SIDIS Background and Trigger

Zhiwen Zhao

2013/11/18 Created

2014/07/06 Updated

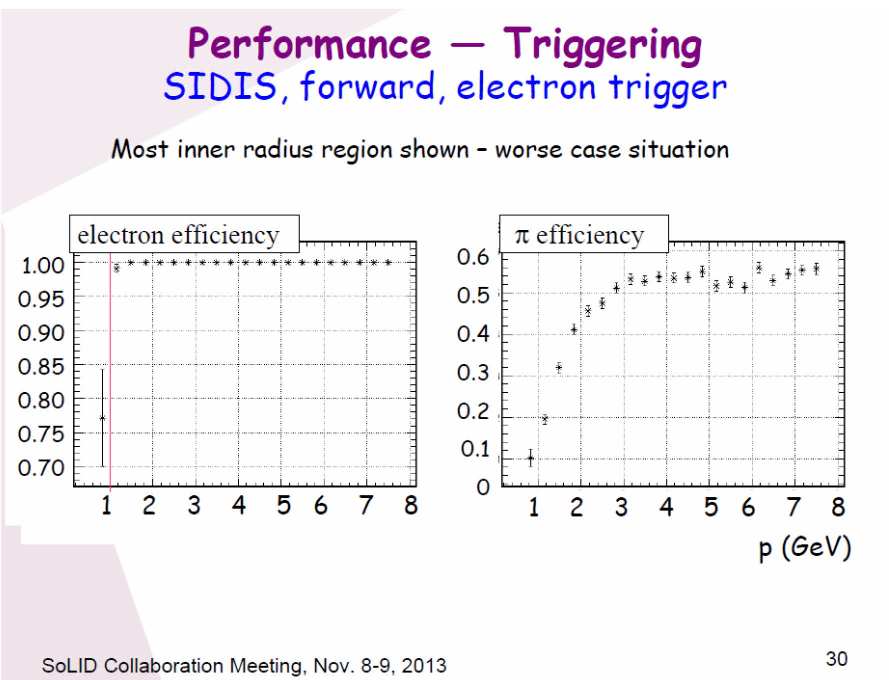
Intro

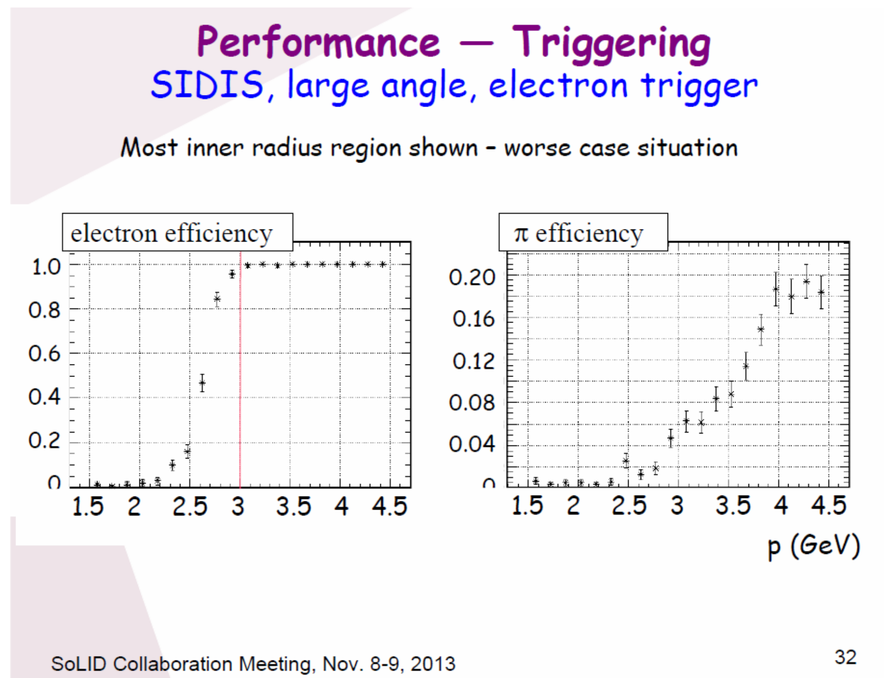
- "Zhiwen" study
  - Use latest SIDIS He3 configuration and GEMC and CLEO magnet
- "Xin" study
  - Xin's latest study in 2012/06 with Comgeant and Babar magnet
  - Detector configuration is very similar to "Zhiwen"
  - https://hallaweb.jlab.org/dvcslog/SoLID/25

SIDIS EC electron trigger (flat)

Electron trigger Assumption

- trig_eff (P>Max)=trig_eff(P=Max)
- trig_eff (P<Min)=0
- trig_eff_Proton = 0.5*trig_eff_pion



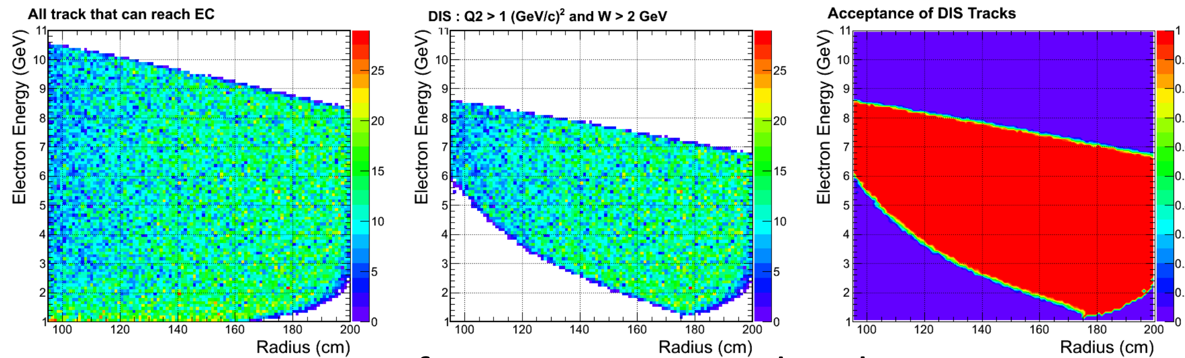


SIDIS FAEC electron trigger (radial below Q2=1)

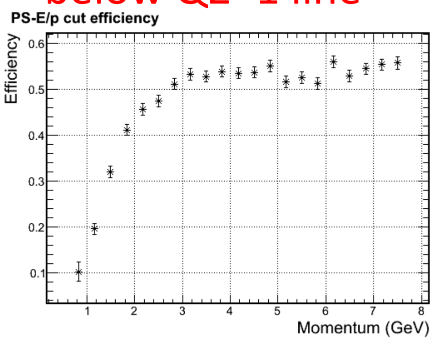
Electron trigger Assumption
- trig_eff (P>Max)=trig_eff(P=Max)
- trig_eff (P<Min)=0
- trig_eff_Proton = 0.5*trig_eff_pion

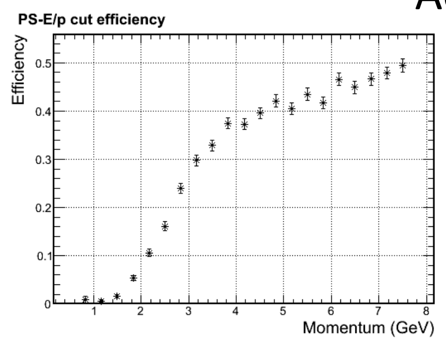
Radius(cm)	P Threshold (GeV)
90 - 110	4.0
110 - 125	3.0
125 - 145	2.0
145 - 230	1.0

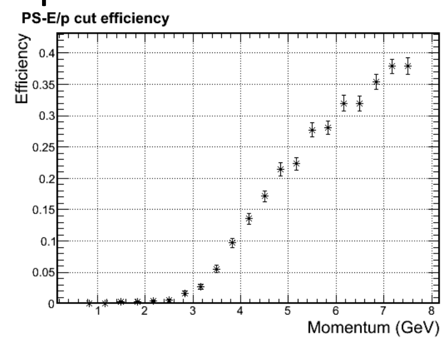
4 points cut, about 0.5GeV below Q2=1 line

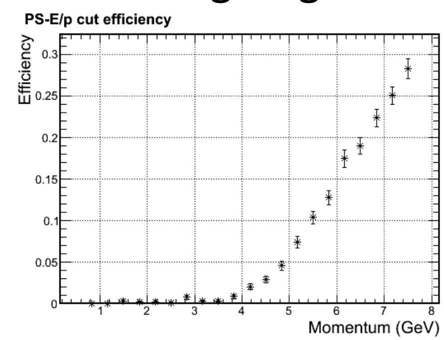


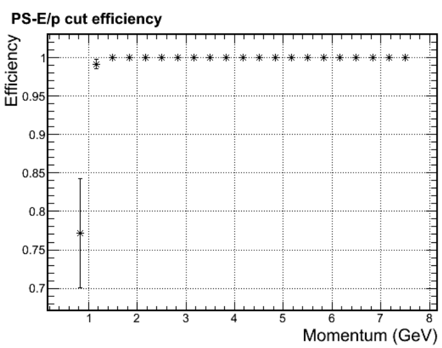
Acceptance for SoLID CLEO and 40 long target

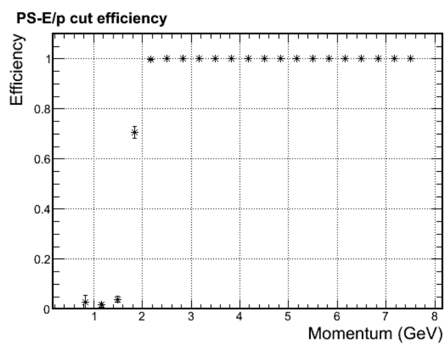


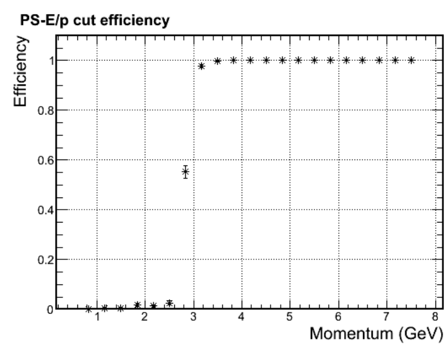


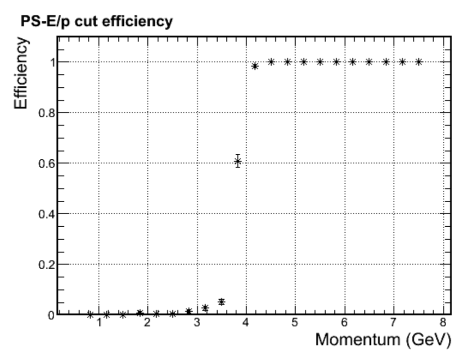










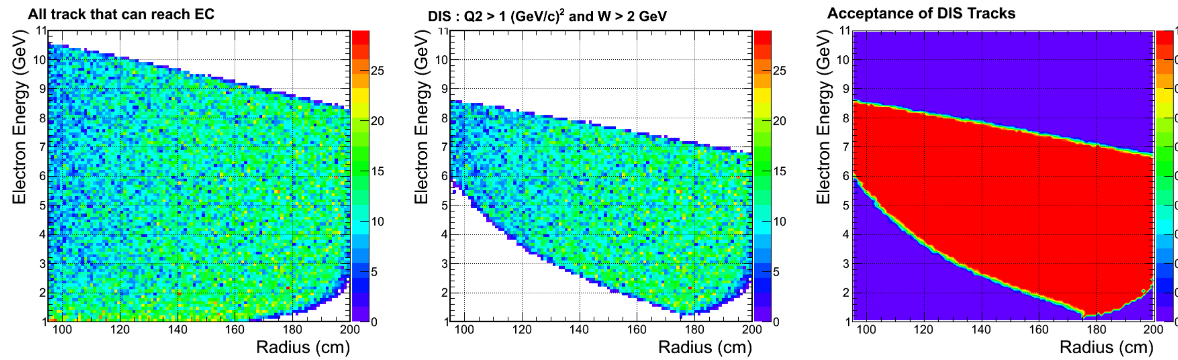


SIDIS FAEC electron trigger (radial on Q2=1)

