B->Eta' K

Padova Belle II meeting
11/05/2020

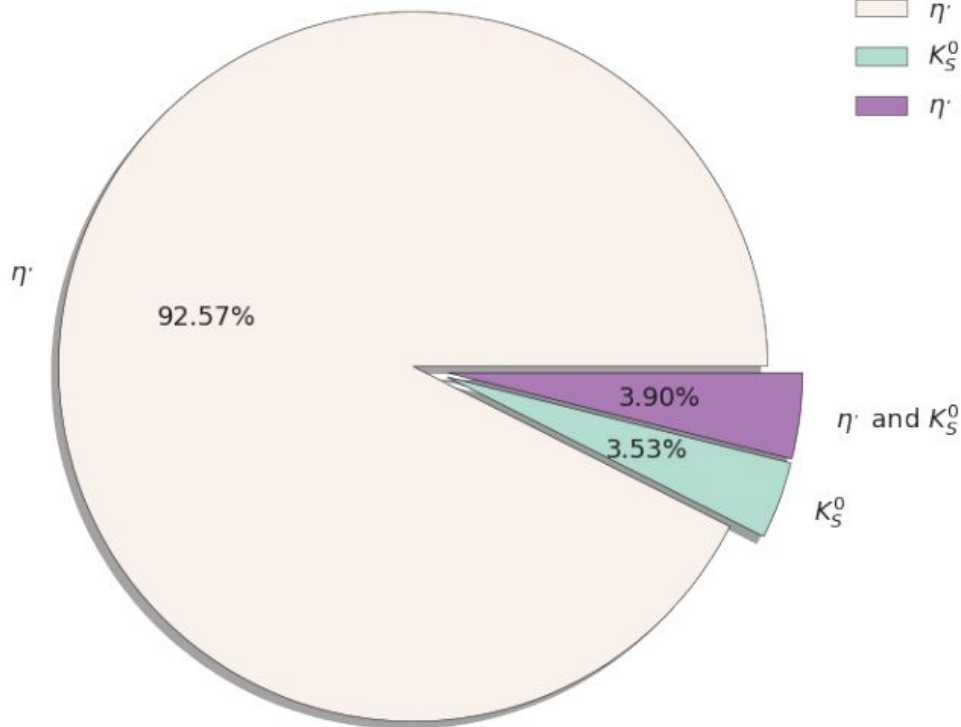Stefano Lacaprara, Valeria Fioroni

INFN Padova & University

Introduction

- MC Study of SxF $B_0 \rightarrow \eta'(\eta(\gamma\gamma)\pi^+\pi^-)K_s$
  - We showed that SxF is small with simple selections
  - Want to understand from where the problem arise anyway
- 2D Fit of Mbc and DeltaE for $B^+ \rightarrow \eta'(\rightarrow\eta(\gamma\gamma)\pi^+\pi^-)K^+$
  - Using RooRarFit (BaBar code used also for B2Tip)
    - Not a long term solution as the code is not maintained
  - Initial Toys studies for 2D fit
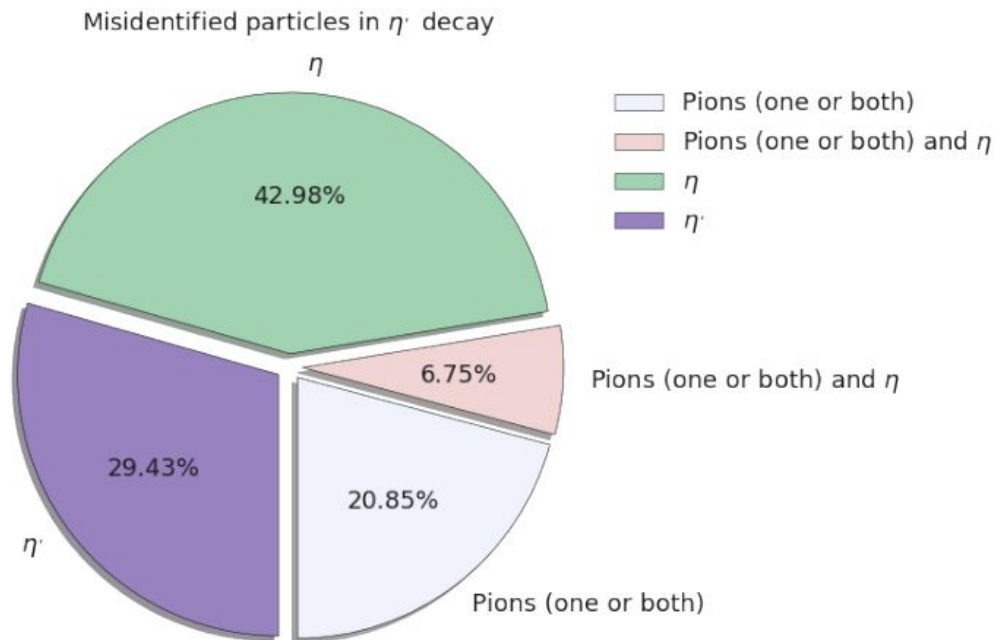 - Using only MC13b as background + signal injection.

