MPD PID II

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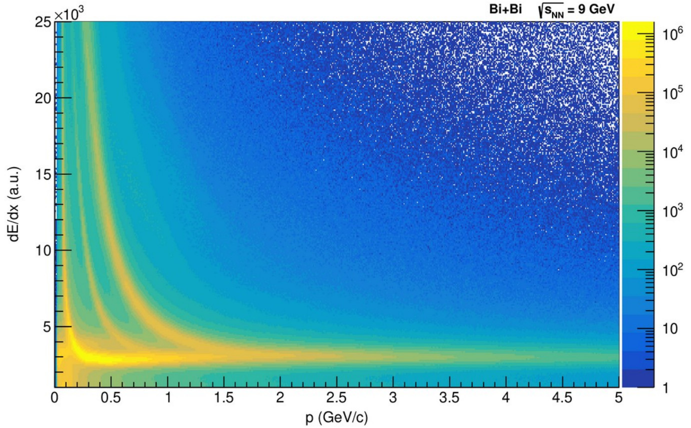
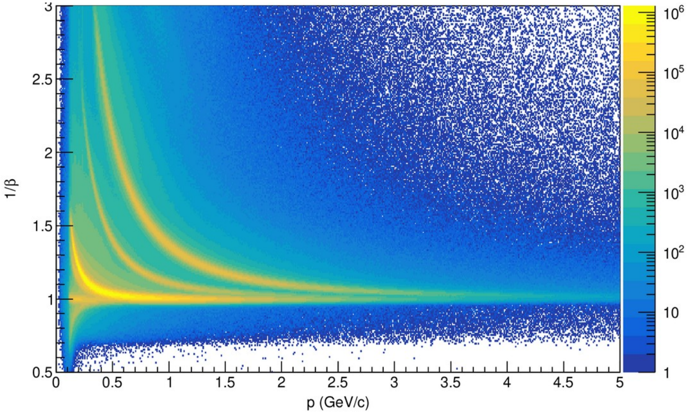
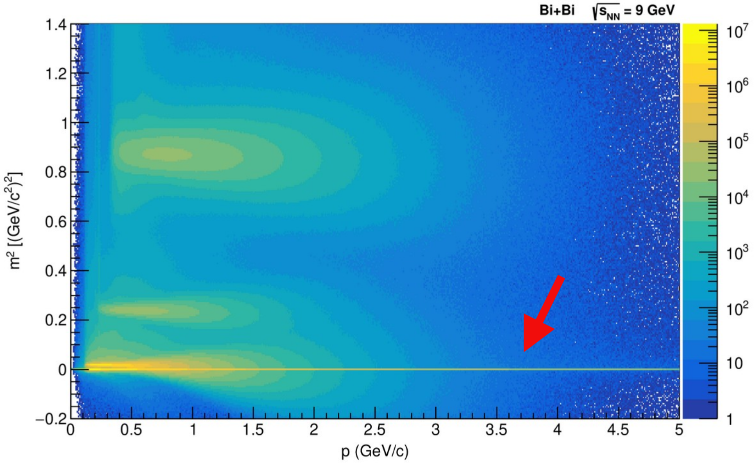
Sample and track selection

- Sample location:
  /eos/nica/mpd/sim/data/exp/dst-BiBi-09GeV-mp07-20-pwg3-250ev/BiBi/09.0GeV-0-14fm/UrQMD/BiBi-09GeV-mp07-20-pwg3-250ev-1
- For parameters extraction and PID tracks with $N_{\text{hits}} \geq 15$ were selected.





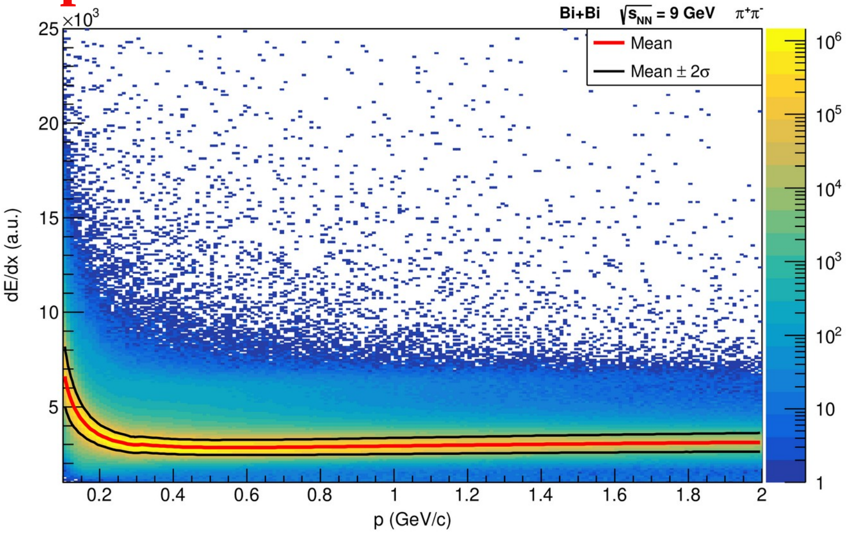
DST sample visualization (all tracks)



Significant number of reconstructed tracks with $m^2 = 0$, independent from PDG or TOF hit flag, may be causing efficiency decrease at post-threshold momenta.

dE/dx PID parameters extraction

pions



- ROOT's **FitSlicesY()** applies gaussian fit for each slice along y-axis of the histogram;

