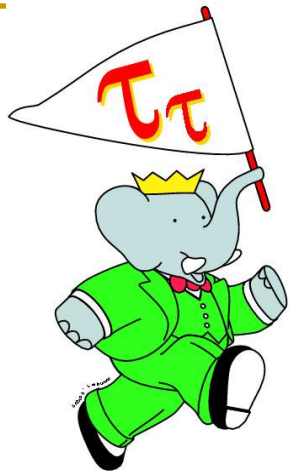
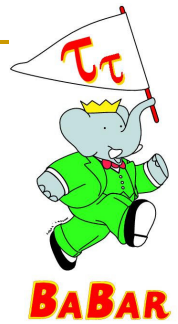
Use of Beam Polarization in $\tau \to \ell\gamma$ Searches



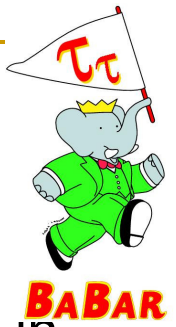
Alberto Cervelli
INFN & Universita' di Pisa

Outline



- Ntuples Production
- Comparison between Polarized and Unpolarized signal events
- Polarization effects on background rejection
- Future Plans
- Conclusions

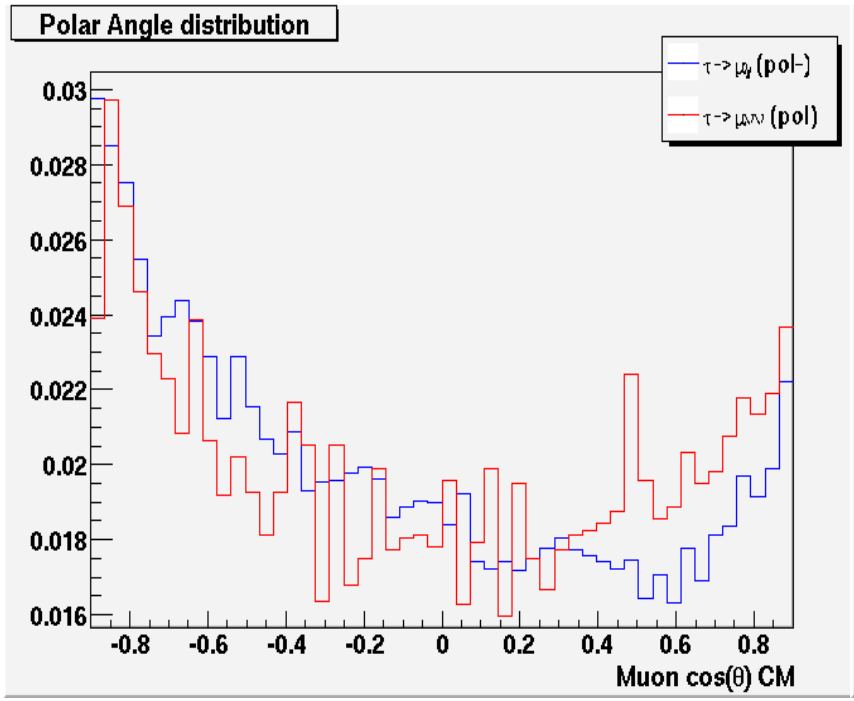
Data Produced

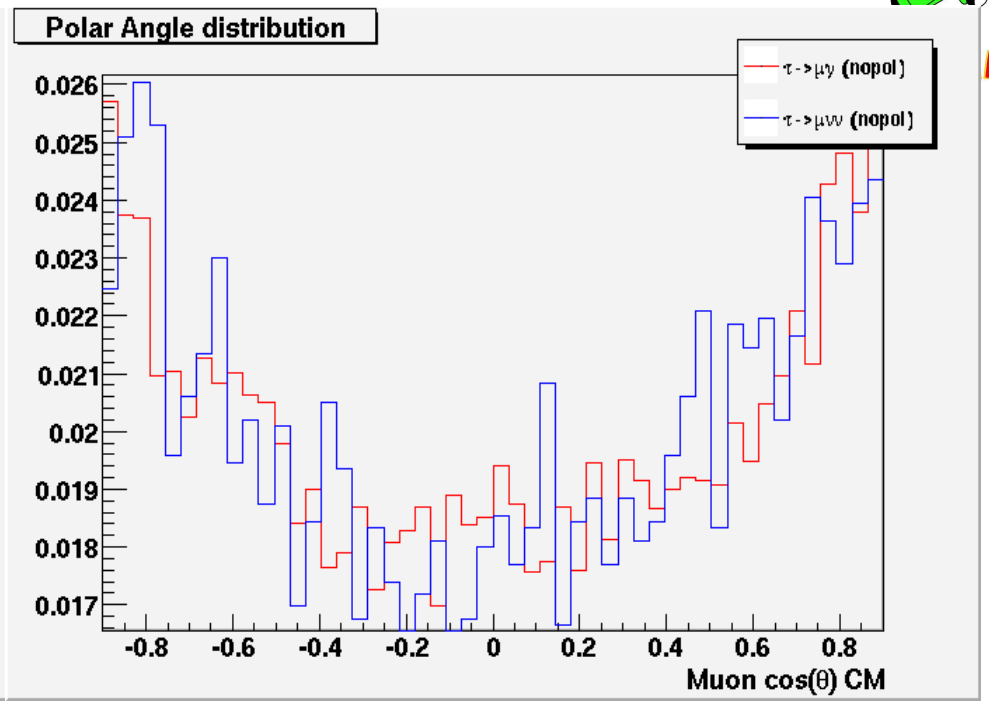


- Since Last Presentation five classes of events were produced using Fast Sim V0.1.1 and modified KK2f and tauola packages in order to simulate polarization effects:
