

Updates on the $B^\pm \rightarrow K^\pm \tau^\pm \ell^\mp$

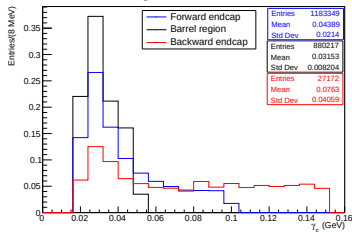
Inclusion of $\tau \rightarrow \rho \nu_\tau$ mode

Dr Devender Kumar

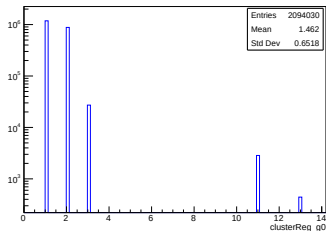
IFJ PAN, Cracow

goodBelleGamma

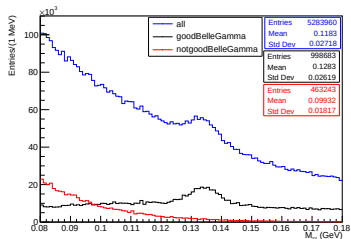
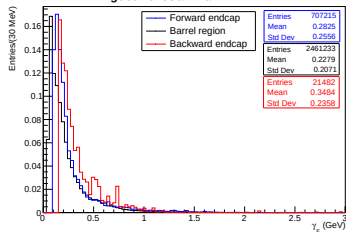
goodBelleGamma==0



clusterReg_g0 (tauDecay_decayModelID==1 && goodBelleGamma_g0==0)

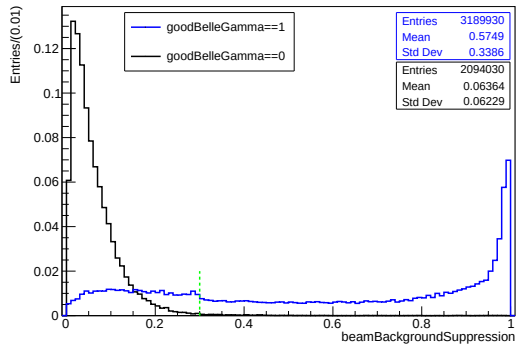
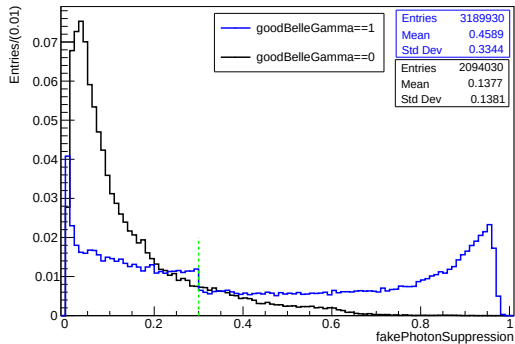


goodBelleGamma==1



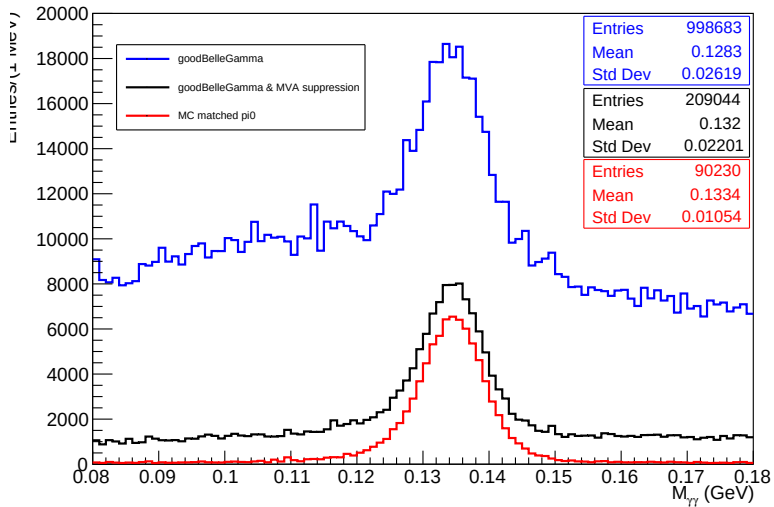
- $\text{goodBelleGamma} \in \text{clusterReg} = [1, 2, 3]$.
- Energy thresholds for these good photons:
 - [1] Forward endcap: > 100 MeV,
 - [2] Barrel region: > 50 MeV, and
 - [3] Backward endcap: > 150 MeV.