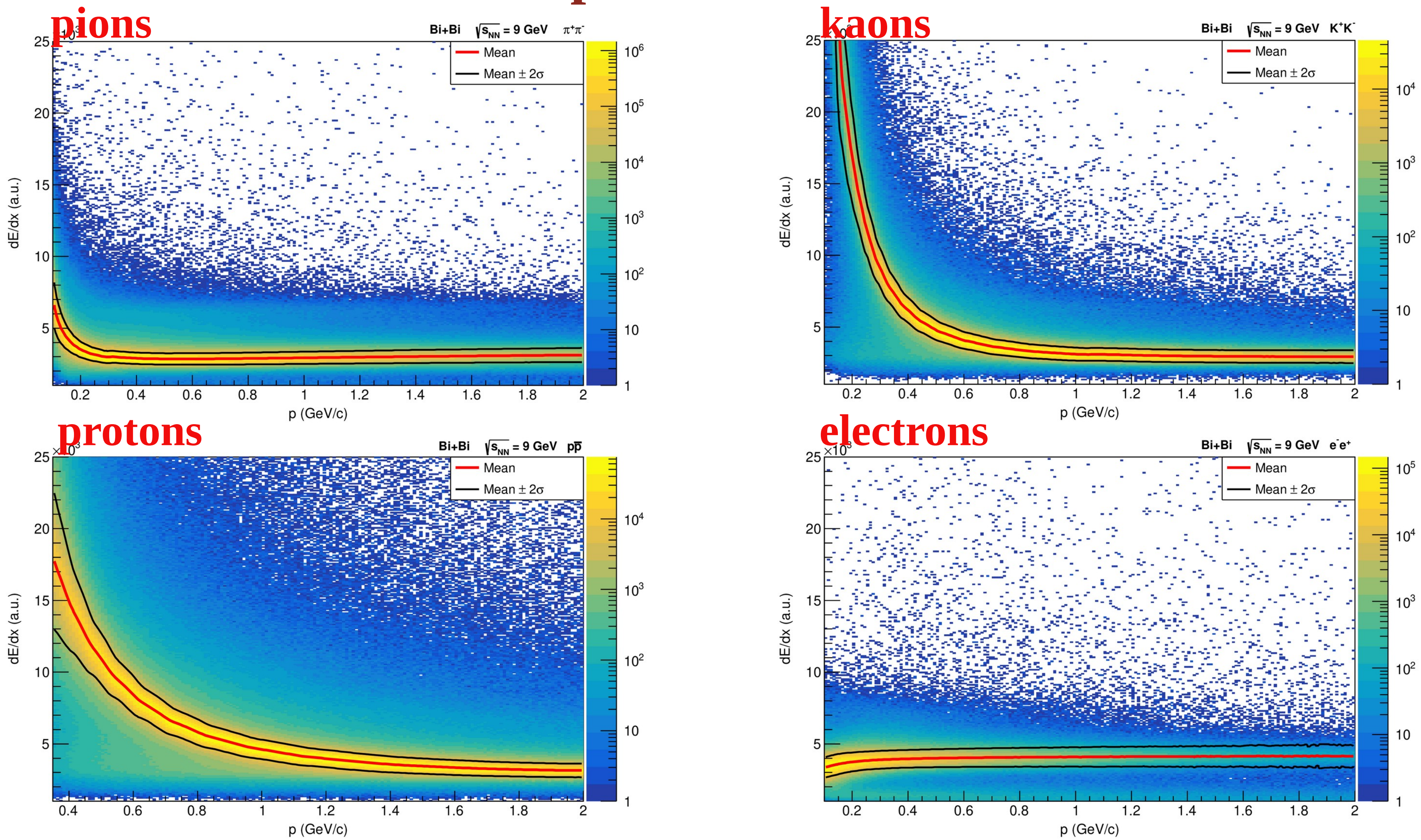
- Extracted mean and standard deviation values for each particle type are used for PID on all momentum interval.

The following n_σ-cut is applied based on extracted information

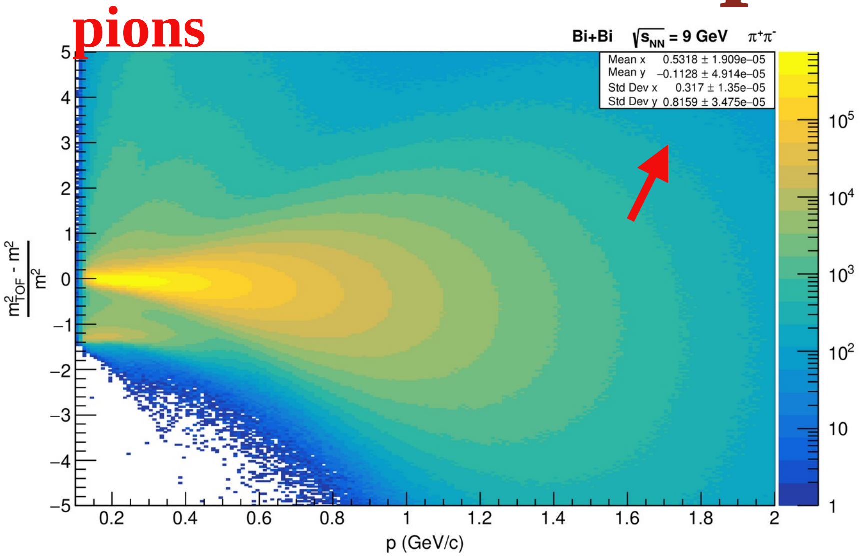
$$|dE/dx - \mu_E(p)| < n_\sigma \sigma_E(p)$$

Extracted $\mu_E(p)$ and $\sigma_E(p)$ are saved in a separate root-file as graphs. Later **Eval()** method is called to evaluate them.

dE/dx PID parameters extraction



m^2 PID parameters extraction



- Relative deviation distribution of m^2 for each particle type is measured;
- Extracted mean and standard deviation values for each particle type are used for PID at high momenta.

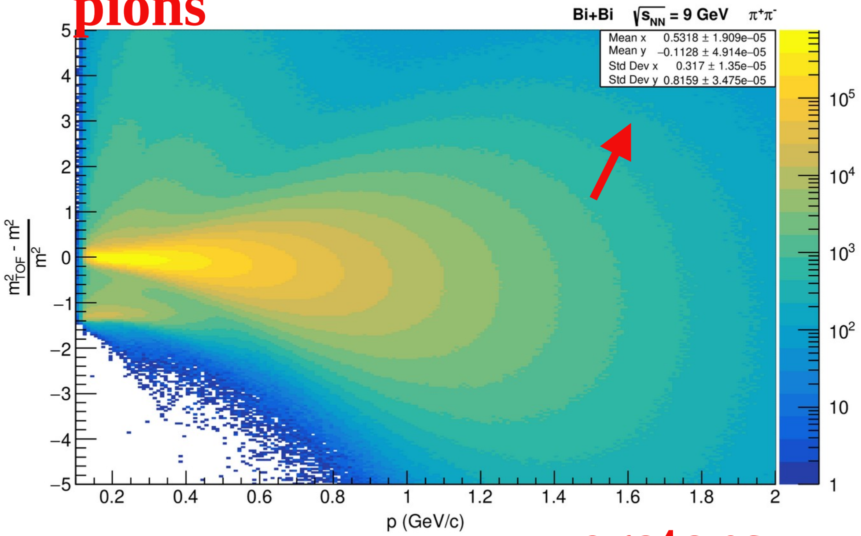
The following n_σ-cut is applied based on extracted information

$$\left| \frac{m^2_{TOF} - m^2}{m^2} - \mu_m \right| < n_\sigma \sigma_m$$

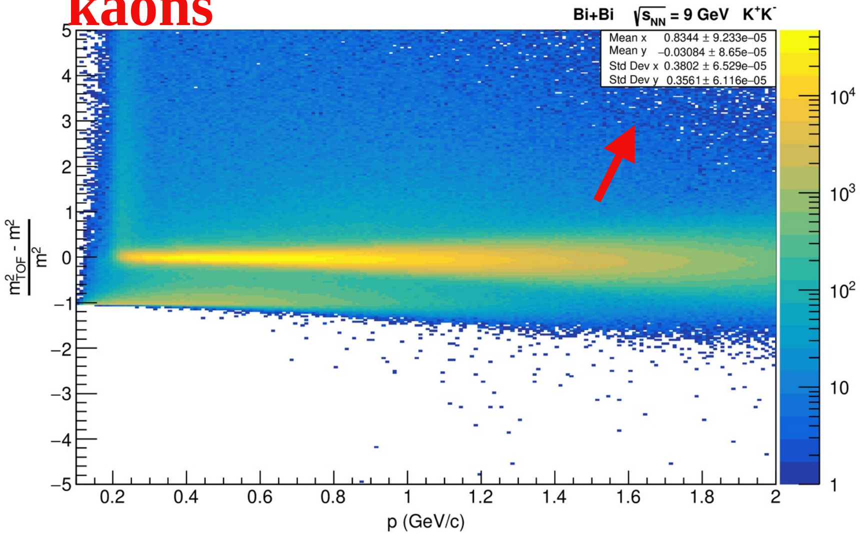
The same approach may be utilized for *1/β* PID at intermediate momenta. However, m^2 cuts can effectively replace *1/β* cuts at both intermediate and high momenta.

