$\pi^0/\eta \to \gamma\gamma$ in Proc9

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Intro

As requested by Tom and Torben at Phys. Perf. meeting today/yesterday

- Produce nice plot for Phase III Data for:
  - $\pi^0 \to \gamma\gamma$
  - $\eta \to \gamma\gamma$
- Similar work done for Phase II, exp3, using Prod6
- Documented on BELLE2-NOTE-PH-2018-038
  - Will present update on η and η' reco at next Phys Performance meeting

Today

- Using **Proc9** data for Phase III
- Release-03-02-02 GT: **data_reprocessing_proc9 mdst** `hlt_hadron` skim
- Exp7 and Exp8 **4S**
- **Exp7** $L_{offline} = 0.643$ fb^{-1}
- **Exp8 4S** $L_{offline} = 1.980$ fb^{-1}

$\pi^0 \to \gamma\gamma$ reconstruction

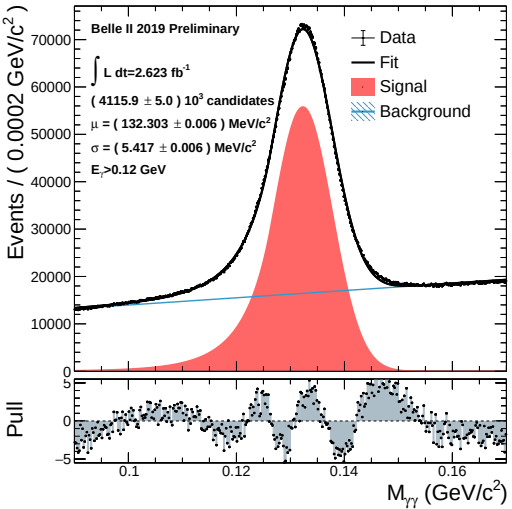
Selection:

- `gamma:tight` from `stdPhotons`
  - $0.296706 < \theta_\gamma < 2.61799$
  - *clusterTimingError* $< 1e6$ and $[E_1/E_9 > 0.4$ or $E > 0.075\,\text{GeV}]$
  - $E_{reg=1/2} > 0.05\,\text{GeV}$ $E_{reg=3} > 0.075\,\text{GeV}$
- Cluster: $N_{hits} > 1.5$, $E_9/E_{21} > 0.9$
- $E_\gamma > 120\,\text{MeV}$

Binned-ML Fit with CrystalBall + Chebychev[1]

Pulls are bad: single CB clearly not enough. Different fit model in next slide.

Invariant Mass plot for Data Proc9



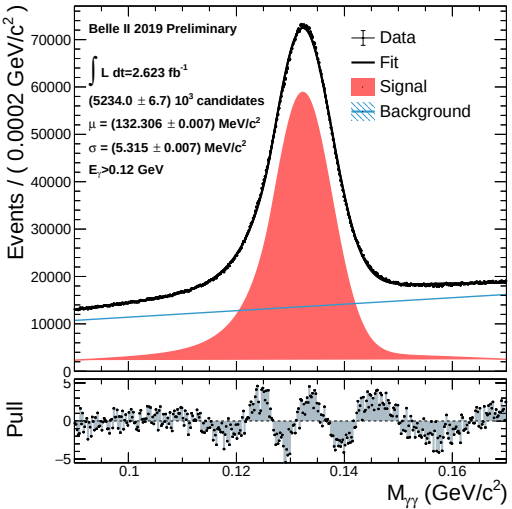
$\pi^0 \to \gamma\gamma$ reconstruction: alternate fit

Same selection as before

- Different fit model
  - add large Gauss (with same mean as CB) to background to reduce a bit the large pulls
- Binned-ML Fit
  - (CrystalBall + Gauss) for Signal
    - $\sigma_{gauss} \sim 44$ MeV
  - Chebychev[1] for background
- Better, not yet perfect.
- μ and σ unchanged

