中国科学技术大学
University of Science and Technology of China

ITS-TPC matching efficiency checks

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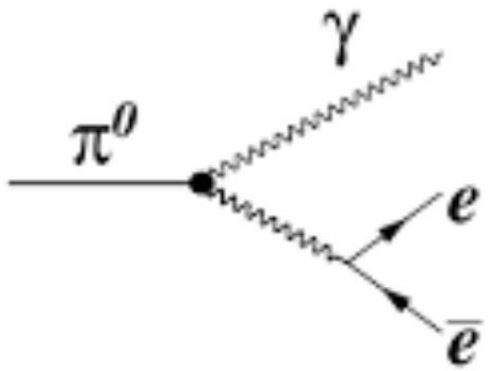
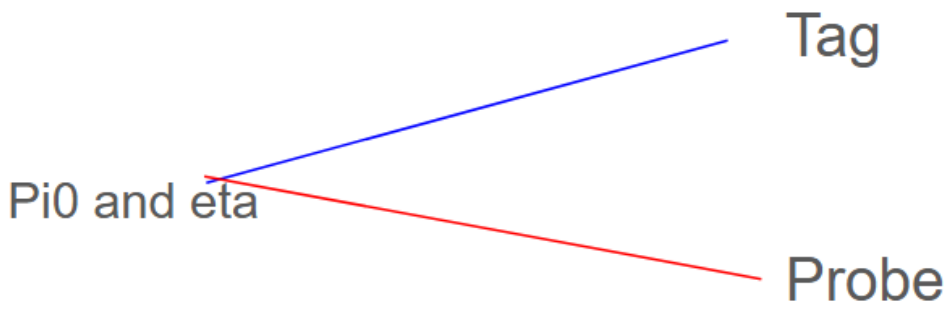
Tag-probe method





$$\mathcal{B}\left(\pi^0 \to e^+e^-\gamma(\gamma)\right) = 1.1836(6)\%$$

- The tag and probe method involves selecting a clean sample of electrons from pi0 Dalitz decay.
- One of the electron (the tag) is well-identified.
- Another electrons (the probe) from same pair is used for the TPC and ITS matching efficiency study.

Data and cuts

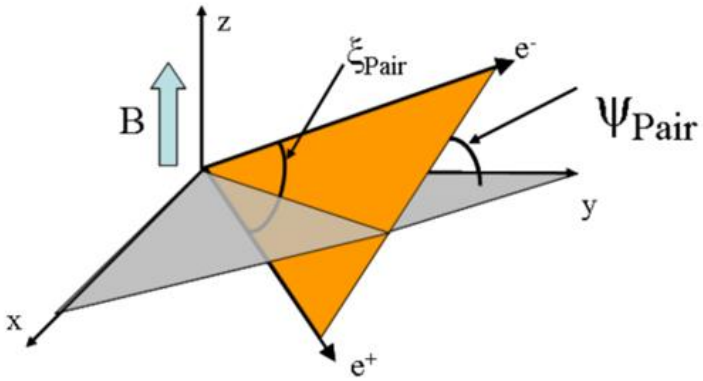
LHC22o pass4: 528021, 528026, 528036, 528094, 528097, 528105, 528107, 528109, 528231, 528232, 528233, 528263, 528266, 528292, 528294, 528316, 528319, 528328, 528329, 528330, 528332, 528336, 528347, 528359, 528379, 528381, 528386, 528448, 528451, 528461, 528463, 528530, 528531, 528534

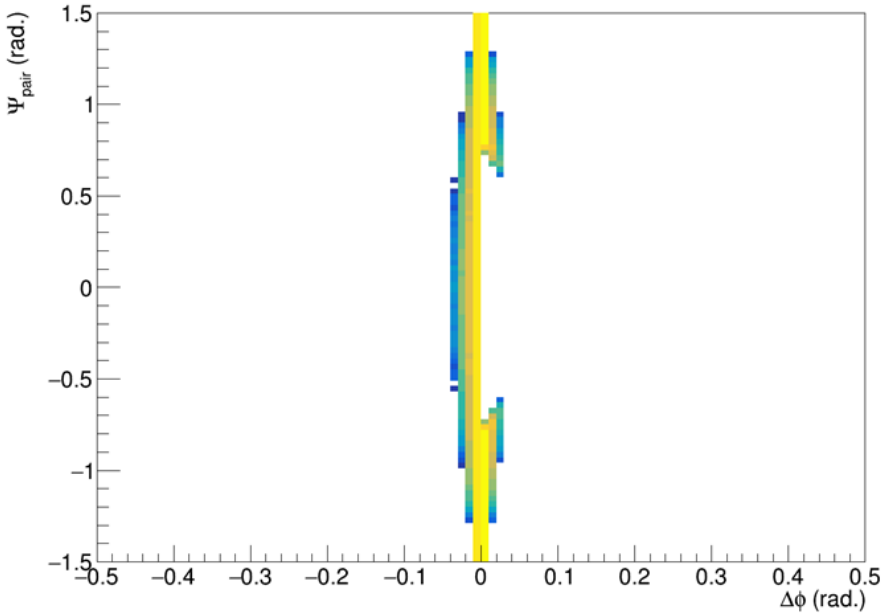
Pair cut (default)

- 0 < m < 0.035 GeV/c2
- Triangle cut ($\psi pair$ and $\Delta\varphi$) (to reject photon conversion electron):
- Reject pairs with ($\Delta\varphi$,$\psi pair$) in triangle (0,-0.8) (0,0.8) (0.12,0)

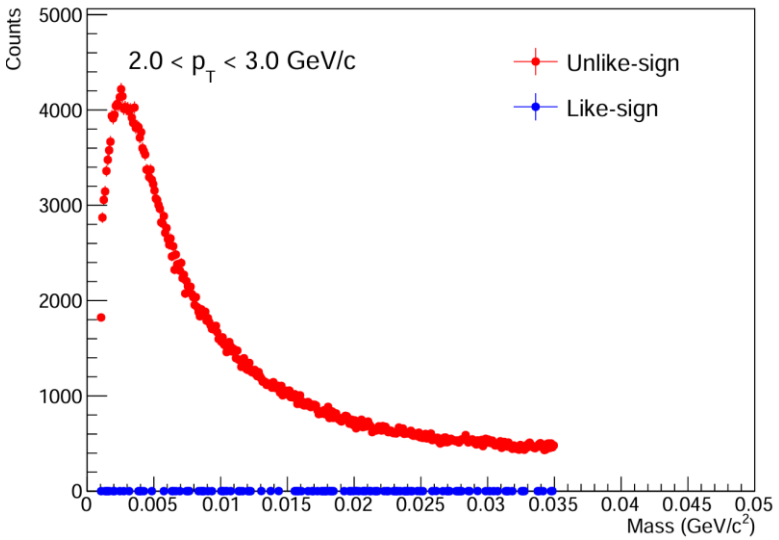
Tag cut (default)

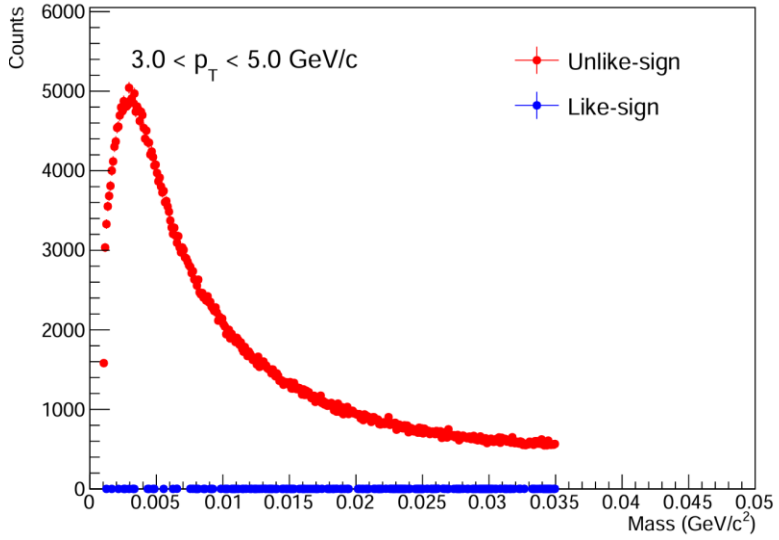
- pT>1.0 GeV/c, |η|<0.9
- TPCncls > 90, TPCchi2 < 4
- ITSMatch
- -3 < TPCnSigmaE < 3
- |TPCnSigmaPi| > 3
- |TPCnSigmaPr| > 3