  - 500K events for $\tau \rightarrow \mu\gamma$ with + polarization
  - 500K events for $\tau \rightarrow \mu\gamma$ with - polarization
  - 500K events for $\tau \rightarrow \mu\gamma$ unpolarized
  - 500K events for $\tau \rightarrow \mu\nu\nu$ with - polarization
  - 500K events for $\tau \rightarrow \mu\nu\nu$ unpolarized

  Albeit quite large the statistics studied is not enough to make studies on samples undergoing the selection made for BaBar analysis.

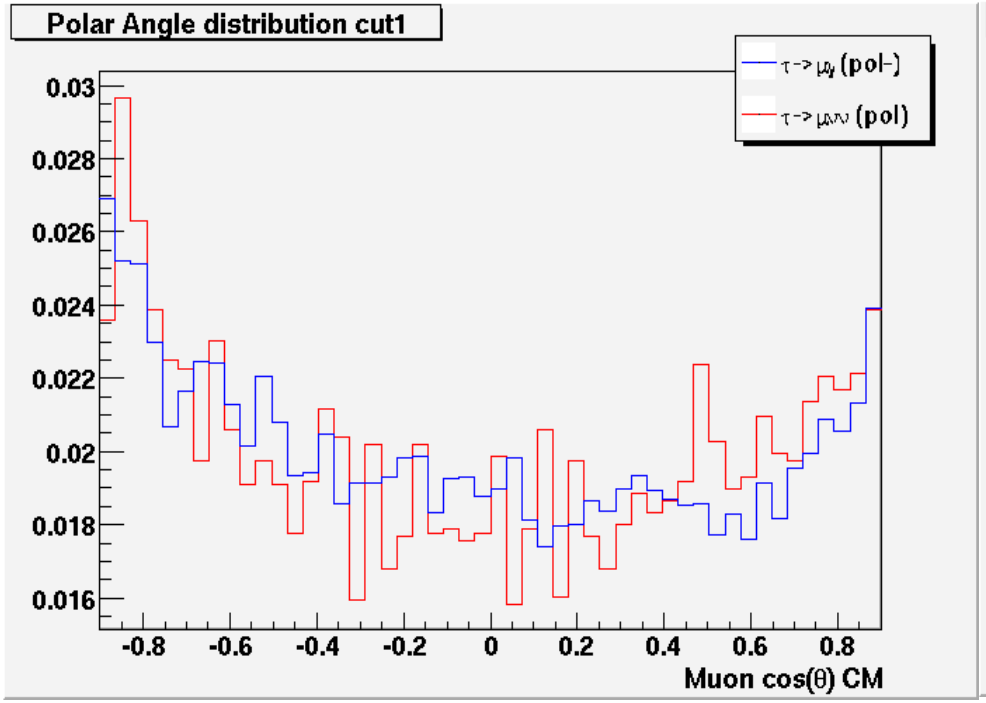
$\mathrm{Cos}(\theta)_{\mu CMS}$:a discriminating variable I

