中国科学院高能物理研究所
Institute of High Energy Physics Chinese Academy of Sciences

Jet Charge at CEPC

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2021 01 29

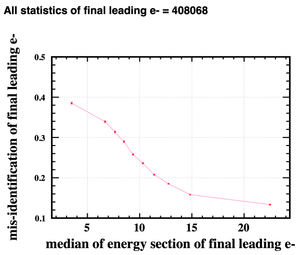
上期回顾

For each event,
Find a Final Leading Particle

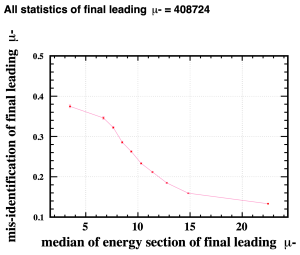
Misjudgment rate ω vs energy section

$$\omega_{leading\ particle} = \Sigma(\omega_i * Probability^{N(statistics)}_i * Probability^{E(energy)}_i)$$

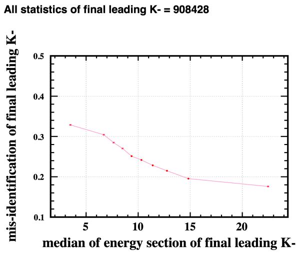
$\omega_{e-} = \Sigma(\omega_i * PN_i * PE_i) = 0.212$



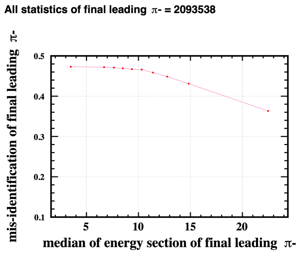
$\omega_{\mu-} = \Sigma(\omega_i * PN_i * PE_i) = 0.213$



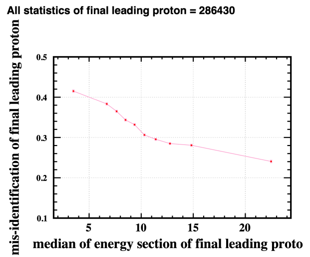
$\omega_{K-} = \Sigma(\omega_i * PN_i * PE_i) = 0.252$



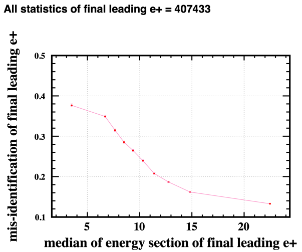
$\omega_{\pi-} = \Sigma(\omega_i * PN_i * PE_i) = 0.456$



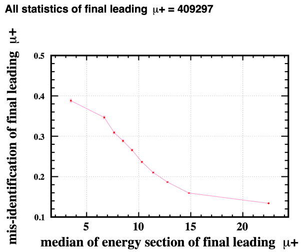
$\omega_{proton} = \Sigma(\omega_i * PN_i * PE_i) = 0.328$



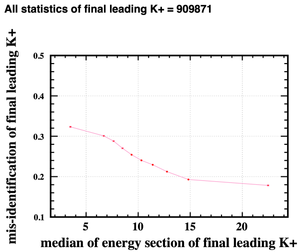
$\omega_{e+} = \Sigma(\omega_i * PN_i * PE_i) = 0.214$



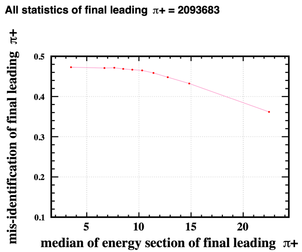
$\omega_{\mu+} = \Sigma(\omega_i * PN_i * PE_i) = 0.214$



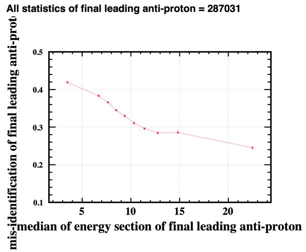
$\omega_{K+} = \Sigma(\omega_i * PN_i * PE_i) = 0.252$



$\omega_{\pi+} = \Sigma(\omega_i * PN_i * PE_i) = 0.456$

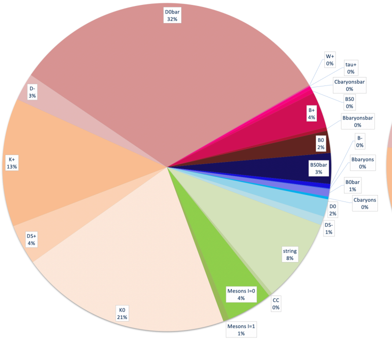


$\omega_{antiproton} = \Sigma(\omega_i * PN_i * PE_i) = 0.330$

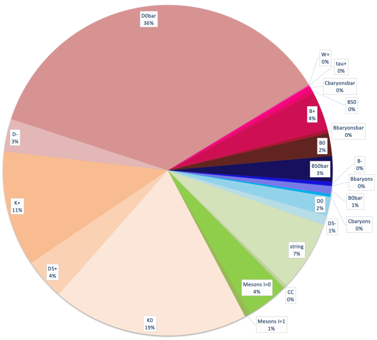


Percent of final leading K+ from different decay chains vs energy section

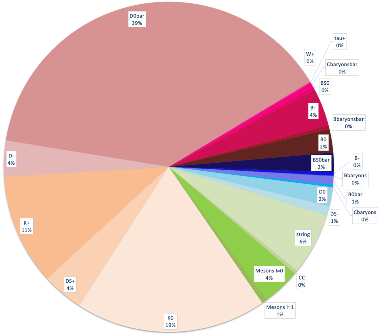
Energy (0.8,6.18)



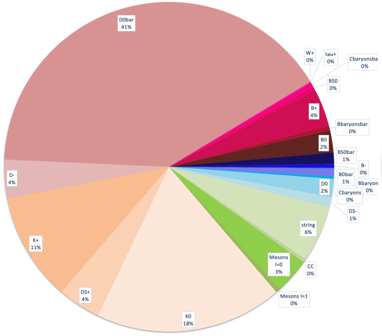
Energy (6.18,7.21)



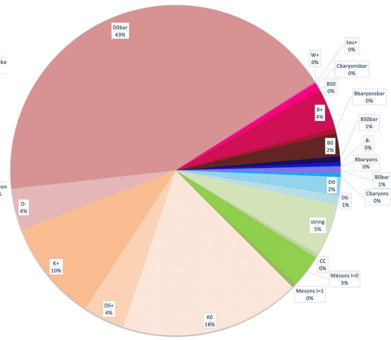
Energy (7.21,8.07)