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$B^0 \to \eta' K_s$ decay

Misidentified particles in B^0 decay

Legend:
- η'
- K_S^0
- η' and K_S^0

η' 92.57%

3.90% η' and K_S^0

3.53% K_S^0

The incorrect reconstruction of B^0 is mainly due to η' reconstruction.

Misreconstructed particle	Counts
η'	70604
η' and K_S^0	2976
K_S^0	2692

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3

$\eta' \to \eta(\gamma\gamma)\pi^+\pi^-$ decay

Misidentified particles in η' decay

- Pions (one or both)
- Pions (one or both) and η
- η
- η'

η — 42.98%

Pions (one or both) and η — 6.75%
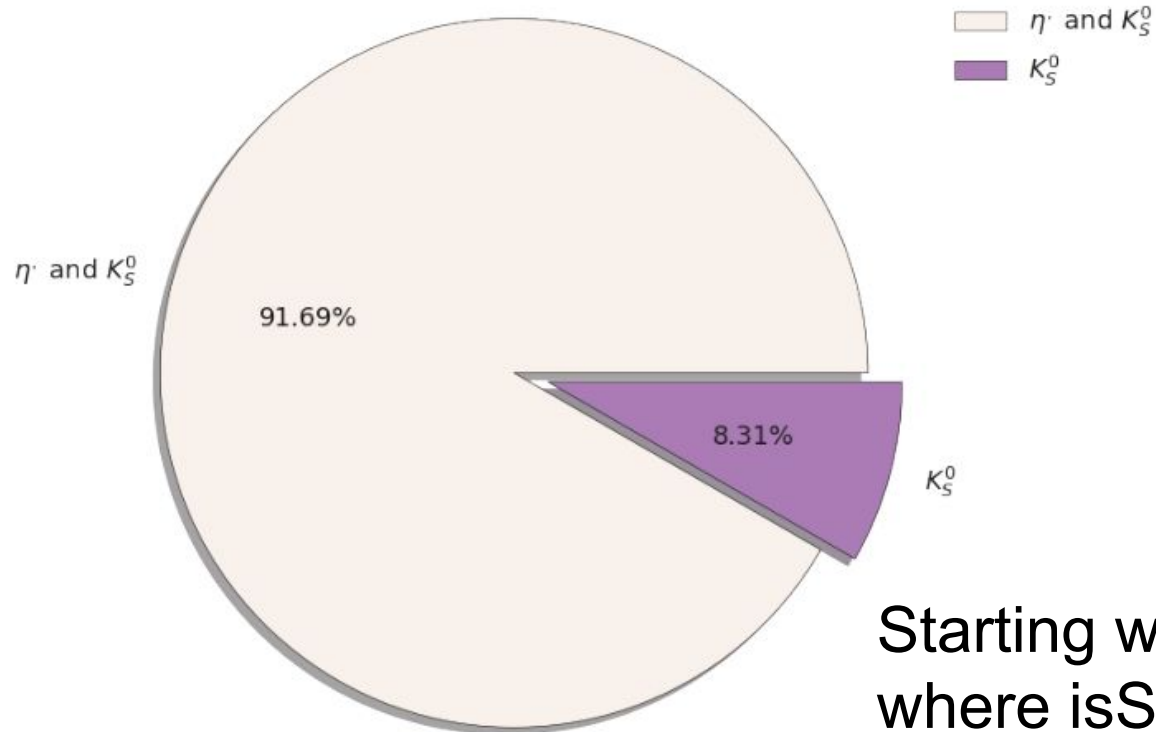
Pions (one or both) — 20.85%

η' — 29.43%

The incorrect reconstruction of the η' particle is mainly due to the η reconstruction ($\sim 50\%$).