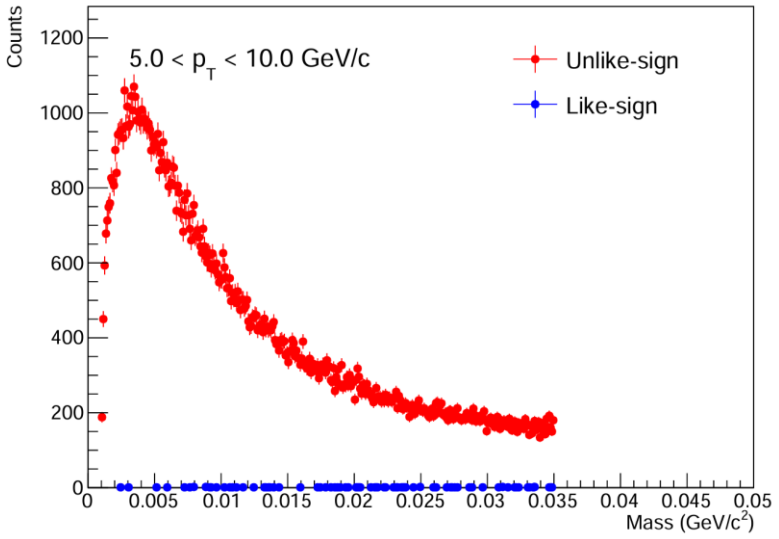


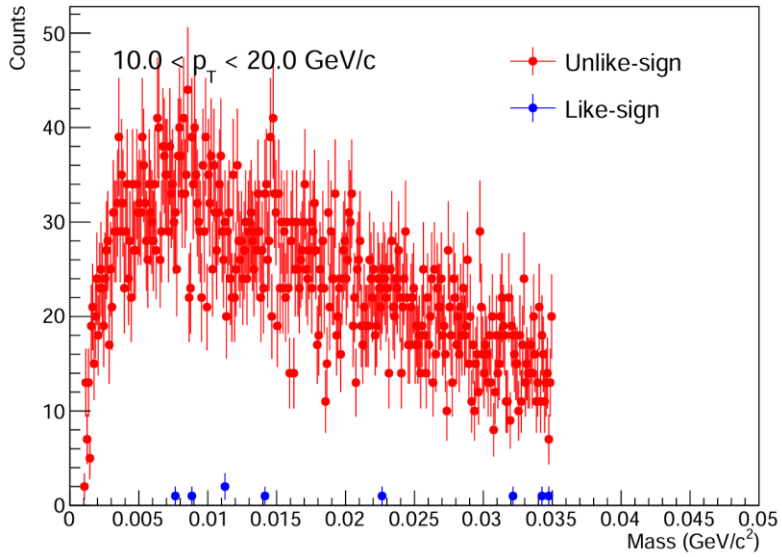


Invariant mass

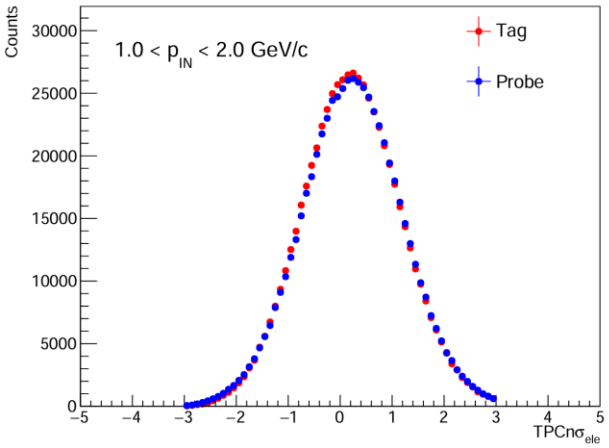


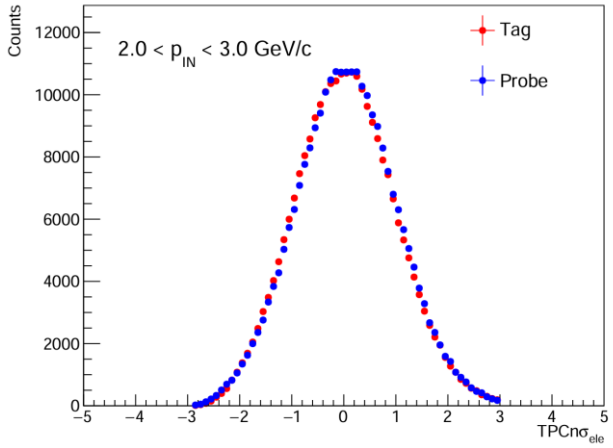


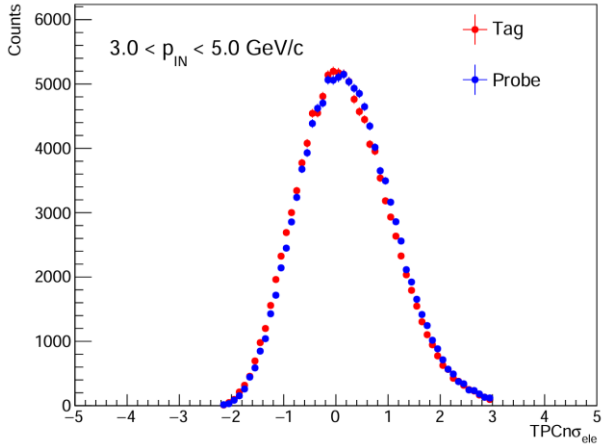


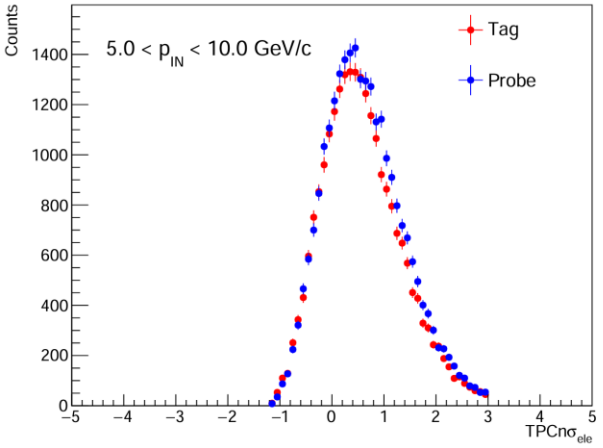


PID performance









- TPCnSigmaE distribution of tag and probe tracks.
  - Electron purity is high

ITS-TPC matching efficiency

Prob: TPC cut

Tag with the below

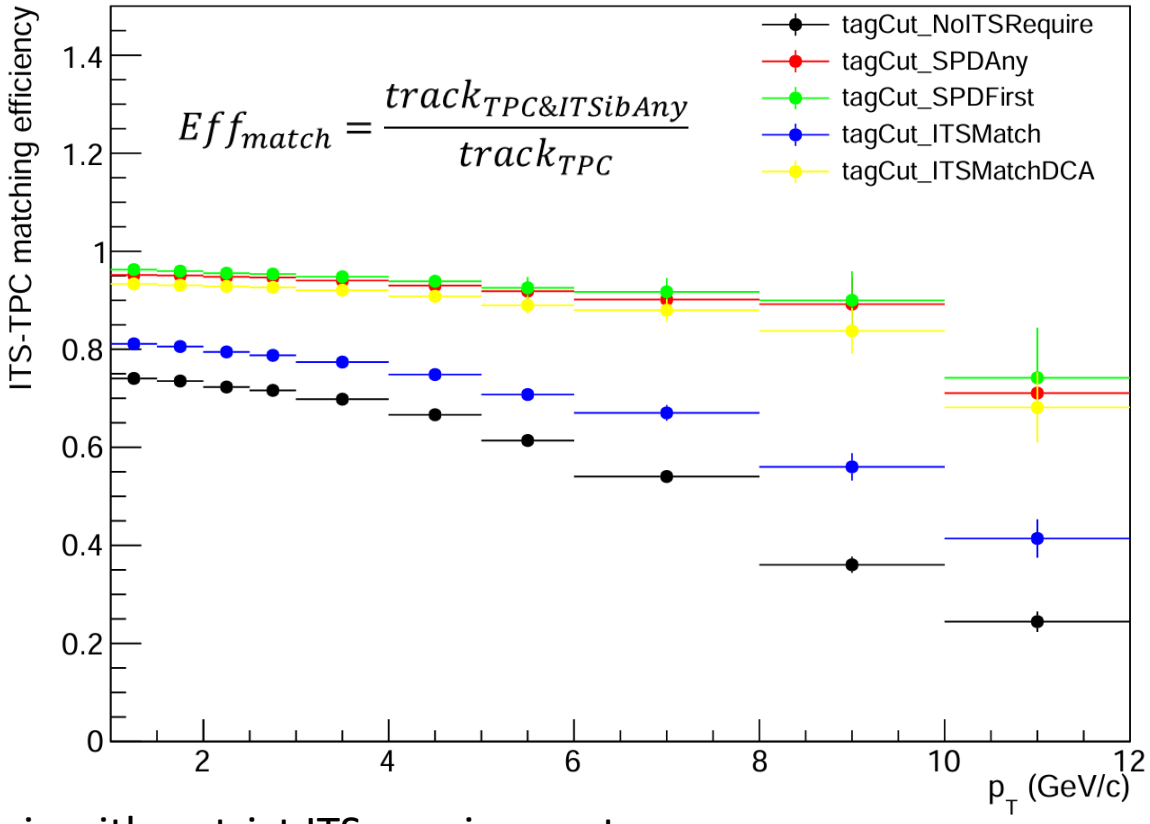
1.Only TPC cuts:
- NoITSRequire

2.TPC + ITS(only inner most layer):
- SPDFirst

3.TPC + ITS(only two inner most layers):
- SPDAny

4.TPC + ITS(7 layer):
- ITSMatch

5.TPC + ITS(7 layer) + DCA(|xy| < 0.1 cm, |z| < 0.15 cm):
