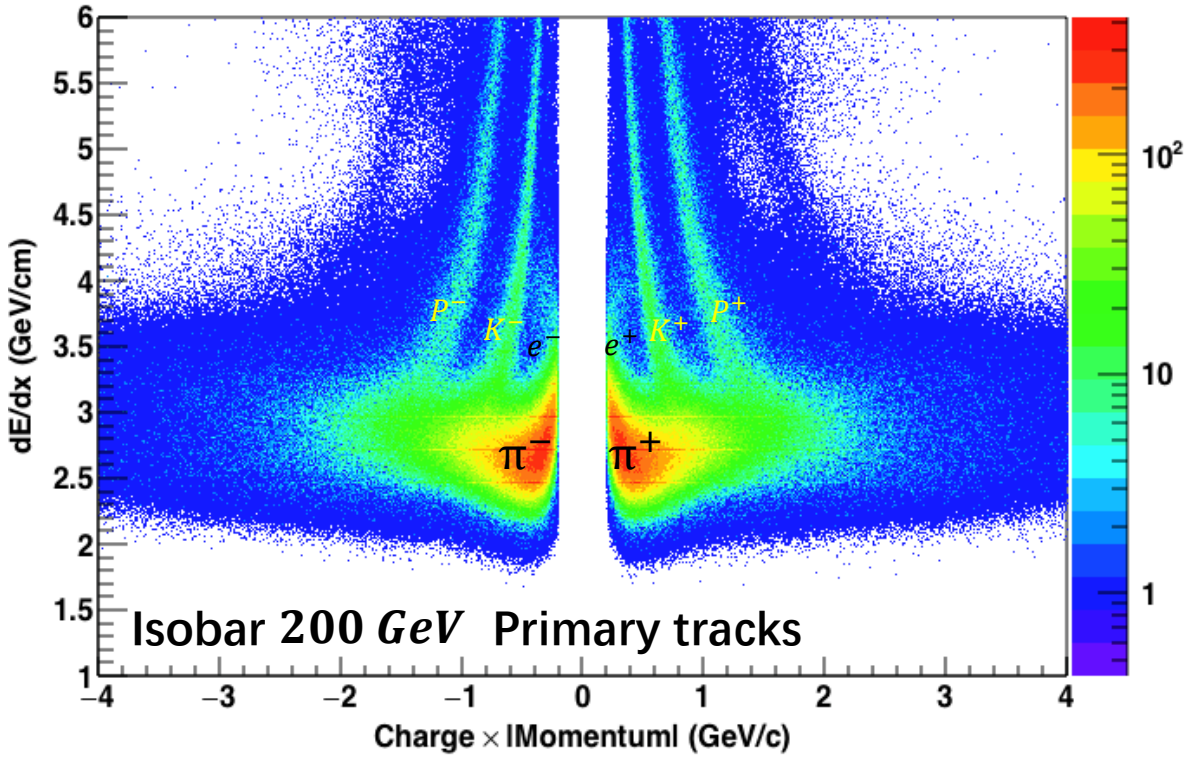
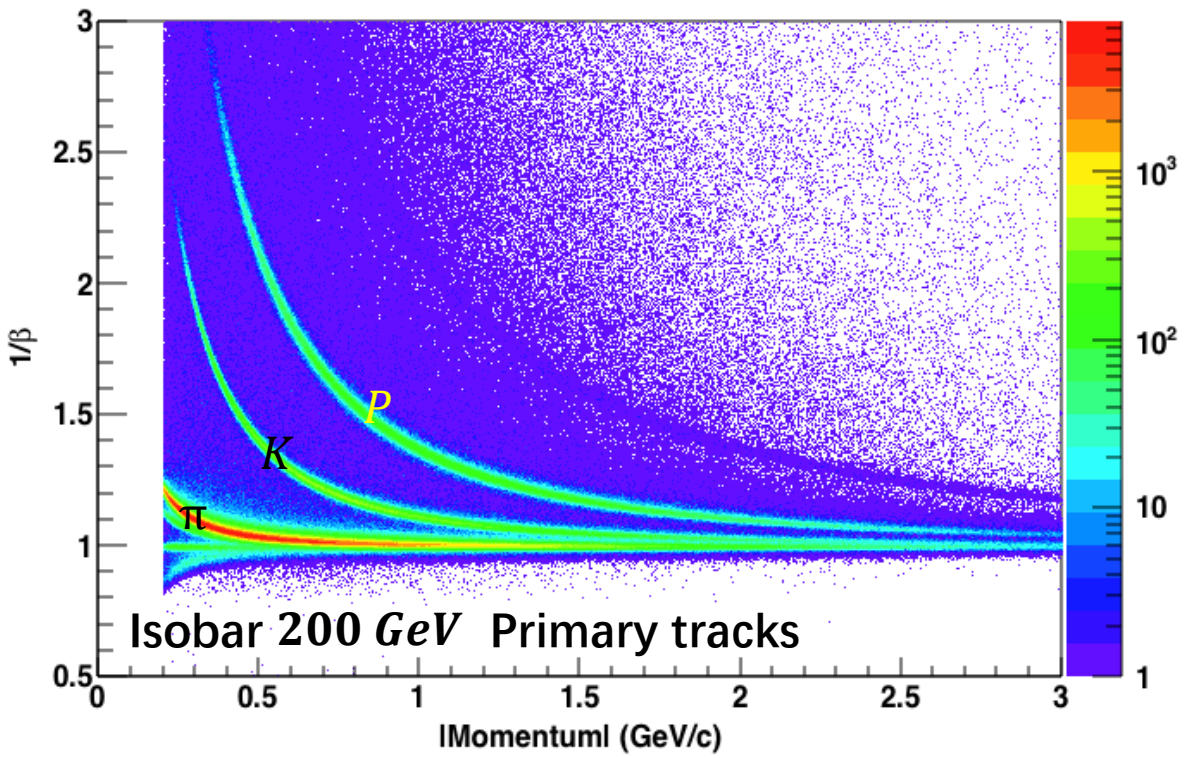
Double_Counting in Isobar collisions – v1

