Analysis of $K^+K^-\pi^0$ with concentration on low-mass region

Data

Dataset:

- Spring 2018 data

Data

Dataset:

- Spring 2018 data

Restrictions:

Data

Dataset:

- Spring 2018 data

Restrictions:

- Incident photon timed to be within central peak

Data

Dataset:

- Spring 2018 data

Restrictions:

- Incident photon timed to be within central peak
- Only best Confidence Level (*CL*) per event kept

Data

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- Only best Confidence Level (*CL*) per event kept
- *CL* must be above 10^{-4}

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Data

Dataset:

- Spring 2018 data

Restrictions:

- Incident photon timed to be within central peak
- Only best Confidence Level (*CL*) per event kept
- *CL* must be above 10^{-4}
- Kaons must be seen in TOF
- Missing mass within 3 standard deviations of central peak

Data

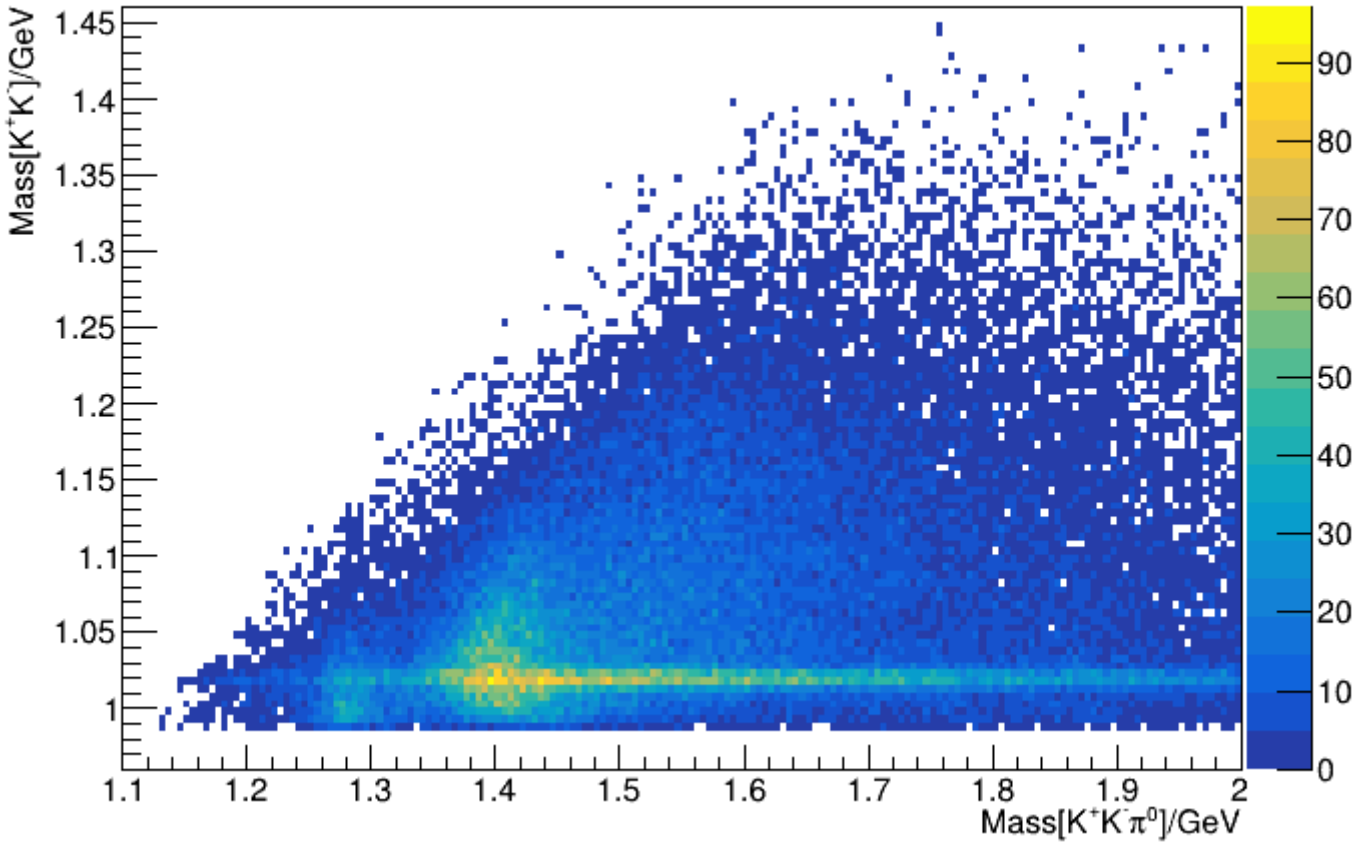
Dataset:

- Spring 2018 data

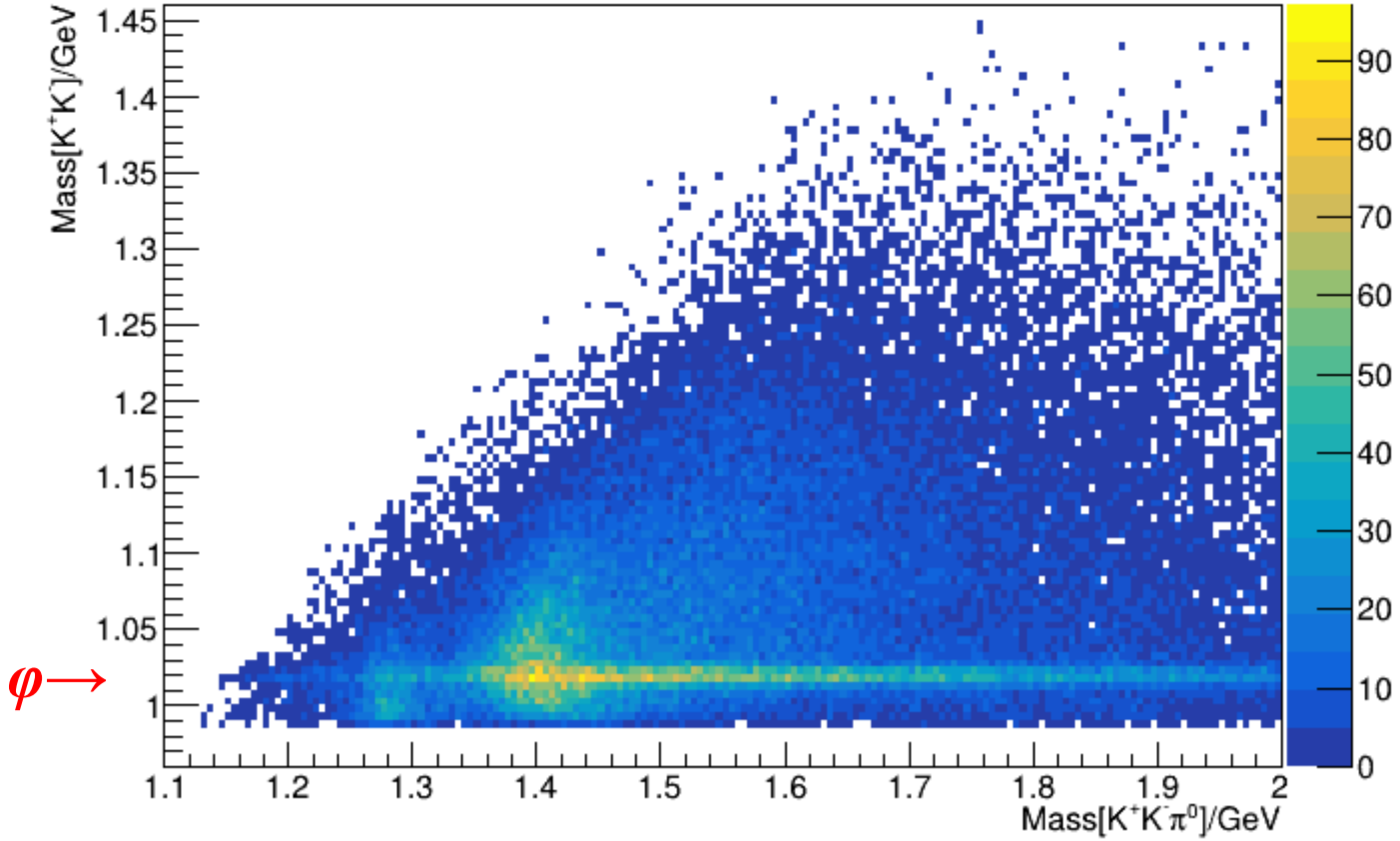
Restrictions:

- Incident photon timed to be within central peak
- Only best Confidence Level (*CL*) per event kept
- *CL* must be above 10^{-4}
- Kaons must be seen in TOF
- Missing mass within 3 standard deviations of central peak
- $0.12\ \text{GeV} < \text{Mass}[\pi^0] < 0.15\ \text{GeV}$

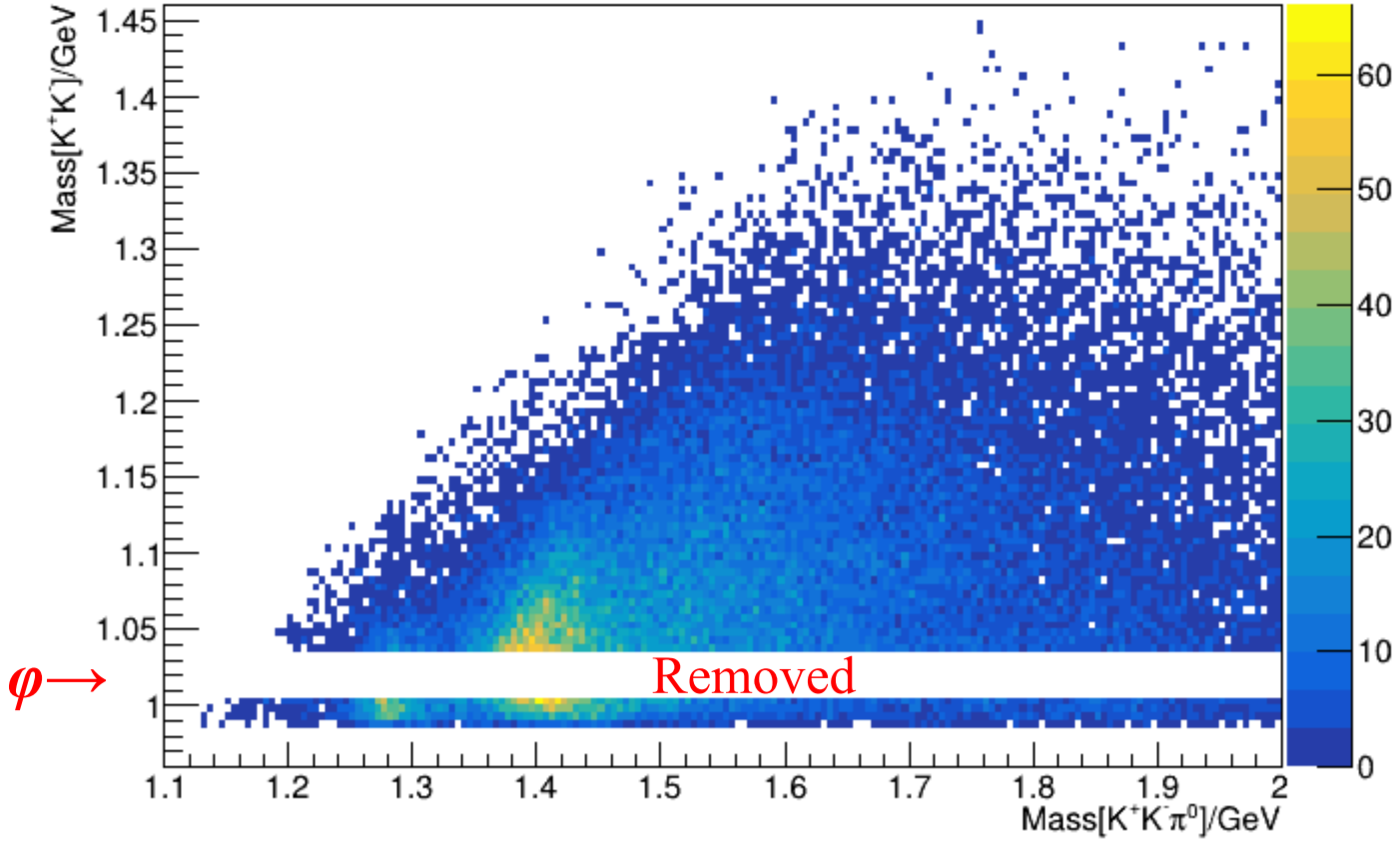
Data


Mass[K⁺K⁻]/GeV
1.45
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
Mass[K⁺K⁻π⁰]/GeV
90
80
70
60
50
40
30
20
10
0

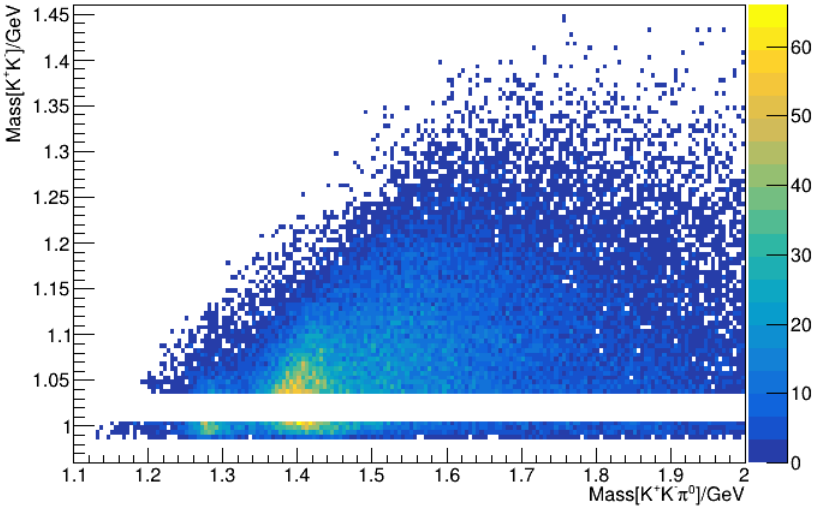
Data


Mass[K⁺K⁻]/GeV
1.45
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
φ→
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
Mass[K⁺K⁻π⁰]/GeV
90
80
70
60
50
40
30
20
10
0

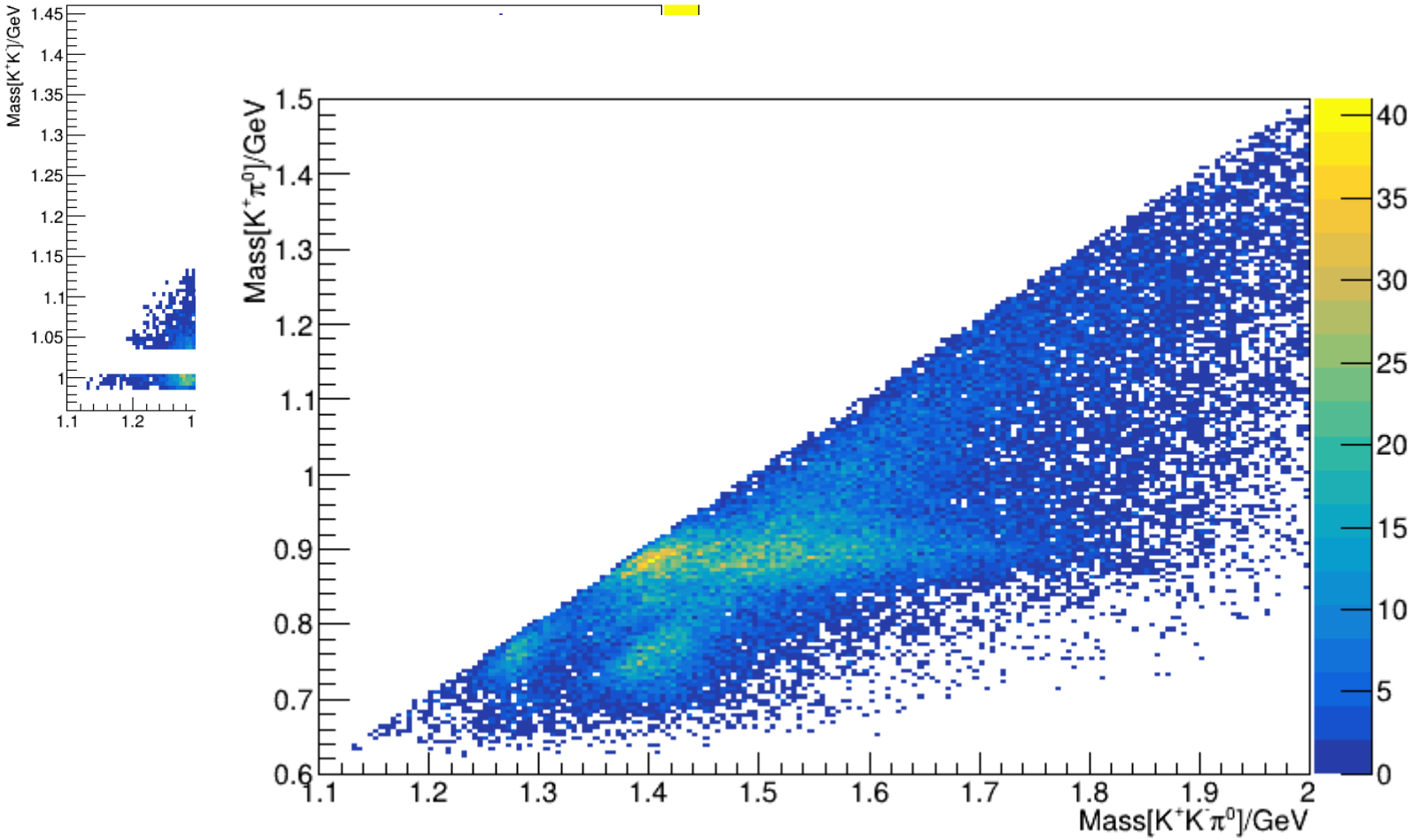
Data


Mass[K⁺K⁻]/GeV
1.45
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
φ→
Removed
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
Mass[K⁺K⁻π⁰]/GeV
60
50
40
30
20
10
0

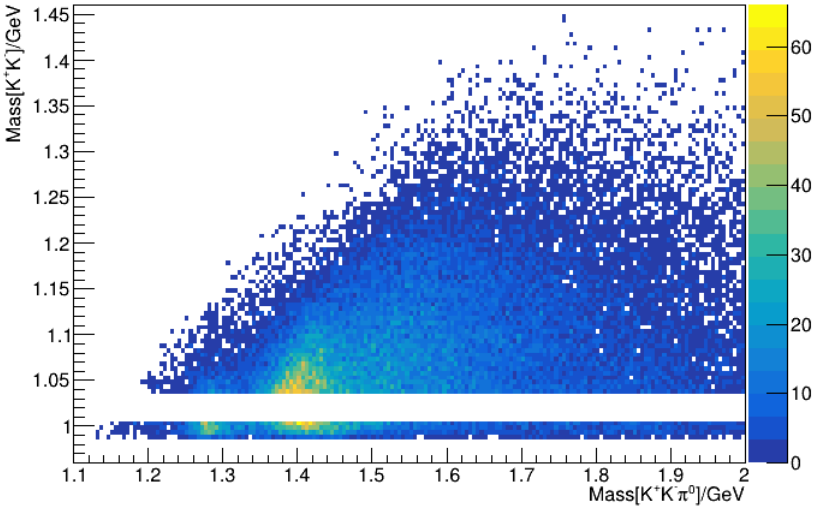
Data

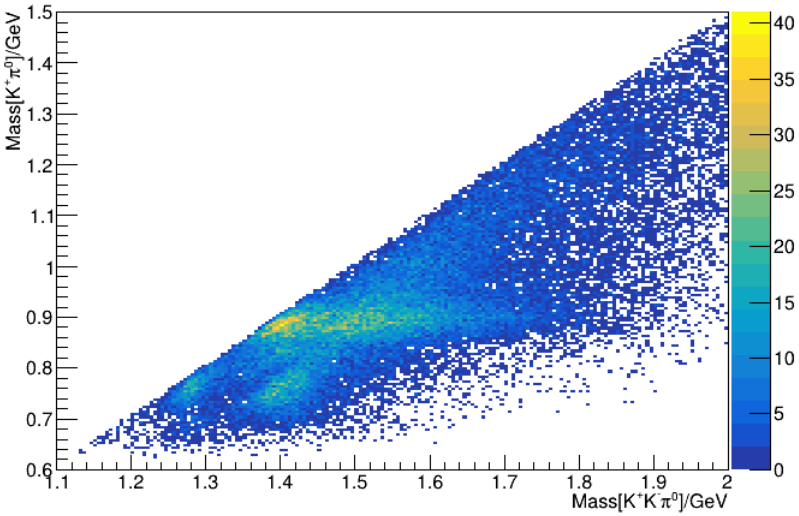

Mass[K⁺K⁻]/GeV
1.45
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
Mass[K⁺K⁻π⁰]/GeV
60
50
40
30
20
10
0

Data



Data





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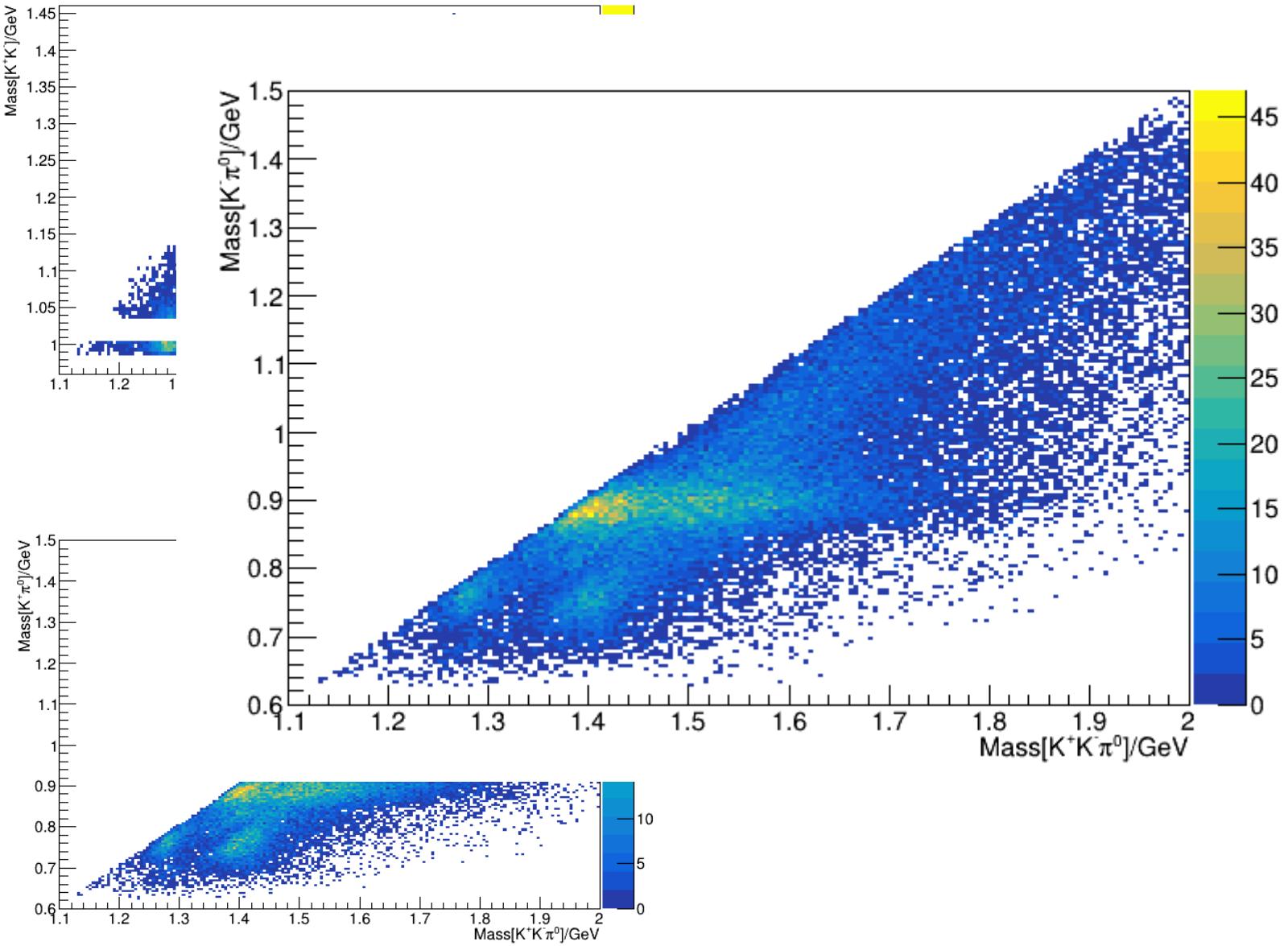

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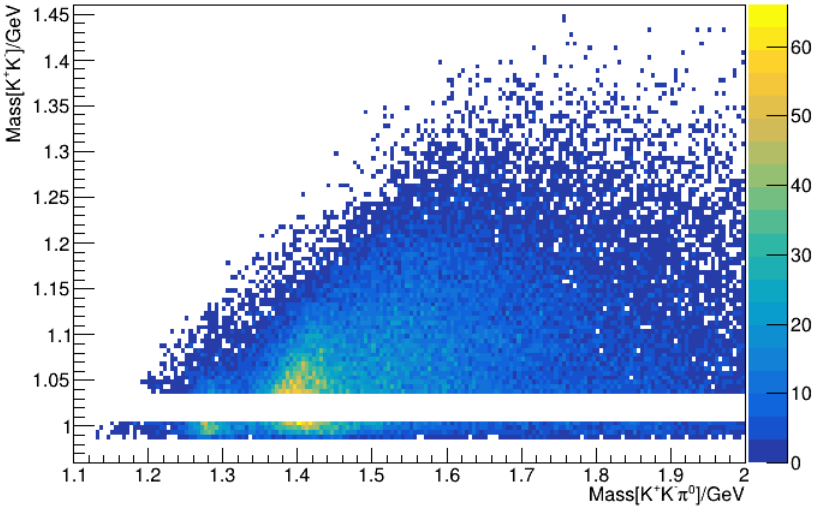
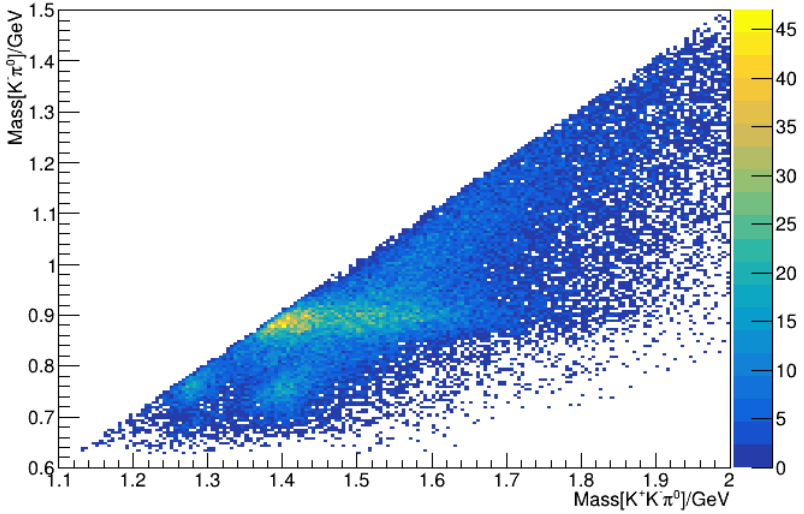
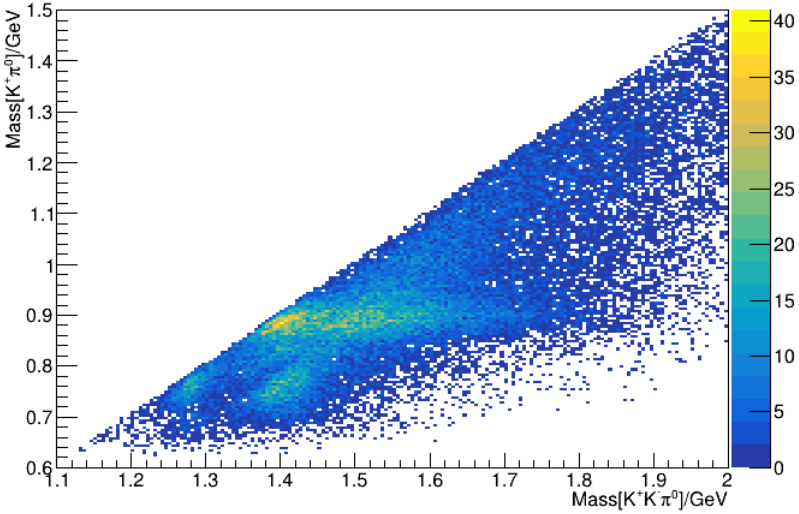
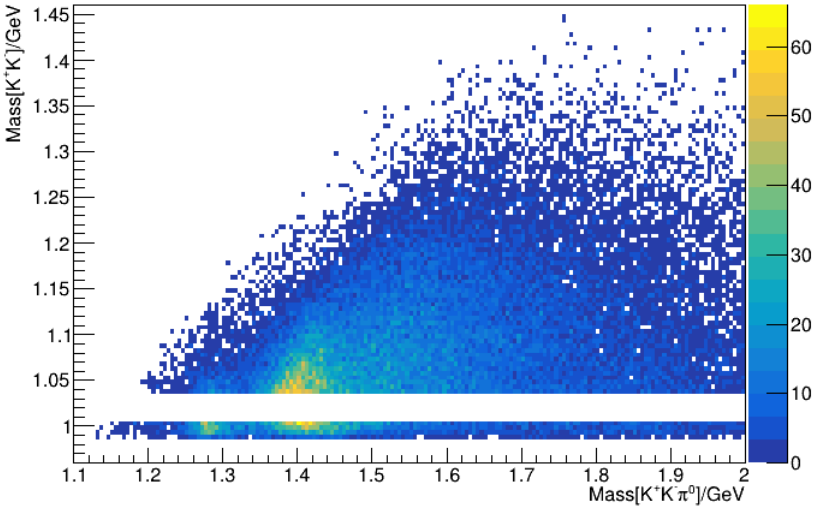


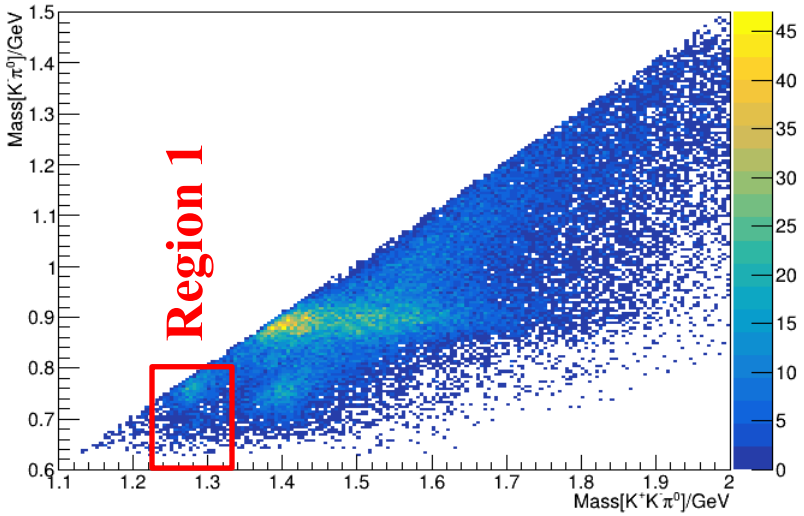


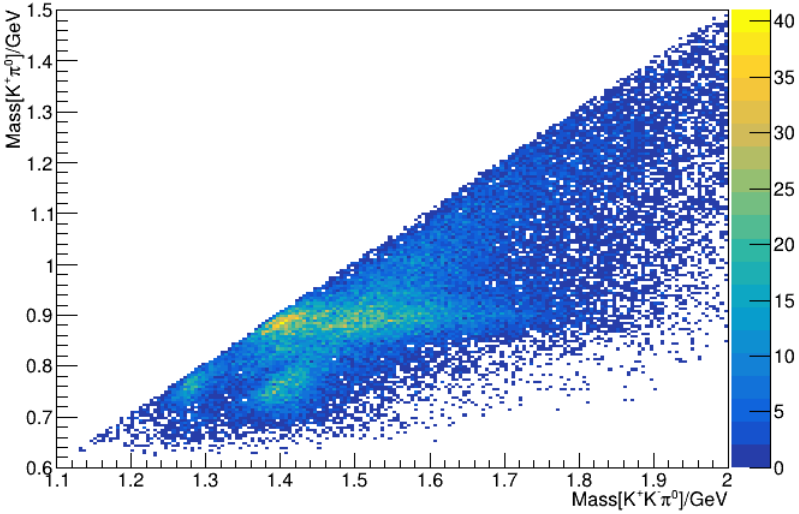


- Three distinct mass regions

Data







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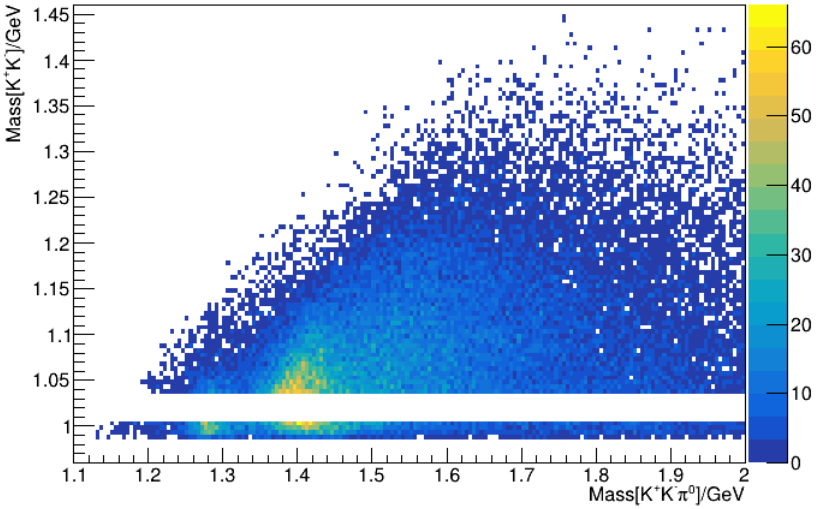

