

π^0 Skim Study in CM2

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For Fully Inclusive $b \rightarrow s\gamma$ group

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Outline

- Introduction
- π^0 skim cuts
- π^0 mass and energy spectrum
- The Comparison of π^0 mass spectrum between SP5 MC and run1 data
- Preliminary π^0 mass fit
- Outlook

Introduction

- π^0 is the dominant background for $b \rightarrow s \gamma$ signal in generic $B\bar{B}$ events
- π^0 correction recipe was provided by Neutral group based on $\tau\tau$ events for SP5 and SP6 (BAD870), but similar study is not done with inclusive events
- This is a first try to migrate current inclusive $b \rightarrow s \gamma$ analysis to CM2
- To understand π^0 spectrum in CM2, provide useful information for other CM2 analyses

π^0 skim

● Skim Cuts

- BGFMultiHadron tag bit
- $1.0 < e1Mag < 3.5$ GeV
- 2nd Fox-Wolfram moment in overall CMS, $R2 < 0.9$
- $nTrk > 2$, from *nGoodTrackLoose*
- $p1Mag < 2.5$ GeV

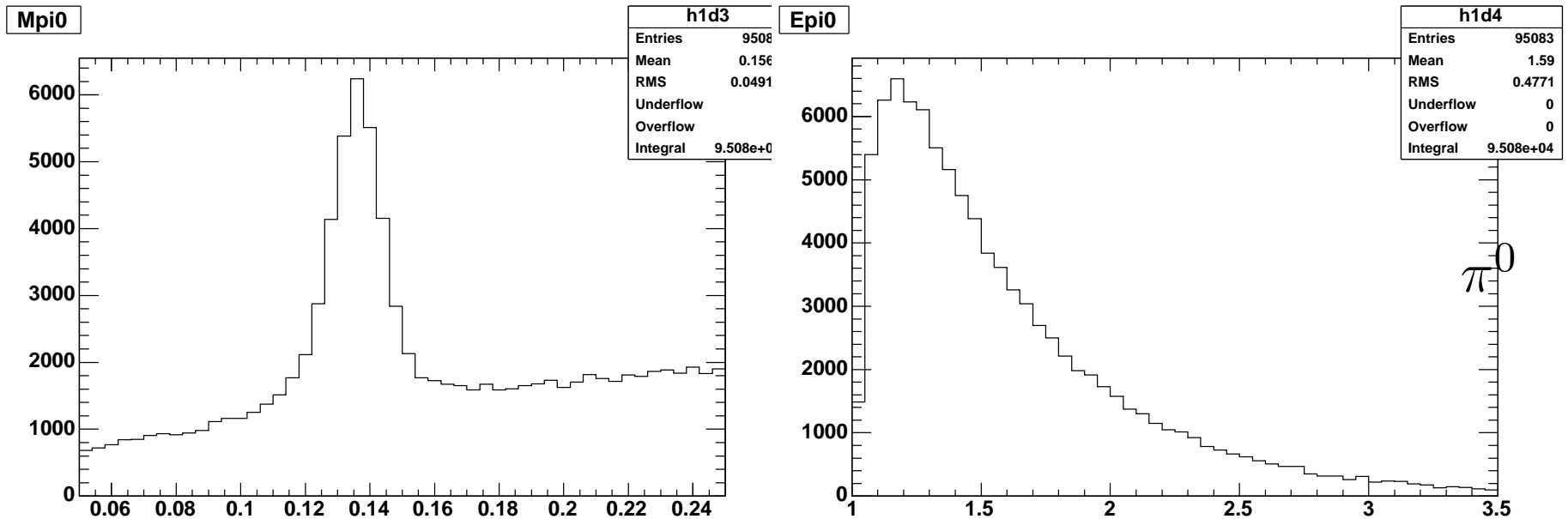
● Skim Efficiency

- $B^0 \bar{B}^0$ MC events: 200k -> 25,393, 12.7%
- $B^+ B^-$ MC events: 200k -> 26,417, 13.2%
- On-Peak run1 data: 500k -> 45,395, 9.1%
- Off-Peak run1 data: 100k -> 7,490, 7.5%