m^2 PID parameters extraction

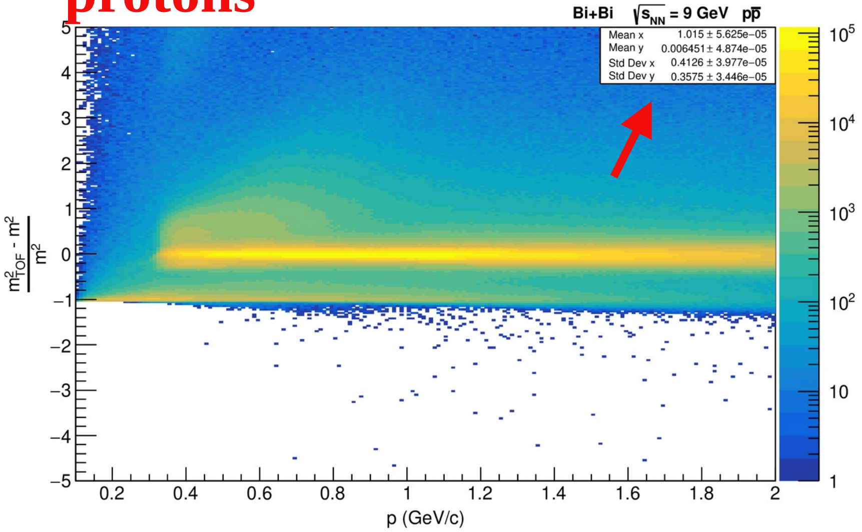
pions



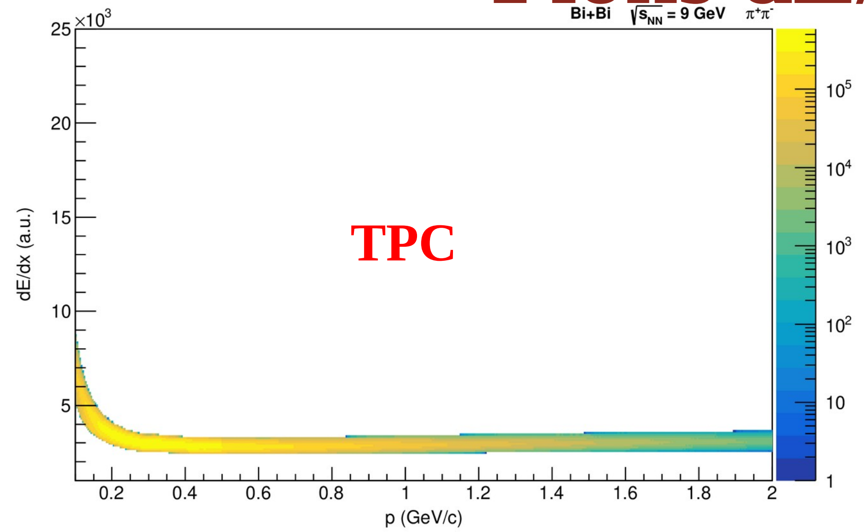
kaons

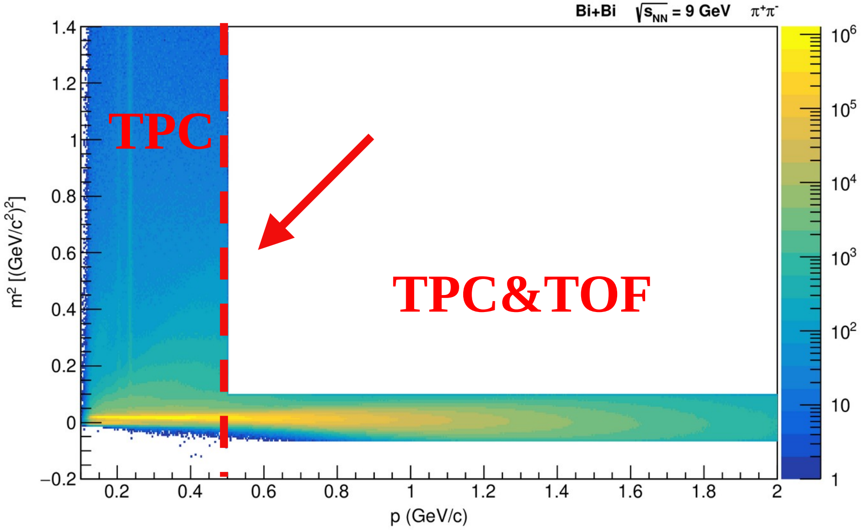


protons



Pions dE/dx and m² n_σ-cuts





- *dE/dx* cut is applied on all momentum interval;
- *m^2* cut (and *1/β* cut, if in use) is applied after a certain momentum threshold (specific for each particle type), e.g. *0.5* GeV/c for pions;
- *n_σ* parameter adjustment is required to achieve adequate efficiency, e.g. *n_σ = 5* for *m^2* for pions, as their relative *m^2* deviation distribution is wider at low momenta.

Pions purity/contamination & miniDST comparison

Purity

$$f(p) = \frac{dN_{true}/dp}{dN_{meas}/dp}$$

- correctly identified

- all identified

Contamination

$$c(p) = \frac{dN_{false}/dp}{dN_{meas}/dp}$$

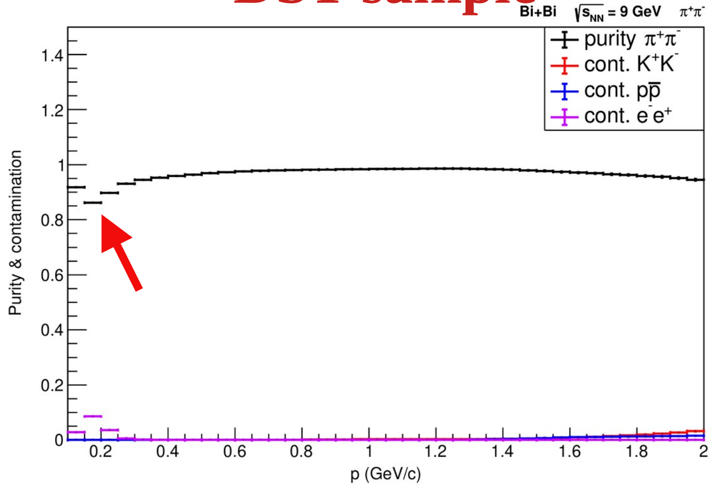
- incorrectly identified

- all identified

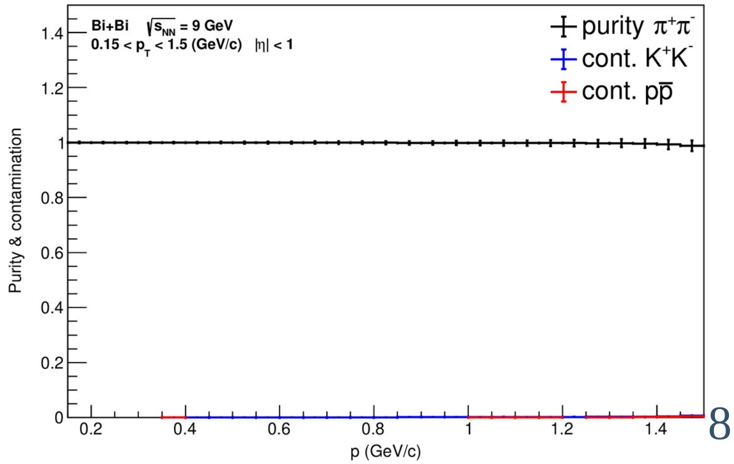
- Noticeable contamination with electrons at low momenta caused by *dE/dx* line intersection;

- Overall agreement with miniDST PID result in terms of purity.