- ITSMatchDCA



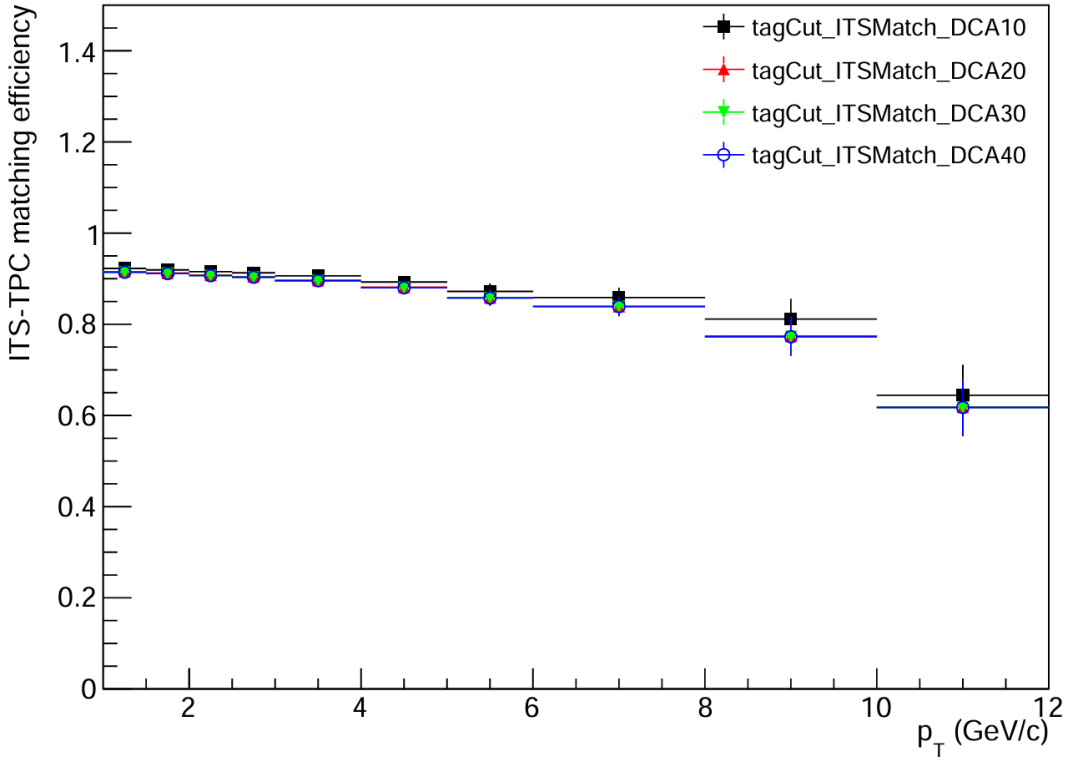
- The matching efficiency of probe will increase if the tag is with a strict ITS requirement.
  - Correlation of two tracks?
- The ITS-TPC matching efficiency decrease with pT.
  - Photon converted electrons contamination?
  - ITS clusters shared by two tracks?

Match efficiency with different DCA

Prob: TPC cut

Tag with the below

1. DCA10:
   - |DCAxy| < 0.1 cm, |DCAz| < 1 cm
2. DAC20:
   - |DCAxy| < 0.5 cm, |DCAz| < 1 cm
3. DAC30:
   - |DCAxy| < 1.5 cm, |DCAz| < 1 cm
4. DAC40:
   - |DCAz| < 1 cm



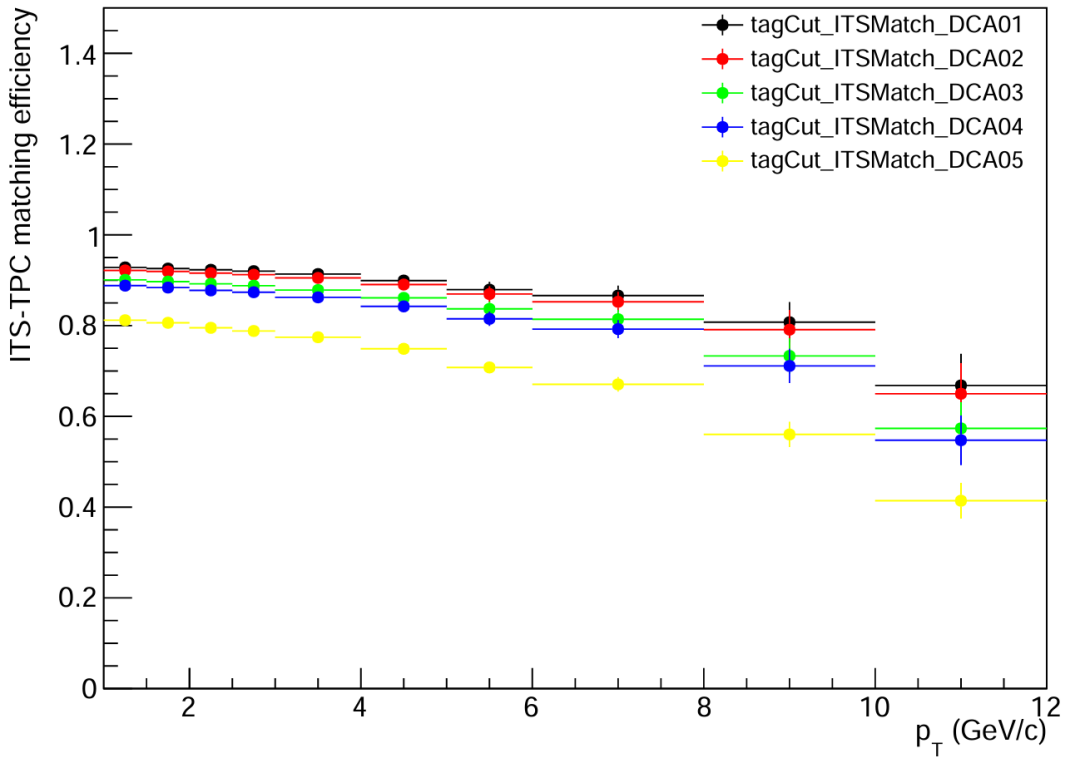
➢ Cut of DCAxy on tags will not influence the matching efficiency of probe