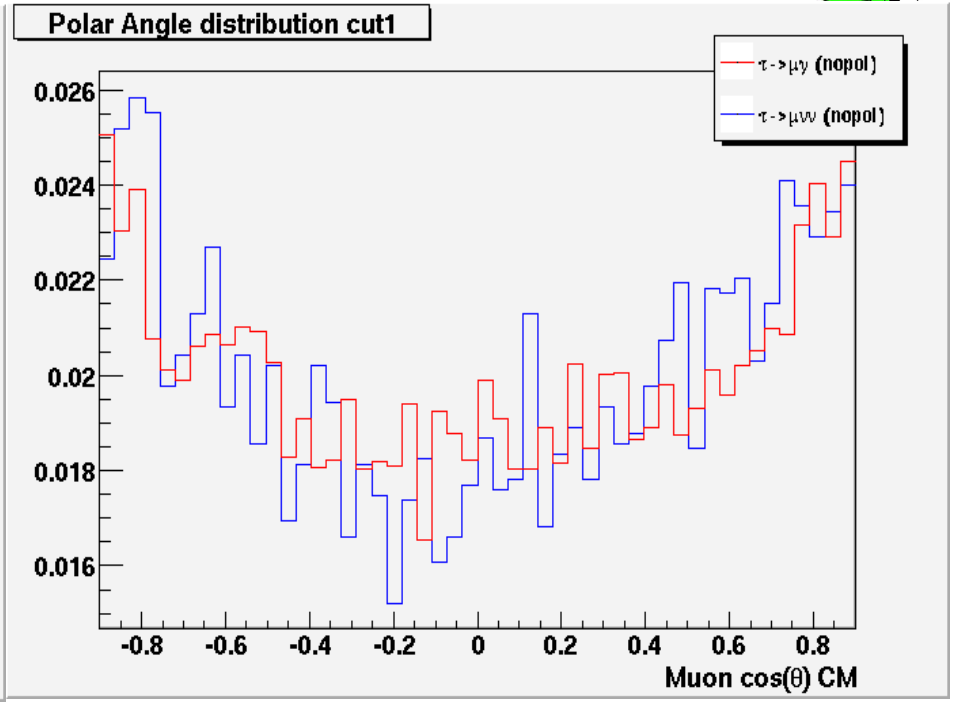




In the case of polarized beams shapes for $\tau \rightarrow \mu\gamma$ and $\tau \rightarrow \mu\nu\nu$ are different → Polarization may give a new handle for background reduction

