

INTERNAL MEETING

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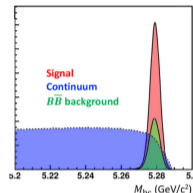
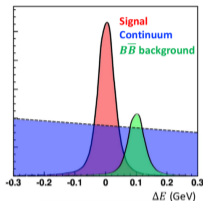
ETAT DES LIEUX

- Belle II analysis: TDCPV measurement in $B^0 \rightarrow \eta' K_S^0$ with 365 fb^{-1} ($\approx 390 \times 10^6$ $B\bar{B}$ pairs)
- Two decay modes : $\eta' \rightarrow \eta(\rightarrow \gamma\gamma)\pi\pi$ (labelled $\eta_{\gamma\gamma}$, == 2g)
 $\eta' \rightarrow \rho(\rightarrow \pi\pi)\gamma$ (labelled $\rho\gamma$, == 1g)
Also tried $\eta' \rightarrow \eta(\rightarrow \pi\pi\pi^0)\pi\pi$ (labelled $\eta_{3\pi}$) but not used in final result because of too large stat uncertainty
- Link to paper: [PHYS. REV. D 110, 112002 \(2024\)](#)

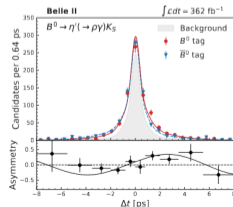
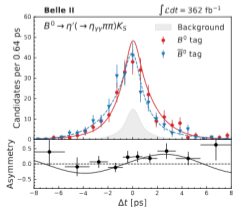
GENERAL OVERVIEW

- Signal yield obtained from simultaneous fit of

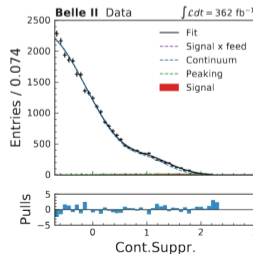
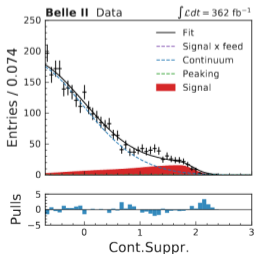
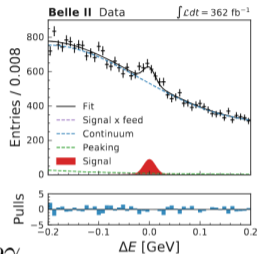
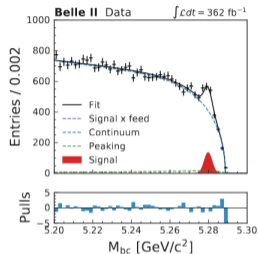
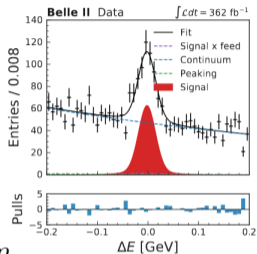
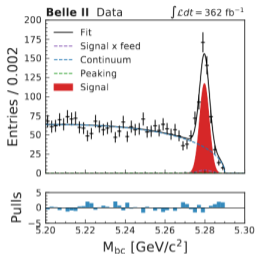
- $\Delta E = E_{B_{sig}}^* - E_{beam}^*$
- $M_{bc} = \sqrt{E_{beam}^{*2} - p_{B_{sig}}^{*2}}$
- BDT output



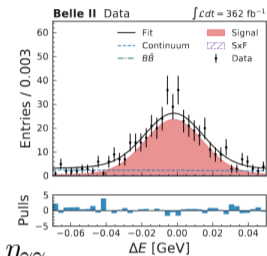
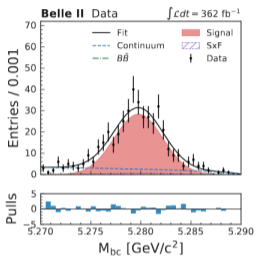
- $N_{sig} = 358 \pm 20(\eta_{\gamma\gamma}) + 471 \pm 29(\rho\gamma)$ with respective purities 79% and 30%
- CP parameters: direct asymmetry $C = -0.19 \pm 0.08$,
 mixing asymmetry $S = 0.67 \pm 0.10$