Selection of π^0 Candidate

- 2γ Mass cut:
 - $E_{\gamma_1}^* > 1.0$ GeV, from user defined HE γ List
 - $E_{\gamma_2} > 30$ MeV, from *GoodPhotonLoose* List
 - $50 < m_{2\gamma} < 250$ MeV
 - $1.0 < E_{2\gamma}^* < 3.5$ GeV
- Truth matching for MC:
 - GHit truth map
 - The mother \leftrightarrow daughter matching

π^0 spectrum (on-peak data)

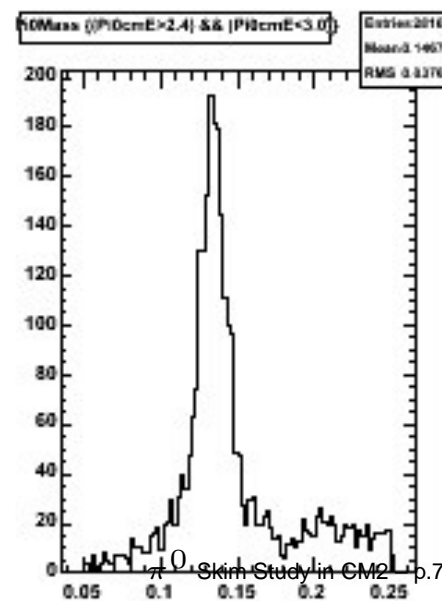