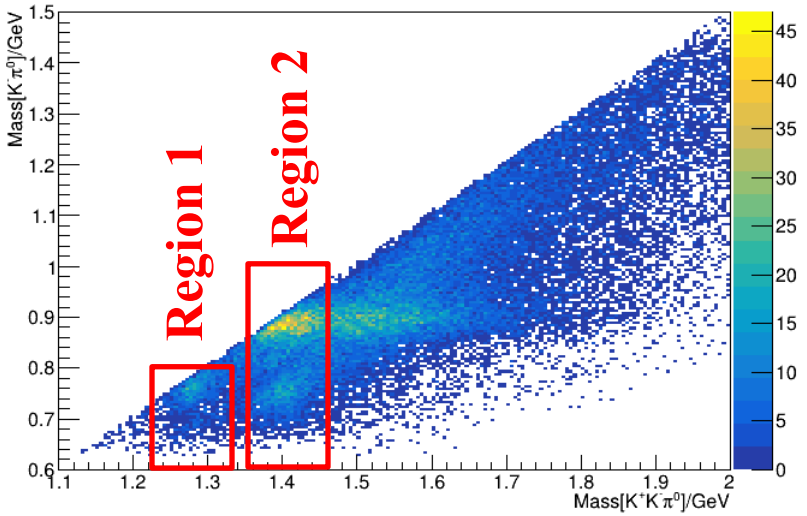

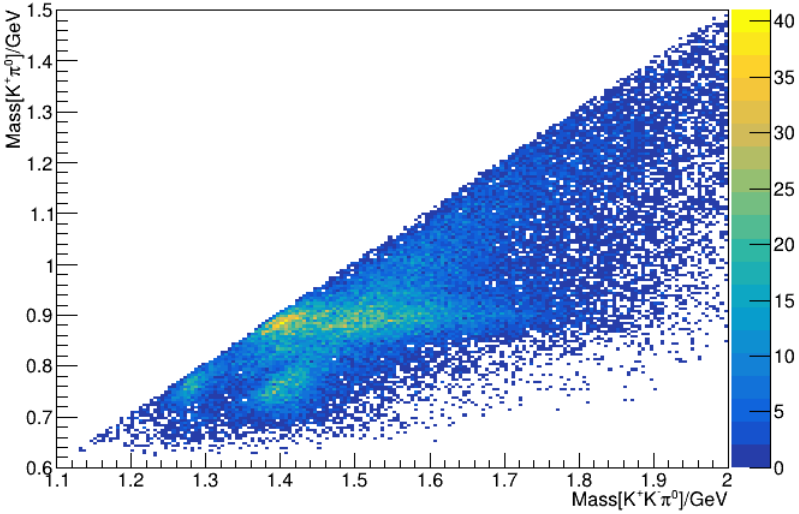

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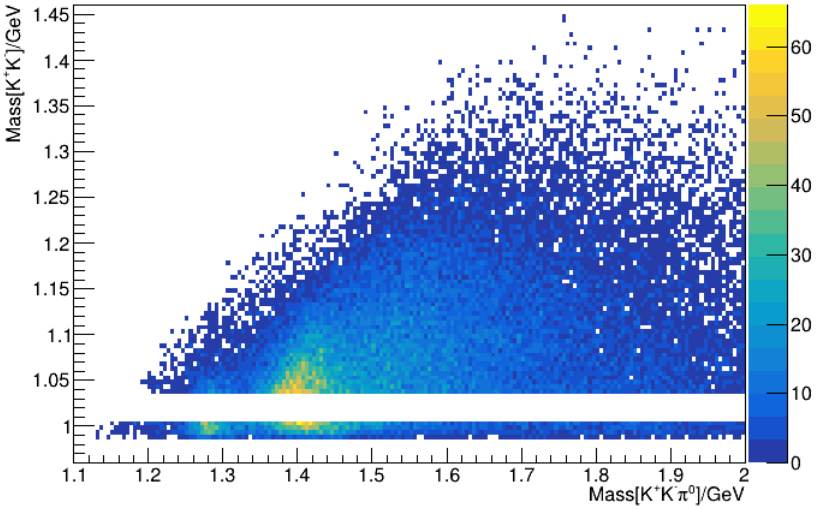
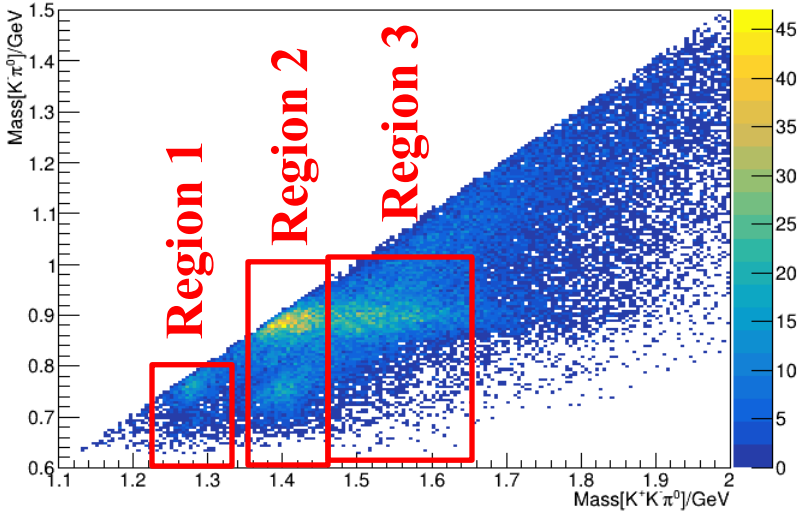
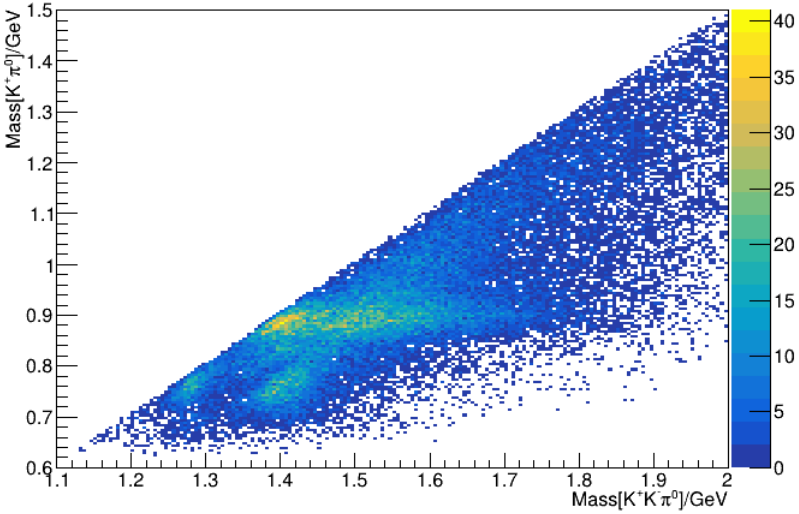
Data

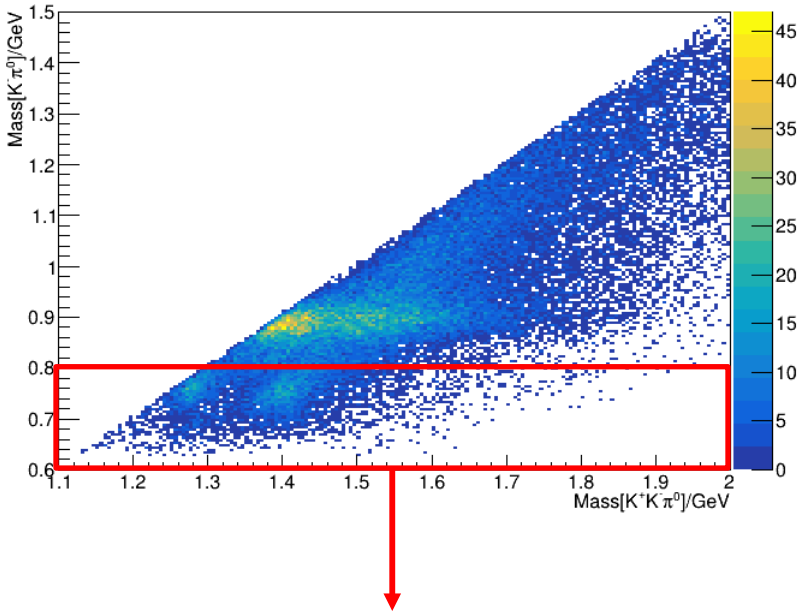




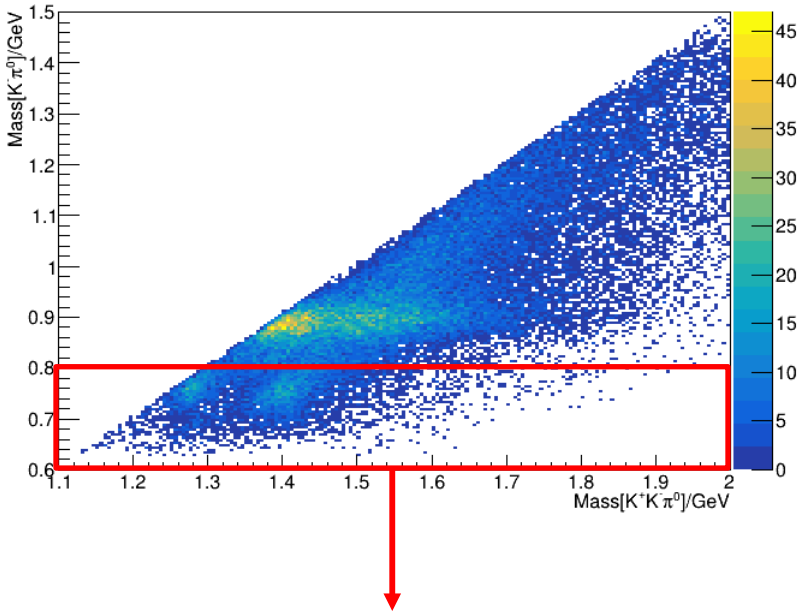


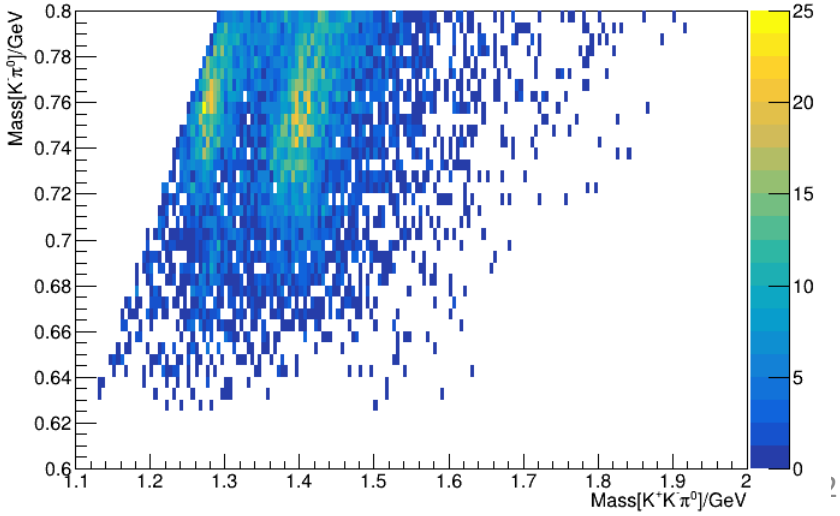
- Three distinct mass regions

Data


Mass[K⁻π⁰]/GeV
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
Mass[K⁺K⁻π⁰]/GeV
45
40
35
30
25
20
15
10
5
0

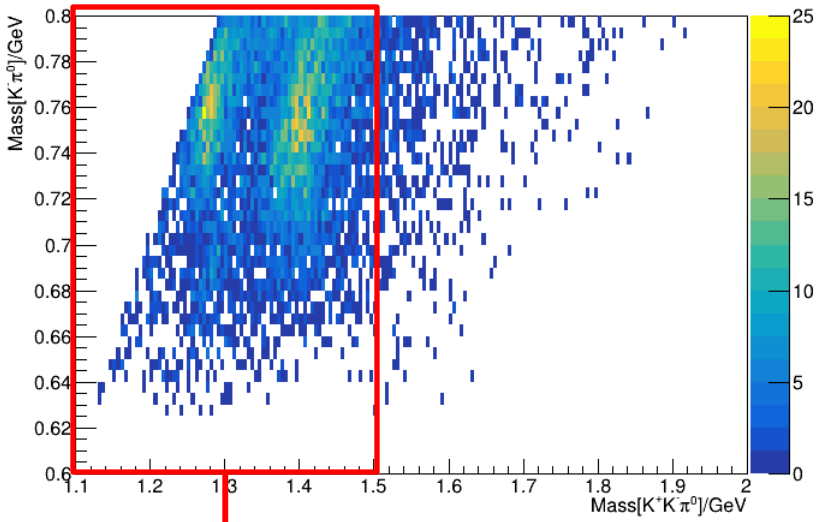
Data

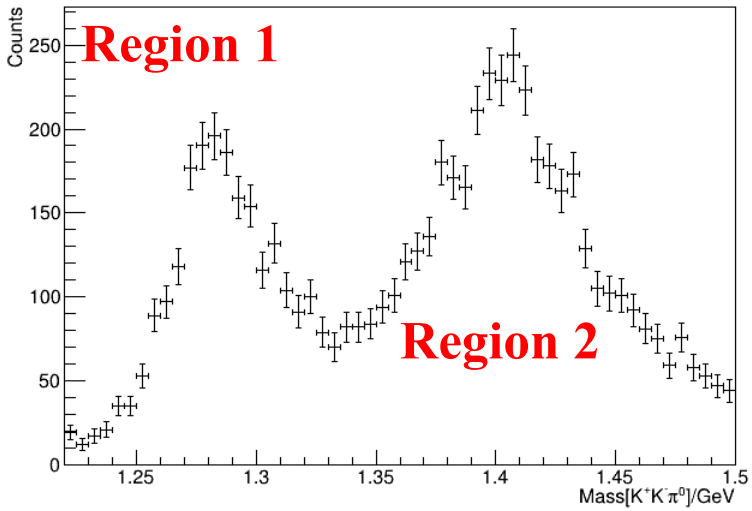




ASU

Data


Mass[K⁻π⁰]/GeV
Mass[K⁺K⁻π⁰]/GeV


Counts
Region 1
Region 2
Mass[K⁺K⁻π⁰]/GeV

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- Only best Confidence Level (*CL*) per event kept
- *CL* must be above 10^{-4}
- Kaons must be seen in TOF
- Missing mass within 3 standard deviations of central peak
- 0.12 GeV < Mass[π^0] < 0.15 GeV
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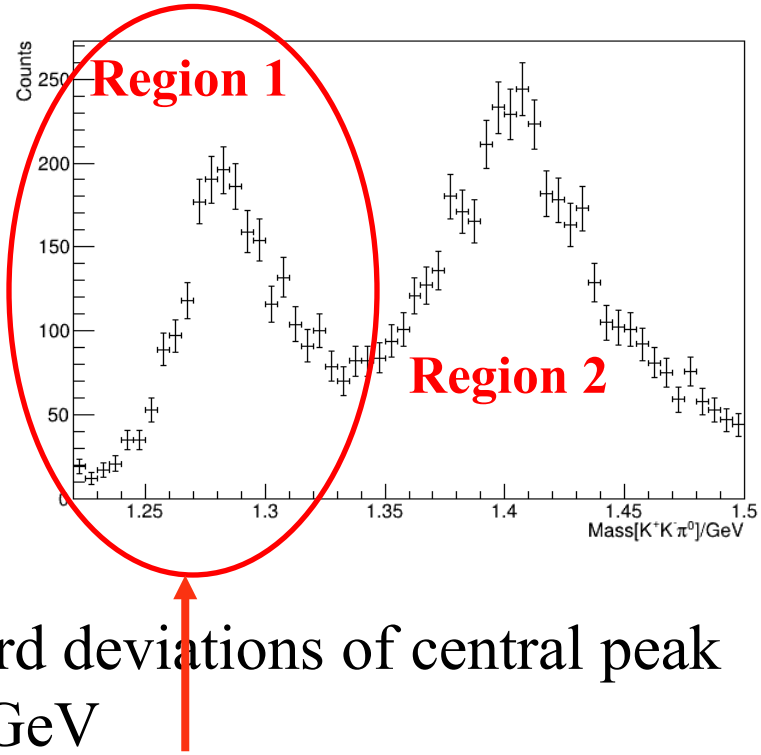


$K^+K^-\pi^0$

The event generator:

- Flat in mass between 1.22 and 1.32 GeV

$K^+K^-\pi^0$

The event generator:

- Flat in mass between 1.22 and 1.32 GeV
- Modified *t*-slope to match the data

$K^+K^-\pi^0$

The event generator:

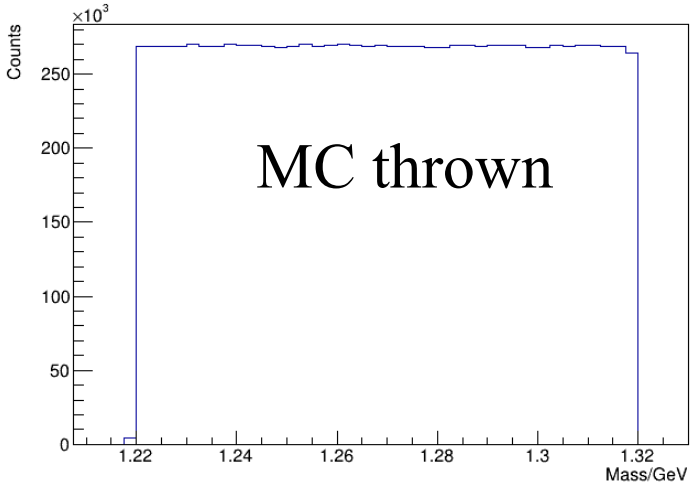
- Flat in mass between 1.22 and 1.32 GeV
- Modified *t*-slope to match the data
- Used actual data to model photon energy spectrum

$K^+K^-\pi^0$

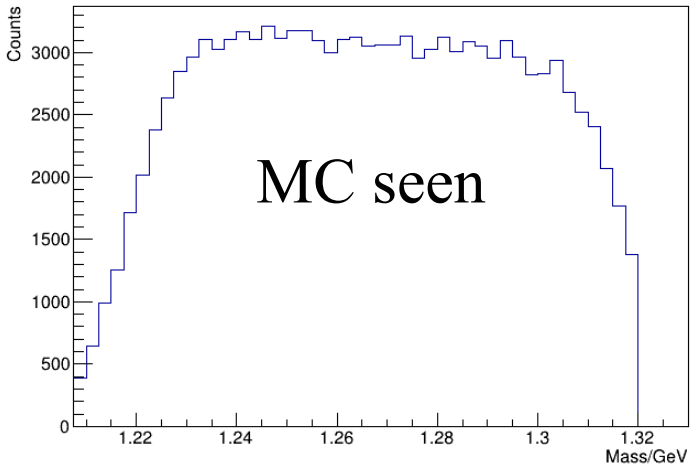
The event generator:

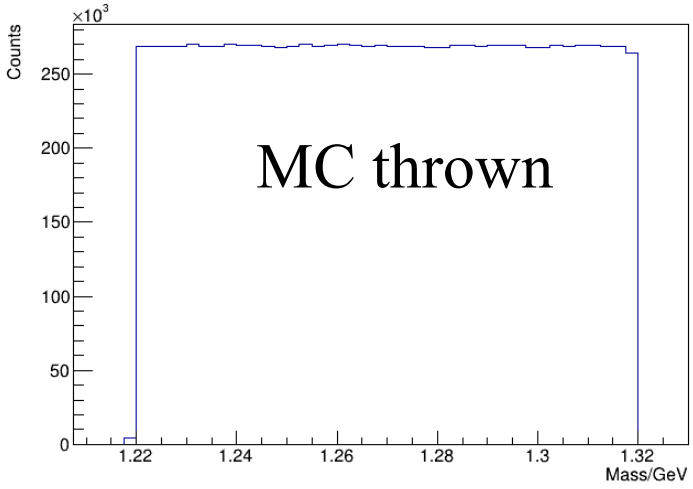
- Flat in mass between 1.22 and 1.32 GeV
- Modified *t*-slope to match the data
- Used actual data to model photon energy spectrum
- Over 10 million thrown events

$K^+K^-\pi^0$

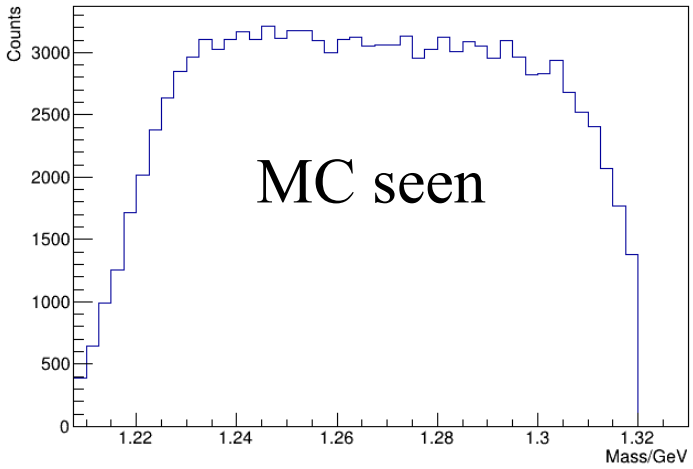

MC thrown
Counts
×10³
250
200
150
100
50
0
1.22
1.24
1.26
1.28
1.3
1.32
Mass/GeV

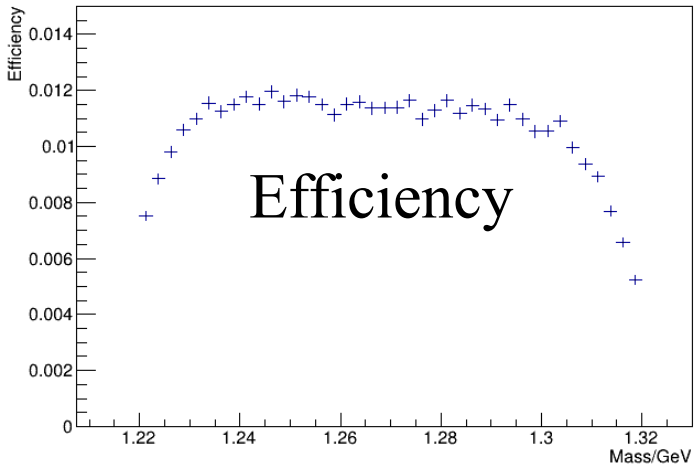
$K^+K^-\pi^0$

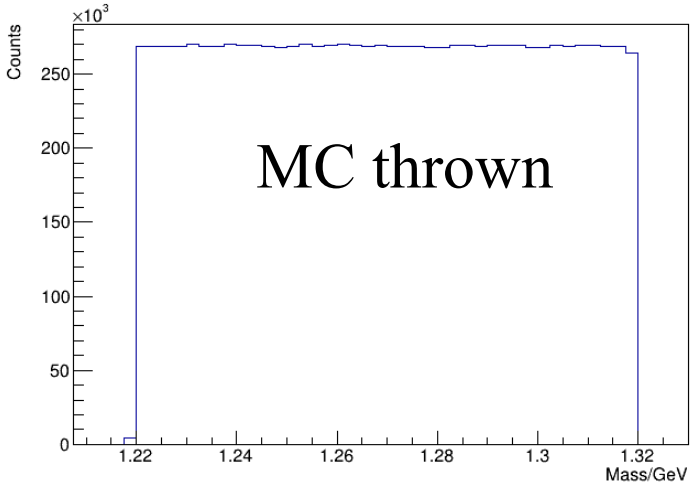

Counts
3000
2500
2000
1500
1000
500
0
1.22
1.24
1.26
1.28
1.3
1.32
Mass/GeV
MC seen


Counts
×10³
250
200
150
100
50
0
1.22
1.24
1.26
1.28
1.3
1.32
Mass/GeV
MC thrown

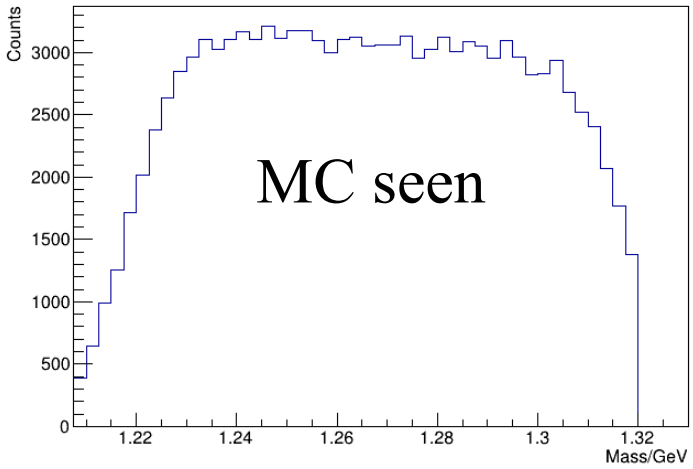
$K^+K^-\pi^0$

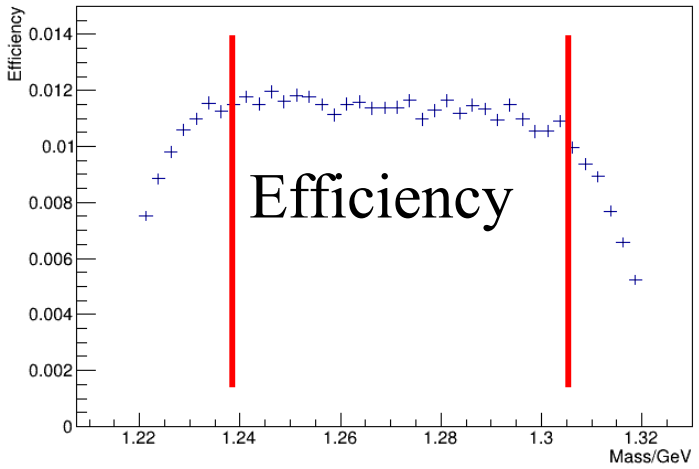

Counts
3000
2500
2000
1500
1000
500
0
1.22
1.24
1.26
1.28
1.3
1.32
Mass/GeV
MC seen

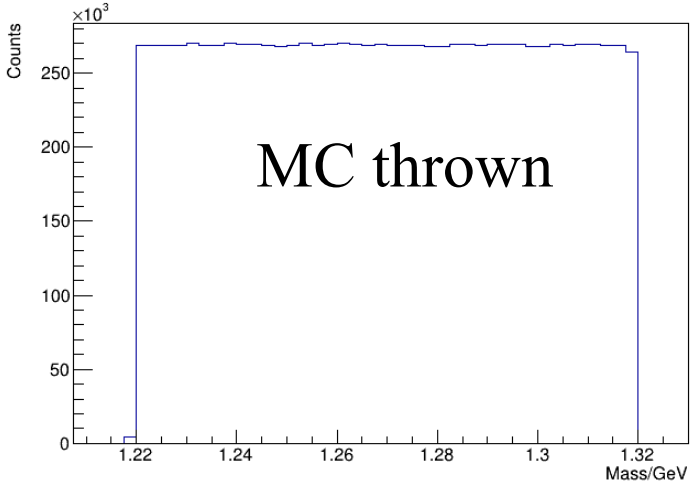

Efficiency
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
1.22
1.24
1.26
1.28
1.3
1.32
Mass/GeV
Efficiency


Counts
×10³
250
200
150
100
50
0
1.22
1.24
1.26
1.28
1.3
1.32
Mass/GeV
MC thrown

$K^+K^-\pi^0$

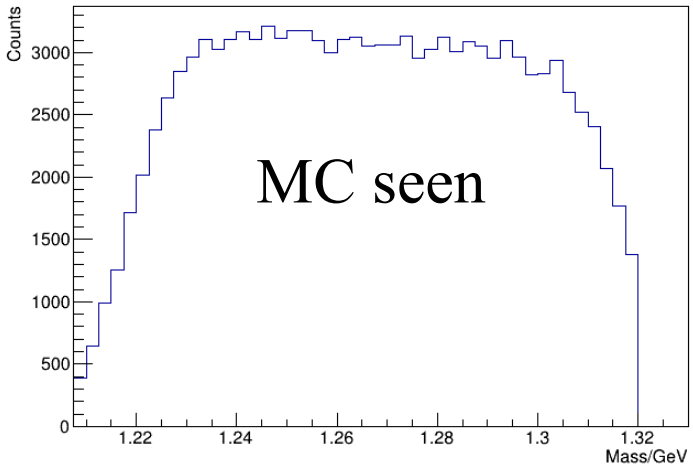


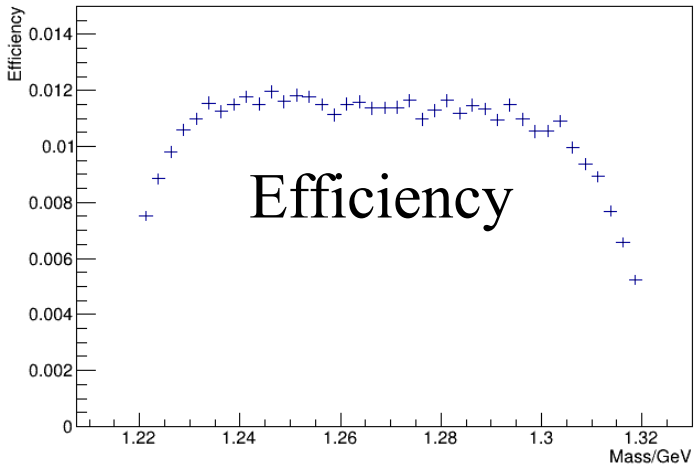


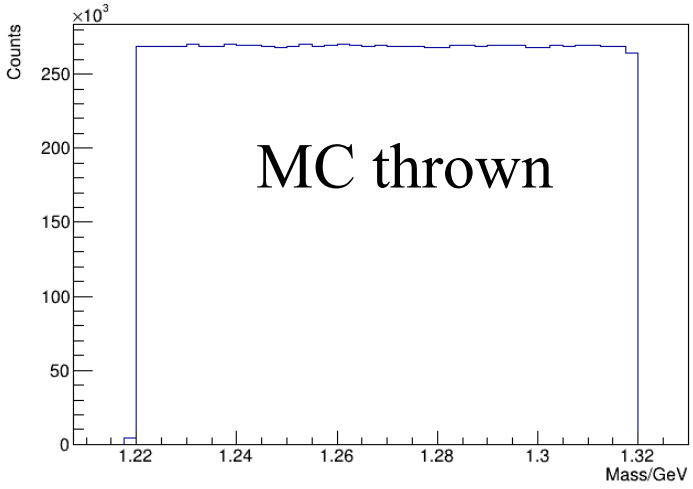


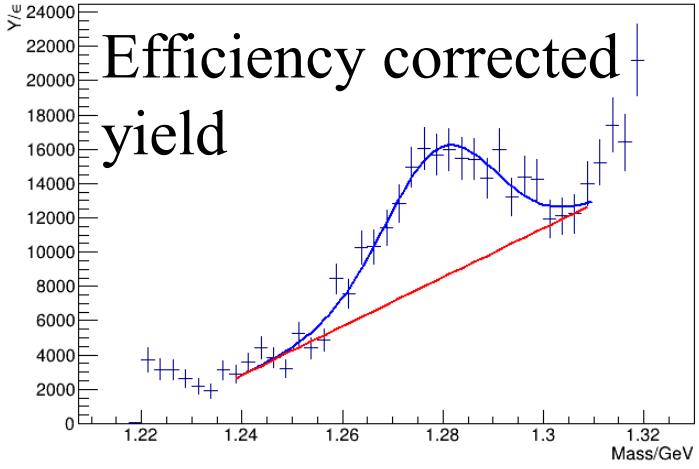
Fairly flat over region 1.24 to 1.31 GeV

$K^+K^-\pi^0$



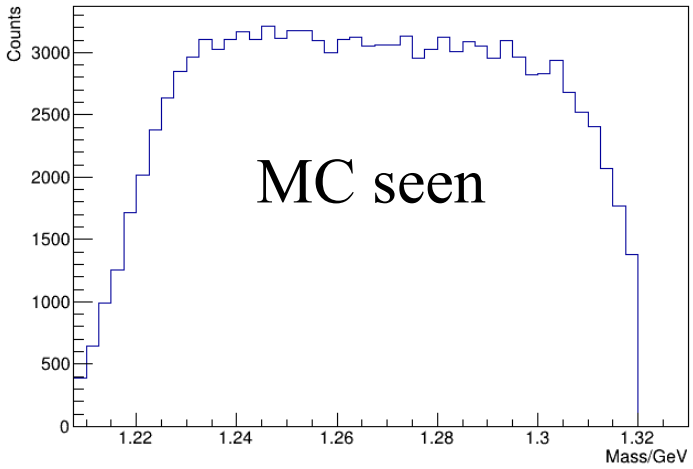


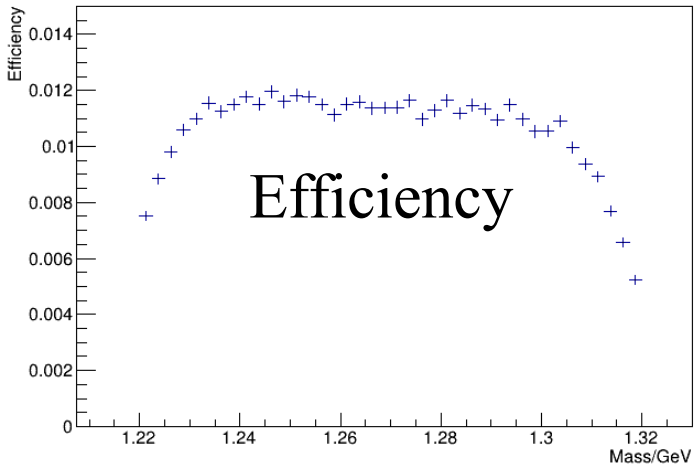


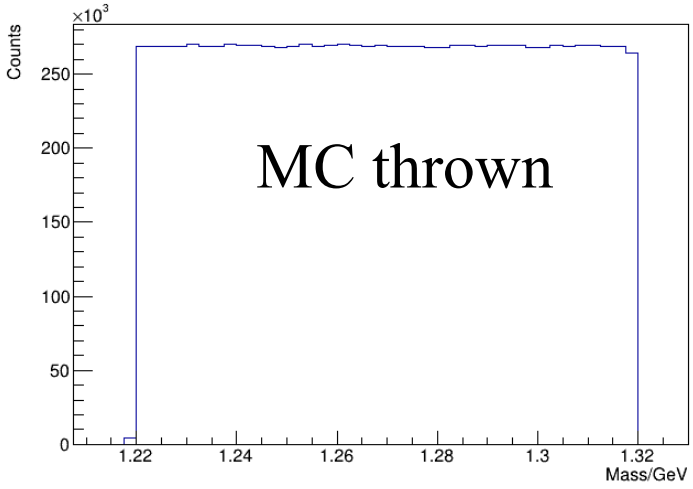


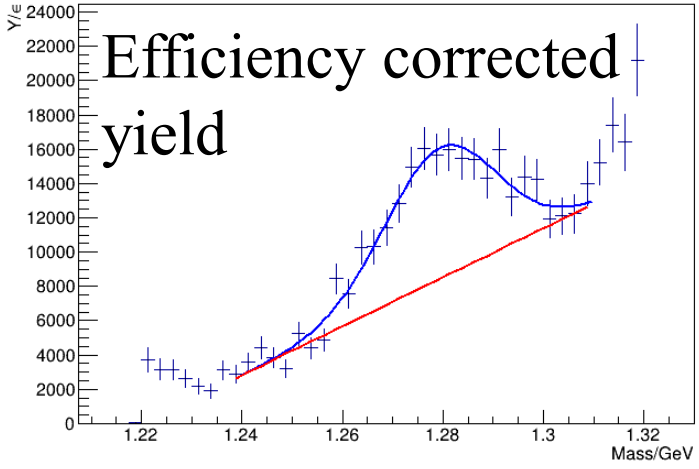
Background subtracted peak is 22% of total counts

$K^+K^-\pi^0$









Center = 1279(2) MeV

FWHM = 24(5) MeV

Definition of (θ,φ) and (θ_H,φ_H)

- The (θ,φ) angles defined from polar and azimuthal angles of the K^+K^- isobar in the Gottfried-Jackson frame of $K^+K^-\pi^0$ system

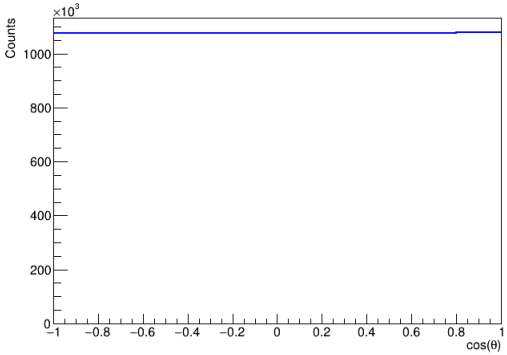
Definition of (θ,φ) and (θ_H,φ_H)

- The (θ,φ) angles defined from polar and azimuthal angles of the K^+K^- isobar in the Gottfried-Jackson frame of $K^+K^-\pi^0$ system

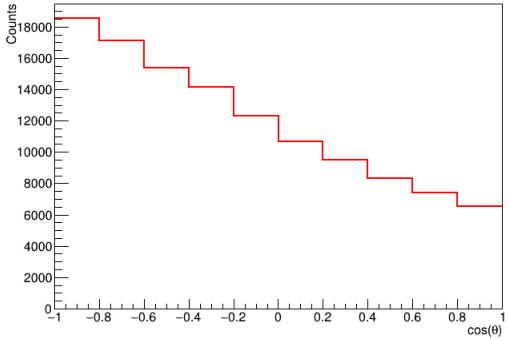
- The (θ_H,φ_H) angles defined from polar and azimuthal angles of the K^+, in the helicity frame of the K^+ K^-