Match efficiency with different DCA

Prob: TPC cut

Tag with the below

1. DCA01:
   - |DCAxy| < 1 cm, |DCAz| < 0.15 cm
2. DAC02:
   - |DCAxy| < 1 cm, |DCAz| < 0.5 cm
3. DAC03:
   - |DCAxy| < 1 cm, |DCAz| < 2 cm
4. DAC04:
   - |DCAxy| < 1 cm, |DCAz| < 3 cm
5. DAC05:
   - |DCAxy| < 1 cm

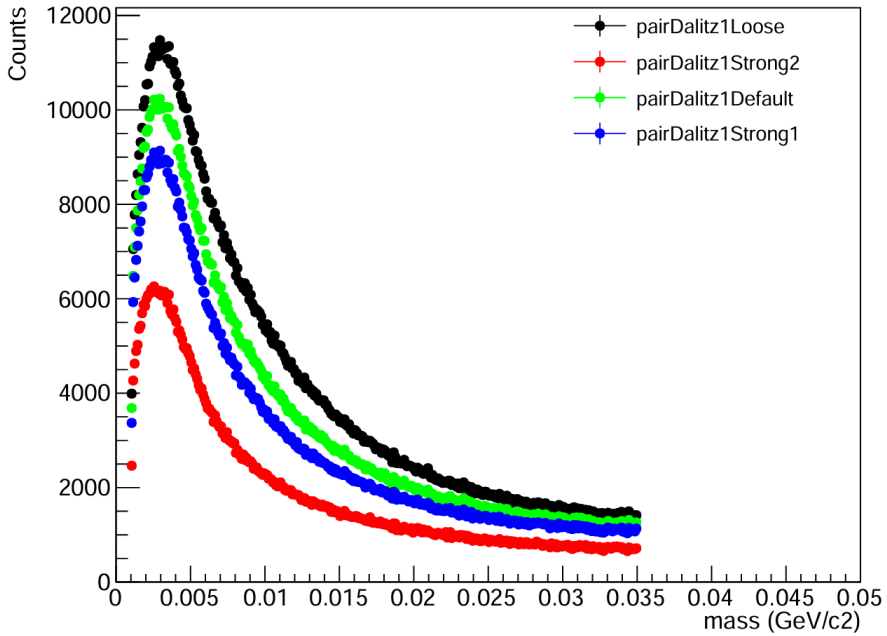


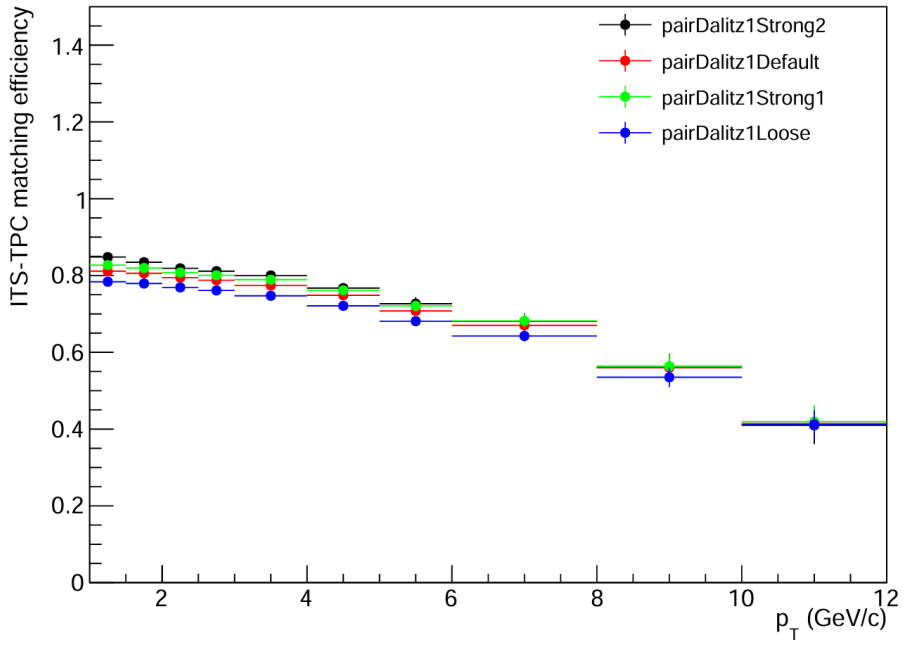
- Cut of DCAz on tags will influence the matching efficiency of probe
  - Further checks needed.

Matching eff with different triangle cut

Triangle cut (Reject pairs with ($\Delta\varphi$,$\psi pair$) in triangle)

- pairDalitz1Loose
  - (0,-0.6) (0,0.6) (0.12,0)
- pairDalitz1Default
  - (0,-0.8) (0,0.8) (0.12,0)
- pairDalitz1Strong1
  - (0,-1.0) (0,1.0) (0.12,0)
- pairDalitz1Strong2
  - (0,-∞) (0,+∞) (+∞,0)



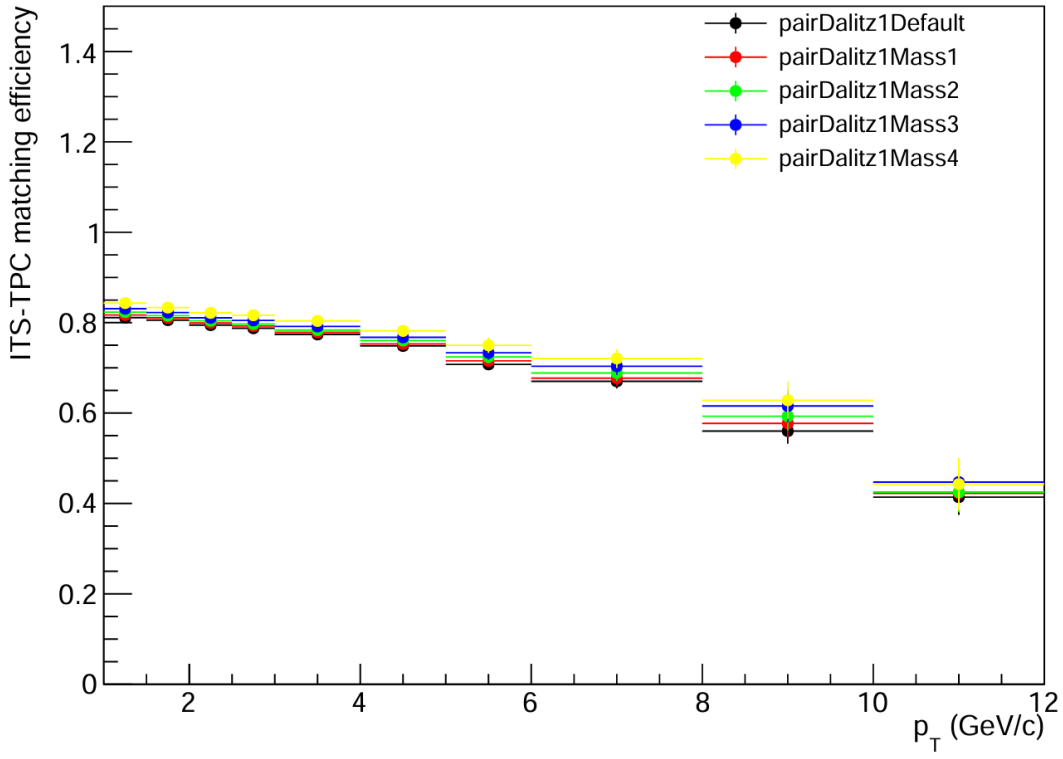


- Triangle cuts will influence the matching efficiency of probe, but not too much.
  - Some photon converted electrons contamination.