Fake photons and beam background suppression: MVA

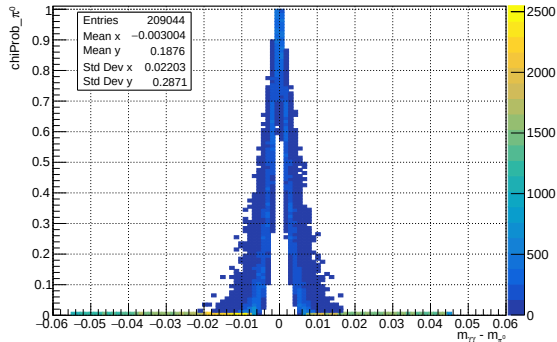
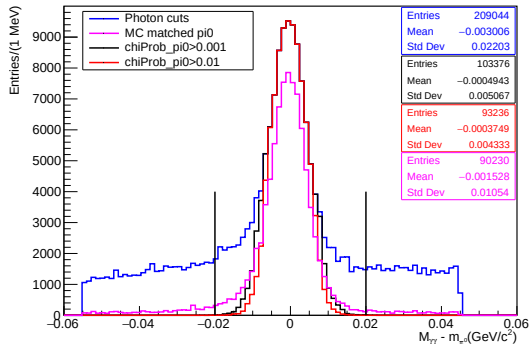


- Training variables: clusterE, clusterHighestE, clusterNhits, clusterTheta, clusterLAT, clusterE9E25, and minC2TDist.
- We select good Belle photons with MVA suppression to be greater than 0.3 for both the variables.

π^0 selection

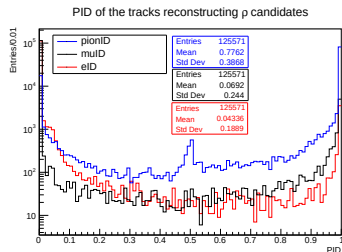
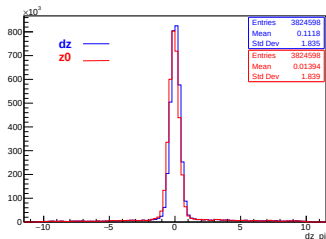
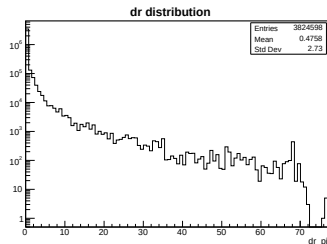


π^0 selection: Mass window or chiProb?



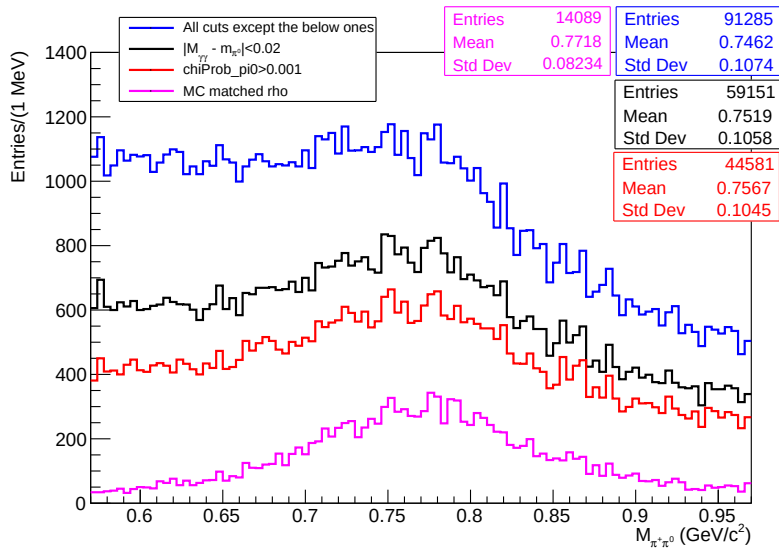
- Relative efficiency for the cut $|M_{\gamma\gamma} - m_{\pi^0}| < 20 \text{ MeV}/c^2$: 65.2%.
- For the $\text{chiProb} > 0.001$: 49.5%.

