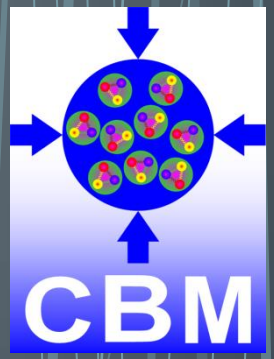
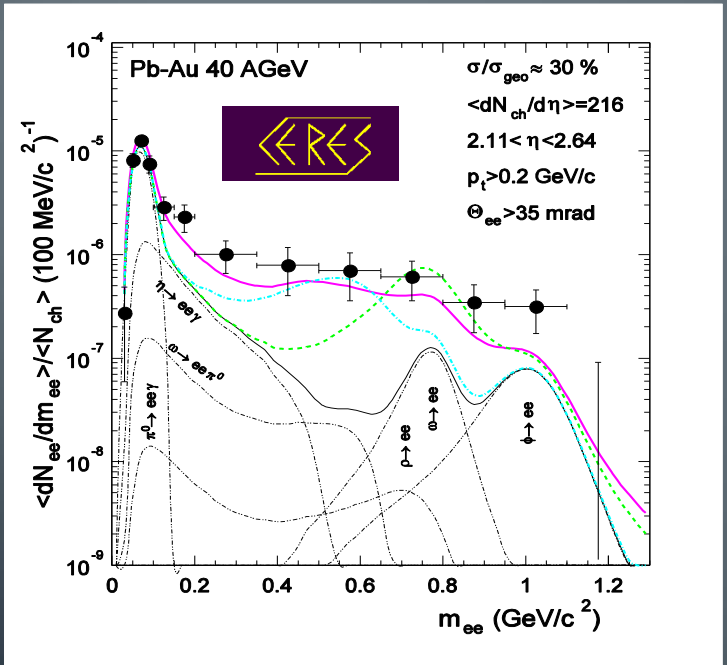
Background rejection in the dilepton analysis with the CBM-MVD

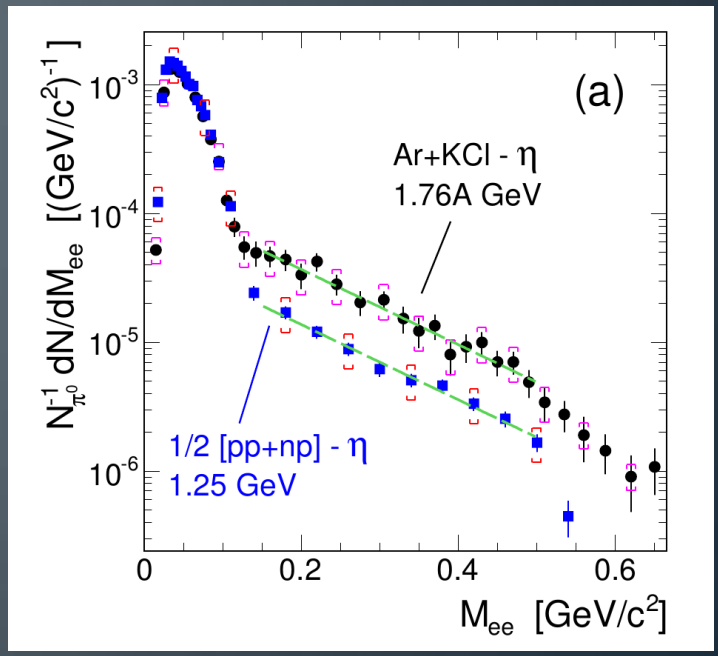
Erik Krebs for the CBM Collaboration



Motivation

- Dileptons as direct probe of the high density phase.
- CERES at 40 and 158 AGeV beam energy: excess higher at lower energy.
- HADES at SIS18.