Distributions of cos(θ) and φ

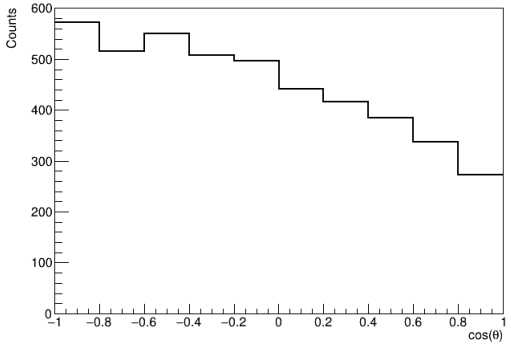
MC thrown



MC seen



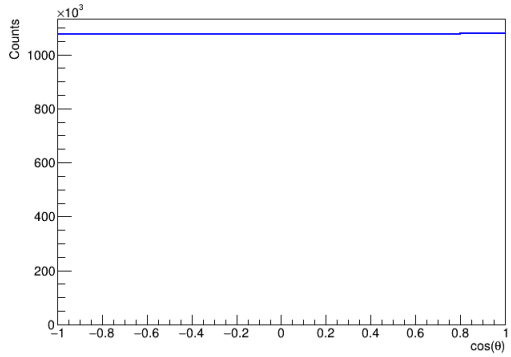
Real data



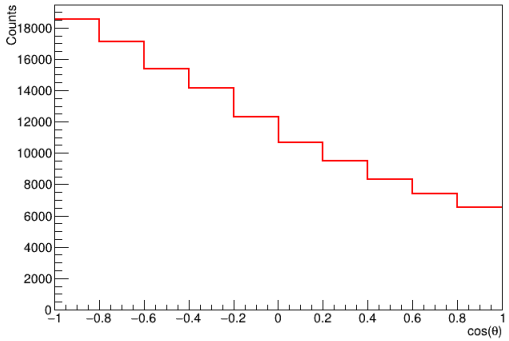
cos(θ) distributions

Distributions of cos(θ) and φ

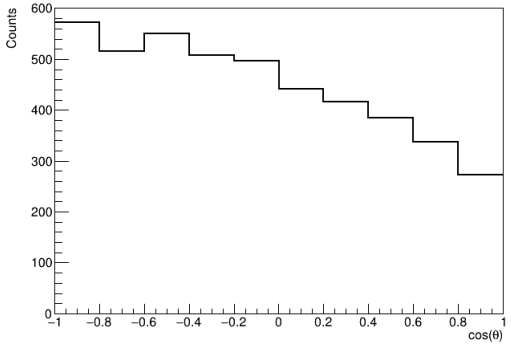
MC thrown



MC seen



Real data



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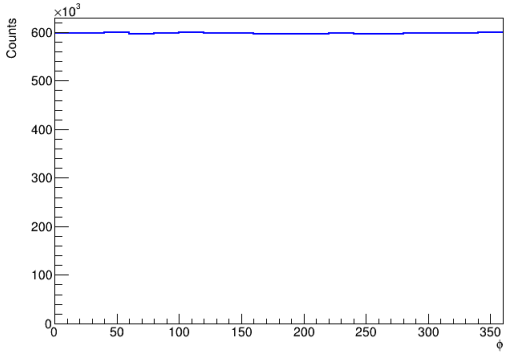
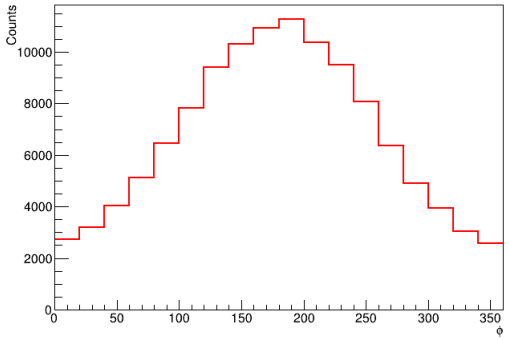


MC seen



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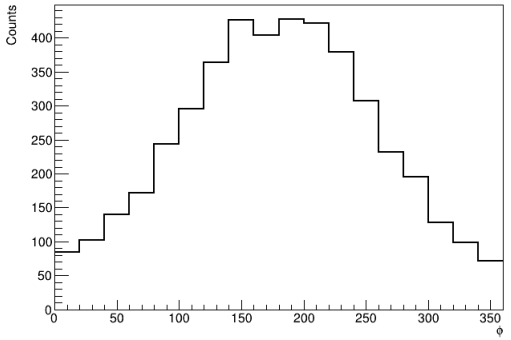

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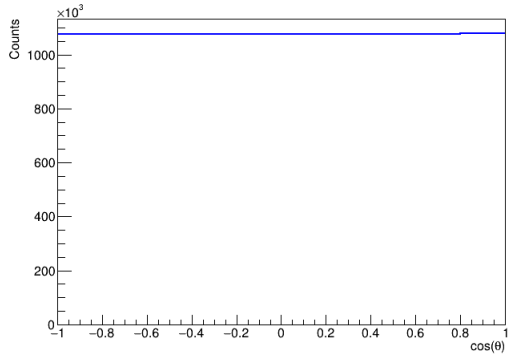
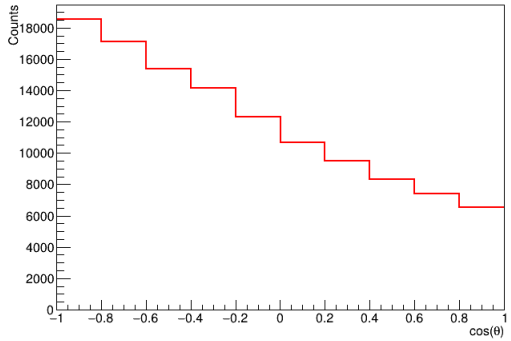


MC seen



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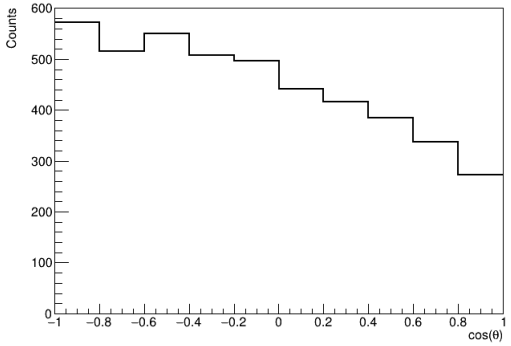

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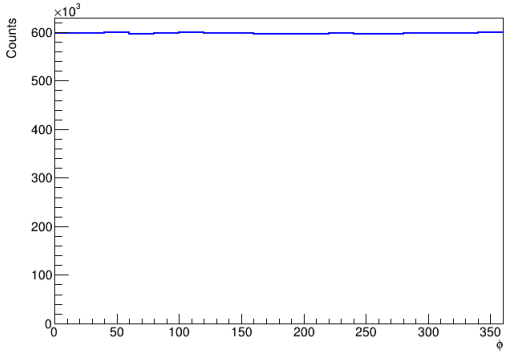

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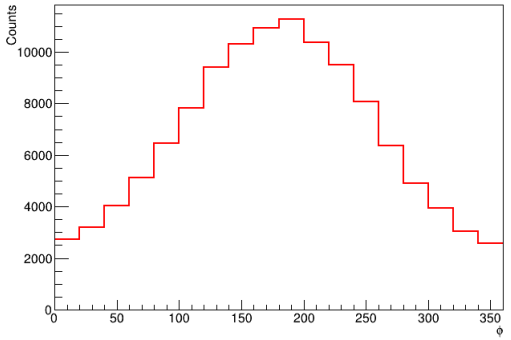

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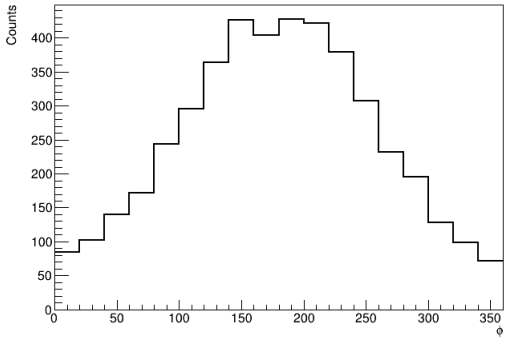

φ distributions

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Distributions of $\cos(\theta_H)$ and φ_H

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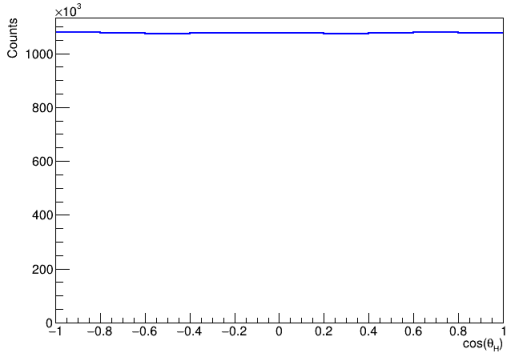

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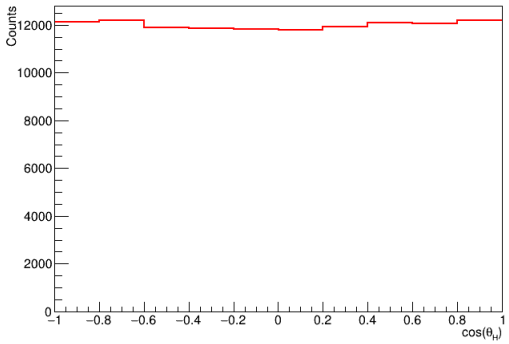

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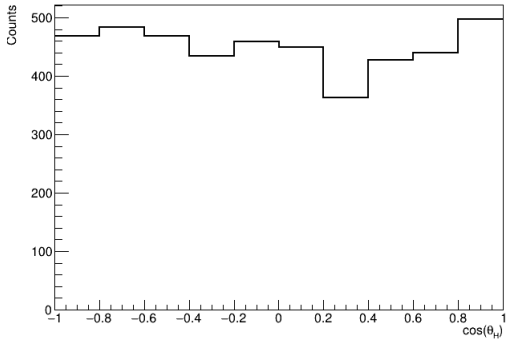

$\cos(\theta_H)$ distributions

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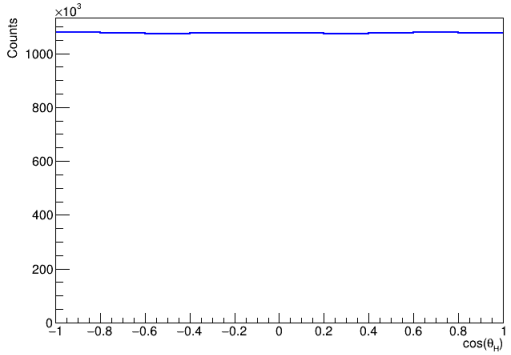

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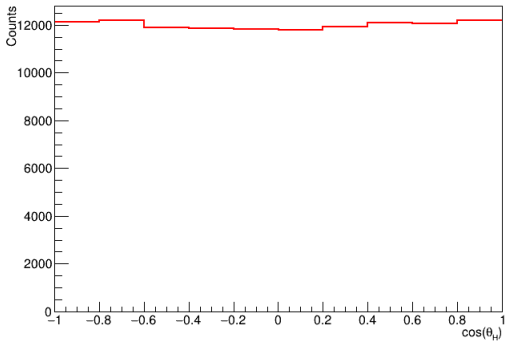

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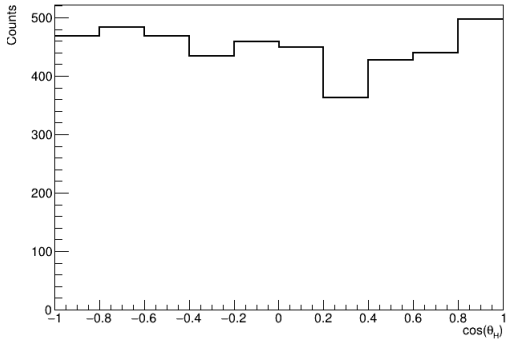

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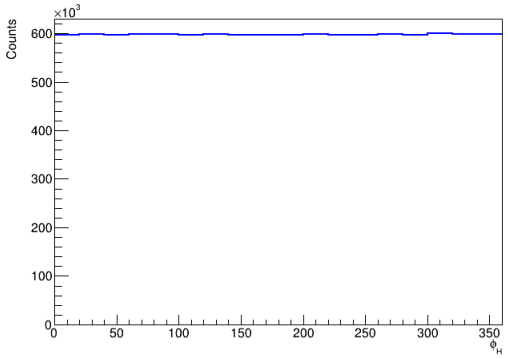
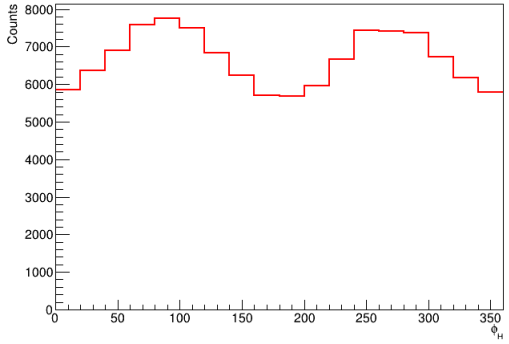


MC seen



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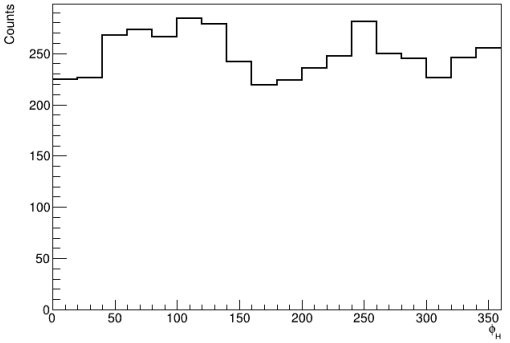
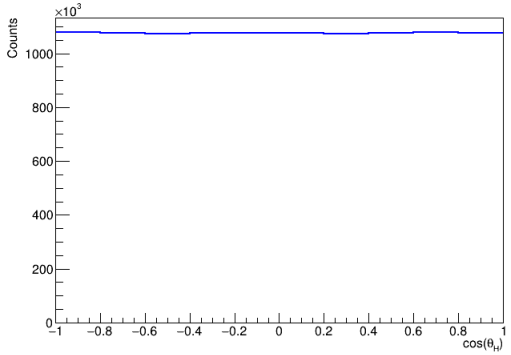


φ_H distributions

Distributions of $\cos(\theta_H)$ and φ_H

MC thrown



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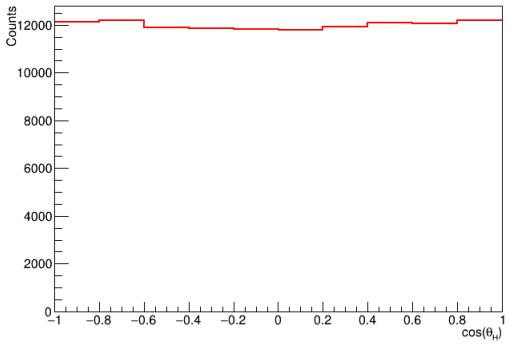

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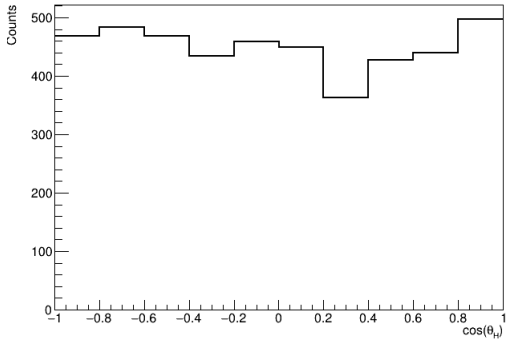

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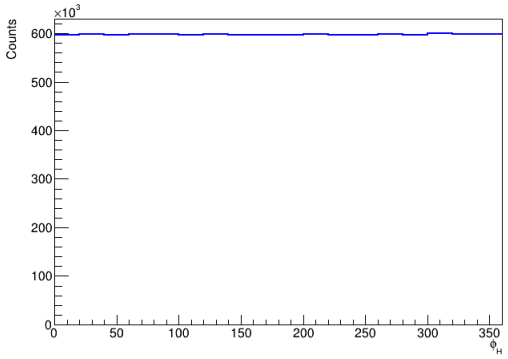

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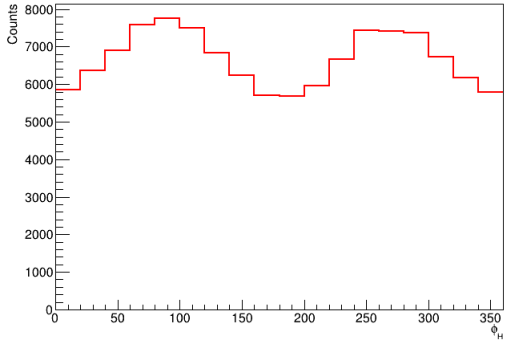

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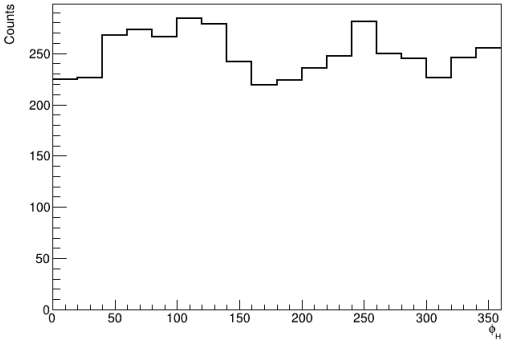

φ_H distributions

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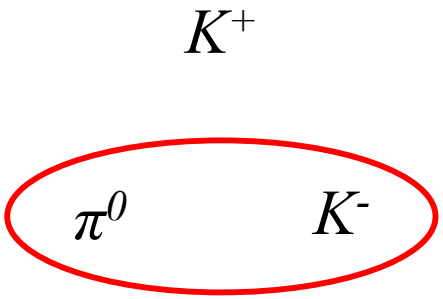

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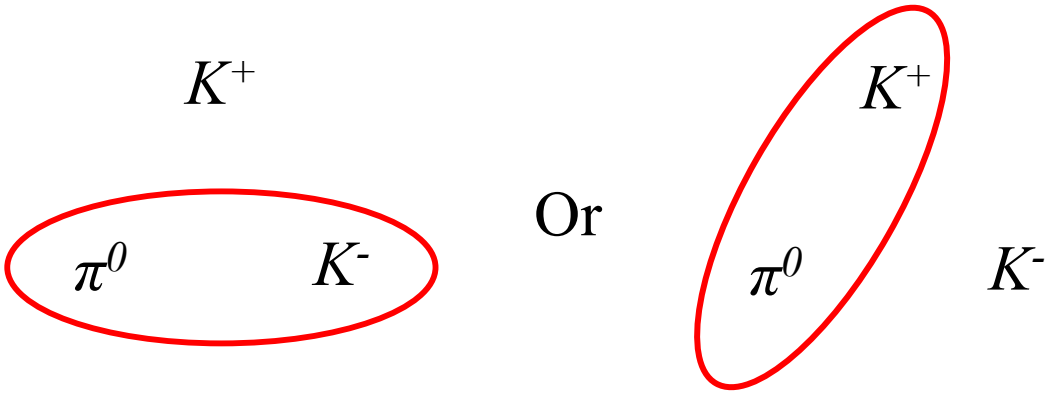

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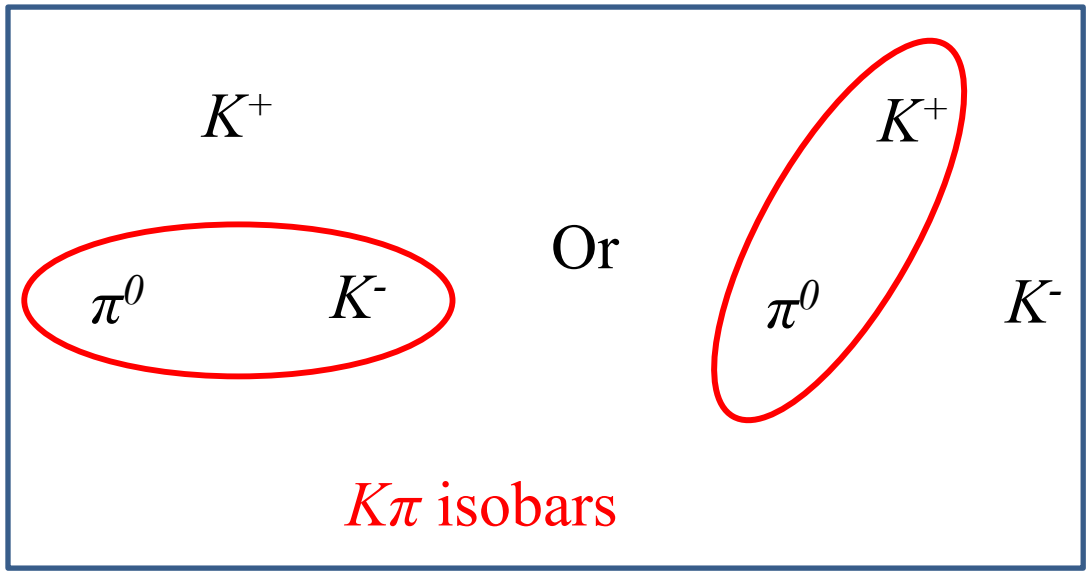

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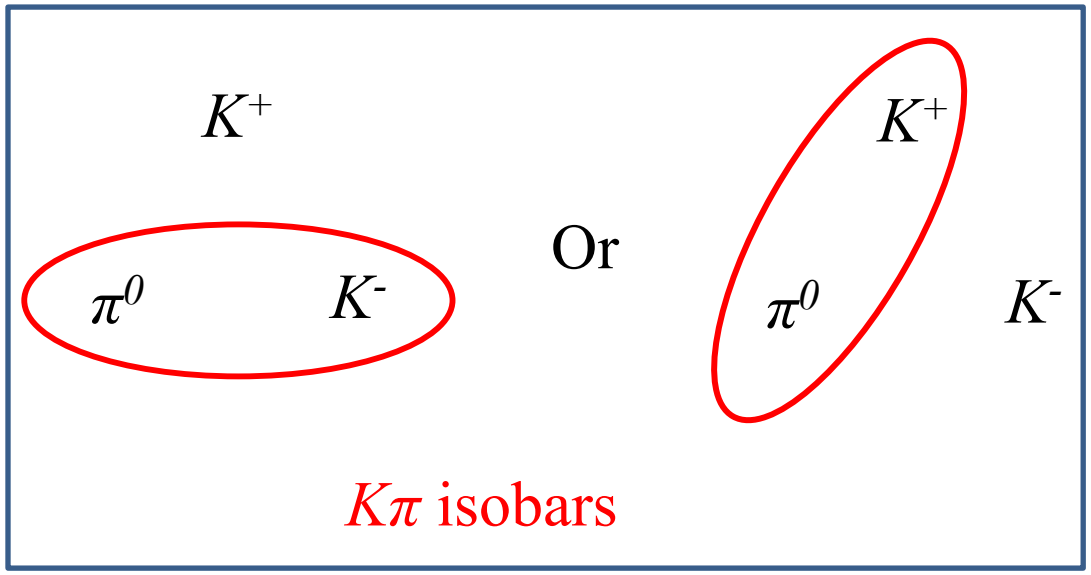

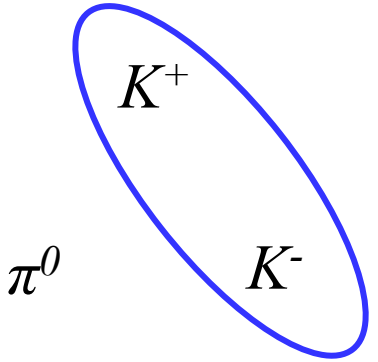

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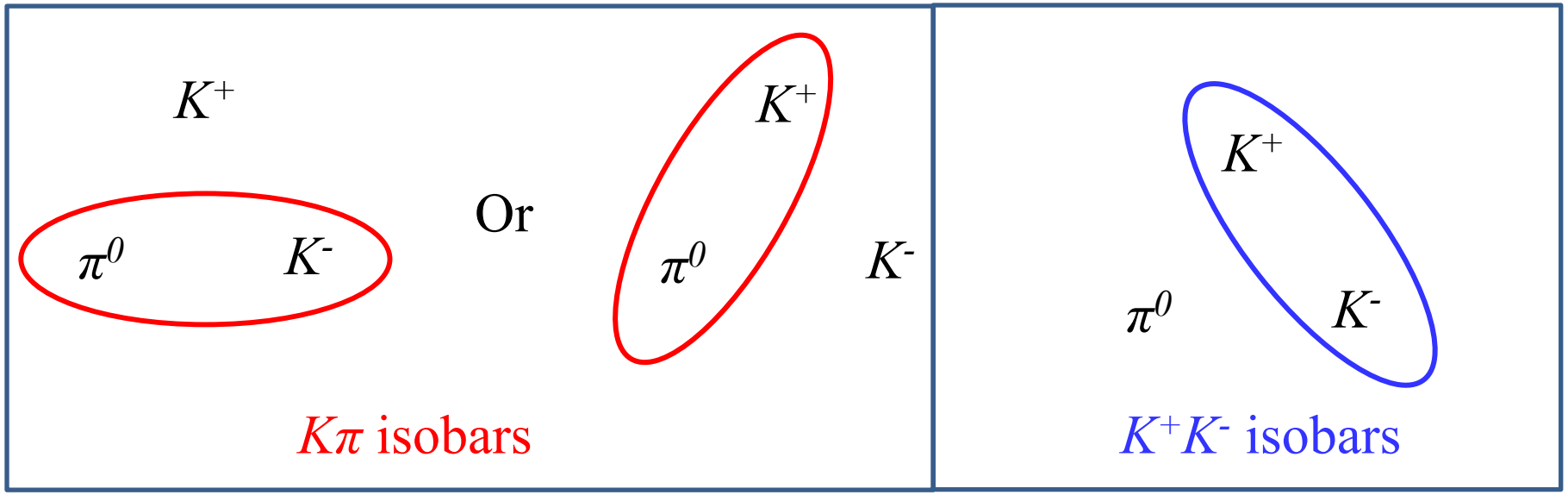

$K\pi$ isobar candidates

$K_0^*(700)$ $I(J^P) = \frac{1}{2}(0^+)$

also known as κ; was $K_0^*(800)$

See the review on "Scalar Mesons below 1 GeV."

Mass (T-Matrix Pole $\sqrt{s}$) = (630–730) $- i$ (260–340) MeV

Mass (Breit-Wigner) = 845 ± 17 MeV

Full width (Breit-Wigner) = 468 ± 30 MeV

$K_0^*(700)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
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Mass (T-Matrix Pole $\sqrt{s}$) = (890 ± 14) $- i$ (26 ± 6) MeV
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$K\pi$	~ 100 %		289
$K^0\gamma$	(2.46±0.21) × 10^{-3}		307
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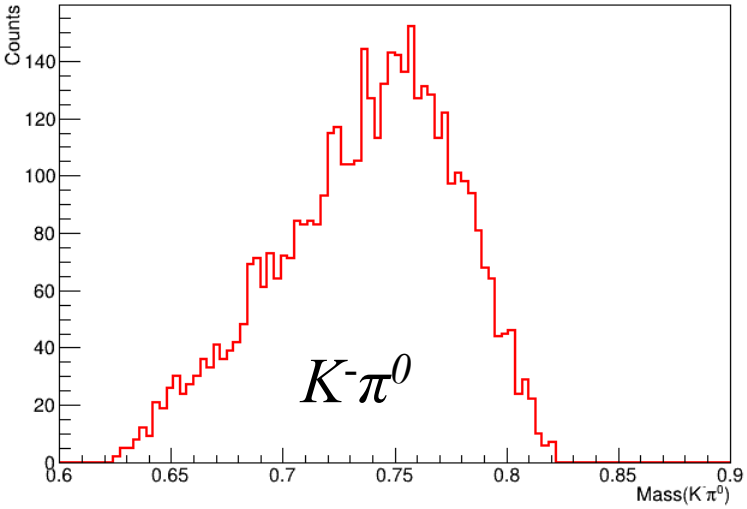
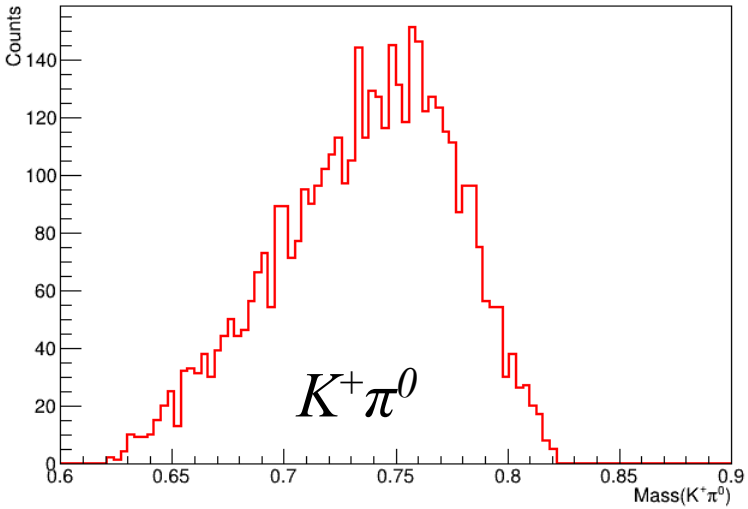
$K\pi\pi$	< 7 × 10^{-4}	95%	223





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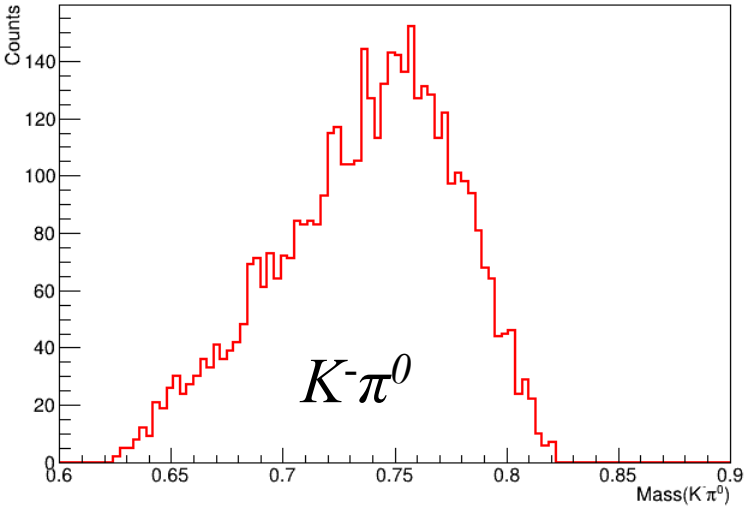

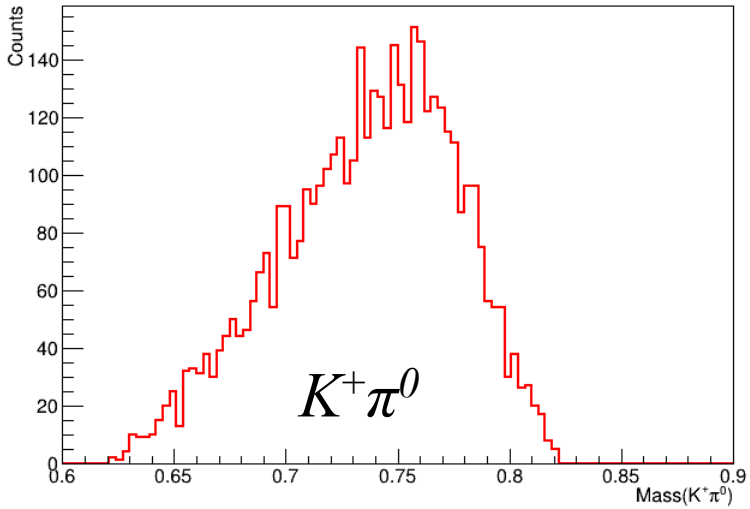

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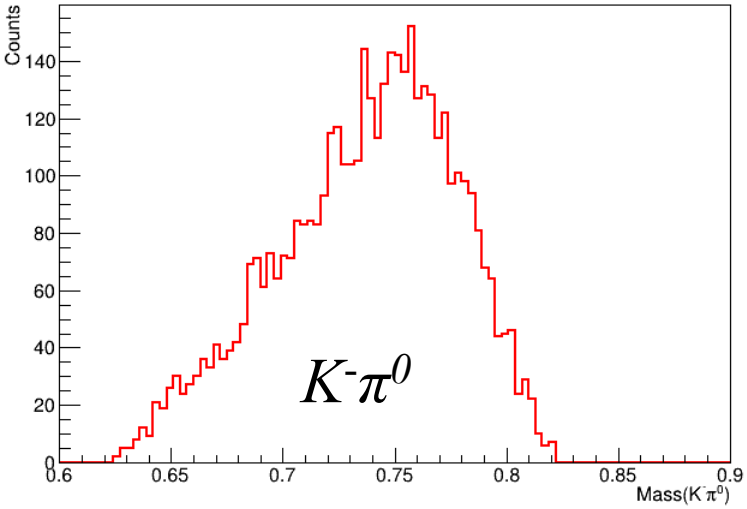

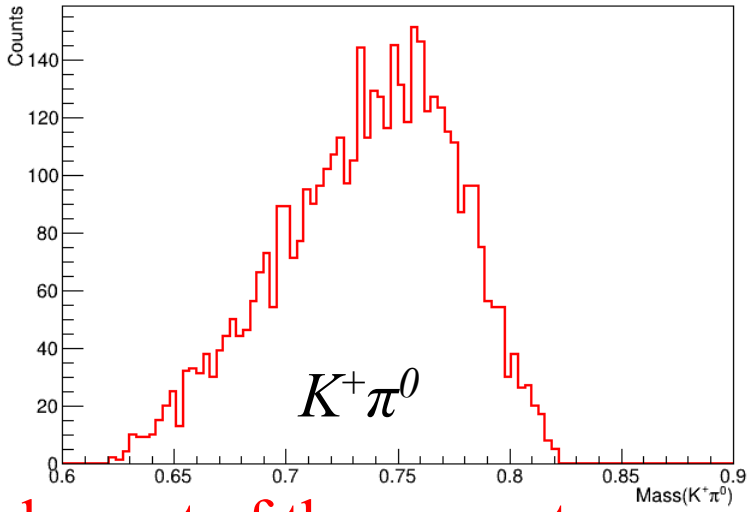

Mass too large and narrow to be part of these events

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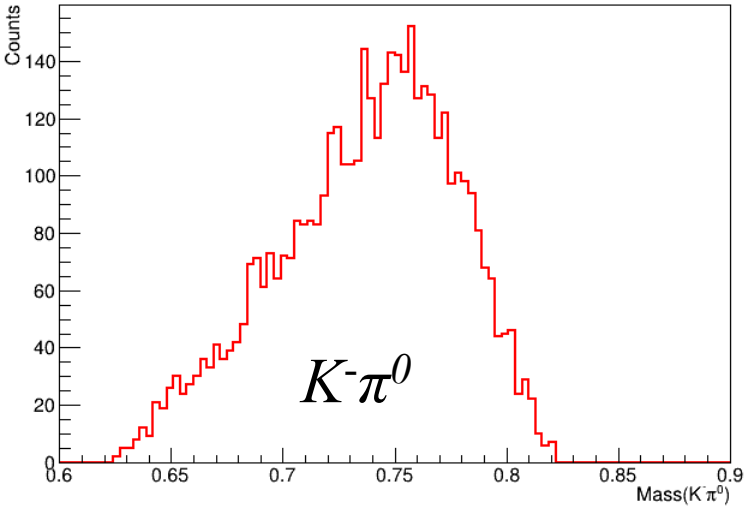

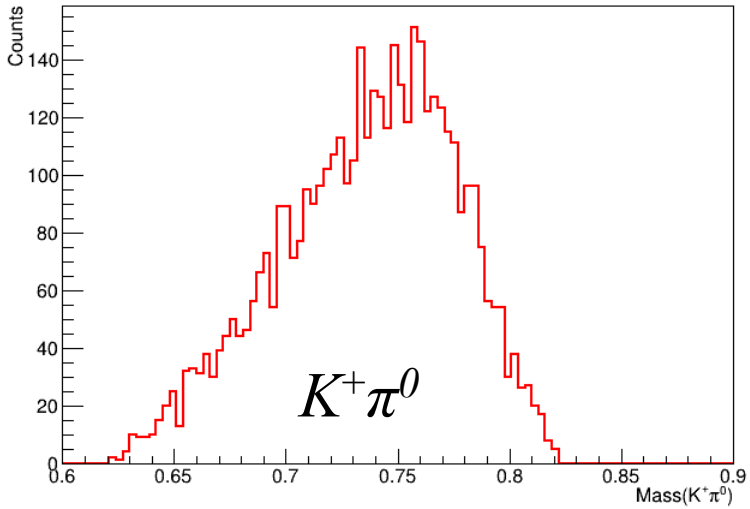

K^+K^- isobar candidates

$f_0(980)$ $I^G(J^{PC}) = 0^+(0^{++})$

See the review on "Scalar Mesons below 1 GeV."