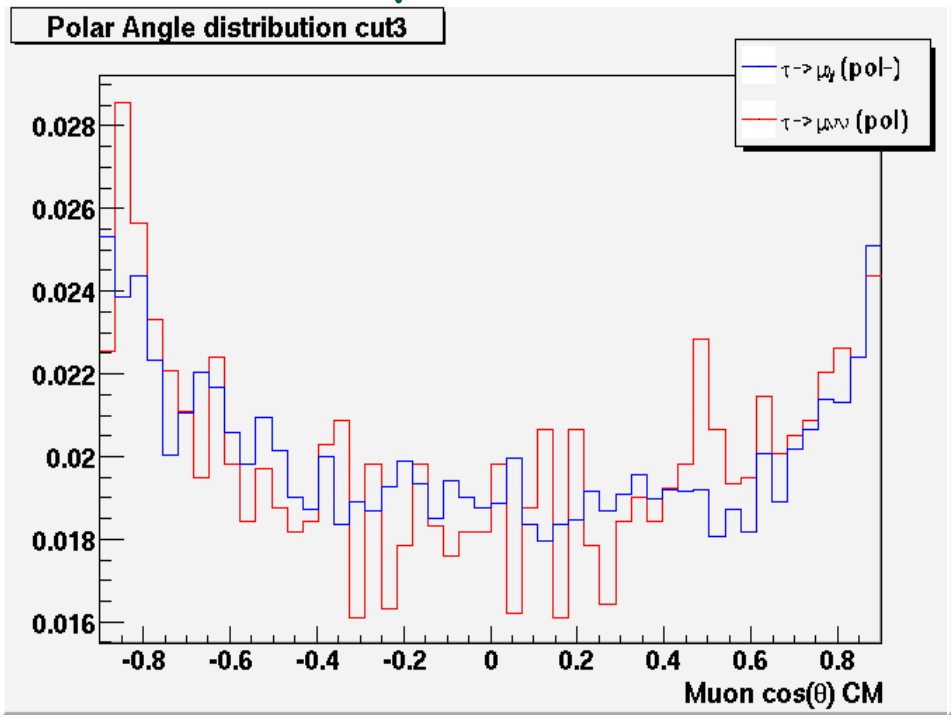
$Cos(\theta)_{\mu CMS}$:a discriminating variable II

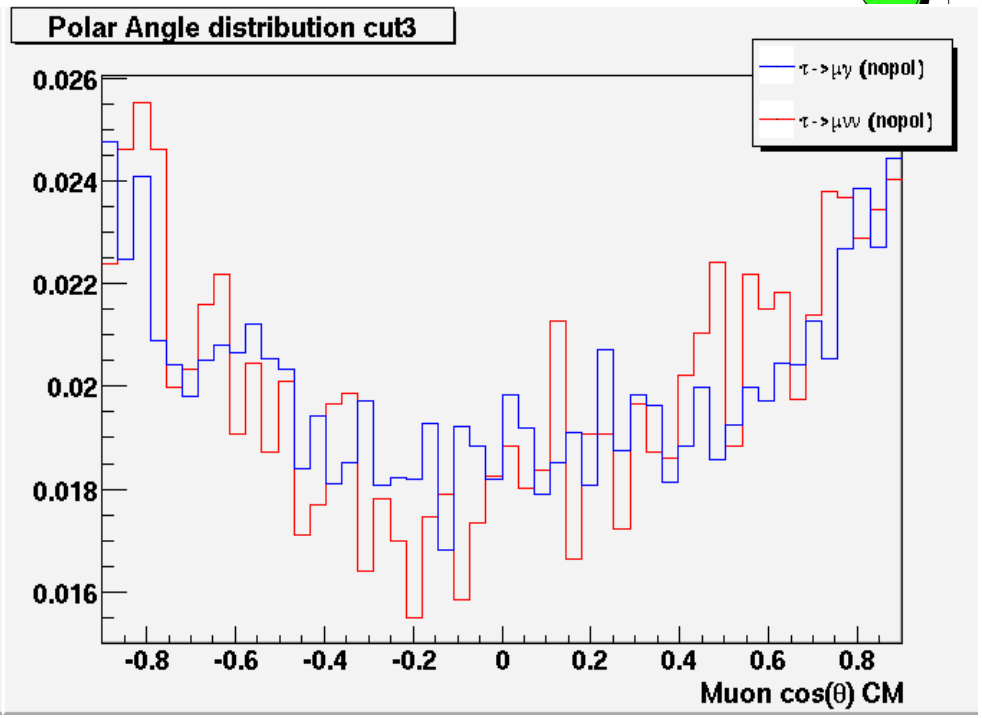




After applying a cut on $2P_{\mu}/s^{1/2} < 0.77$ polarization seems to have lesser discriminating power