Match eff with different mass cut

Mass cut:

1.stand cuts (m < 0.035 GeV/c2)
2.Tight cut1 (m < 0.03 GeV/c2)
3.Tight cut2 (m < 0.025 GeV/c2)
4.Tight cut3 (m < 0.02 GeV/c2)
5.Tight cut4 (m < 0.015 GeV/c2)

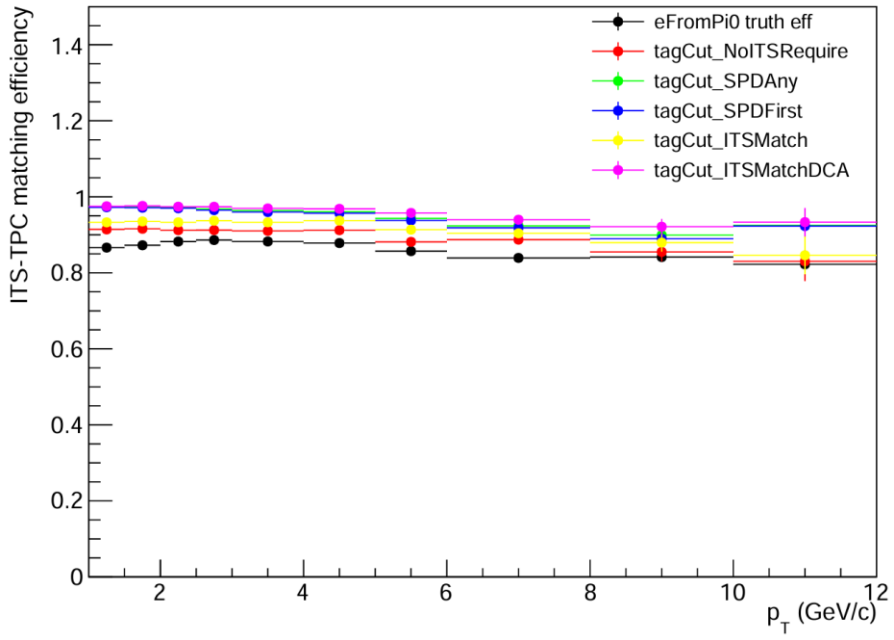


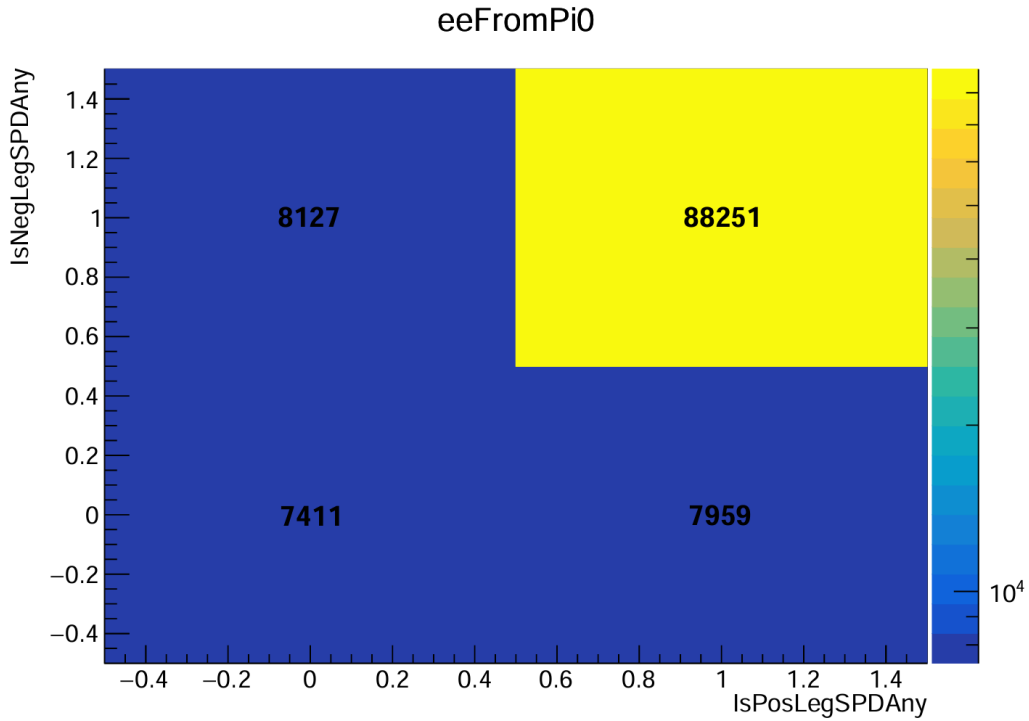
- Invariant mass cuts will not influence the matching efficiency too much.

Check in MC

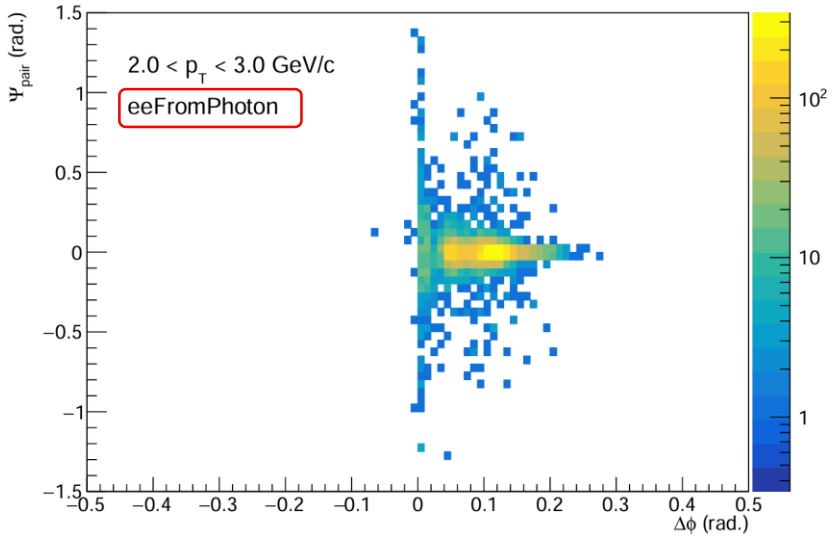
MC: LHC23k2c, GP MC anchored to pass4 HIR data

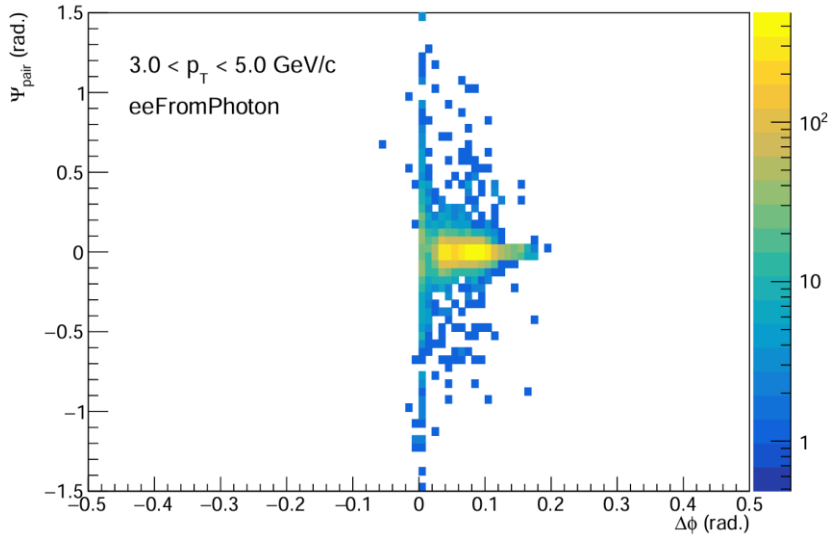
- In MC, the ITS performance shows a strong correlation for the two electrons from Pi0
  - If the ITS cuts are applied on tag, the probe will be more likely to have ITS hits.
  - Probably reduced for eeFromJpsi (checks ongoing).