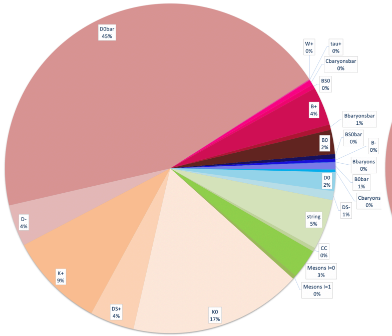


Energy (8.07,8.92)

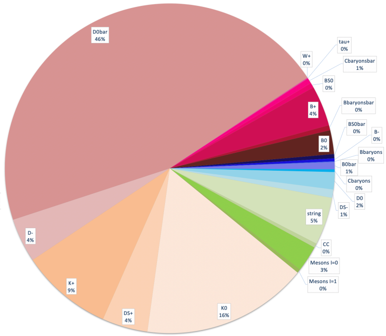


Energy (8.92,9.81)

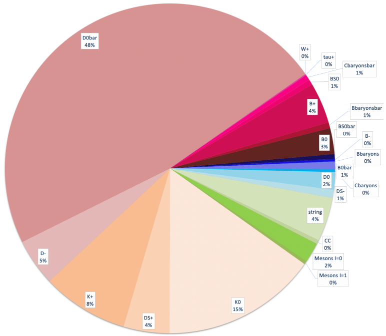




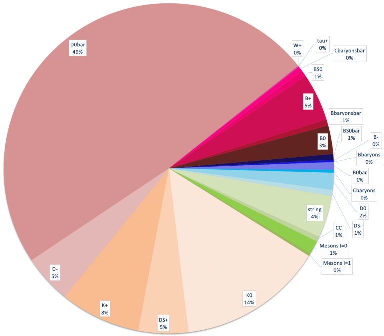
Energy (9.81,10.81)



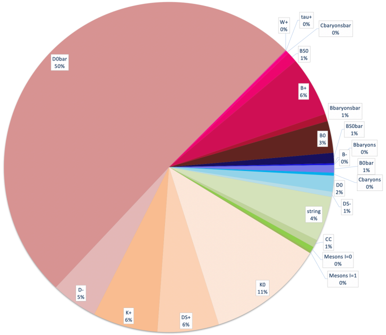
Energy (10.81,11.98)



Energy (11.98,13.55)



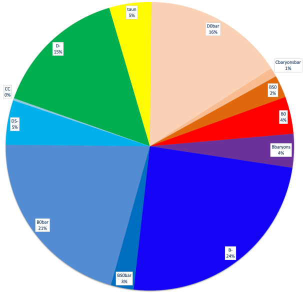
Energy (13.55,16.10)



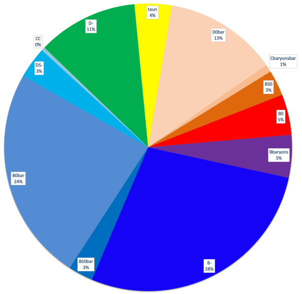
Energy (16.10,28.85)

Percent of final leading μ- from different decay chains vs energy section

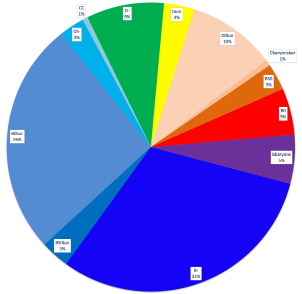
Energy (0.8,7.33)



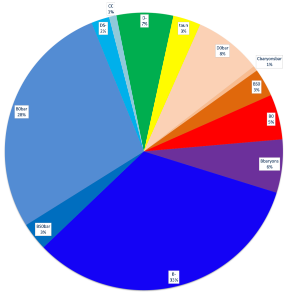
Energy (7.33,8.80)



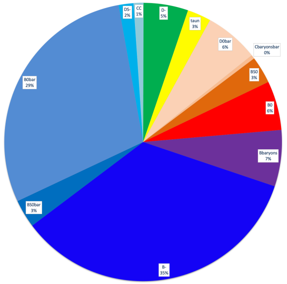
Energy (8.80,10.09)

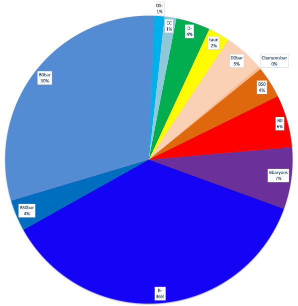


Energy (10.09,11.34)

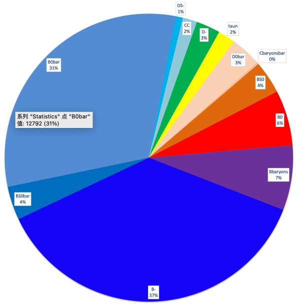


Energy (11.34,12.65)

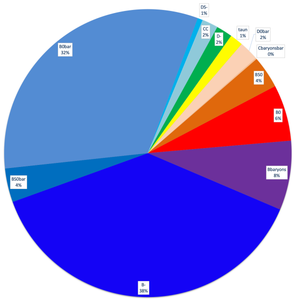




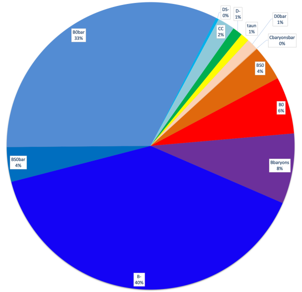
Energy (12.65,14.10)



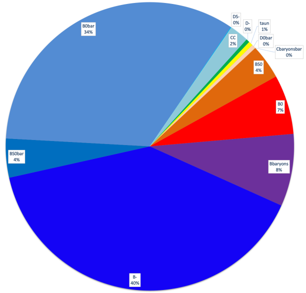
Energy (14.10,15.77)



Energy (15.77,17.85)



Energy (17.85,20.85)

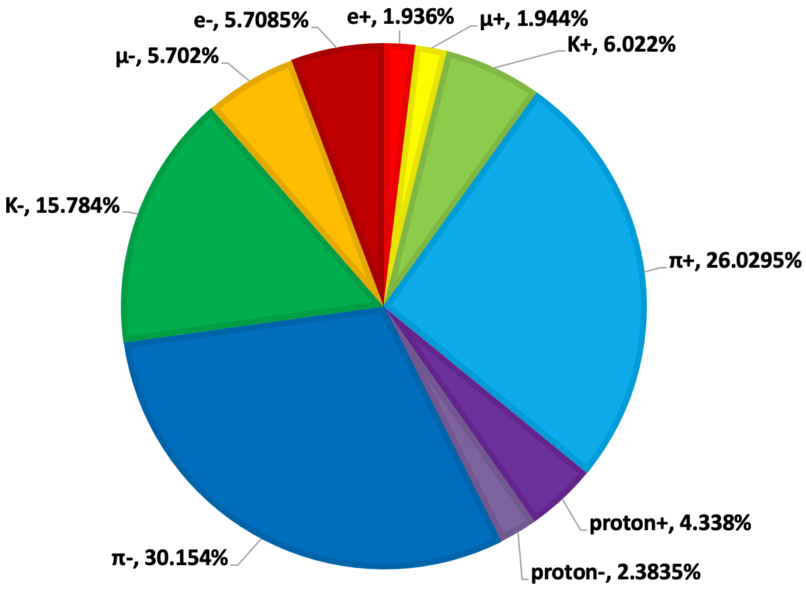


Energy (17.85,38.45)