$Cos(\theta)_{\mu CMS}$:a discriminating variable II

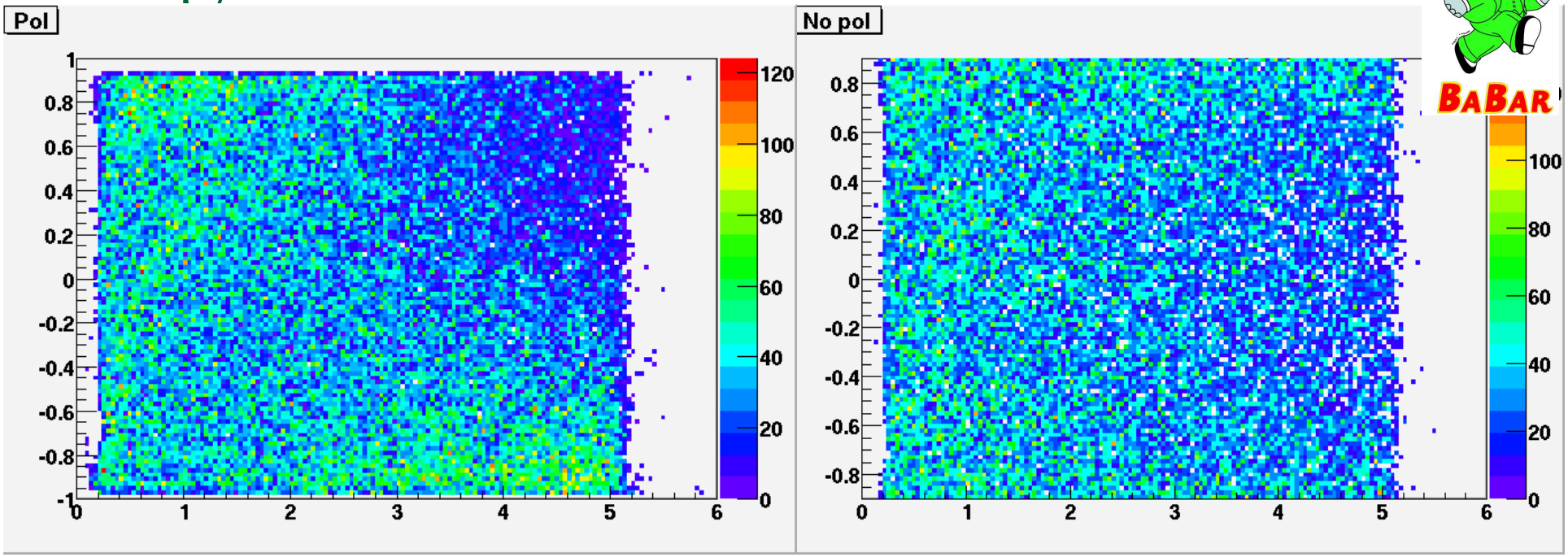




Releasing the cut requiring $2P_{\mu}/s^{1/2} < 0.87$ background and signal shapes differ again