Double-counting Due to MisPID

Isobar $\sqrt{s_{NN}} = 200\ GeV$ Primary tracks

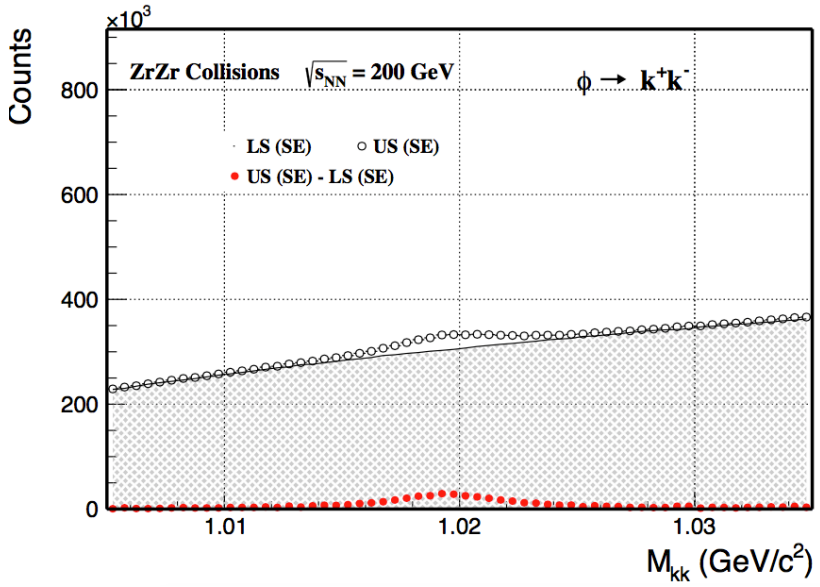


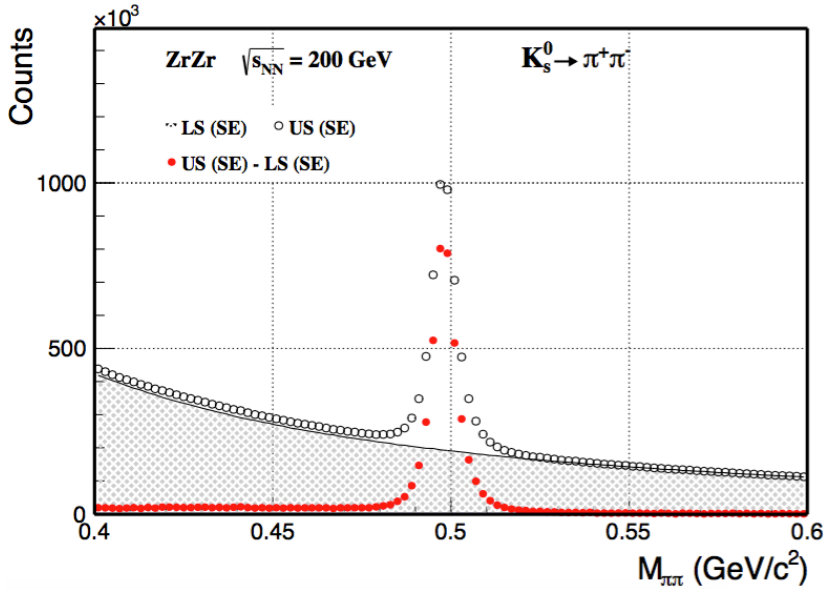
TPC PID

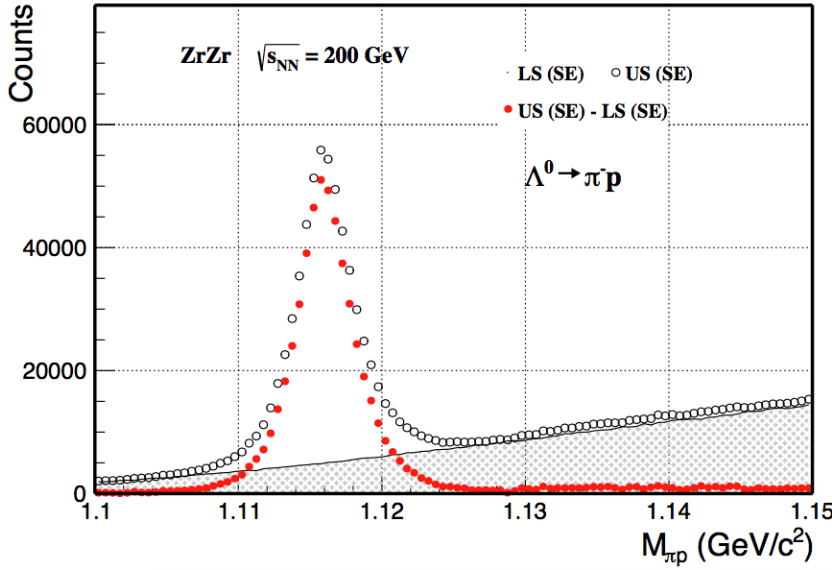


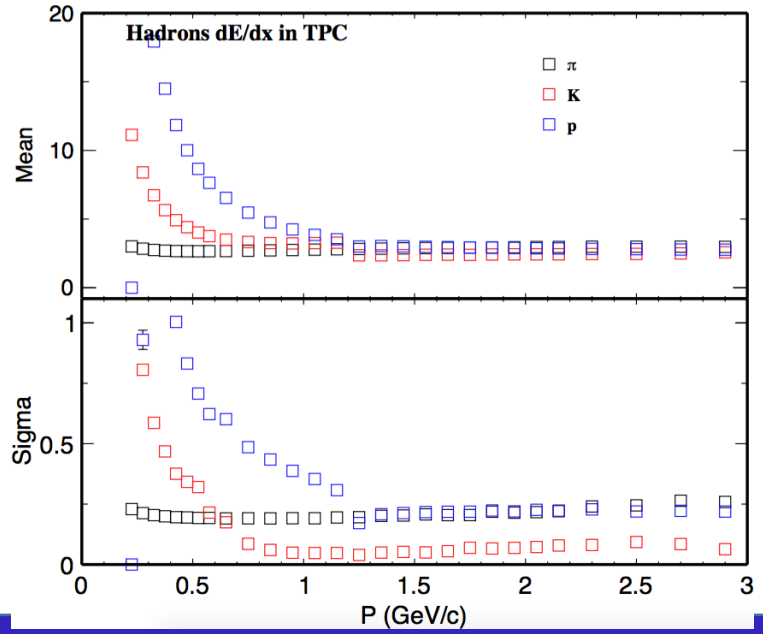
TOF PID: $\beta=\frac{L}{ct}$

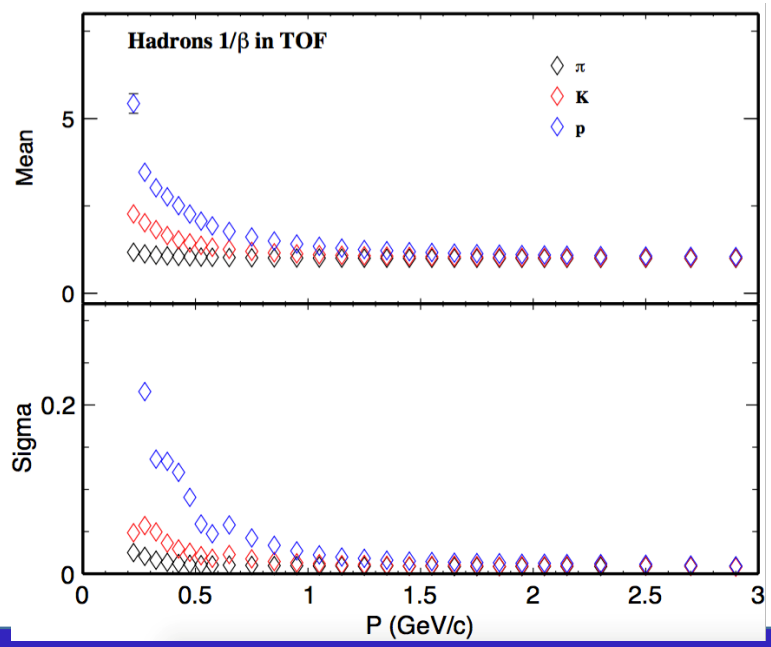
Pure samples & dE/dx, 1/β distributions