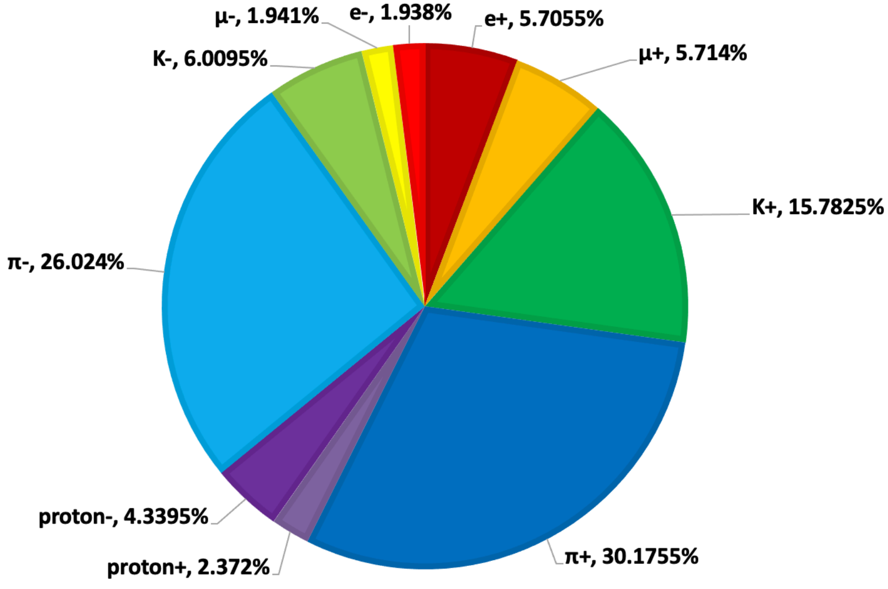
Now,

For each jet,
Find a Final Leading Particle

Percent of final charged leading particles of b jet and bbar jet



b jet



bbar jet

b jet & bbar jet leading particle distribution

bbar→ b↓	e+	e-	μ+	μ-	K+	K-	π+	π-	p+	p-	total
e+	0.109%	0.037%	0.109%	0.037%	0.304%	0.117%	0.583%	0.507%	0.047%	0.086%	**1.936%**
e-	0.328%	0.110%	0.327%	0.111%	0.899%	0.341%	1.721%	1.488%	0.1345%	0.249%	**5.7085%**
μ+	0.1105%	0.037%	0.112%	0.038%	0.307%	0.117%	0.587%	0.506%	0.046%	0.0835%	**1.944%**
μ-	0.323%	0.110%	0.328%	0.110%	0.900%	0.342%	1.725%	1.480%	0.135%	0.249%	**5.702%**
K+	0.3435%	0.116%	0.342%	0.119%	0.949%	0.3645%	1.818%	1.564%	0.143%	0.263%	**6.022%**
K-	0.905%	0.307%	0.901%	0.307%	2.488%	0.944%	4.768%	4.112%	0.373%	0.679%	**15.784%**
π+	1.483%	0.506%	1.492%	0.503%	4.1045%	1.567%	7.861%	6.768%	0.617%	1.128%	**26.0295%**
π-	1.7205%	0.584%	1.721%	0.583%	4.775%	1.811%	9.090%	7.853%	0.7145%	1.302%	**30.154%**
p+	0.248%	0.084%	0.246%	0.086%	0.683%	0.261%	1.306%	1.125%	0.104%	0.195%	**4.338%**
p-	0.135%	0.047%	0.136%	0.047%	0.373%	0.145%	0.7165%	0.621%	0.058%	0.105%	**2.3835%**
total	**5.7055%**	**1.938%**	**5.714%**	**1.941%**	**15.7825%**	**6.0095%**	**30.1755%**	**26.024%**	**2.372%**	**4.3395%**	**100.00%**

b jet & bbar jet leading particle distribution

等待做成colorful的图。。。

b jet & bbar jet leading particle distribution 先分四种情况研究

bbar jet→ b jet↓	**eμK**	**πp**
eμK	case 1	case 2
πp	case 3	case 4

1

For
b jet is {e,μ,K}
bbar jet is {e,μ,K}

For {b jet = e, μ, K}{bbar jet = e, μ, K} ,no energy cut

$N_{\{all\}} = 16396350$

$N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}} = 2254715$

$N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}\{charge\_verse\}} = 1374412$

$N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}\{charge\_nn\}} = 439801$

$N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}\{charge\_np\}} = 1213180 = N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}\{charge\_verse\}\{charge\_correct\}}$

$N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}\{charge\_pn\}} = 161232$

$N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}\{charge\_pp\}} = 440502$

For {b jet = e, μ, K}{bbar jet = e, μ, K} ,no energy cut

Percent of {b jet = e, μ, K}{bbar jet = e, μ, K} = $\frac{N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}}}{N_{\{all\}}} = \frac{2254715}{16396350}$ = 0.1375

Percent of {charge_verse} = $\frac{N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}\{charge\_verse\}}}{N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}}} = \frac{1374412}{2254715}$ = 0.6096

Percent of {charge_correct}= $\frac{N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}\{charge\_verse\}\{charge\_correct\}}}{N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}\{charge\_verse\}}} = \frac{1213180}{1374412}$ = 0.8827

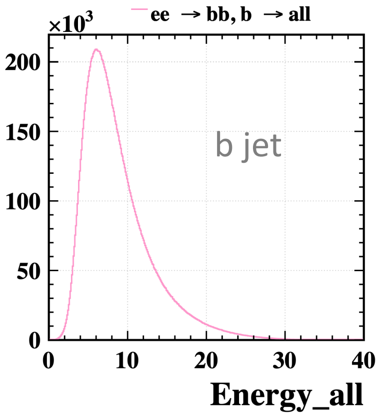
Efficiency = $\frac{N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}\{charge\_verse\}\{charge\_correct\}}}{N_{\{all\}}} = \frac{1213180}{16396350}$ = 0.07399