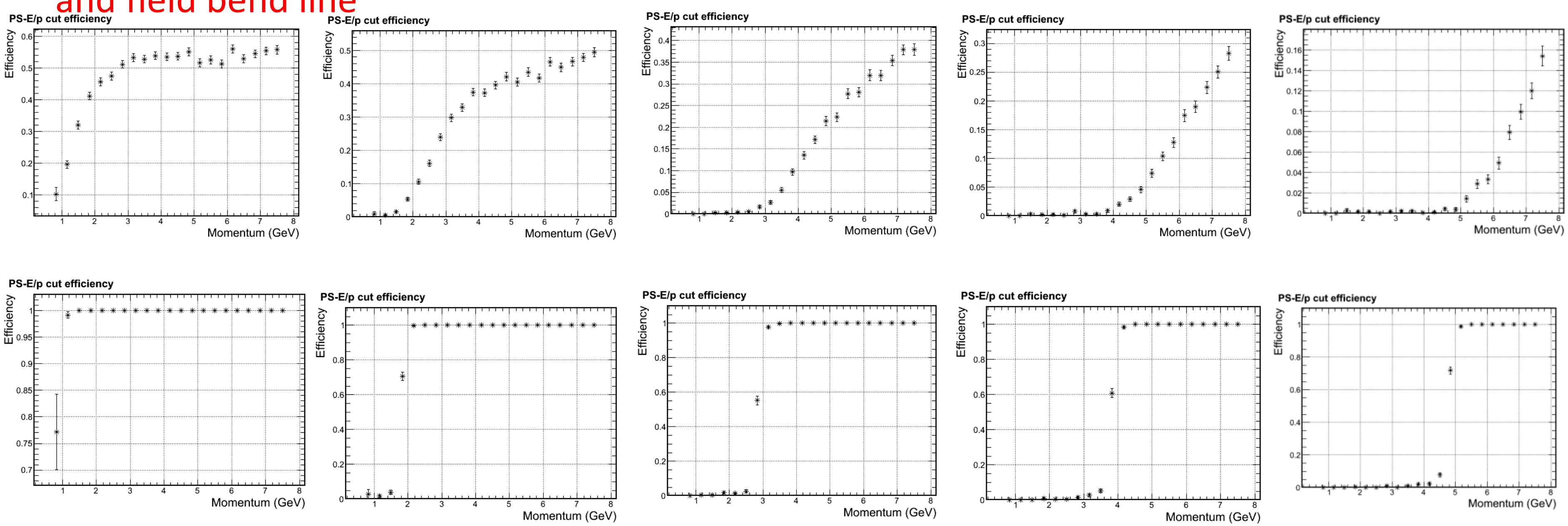
Radius(cm)	P Threshold (GeV)
90 - 105	5.0
105 - 115	4.0
115 - 130	3.0
130 - 150	2.0
150 - 200	1.0
200 - 230	2.0

6 point cut, right on Q2=1 line and field bend line

Electron trigger Assumption
- trig_eff (P>Max)=trig_eff(P=Max)
- trig_eff (P<Min)=0
- trig_eff_Proton = 0.5*trig_eff_pion
- If (trig_eff<0.01) trig_eff = 0

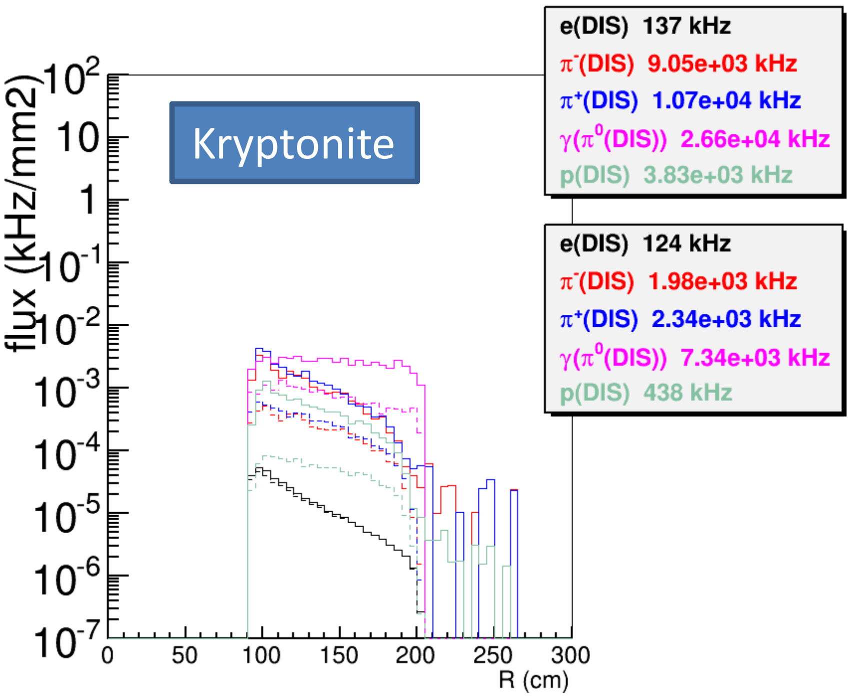


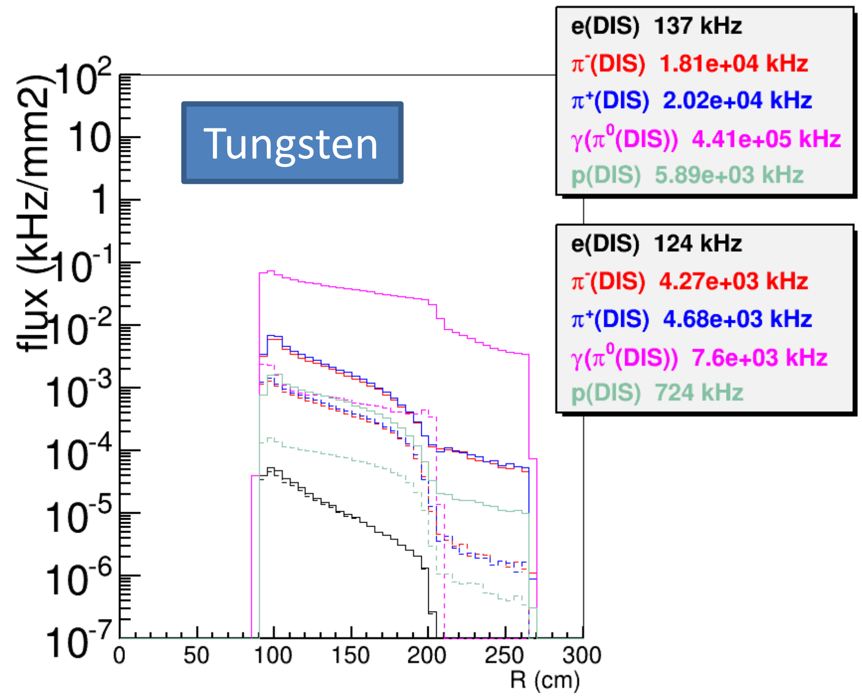
Acceptance for SoLID CLEO and 40 long target



FAEC electron trigger rate (flat)

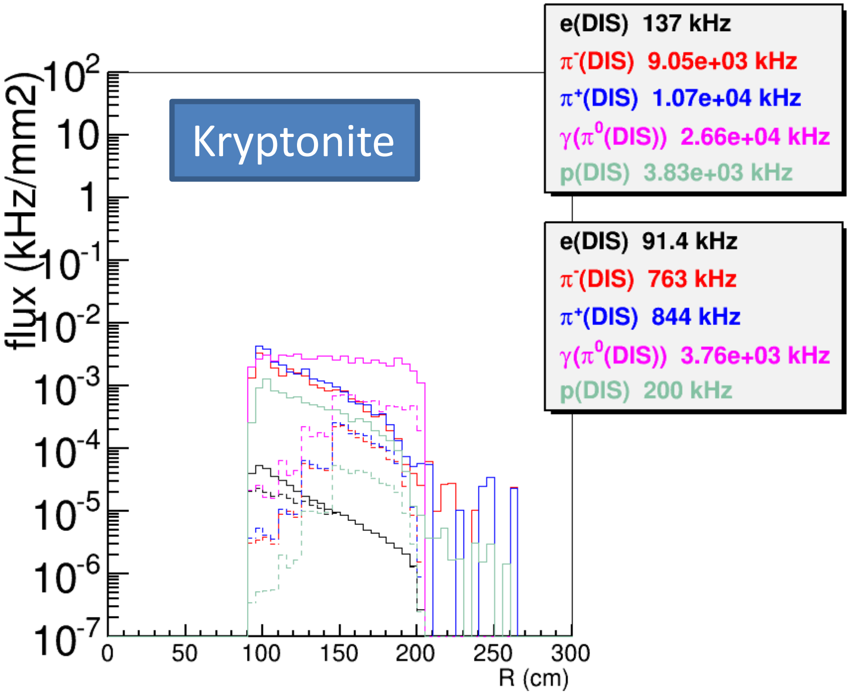
- FAEC geometry: Z_front=415cm, R(90,230)cm
- Shows rate before and after trigger cut
- "Kryptonite": all rate from He3 by eicRate, everything is kryptonite including target collimator, so no secondary
- "Tungsten": all rate from He3 and target window by eicRate, everything is real material including target collimator as Tungsten, so secondary are present. Only "eDIS" is like "Kryptonite" case

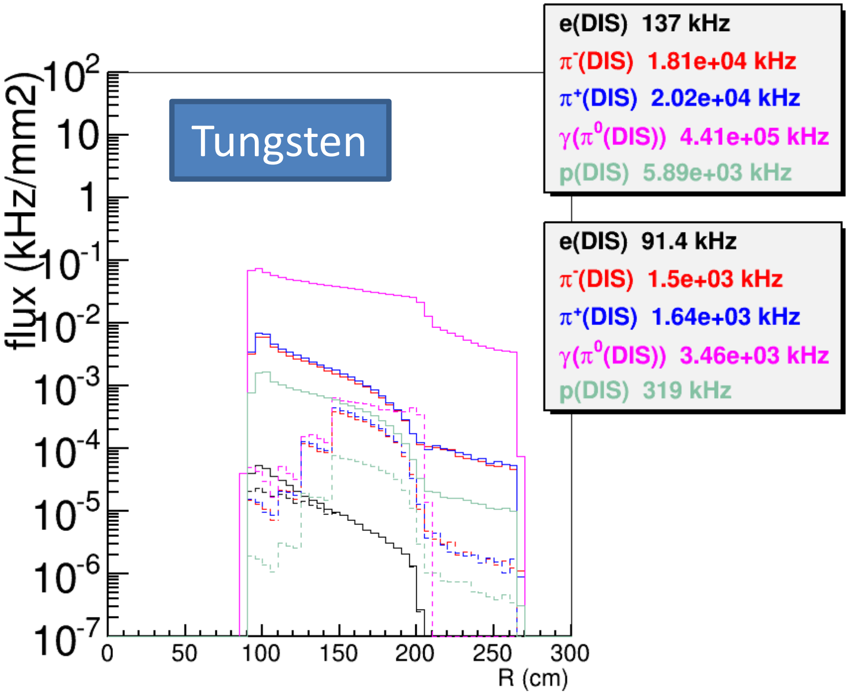




FAEC electron trigger rate (radial below Q2=1)

- FAEC geometry: Z_front=415cm, R(90,230)cm
- Shows rate before and after trigger cut
- “Kryptonite”: all rate from He3 by eicRate, everything is kryptonite including target collimator, so no secondary
- “Tungsten”: all rate from He3 and target window by eicRate, everything is real material including target collimator as Tungsten, so secondary are present. Only “eDIS” is like “Kryptonite” case





FAEC electron trigger rate (radial on Q2=1)