TPC and TOF MisPID Probability for Pion/Kaon

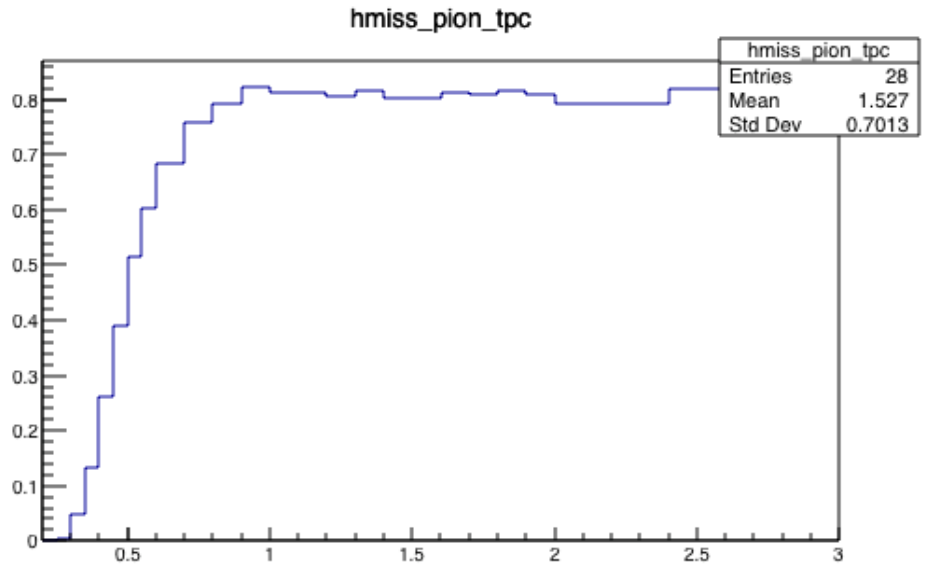
Step1

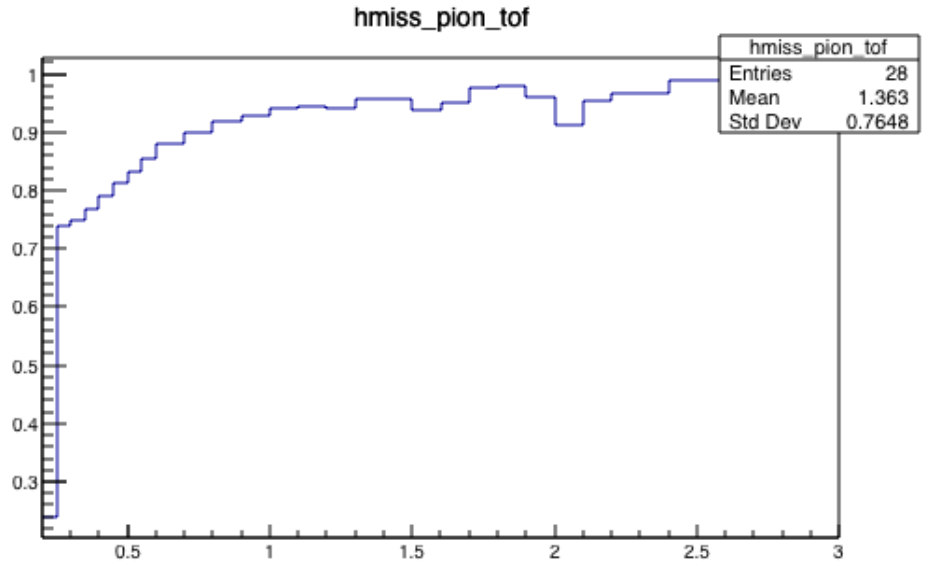
- $X_1 \sim N(\mu_1, \sigma_1^2)$ with pdf $f_1(x_1)$ and cdf $F_1(x_1)$ and
- $X_2 \sim N(\mu_2, \sigma_2^2)$ with pdf $f_2(x_2)$ and cdf $F_2(x_2)$
- $C=\frac{\mu_2\sigma_1^2-\sigma_2(\mu_1\sigma_2+\sigma_1\sqrt{(\mu_1-\mu_2)^2+2(\sigma_1^2-\sigma_2