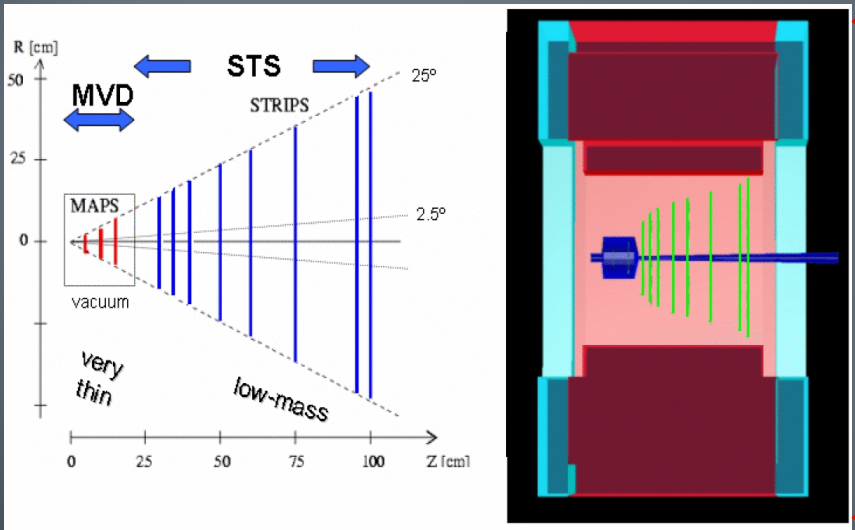


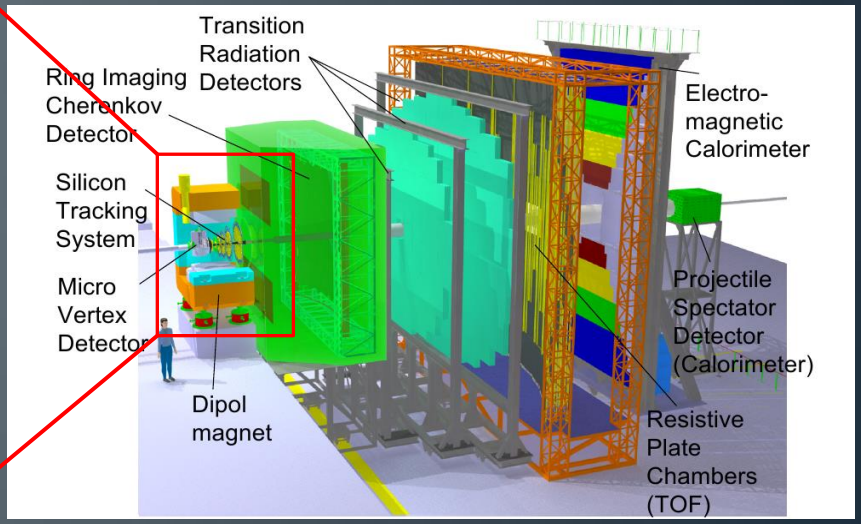


CERES coll., Phys. Rev. 91 (2003) 042301

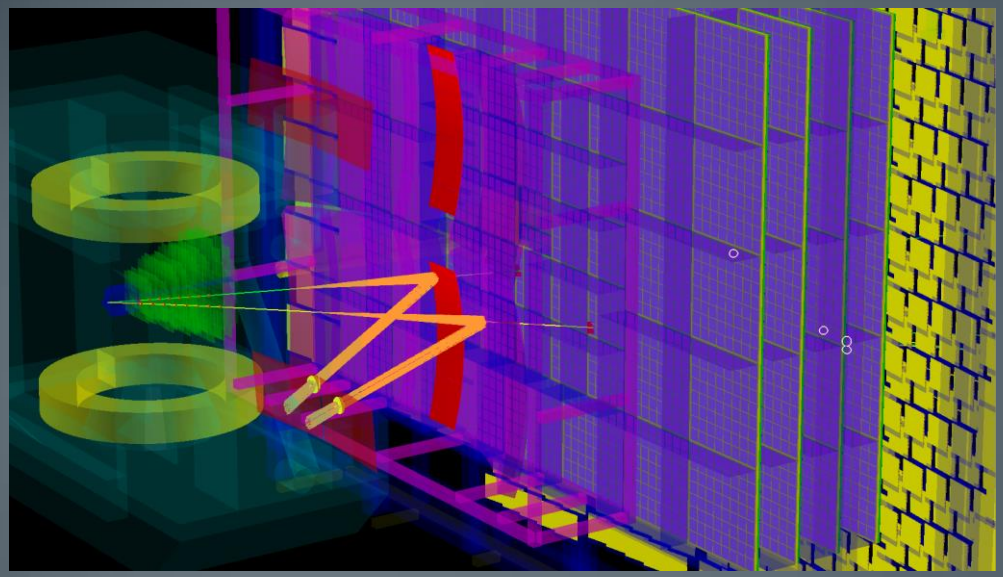
HADES: Phys.Rev.C84:014902,2011

CBM Detector





CBM Detector



- Without hadron-blind detector before the tracking.
- Background due to material budget of the STS and MVD.
- Sufficient π discrimination (misidentification $<10^{-4}$).

UrQMD: Au+Au collision at beam energy 25AGeV, zero impact parameter

$e^+ e^- \gamma$

1.2%

↑

~350 $\pi^0 \rightarrow 98.8\%\ \gamma\gamma$

~3 $\gamma_{target} \rightarrow e^+e^-$

~700 $\pi^{+/-}$ could be identified as an electron