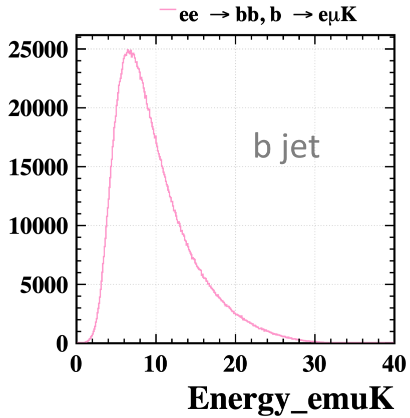
ω =1- Percent of {charge_correct} = 0.1173

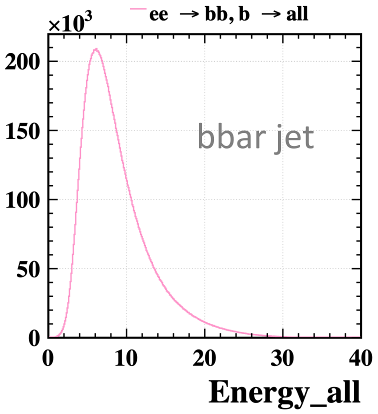
$(1-2*\omega)^2$ = 0.5858

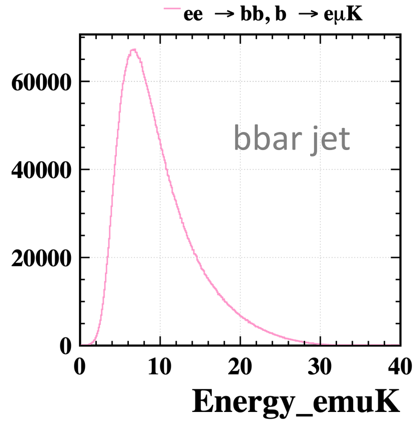
Effective tagging power = Efficiency * $(1-2*\omega)^2$ = 0.04334

Energy spectrum of {b jet = e, μ, K}{bbar jet = e, μ, K}





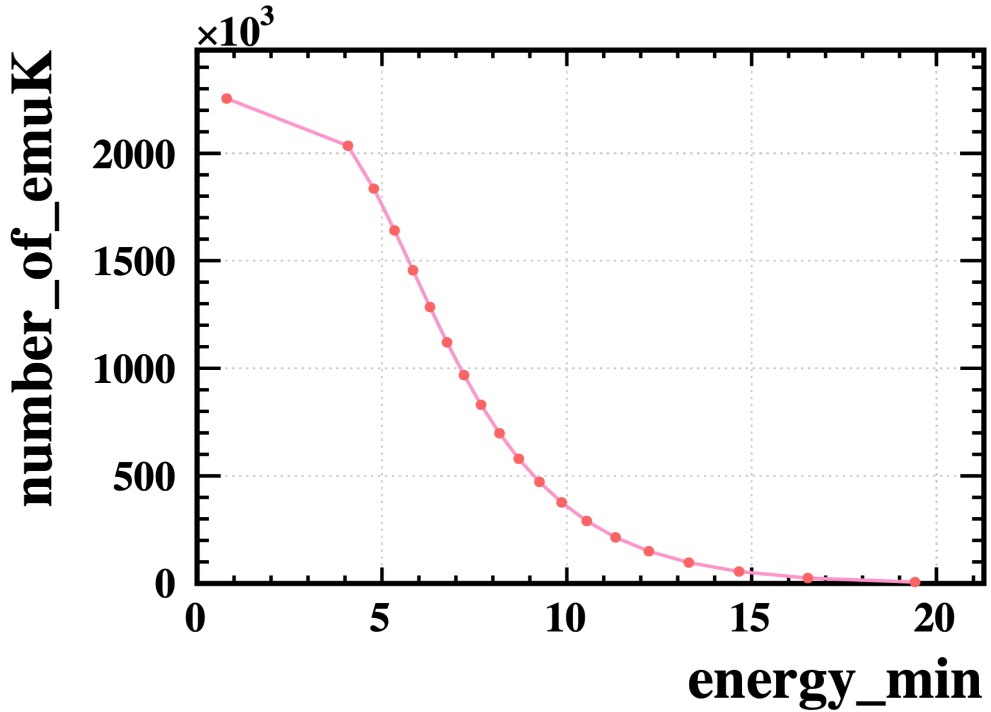




Percent of {b jet = e, μ, K}{bbar jet = e, μ, K}

$$= \frac{N_{\{b\ jet\ =\ e,\ \mu,\ K\}\{bbar\ jet\ =\ e,\ \mu,\ K\}}}{N_{\{all\}}} = \frac{2254715}{16396350} = 0.1375$$