^2)\log(\frac{\sigma_1}{\sigma_2})})}{\sigma_1^2-\sigma_2^2}$
- $P(X_1>C)+P(X_2<C)=1-F_1(C)+F_2(C)=1-\frac{1}{2}\mathrm{erf}\left(\frac{C-\mu_1}{\sqrt{2}\sigma_1}\right)+\frac{1}{2}\mathrm{erf}\left(\frac{C-\mu_2}{\sqrt{2}\sigma_2}\right)$

Note: just use dedx, 1/β informations.

Step2

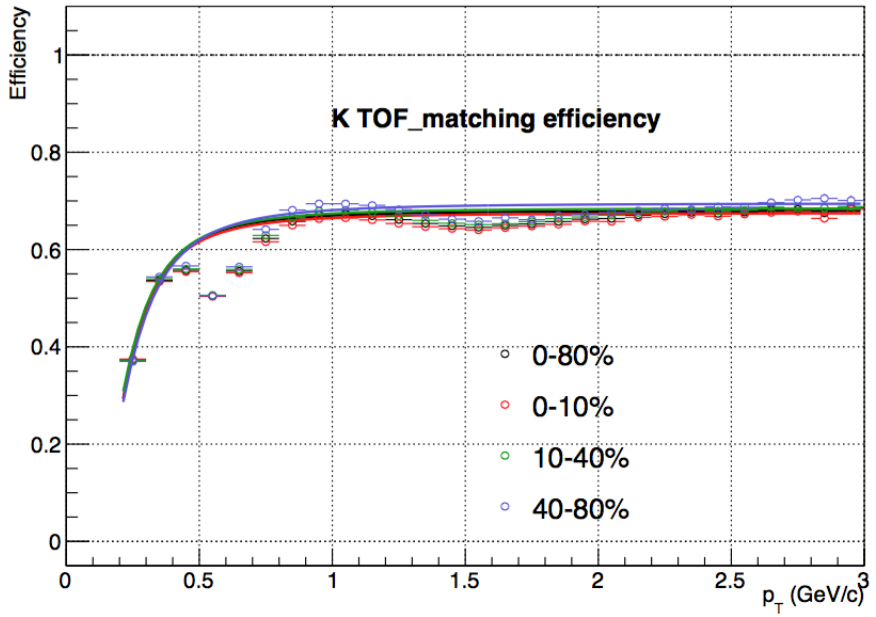
Pion/Kaon misPID probability convert to D0 countings.

