

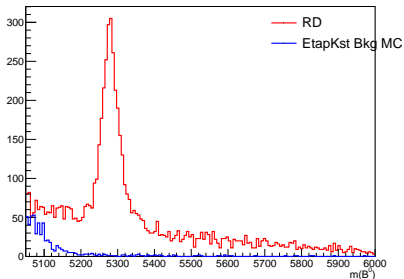
$B^0 \rightarrow K_S^0 \eta'$  time-dependent analysis meeting

Pio Francesco Varrella

March 18, 2026

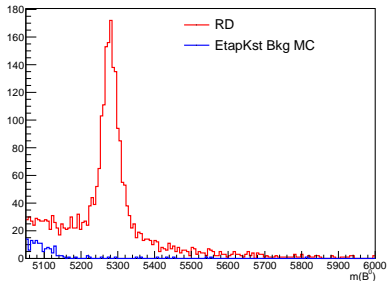
# Comparison of $m_{B^0}$ between RUN2 $K_S\eta'$ RD and RUN2 $B^+ \rightarrow K^{*+}\eta'$ Bkg MC

RUN2 EtapKs RD vs RUN2 EtapKst Bkg MC | 1g DD



1g DD  
564 events

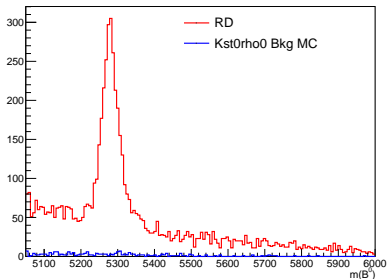
RUN2 EtapKs RD vs RUN2 EtapKst Bkg MC | 1g LL



1g LL  
142 events

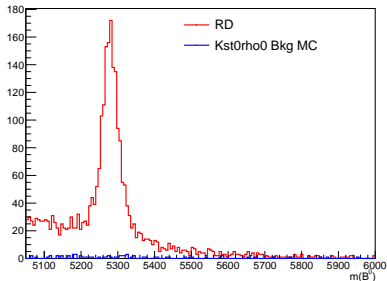
# Comparison of $m_{B^0}$ between RUN2 $K_S\eta'$ RD and RUN2 $B^0 \rightarrow K^{*0}\rho^0$ Bkg MC

RUN2 EtapKs RD vs RUN2 Kst0rho0 Bkg MC | 1g DD



1g DD  
209 events

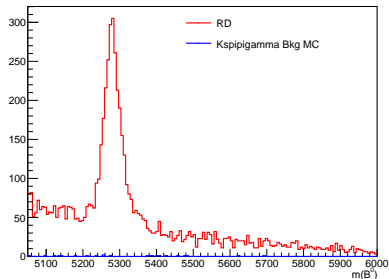
RUN2 EtapKs RD vs RUN2 Kst0rho0 Bkg MC | 1g LL



1g LL  
66 events

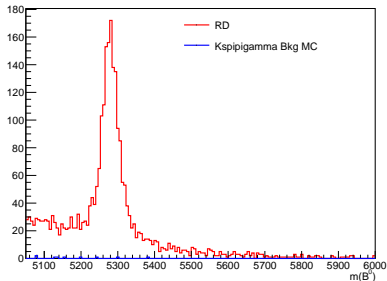
# Comparison of $m_{B^0}$ between RUN2 $K_S\eta'$ RD and RUN2 $B^0 \rightarrow K_S\pi^+\pi^-\gamma$ Bkg MC

RUN2 EtapKs RD vs RUN2 Kspigamma Bkg MC | 1g DD



1g DD  
22 events

RUN2 EtapKs RD vs RUN2 Kspigamma Bkg MC | 1g LL

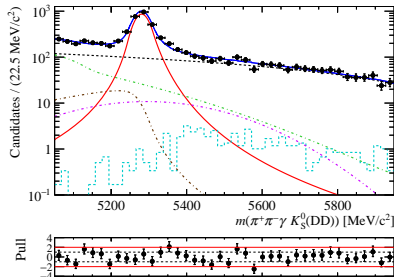
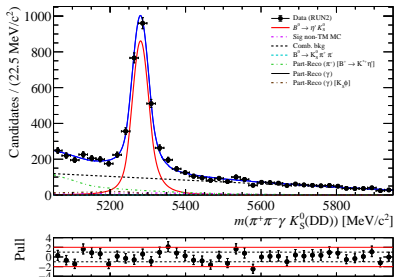