解决一个疑惑：Number of {b jet = e, μ, K}{bbar jet = e, μ, K}



说明左图的点纵轴的差值不应该等值：

设总事例数为 N，每个bin内事例数为 n。

设第 i 次对两边 jet LP 做 energy cut，还剩事例数为 n_i。

- 每一边还剩下的事例数占比为 $\frac{n_i}{N}$
- 两边还剩下的事例数占比为 $\left(\frac{n_i}{N}\right)^2$

那么，

第 $(i+1)$ 次对两边 jet LP 做 energy cut，

比上次少了 $\left(\frac{n_i}{N}\right)^2 - \left(\frac{n_{i+1}}{N}\right)^2$

$$= \left(\frac{n_i}{N}\right)^2 - \left(\frac{n_i - n_0}{N}\right)^2$$

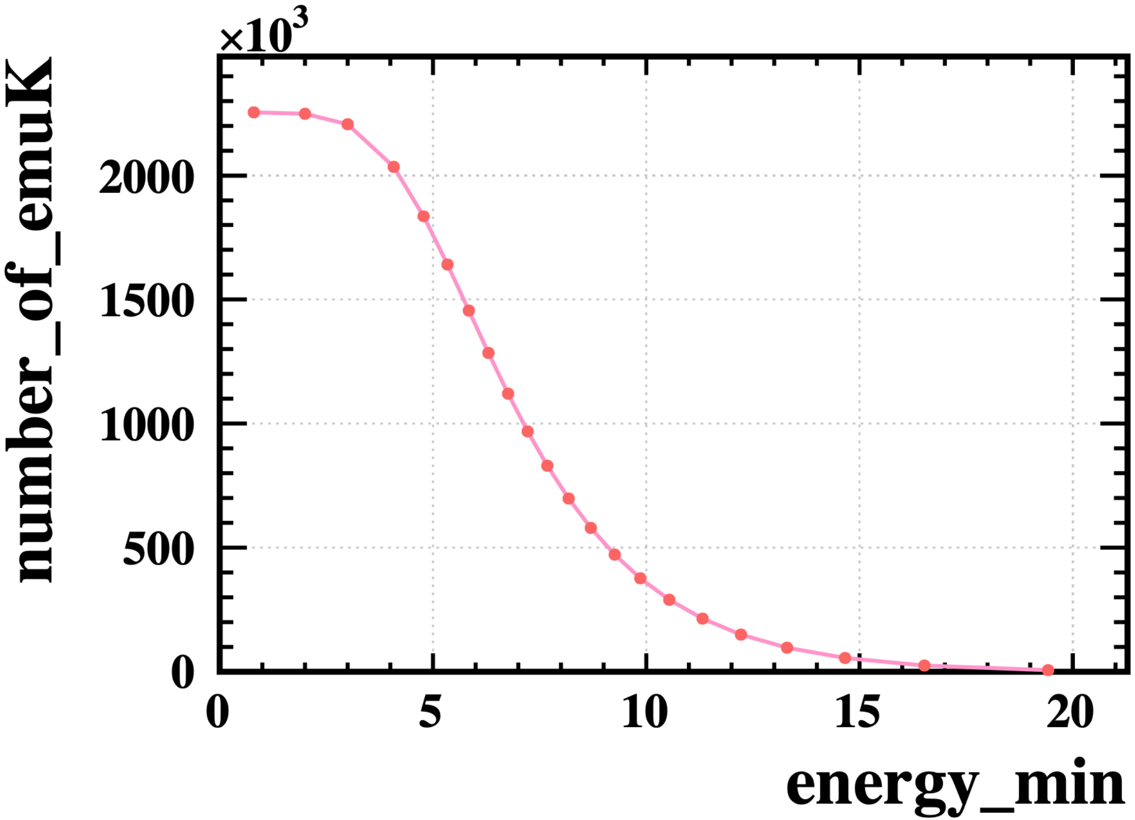
$$= \frac{2n_0}{N^2} \cdot n_i - \frac{n_0^2}{N^2}$$

是 n_i 的一次函数。

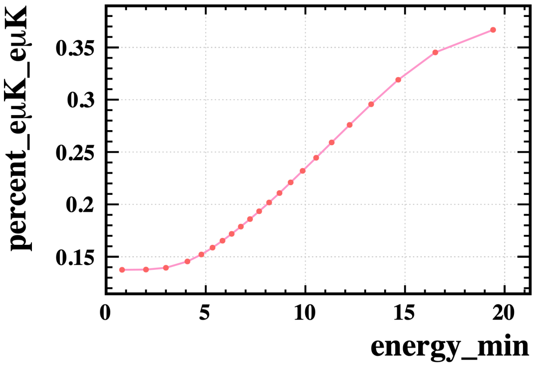
n_i 逐渐减小

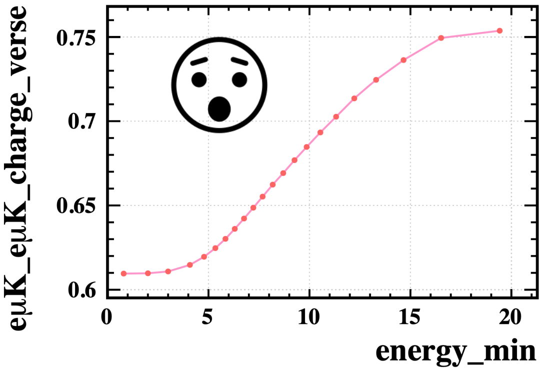
因此左图每两点的纵坐标差值逐渐减小。

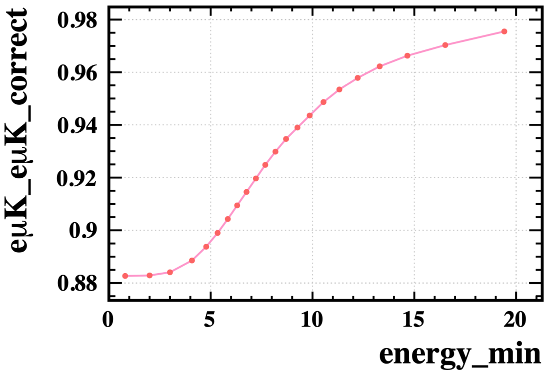
前面加上两个点之后。。Number of {b jet = e, μ, K}{bbar jet = e, μ, K}



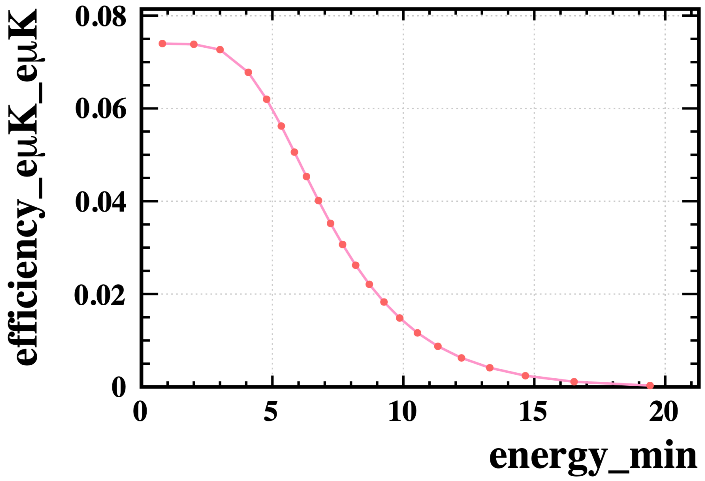
Steps for Efficiency of {b jet = e, μ, K}{bbar jet = e, μ, K}