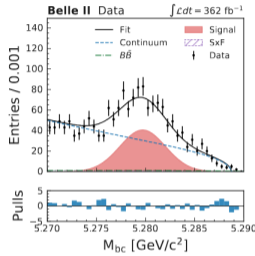
MORE DETAILS – YIELDS FITS



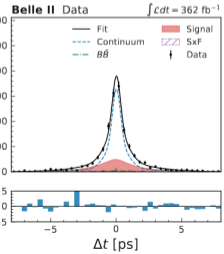
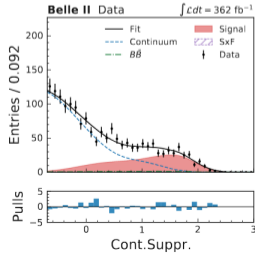
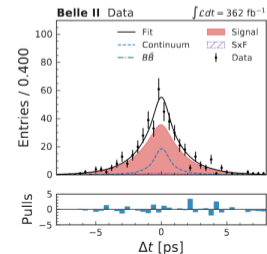
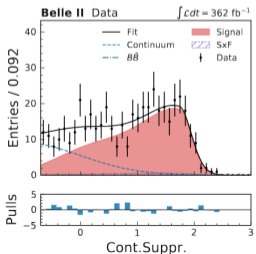
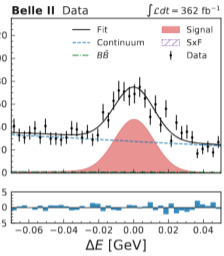
SIGNAL REGION: $M_{bc} > 5.27 \text{ GeV}/c^2$, $\Delta E \in [-0.07, 0.05] \text{ GeV}$



$\eta\gamma\gamma$



$\rho\gamma$



MORE DETAILS – YIELDS

Yields in signal region: $M_{bc} > 5.27 \text{ GeV}/c^2$, $\Delta E \in [-0.07, 0.05] \text{ GeV}$

	N_{sig}	$q\bar{q}$	$B\bar{B}$	N_{bkg}	S/B	S/S+B
$\eta_{\gamma\gamma}$	358 ± 20	94.4 ± 2	0 ± 0.2	94.4 ± 2.2	3.8	79%
$\rho\gamma$	471 ± 29	1060 ± 7	33 ± 5	1093 ± 12	0.43	30%

As comparison; LHCb yields in signal region ($\mu \pm 3\sigma$):

	N_{sig} DD/LL	N_{sig} tot	N_{bkg} DD/LL	N_{bkg}	S/B	S/S+B
$\eta_{\gamma\gamma}$	336(DD) + 363(LL)	699	71(DD) + 53(LL)	124	5.6	85%
$\rho\gamma$	2199(DD) + 1364(LL)	3563	560(DD) + 166(LL)	726	4.9	83%

CONCLUSION

Channel	Signal yield	$C_{\eta'K_S^0}$	$S_{\eta'K_S^0}$
$\eta' \rightarrow \eta_{\gamma\gamma} \pi^+ \pi^-$	358 ± 20	-0.10 ± 0.13	0.69 ± 0.14
$\eta' \rightarrow \rho\gamma$	471 ± 29	-0.24 ± 0.10	0.65 ± 0.13
$\eta' \rightarrow \eta_{3\pi} \pi^+ \pi^-$	55 ± 8	0.11 ± 0.32	0.25 ± 0.50
Sim. fit	829 ± 35	-0.19 ± 0.08	0.67 ± 0.10

Parameter	Result	Analysis	$nB\bar{B} (\times 10^6)$
C_{CP}	$-0.19 \pm 0.08 \pm 0.026$	this analysis	387
	-0.05 ± 0.04	World average [5]	
	$-0.03 \pm 0.05 \pm 0.03$	Belle [3]	772
	$-0.08 \pm 0.06 \pm 0.02$	BaBar [4]	467
S_{CP}	$0.67 \pm 0.10 \pm 0.036$	this analysis	387
	0.63 ± 0.06	World average [5]	
	$0.68 \pm 0.07 \pm 0.03$	Belle [3]	772
	$0.57 \pm 0.08 \pm 0.02$	BaBar [4]	467