1g LL  
9 events

1g DD

# $m_{B^0}$ fit plot of Run 2 $K_S \eta'$ data with partial-reconstructed $B^+ \rightarrow K^{*+} \eta'$ included

- Model :  $f \times (\text{Argus} \otimes \text{DSCB}) + (1 - f) \times \text{Gauss}$



Param	Val $\pm$ Err	$\frac{f_i}{f_S}$
$\mu$	$5280.74 \pm 0.74$	
$\sigma_{data}$	$22.27 \pm 0.75$	
$N_{B^0 \rightarrow K_S \eta'}$	$2388.18 \pm 69.09$	
$N_{non-TM}$	213.63	0.09
$N_{comb}$	$2906.12 \pm 134.84$	
$N_{B^0 \rightarrow K_S \pi^+ \pi^-}$	41.00	0.02
$N_{PR}^{(\gamma)}$	$170.81 \pm 108.27$	0.07
$N_{B^+ \rightarrow K^{*+} \eta'}$	$771.01 \pm 142.18$	0.32

# Detail of $B^+ \rightarrow K^{*+} \eta'$ Bkg MC shape fixing [1g DD]

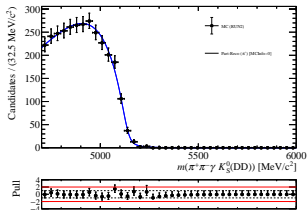


Figure: Particles correctly reconstructed

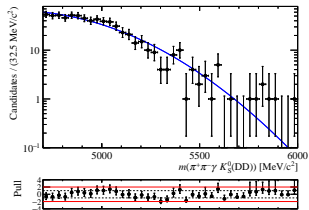


Figure: Particles not correctly reconstructed

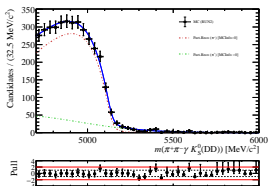
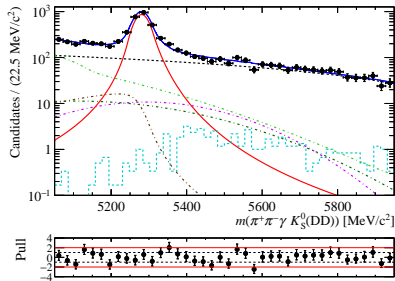
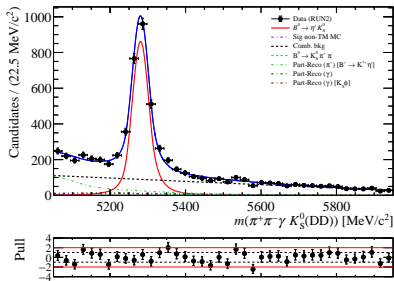


Figure: All together

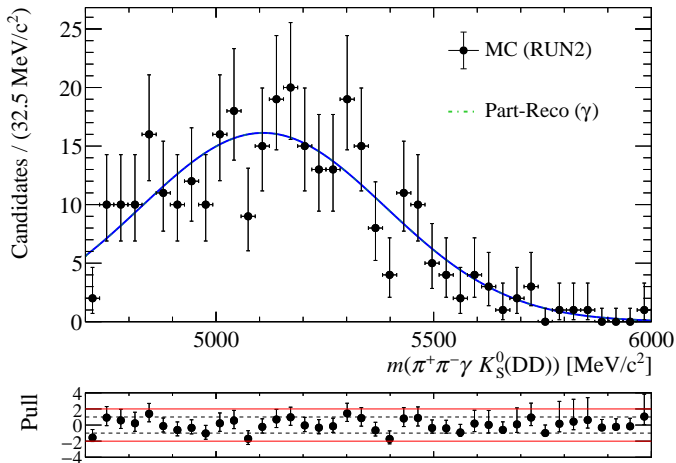
# $m_{B^0}$ fit plot of Run 2 $K_S \eta'$ data with additional partial-reconstructed $B^0 \rightarrow K^{*0} \rho^0$ included (free yield)