- FAEC geometry: Z_front=415cm, R(90,230)cm
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- "Kryptonite": all rate from He3 by eicRate, everything is kryptonite including target collimator, so no secondary
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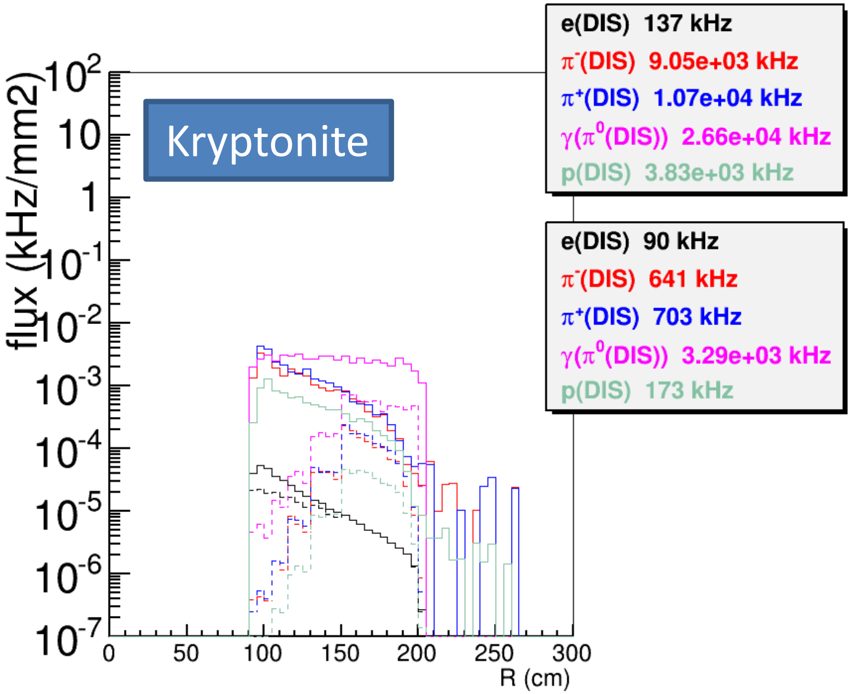
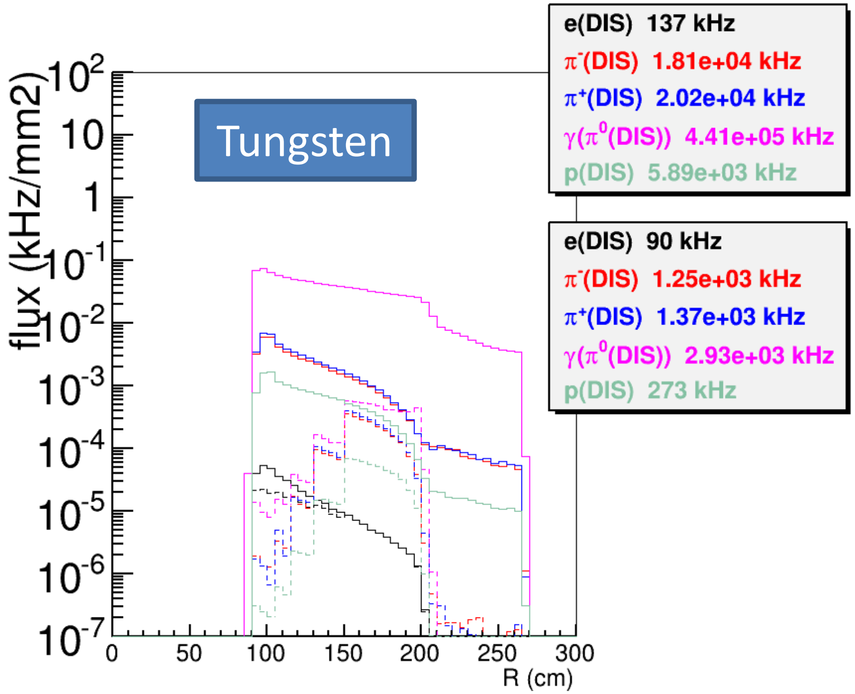
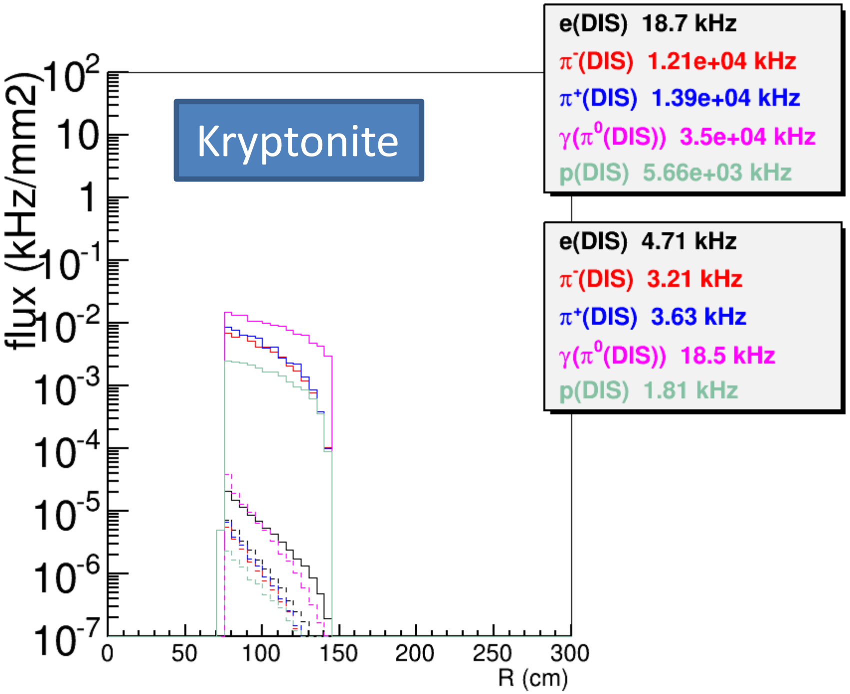
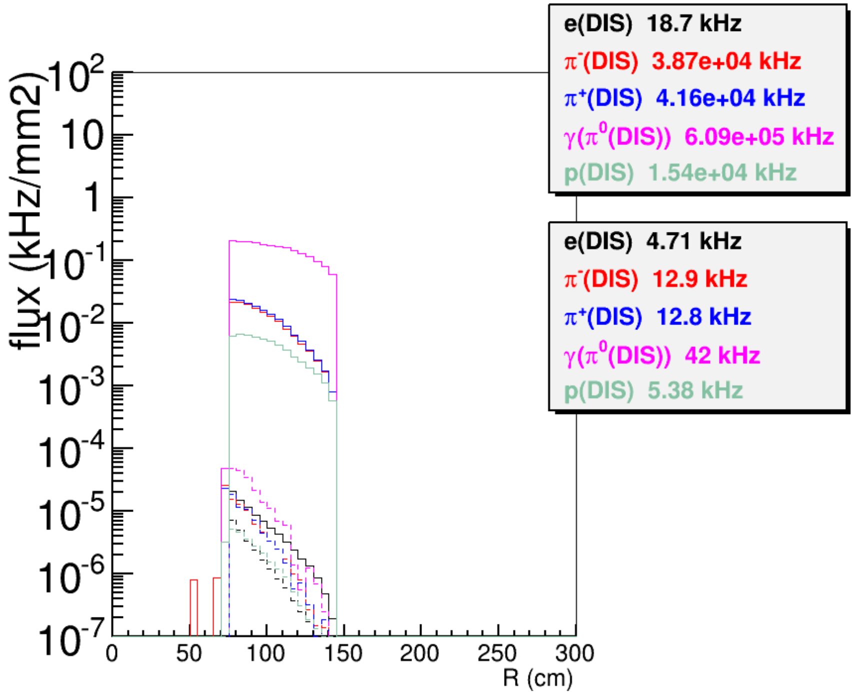




LAEC electron trigger rate (flat)

- LAEC geometry: Z_front=-65cm, R(80,140)cm
- Shows rate before and after trigger cut
- "Kryptonite": all rate from He3 by eicRate, everything is kryptonite including target collimator, so no secondary
- "Tungsten": all rate from He3 and target window by eicRate, everything is real material including target collimator as Tungsten, so secondary are present. Only "eDIS" is like "Kryptonite" case





Rate (kHz) *full azimuthal*		FAEC Zhiwen	FAEC Xin	LAEC Zhiwen	LAEC Xin
e-(W>2)	Kry	137	55	18.7	
π^-	Kry	9.05e3		1.21e4	
	Tung	1.81e4	5.4e3	3.87e4	
π^+	Kry	1.07e4		1.39e4	
	Tung	2.02e4	9.0e3	4.16e4	
$\gamma(\pi^0)$	Kry	2.66e4	605	3.50e4	
	Tung	4.41e5		6.09e5	
e (π^0)	Kry	38.4		39.3	
	Tung	2.1e4		5.1e3	
p	Kry	3.83e3		5.65e3	
	Tung	5.89e3		1.54e4	

		FAEC Zhiwen (flat)	FAEC Zhiwen (Radial below)	FAEC Zhiwen (Radial on)	FAEC Xin	LAEC Zhiwen (flat)	LAEC Xin
e-(W>2)	kry	124	91.4	90	41	4.7	13
π^-	Kry	1.98e3	763	641		3.21	
	Tung	4.27e3	1.50e3	1.25e3	2.9e3	12.9	41/20
π^+	Kry	2.34e3	844	703		3.63	
	Tung	4.68e3	1.64e3	1.37e3	4.8e3	12.8	58/20
γ (π^0)	Kry	7.34e3	3.76e3	3.29e3	462	18.5	31
	Tung	7.60e3	3.46e3	2.93e3		42	
e (π^0)	Kry			4.8		0	
	Tung			202		0.8	
p	Kry	438	200	173		1.81	
	Tung	724	319	273	2e3	5.38	
Total	Tung	17.4e3	7.0e3	6.3e3		77.8	44

Top section:
EC untriggered rate

Bottom section:
EC triggered rate with electron single trigger

Gamma from pi0 trigger rate should divide by a number 1- 2 as both photons give one trigger only.
Need more study with FAEC and LAEC together

eDIS(W>2,Q2>1) from "eicRate"
- at FAEC has 76kHz before trigger, 76kHz after trigger radial on Q2=1
- at LAEC has 14.3kHz before trigger, 4.7kHz after trigger flat

Background from π^0

tungsten, trigger radial on Q2=1

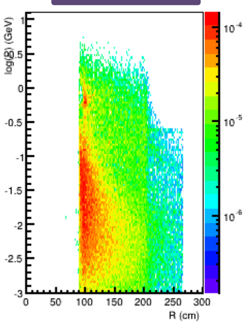
- A lot of high energy electron,positron,gamma from pi0 on FAEC, dominant by target, not window
- Some of them should from target cell wall and other materials in flight path

Rate (kHz) *full azimuthal*	He3	Windown upstream	Window Downstream	Total
γ (π^0) FAEC	2.83e3	4.85	95.2	2.93e3
e (π^0) FAEC	192	0.30	9.7	202
γ (π^0) LAEC	14.6	16.4	11.0	42
e (π^0) LAEC	0.52	0.25	0.07	0.8
γ (π^0) LGCC				1.41e3
e (π^0) LGCC				55

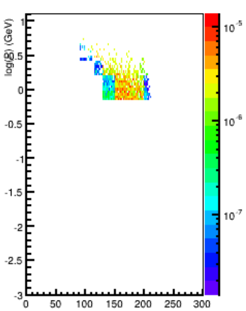
e(pi0)

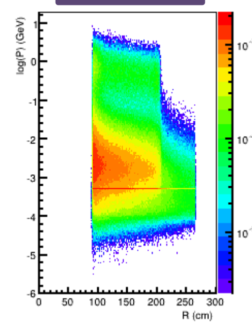
Tung

γ(pi0)

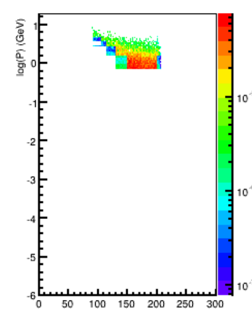


FAEC, Before cut





FAEC, After cut



- If we assume LGCC and FAEC has about same angle vs radius relation, we have about 55kHz electron and positron produced before LGCC and they will trigger FAEC and can't be rejected by LGCC
- LGCC and FAEC angle vs radius relation doesn't hold that well because charged particles are turning in-between, This rate

electron single trigger rate

- Try similar method from PAC35 proposal
- Assume
  - SPD reject gamma by 10, SPD and MRPC together to reject gamma from pi0 by 20
  - Add EC preshower cut will reduce hadron by 2, electron and gamma by 5%
  - LGCC with p.e. >=2 and random coincidence reject by
    - 4=1/(30*(220kHz+65kHz)*30ns) for whole area
    - 40 for 3 sectors
    - 120 for 1 sector
  - LGCC with p.e.>2 for correlated coincidence for hadron reject by
    - 55=1/(30*20kHz*30ns) for whole area
- FAEC (trigger radial on Q2=1)