charged π selection



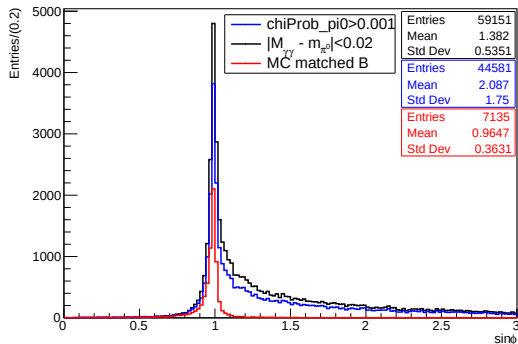
- Distances of the point of closest approach with respect to origin: $|dr| < 1$ cm and $|dz| < 4$ cm.
- PID conditions: $eID < 0.98$, $muID < 0.98$, and $pionID > 0.4$.

$M_{\pi^+\pi^0}$ distribution

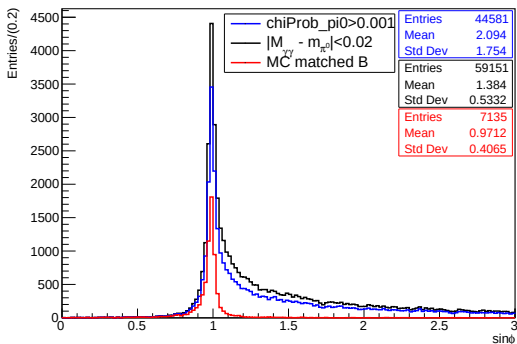


$\sin \phi$ distributions

m_p from pions

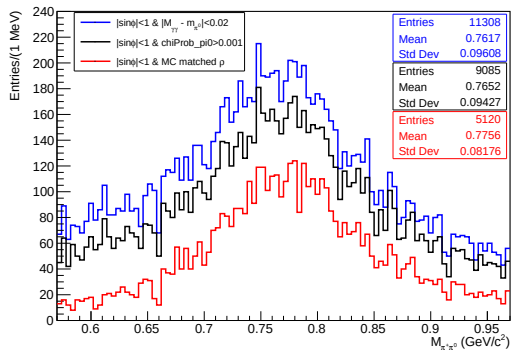
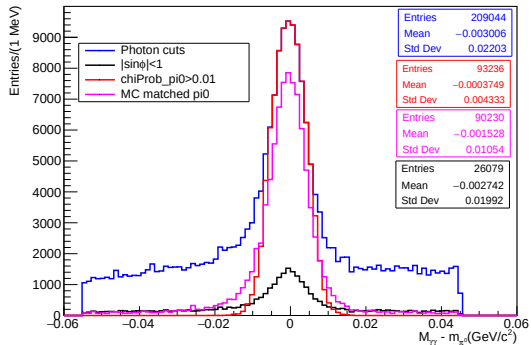