- Model: Gaussian with free yield



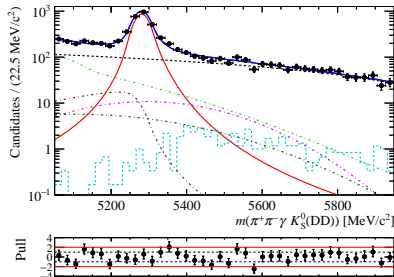
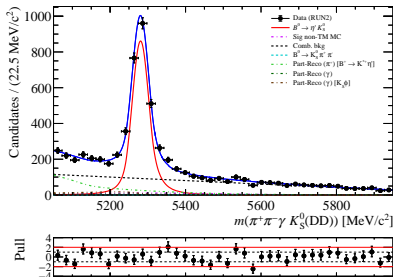
$\mu$	$5280.68 \pm 0.76$	
$\sigma_{data}$	$22.14 \pm 0.81$	
$N_{B^0 \rightarrow K_S \eta'}$	$2375.33 \pm 76.25$	
$N_{non-TM}$	212.49	0.09
$N_{comb}$	$2756.04 \pm 405.61$	
$N_{B^0 \rightarrow K_S \pi^+ \pi^-}$	40.78	0.02
$N_{PR}^{(\gamma)}$	$148.16 \pm 121.62$	0.06
$N_{B^+ \rightarrow K^{*+} \eta'}$	$753.04 \pm 148.69$	0.32
$N_{B^0 \rightarrow K^{*0} \rho^0}$	$205.33 \pm 520.02$	0.09

# Detail of $B^0 \rightarrow K^{*0} \rho^0$ Bkg MC shape fixing [1g DD]



# $m_{B^0}$ fit plot of Run 2 $K_S\eta'$ data with additional partial-reconstructed $B^0 \rightarrow K^{*0}\rho^0$ included (Gauss constr)

- Model: Gaussian with Gaussian constrained yield ( $100 \pm 100$ )

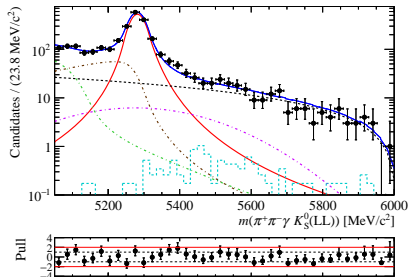
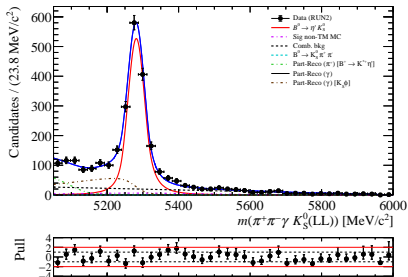


$\mu$	$5280.71 \pm 0.74$	
$\sigma_{data}$	$22.21 \pm 0.75$	
$N_{B^0 \rightarrow K_S \eta'}$	$2382.11 \pm 69.22$	
$N_{non-TM}$	213.09	0.09
$N_{comb}$	$2828.64 \pm 152.59$	
$N_{B^0 \rightarrow K_S \pi^+ \pi^-}$	40.90	0.02
$N_{PR}^{(\gamma)}$	$159.36 \pm 108.58$	0.07
$N_{B^+ \rightarrow K^{*+} \eta'}$	$763.37 \pm 141.98$	0.32
$N_{B^0 \rightarrow K^{*0} \rho^0}$	$104.09 \pm 83.11$	0.04