  215kHz

  =90+55+(202-55)/40+2930/20/40+2900/2/40+2900/2/55

  =90(eDIS)+

  55(e(π^0) front)+3.6(e(π^0) back) +3.7(γ(π^0))+

  36(hadron rand. coin.)+ 26(hadron corr. coin.)
- LAEC (trigger flat)

  41kHz

  = 4.7+0.8+42/10+31.1

  = 4.7(eDIS)+0.8(e(π^0))+8.4(γ(π^0))+31.1(hadron)

PAC35 proposal text

8 Trigger Setup and DAQ

With 30 sectors, singles triggers will be first generated in each sector then the coincidence triggers will be formed between sectors. Three types of triggers will be formed and the rates are estimated as following:

8.1 Electron singles trigger

In the large-angle side, the trigger is provided solely by the large-angle Calorimeter with high threshold. With the on-line hadron rejection $R_{LC} = 20$ from the calorimeter, the rates are expected to be

$$T_L^e(11\text{ GeV}) = Y_L^e + Y_L^\gamma + \frac{Y_L^h}{R_{LC}} = 11 + 51.5 + \frac{55.6}{20} = 65\text{ kHz}$$

$$T_L^e(8.8\text{ GeV}) = 16.5 + 37 + \frac{36.7}{20} = 55\text{ kHz}. \quad (1)$$

For the forward-angle acceptance, the electron trigger is formed from the coincidence between large calorimeter signal and CO_2 gas Čerenkov detector. The on-line hadron rejection is about $R_{LC} = 10$ for the calorimeter. The actual hadron/photon rejection performance from the gas Čerenkov depends on the background rates. The background rates in such a gas Čerenkov detector are studied using GEANT3 simulation. With a 15 μA beam, a 40 cm target and a threshold of 2 photoelectrons, the rates are about 40 MHz. With 30 trigger sectors and a 20 ns coincidence window, the actual online rejection ratio is expected to be about 40. Thus the electron single rates in forward-angle are

$$T_F^e(11\text{ GeV}) = Y_F^e + \frac{Y_F^\gamma}{R_{GC}} + \frac{Y_F^h}{R_{GC}R_C} = 88.5 + \frac{623}{40} + \frac{6100}{40\cdot 10} = 119\text{ kHz}$$

$$T_F^e(8.8\text{ GeV}) = 151 + \frac{596}{40} + \frac{5180}{40\cdot 10} = 179\text{ kHz}. \quad (2)$$

In total, the electron singles trigger rates will be about 184 kHz and 234 kHz for 11 GeV and 8.8 GeV, respectively. In addition, as an option, the heavy gas Čerenkov and MRPC can be further added to the trigger to suppress the trigger rates from high energy photon and hadrons.

Xin's study

Single electron trigger @ 11 GeV:

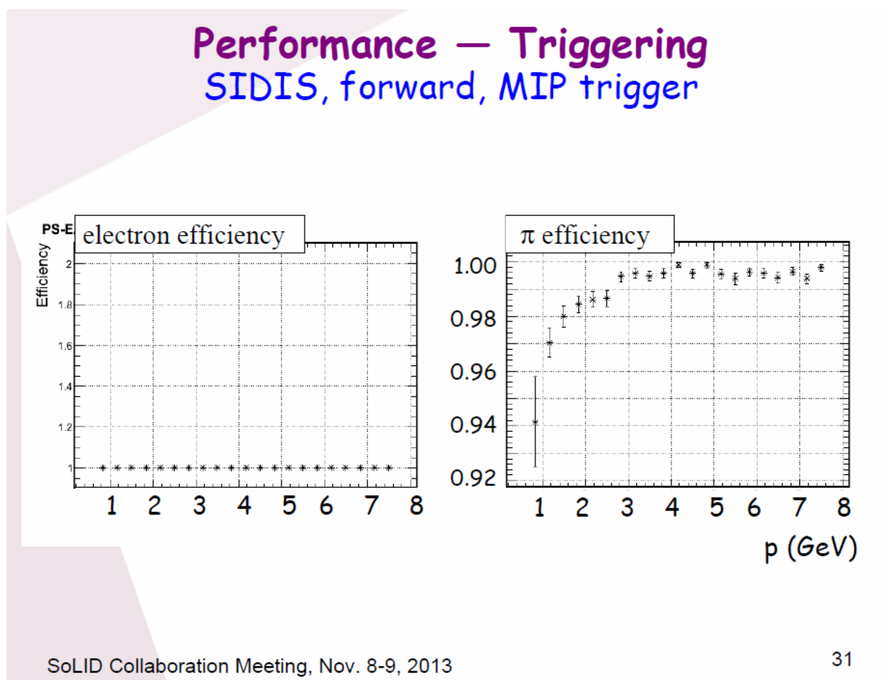
–Forward angle: 41 kHz (electron) + 9.7 MHz (hadron)/ 400 + 462 (photon)/40 ~ 77 kHz.

–Large angle: 14.3 kHz (electron) + 31 kHz (photon) ~ 44 kHz.

•Total: 121 kHz.

SIDIS EC MIP Trigger (rough)

MIP trigger Assumption
- trig_eff (P>Max)=trig_eff(P=Max)
- trig_eff (P<0.22GeV) = 0
- trig_eff (0.22GeV<P<Min)=0.8*trig_eff (P=Min)
- trig_eff_Proton = trig_eff_pion



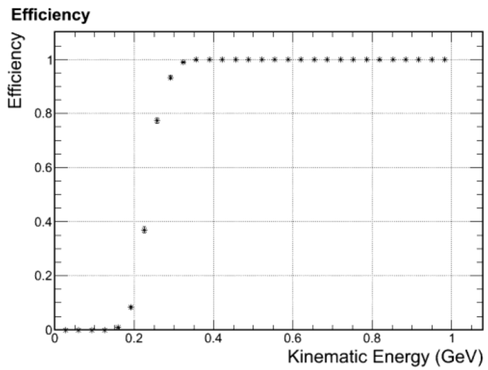
SIDIS EC MIP Trigger (100%)

- Detailed study at low energy, cut at ~200MeV to ensure pion eff is 100% at Ek=1GeV
- Independent curve for all 4 particles

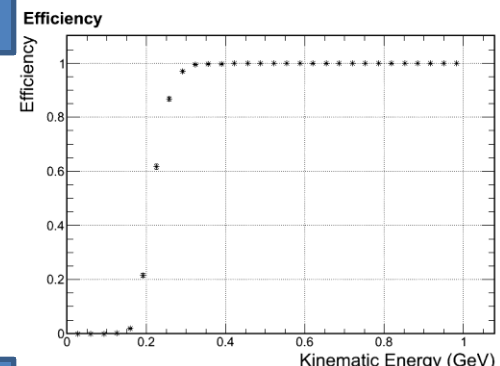
MIP trigger Assumption

- trig_eff (Ek>Max)=trig_eff(P=Max)
- trig_eff (Ek<Min)=0
- If (trig_eff<0.01) trig_eff = 0

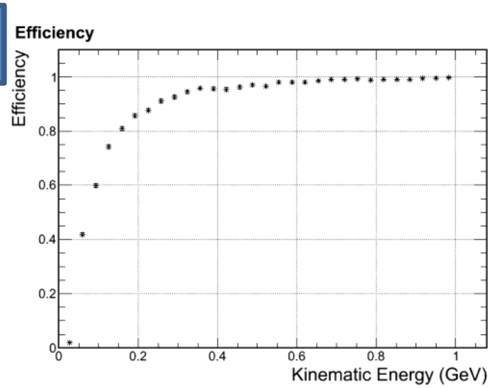
e



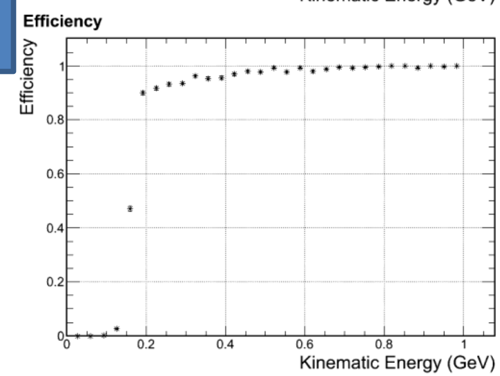
gamam



pion



p

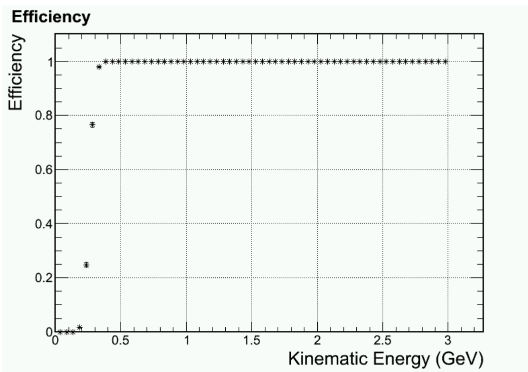


SIDIS EC MIP Trigger (95%)

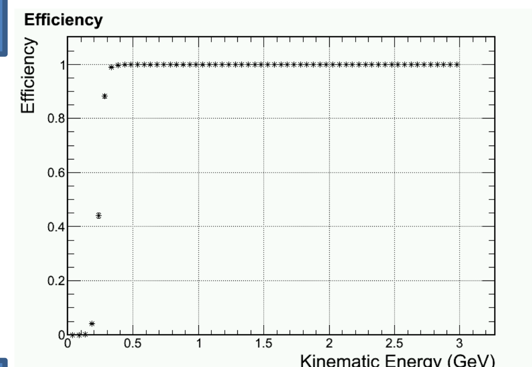
- Detailed study at low energy, cut a bit higher than ~200MeV to ensure pion eff is 95% at Ek=1GeV
- Independent curve for all 4 particles

MIP trigger Assumption
- trig_eff (Ek>Max)=trig_eff(P=Max)
- trig_eff (Ek<Min)=0
- If (trig_eff<0.01) trig_eff = 0

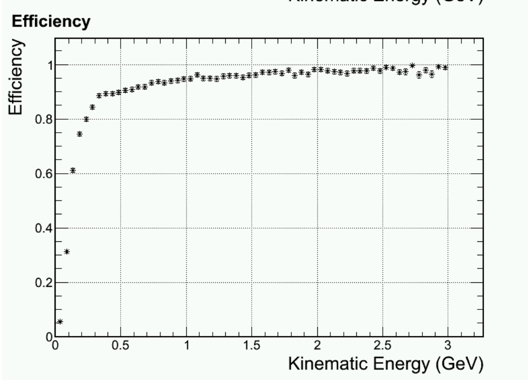
e



gamam



pion



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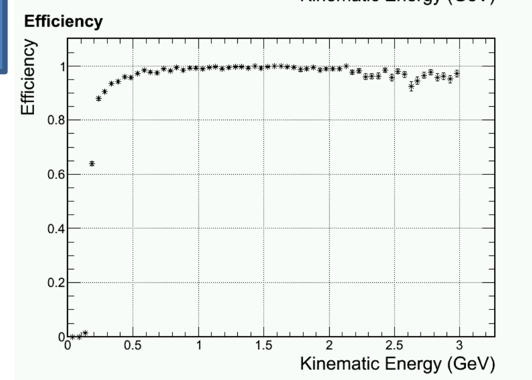

FAEC MIP trigger rate (rough)