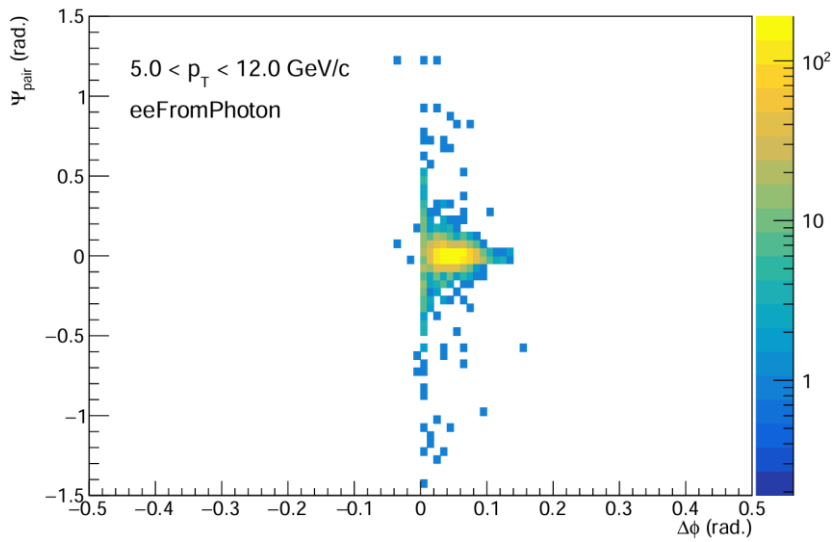


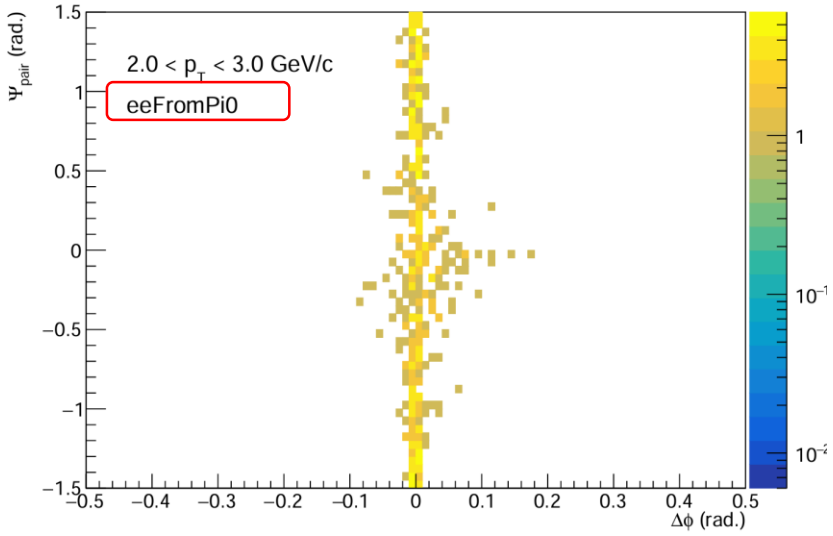


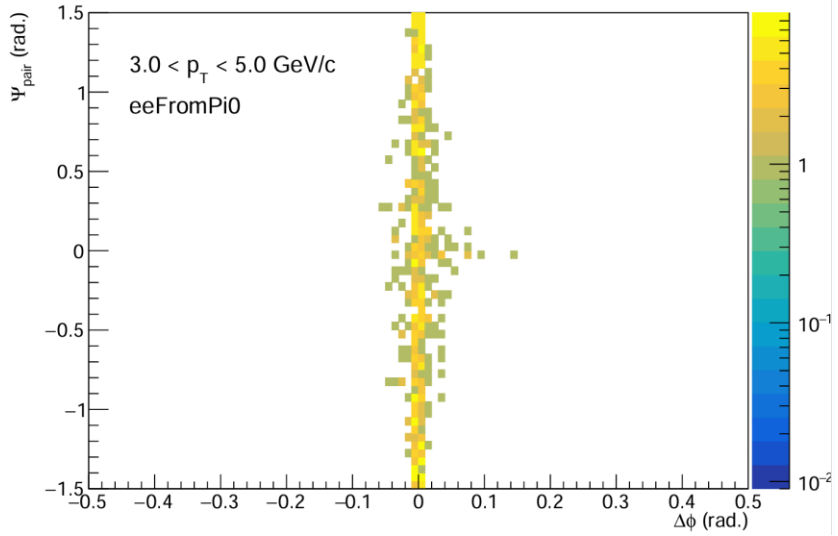
Check in MC (triangle distribution)