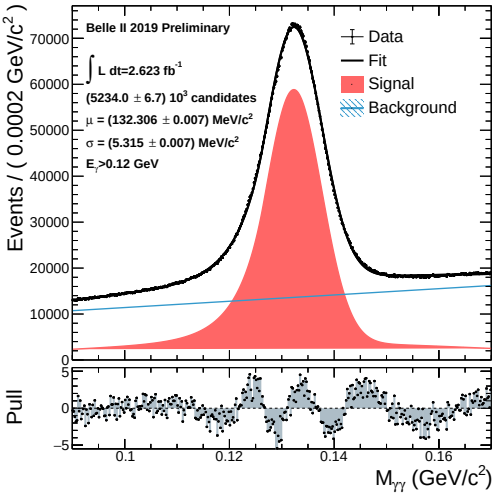
For approval

Invariant Mass plot for Data Proc9

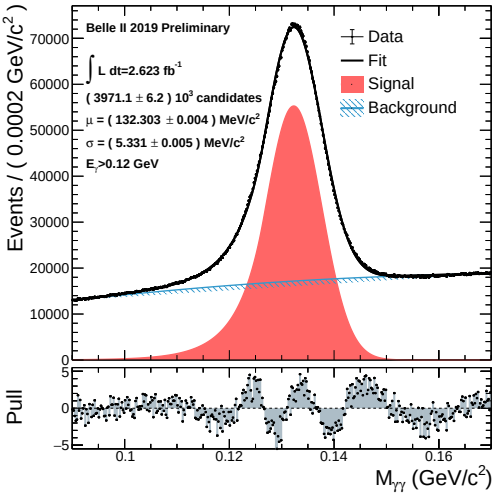


$\pi^0 \to \gamma\gamma$ reconstruction: alternate fit (2)

Invariant Mass plot for Data Proc9: Fit: Signal(CB+G) + Background(Cheb[1])

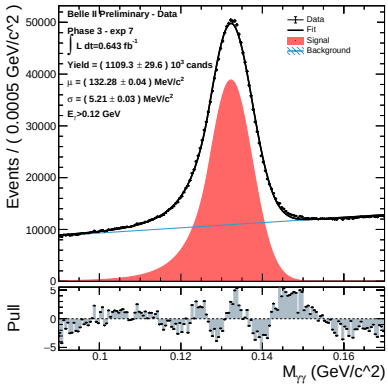


Invariant Mass plot for Data Proc9: Fit: Signal(CB) + Background(G+Cheb[1])

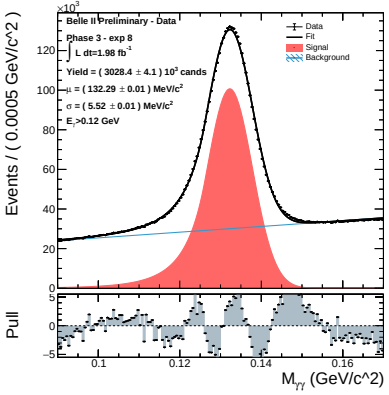


$\pi^0 \to \gamma\gamma$ Data Proc9 Exp7 - Exp8 comparison

Data - Phase III Proc 9 - Exp7



Data - Phase III Proc 9 - Exp8



Exp8 peak broader that exp7 (5.21 vs 5.51 MeV).
Fit with single CB not optimal (θ, p dependent resolution and tails?)
Yield vs exp ok, a bit less in exp7

$\eta \to \gamma\gamma$ reconstruction

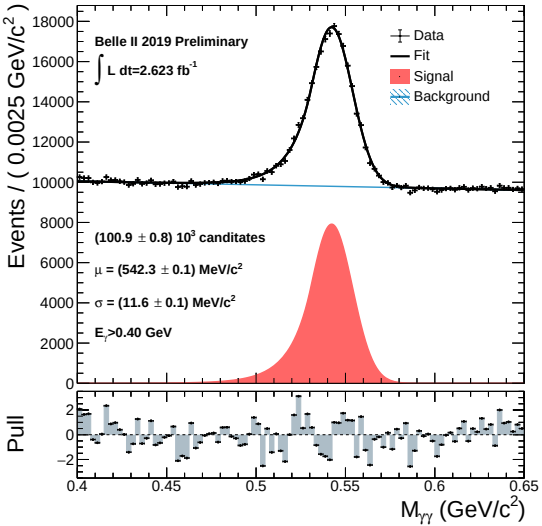
Selection:

- `gamma:tight` from `stdPhotons`
  - $0.296706 < \theta_\gamma < 2.61799$
  - *clusterTimingError* $<$ 1e6 and $[E_1/E_9 > 0.4$ or $E > 0.075$ GeV$]$
  - $E_{reg==1} > 0.05$ GeV
    $E_{reg==2} > 0.05$ GeV
    $E_{reg==3} > 0.075$ GeV
- Cluster: $N_{hits} > 1.5$, $E_9/E_{21} > 0.9$
- $E_\gamma > 400$ MeV

Binned-ML Fit with CrystalBall + Chebychev[1]