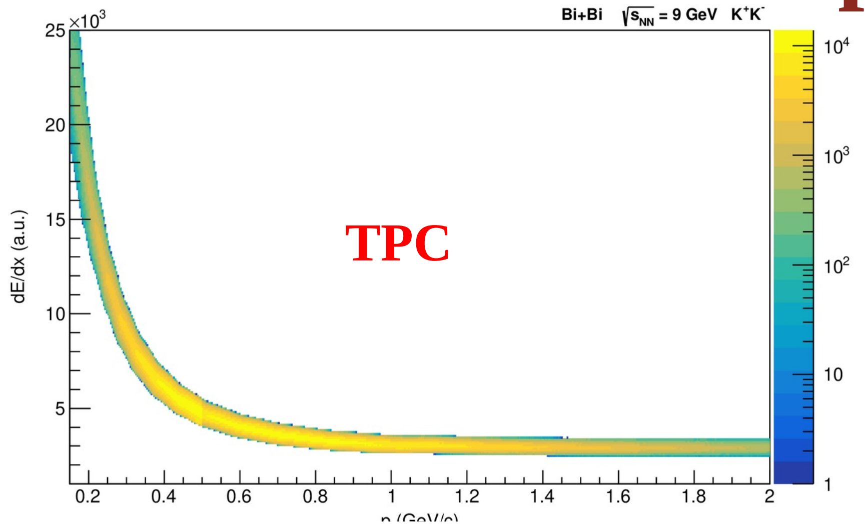
DST sample

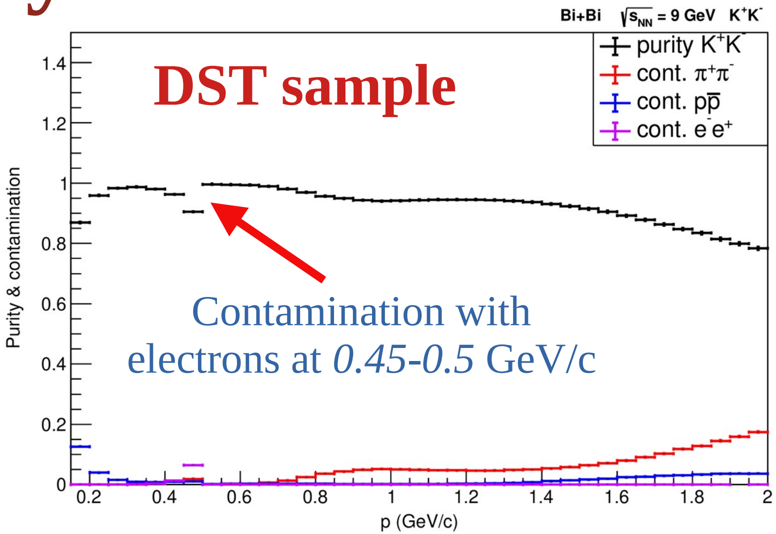


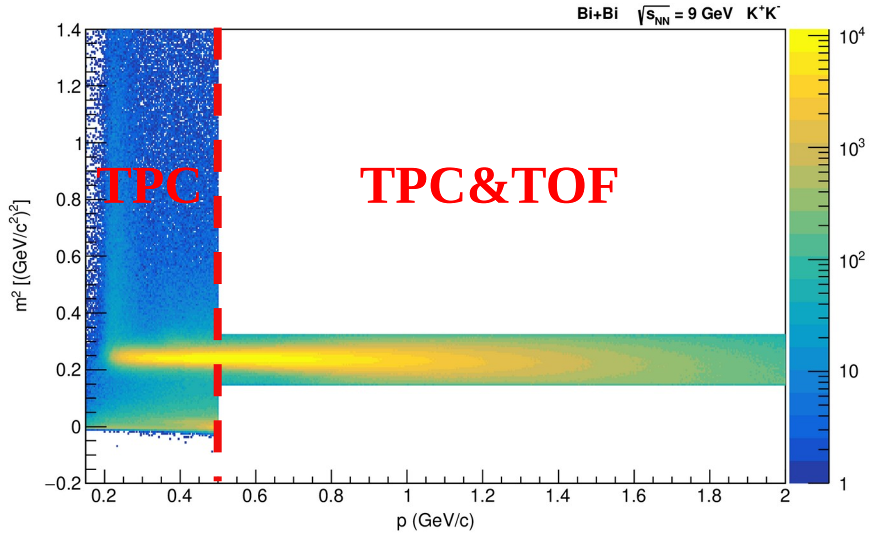
miniDST sample

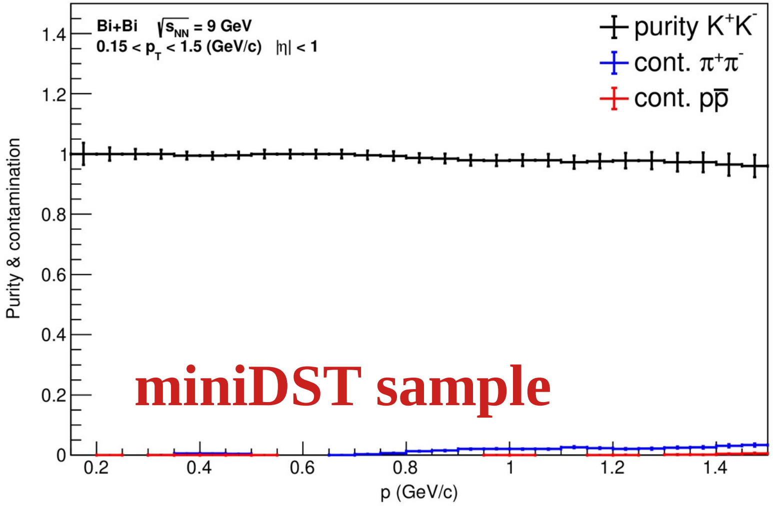


Kaons n_σ-cuts & purity/contamination

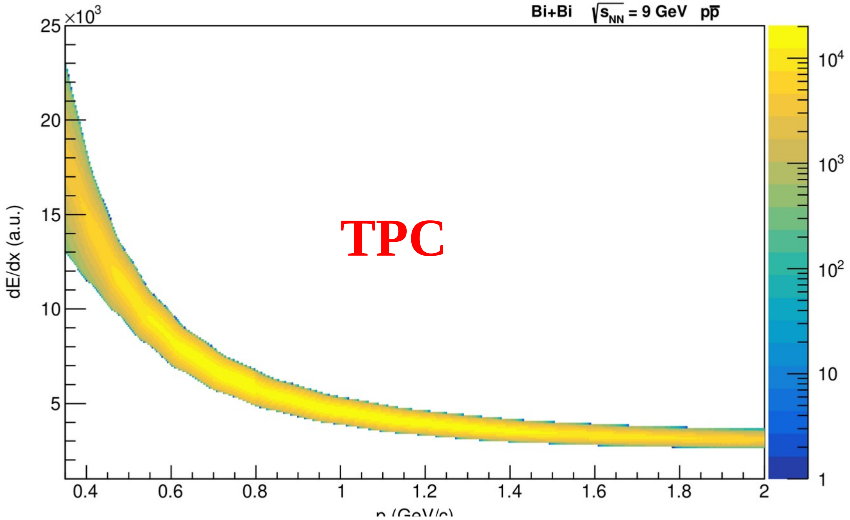


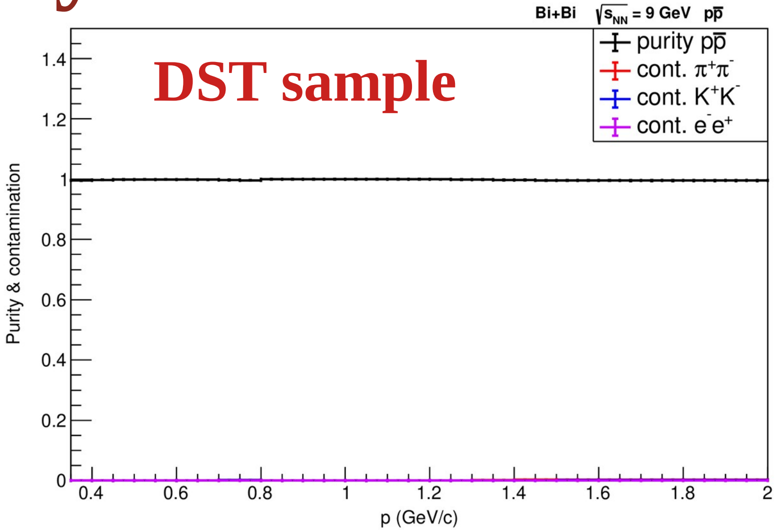


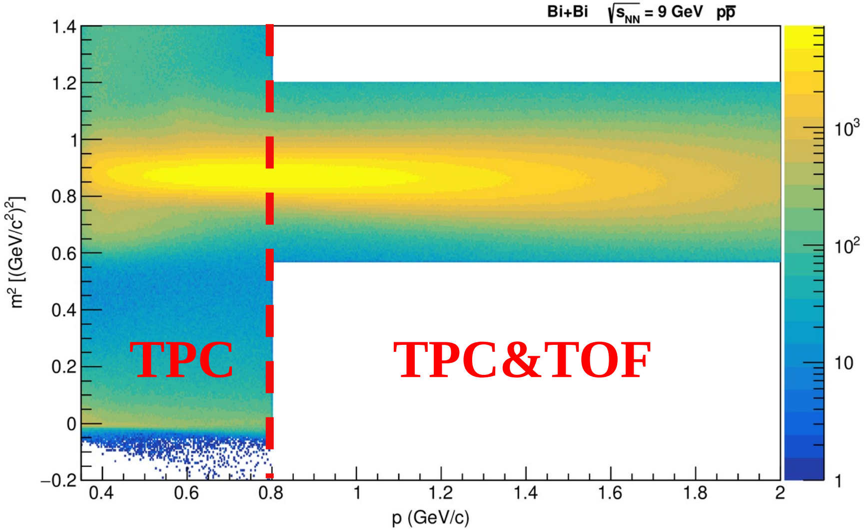


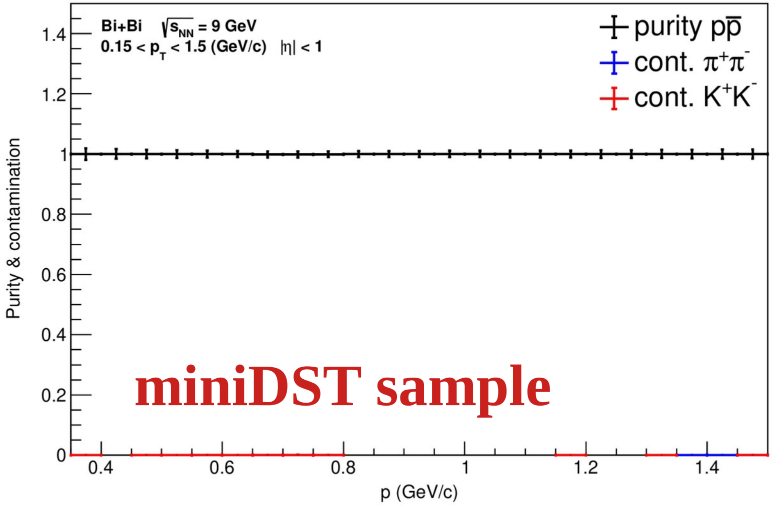


Protons n_σ-cuts & purity/contamination