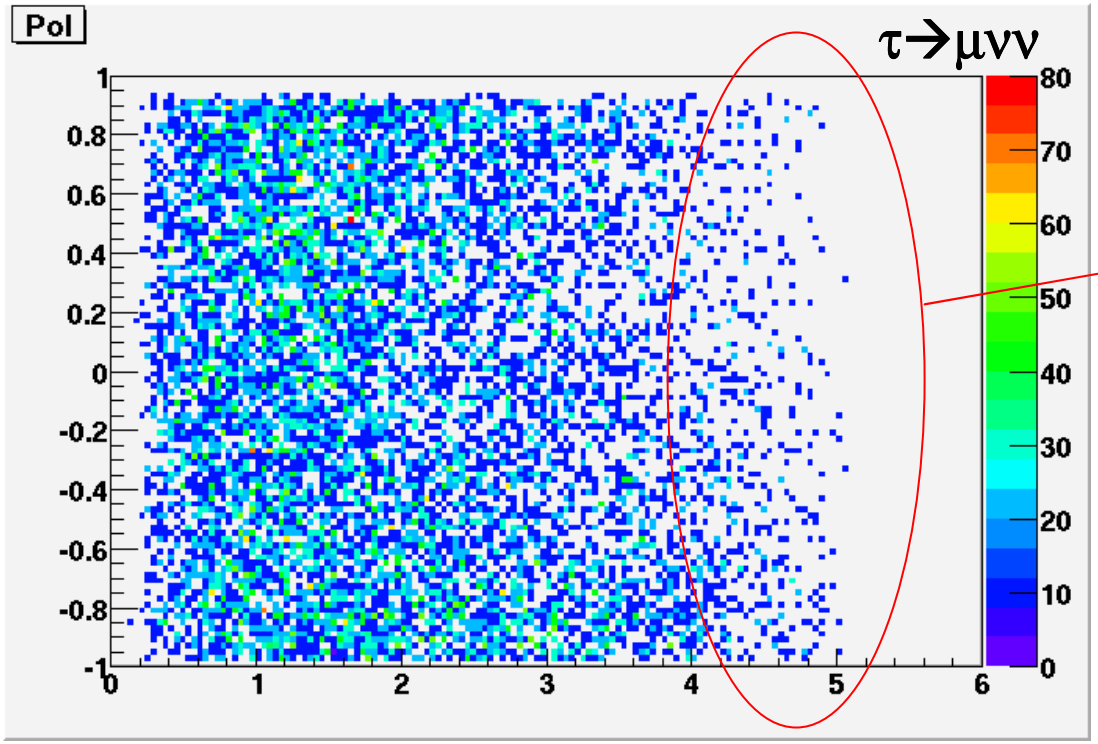
Possible hint for a momentum magnitude-angle correlation

Angle Momentum Correlation



- A correlation between angle and momentum arise when beams are polarized
- Probably angle and momentum may be used together to have a better background rejection→ Polarization still a good handle to reduce backgrounds

Backgrounds

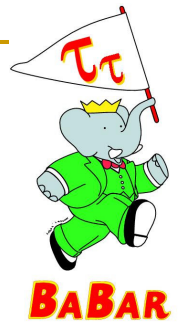


τ→μνν do are not present in high P regions.

Di-muon peak in this region

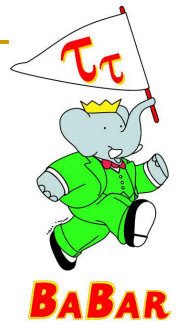
- Only τ→μνν were simulated
- Even if τ→μνν are an irreducible background their distribution in momentum is different from di-muon events.

Conclusions



- Polarization provide a good handle for $\tau \rightarrow \mu\gamma$ selection:
  - Shapes for $\tau \rightarrow \mu\gamma$ and $\tau \rightarrow \mu\nu\nu$ are different
  - It could be used to reduce $\tau \rightarrow \mu\nu\nu$ backgrounds using variables like $\mathrm{Cos}(\theta)_{\mu CMS}$
  - Correlation between $\mathrm{Cos}(\theta)_{\mu CMS}$ and P_{μ}^{CMS} is observed in polarized beams
- Need to produce more statistics to study selection details in polarized environment
- Need to produce a large di-muon sample in order to study effects of polarization on di-muon background rejection (needs long machine times and selection at generator level)