- FAEC geometry: Z_front=415cm, R(90,230)cm
- Shows rate before and after trigger cut
- “Kryptonite”: all rate from He3 by eicRate, everything is kryptonite including target collimator, so no secondary
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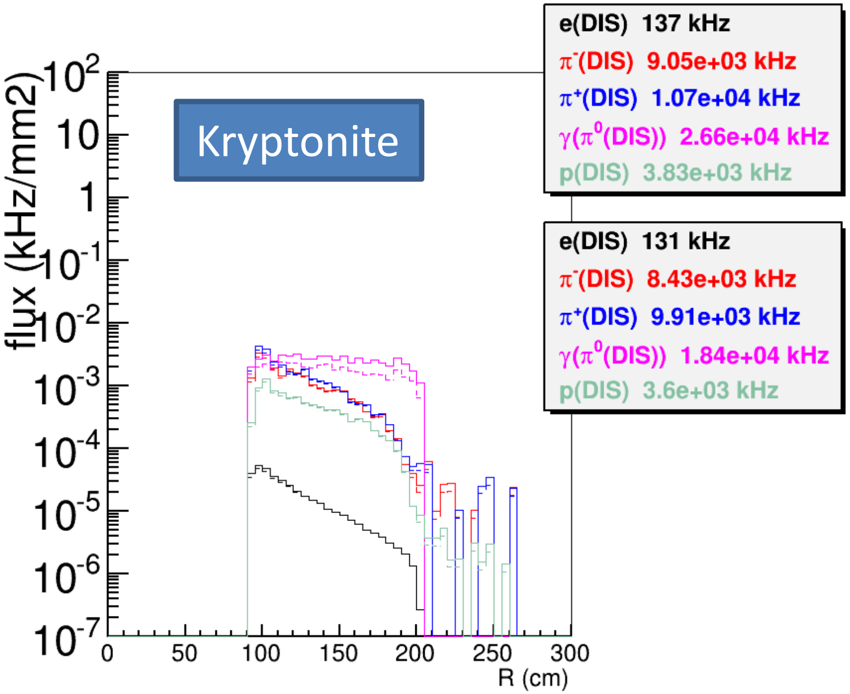
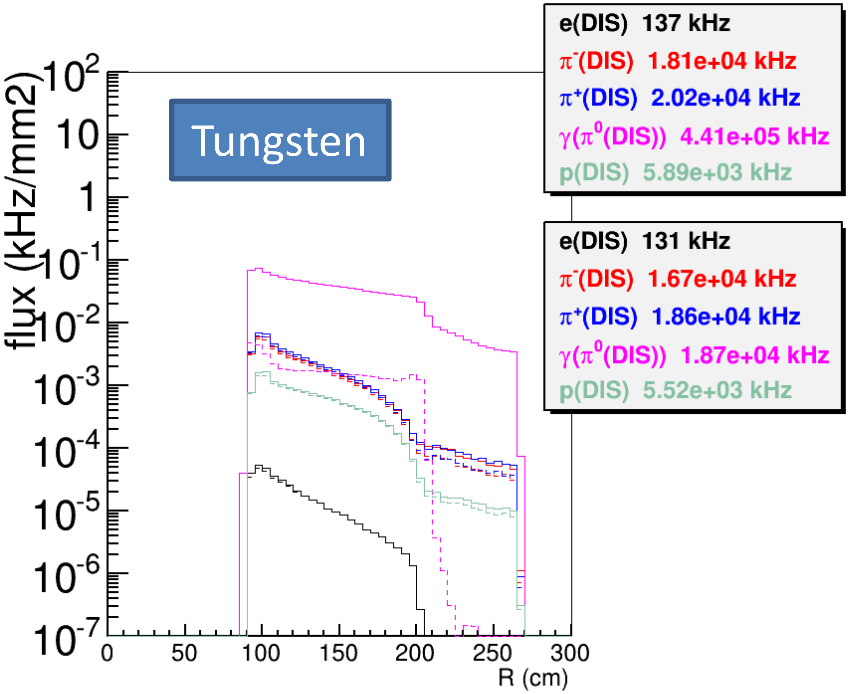
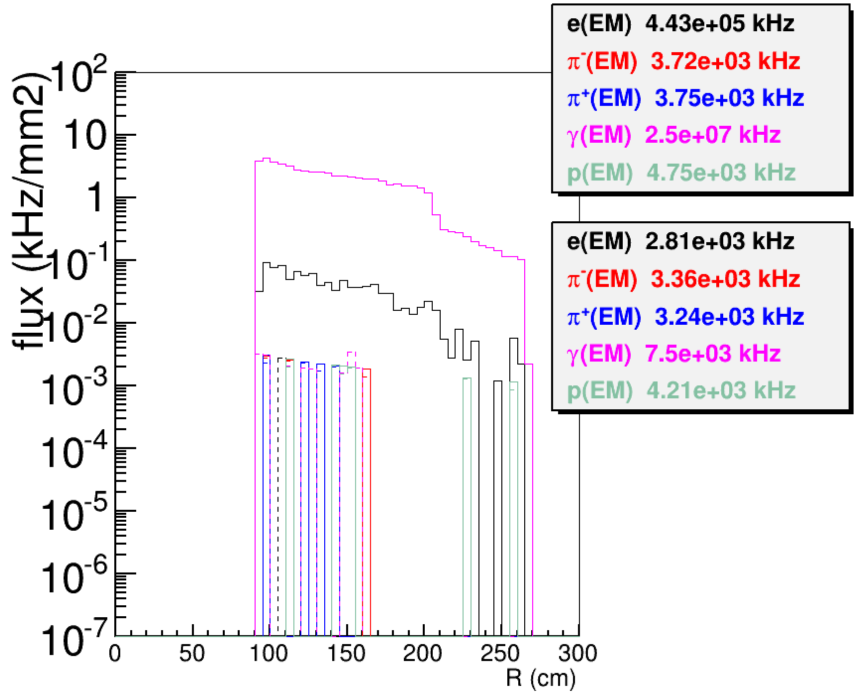




FAEC MIP trigger rate by EM photon

- We ran 1e8 electron on target with all real materials and all physics
- For 15 uA running condition, the normalization factor is 1e6=15e-6/1.6e-19/1e8
- There is too small enough statistics of gamma passing the cut to have an accurate estimate, need a lot more
- We might be able to claim no photon in EM process pass the cut
- High energy gamma might be from pi0 production and thus over counting.

- But PAC35 proposal has 200MHz soft photon passing 200MeV cut, comparing to 600kHz hard photon from pi0



Rate (kHz) *full azimuthal*		FAEC			
		Zhiwen			Xin
e-(W>2)	Kry		137		
π-	Kry		9.05e3		
	Tung		1.81e4		
π^+	Kry		1.07e4		
	Tung		2.02e4		
$\gamma(\pi^0)$	Kry		2.66e4		
	Tung		4.41e5		
e (π^0)	Kry		38.4		
	Tung		2.1e4		
p	Kry		3.83e3		
	Tung		5.89e3		
e-(W>2)	kry	131	137	137	
π-	Kry	8.43e3	8.93e3	8.48e3	
	Tung	1.67e4	1.77e4	1.68e4	5.7e3 (all neg hadron
π^+	Kry	9.91e3	1.05e4	1.00e4	
	Tung	1.86e4	1.97e4	1.87e4	12.6e3 (all pos hadron)
$\gamma\ (\pi^0)$	Kry	1.84e4	2.06e4	1.99e4	
	Tung	1.87e4	2.11e4	2.02e4	
e (π^0)	Kry		38	38	
	Tung		2.5e3	2.36e3	
p	Kry	3.60e3	3.61e3	3.49e3	
	Tung	5.52e3	5.41e3	5.23e3	
Total	Tung	6.2e4	6.7e4	6.1e4	20e3
		rough	100%	95%	

Top section:
EC untriggered rate

Bottom section:
EC triggered rate with
MIP trigger

Gamma from pi0 trigger rate should divide by a number 1- 2 as both photons give one trigger only.
Need more study with FAEC and LAEC together

Charged particle single trigger rate

- Try similar method from PAC35 proposal
- Question about PAC35 proposal
  - Why EM photon pass 200MeV cut has 200Mhz rate?
- Assume
  - EM photon can't pass trigger (???)
  - SPD and MRPC together to reject gamma from pi0 by 20
  - HGCC can give a factor of ???
- FAEC (trigger 100%)
  - 46.5MHz

    =0.137+42.8+2.5+21.1/20

    = 0.137(eDIS)+42.8(hadron)+2.5(e(π^0))+1.1(γ(π^0))

8.2 Charged particle singles trigger

The total energy deposition of the hadrons in the calorimeter is about 300 MeV and the energy resolution associated with it is about 11%. So applying a threshold of 200 MeV on the total energy will help to reject most of the low energy photons. The total rate of photons, including both soft photons and photons from π^o decay, passing this threshold is about 200 MHz for both beam energies.

The calorimeter signal of individual block will first locally match the MRPC detector right in front. The average background rate in MRPC is about 10 kHz/cm^2, and each set of MRPC covers about 500 cm^2 area. With a 10 ns coincidence window, the photon rejection factor is about 20.

To further reduce the photon contamination, a layer of 3 mm thin scintillator will be inserted in front of the heavy gas Čerenkov. By applying an appropriate threshold, the total counting rate in the whole scintillator layer can be controlled to be below 300 MHz, which leads 10 MHz in each sector. Now with a 15 ns coincidence window with the shower+MRPC signal, the photon events can be further suppressed by a factor of 6.5.

The total rates for the charged particle singles trigger are

$$\begin{aligned} T_F^h(11\ \mathrm{GeV}) &= Y_F^h + Y_F^e + \frac{Y_F^{\gamma all}}{R_{MRPC} R_S} \\ &= 6.1 + 0.1 + \frac{200}{20 \cdot 6.5} = 7.7\ \mathrm{MHz} \\ T_F^e(8.8\ \mathrm{GeV}) &= 5.2 + 0.15 + \frac{200}{20 \cdot 6.5} = 6.9\ \mathrm{MHz}. \end{aligned} \qquad (3)$$

Xin's study

Single hadron trigger @ 11 GeV:
–~20 MHz

Coincidence trigger rate

8.3 Coincidence trigger

The coincidence trigger is formed by electron trigger and charged particle trigger from different sectors to reduce the rate due to the strong correlation of the two triggers in one sector. 30 sectors can be grouped into 10 groups and form 90 coincidence combinations to reduce the need of coincidence modules. With a 35 ns coincidence window, the final coincidence rates are:

$$\begin{aligned} T^c(11\text{ GeV}) &= T^{phy} + T_F^h \cdot T^e \cdot Window \\ &= 2.8\text{ kHz} + 0.9 \cdot 7.8\text{ MHz} \cdot 184\text{ kHz} \cdot 35\text{ ns} = 48\text{ kHz} \\ T^c(8.8\text{ GeV}) &= 1.6\text{ kHz} + 0.9 \cdot 6.9\text{ MHz} \cdot 234\text{ kHz} \cdot 35\text{ ns} = 53\text{ kHz}. \end{aligned} \tag{4}$$

2.8kHz+0.9*256kHz*46.5Mhz*30ns = !!!

Xin's study
121e3*20e6 * 35e-9 ~ 85 kHz

- Try similar method from PAC35 proposal
- Borrow PAC35 SIDIS physics rate 2.8kHz
- electron single trigger rate, FEAC 215kHz, LAEC 41kHz, total 256kHz
- Charged particle single trigger rate, FEAC 40MHz
- Time window 30ns

Trigger with 40% of hadron from eicrate

Dec 2013

Electron trigger

FAEC (trigger radial on Q2=1)

140kHz

=90+(55+(202-55)/40+2930/20/40+2900/2/40+2900/2/55)*0.4

=90(eDIS)+22(e(π^0) front)+1.47(e(π^0) back) +1.47(γ(π^0))+14.5(hadron rand. coin.)+10.65(hadron corr. coin.)

LAEC (trigger flat)

19.1kHz

= 4.7+(0.8+42/10+31.1)*0.4

= 4.7(eDIS)+0.32(e(π^0))+1.68(γ(π^0))+12.44(hadron)

Charged particle trigger

FAEC (trigger 100%)

18.7MHz

=0.137+(42.8+2.5+21.1/20)*0.4

= 0.137(eDIS)+17.1(hadron)+1(e(π^0))+0.4(γ(π^0))

Coincidence trigger

Random coincidence rate	89.3kHz = (140+19.1)kHz*18.7Mhz*30ns
SIDIS physics rate	2.8kHz (need update)
Total rate	92.1kHz

This has not included the impact on other detector rate and rejection other than EC, so the rate should be less.