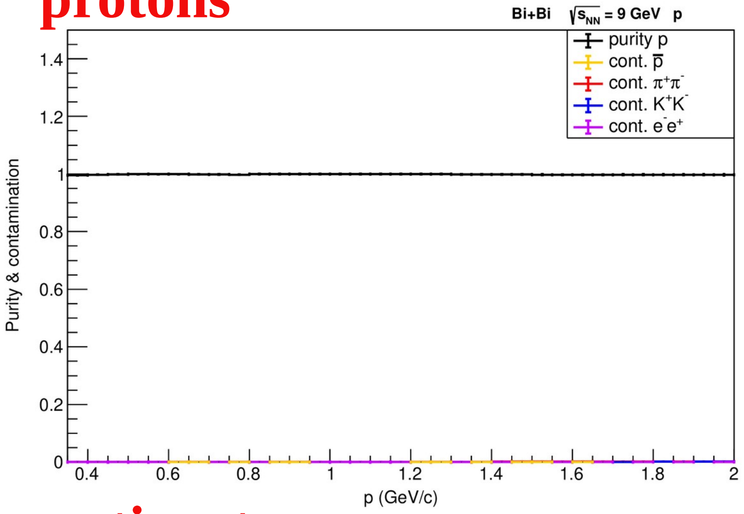




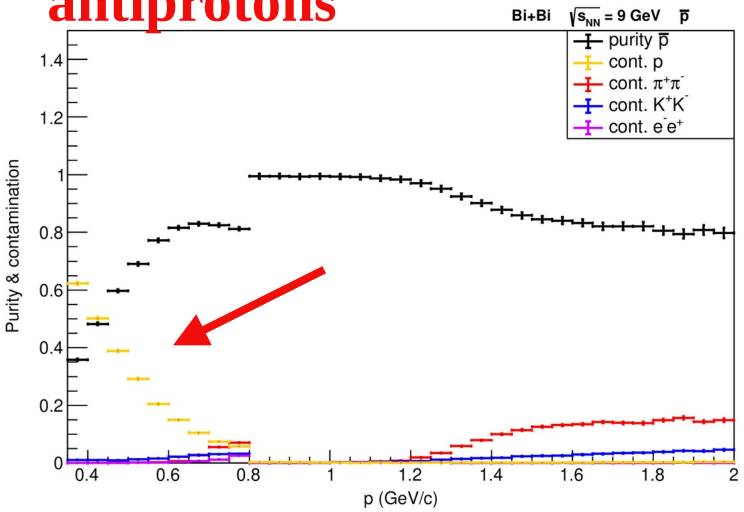


Protons/antiprotons purity comparison

protons



antiprotons



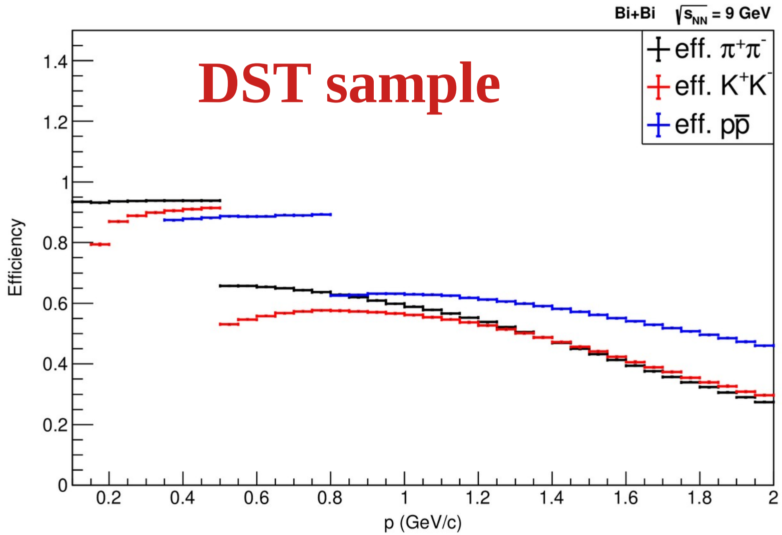
- Separate purity measurement for antiprotons is required due to their relatively low multiplicity;
- High misidentification level at low momenta, because of apparent wrong charge sign reconstruction;
- Noticeable contamination with pions at high momenta.