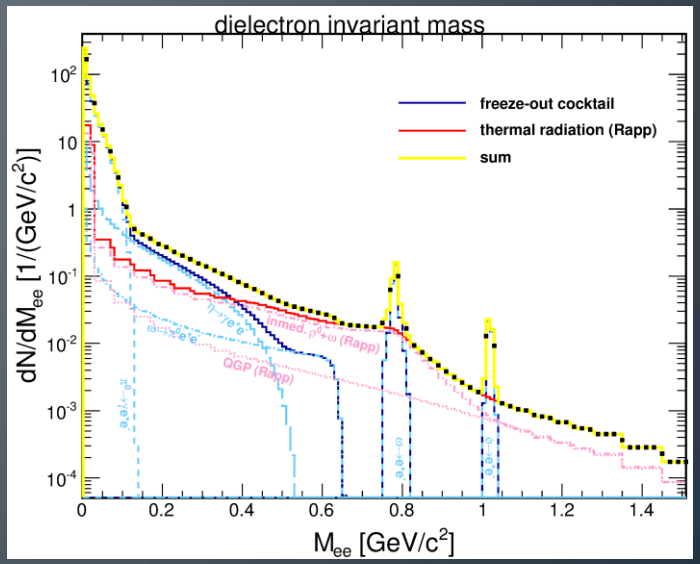
- Challenges:
  - Low branching ratios:

Particle	Decay Channel	Branching Ratio
ρ^0	e^+e^-	$4.7 \cdot 10^{-5}$
ω	e^+e^-	$7.3 \cdot 10^{-5}$
ω	$\pi^0e^+e^-$	$7.7 \cdot 10^{-4}$
Φ	e^+e^-	$3.0 \cdot 10^{-4}$

  - Large background from γ-conversions and π^0-Dalitz decays.

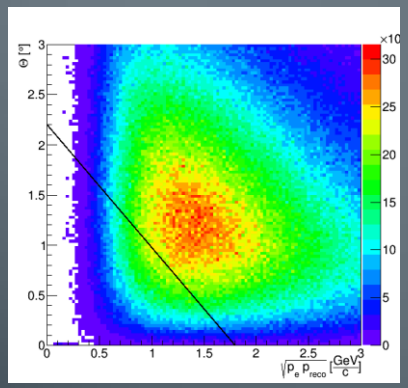
Simulation

- UrQMD Central AuAu at 8 GeV.
- 25 µm gold target.
- Analysis with and without MVD.
- PID from acceptance in RICH and TRD.
- Low mass vector mesons from Pluto.
- From thermalized medium: QGP and hot hadron gas
  - → Florian Seck HK2.5