m_p from PDG



- Good candidates $\in |\sin \phi| < 1.0$

$M_{\gamma\gamma}$ and $M_{\pi^+\pi^0}$ distributions

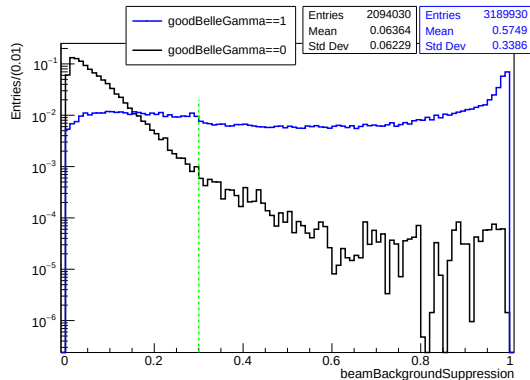
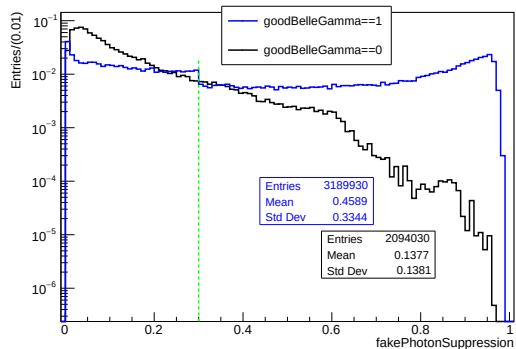


Summary

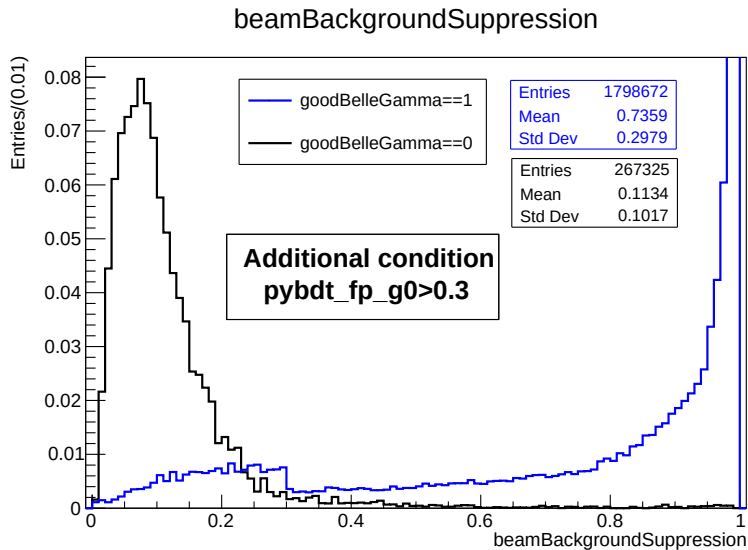
- Lepton veto for the charged pion selection: $eID < 0.98$ & $\mu ID < 0.98$.
- $\pi^\pm$ selection over $K^\pm$: $pionID > 0.4$.
- We select photons with $goodBelleGamma == 1$.
- ECL clusters from fake-photons and beam background are suppressed using TMVA: $fakePhotonSuppression > 0.3$ and $beamBackgroundSuppression > 0.3$.
- Invariant mass $M_{\gamma\gamma}$ is constrained to the nominal π^0 mass $\implies$ $chiProb$ is required to be greater than 0.001.

Back Up

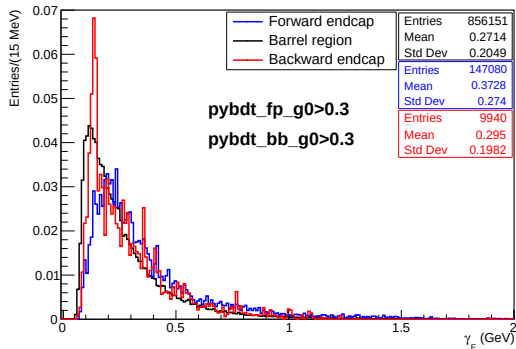
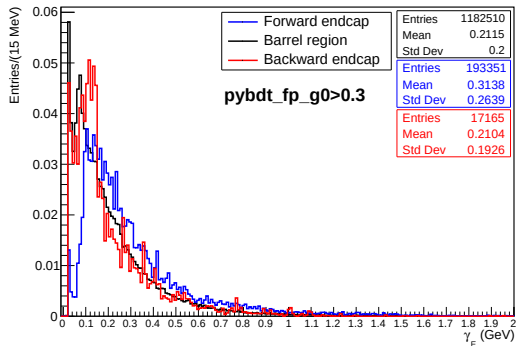
Fake photons and beam background suppression: MVA



Beam Background Suppression



E_γ distributions post cleaning



- Applying the energy condition on the first photon reconstructing a π^0 rejects 0.5% of the selected candidates.