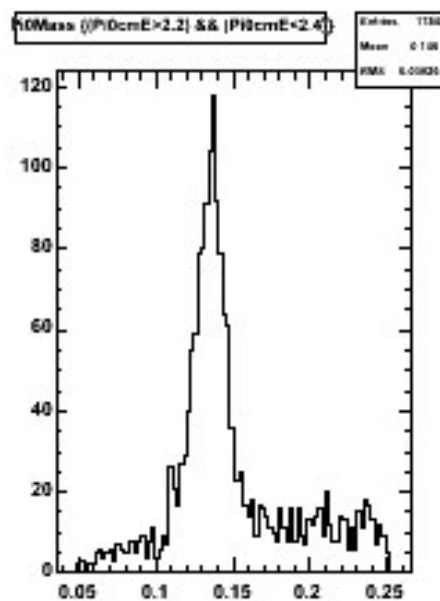
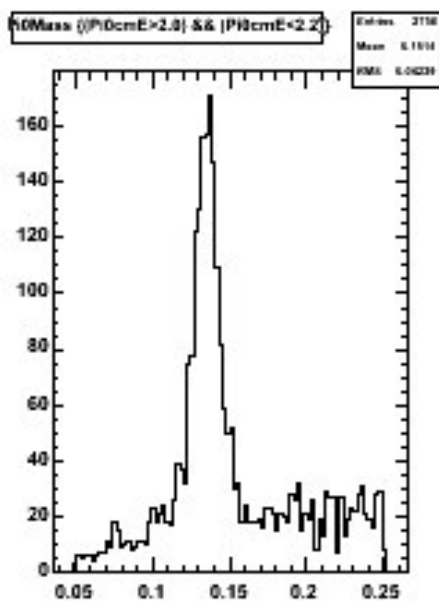
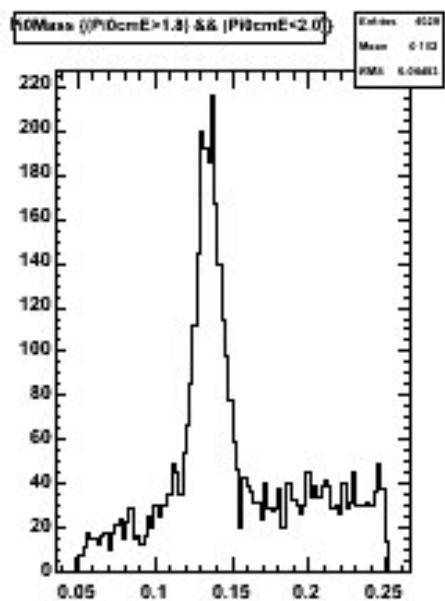
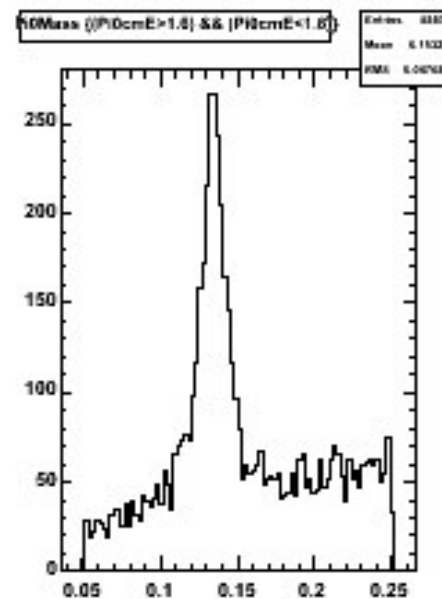
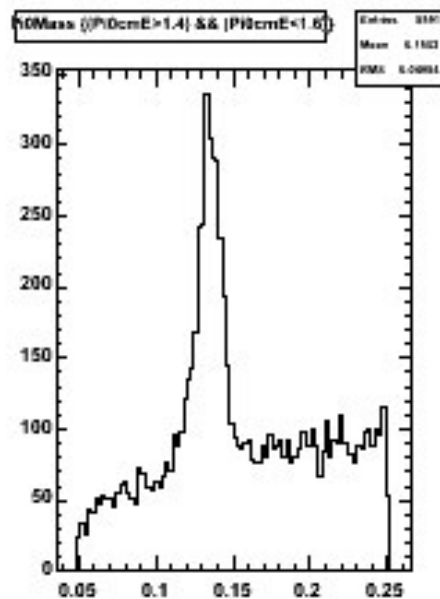
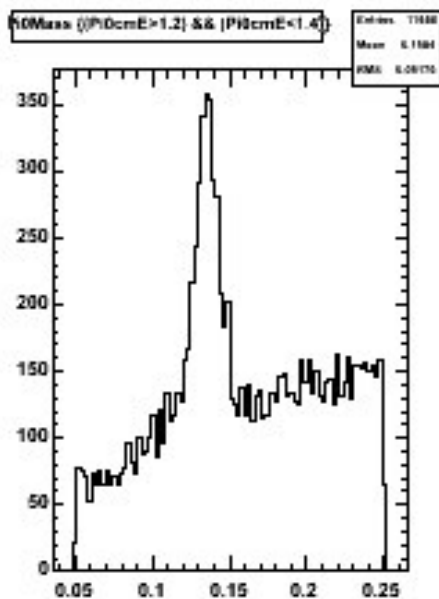
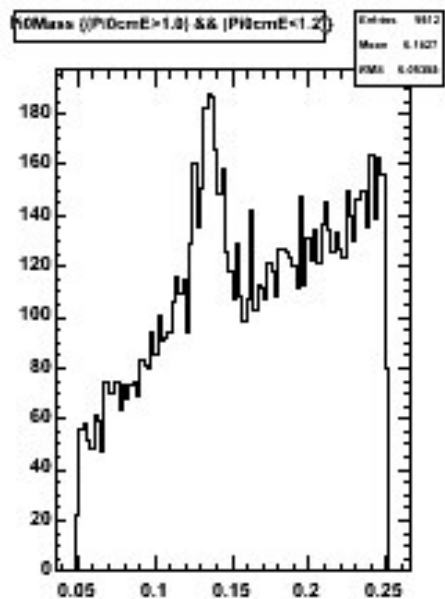


spectrum will be studied in 8 different $E_{\pi^0}^*$ bins:

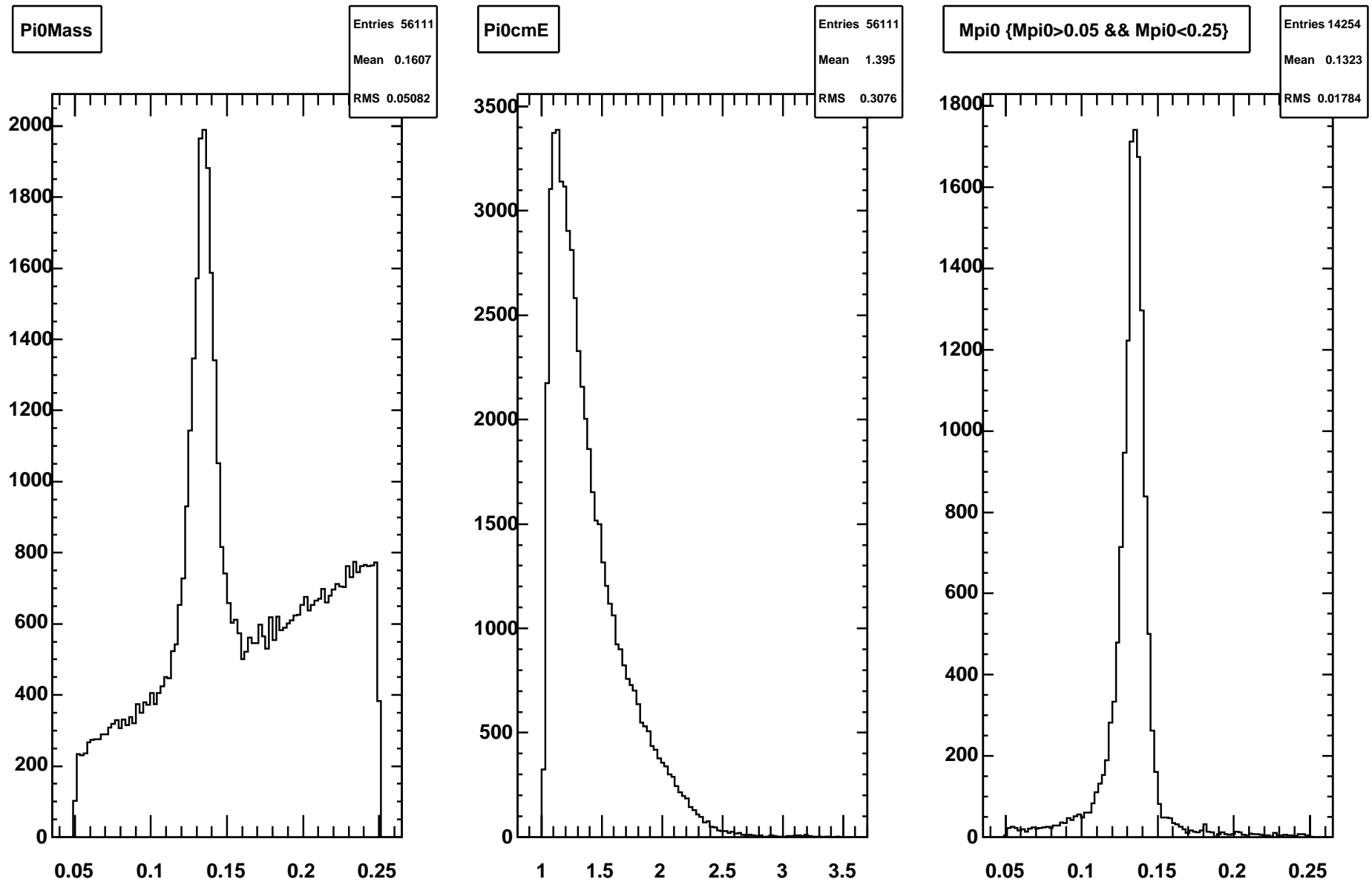
1.0-1.2, 1.2-1.4, 1.4-1.6, 1.6-1.8,

1.8-2.0, 2.0-2.2, 2.2-2.4, 2.4-3.0

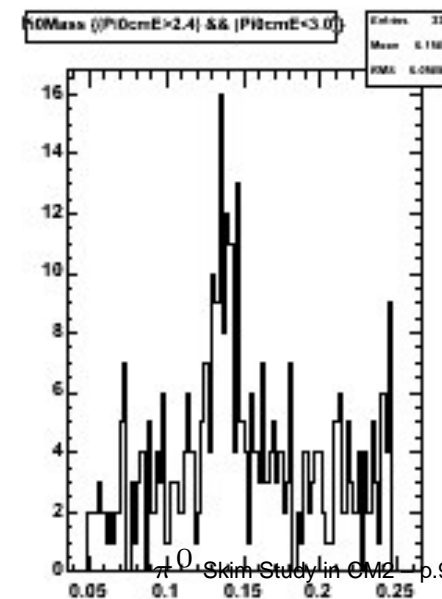