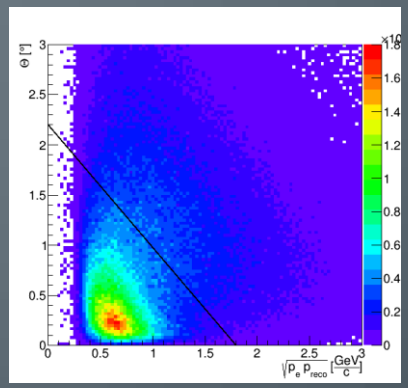


Main Cuts

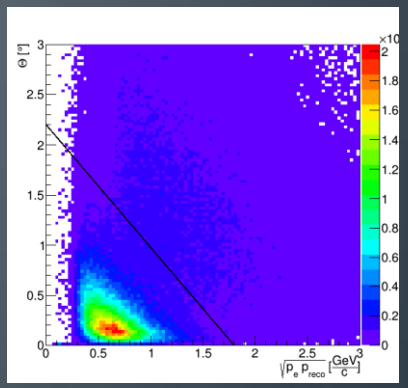
- Primary track cut
  - Extrapolate tracks to primary vertex and cut on deviation to the vertex.
- Track topology cut
  - Cut on opening angle and product of momenta



Signal

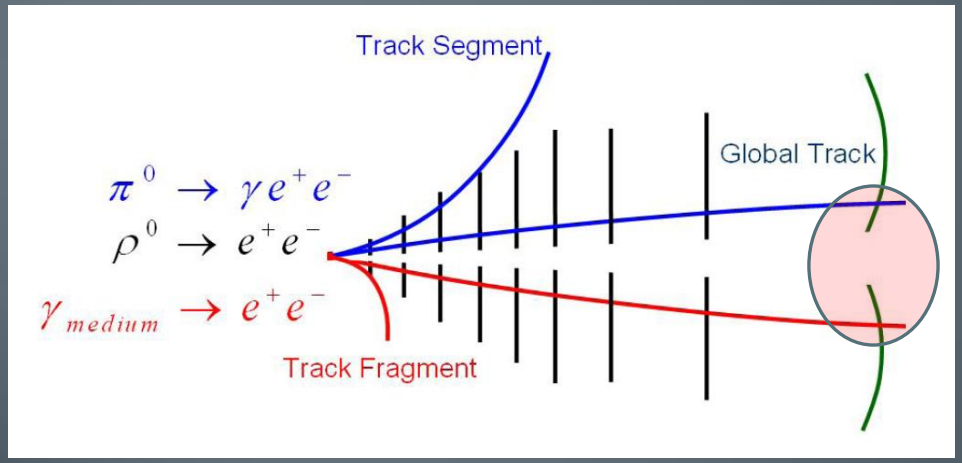


π^0-Dalitz



γ-conversions

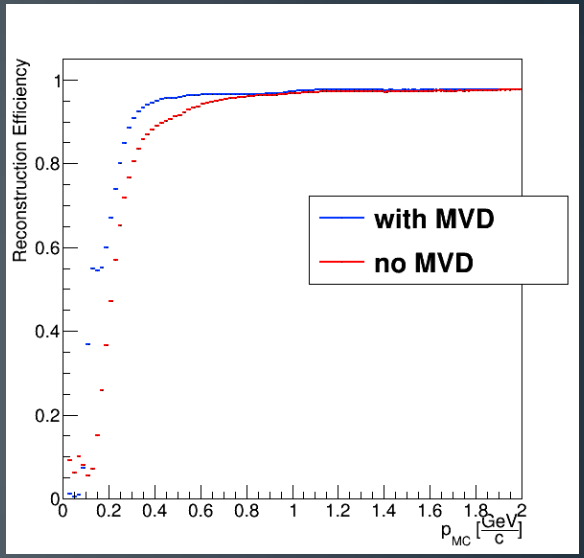
- Can the Micro Vertex Detector contribute to reduce the background?
- Additional tracking stations near the target region.
- Reconstruct more low momentum tracks.