Update Jan 2014

Background from π^0

tungsten, trigger radial on Q2=1

- A lot of high energy electron,positron,gamma from pi0 on FAEC, dominant by target, not window
- Some of them should from target cell wall and other materials in flight path

Rate (kHz) *full azimuthal*	He3	Windown upstream	Window Downstream	Total	Total (Zhiwen)
γ (π^0) FAEC	2.55e3	4	84.3	2.64e3	2.93e3
e (π^0) FAEC	110.1	0.3	3.8	115	202
γ (π^0) LAEC	6.28	5.88	7.38	20	42
e (π^0) LAEC	0.23	0	0.14	0.4	0.8
γ (π^0) LGCC	1.93e3	2.5	2.7	2e3	1.41e3
e (π^0) LGCC	37.4	0	2.3	40	55

- Based on Zhihong 's event-by-event analysis of π^0 background with same EC trigger condition and no double counting
- Comparing to previous Zhiwen study, this removing the possibility of having multiple triggers for one event and the LGCC and EC correlation is treated correctly.
- This is only study for FAEC ele trigger, NOT FAEC MIP trigger yet which has small contribution to total FAEC trigger anyhow

Trigger with 40% of hadron from eicrate

Update Jan 2014

Electron trigger

FAEC (trigger radial on Q2=1)

126.8kHz

=90+(40+(115-40)/40+2640/20/40+2900/2/40+2900/2/(55/0.4))*0.4

=90(eDIS)+16(e(π^0) front)+0.75(e(π^0) back) +1.32(γ(π^0))+14.5(hadron rand. coin.)+4.22(hadron corr. coin.)

LAEC (trigger flat)

18.1kHz

= 4.7+(0.4+20/10+31.1)*0.4

= 4.7(eDIS)+0.16(e(π^0))+0.8(γ(π^0))+12.4(hadron)

Charged particle trigger

FAEC (trigger 100%)

18.7MHz

=0.137+(42.8+2.5+21.1/20)*0.4

= 0.137(eDIS)+17.1(hadron)+1(e(π^0))+0.4(γ(π^0))

Coincidence trigger

Random coincidence rate	81.3kHz = (126.8+18.1)kHz*18.7Mhz*30ns
SIDIS physics rate	2.8kHz (need update)
Total rate	84kHz

Update include new π^0 background analysis and factor 0.4 for hadron correlated coincidance

Summary

- geometry (use full size of EC for background and trigger study)
  - FAEC : Z_front=415cm, R(90,230)cm
  - LAEC : Z_front=-65cm, R(80,140)cm
- electron trigger
  - FAEC use "radial on Q2=1" threshold, LAEC use flat 3GeV threshold
  - FA uses EC(PS+S)+LGCC+SPD+MRPC, LA uses EC(S)+SPD
- Charged particle trigger
  - FAEC uses "100%" trigger threshold
  - FA uses EC(S)+SPD+MRPC

If EC preshower NOT in ele FAEC trigger, remove factor 2 on hadron rate reduction at FAEC

Dec 2013

FAEC (trigger radial on Q2=1)

165kHz =90+(55+(202-55)/40+2930/20/40+2900/40+2900/55)*0.4

Random coincidence rate

103.3kHz = (165+19.1)kHz*18.7Mhz*30ns

Update Jan 2014

FAEC (trigger radial on Q2=1)

145.5kHz =90+(40+(115-40)/40+2640/20/40+2900/40+2900/(55/0.4))*0.4

Random coincidence rate

91.8kHz = (145.5+18.1)kHz*18.7Mhz*30ns

Study how EC range affect trigger rate

Rate (kHz) *full azimuthal*		FAEC (ele trigger)		FAEC (MIP trigger)	
		old	new	old	new
e-(W>2)	Kry	137	93.4	137	93.4
π-	Kry	9.05e3		9.05e3	
	Tung	1.81e4	1.34e4	1.81e4	1.34e4
π^+	Kry	1.07e4		1.07e4	
	Tung	2.02e4	1.49e4	2.02e4	1.49e4
$\gamma(\pi^0)$	Kry	2.66e4		2.66e4	
	Tung	4.41e5	3.81e5	4.41e5	3.81e5
e (π^0)	Kry	38.4		38.4	
	Tung	2.1e4	1.63e4	2.1e4	1.63e4
p	Kry	3.83e3		3.83e3	
	Tung	5.89e3	4.65e3	5.89e3	4.64e3
e-(W>2)	kry	90	70.5	137	93.4
π-	Kry	641		8.93e3	
	Tung	1.25e3	1.25e3	1.77e4	1.31e4
π^+	Kry	703		1.05e4	
	Tung	1.37e3	1.37e3	1.97e4	1.45e4
γ (π^0)	Kry	3.29e3		2.06e4	
	Tung	2.93e3	2.92e3	2.11e4	1.69e4
e (π^0)	Kry	4.8		38	
	Tung	202	201	2.5e3	1.93e3
p	Kry	173		3.61e3	
	Tung	273	273	5.41e3	4.33e3
Total	Tung				

Update Jul 2014

Top section:
EC untriggered rate

Bottom section:
EC triggered rate
(left) electron single trigger with "radial on Q2=1"
(right) MIP trigger with "100%"

Old
LAEC at R(80,140)cm
FAEC at R(90,230)cm

New
LAEC at R(80,140)cm
FAEC at R(105,235)cm ,8 degree relative to target downstream end

e and gamma from pi0 trigger has over counting problem, need Zhhong's event-by-event study

Study how EC range affect trigger rate

tungsten, trigger radial on Q2=1

Update Jul 2014

Background from π^0

- A lot of high energy electron,positron,gamma from pi0 on FAEC, dominant by target, not window
- Some of them should from target cell wall and other materials in flight path

Old
LAEC at R(80,140)cm
FAEC at R(90,230)cm

New
LAEC at R(80,140)cm
FAEC at R(105,235)cm ,8 degree relative to target downstream end

Additional change:
Zhihong use normalization factor 241 for He3 and window in "old", They are 212 for He3 and 136 for window as they should be in "new", Most rate is from He3, so the effect is small.
Instead of use 1st particles in a event to trigger, Zhihong use particles with higest chance to trigger

old

Rate (kHz) *full azimuthal*	He3	Windown upstream	Window Downstream	Total	Total (Zhiwen)
γ (π^0) FAEC	2.55e3	4	84.3	2.64e3	2.93e3
e (π^0) FAEC	110.1	0.3	3.8	115	202
γ (π^0) LAEC	6.28	5.88	7.38	20	42
e (π^0) LAEC	0.23	0	0.14	0.4	0.8
γ (π^0) LGCC	1.93e3	2.5	2.7	2e3	1.41e3
e (π^0) LGCC	37.4	0	2.3	40	55

new

Rate (kHz) *full azimuthal*	He3	Windown upstream	Window Downstream	Total	Total (Zhiwen)
γ (π^0) FAEC	2.16e3	0.54	77.22	2.24e3	2.92e3
e (π^0) FAEC	101.49	0	3.36	104.9	201
γ (π^0) LAEC	10.53	13.24	7.4	31.2	42
e (π^0) LAEC	0.2	0.14	0	0.34	0.8
γ (π^0) LGCC	1.62e3	1.26	55.26	1.68e3	
e (π^0) LGCC	37.16	0	3.66	40.8	

- Based on Zhihong 's event-by-event analysis of π^0 background with same EC trigger condition and no double counting
- Comparing to previous Zhiwen study, this removing the possibility of having multiple triggers for one event and the LGCC and EC correlation is treated correctly.
- This is only study for FAEC ele trigger, NOT FAEC MIP trigger yet which has small contribution to total FAEC trigger anyhow

Update Jul 2014

eDIS from window

- It was missing in previous calculation

electron single trigger with “radial on Q2=1”
MIP trigger with “100%”

Rate (kHz) *full azimuthal*	FAEC Window Donwstream	FAEC Windown Upstream	LAEC Window Donwstream	LAEC Windown Upstream
e (untrigger)	3.43	2.16	14.3	13.6
e (ele trigger)	2.24	1.46	2.81	4.17
e (MIP trigger)	3.40	2.15		

New
LAEC at R(80,140)cm
FAEC at R(105,235)cm ,8 degree relative to target downstream end

Trigger with 40% of hadron from eicrate

Update Jul 2014

Electron trigger

FAEC (trigger radial on Q2=1)

129.7kHz

=(70.5+2.24+1.46)+(40.8+(104.9-40.8)/40+2240/20/40+2900/40+2900/(55/0.4))*0.4

=74.2(eDIS)+16.32(e(π^0) front)+0.64(e(π^0) back) +1.12(γ(π^0))+29(hadron rand. coin.)+8.44(hadron corr. coin.)

LAEC (trigger flat)

25.5kHz

= (4.7+2.81+4.17)+(0.34+31.2/10+31.1)*0.4

= 11.68(eDIS)+0.14(e(π^0))+1.25(γ(π^0))+12.4(hadron)

Charged particle trigger

FAEC (trigger 100%)

14MHz

=(0.0934+0.0034+0.00215)+(31.9+1.93+16.9/20)*0.4

=0.1(eDIS)+12.76(hadron)+0.77(e(π^0))+0.338(γ(π^0))

Coincidence trigger

Random coincidence rate	65.2kHz = (129.7+25.5)kHz*14Mhz*30ns
SIDIS physics rate	4kHz (new rate with CLEO configuration by Zhihong)
Total rate	69.2kHz

Remove preshower in FAEC ele trigger, with new FAEC R(105,235)cm, add eDIS from window

Summary

Update Jul 2014

- geometry (use full size of EC for background and trigger study)
  - FAEC : Z_front=415cm, R(105,235)cm
  - LAEC : Z_front=-65cm, R(80,140)cm
- electron trigger
  - FAEC use “radial on Q2=1” threshold, LAEC use flat 3GeV threshold
  - FA uses EC(S)+LGCC+SPD+MRPC, LA uses EC(S)+SPD
- Charged particle trigger
  - FAEC uses “100%” MIP trigger threshold
  - FA uses EC(S)+SPD+MRPC

backup

SIDIS EC Acceptance

	Z(cm)	R(cm) (module edge)	R(cm) (module center)	R(cm) (physics)	θ(°) (Physics) (target center)	θ(°) (Physics) (target up edge)	θ(°) (Physics) (target down edge)
FAEC	415,465	105,235	107,230	107,220	7.96,14.85	7.76,14.35	8.13,15.4
LAEC	-65,-15	80,144	83,140	83,127	16.24,24	15.22,22.6	17.40,25.6

- Coil center at z=0
- Target center at z=-350cm, 40cm long
- CoilCollarDownstream edge r=144cm,z=193cm, θ=14.85° relative to target center
- HGCC tank inner edge r=83cm,z=306cm, θ=7.2° relative to target center
- LGCC tank inner edge r=58cm,z=97cm, θ=7.4° relative to target center

Rate in proposal

SIDIS PAC34: BaBar,60% eff, any cut(?)