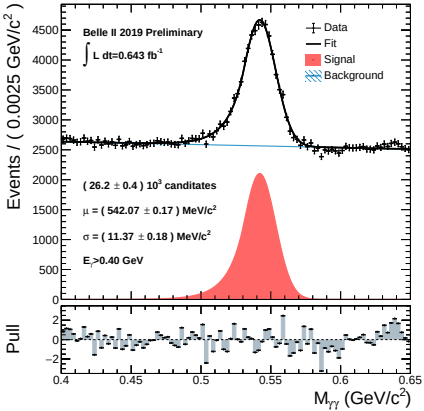
For approval

Invariant Mass plot for Data Proc9

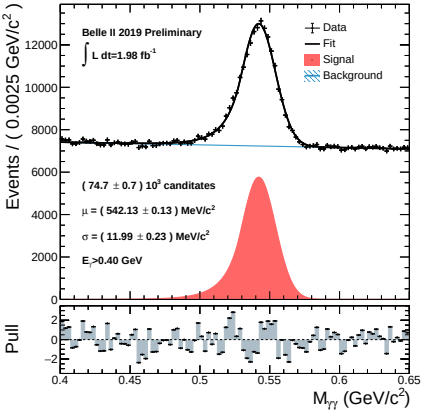


$\eta \to \gamma\gamma$ Data Proc9 Exp7 - Exp8 comparison

Data - Phase III Proc 9 - Exp7



Data - Phase III Proc 9 - Exp8



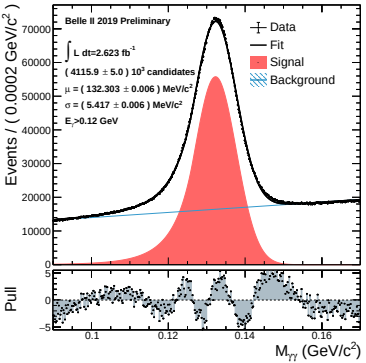
Exp8 peak broader that exp7 (11.37 vs 11.99 MeV).
Yield vs exp ok.

Additional stuff

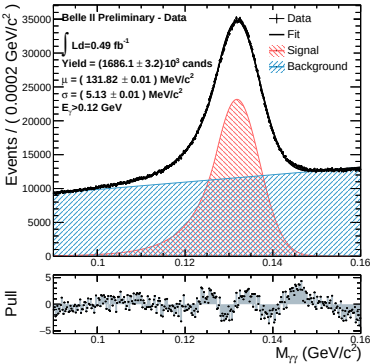
Additional or backup slides

$\pi^0 \to \gamma\gamma$ reconstruction Phase II Prod6

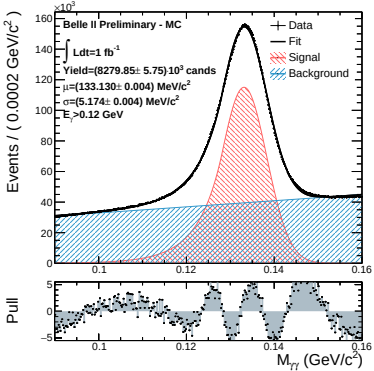
Invariant Mass plot for Data Proc9



Invariant Mass plot for Data Phase II Prod6

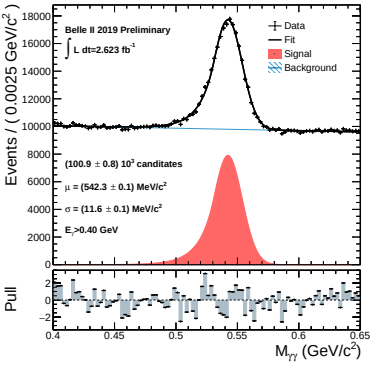


Invariant Mass plot for MC BGx1 Phase II

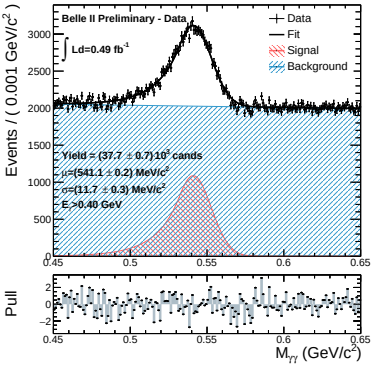


$\eta \to \gamma\gamma$ reconstruction Phase II Prod6

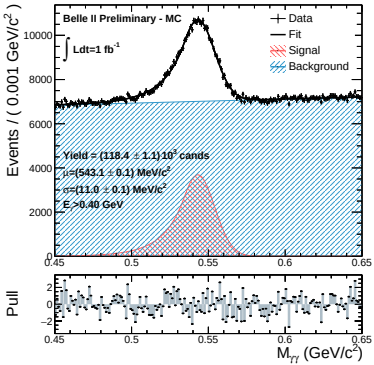
Invariant Mass plot for Data Proc9



Invariant Mass plot for Data Phase II Prod6



Invariant Mass plot for MC BGx1 Phase II



Bibliography I