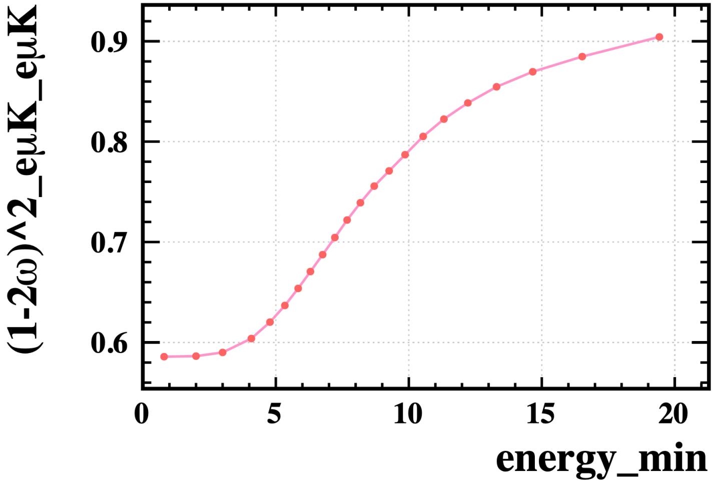




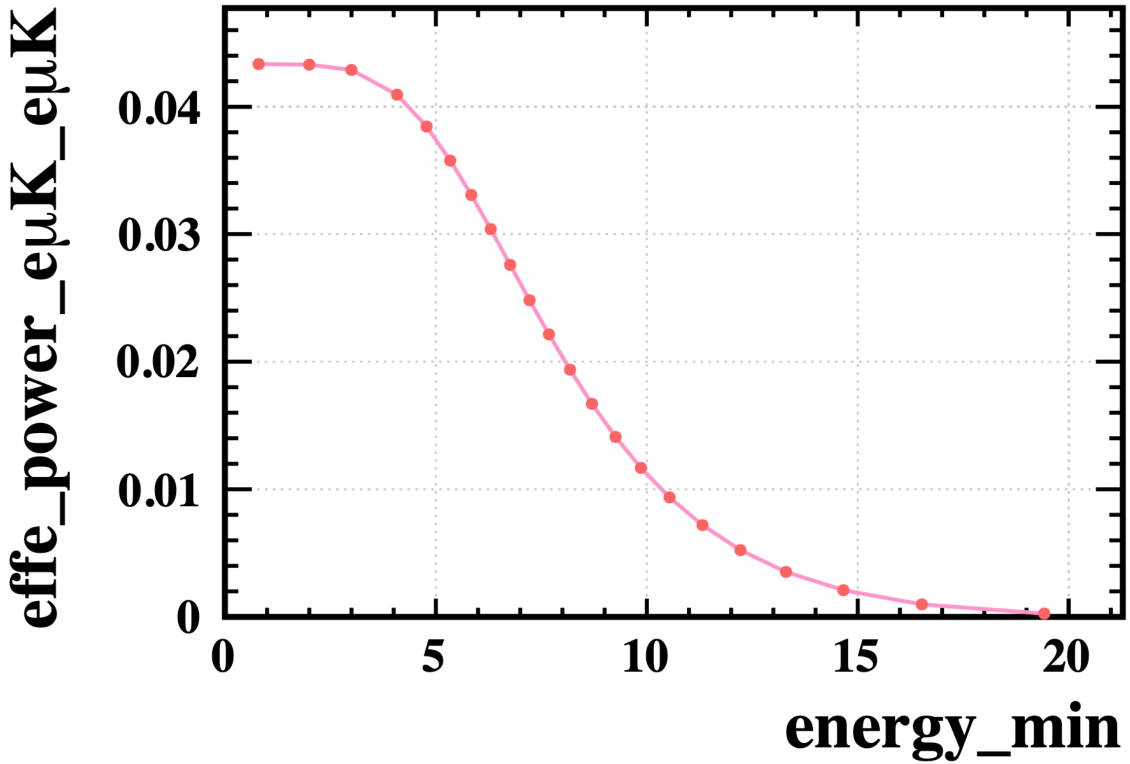


Efficiency & $(1-2*\omega)^2$ of{b jet = e, μ, K}{bbar jet = e, μ, K}





Effective tagging power of {b jet = e, μ, K}{bbar jet = e, μ, K}



2

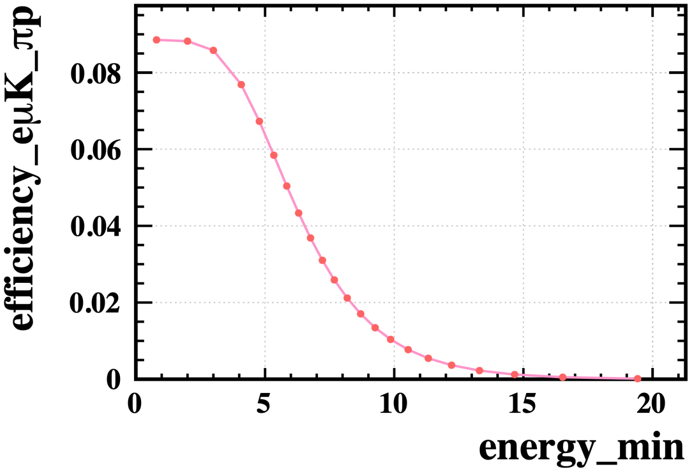
For
b jet is {e,μ,K}
bbar jet is {π,proton}

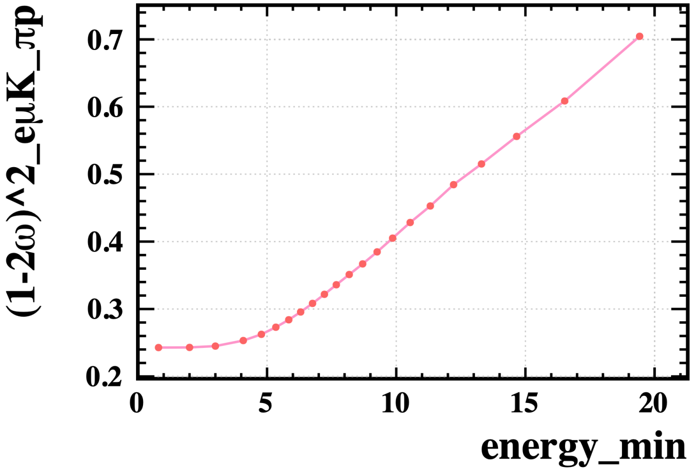
For {π,proton}

I need to check the proton...