T-matrix pole $\sqrt{s} = (980–1010) - i\ (20–35)$ MeV [i]

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Mass $m = 1019.461 \pm 0.016$ MeV
Full width $\Gamma = 4.249 \pm 0.013$ MeV $\quad$ (S = 1.1)

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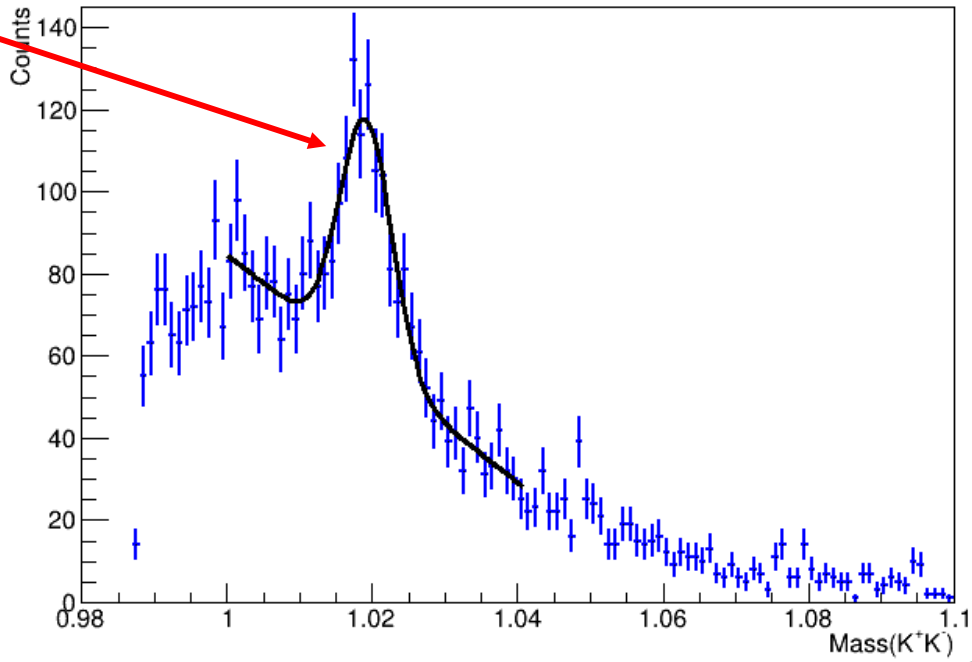

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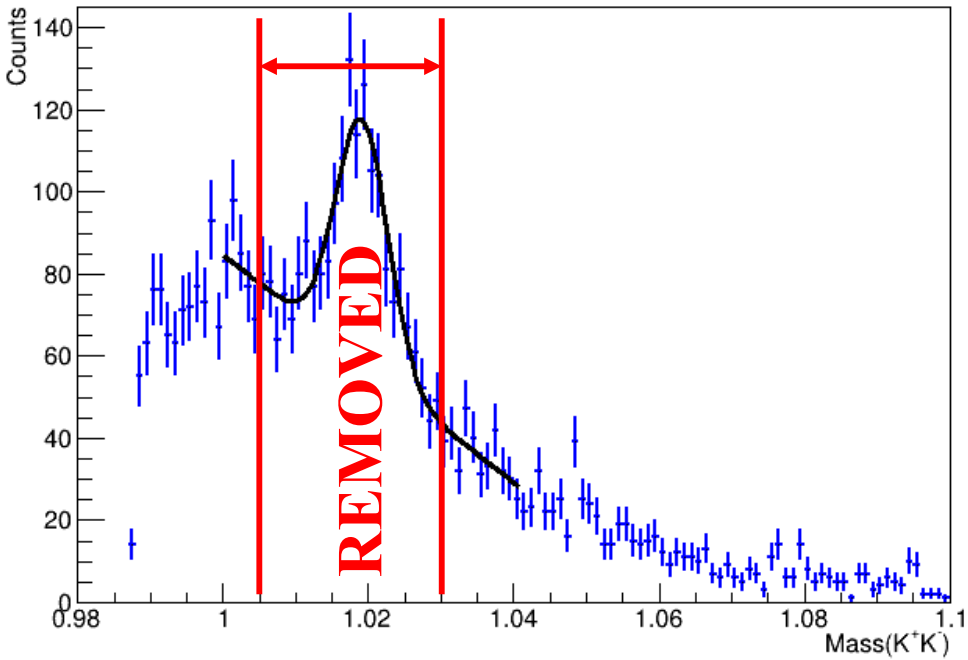

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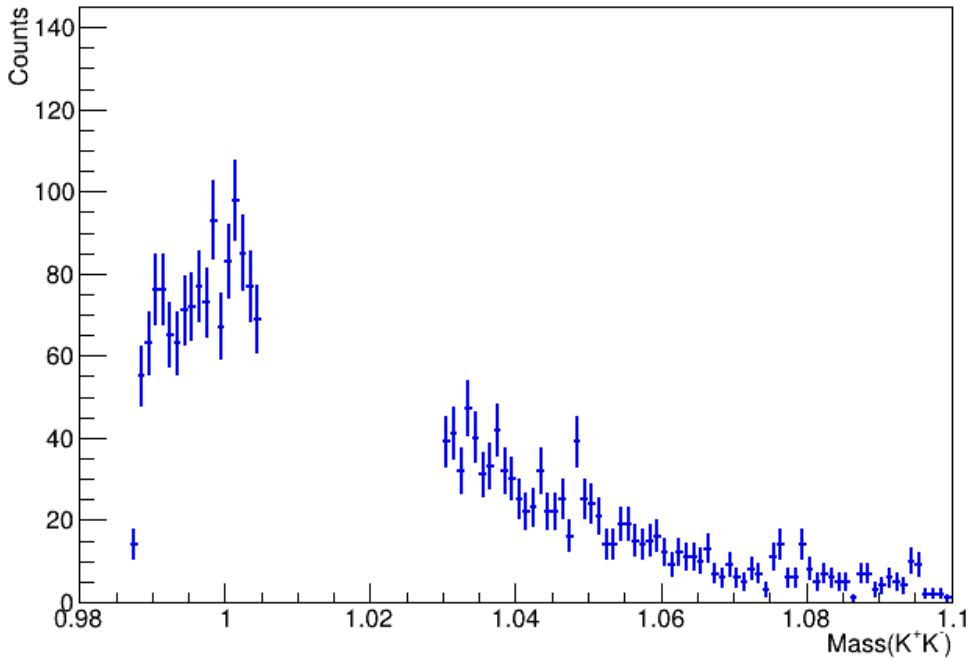

ASU

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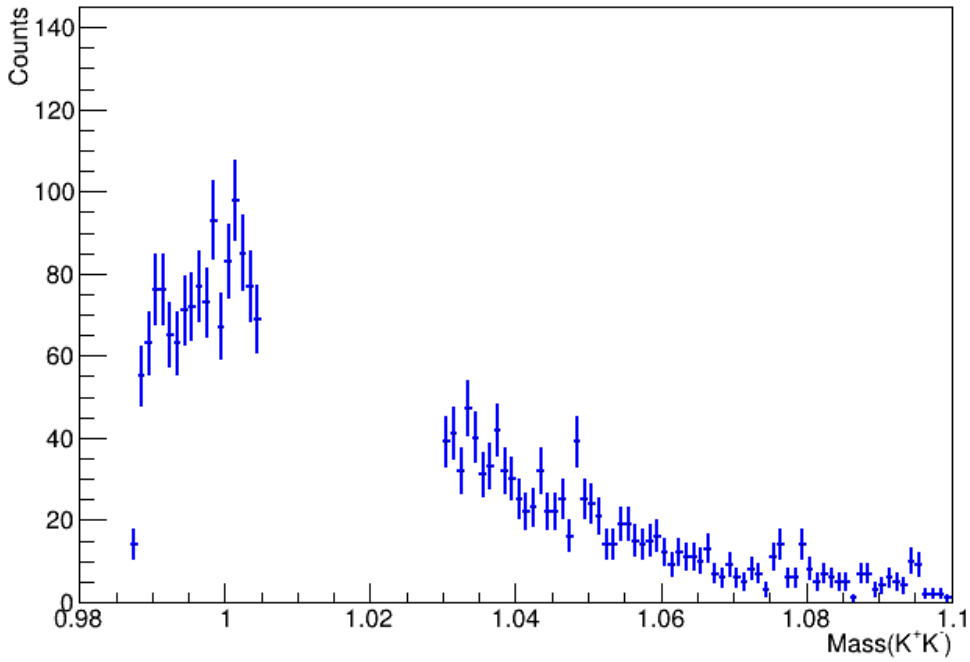
Different by isospin



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Different by isospin

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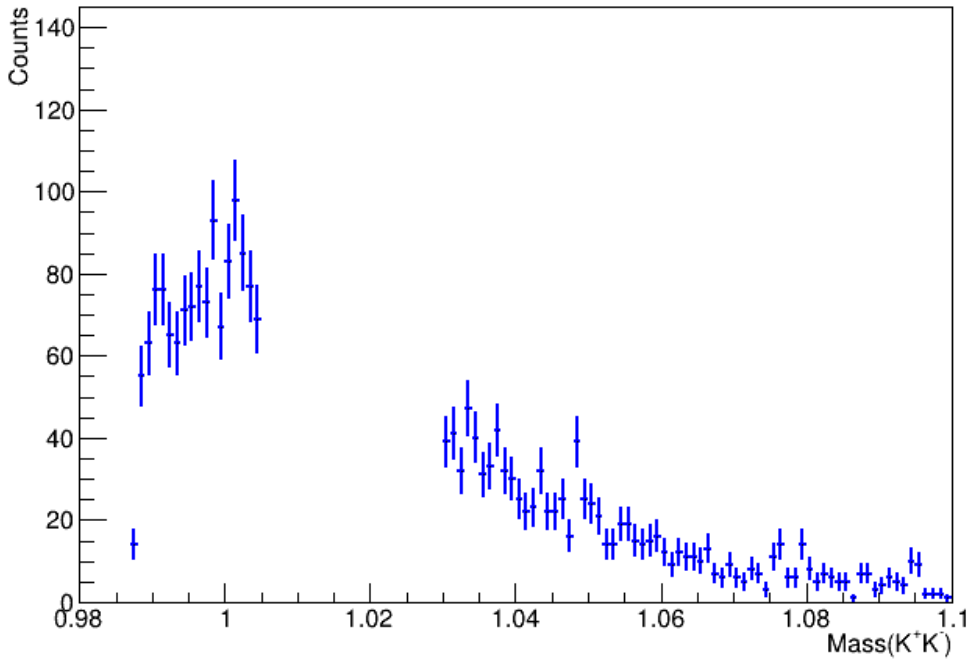

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Different by isospin

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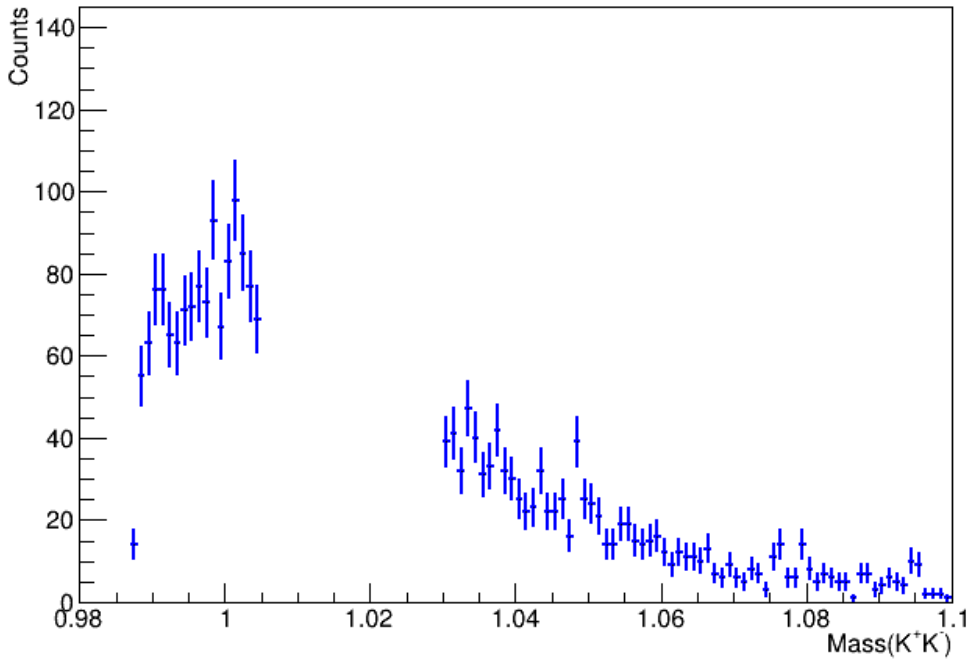
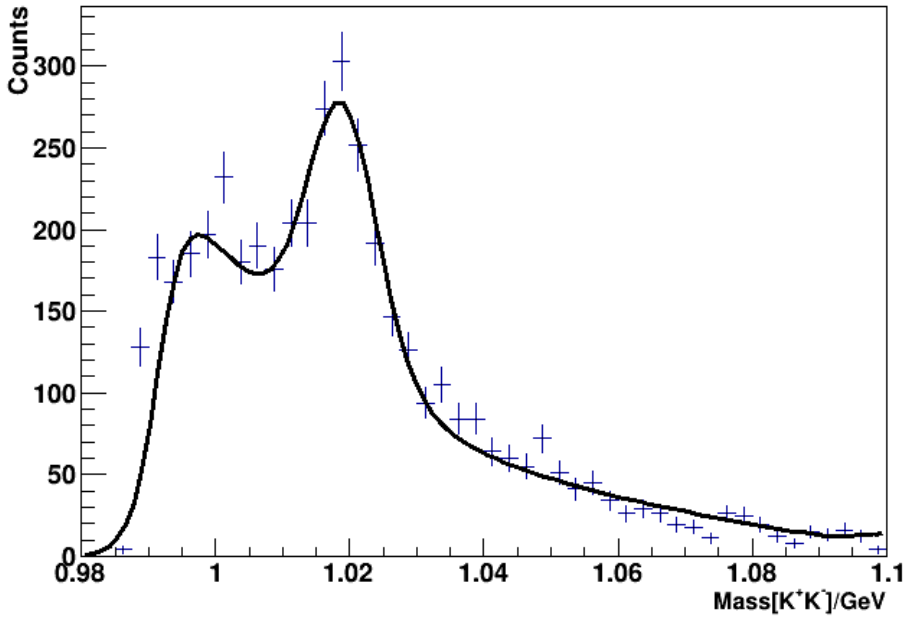
- **$a_0\pi$ can come from I=0,1 meson**



Fit to K^+K^-

- Fitting function includes



Fit to K^+K^-

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  - φ meson : Voigtian with
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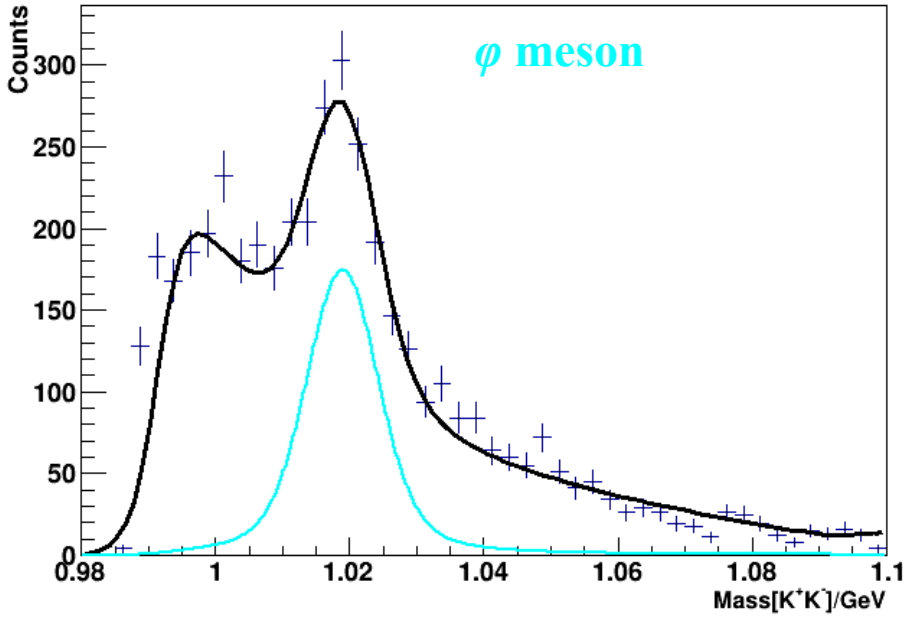

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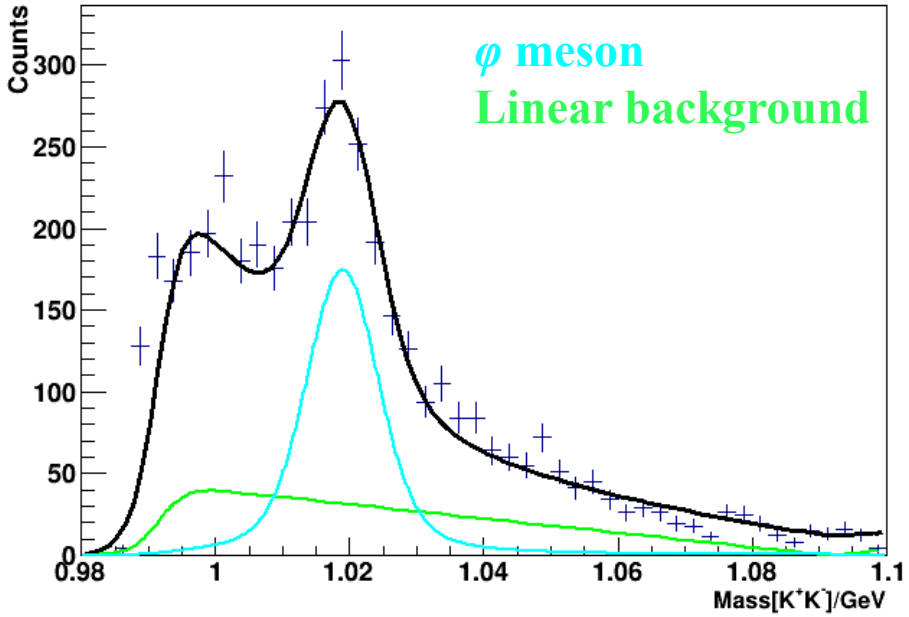

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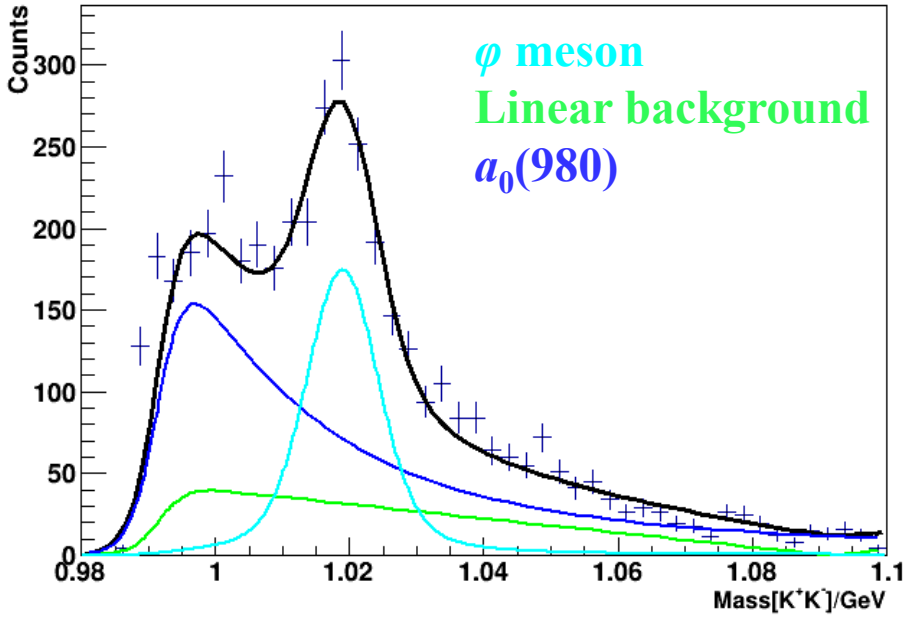
  - $a_0(980)$: Voigtian (multiplied by sigmoid) with
    - Center locked at 980 MeV
    - Width allowed to vary between 50 and 100 MeV



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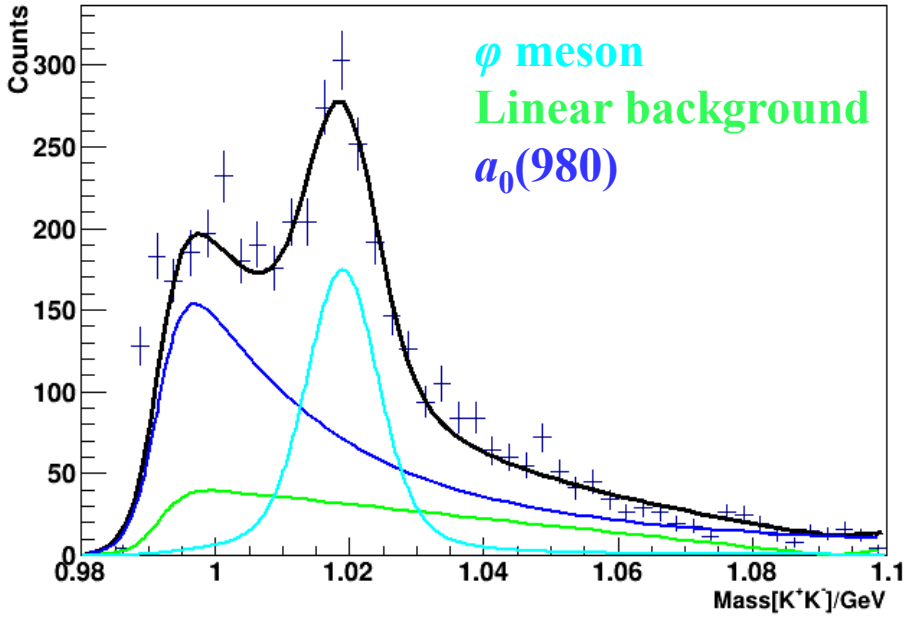
Same σ of gaussian smear



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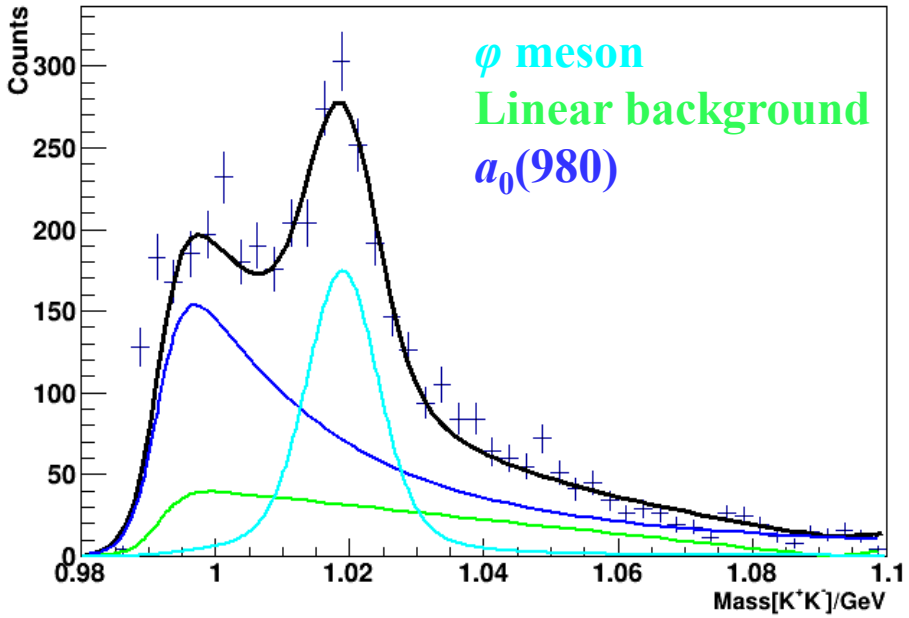
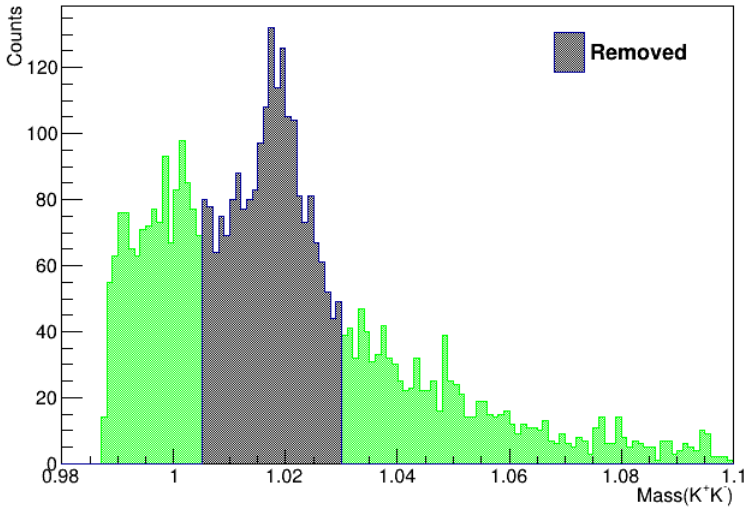


- Possible large contribution from $a_0(980)$ [or $f_0(980)$]

Removal of the φ



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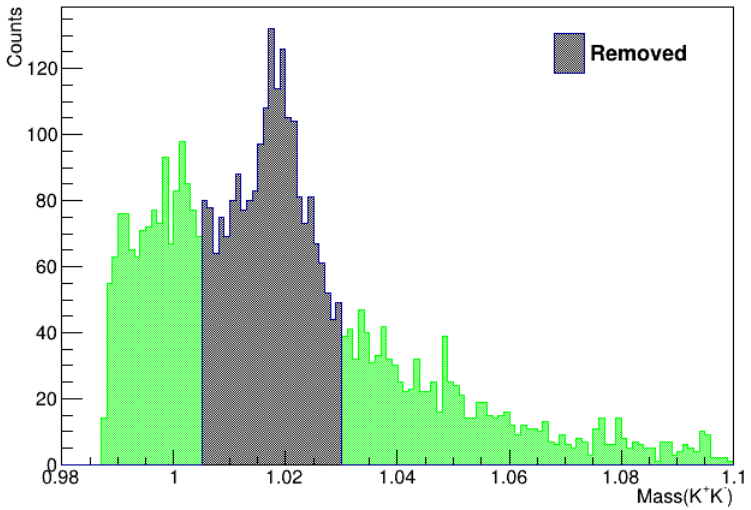

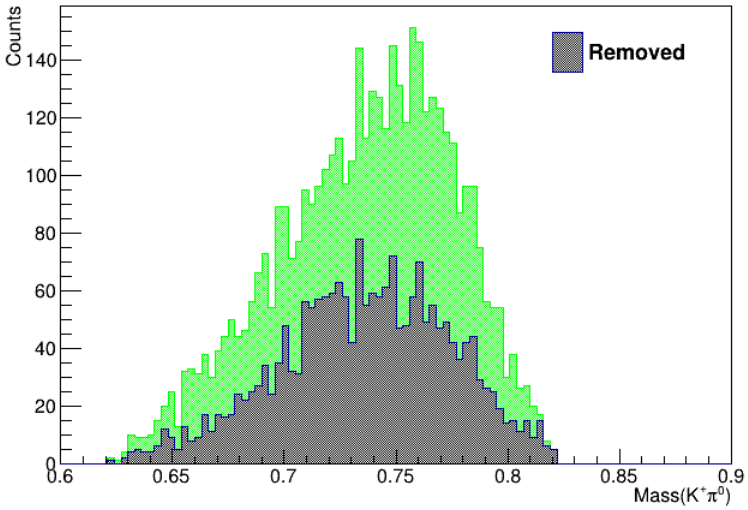

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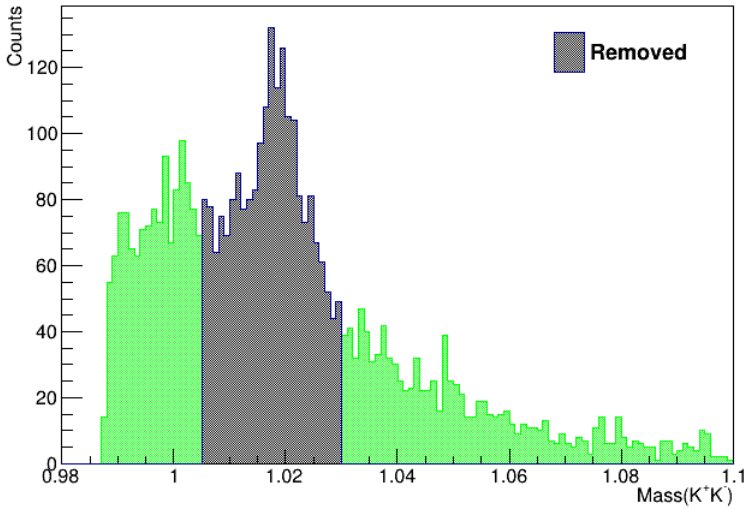

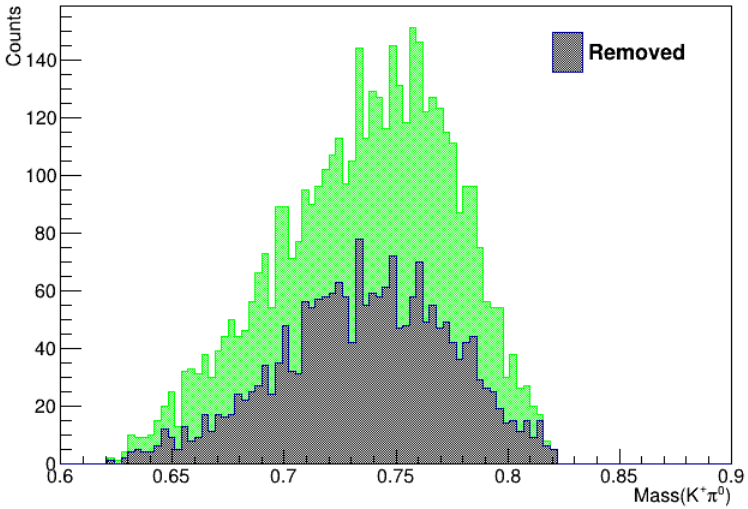

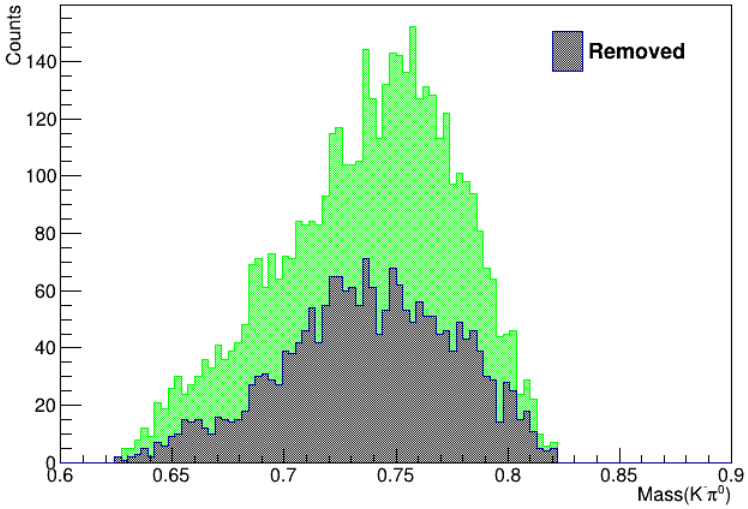

ASU

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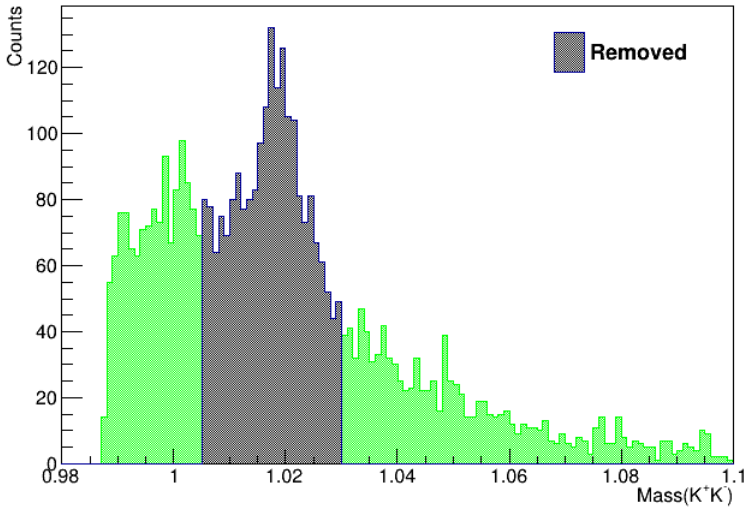
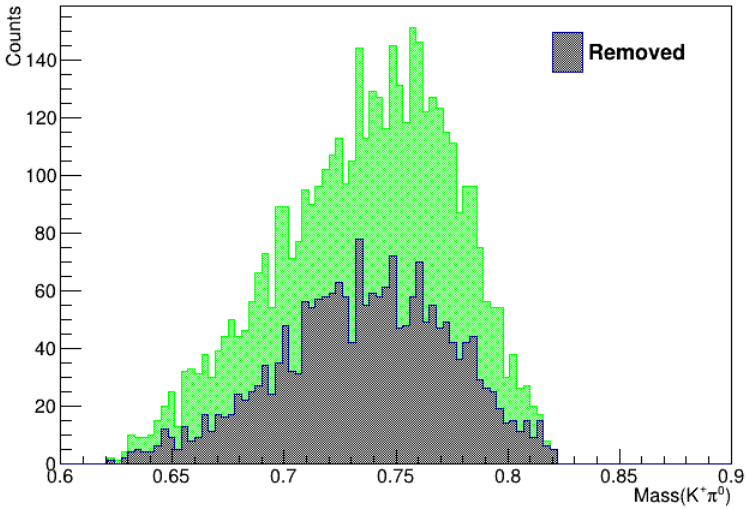
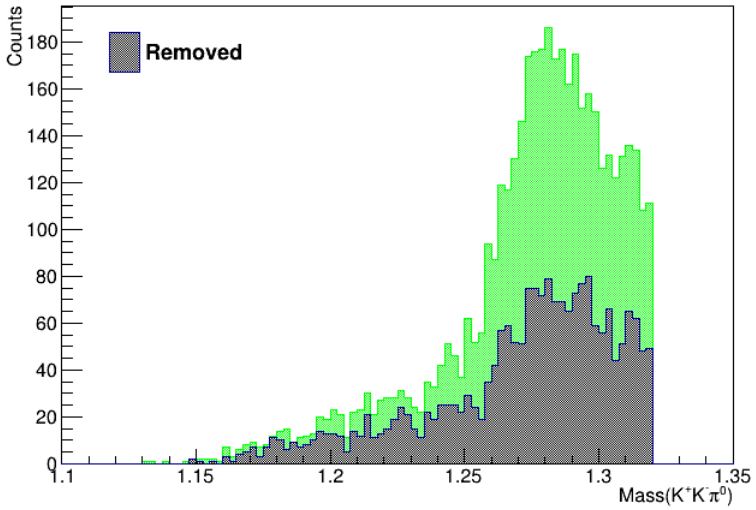
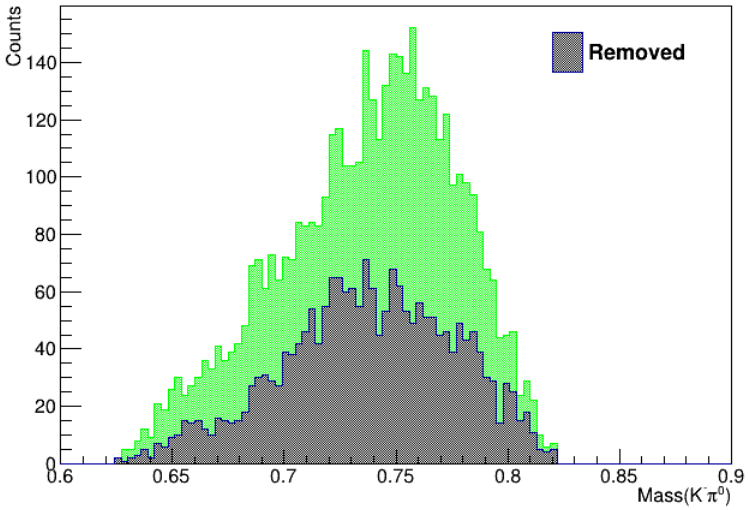