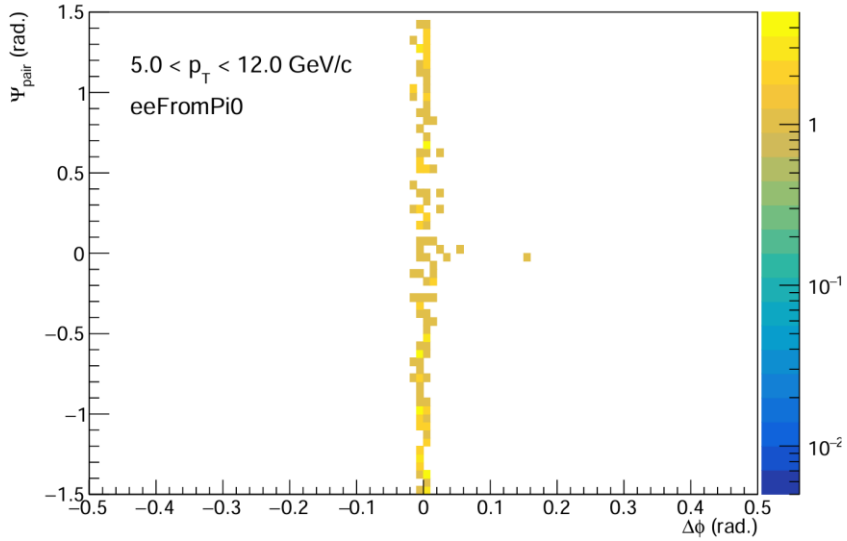




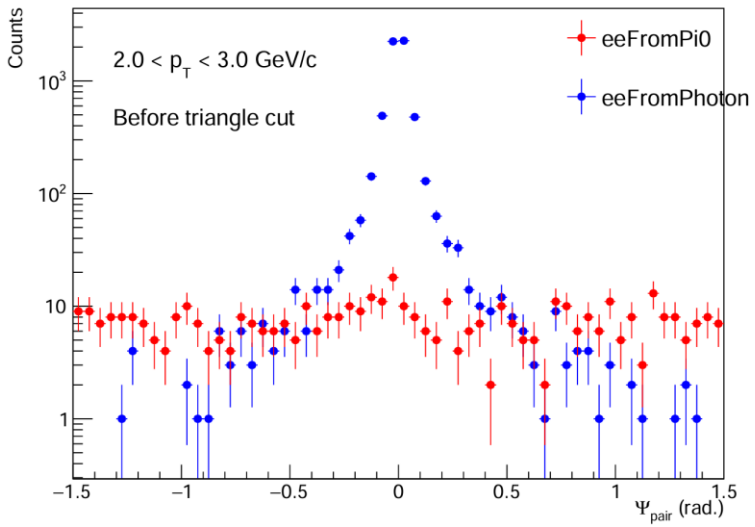


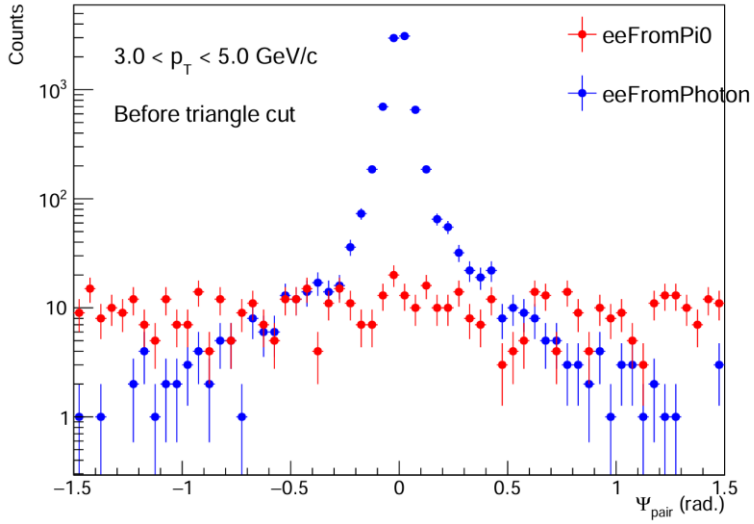


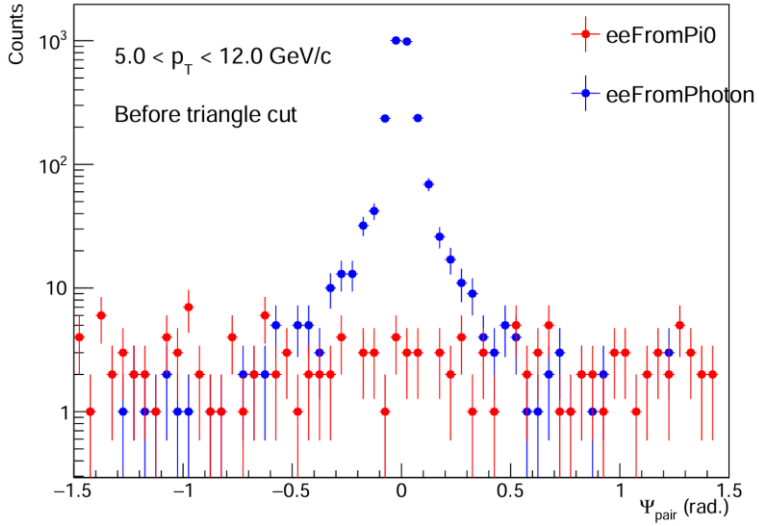


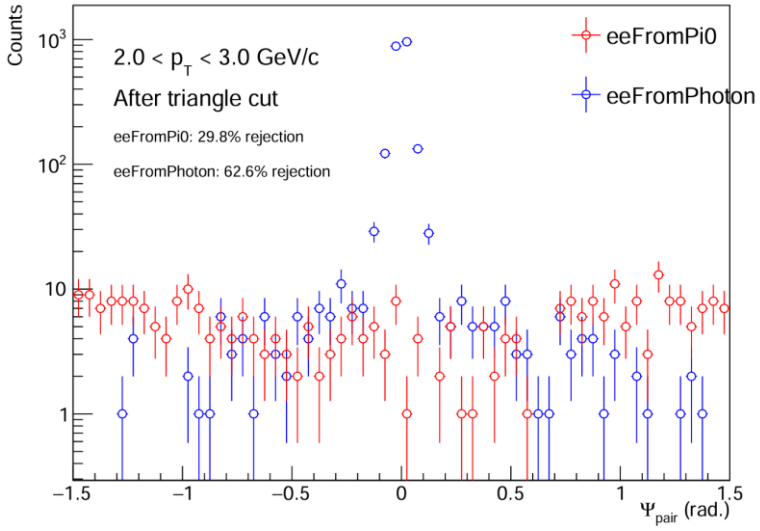


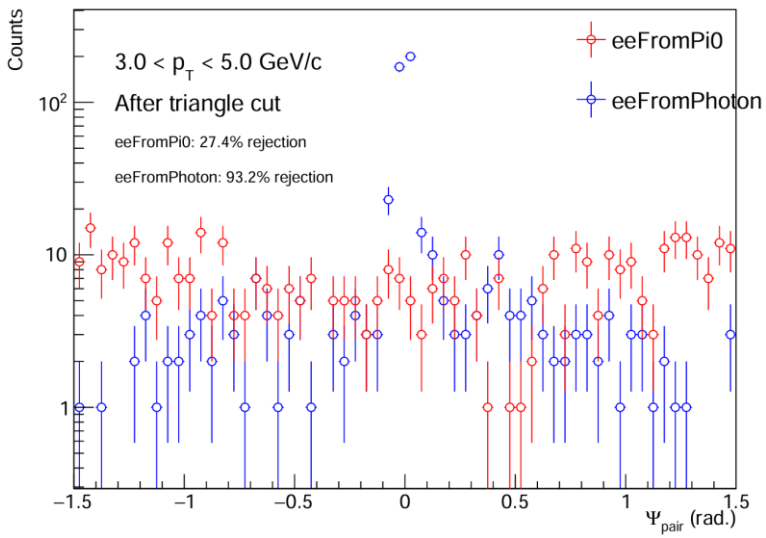
Check in MC (pairDalitz1Default)