Fake Pair

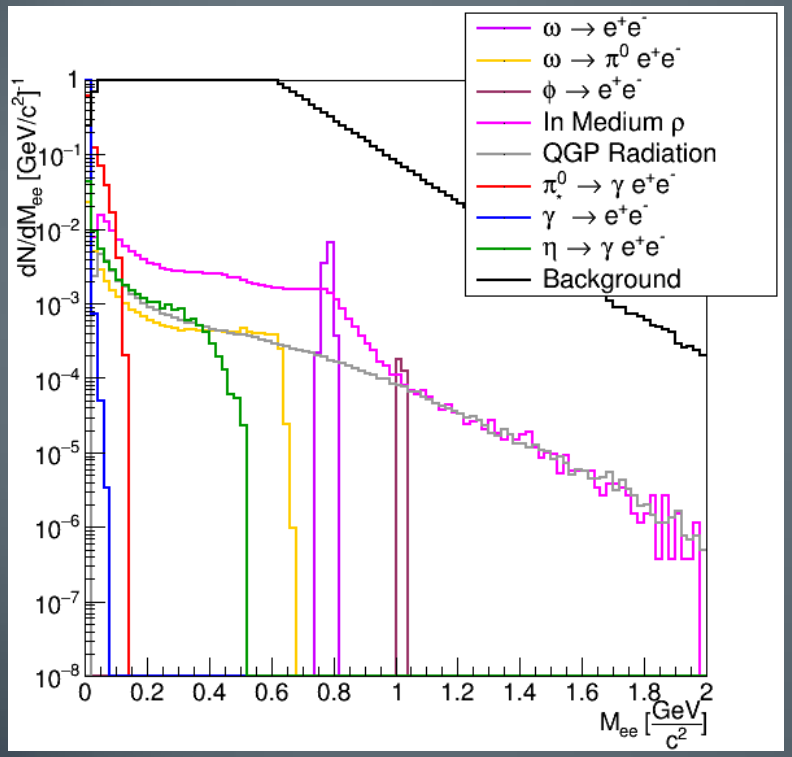
γ-Conversions

- Able to reconstruct additional low momentum tracks.
- But MVD is also a source of background.
- Conversions in MVD misidentified as primary tracks
- Simple χ^2-cut alone not sufficient when including MVDs.
- Many γ-conversions produced outside the target region have no hit in the first MVD station.
- Keep all tracks with a hit in the first MVD.
- Extrapolate tracks to the first station and cut if they are outside its acceptance.

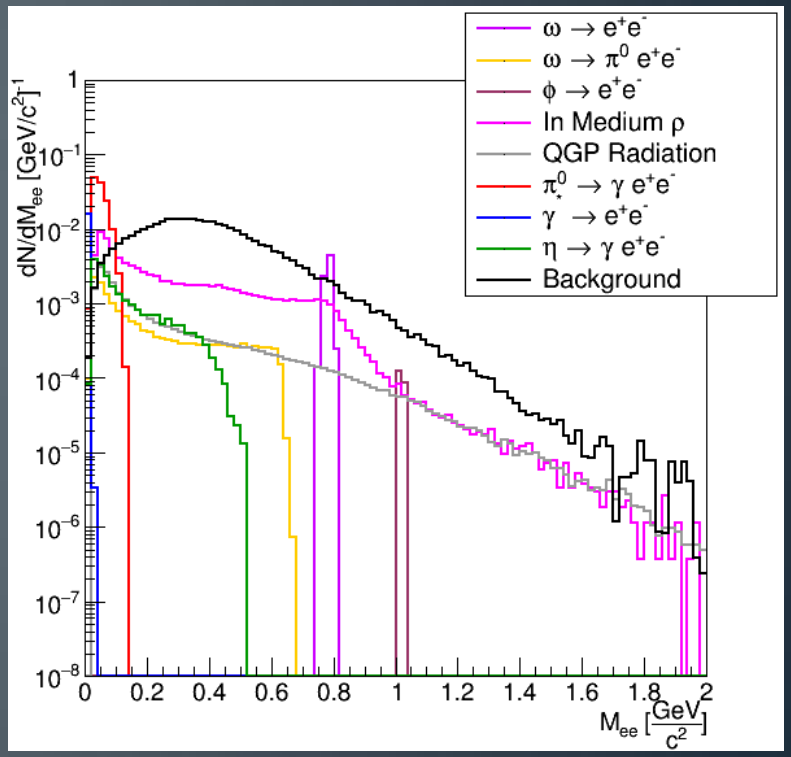


Reconstruction efficiency with and without the MVD.