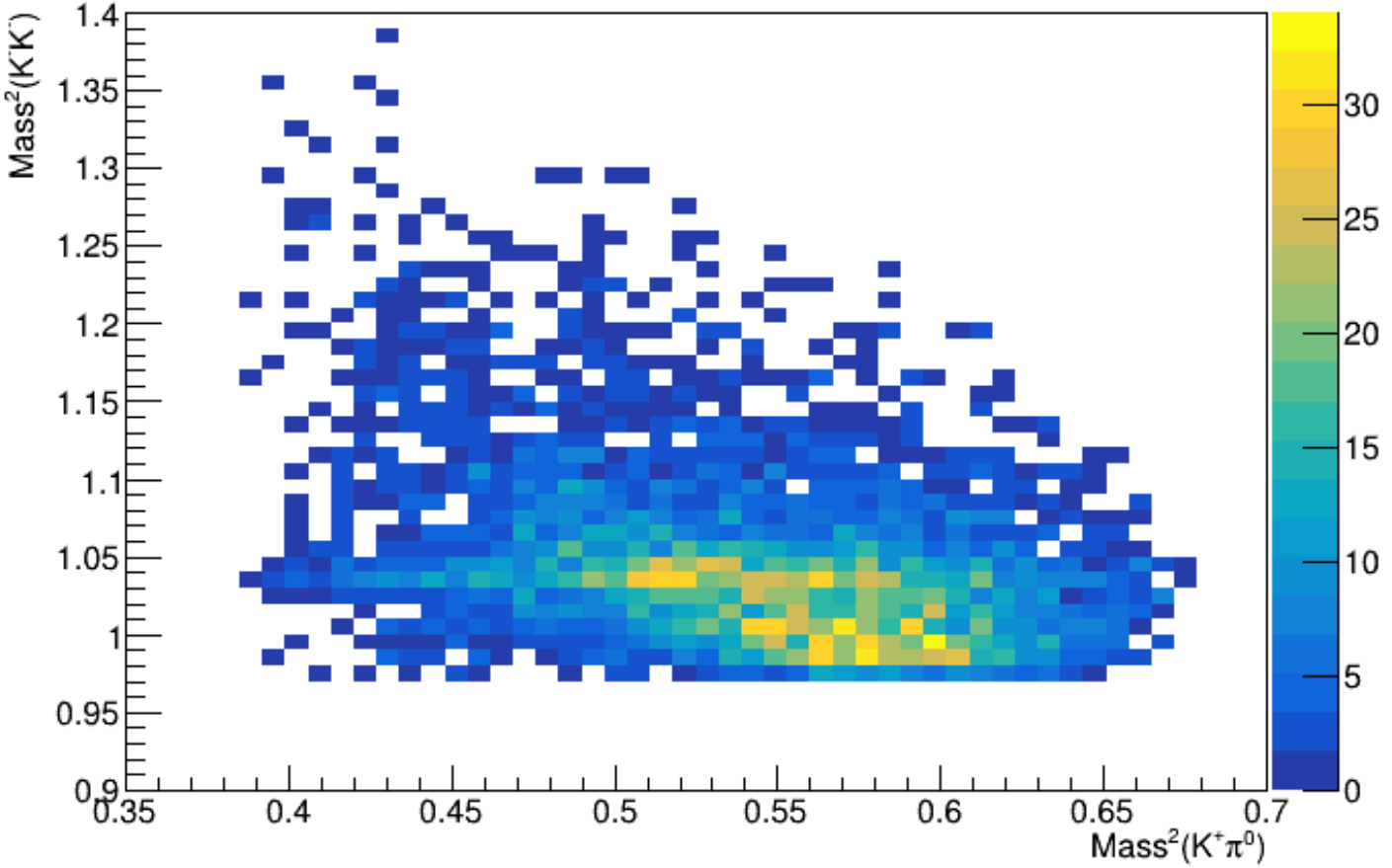






Dalitz plots

with mass($K^+K^-\pi^0$)
1220 – 1320 MeV



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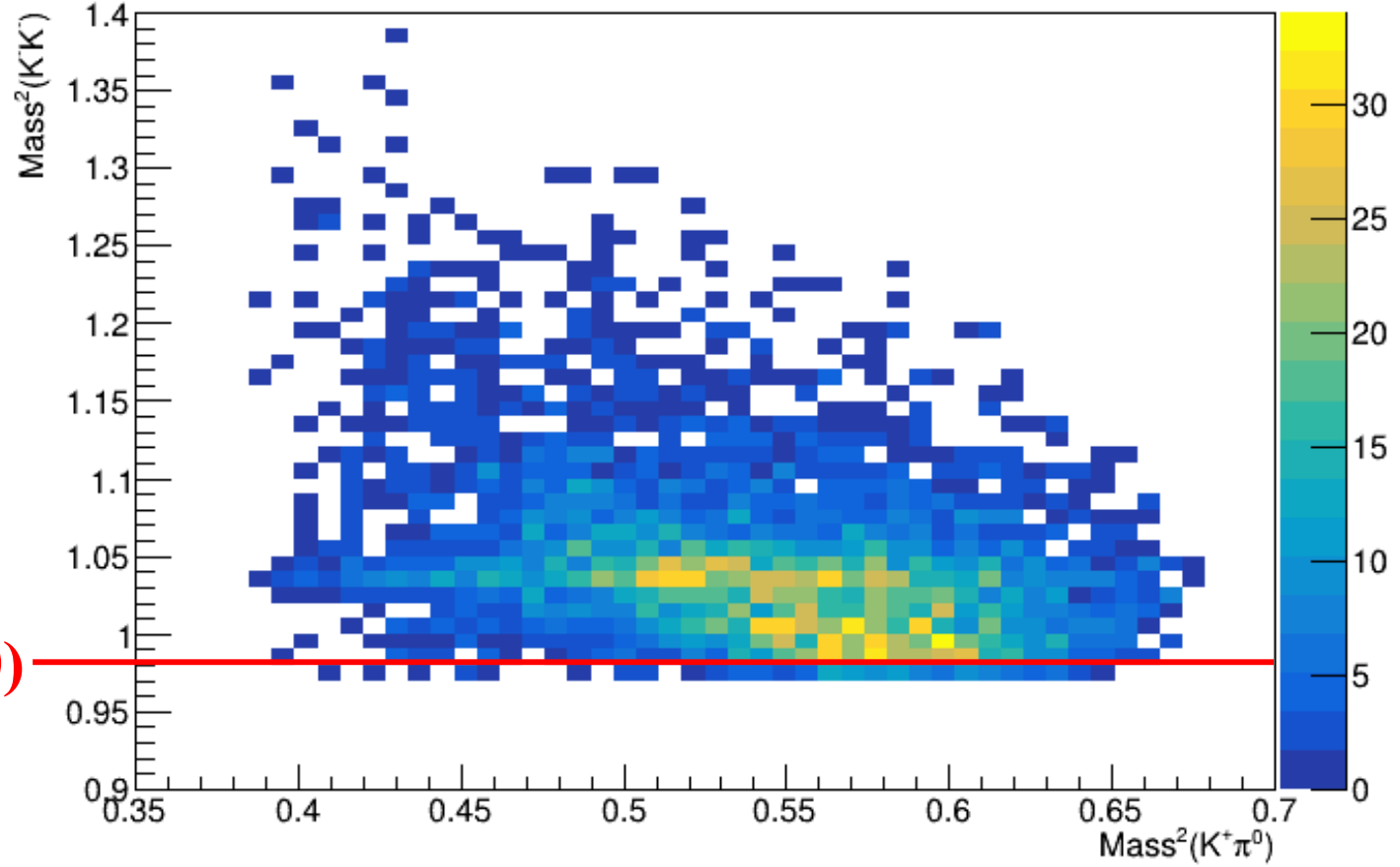

a(980)

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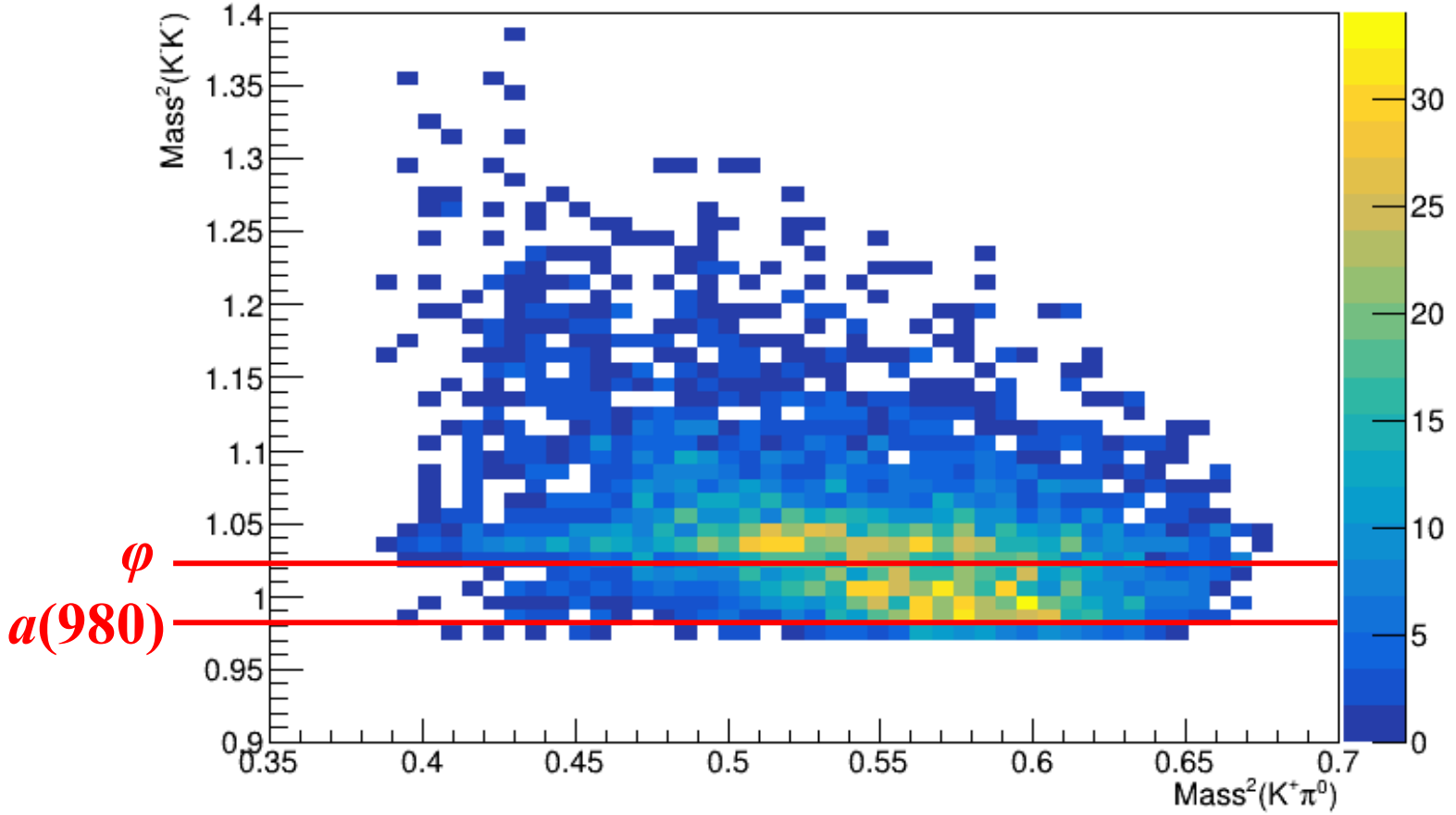
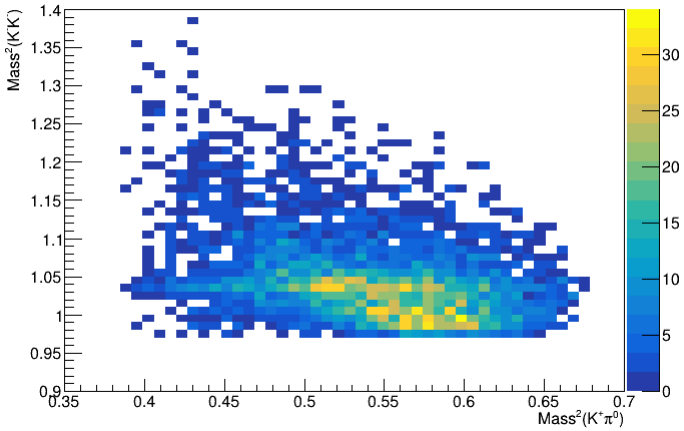


ASU



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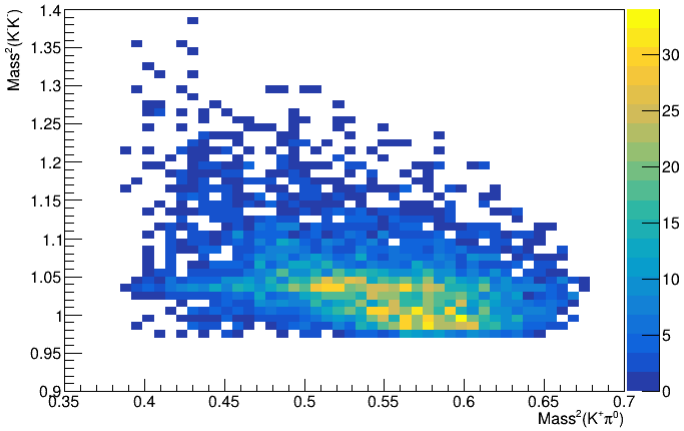

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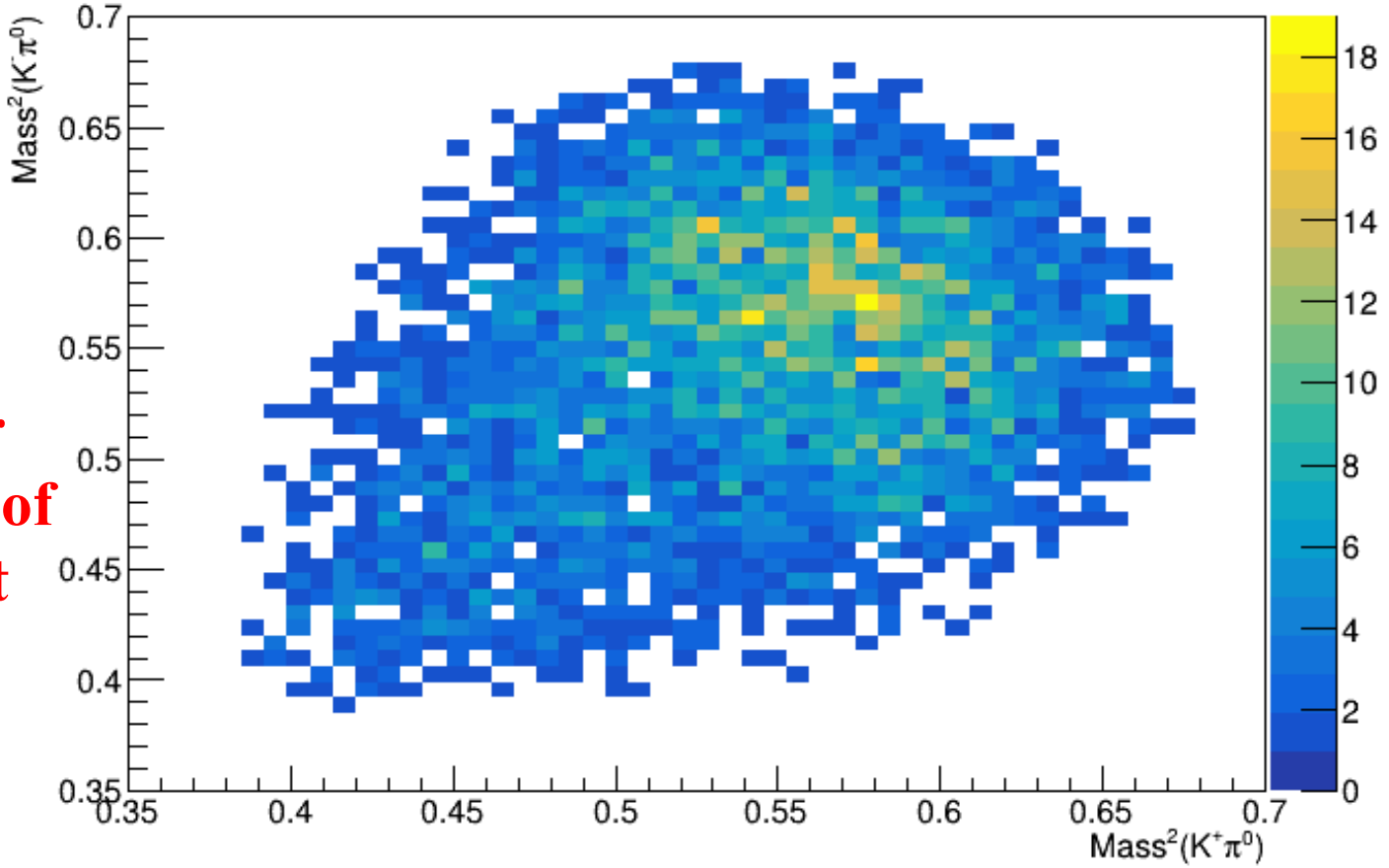
No clear horizontal or vertical bands of enhancement



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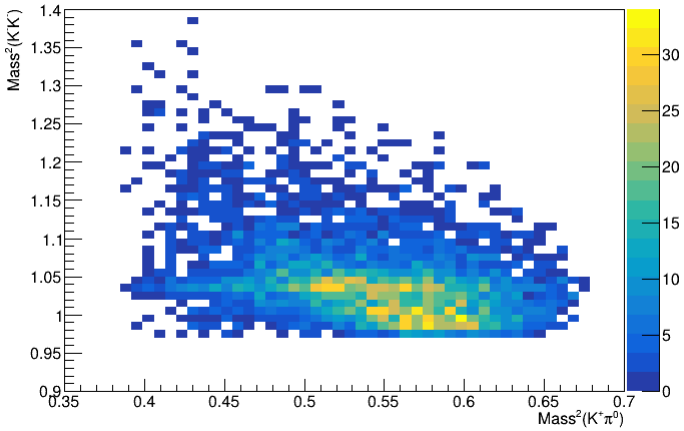

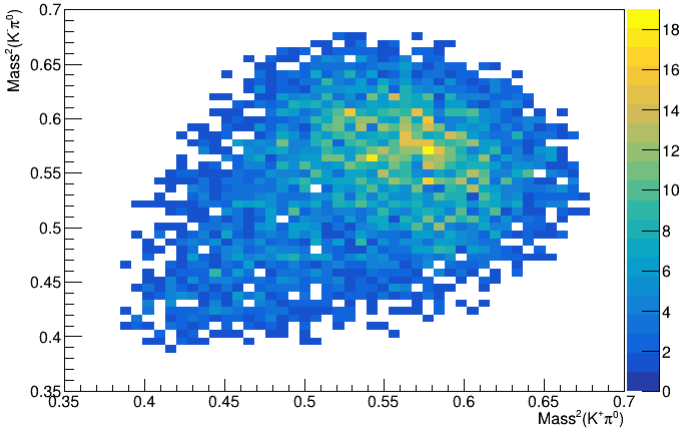

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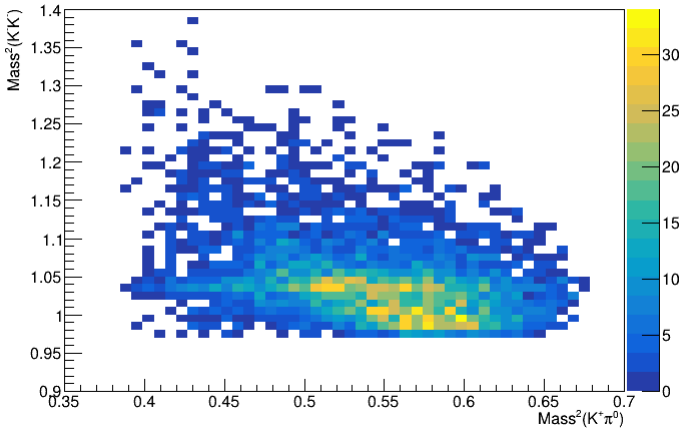
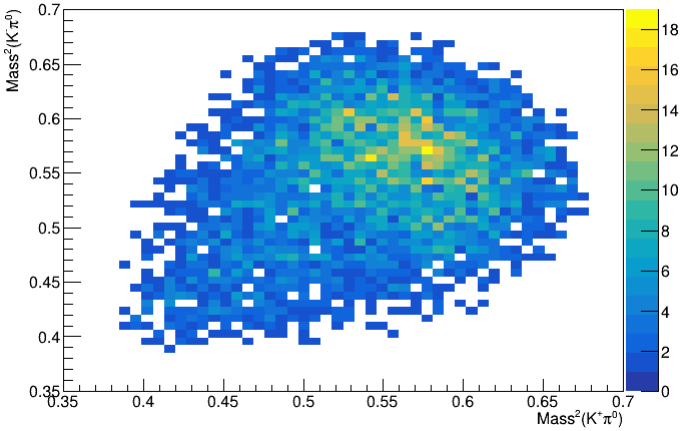
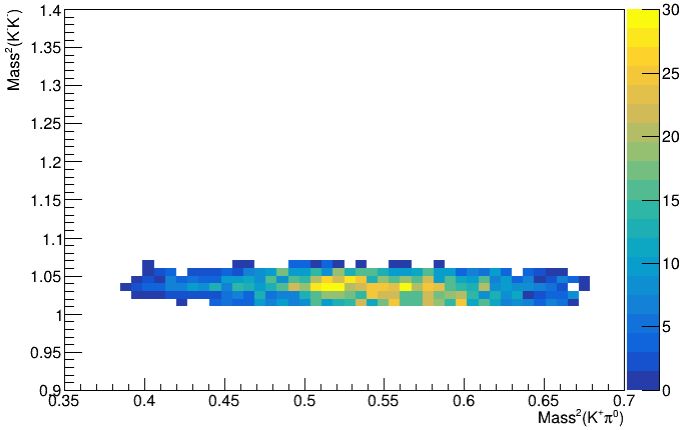
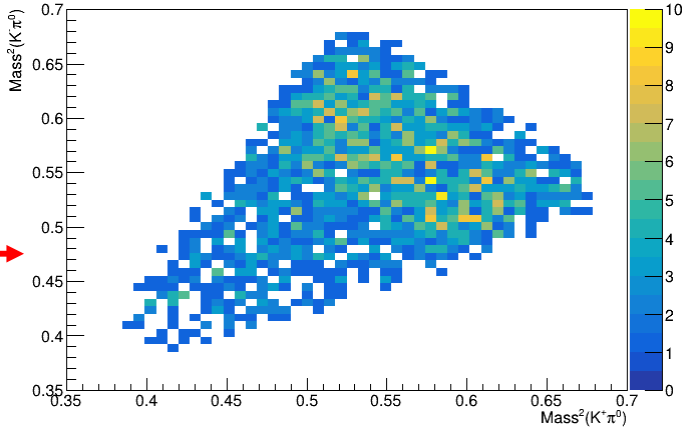






φ region only



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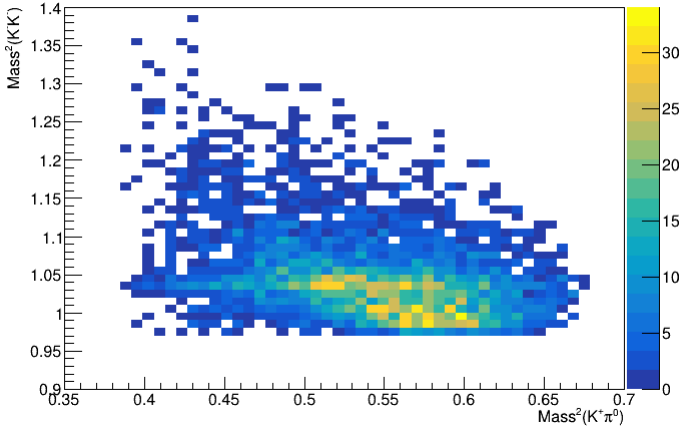
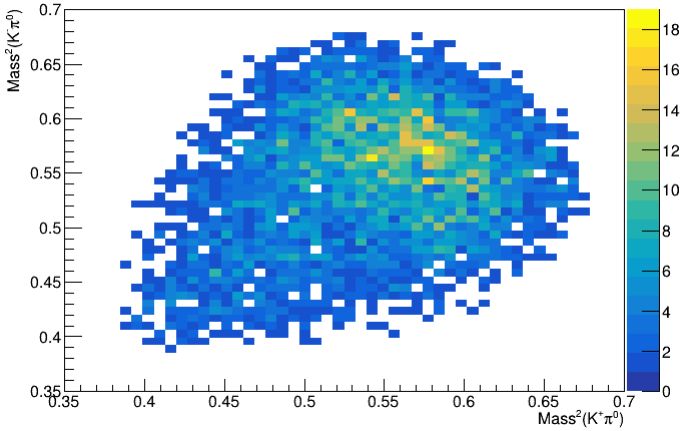
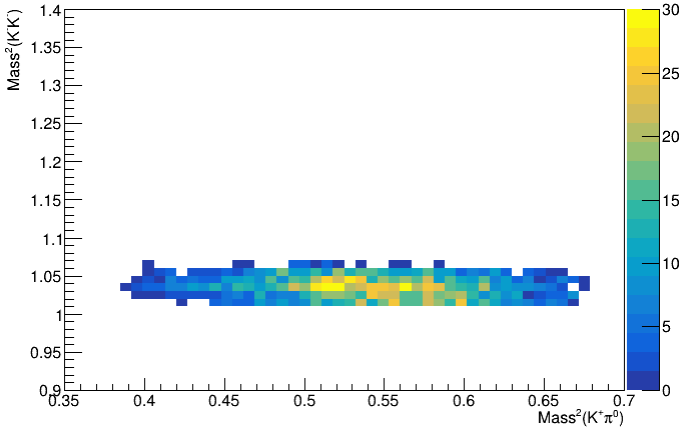
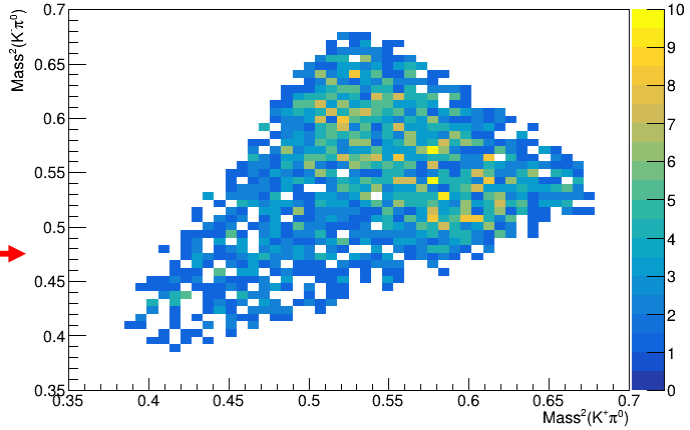
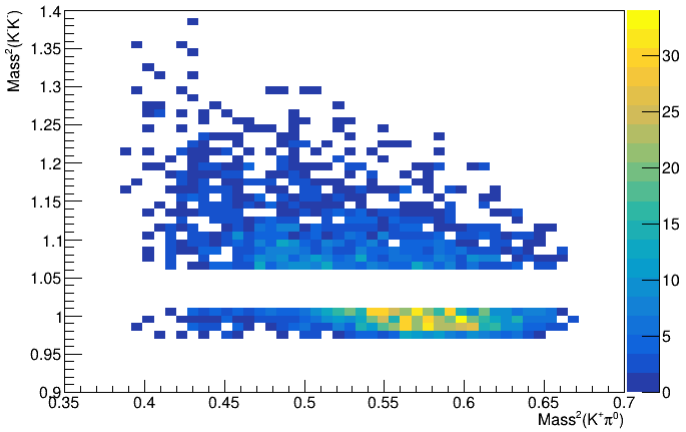




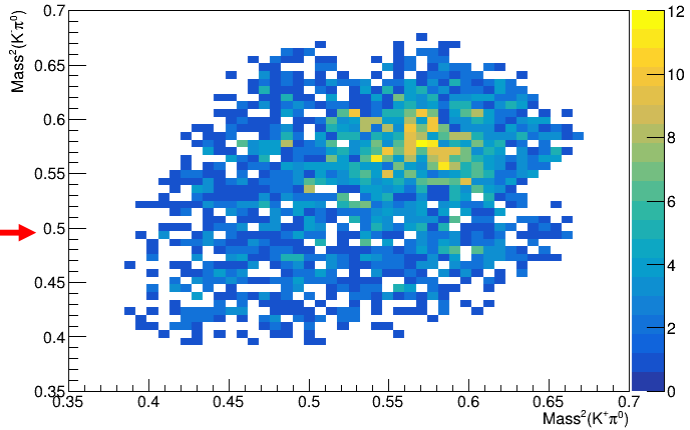


φ region only



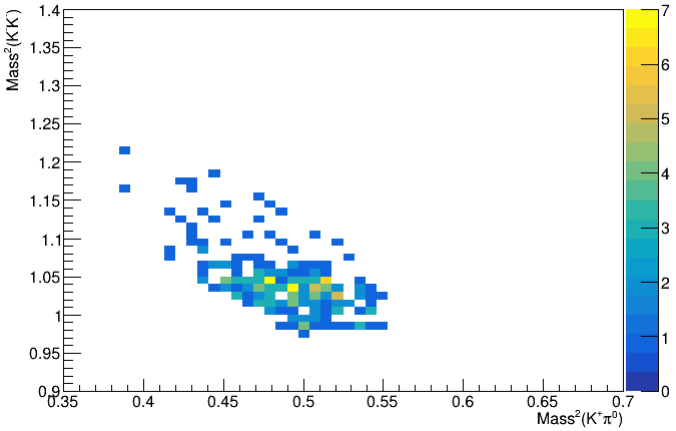


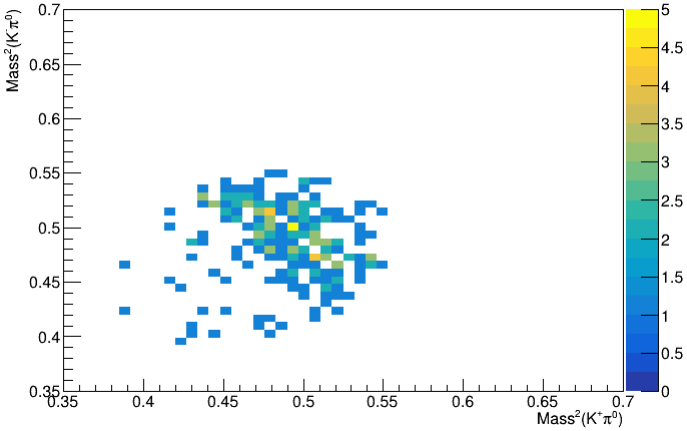
φ region removed

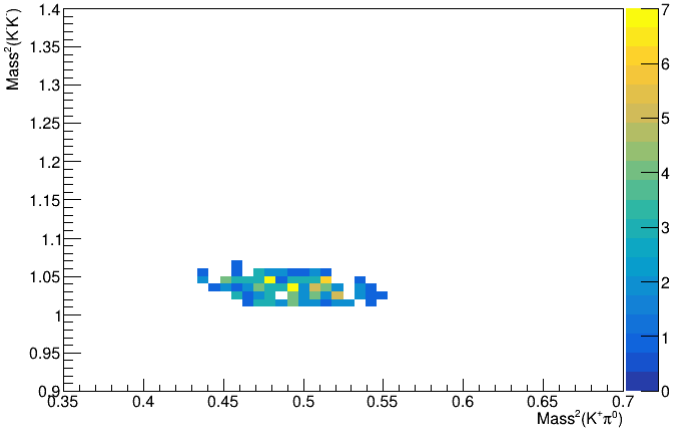


Dalitz plots

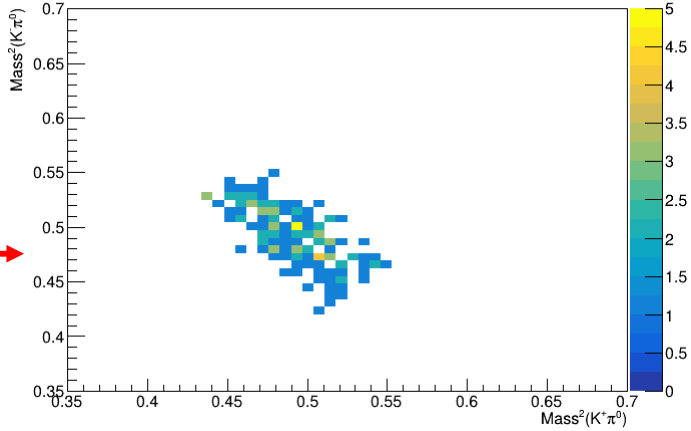
with mass($K^+K^-\pi^0$)
1220 – 1240 MeV