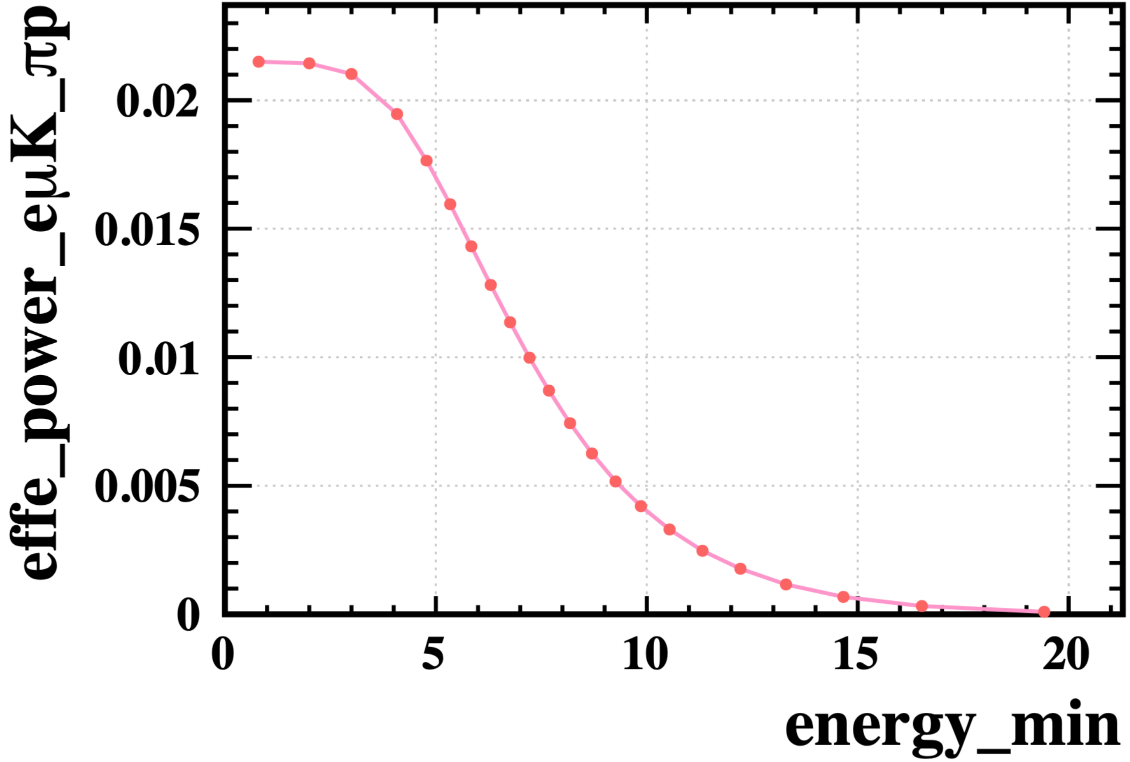
But even so, let's move on...

Efficiency & $(1-2*\omega)^2$ of {b jet = e, μ, K}{bbar jet = π,proton}





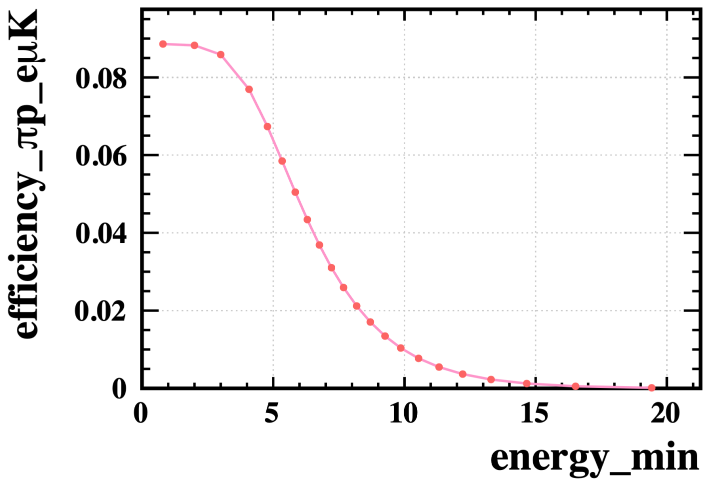
Effective tagging power of {b jet = e, μ, K}{bbar jet = π,proton}

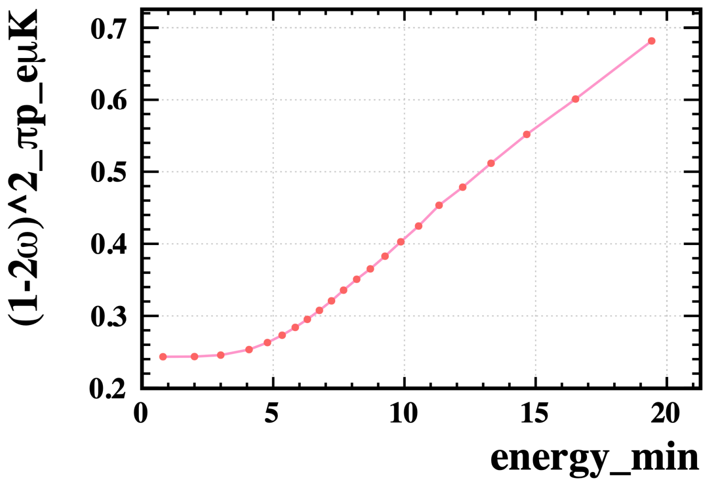


3

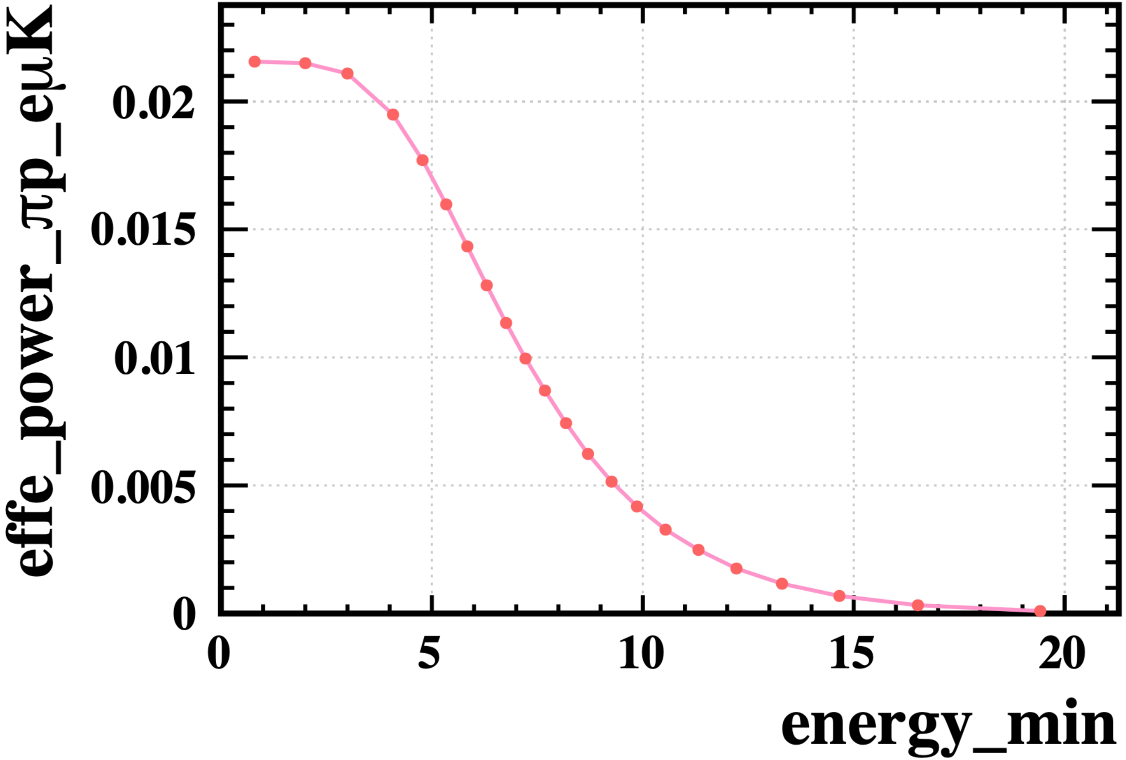
For
b jet is {π,proton}
bbar jet is {e,μ,K}