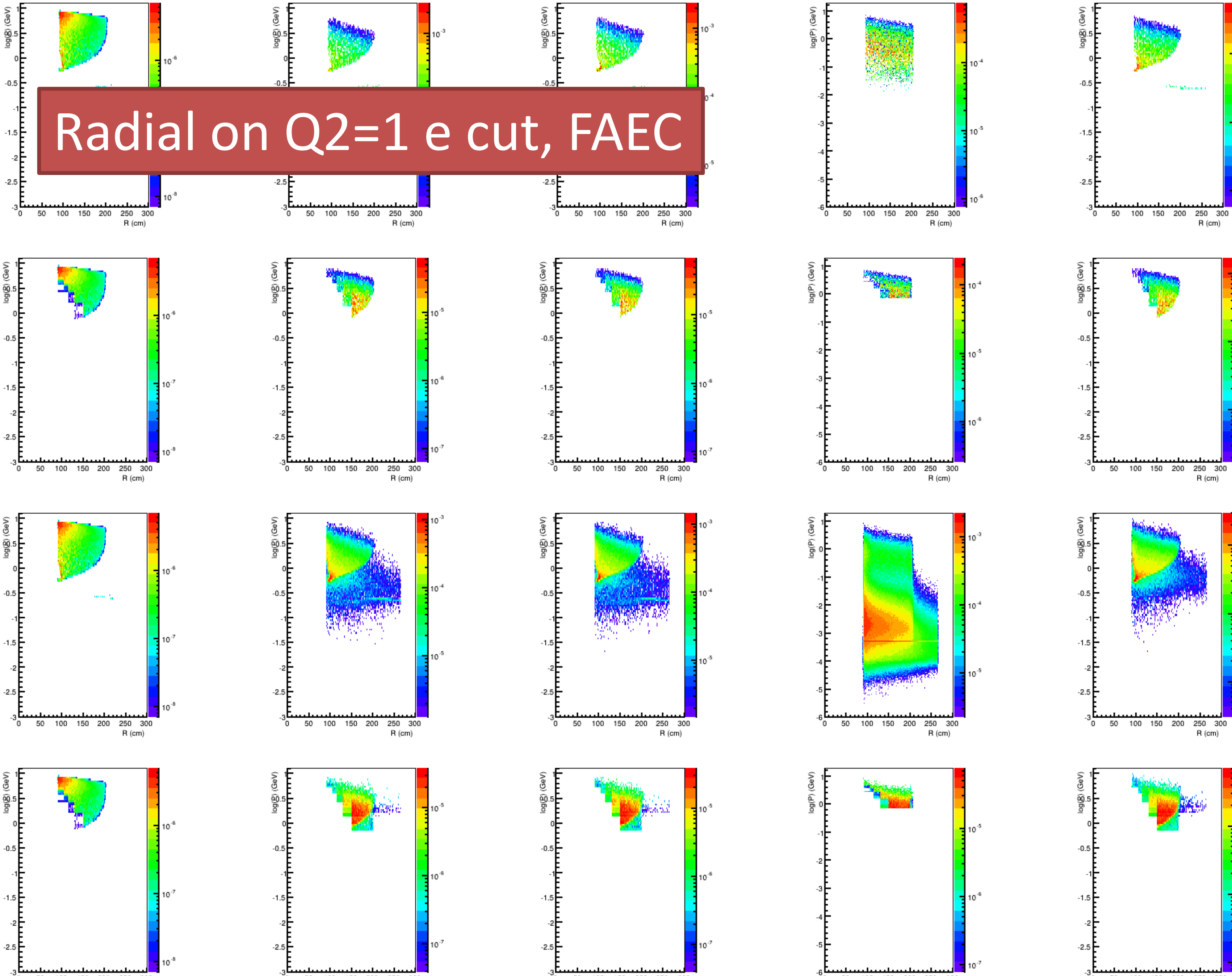
Process	Rate Forward angle	Rate Large angle	Rate Total
(e,eπ^+)	2451 Hz	66.2	2518 Hz
(e,eπ^-)	1696	40.3	1737 Hz
single e^-	58 kHz	23.0 kHz	81 kHz
single π^-	2.0 MHz	4.0 kHz	2.0 MHz
single K^-	95.1 kHz	0.36 kHz	95 .5 kHz
single π^+	3.2 MHz	5.4 kHz	3.2 MHz
single K^+	380 kHz	1.9 kHz	382 kHz
single proton	1.0 MHz	4.9 kHz	1 MHz
single γ	2.4-4.0 MHz	3.0-6.0 kHz	2.4-4.0 MHz

SIDIS PAC35: CDF, 85% eff, FAEC electron trig cut 0.9GeV, FAEC MIP trigger cut 200(MeV)
LAEC cut 3.5GeV, SPD cut(?)

Process	Rate Forward angle 11 GeV	Rate Large angle 11 GeV	Rate Forward angle 8.8 GeV	Rate Large angle 8.8 GeV
(e,eπ^+)	1467 Hz	192 Hz	810 Hz	117 Hz
(e,eπ^-)	1010 Hz	120 Hz	554 Hz	73 Hz
single e^-	88.5 kHz	11.0 kHz	151 kHz	16.5 kHz
high energy photon	623 kHz	51.5 kHz	596 kHz	37 kHz
single π^+	2.90 MHz	20.2 kHz	2.5 MHz	13.4 kHz
single π^-	1.77 MHz	14.5 kHz	1.47 MHz	9.2 kHz
single K^+	226 kHz	5.9 kHz	185 kHz	4.1 kHz
single K^-	54.6 kHz	1.2 kHz	39.9 kHz	0.6 kHz
single proton	1.15 MHz	13.8 kHz	0.99 MHz	9.4 kHz
low energy photon	200 MHz	-	200 MHz	-