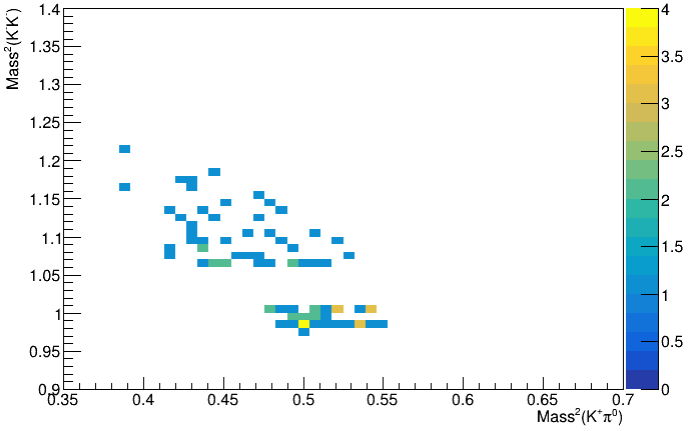




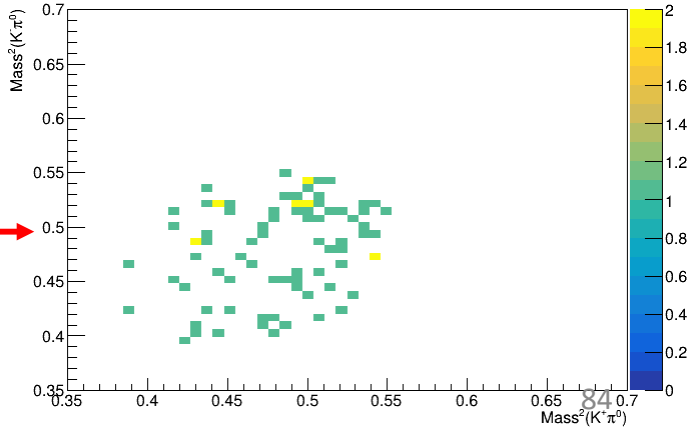


φ region only



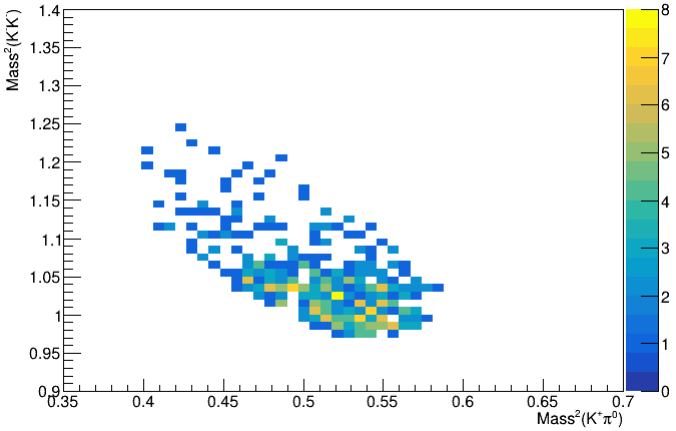


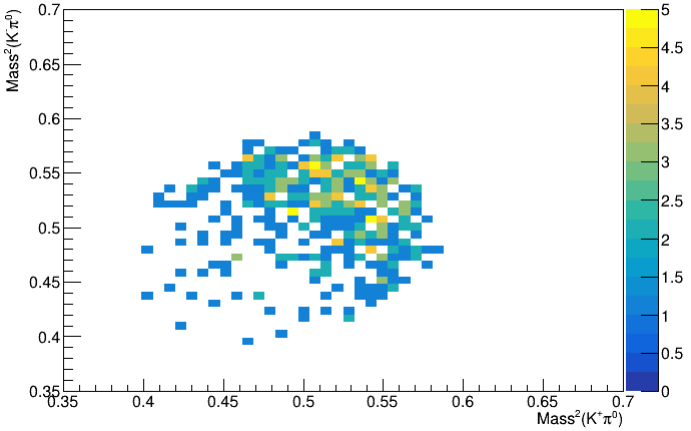
φ region removed

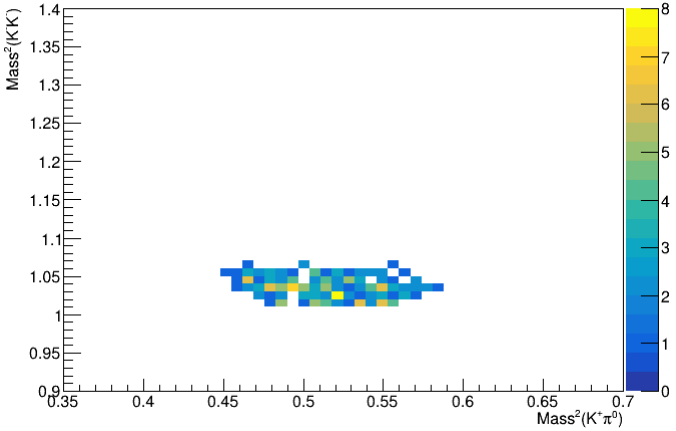


Dalitz plots

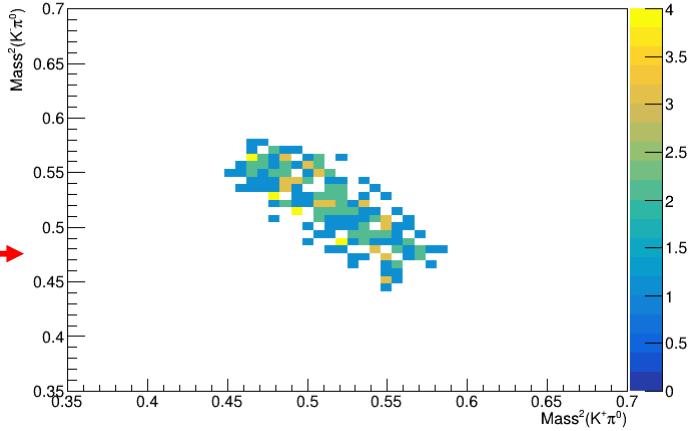
with mass($K^+K^-\pi^0$)
1240 – 1260 MeV

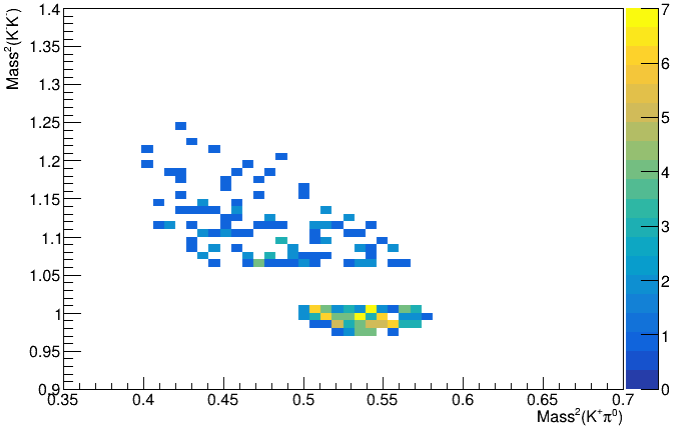




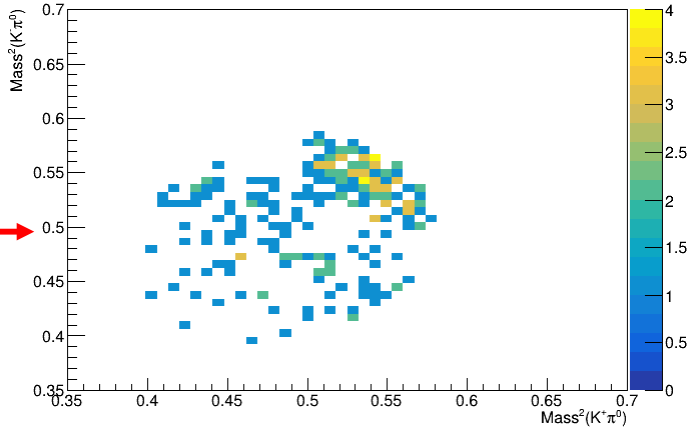


φ region only



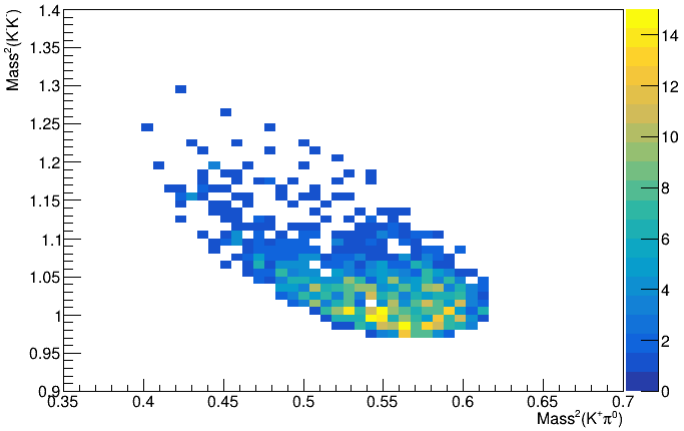


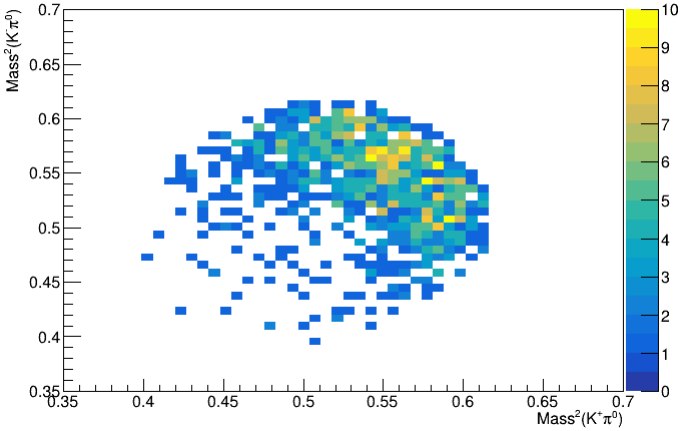
φ region removed

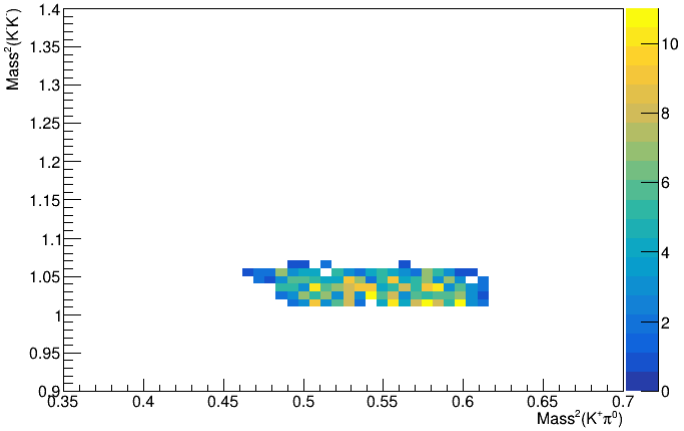


Dalitz plots

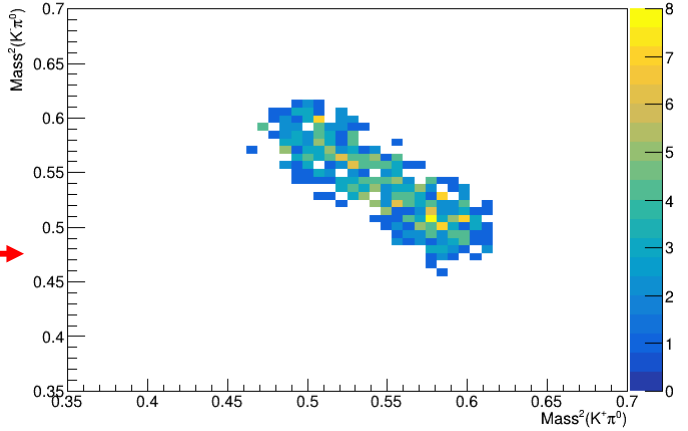
with mass($K^+K^-\pi^0$)
1260 – 1280 MeV

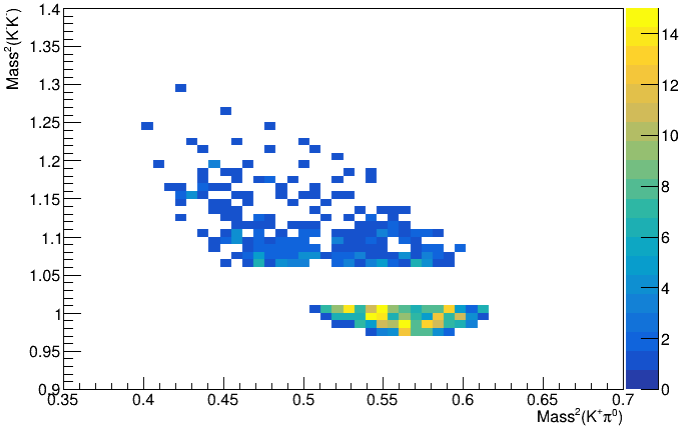






φ region only





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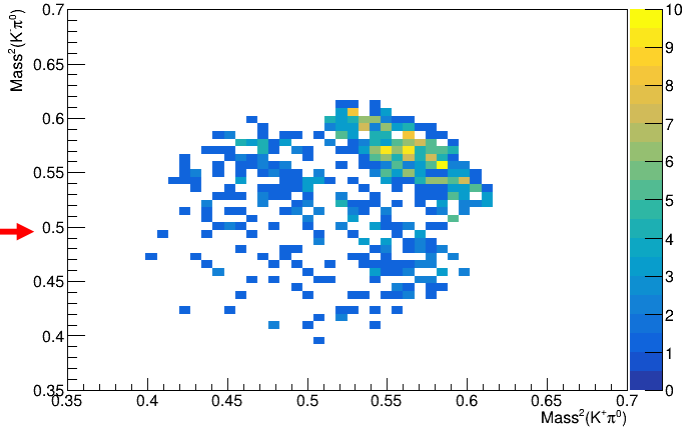
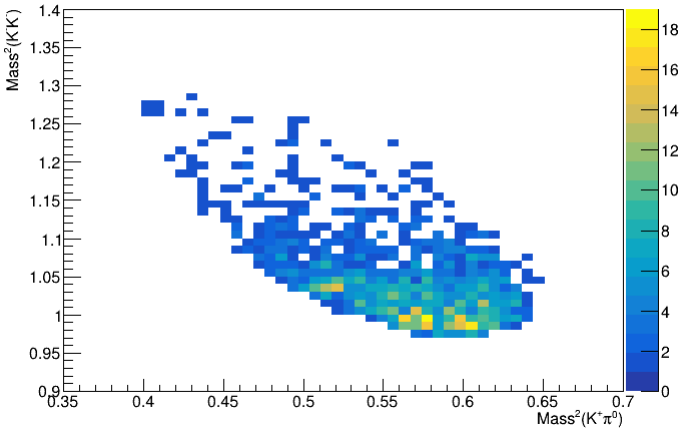
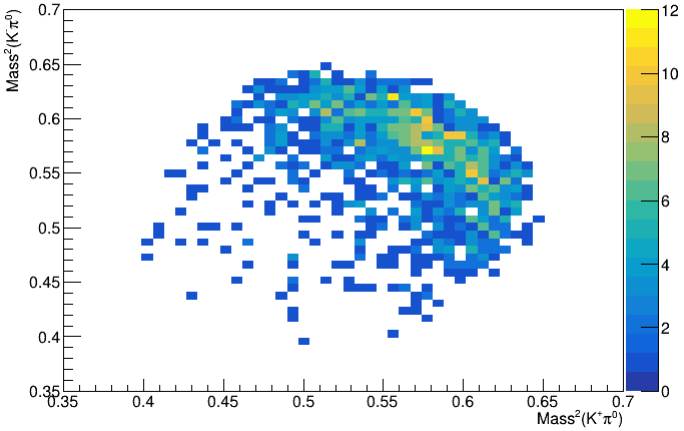
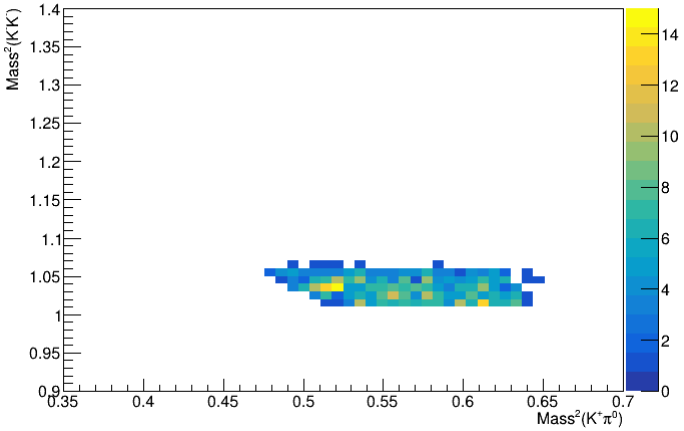


Dalitz plots

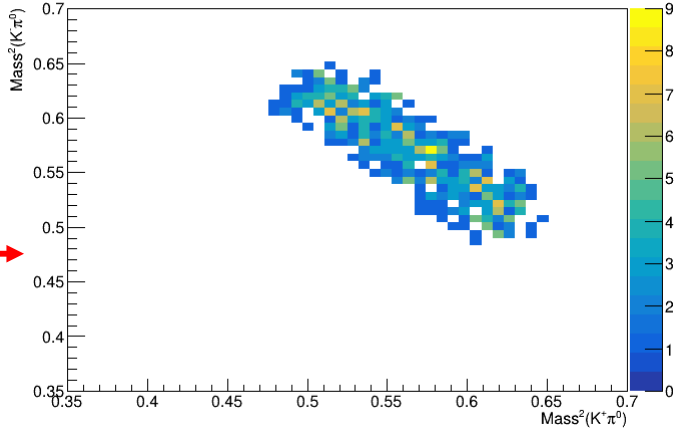
with mass($K^+K^-\pi^0$)
1280 – 1300 MeV

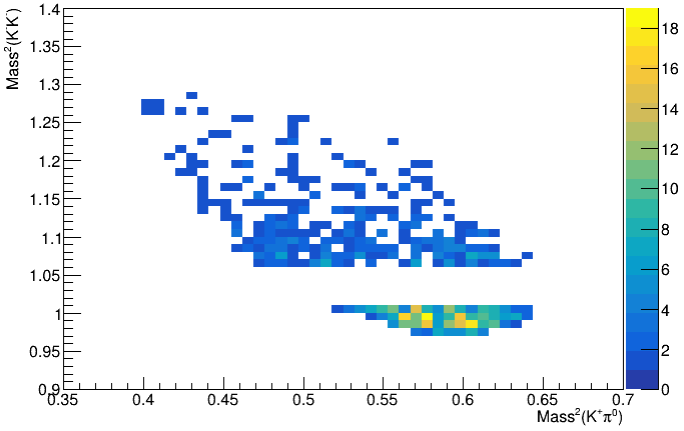






φ region only





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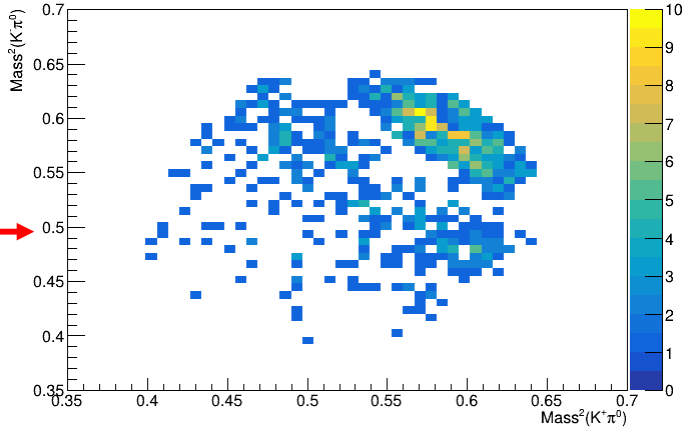
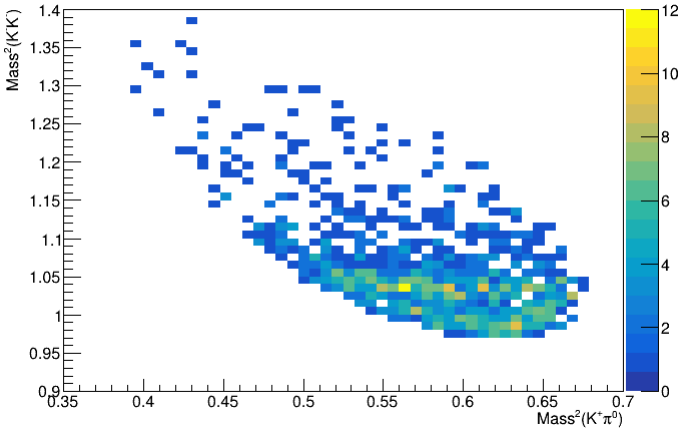
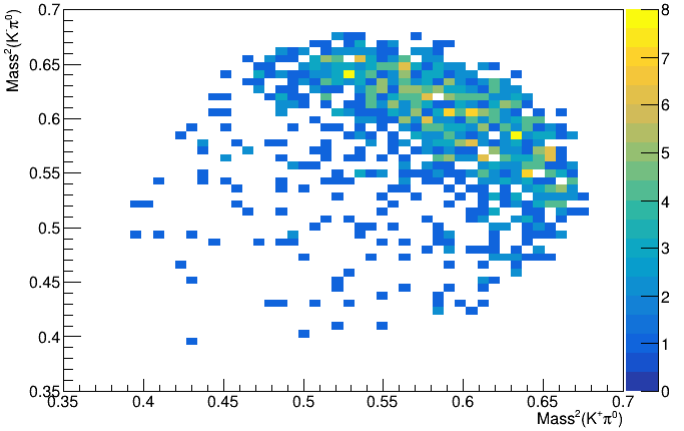
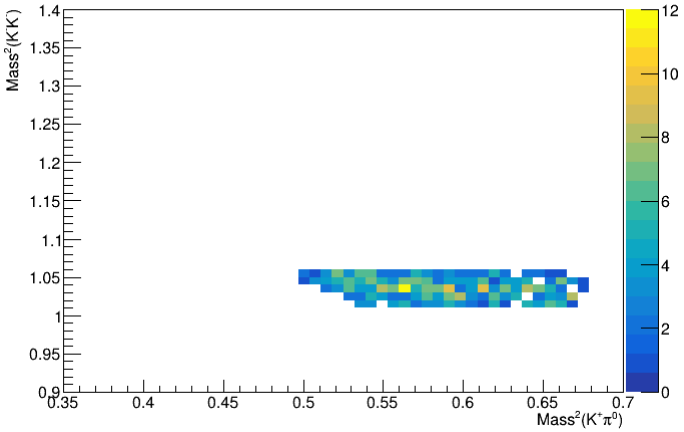


Dalitz plots

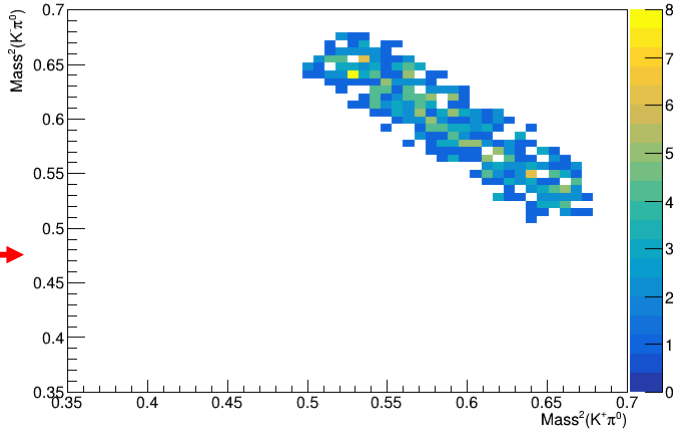
with mass($K^+K^-\pi^0$)
1300 – 1320 MeV

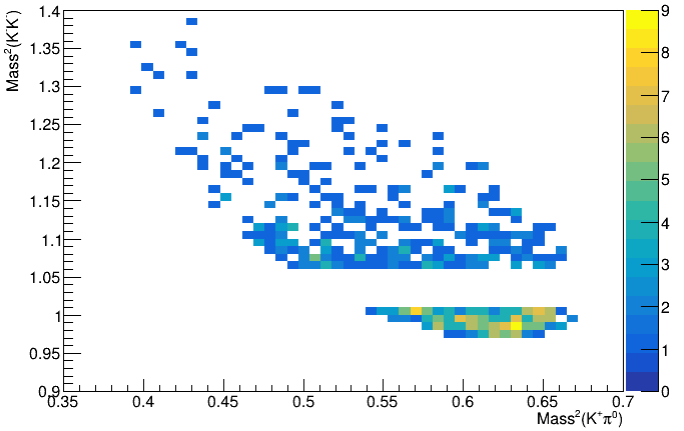






φ region only





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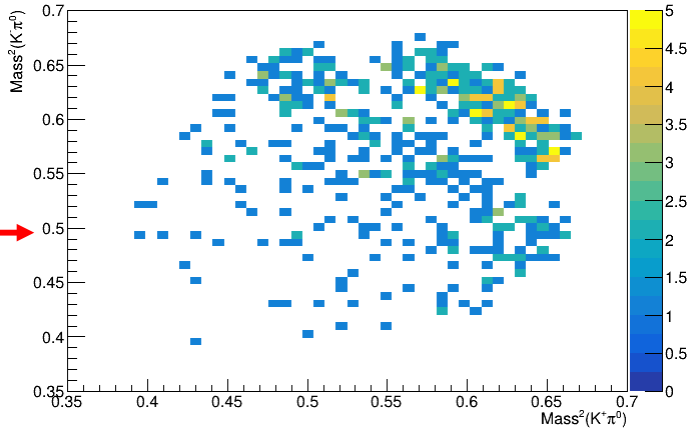

Candidates for $R \rightarrow KK\pi$ or $a^0(980)\ \pi$

- Initially Looking at mass range between 1220 and 1320 MeV
- Only considering mesons that have been seen within PDG to decay
  - $KK\pi$
  - $a^0(980)\ \pi$

Candidates for $R \rightarrow KK\pi$ or $a^0(980)\,\pi$

$a_1(1260)$ [j]

$I^G(J^{PC}) = 1^-(1^{++})$

Mass $m = 1230 \pm 40$ MeV [i]
Full width $\Gamma = 250$ to 600 MeV [i]

$a_1(1260)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
3π	seen	577
$(\rho\pi)_{S-\text{wave}},\ \rho \rightarrow \pi\pi$	seen	353
$(\rho\pi)_{D-\text{wave}},\ \rho \rightarrow \pi\pi$	seen	353
$(\rho(1450)\pi)_{S-\text{wave}},\ \rho \rightarrow \pi\pi$	seen	†
$(\rho(1450)\pi)_{D-\text{wave}},\ \rho \rightarrow \pi\pi$	seen	†
$f_0(500)\pi,\ f_0 \rightarrow \pi\pi$	seen	–
$f_0(980)\pi,\ f_0 \rightarrow \pi\pi$	not seen	179
$f_0(1370)\pi,\ f_0 \rightarrow \pi\pi$	seen	†
$f_2(1270)\pi,\ f_2 \rightarrow \pi\pi$	seen	†
$\pi^+\pi^-\pi^0$	seen	576
$\pi^0\pi^0\pi^0$	not seen	577
$KK\pi$	seen	250
$K^*(892)K$	seen	†
$\pi\gamma$	seen	608

Candidates for $R \rightarrow KK\pi$ or $a^0(980)\,\pi$

$a_1(1260)$ [j]

$I^G(J^{PC}) = 1^-(1^{++})$

Mass $m = 1230 \pm 40$ MeV [j]

Full width $\Gamma = 250$ to 600 MeV [j]

Very wide

$a_1(1260)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
3π	seen	577
$(\rho\pi)_{S\text{-wave}},\ \rho \rightarrow \pi\pi$	seen	353
$(\rho\pi)_{D\text{-wave}},\ \rho \rightarrow \pi\pi$	seen	353
$(\rho(1450)\pi)_{S\text{-wave}},\ \rho \rightarrow \pi\pi$	seen	†
$(\rho(1450)\pi)_{D\text{-wave}},\ \rho \rightarrow \pi\pi$	seen	†
$f_0(500)\pi,\ f_0 \rightarrow \pi\pi$	seen	–
$f_0(980)\pi,\ f_0 \rightarrow \pi\pi$	not seen	179
$f_0(1370)\pi,\ f_0 \rightarrow \pi\pi$	seen	†
$f_2(1270)\pi,\ f_2 \rightarrow \pi\pi$	seen	†
$\pi^+\pi^-\pi^0$	seen	576
$\pi^0\pi^0\pi^0$	not seen	577
$KK\pi$	seen	250
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Candidates for $R \rightarrow KK\pi$ or $a^0(980)\,\pi$

$a_1(1260)$ [j]

$I^G(J^{PC}) = 1^-(1^{++})$

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Very wide

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$(\rho(1450)\pi)_{S\text{-wave}}$, $\rho \rightarrow \pi\pi$	seen	†
$(\rho(1450)\pi)_{D\text{-wave}}$, $\rho \rightarrow \pi\pi$	seen	†
$f_0(500)\pi$, $f_0 \rightarrow \pi\pi$	seen	–
$f_0(980)\pi$, $f_0 \rightarrow \pi\pi$	not seen	179
$f_0(1370)\pi$, $f_0 \rightarrow \pi\pi$	seen	†
$f_2(1270)\pi$, $f_2 \rightarrow \pi\pi$	seen	†
$\pi^+\pi^-\pi^0$	seen	576
$\pi^0\pi^0\pi^0$	not seen	577
$KK\pi$	seen	250
$K^*(892)K$	seen	†
$\pi\gamma$	seen	608

Not using at this stage of the analysis

Candidates for $R \rightarrow KK\pi$ or $a^0(980)\,\pi$

$f_1(1285)$ $\quad I^G(J^{PC}) = 0^+(1^{++})$

Mass $m = 1281.9 \pm 0.5$ MeV (S = 1.8)
Full width $\Gamma = 22.7 \pm 1.1$ MeV (S = 1.5)

$f_1(1285)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
4π	(32.7 ± 1.9) %	S=1.2	568
$\pi^0\pi^0\pi^+\pi^-$	(21.8 ± 1.3) %	S=1.2	566
$2\pi^+2\pi^-$	(10.9 ± 0.6) %	S=1.2	563
$\rho^0\pi^+\pi^-$	(10.9 ± 0.6) %	S=1.2	336
$\rho^0\rho^0$	seen		†
$4\pi^0$	$< 7 \times 10^{-4}$	CL=90%	568
$\eta\pi^+\pi^-$	(35 ±15) %		479
$\eta\pi\pi$	(52.2 ± 2.0) %	S=1.2	482
$a_0(980)\pi$ [ignoring $a_0(980) \rightarrow K\overline{K}$]	(38 ± 4) %		238
$\eta\pi\pi$ [excluding $a_0(980)\pi$]	(14 ± 4) %		482
$K\overline{K}\pi$	(9.0 ± 0.4) %	S=1.1	308
$K\overline{K}^*(892)$	not seen		†
$\pi^+\pi^-\pi^0$	(3.0 ± 0.9) $\times 10^{-3}$		603
$\rho^\pm\pi^\mp$	$< 3.1 \times 10^{-3}$	CL=95%	390
$\gamma\rho^0$	(6.1 ± 1.0) %	S=1.7	406
$\phi\gamma$	(7.4 ± 2.6) $\times 10^{-4}$		236
e^+e^-	$< 9.4 \times 10^{-9}$	CL=90%	641

Candidates for $R \rightarrow KK\pi$ or $a^0(980)\,\pi$

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$\rho^0\pi^+\pi^-$	(10.9 ± 0.6) %	S=1.2	336
$\rho^0\rho^0$	seen		†
$4\pi^0$	$< 7 \times 10^{-4}$	CL=90%	568
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$K\overline{K}^*(892)$	not seen		†
$\pi^+\pi^-\pi^0$	(3.0 ± 0.9) $\times 10^{-3}$		603
$\rho^\pm\pi^\mp$	$< 3.1 \times 10^{-3}$	CL=95%	390
$\gamma\rho^0$	(6.1 ± 1.0) %	S=1.7	406
$\phi\gamma$	(7.4 ± 2.6) $\times 10^{-4}$		236
e^+e^-	$< 9.4 \times 10^{-9}$	CL=90%	641

Candidates for $R \rightarrow KK\pi$ or $a^0(980)\,\pi$

$f_1(1285)$ $\quad I^G(J^{PC}) = 0^+(1^{++})$

Mass $m = 1281.9 \pm 0.5$ MeV (S = 1.8)
Full width $\Gamma = 22.7 \pm 1.1$ MeV (S = 1.5)

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$\rho^0\pi^+\pi^-$	(10.9 ± 0.6) %	S=1.2	336
$\rho^0\rho^0$	seen		†
$4\pi^0$	< 7 × 10^{-4}	CL=90%	568
$\eta\pi^+\pi^-$	(35 ±15) %		479
$\eta\pi\pi$	(52.2 ± 2.0) %	S=1.2	482
$a_0(980)\pi$ [ignoring $a_0(980) \rightarrow K\overline{K}$]	(38 ± 4) %		238
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$K\overline{K}\pi$	(9.0 ± 0.4) %	S=1.1	308
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$\phi\gamma$	(7.4 ± 2.6) × 10^{-4}		236
e^+e^-	< 9.4 × 10^{-9}	CL=90%	641

Will count $f_1(1285)$ as having branches to $KK\pi$ and $a^0(980)\,\pi$

Candidates for $R \rightarrow KK\pi$ or $a^0(980)\,\pi$

$\eta(1295)$ $\quad I^G(J^{PC}) = 0^+(0^{-+})$

See the review on "Spectroscopy of Light Meson Resonances."
Mass $m = 1294 \pm 4$ MeV $\quad (S = 1.6)$
Full width $\Gamma = 55 \pm 5$ MeV

$\eta(1295)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\eta\pi^+\pi^-$	seen	487
$a_0(980)\,\pi$	seen	248
$\eta\pi^0\pi^0$	seen	490
$\eta(\pi\pi)_{S\text{-wave}}$	seen	–

Will count $\eta(1295)$ has having a branch to $a^0(980)\,\pi$

Initial PWA setup

- Used PWA expression:

$$\sqrt{2l+1}\sqrt{2s+1}\,\frac{m_0\Gamma}{m_0{}^2 - m^2 - im_0\Gamma}\,a_{Jlsm}\sum_{\lambda} D^{J*}_{m\lambda}(\varphi_{GJ},\theta_{GJ})D^{s*}_{\lambda 0}(\varphi_h,\theta_h)\langle l0s\lambda|J\lambda\rangle,$$

where a_{Jlsm} are the coefficients of the fit

Initial PWA setup

- Used PWA expression:

$$\sqrt{2l+1}\sqrt{2s+1}\,\frac{m_0\Gamma}{m_0{}^2 - m^2 - im_0\Gamma}\,a_{Jlsm}\sum_{\lambda} D^{J*}_{m\lambda}(\varphi_{GJ},\theta_{GJ})D^{s*}_{\lambda 0}(\varphi_h,\theta_h)\langle l0s\lambda|J\lambda\rangle,$$

where a_{Jlsm} are the coefficients of the fit

- Used AmpTools for PWA

Initial PWA setup

- Used PWA expression:

$$\sqrt{2l+1}\sqrt{2s+1}\,\frac{m_0\Gamma}{m_0{}^2 - m^2 - im_0\Gamma}\,a_{Jlsm}\sum_{\lambda} D^{J*}_{m\lambda}(\varphi_{GJ},\theta_{GJ})D^{s*}_{\lambda 0}(\varphi_h,\theta_h)\langle l0s\lambda|J\lambda\rangle,$$

where a_{Jlsm} are the coefficients of the fit

- Used AmpTools for PWA

- Meson Resonance (R) = $KK\pi$ system

Initial PWA setup

- Used PWA expression:

$$\sqrt{2l+1}\sqrt{2s+1}\,\frac{m_0\Gamma}{m_0{}^2 - m^2 - im_0\Gamma}\,a_{Jlsm}\sum_\lambda D^{J*}_{m\lambda}(\varphi_{GJ},\theta_{GJ})D^{s*}_{\lambda 0}(\varphi_h,\theta_h)\langle l0s\lambda|J\lambda\rangle,$$

where a_{Jlsm} are the coefficients of the fit

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- Meson Resonance (R) = $KK\pi$ system
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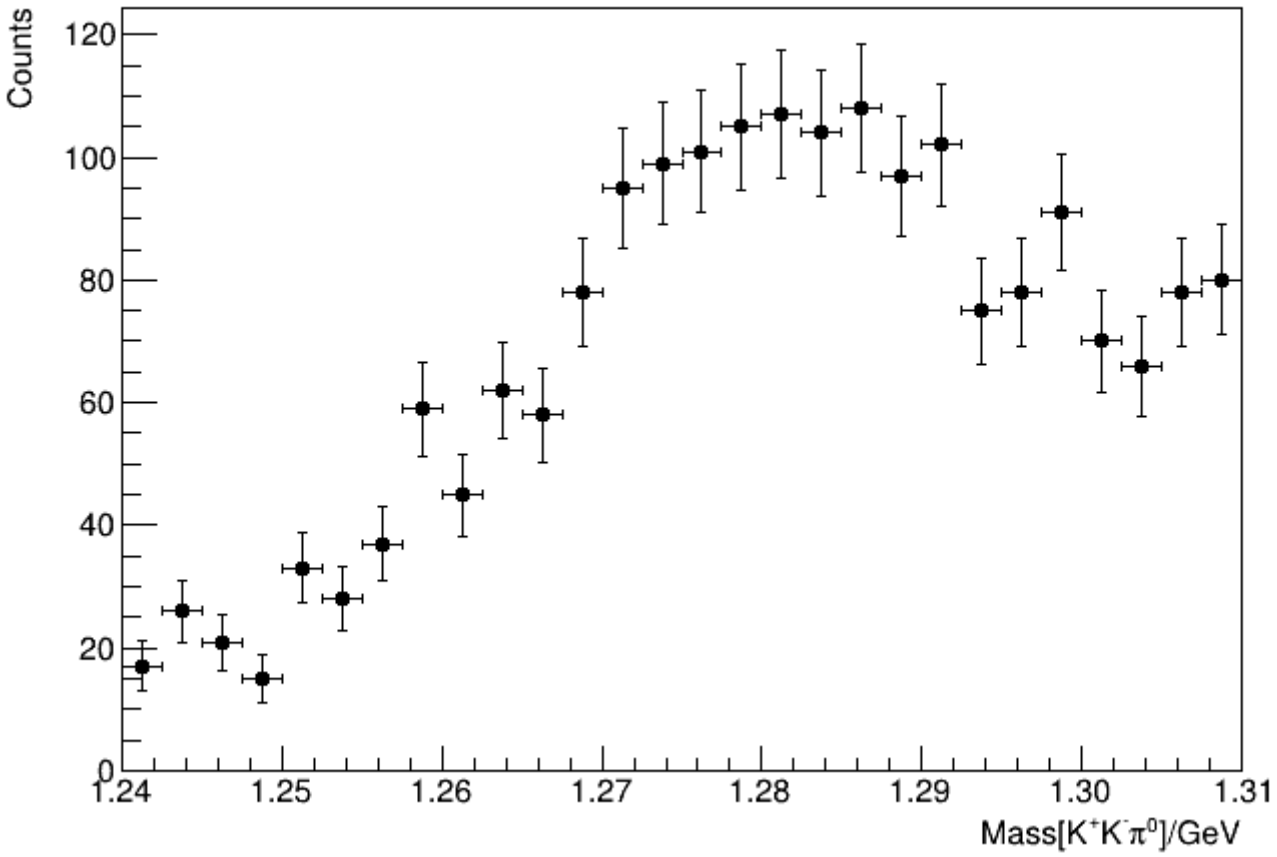
  - $f_1(1285)\rightarrow K^+K^-\pi^0$