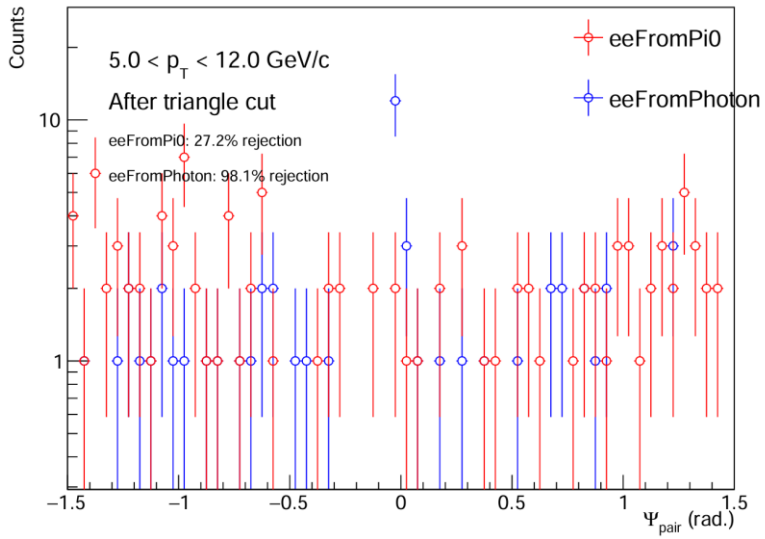




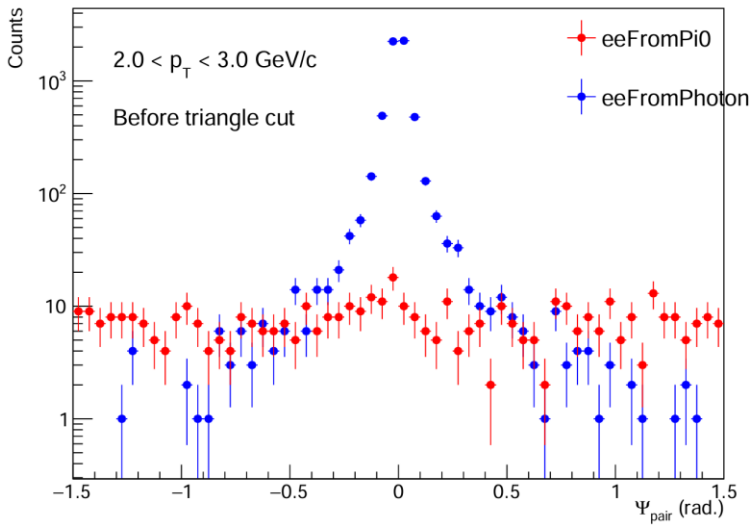


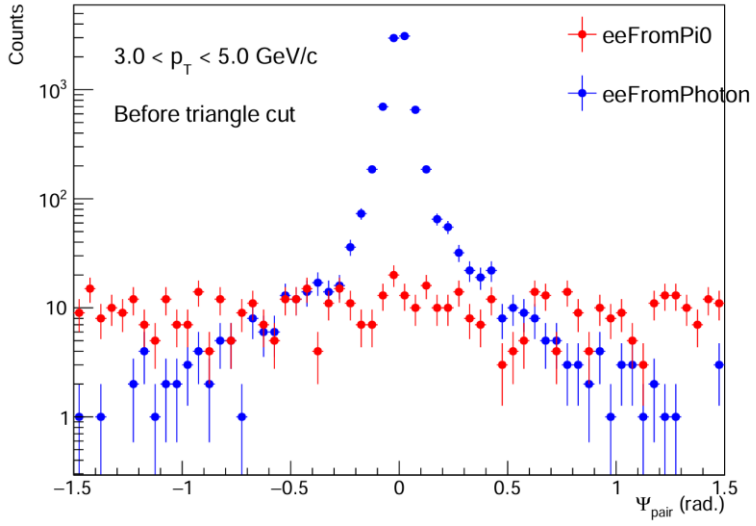


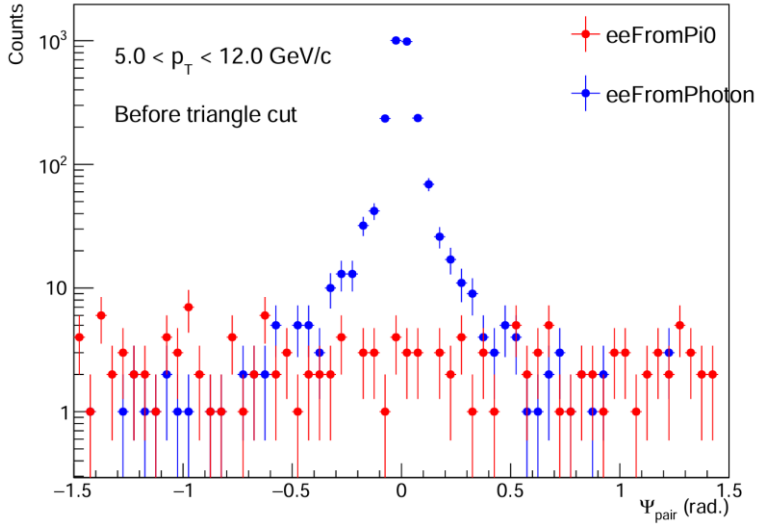


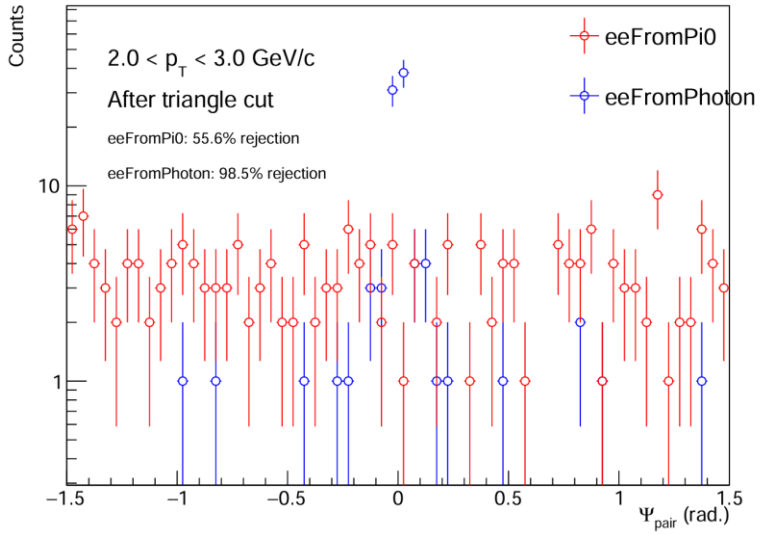


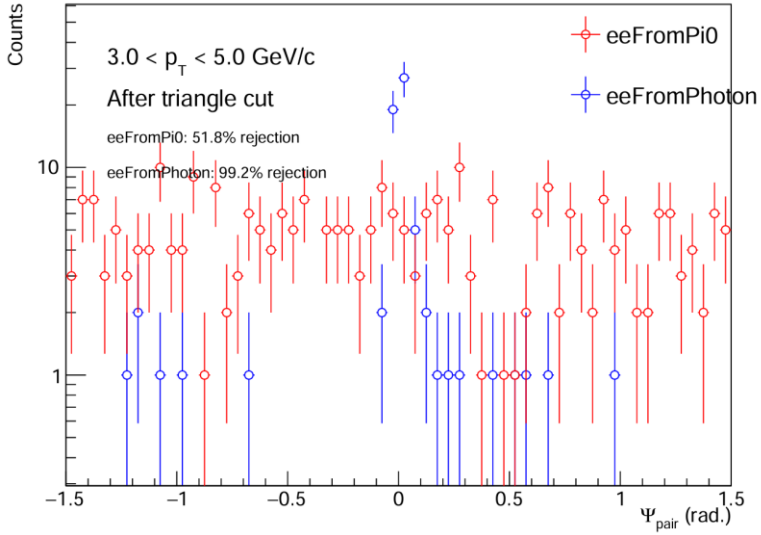
Check in MC (pairDalitz1Strong2)

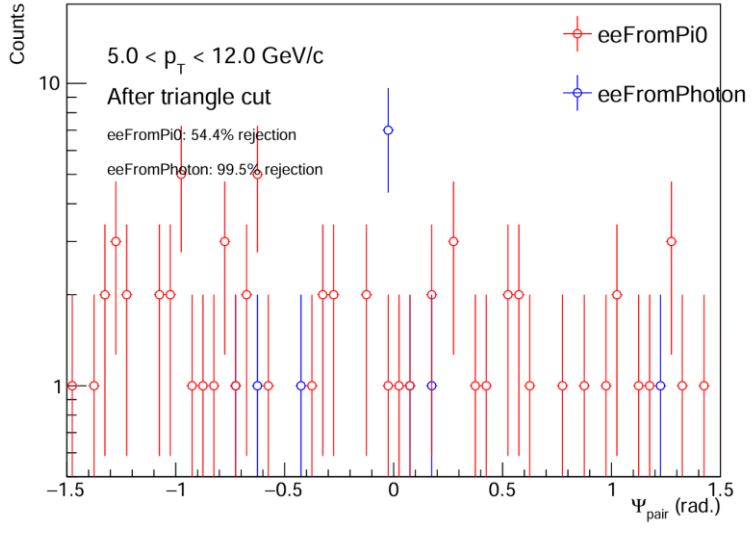












Summary

- ITS-TPC matching efficiency from tag-probe using eeFromPi0 shows correlation of two tracks
  - Todo: check correlation in eeFromJpsi.
- ITS-TPC matching efficiency decrease with pT.
  - Photon converted electrons contamination?
  - ITS cluster shared??