Invariant Mass Cocktail with MVD

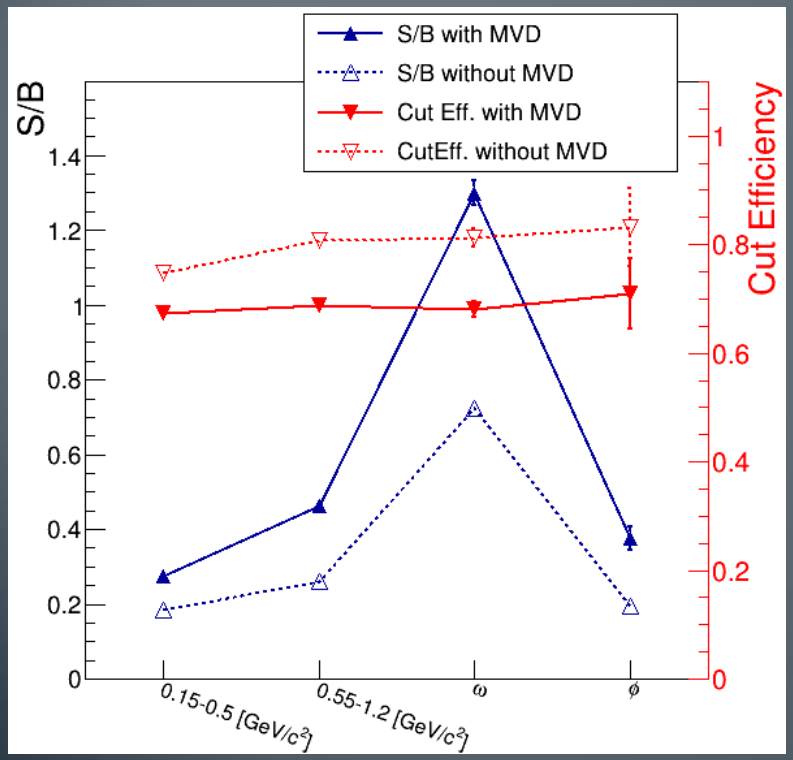


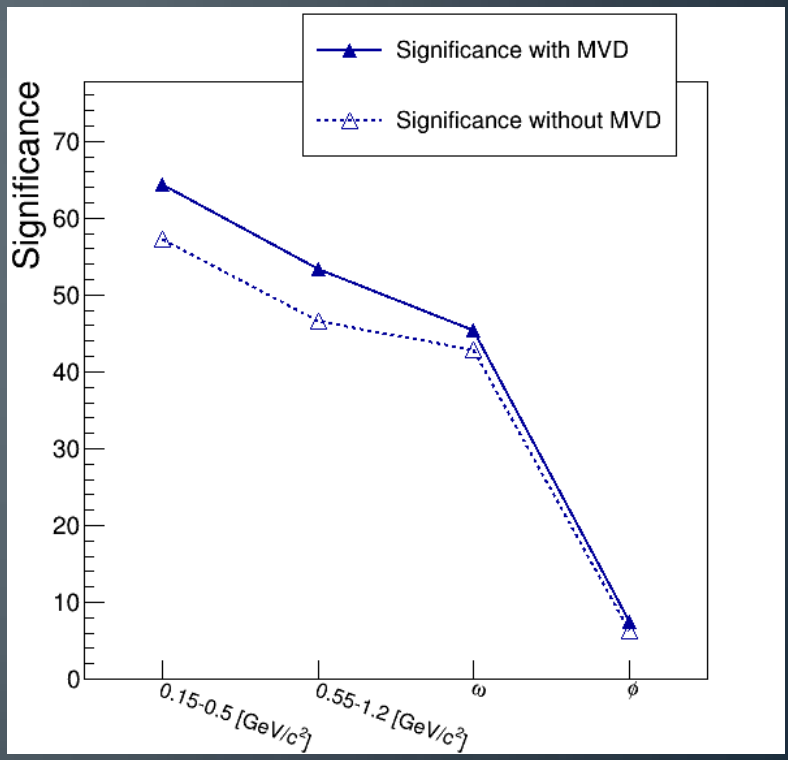
After PID



All cuts applied

- Improved signal-to-background but also signal loss with the MVD.
- Overall significance is higher with MVD.