Coherently added

Fit to $K^+K^-\pi^0$ mass spectrum



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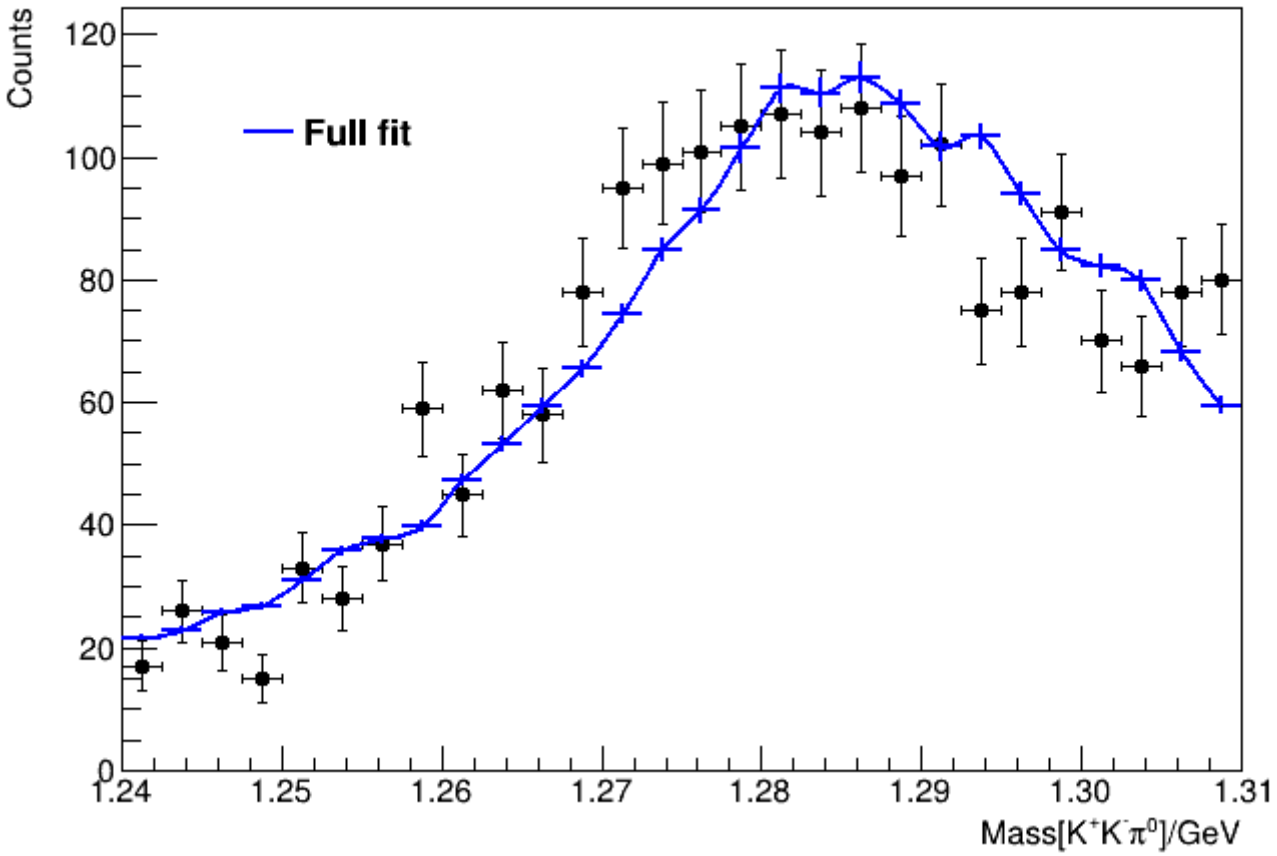

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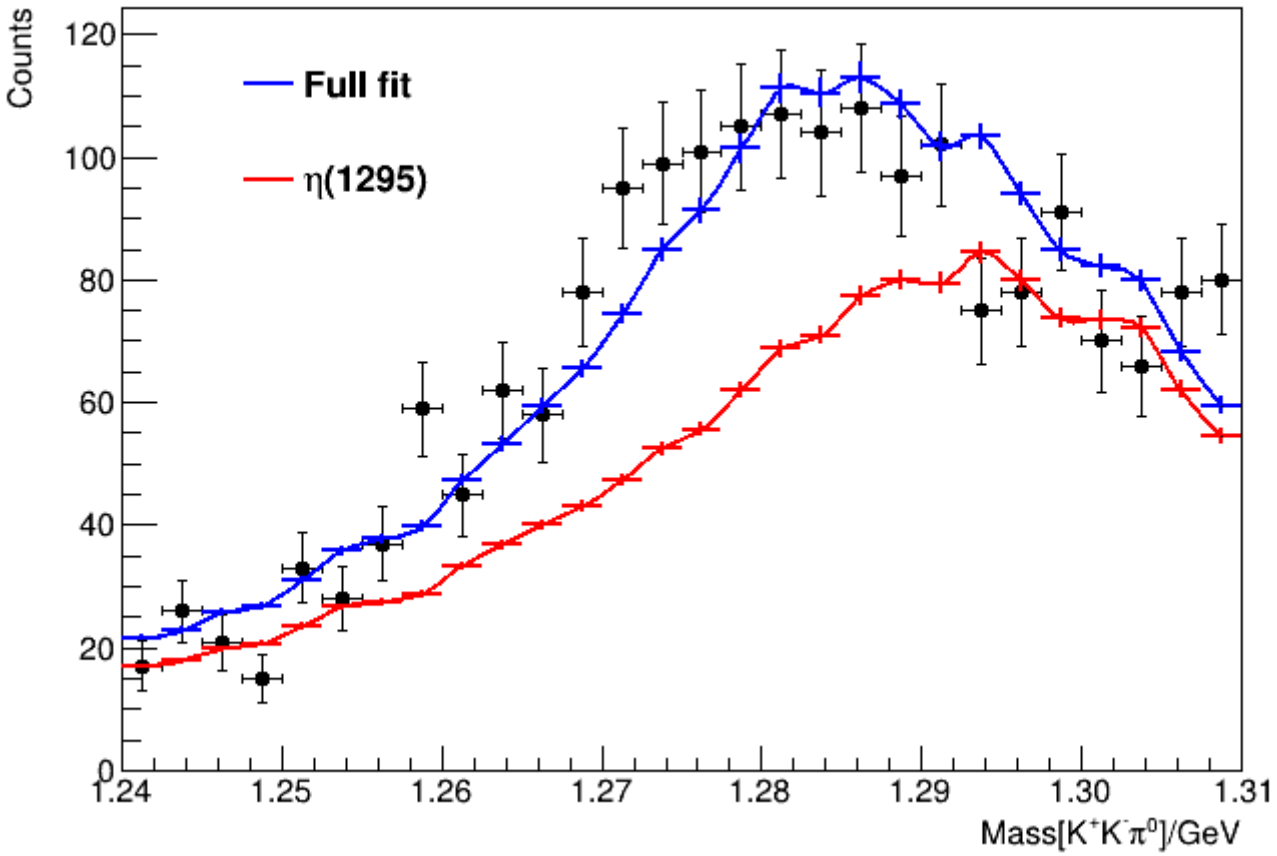

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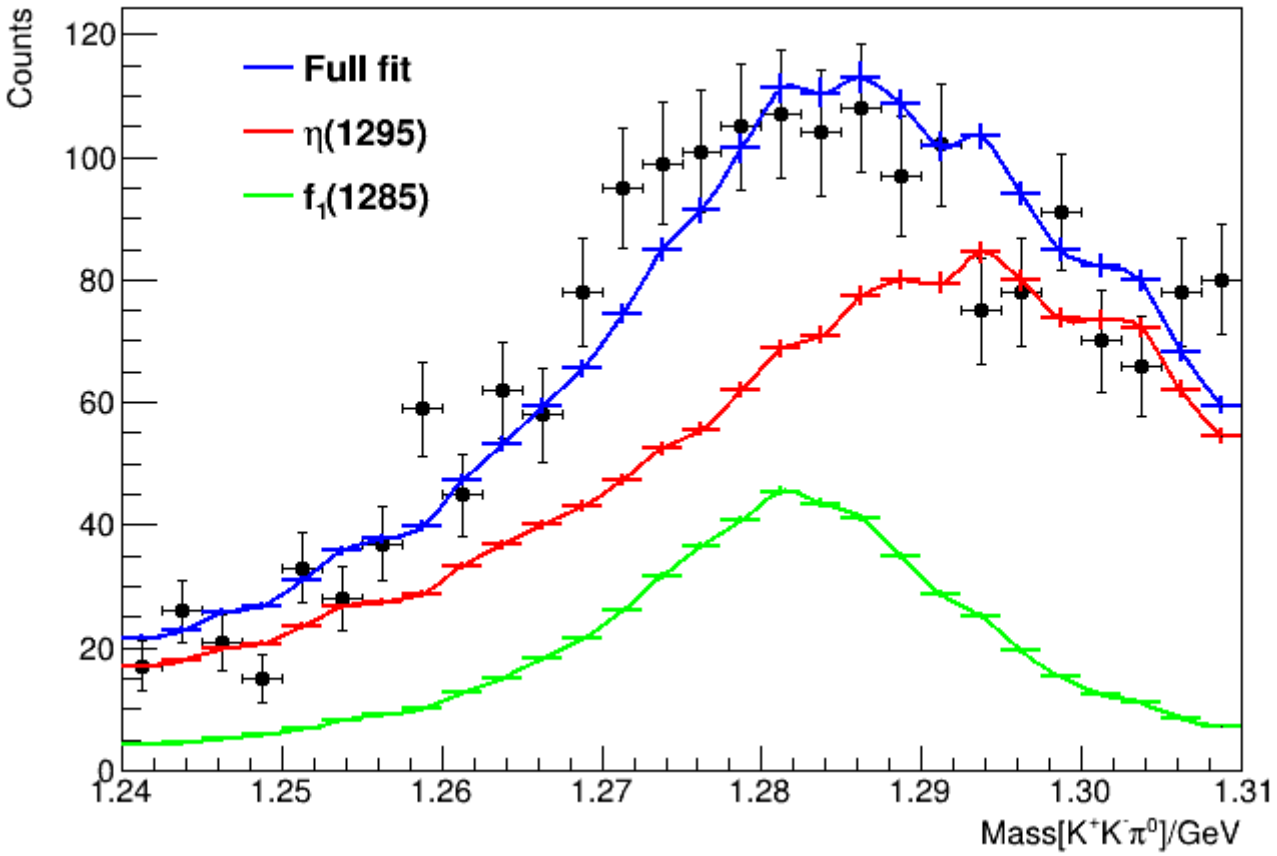
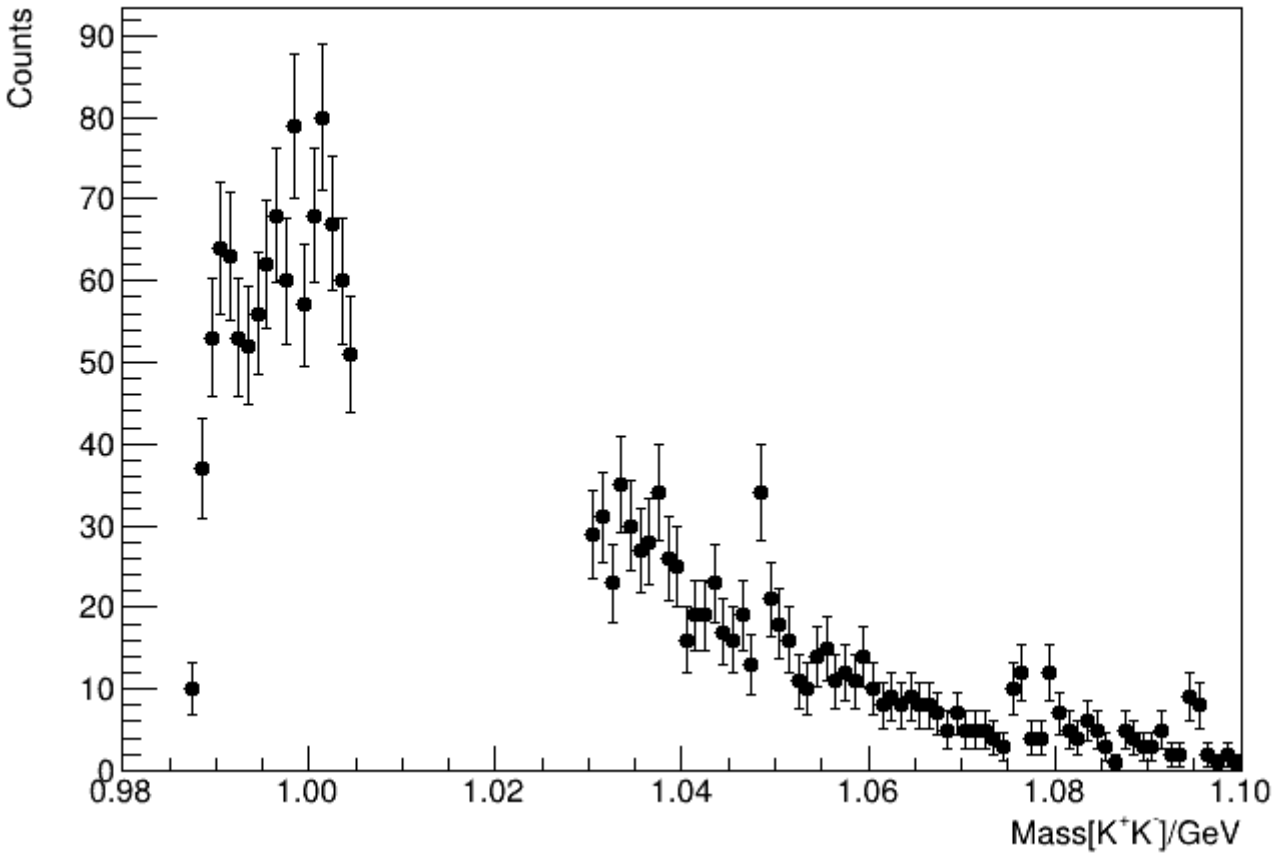
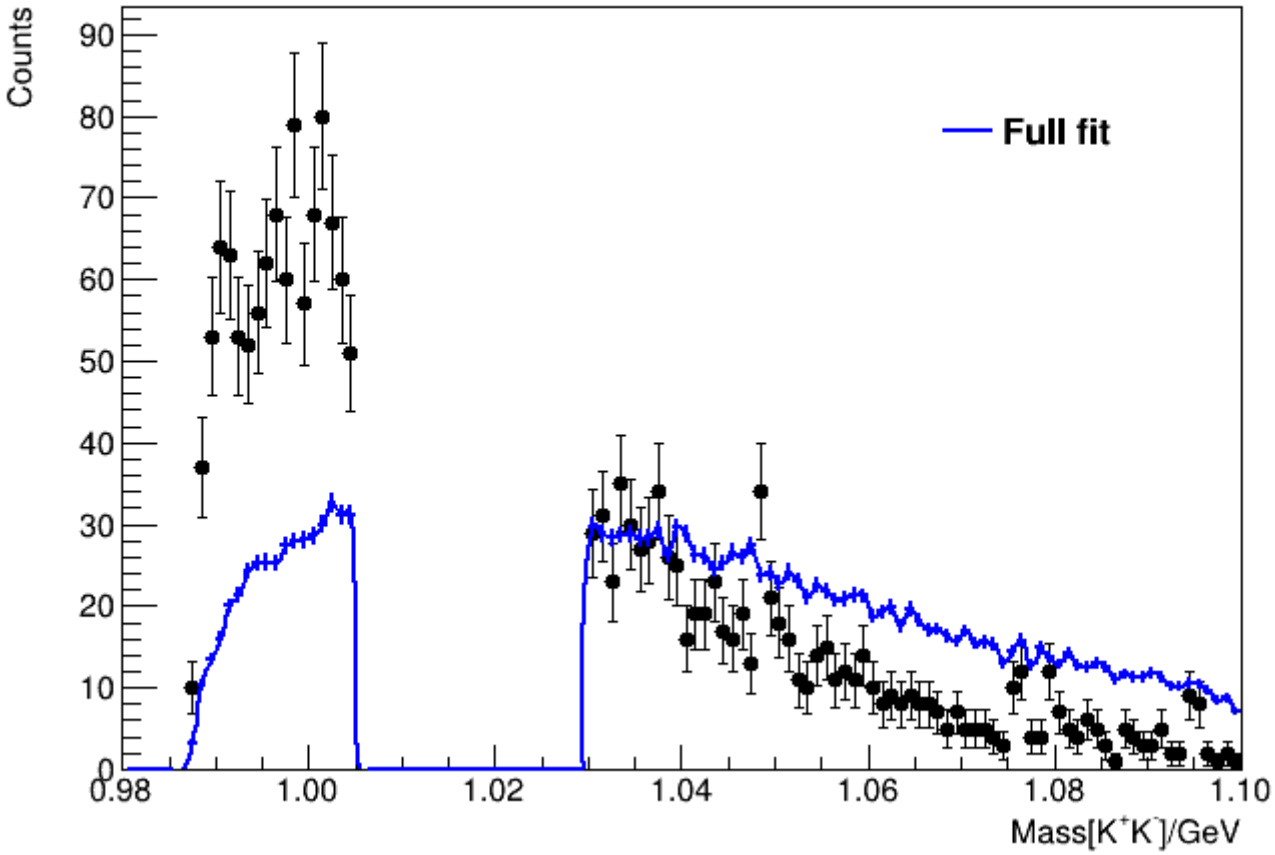


Fit to K^+K^- mass spectrum



Fit to K^+K^- mass spectrum



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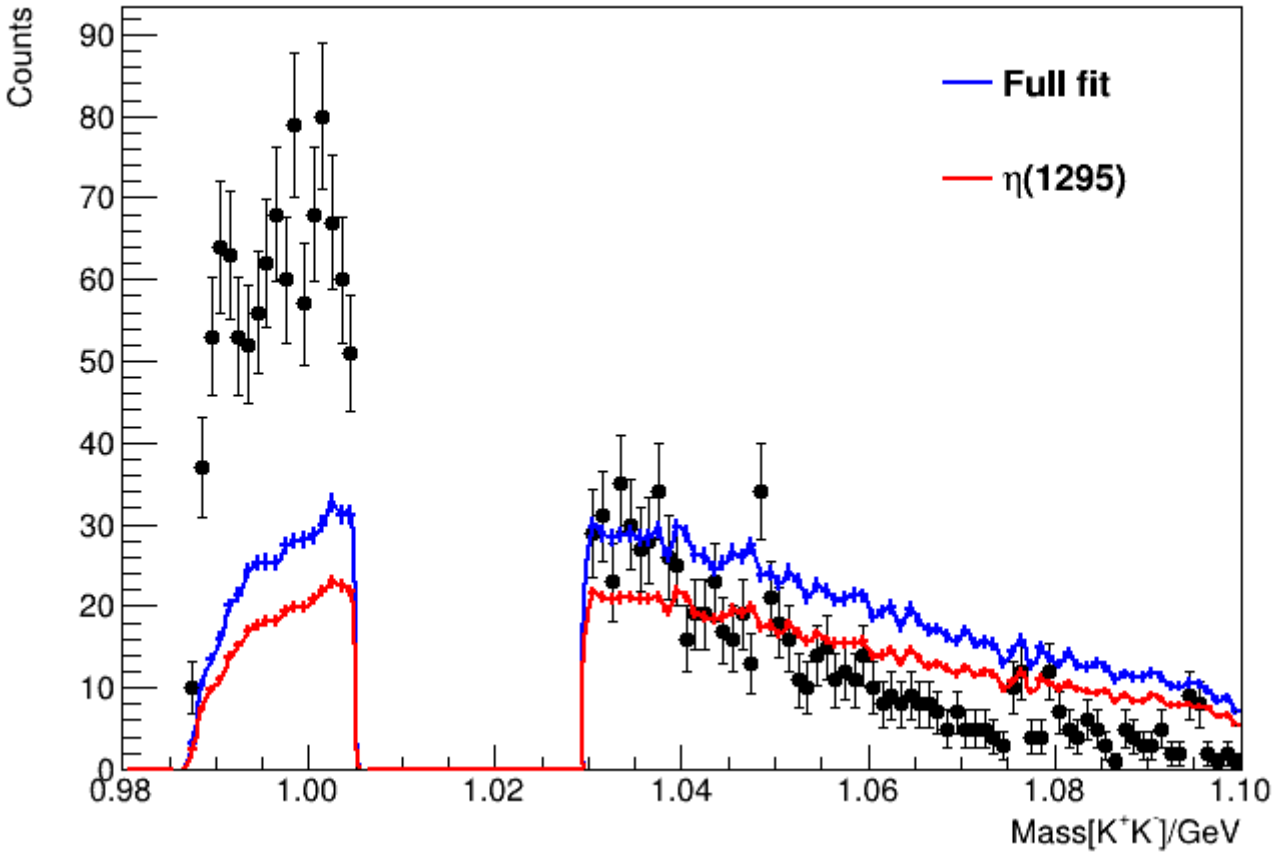
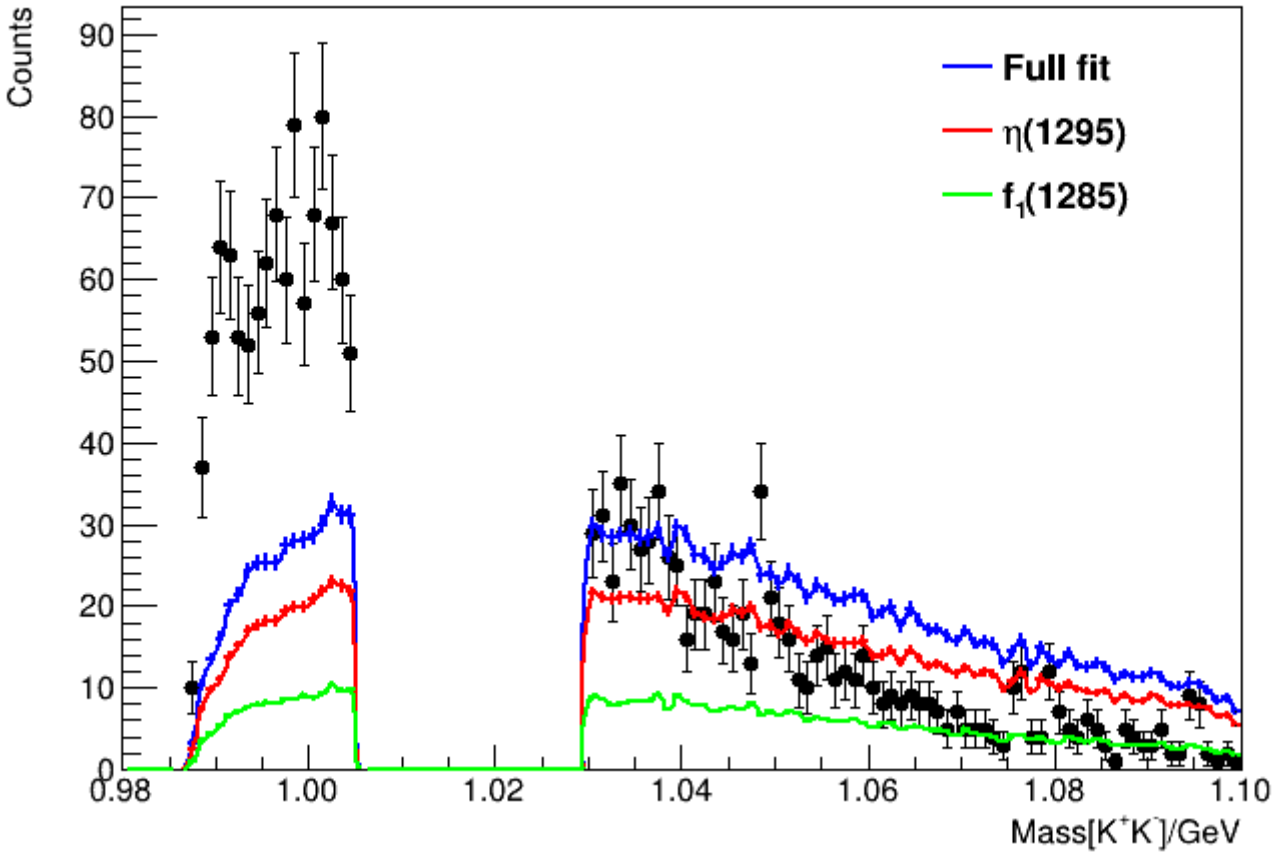


Fit to K^+K^- mass spectrum



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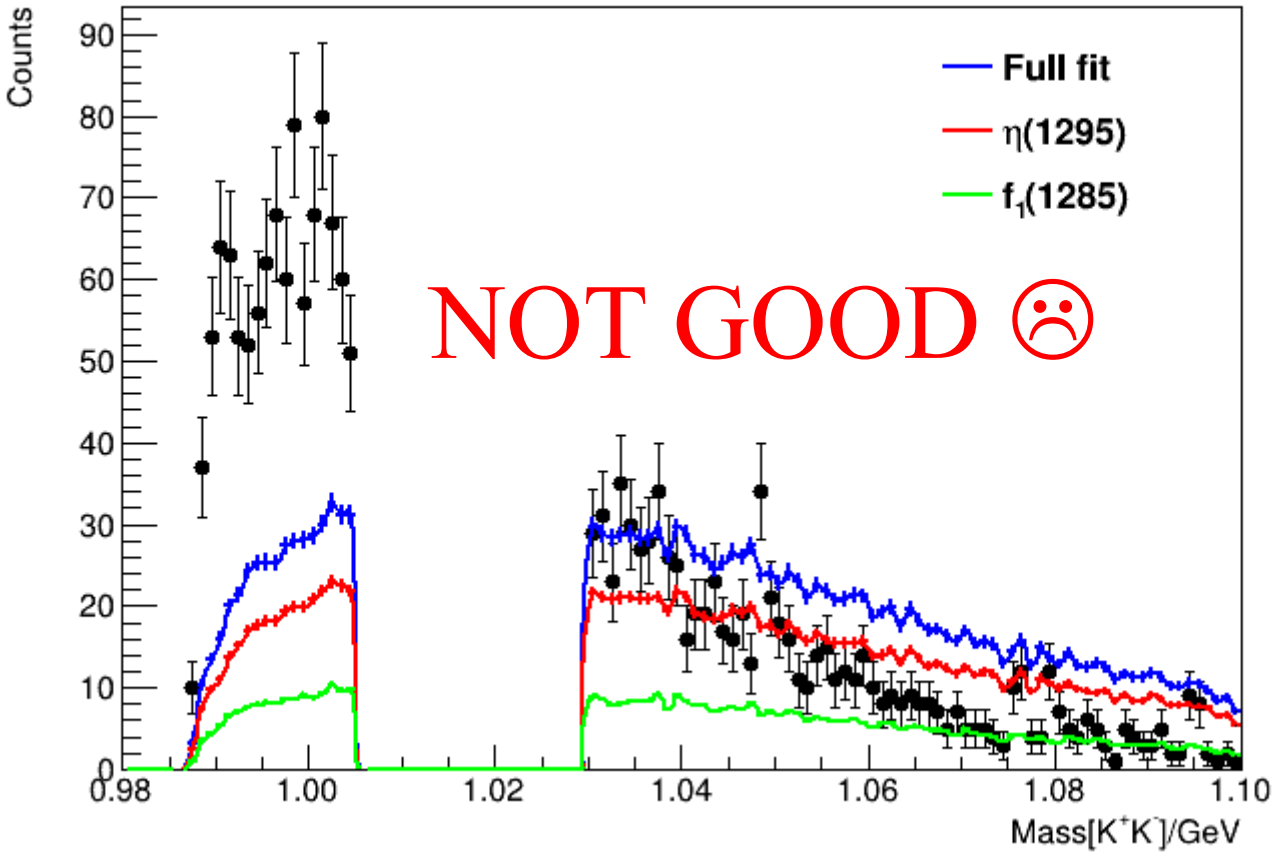
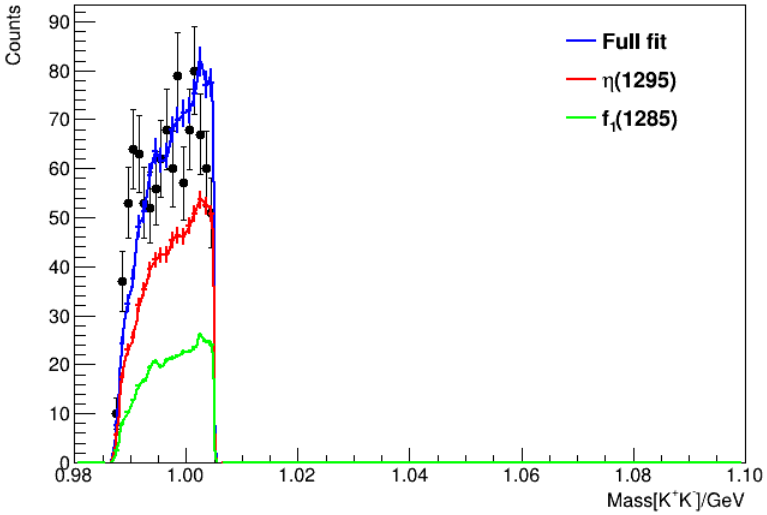
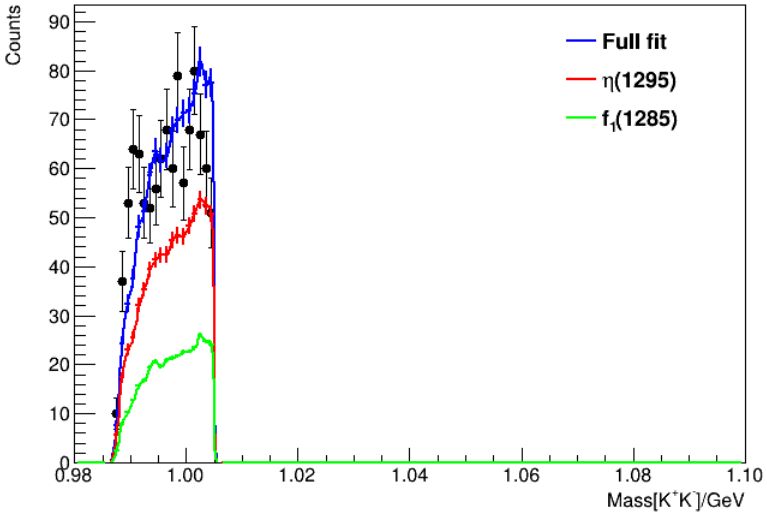


Fit to limited K^+K^- mass spectrum

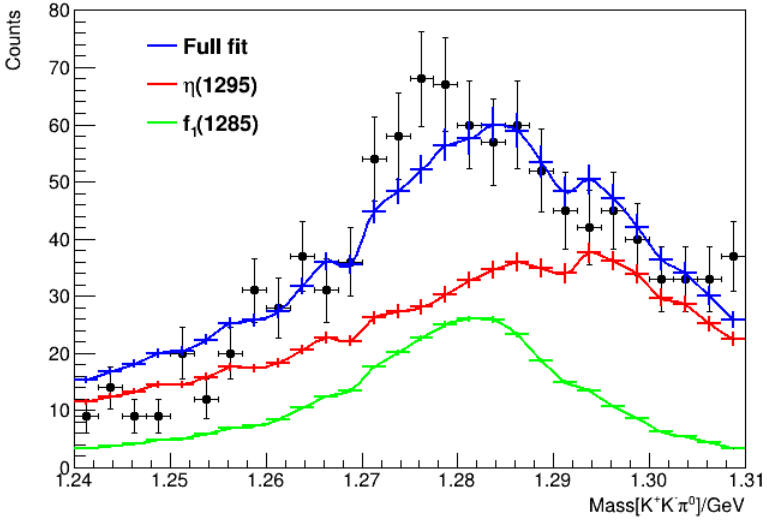


Left side

Fit to limited K^+K^- mass spectrum



Left side



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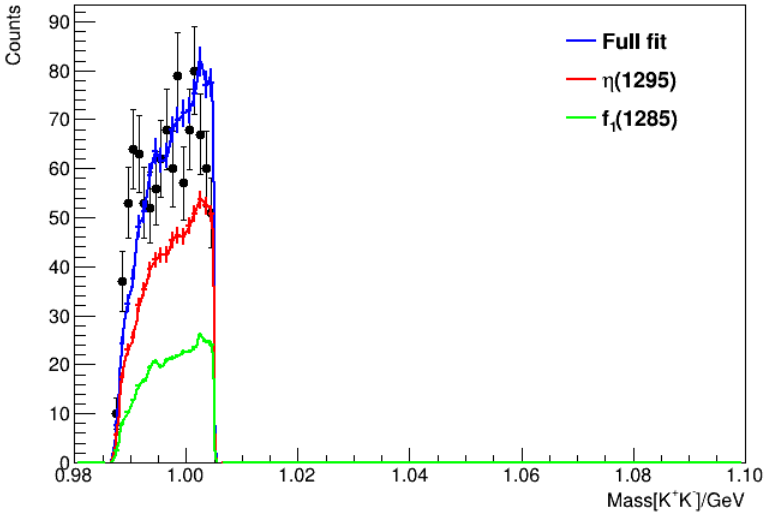

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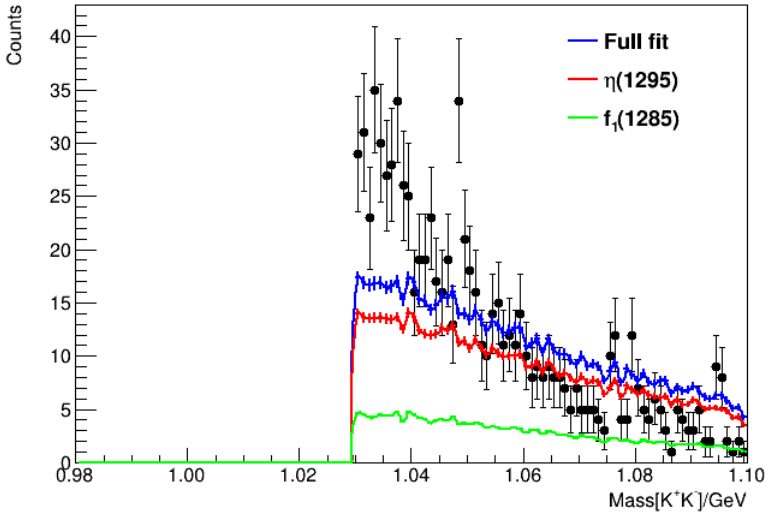
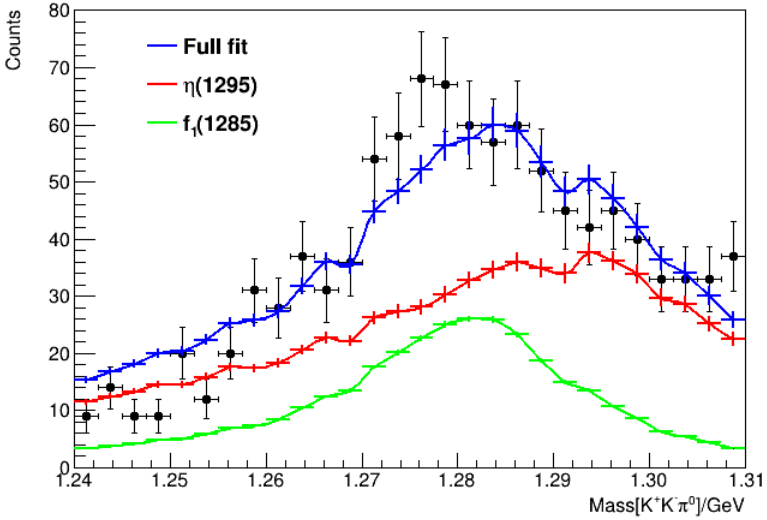
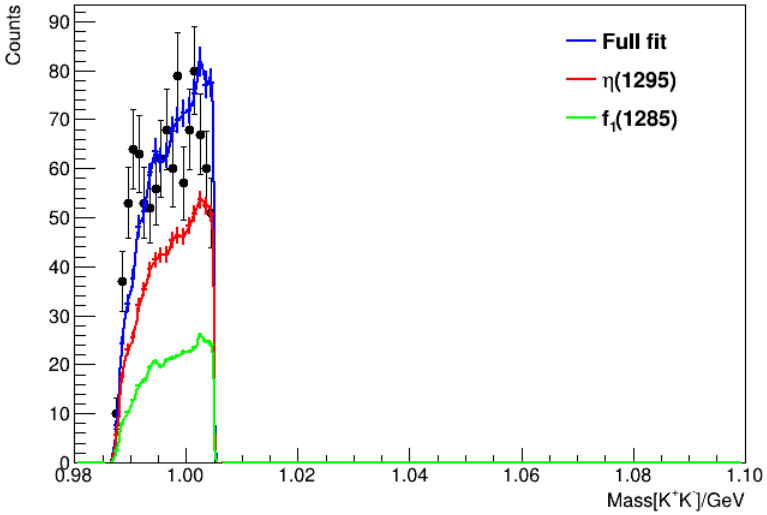