Radial on Q2=1 e cut, FAEC

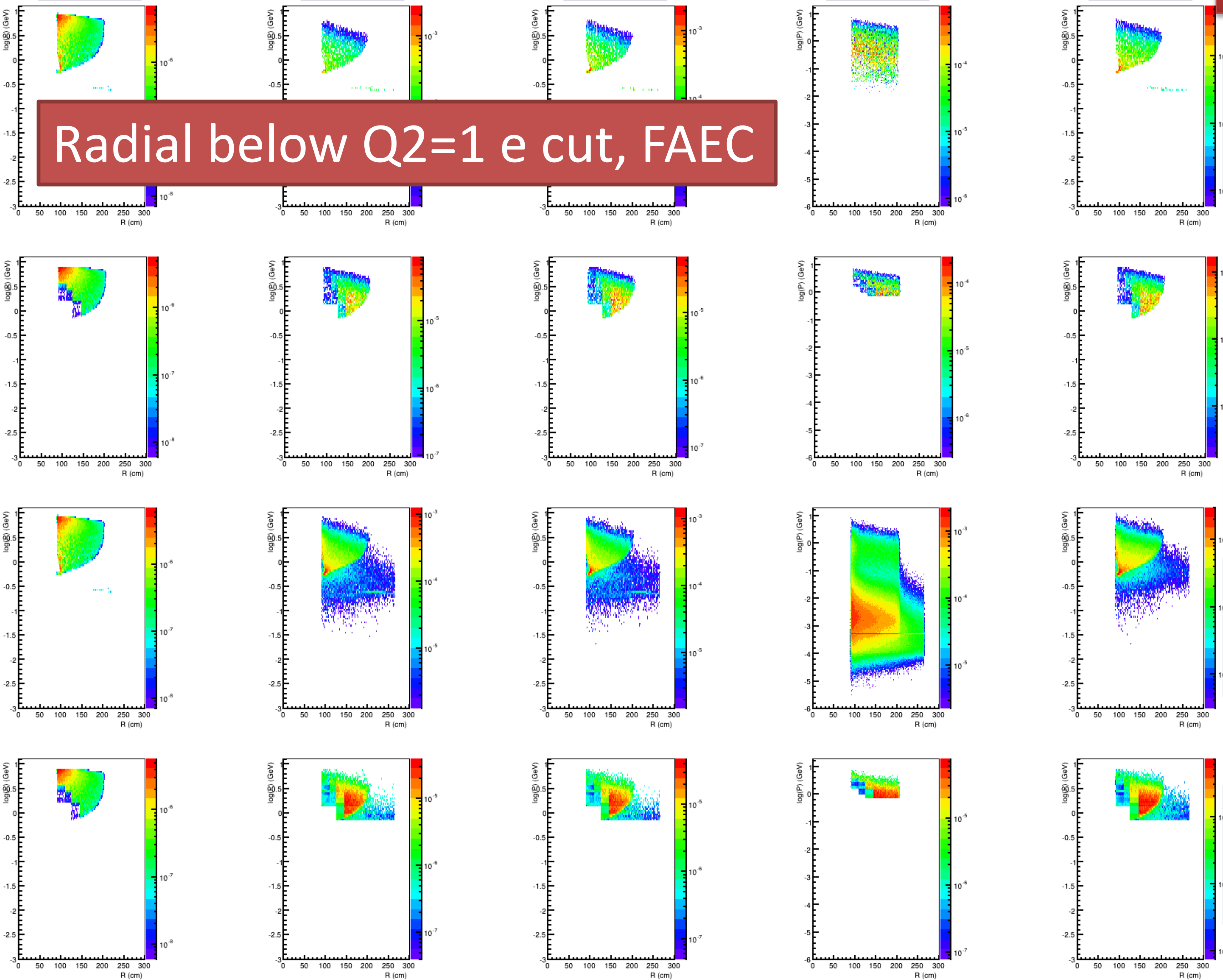
e DIS	pi-	pi+	γ(pi0)	p

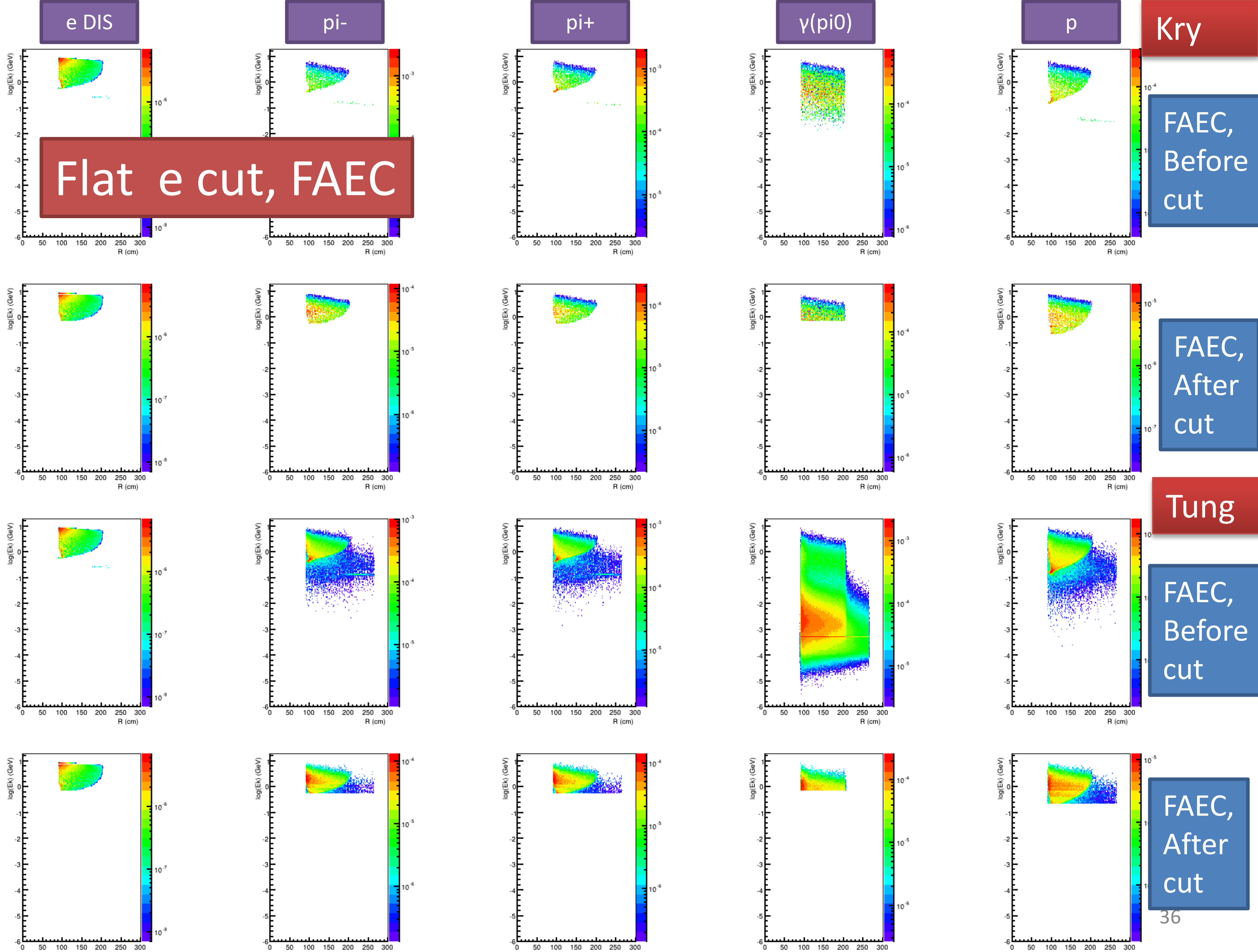


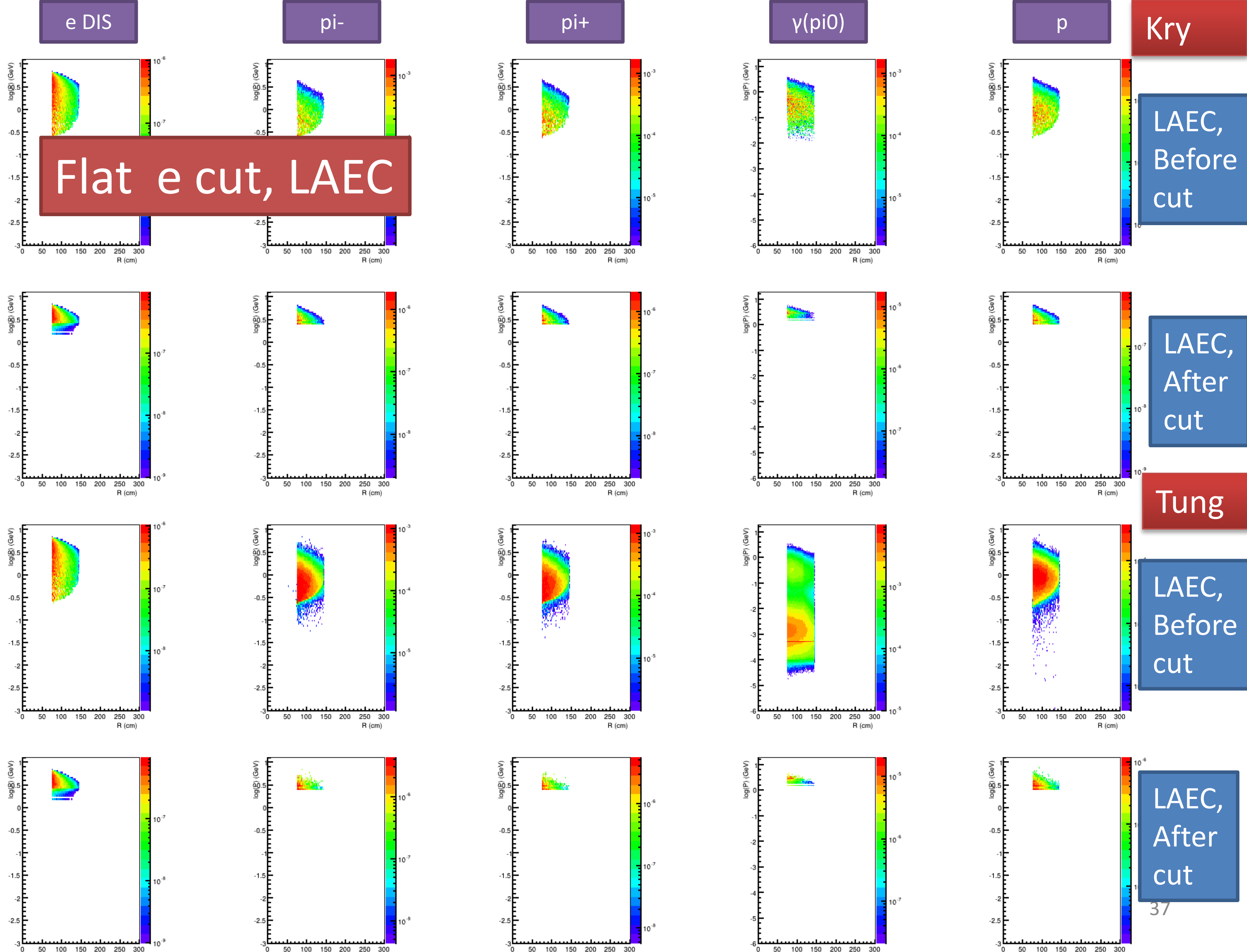
Kry
- FAEC, Before cut
- FAEC, After cut

Tung
- FAEC, Before cut
- FAEC, After cut

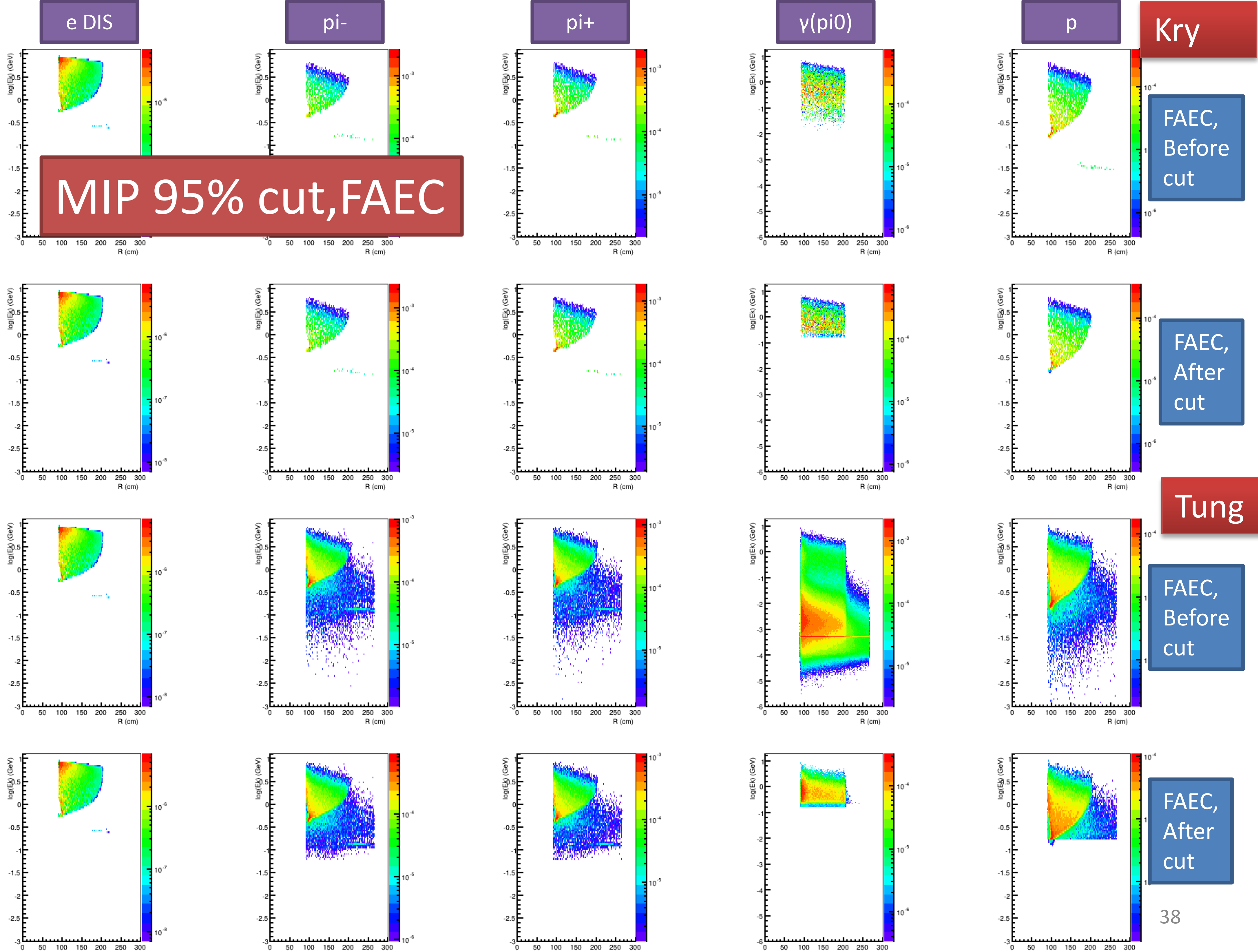
Radial below Q2=1 e cut, FAEC



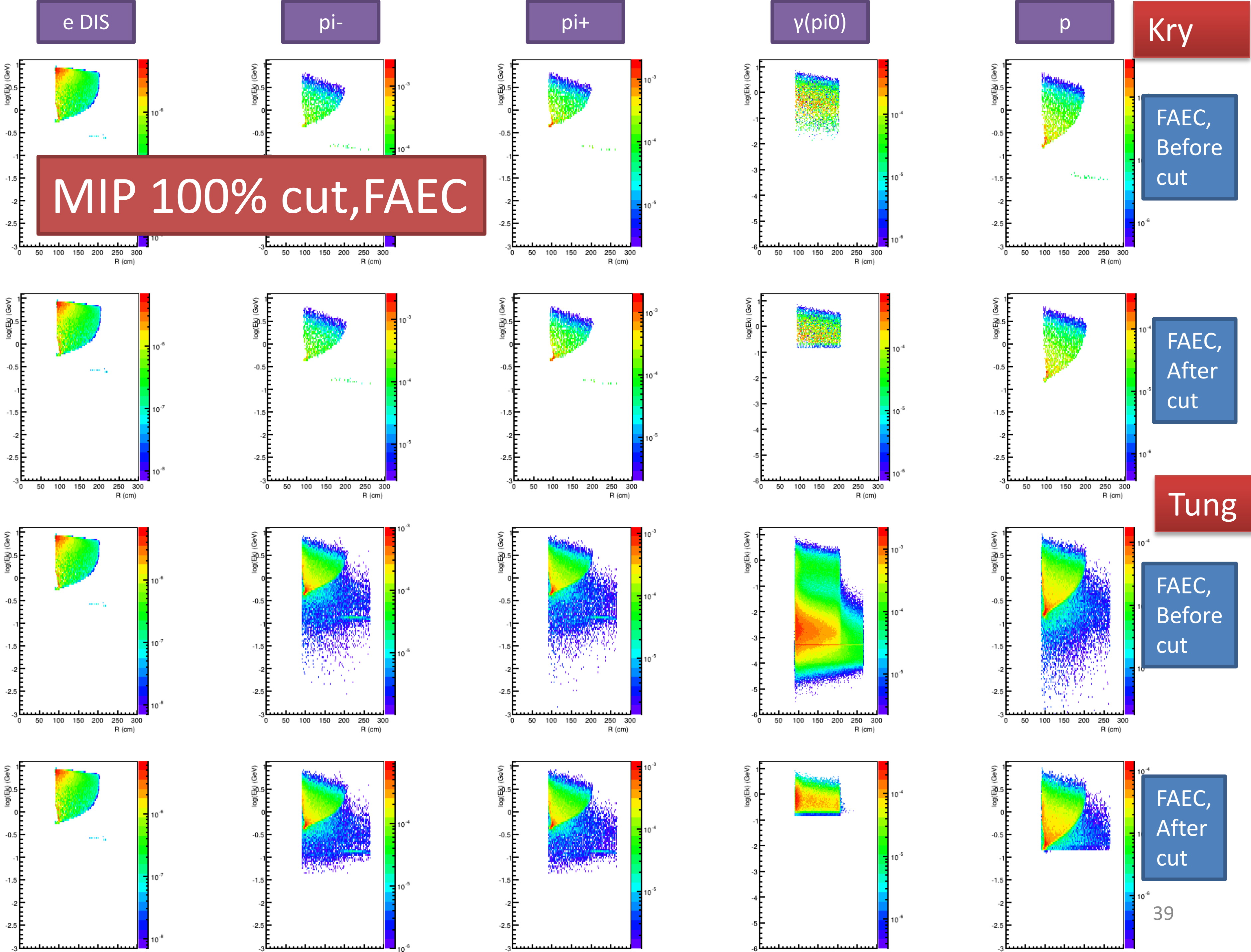

e DIS
pi-
pi+
γ(pi0)
p
Kry
Flat e cut, FAEC
FAEC, Before cut
FAEC, After cut
Tung
FAEC, Before cut
FAEC, After cut
log(Ek) (GeV)
R (cm)



e DIS
pi-
pi+
γ(pi0)
p
Kry
Flat e cut, LAEC
LAEC, Before cut
LAEC, After cut
Tung
LAEC, Before cut
LAEC, After cut
log(E) (GeV)
log(P) (GeV)
R (cm)



e DIS
pi-
pi+
γ(pi0)
p
Kry
MIP 95% cut,FAEC
FAEC, Before cut
FAEC, After cut
Tung
FAEC, Before cut
FAEC, After cut
log(Ek) (GeV)
R (cm)


e DIS
pi-
pi+
γ(pi0)
p
Kry
MIP 100% cut,FAEC
FAEC, Before cut
FAEC, After cut
Tung
FAEC, Before cut
FAEC, After cut
log(Ek) (GeV)
R (cm)

MIP rough cut,FAEC

e DIS | pi- | pi+ | γ(pi0) | p

Kry

FAEC, Before cut

FAEC, After cut

Tung

FAEC, Before cut

FAEC, After cut