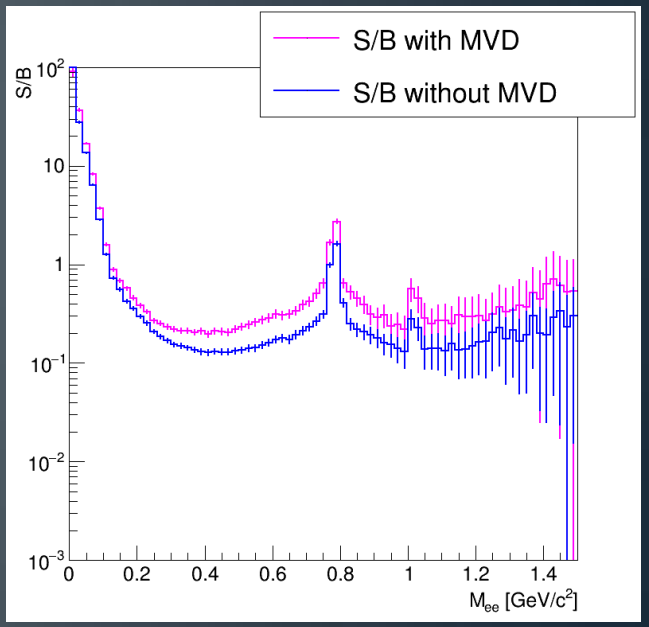


Summary

- More low momenta tracks can be reconstructed by using the MVD as additional tracking stations.
- A source of background is e^+/e^- from γ-conversions produced in the MVD stations.
- This additional background can be reduced.
- Improved signal-to-background and significance at the cost of signal efficiency when including the MVD in the analysis in case of Monte-Carlo PID.