PID efficiency for hadrons

Efficiency

$$f(p) = \frac{dN_{pid}/dp}{dN_{viable}/dp}$$

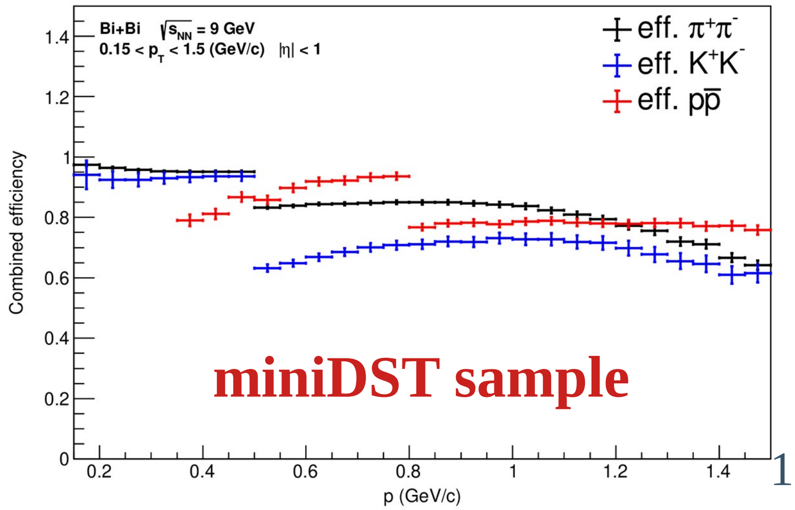
- identified
- selected for identification



- High efficiency at low momenta, drop at threshold momenta due to TOF match requirement for m^2 PID;

- Overall agreement with miniDST PID result in terms of efficiency;

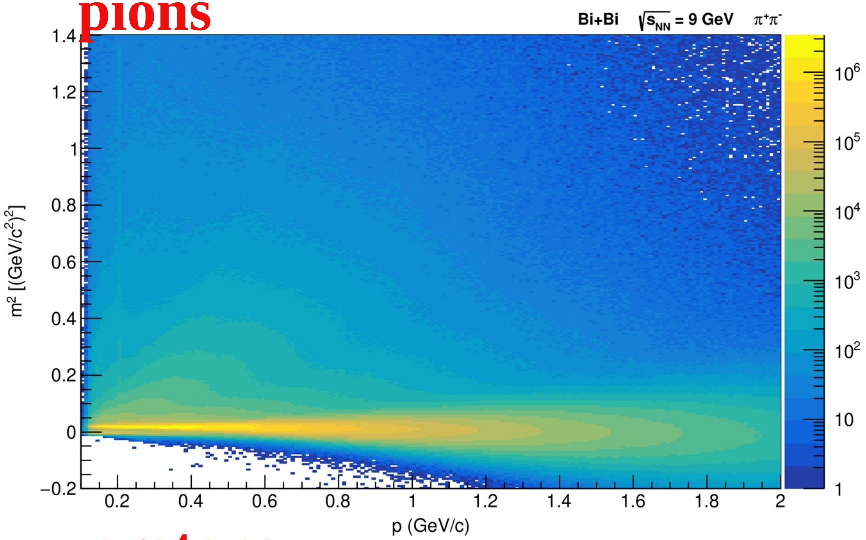
- Lower post-threshold efficiency in DST sample compared to miniDST result.