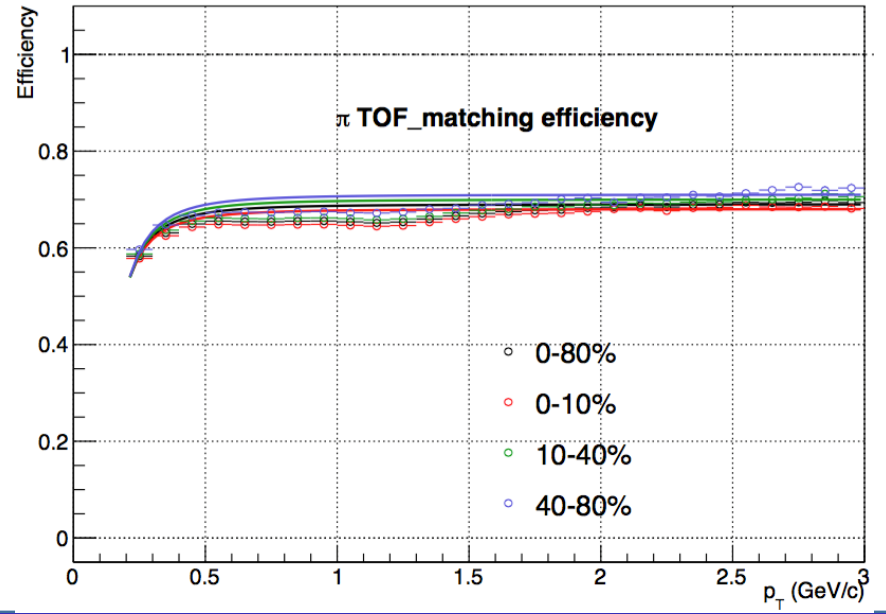




Double counting

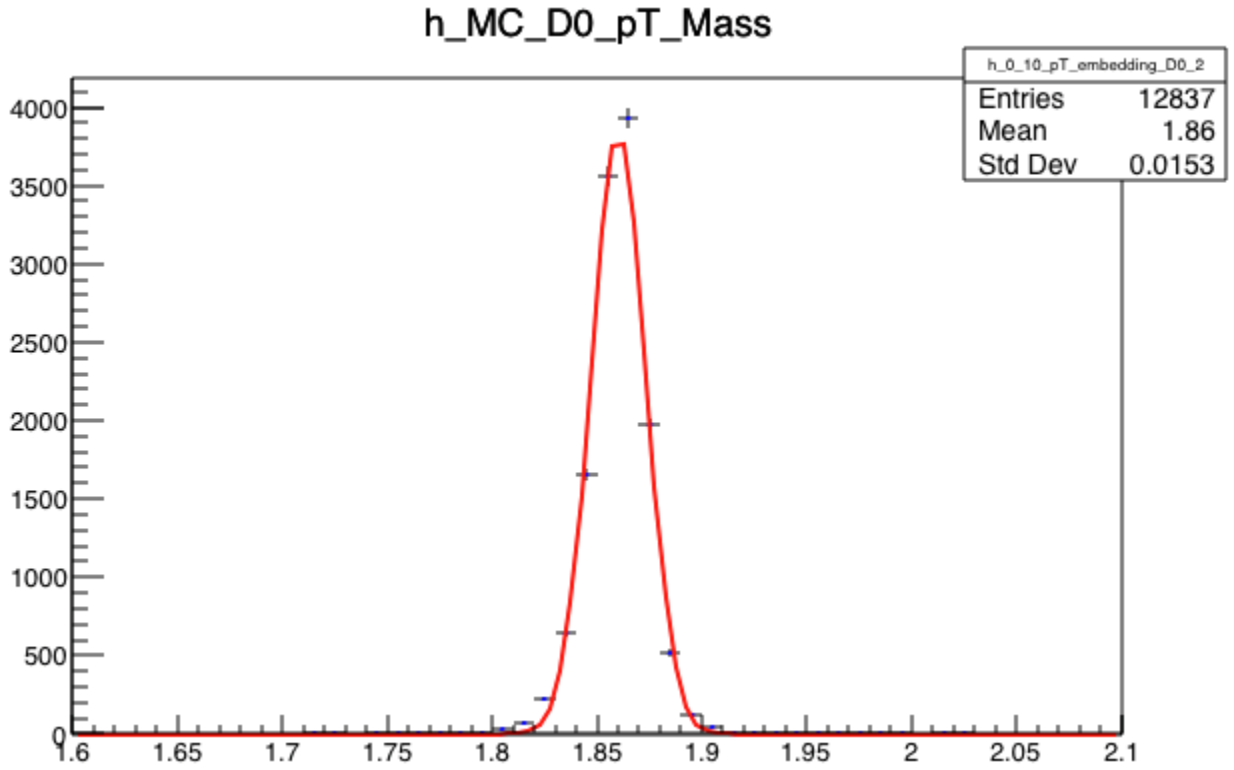
```
if(p1<1.6)                                          //pion
{
    ppbin = h_miss_pion_tpc->GetXaxis()->FindBin(p1);
    pion_mis_tpc = h_miss_pion_tpc->GetBinContent(ppbin+1);
    pion_mis_tof = h_miss_pion_tof->GetBinContent(ppbin+1);
    pion_mis =pion_mis_tpc/2.* pion_mis_tof/2.;
}
else if(p1<3.)
{

    if((rand()%10) < (10*funeff_0_10->Eval(pt1)))                  //TOF matched
    {
        ppbin = h_miss_pion_tpc->GetXaxis()->FindBin(p1);
        pion_mis_tpc = h_miss_pion_tpc->GetBinContent(ppbin+1);
        pion_mis_tof = h_miss_pion_tof->GetBinContent(ppbin+1);
        pion_mis =pion_mis_tpc/2.* pion_mis_tof/2.;
    }
    else
    {
        ppbin = h_miss_pion_tpc->GetXaxis()->FindBin(p1);
        pion_mis_tpc = h_miss_pion_tpc->GetBinContent(ppbin+1);
        pion_mis =pion_mis_tpc/2.;

    }
}
else
{
    if((rand()%10) < (10*funeff_0_10->Eval(3.0-1.0e-6)))           //TOF matched
    {
        ppbin = h_miss_pion_tpc->GetXaxis()->FindBin(2.5);
        pion_mis_tpc = h_miss_pion_tpc->GetBinContent(ppbin+1);
        pion_mis_tof = h_miss_pion_tof->GetBinContent(ppbin+1);
        pion_mis =pion_mis_tpc/2.* pion_mis_tof/2.;
    }
    else
    {
        ppbin = h_miss_pion_tpc->GetXaxis()->FindBin(2.5);
        pion_mis_tpc = h_miss_pion_tpc->GetBinContent(ppbin+1);
        pion_mis =pion_mis_tpc/2.;
    }
}

float a= rand()%10;              //random between 0-10
if(a<(((10*pion_mis))))
{
        mass1=massK;
        pt1_mis=pt2;
        eta1_mis=eta2;
        phi1_mis=phi2;
}
else{
    mass1=0;
    pt1_mis=0;
    eta1_mis=0;
    phi1_mis=0;
}
```

