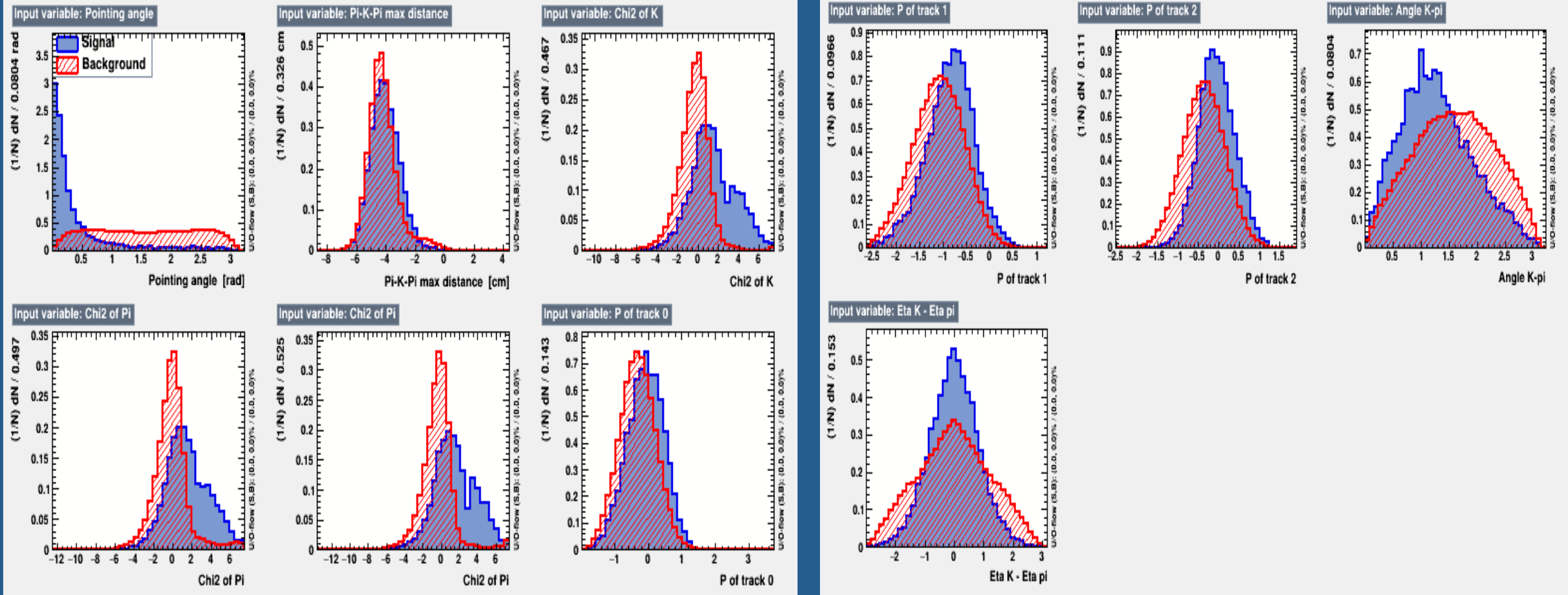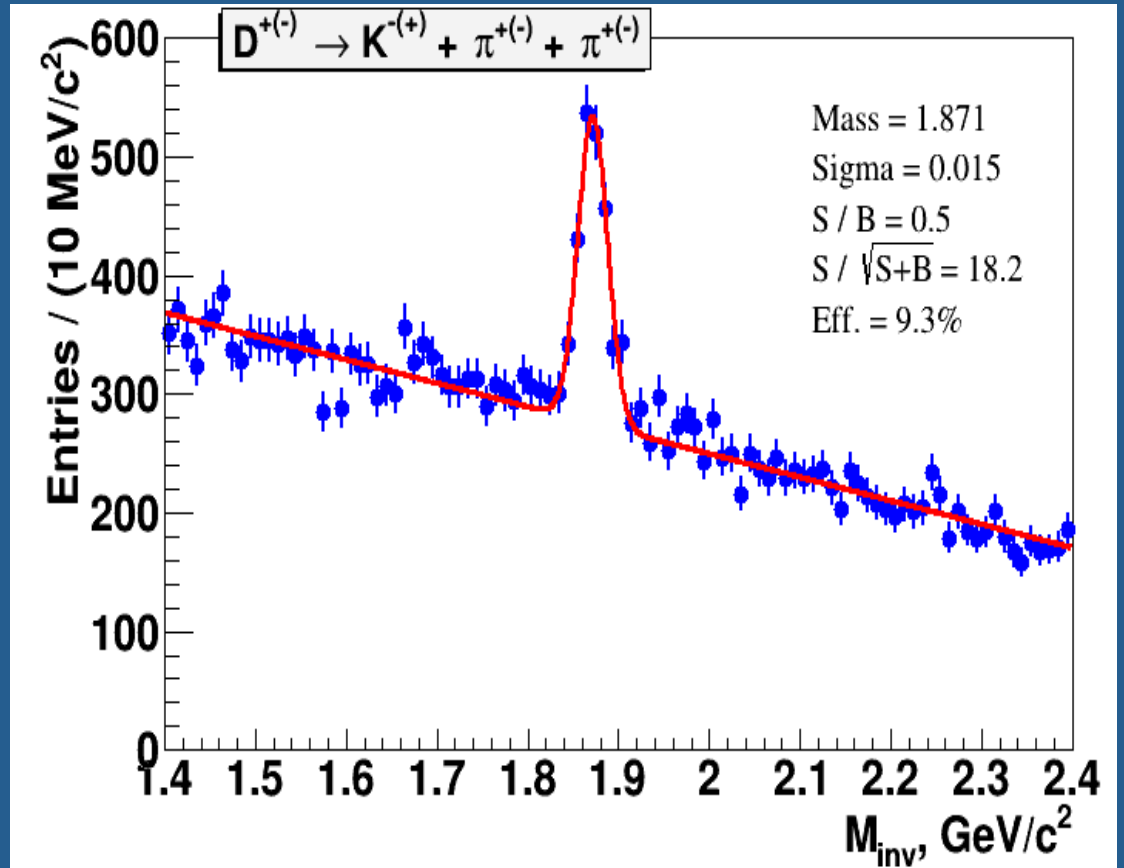
TMVA package: network performance

D$^{+(-)}$ 3-prong decays

Cuts on variables

Mass = 1.870
Sigma = 0.015
S / B = 0.35
S / $\sqrt{S+B}$ = 13.6
Eff. = 7.2%

TMVA

$D^{+(-)} \rightarrow K^{-(+)} + \pi^{+(-)} + \pi^{+(-)}$

Mass = 1.871
Sigma = 0.015
S / B = 0.5
S / $\sqrt{S+B}$ = 18.2
Eff. = 9.3%

Outlook

- Import ITS tracking package from BM@N

- Reproduce (improve?) D-meson results in Au+Au

- Leptonic decays – try to get a feeling on those