1g LL

# $m_{B^0}$ fit plot of Run 2 $K_S \eta'$ data with partial-reconstructed $B^+ \rightarrow K^{*+} \eta'$ included

- Model :  $f \times (\text{Argus} \otimes \text{DSCB}) + (1 - f) \times \text{Gauss}$



$\mu$	$5281.60 \pm 0.93$	
$\sigma_{data}$	$23.60 \pm 0.97$	
$N_{B^0 \rightarrow K_S \eta'}$	$1472.21 \pm 50.92$	
$N_{non-TM}$	114.22	0.08
$N_{comb}$	$534.28 \pm 45.19$	
$N_{B^0 \rightarrow K_S \pi^+ \pi^-}$	9.33	0.01
$N_{PR}^{(\gamma)}$	$489.81 \pm 55.56$	0.33
$N_{B^+ \rightarrow K^{*+} \eta'}$	$151.02 \pm 30.67$	0.10

# Detail of $B^+ \rightarrow K^{*+} \eta'$ Bkg MC shape fixing [1g LL]

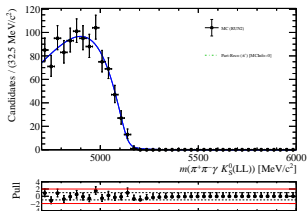


Figure: Particles correctly reconstructed

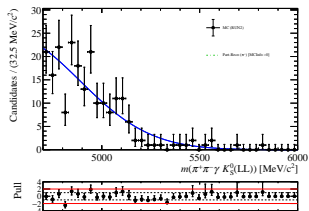


Figure: articles not correctly reconstructed

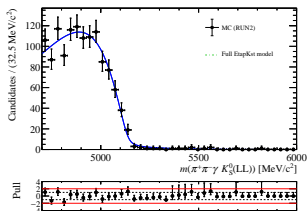
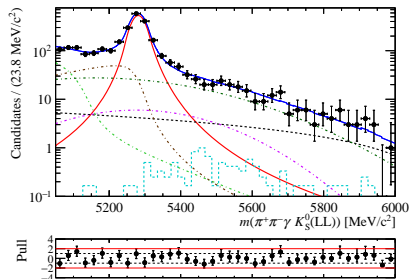
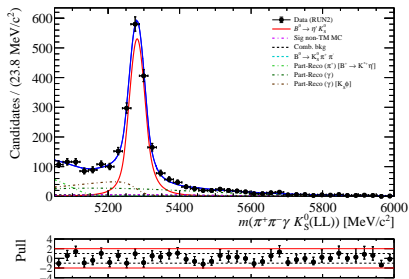


Figure: All together

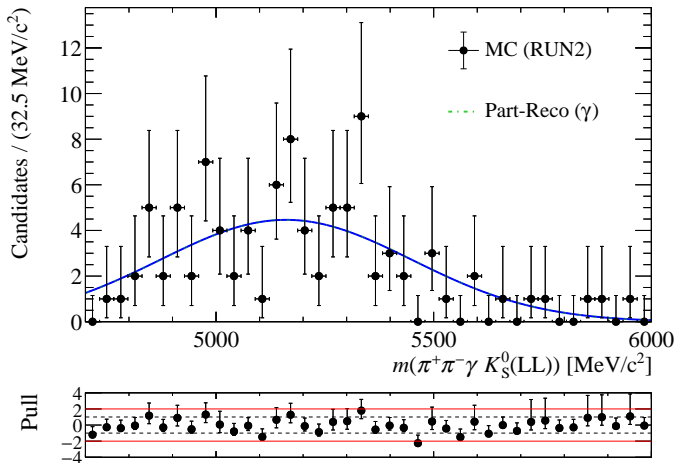
# $m_{B^0}$ fit plot of Run 2 $K_S \eta'$ data with additional partial-reconstructed $B^0 \rightarrow K^{*0} \rho^0$ included (free yield)