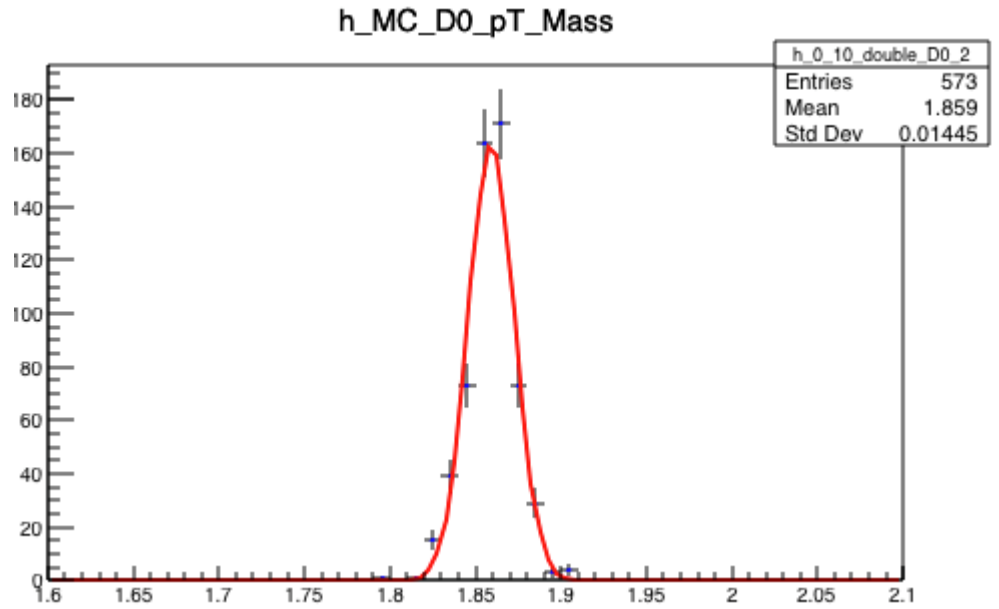




D0 Double-counting Estimation

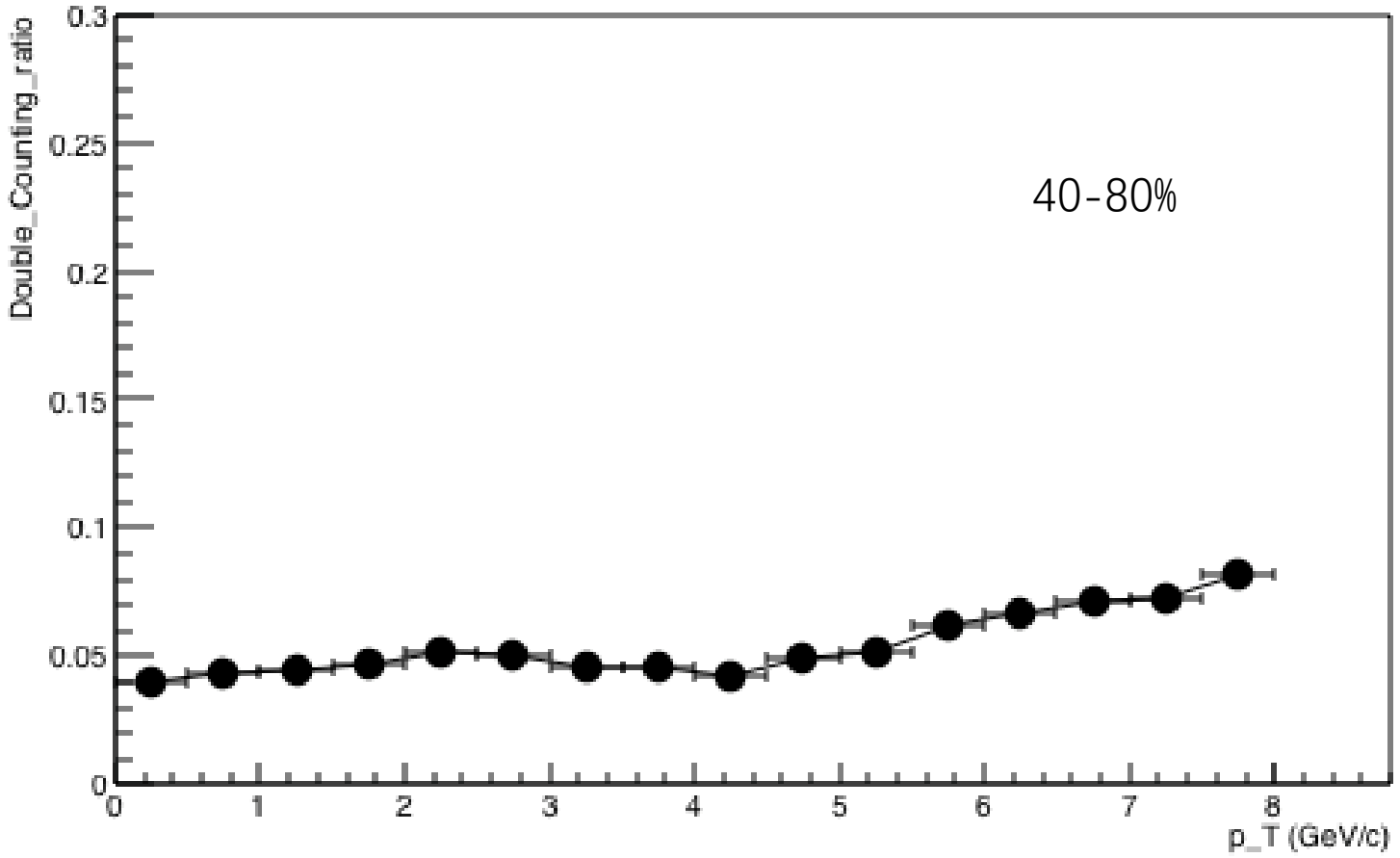
- Same momentum resolution smearing used in Fast_simulation
- Fold in the mis-PID probability into the D0 decay kinematics by PYTHIA
- Signals and double-counting entries were counted within 3σ.