Right side



Fit to limited K^+K^- mass spectrum



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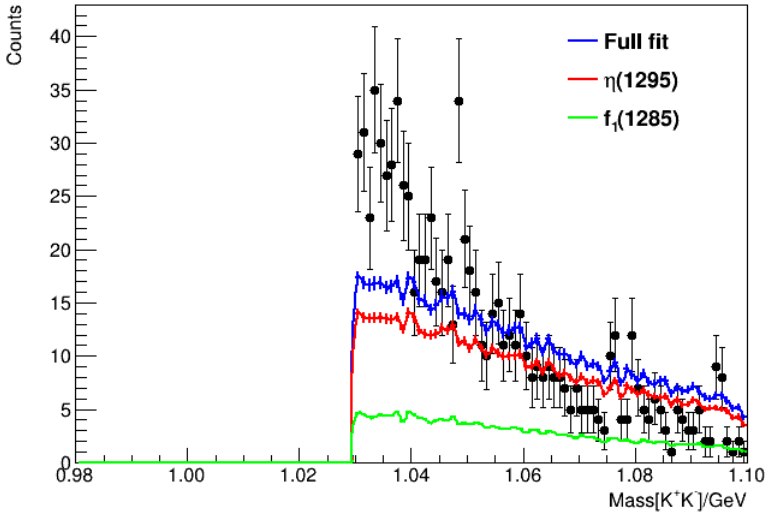
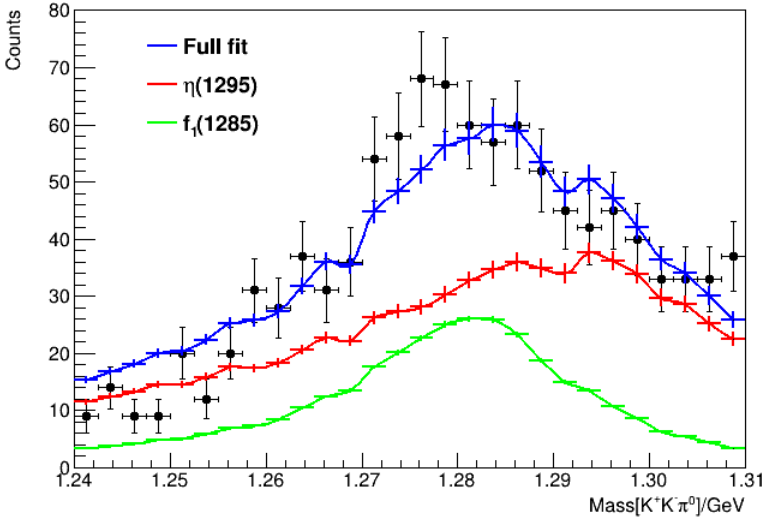
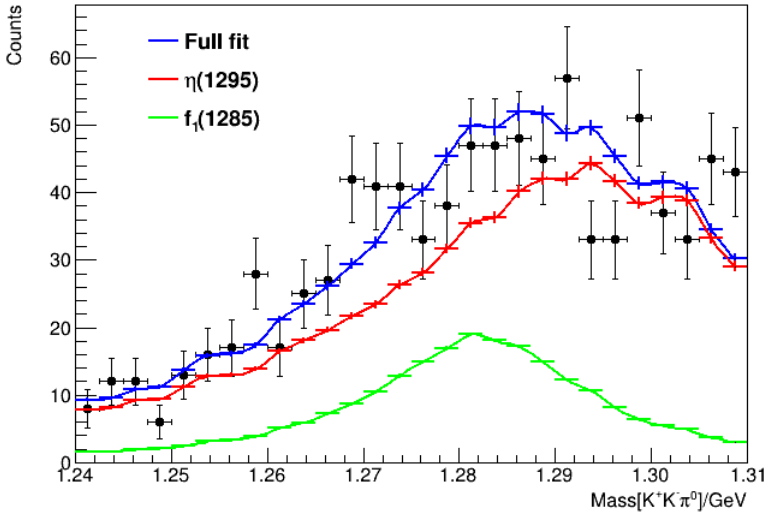


Right side





Modification for $a_0(980)$ decay

- Included Breit-Wigner factor for $a_0(980)$ contributions: $\frac{m_0\Gamma}{{m_0}^2 - m^2 - i m_0\Gamma}$, where
  - $m_0 = 980$ MeV
  - $\Gamma = 50$ MeV

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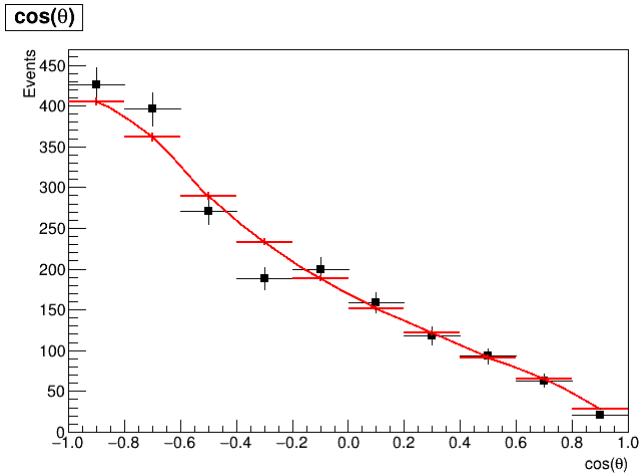

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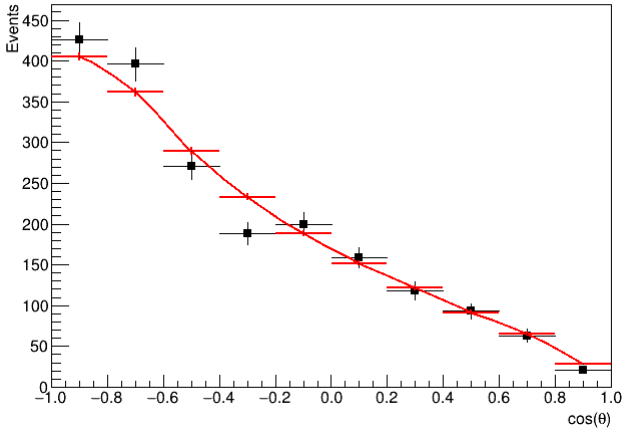
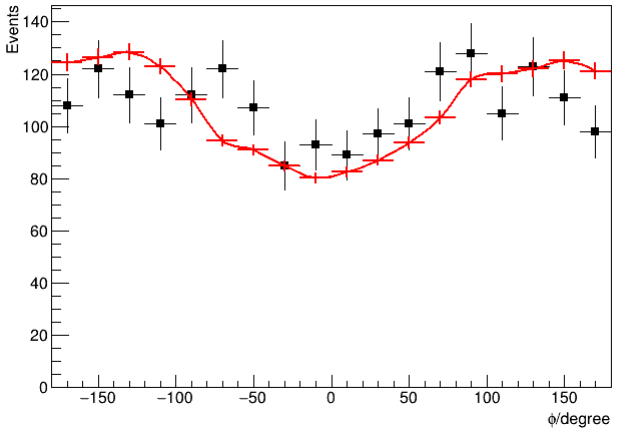
cos(θ)



ϕ



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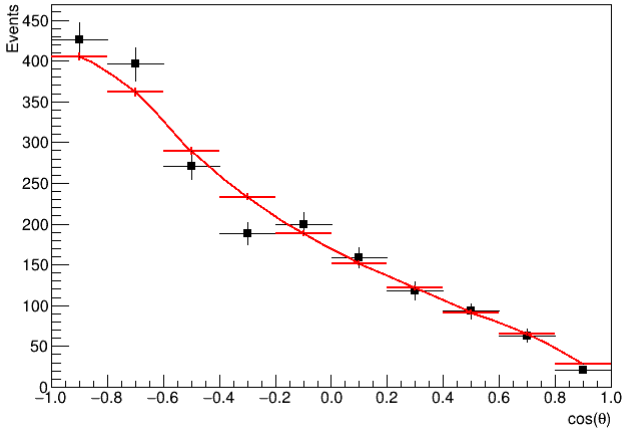
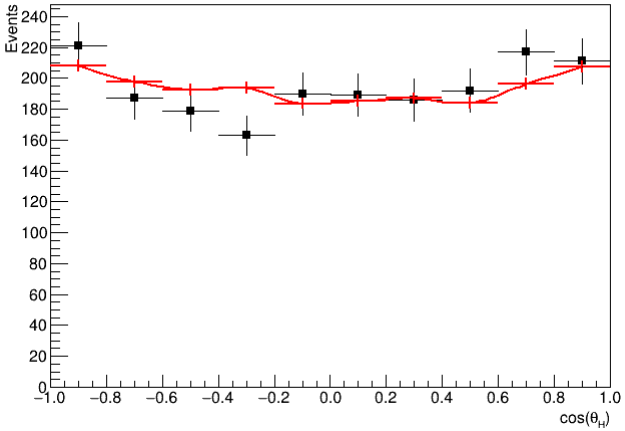
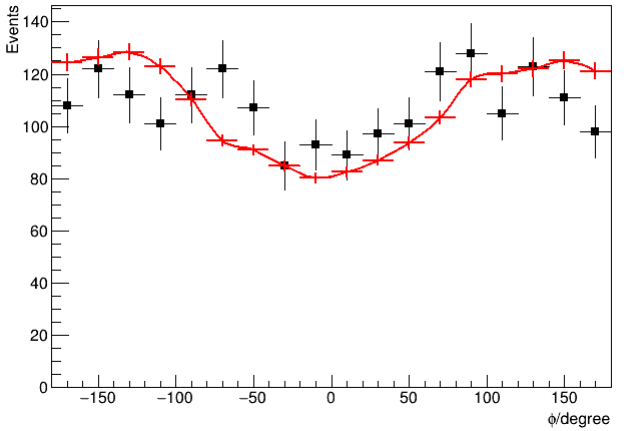


cos(θ_H)



ϕ



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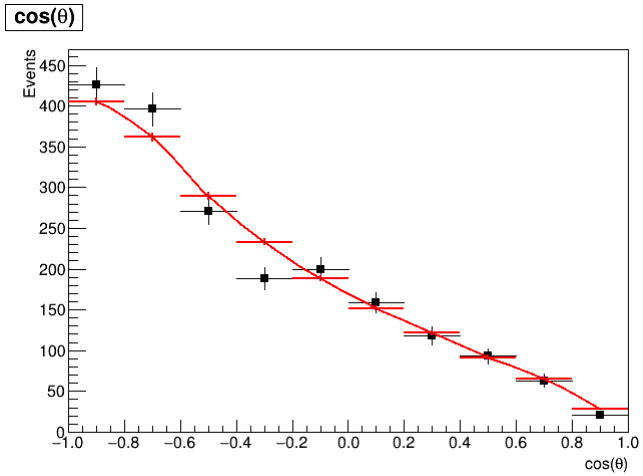

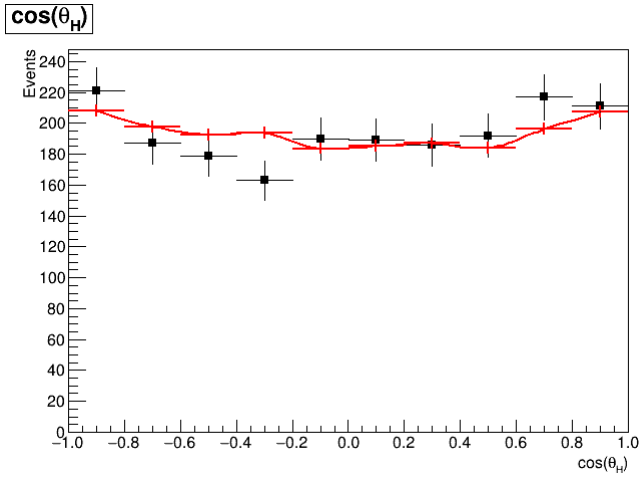

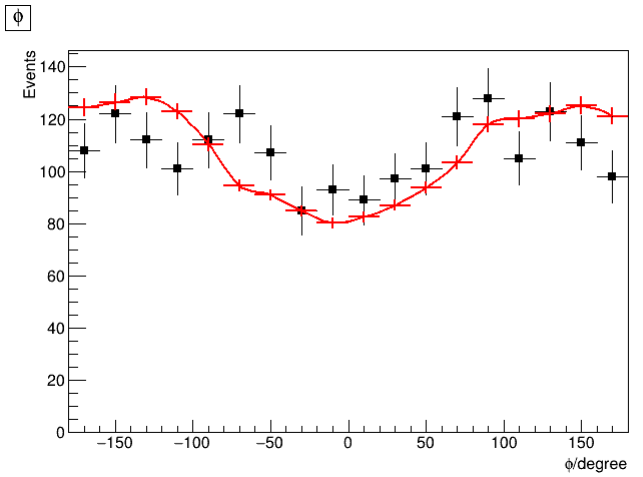

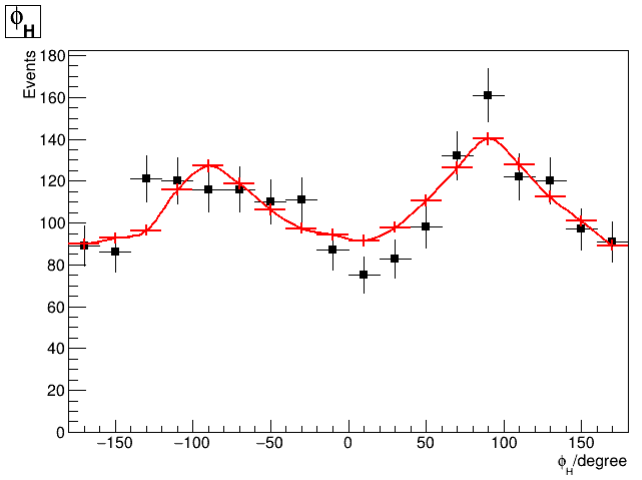

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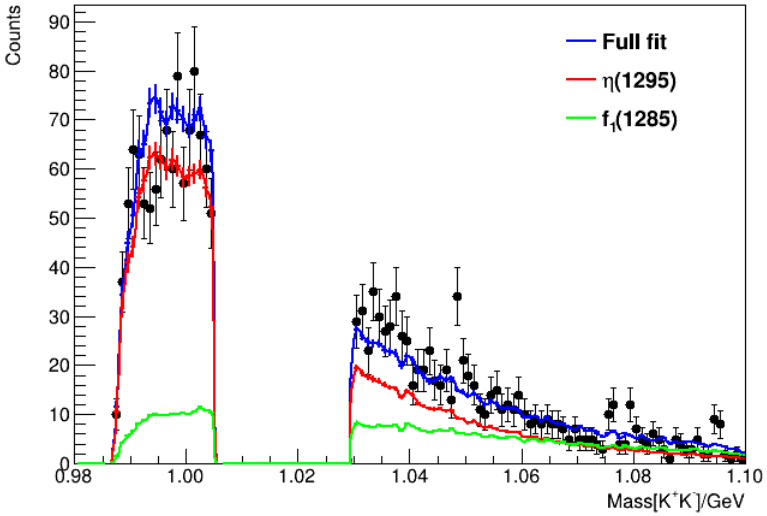

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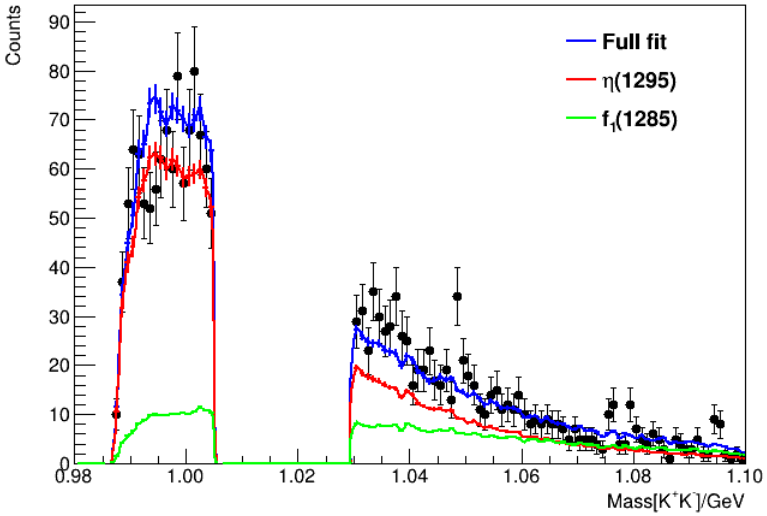

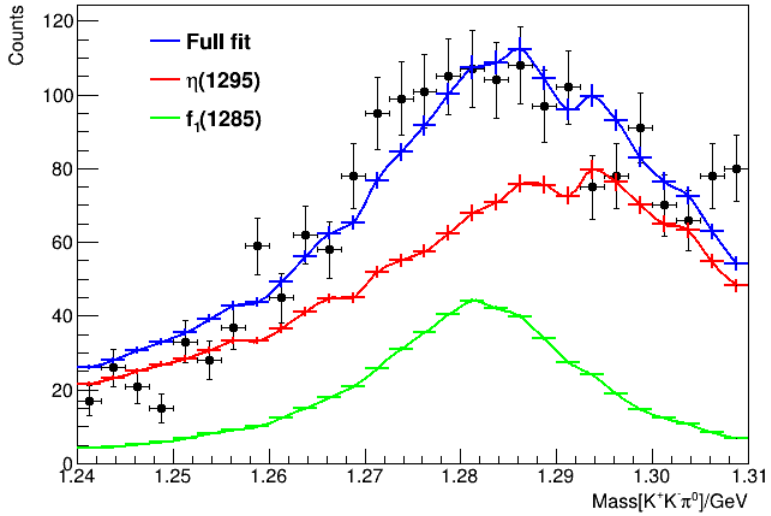

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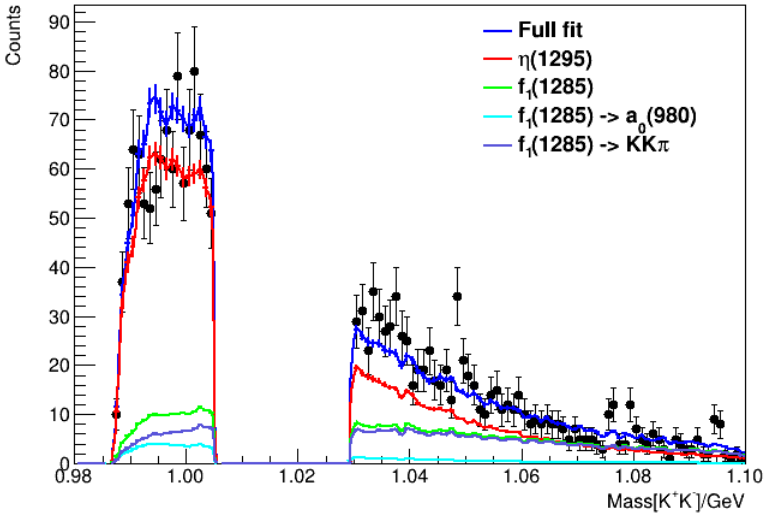

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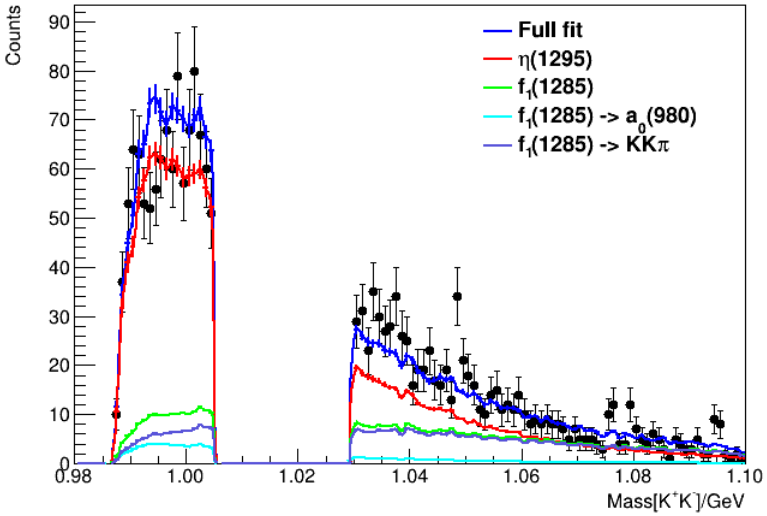

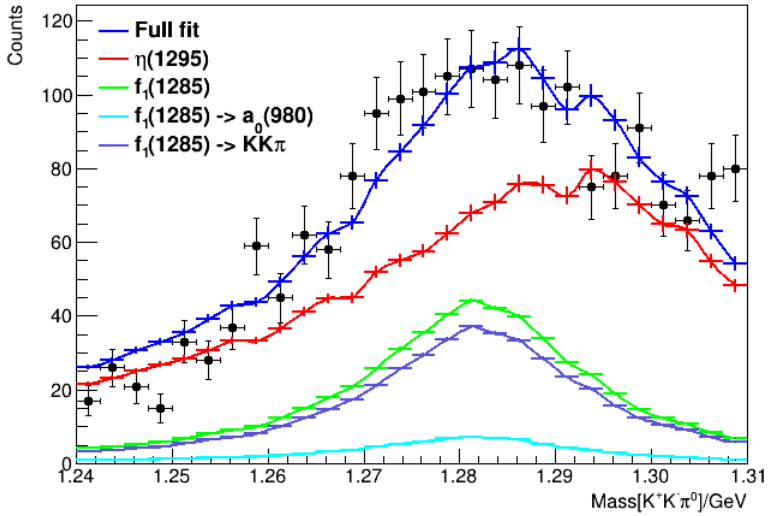

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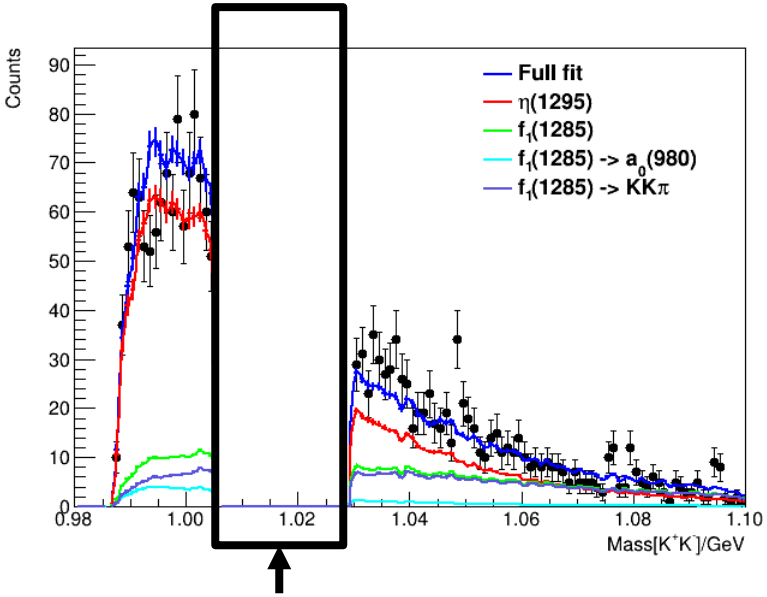
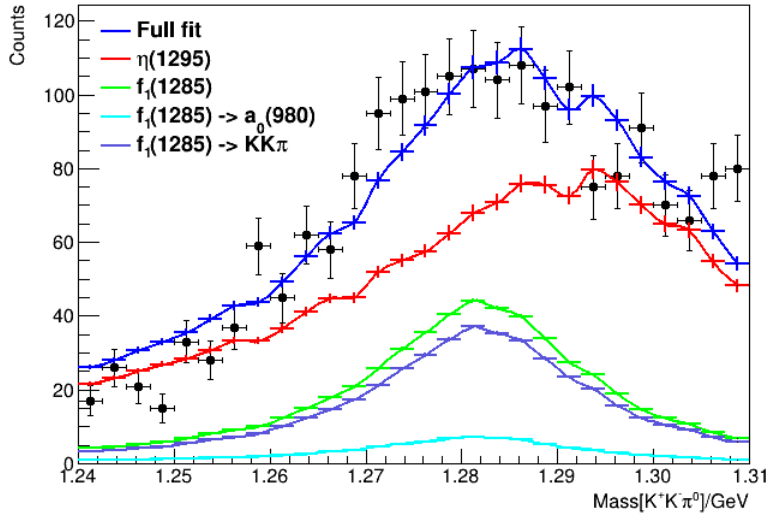


NOTE: Neglecting the gap



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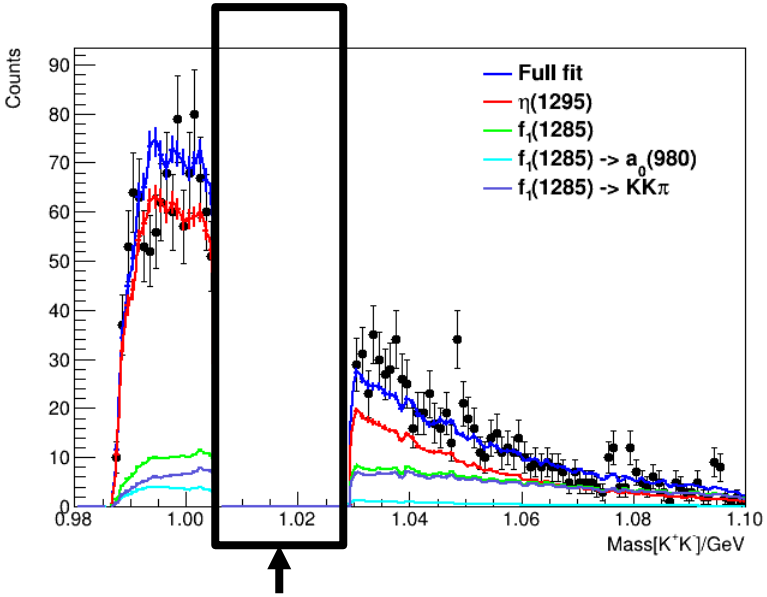

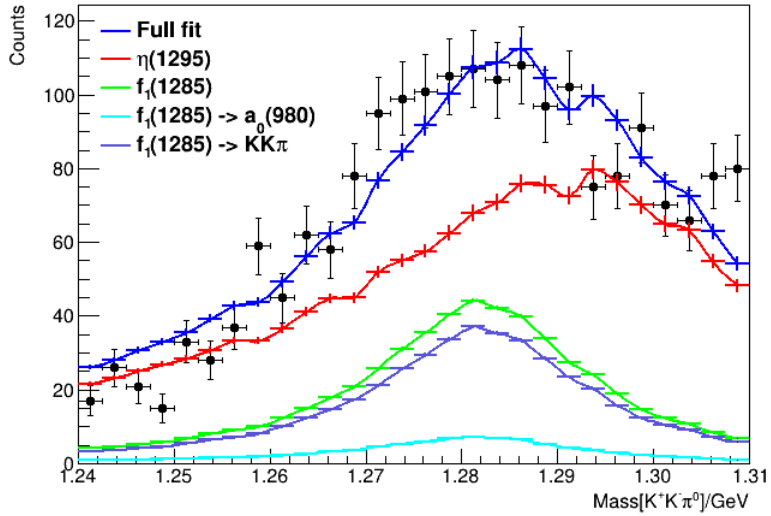

NOTE: Neglecting the gap (for now)

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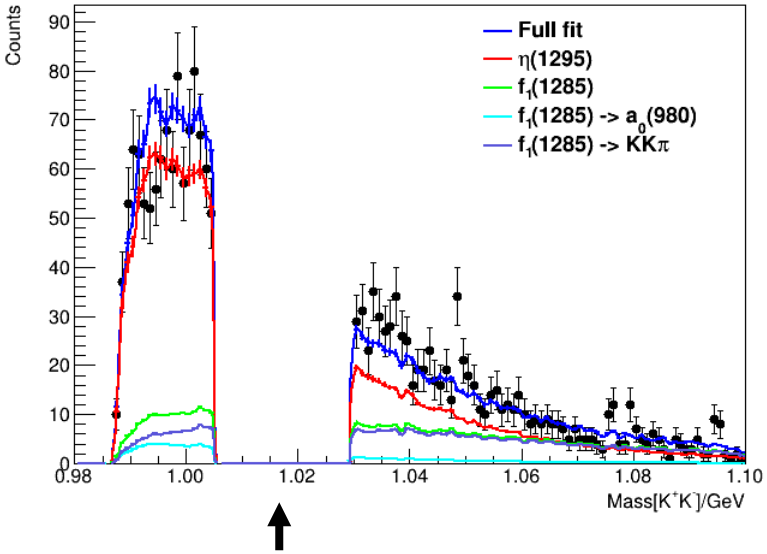

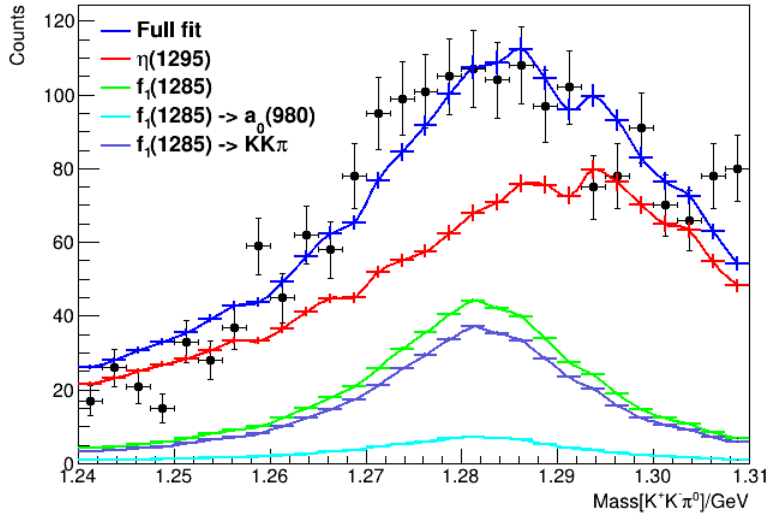

NOTE: Neglecting the gap (for now)

$f_1(1285)$: Branching ratio of decay $a_0(980)\pi$ to $KK\pi$ = 0.32(6)

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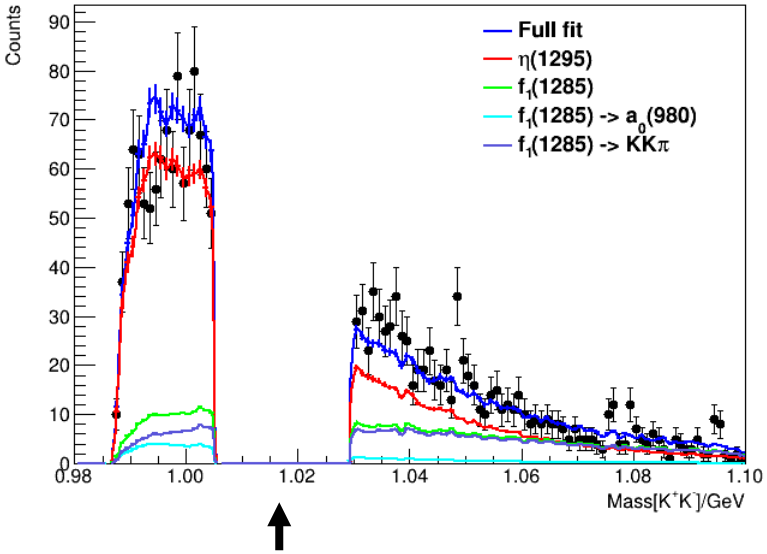

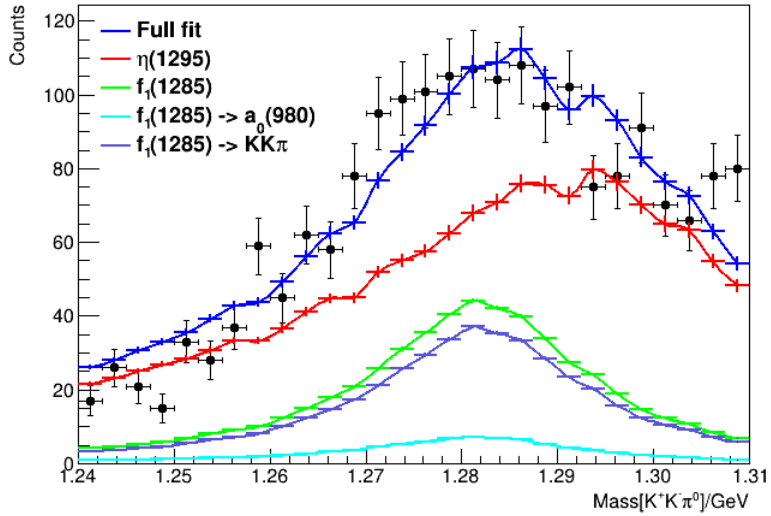

NOTE: Neglecting the gap (for now)

$f_1(1285)$: Branching ratio of decay $a_0(980)\pi$ to $KK\pi$ = 0.32(6) +/- **?**

$f_1(1285) \rightarrow KK\pi$ or $a^0(980)\ \pi$

$f_1(1285)$ $I^G(J^{PC}) = 0^+(1^{++})$

Mass $m = 1281.9 \pm 0.5$ MeV (S = 1.8)
Full width $\Gamma = 22.7 \pm 1.1$ MeV (S = 1.5)

$f_1(1285)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
4π	(32.7± 1.9) %	S=1.2	568
$\pi^0\pi^0\pi^+\pi^-$	(21.8± 1.3) %	S=1.2	566
$2\pi^+2\pi^-$	(10.9± 0.6) %	S=1.2	563
$\rho^0\pi^+\pi^-$	(10.9± 0.6) %	S=1.2	336
$\rho^0\rho^0$	seen		†
$4\pi^0$	$< 7 \times 10^{-4}$	CL=90%	568
$\eta\pi^+\pi^-$	(35 ±15) %		479
$\eta\pi\pi$	(52.2± 2.0) %	S=1.2	482
$a_0(980)\pi$ [ignoring $a_0(980) \rightarrow K\overline{K}$]	(38 ± 4) %		238
$\eta\pi\pi$ [excluding $a_0(980)\pi$]	(14 ± 4) %		482
$K\overline{K}\pi$	(9.0± 0.4) %	S=1.1	308
$K\overline{K}^*(892)$	not seen		†
$\pi^+\pi^-\pi^0$	$(3.0\pm 0.9) \times 10^{-3}$		603
$\rho^\pm\pi^\mp$	$< 3.1 \times 10^{-3}$	CL=95%	390
$\gamma\rho^0$	(6.1± 1.0) %	S=1.7	406
$\phi\gamma$	$(7.4\pm 2.6) \times 10^{-4}$		236
e^+e^-	$< 9.4 \times 10^{-9}$	CL=90%	641

Candidates for $R \rightarrow KK\pi$ or $a^0(980)\,\pi$

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The $KK\pi$ branching ratio of 9.0% might need to be modified to include a breakdown of portion being attributable to $a_0(980)\pi \rightarrow KK\pi$

Title