- Model: Gaussian with free yield



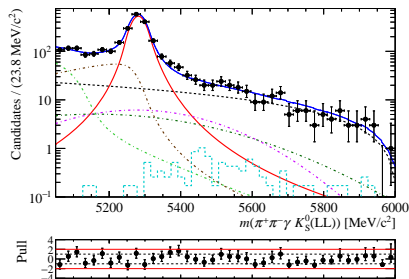
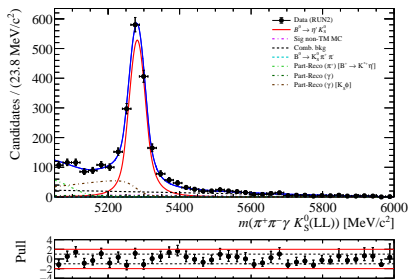
$\mu$	$5281.22 \pm 0.91$	
$\sigma_{data}$	$22.50 \pm 0.96$	
$N_{B^0 \rightarrow K_S \eta'}$	$1413.79 \pm 52.72$	
$N_{non-TM}$	109.69	0.08
$N_{comb}$	$119.43 \pm 152.94$	
$N_{B^0 \rightarrow K_S \pi^+ \pi^-}$	8.96	0.01
$N_{PR}^{(\gamma)}$	$428.76 \pm 58.92$	0.30
$N_{B^+ \rightarrow K^{*0} \eta'}$	$144.64 \pm 29.96$	0.10
$N_{B^0 \rightarrow K^{*0} \rho^0}$	$544.90 \pm 189.19$	0.39

# Detail of $B^0 \rightarrow K^{*0} \rho^0$ Bkg MC shape fixing [1g LL]



# $m_{B^0}$ fit plot of Run 2 $K_S \eta'$ data with additional partial-reconstructed $B^0 \rightarrow K^{*0} \rho^0$ included (Gauss constr)

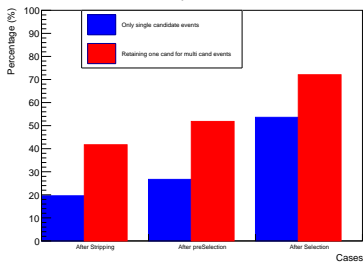
- Model: Gaussian with Gaussian constrained yield ( $100 \pm 5$ )



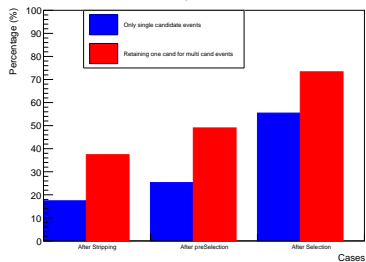
$\mu$	$5281.54 \pm 0.92$	
$\sigma_{data}$	$23.35 \pm 0.95$	
$N_{B^0 \rightarrow K_S \eta'}$	$1460.11 \pm 50.51$	
$N_{non-TM}$	113.28	0.08
$N_{comb}$	$457.72 \pm 44.94$	
$N_{B^0 \rightarrow K_S \pi^+ \pi^-}$	9.25	0.01
$N_{PR}^{(\gamma)}$	$478.98 \pm 55.28$	0.33
$N_{B^+ \rightarrow K^{*+} \eta'}$	$149.64 \pm 30.44$	0.10
$N_{B^0 \rightarrow K^{*0} \rho^0}$	$100.39 \pm 7.19$	0.07