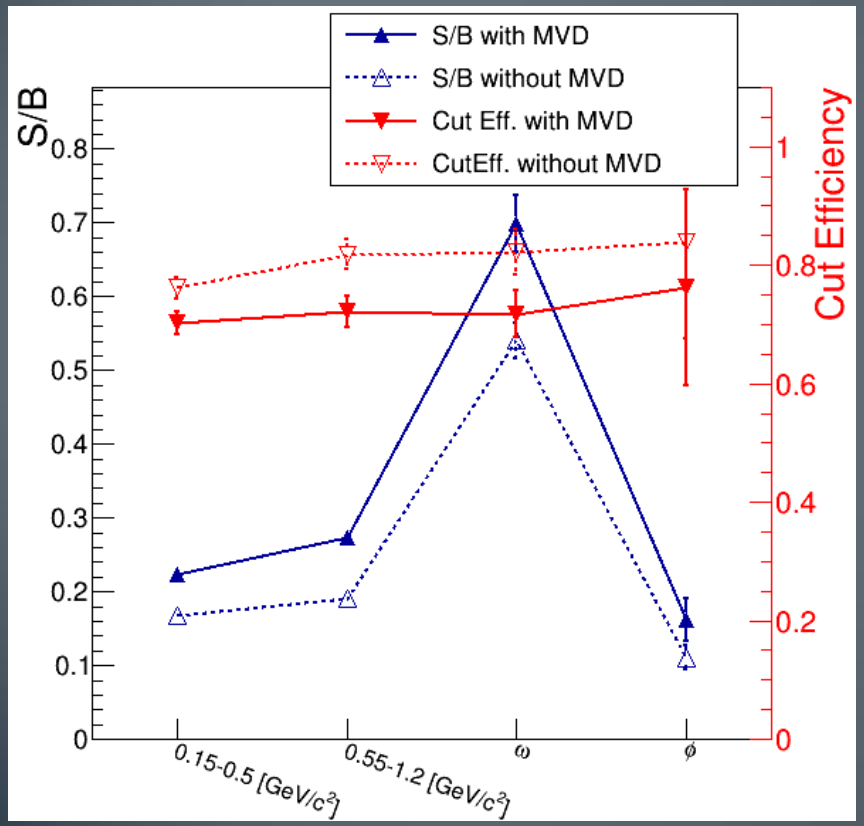
Invariant Mass with and without MVD

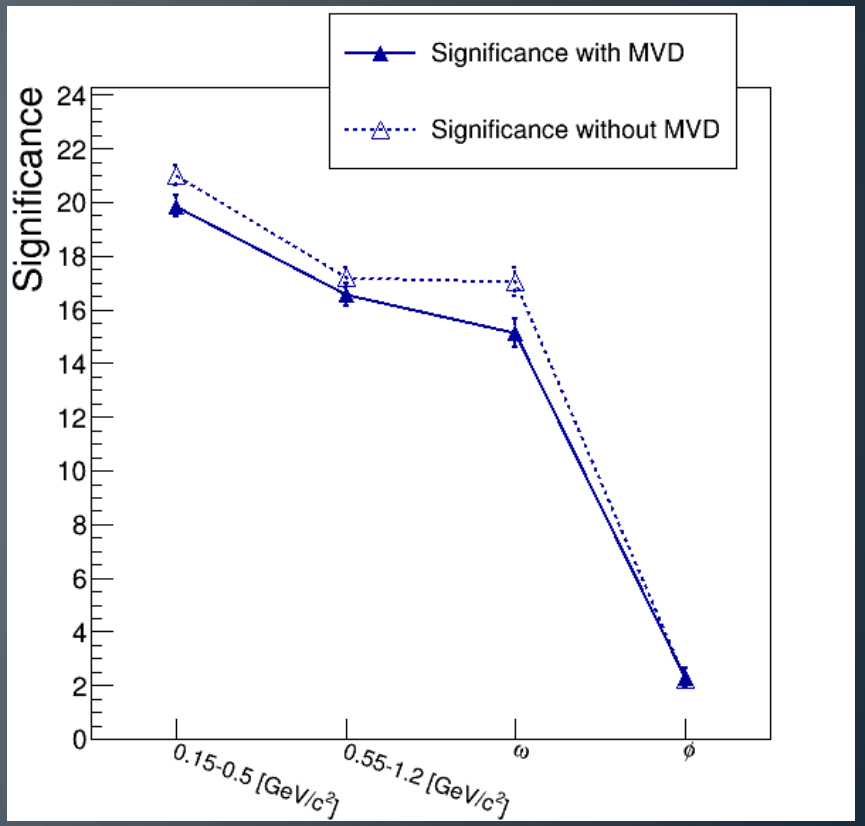
Mass Range [GeV]	Number MVD	Cut Efficiency	S/B	$S/\sqrt{S+B}$
0-0.15	0	$(25\pm1)10^{-2}$	4.7 ± 0.1	238 ± 1
	4	$(21\pm1)10^{-2}$	5.8 ± 0.1	234 ± 1
0.15-0.6	0	0.75 ± 0.01	0.19 ± 0.01	57.2 ± 0.4
	4	0.67 ± 0.01	0.28 ± 0.01	64.4 ± 0.4
0.6-1.2	0	0.81 ± 0.01	0.26 ± 0.01	46.6 ± 0.4
	4	0.69 ± 0.01	0.46 ± 0.01	53.4 ± 0.5
ω	0	0.81 ± 0.02	0.73 ± 0.01	42.8 ± 0.5
	4	0.68 ± 0.01	1.3 ± 0.1	45.4 ± 0.6
φ	0	0.83 ± 0.07	0.20 ± 0.01	6.3 ± 0.4
	4	0.71 ± 0.06	0.38 ± 0.03	7.5 ± 0.5



All cuts applied.

Real PID


S/B with MVD
S/B without MVD
Cut Eff. with MVD
CutEff. without MVD
S/B
Cut Efficiency
0.15-0.5 [GeV/c²]
0.55-1.2 [GeV/c²]
ω
φ


Significance with MVD
Significance without MVD
Significance
0.15-0.5 [GeV/c²]
0.55-1.2 [GeV/c²]
ω
φ