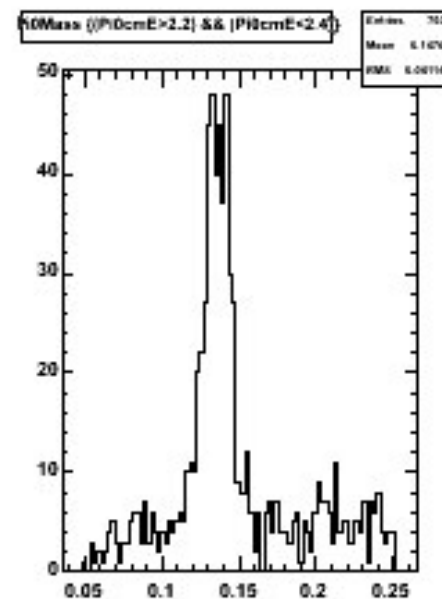
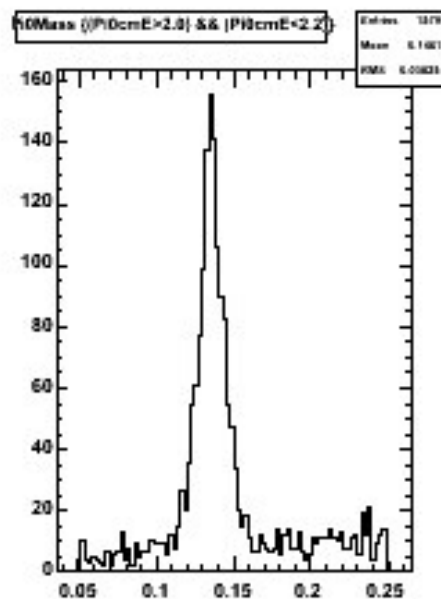
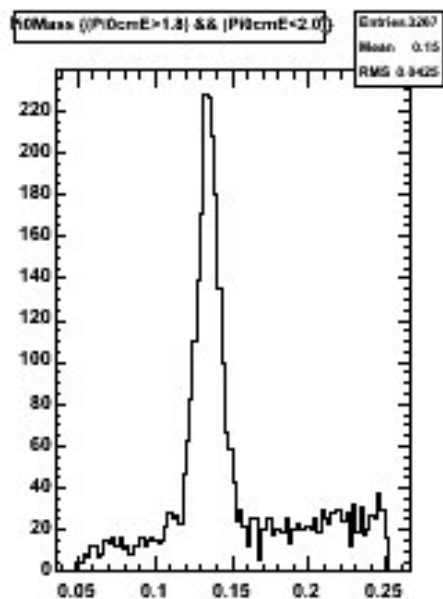
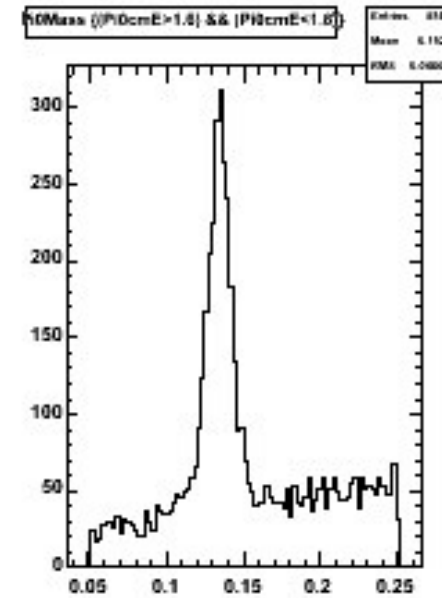