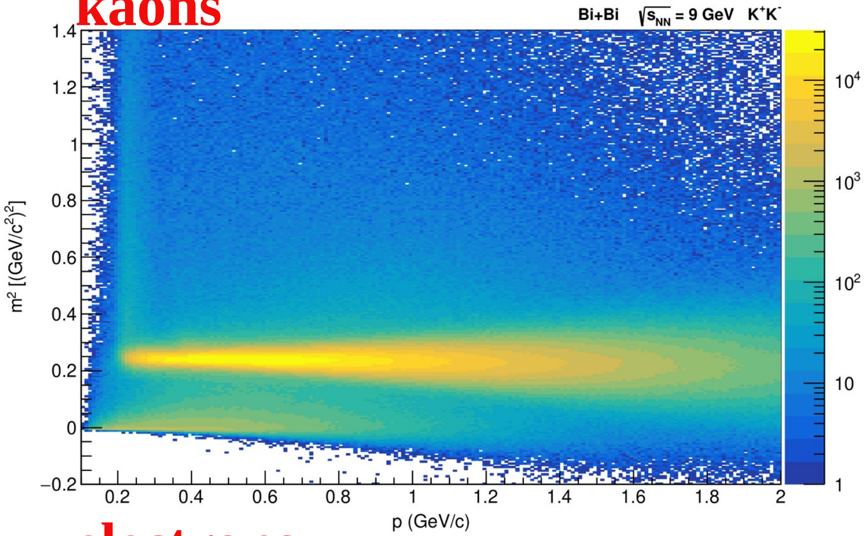
BACKUP

Separate m^2 distributions for hadrons and electrons

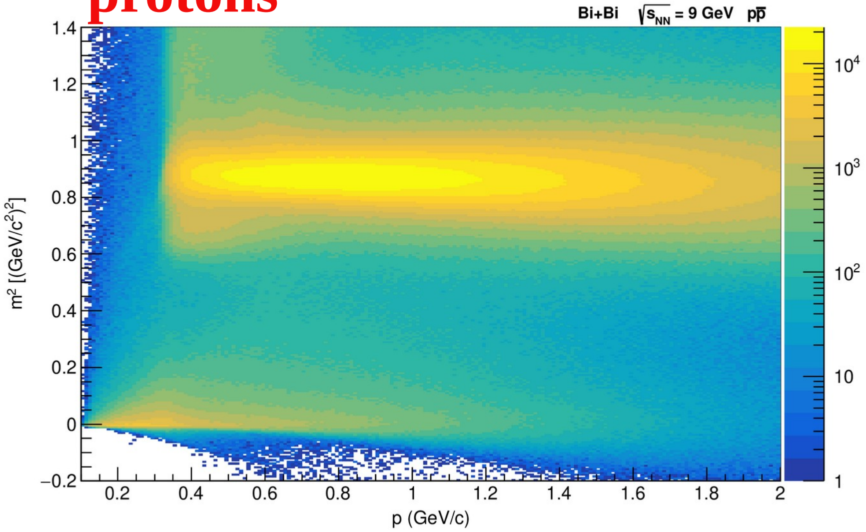
pions



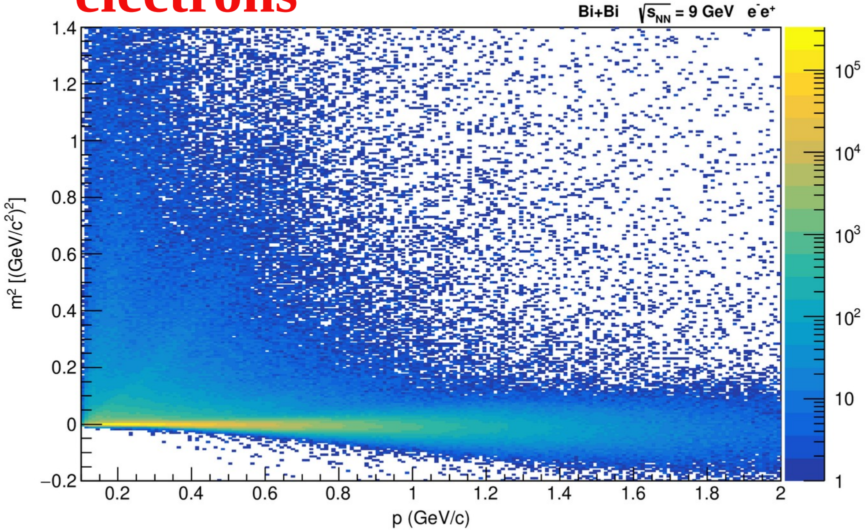
kaons



protons

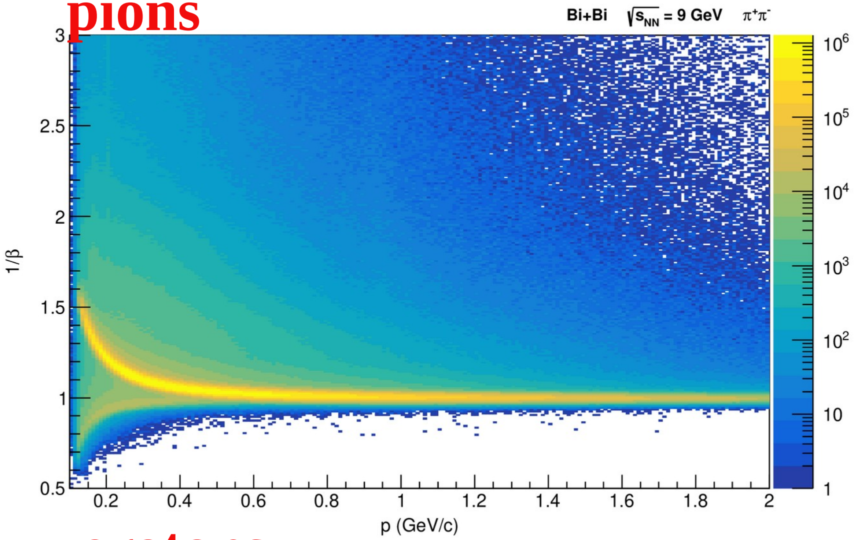


electrons

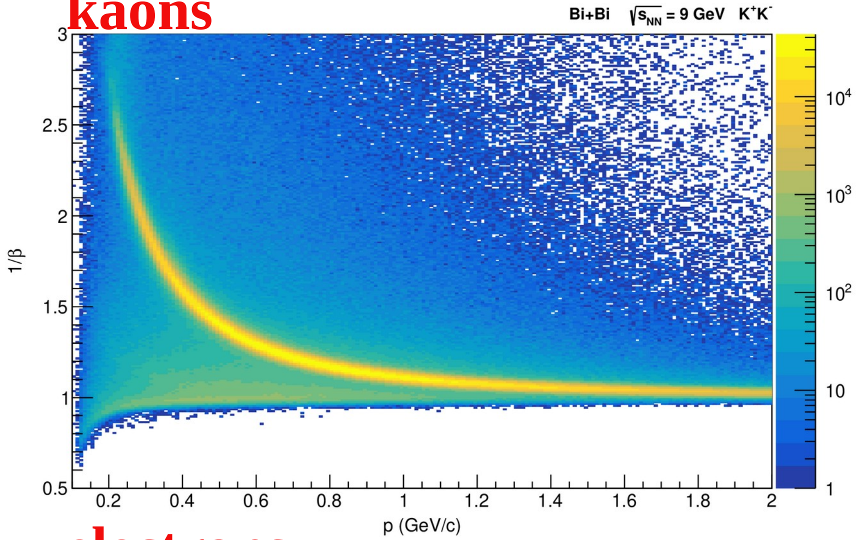


Separate 1/β distributions for hadrons and electrons