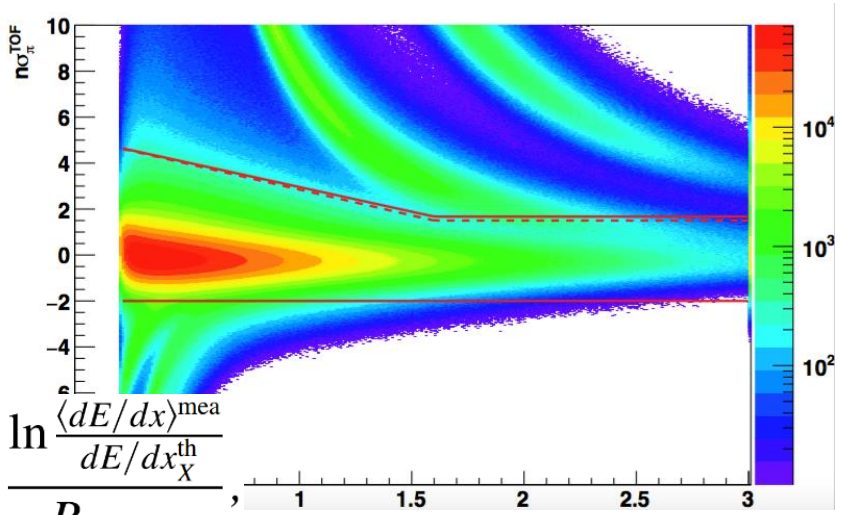
Double-counting Rate vs. D0 pT

Step3

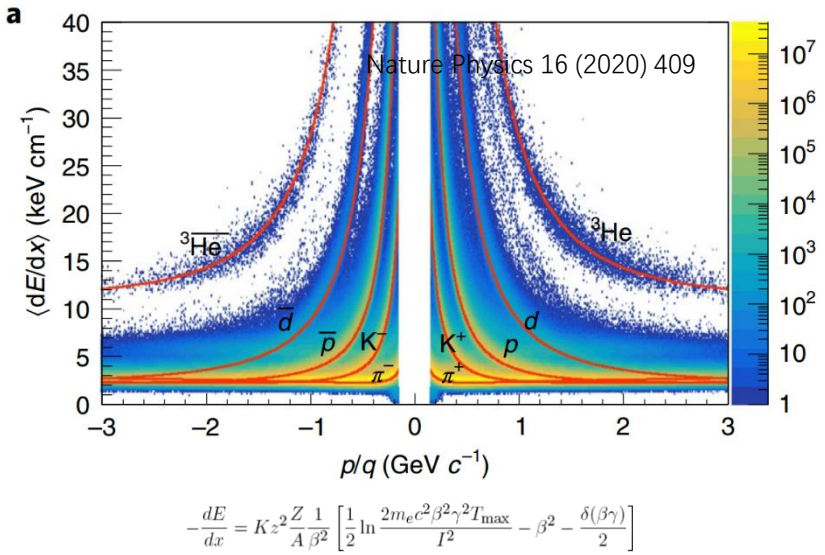


To Do -- calibration

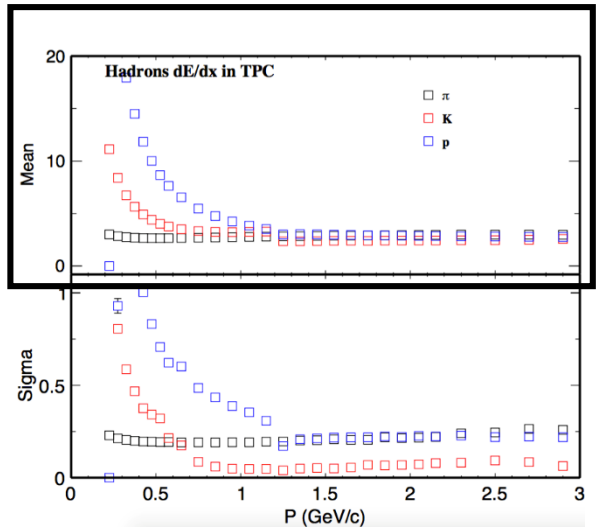
mean



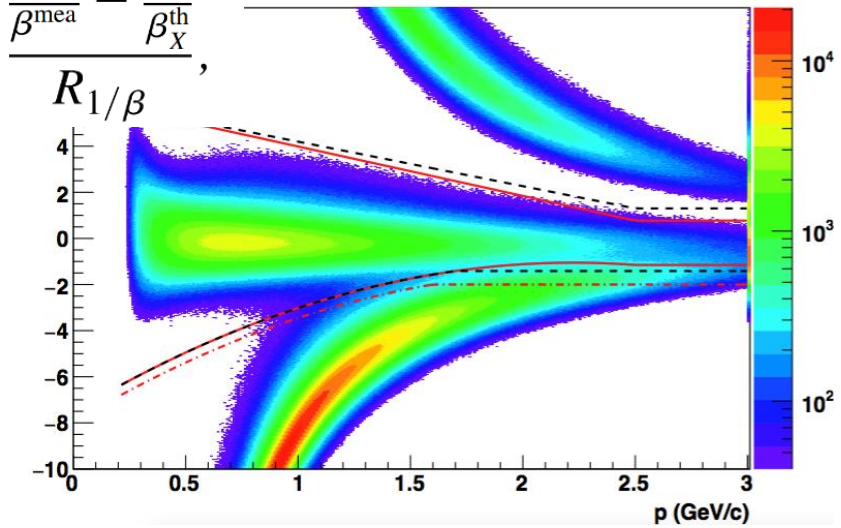
$$n\sigma_X^{dE/dx} = \frac{\ln \frac{\langle dE/dx \rangle^{mea}}{dE/dx_X^{th}}}{R_{dE/dx}},$$

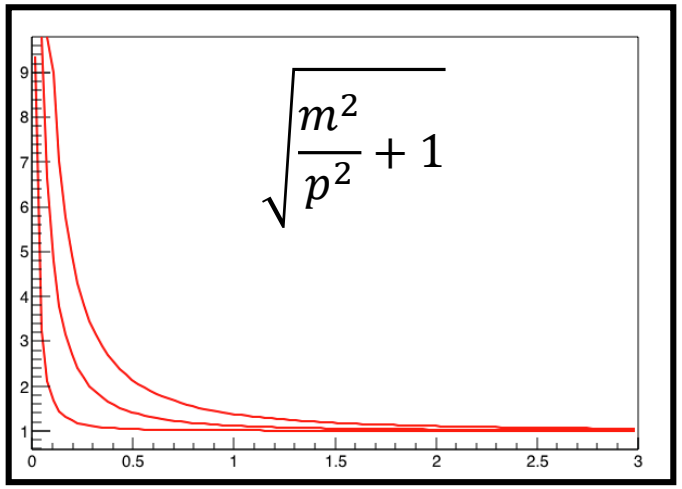


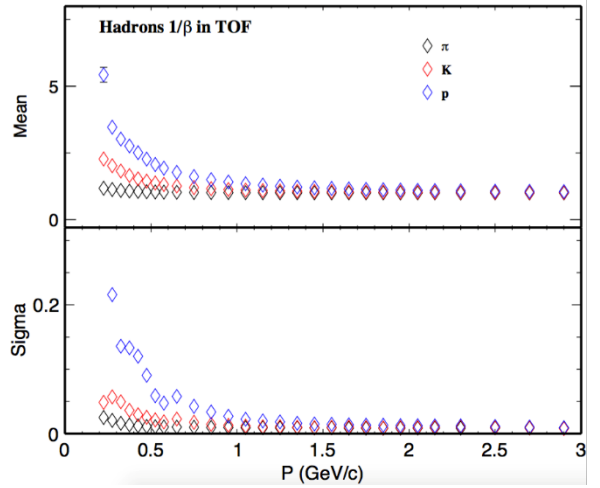
$$-\frac{dE}{dx} = Kz^2\frac{Z}{A}\frac{1}{\beta^2}\left[\frac{1}{2}\ln\frac{2m_e c^2\beta^2\gamma^2 T_{max}}{I^2} - \beta^2 - \frac{\delta(\beta\gamma)}{2}\right]$$



$$n\sigma_X^{TOF} = \frac{\frac{1}{\beta^{mea}} - \frac{1}{\beta_X^{th}}}{R_{1/\beta}},$$







sigma

Pure samples $n\sigma_K$ && $n\sigma_\pi$

To do -- Some details

Cuts for pure sample are the same with the real data analysis;

Systematic uncertainty for DC ratio.