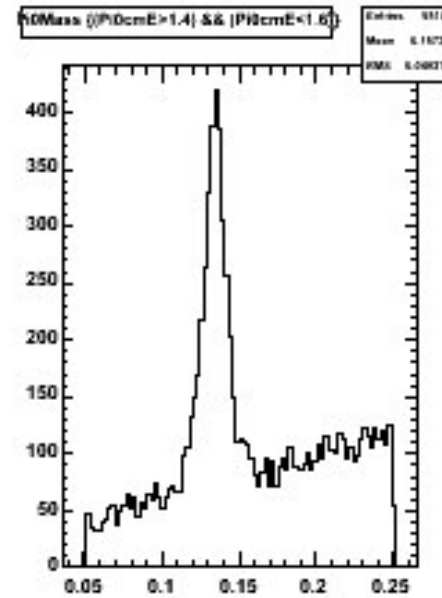
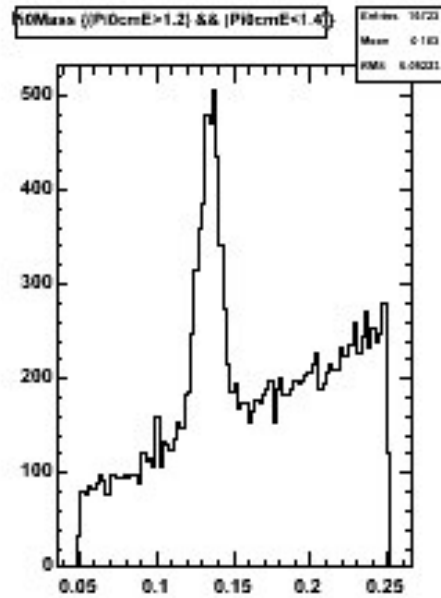
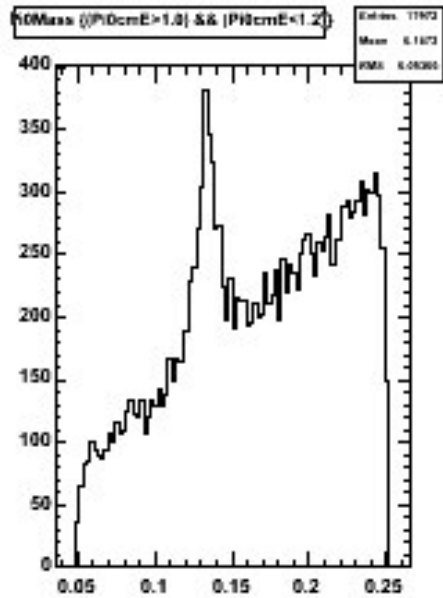
M_{π_0} in different $E_{\pi_0}^*$ bins (on-peak data)