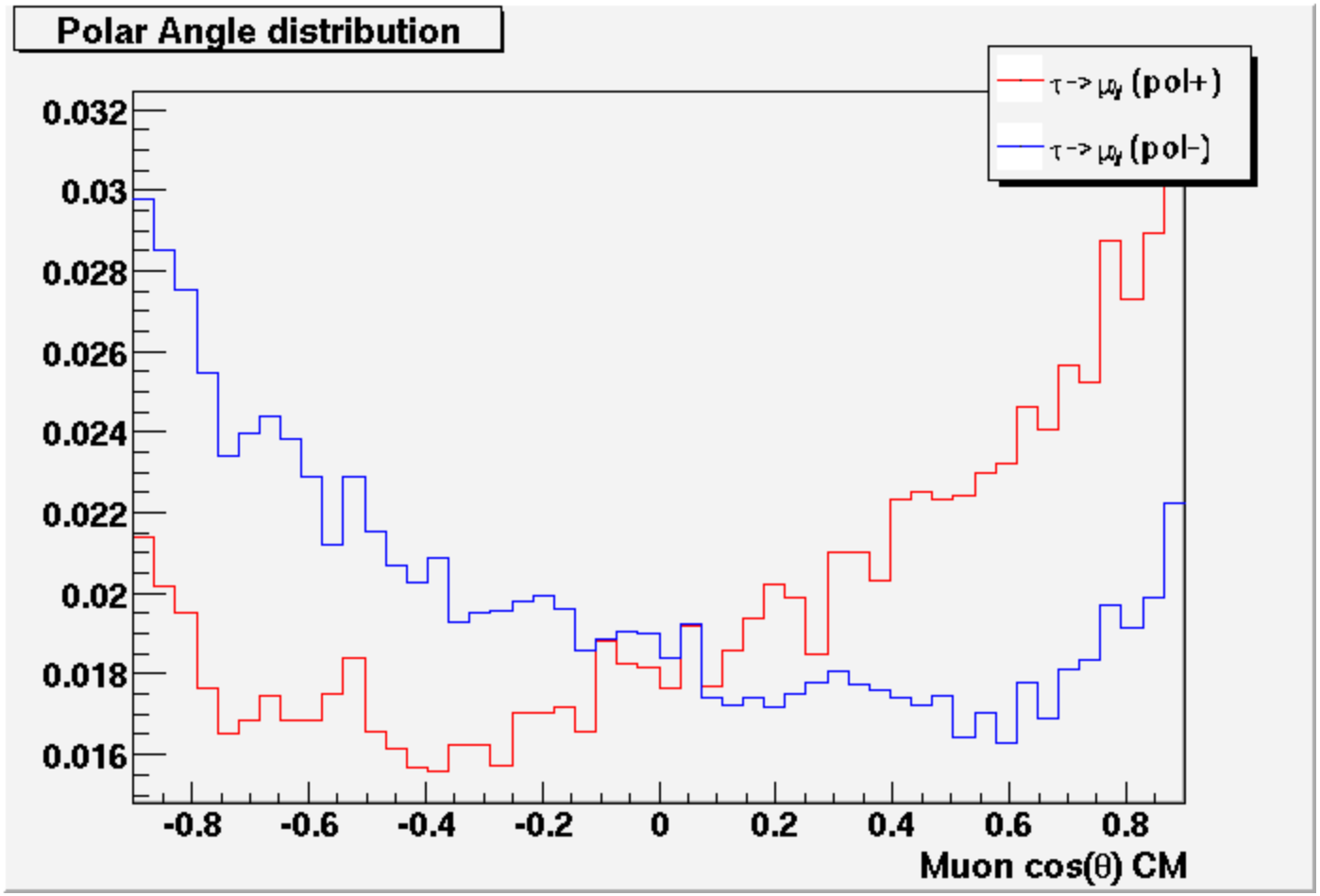
Plans for the next weeks



- Prepare a large sample (~3-4 M events) for radiative di-muon events with $\mu\mu\gamma$ final states
- Produce more statistics for polarized signal and $\tau \rightarrow \mu\nu\nu$ backgrounds
- Try to reproduce the BaBar analysis on the fast sim produced ntuples to have a quantitative estimation of polarization effects
- (Plug the polarization in the NN used in the latest BaBar analysis)

Backup

Pol+ Vs Pol -


Polar Angle distribution
τ -> μν (pol+)
τ -> μν (pol-)
0.032
0.03
0.028
0.026
0.024
0.022
0.02
0.018
0.016
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
Muon cos(θ) CM

Selection after cuts on P and E_γ