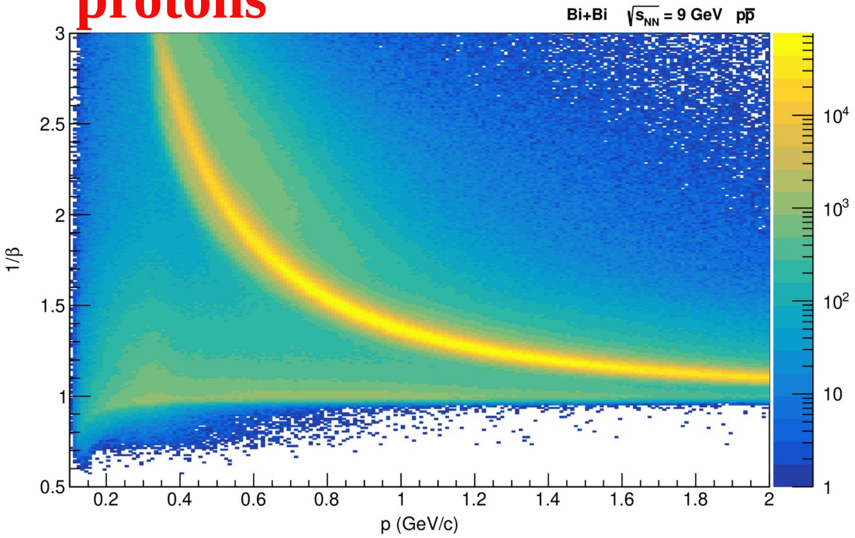
pions



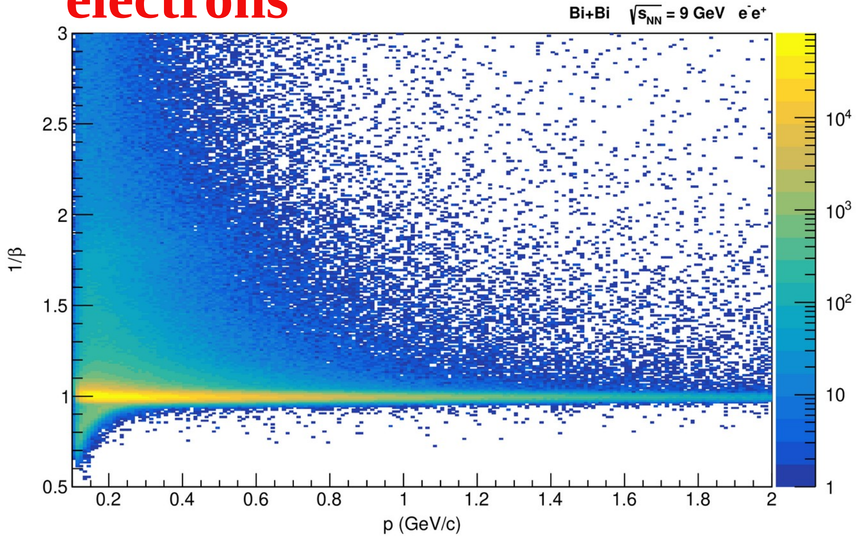
kaons



protons

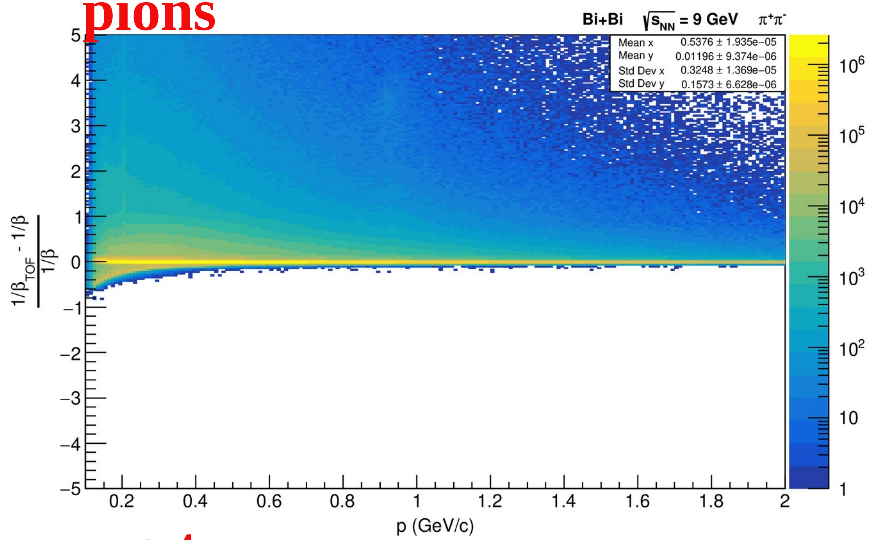


electrons

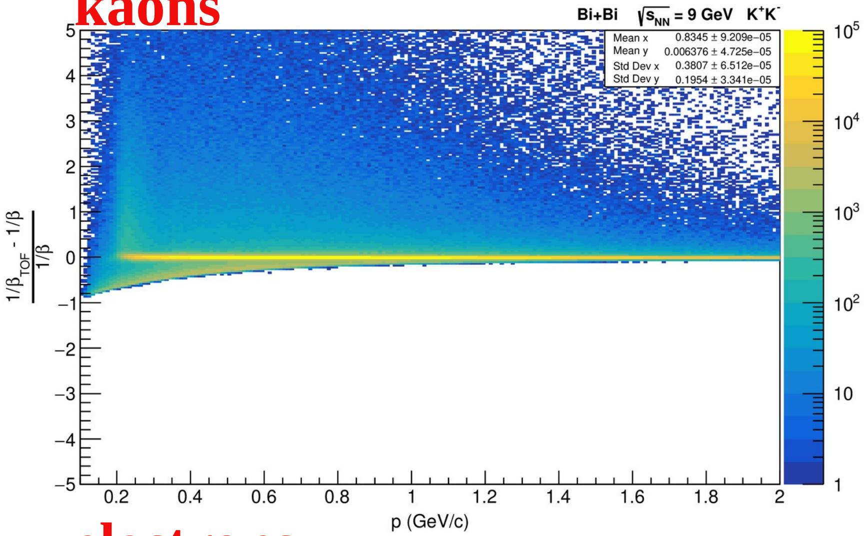


Separate 1/β relative deviation distributions

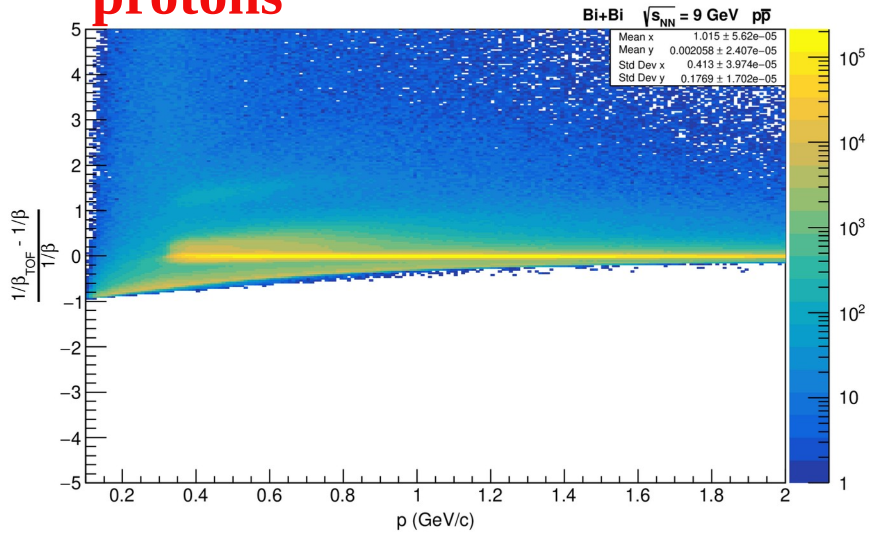
pions



kaons



protons



electrons