# Check for multiple candidates in Run2 $K_S\eta'$ data

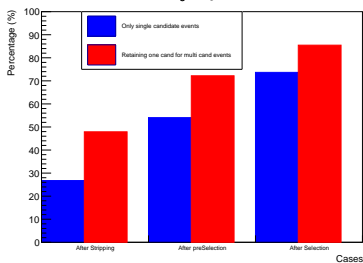
## Run2 $K_S\eta'$ 1g DD data



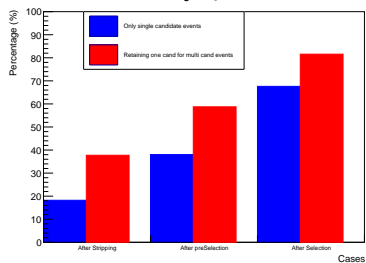
## Run2 $K_S\eta'$ 1g LL data



## Run2 $K_S\eta'$ 2g DD data

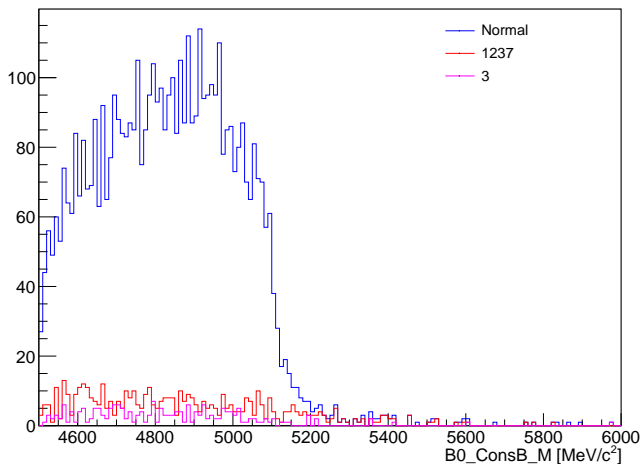


## Run2 $K_S\eta'$ 2g LL data

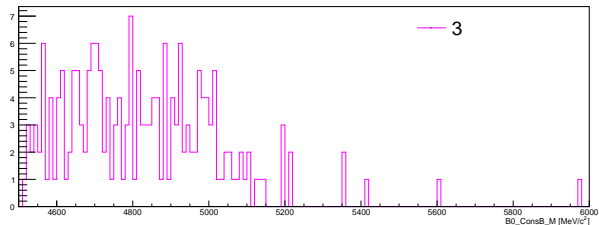
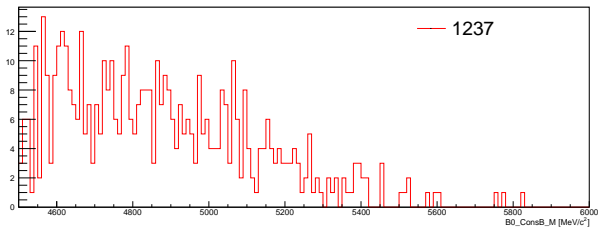


# Backup

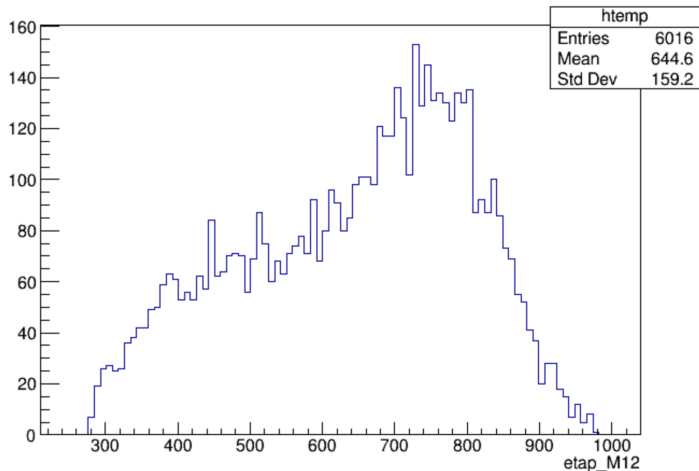
# Comparison of $B^+ \rightarrow K^{*+} \eta'$ Bkg MC for categories photon (3) and $\eta'$ daughters non being the right one



# Comparison of $B^+ \rightarrow K^{*+} \eta'$ Bkg MC for categories photon (3) and $\eta'$ daughters non being the right one plotted apart



# $m(\pi_{\eta'}^+, \pi_{\eta'}^-)$ invariant mass distribution for 1g DD



# $m(\pi_{\eta'}^+, \pi_{\eta'}^-)$ invariant mass distribution of 1g DD for $m(B^0) < 5200 \text{ MeV}/c^2$ and for $m(B^0) > 5400 \text{ MeV}/c^2$