Efficiency & $(1-2*\omega)^2$ of {b jet = π,proton}{bbar jet = e, μ, K}





Effective tagging power of {b jet = π,proton}{bbar jet = e, μ, K}



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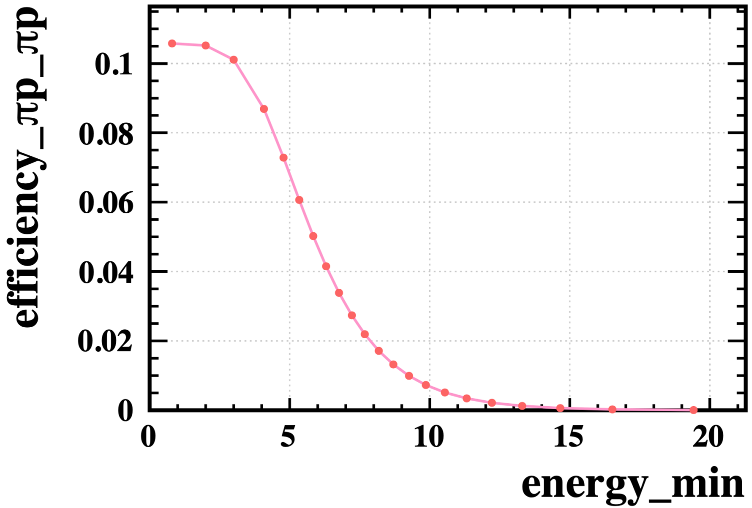
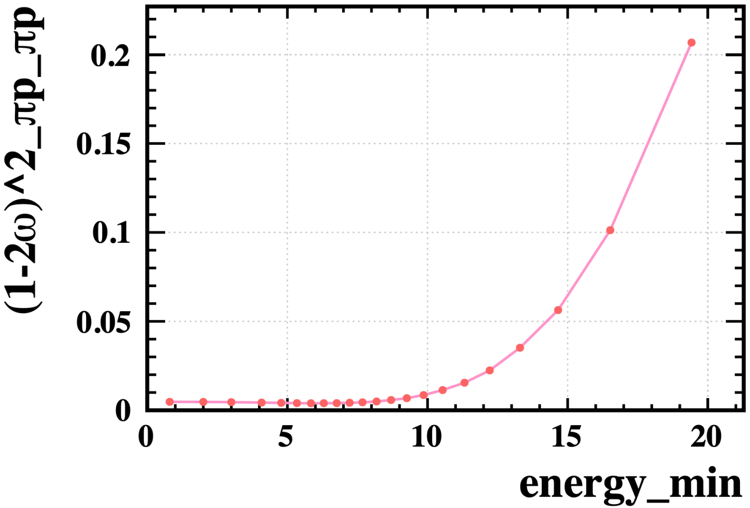
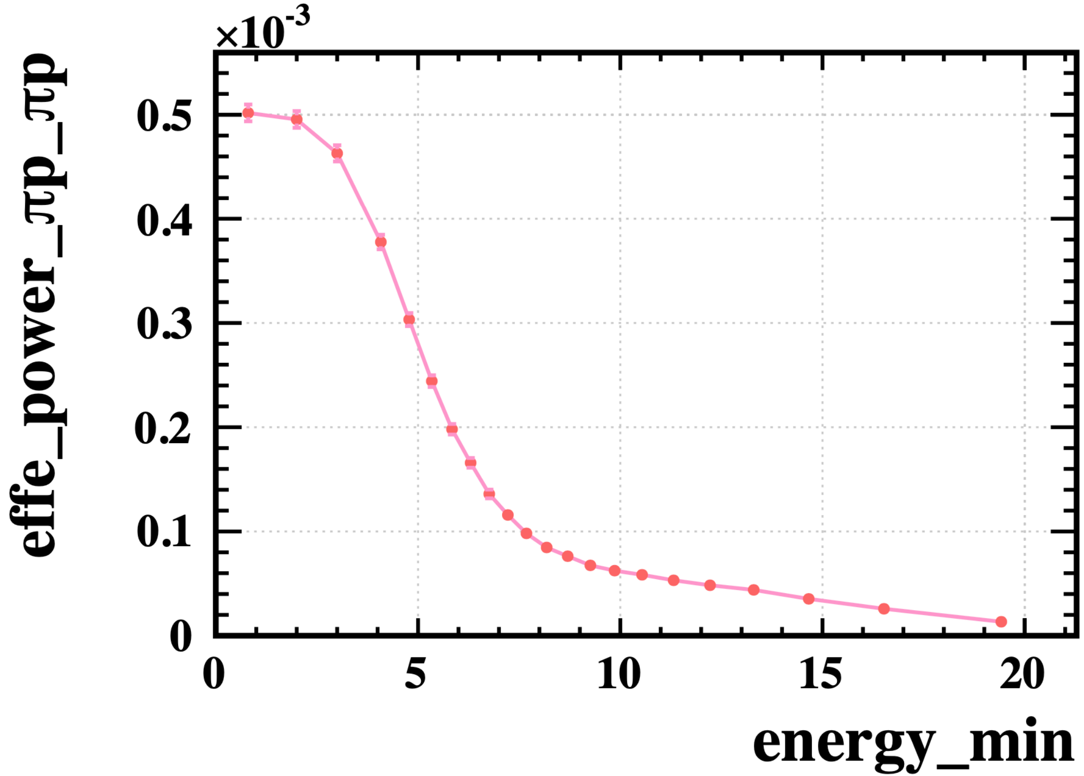
For
b jet is {π,proton}
bbar jet is {π,proton}

Efficiency & $(1-2*\omega)^2$ of {b jet = π,proton}{bbar jet = π,proton}





Effective tagging power of {b jet = π,proton}{bbar jet = π,proton}



未完待续。。

Efficiency & omega之间隐含的关联关系，是啥？

为什么effective tagging power总是单调的？

下期预告

Questions above …

Same charge of two jets' leading particle

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