π^0 spectrum for $B^0\bar{B}^0$ MC

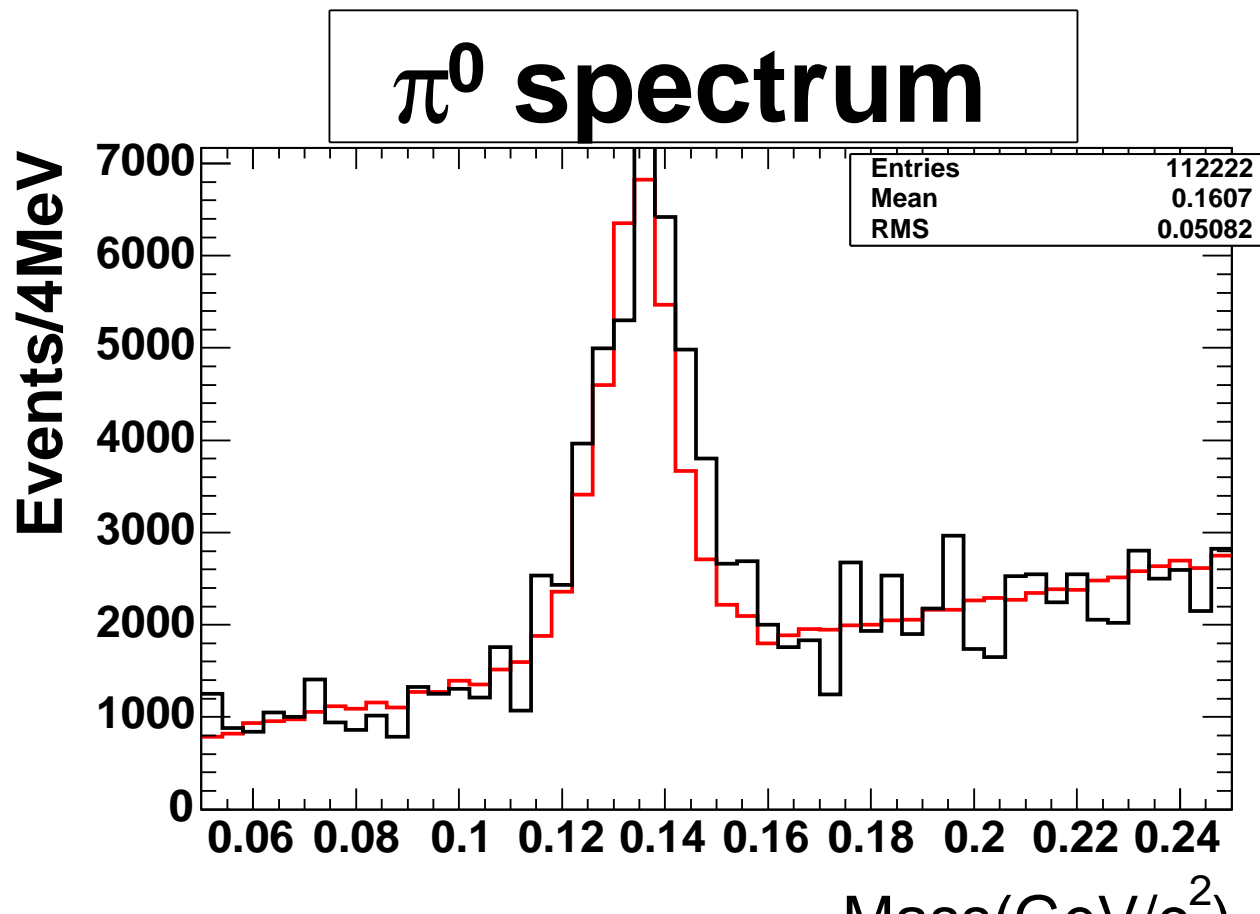


M_{π^0} in 8 different $E_{\pi^0}^*$ bins ($B^0 \bar{B}^0$)



MC and Run1 data comparison

- on-off: On-peak - $\frac{L_{on}}{L_{off}}$ off-peak
- Combine both $B^0\bar{B}^0$ and B^+B^- , normalized to same number of Bs



π^0 mass fit function

- The signal Model:

$$f(m) = A_g [f_1 G(m, \mu_1, \sigma_1) + (1 - f_1) G(m, \mu_2, \sigma_2)], m > m_0$$

$$f(m) = N \left[\frac{p\sigma_1/\lambda}{(m_0 - m) + p\sigma_1/\lambda} \right]^p, m < m_0$$

where $m_0 = \mu_1 - \lambda\sigma_1$

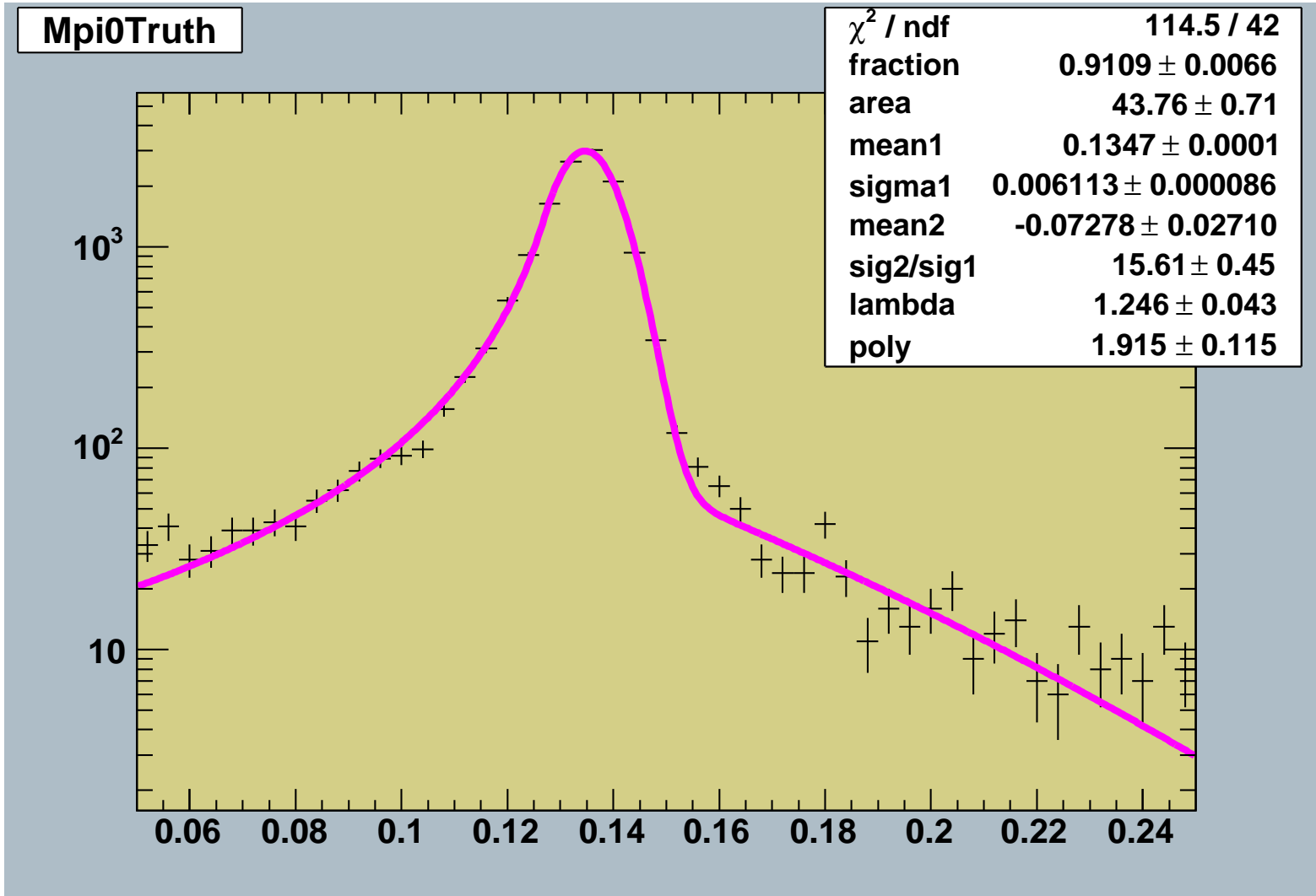
8 fit parameters: $A_g, f_1, \mu_1, \sigma_1, \mu_2, \sigma_2, p$ and λ .

- Background:

$$f(m) = \frac{am^b}{(m^2 + c)^d}$$

4 fit parameters: a, b, c, d

Preliminary π^0 mass fit



Summary and Outlook

- A simple data MC comparison was done on π^0 skim
- Preliminary Mass fits on truth matched π^0 mass spectrum were performed, more complete mass fits are expected
- Only skim samples were studied so far, more cuts will be implemented, such as photon quality cut, fisher cut, etc
- The mass fits now are done by my personal codes, John and Francesca's complete π^0/η mass fit package will be borrowed and migrated to CM2
- This study is intended to be done on full statistics (run1 to run4 data) once all cuts are finalized and codes are implemented