Misreconstructed particle	Counts
η	31627
η and pions	4964
pions	15338
η'	21651

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4

$B^0 \to \eta' K_s$ decay

isSignal=NaN in B^0 decay

Legend:
- η' and K_S^0
- K_S^0

η' and K_S^0

91.69%

8.31%

K_S^0

Particle	NaN counts
η' and K_S^0	19643
K_S^0	1780

Starting with 97696 candidates
where isSignal!=1
20% NaN

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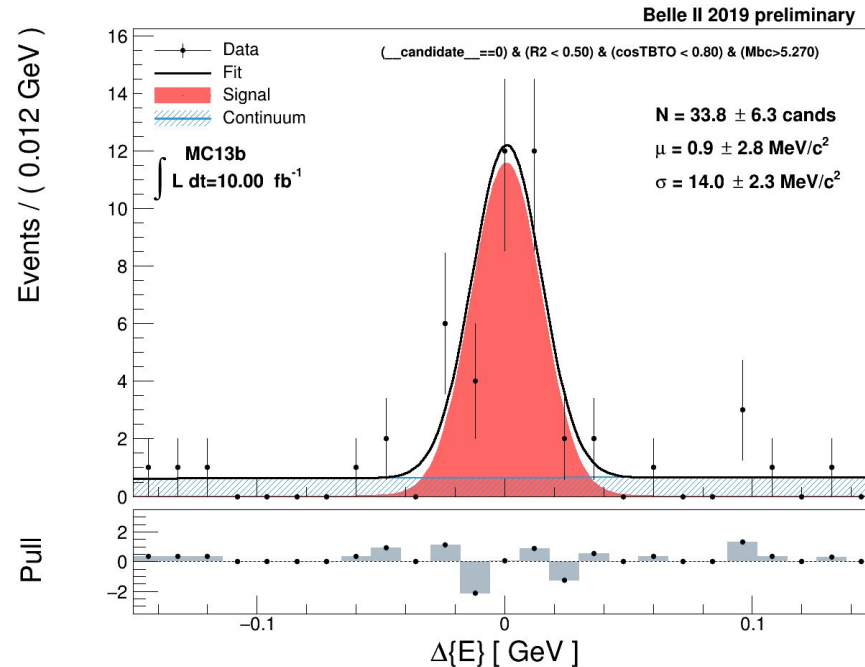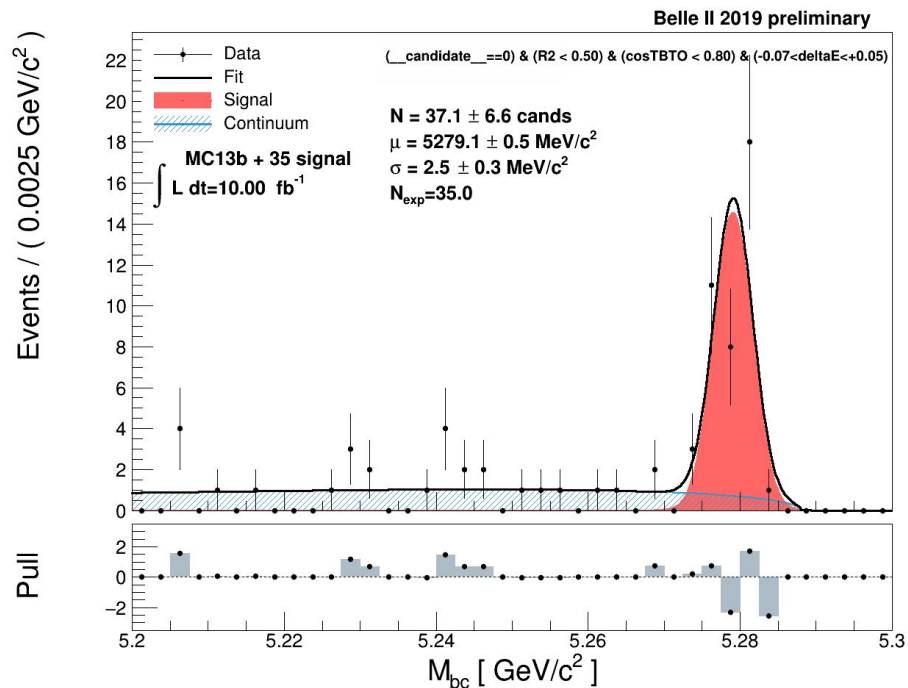# $\eta' \rightarrow \eta(\gamma\gamma)\pi^+\pi^-$ decay

isSignal=NaN in η' decay

Legend:
- Pions (one or both)
- Pions (one or both) and η
- η

η

67.07%

Pions (one or both) and η

2.24%

30.69%

Pions (one or both)
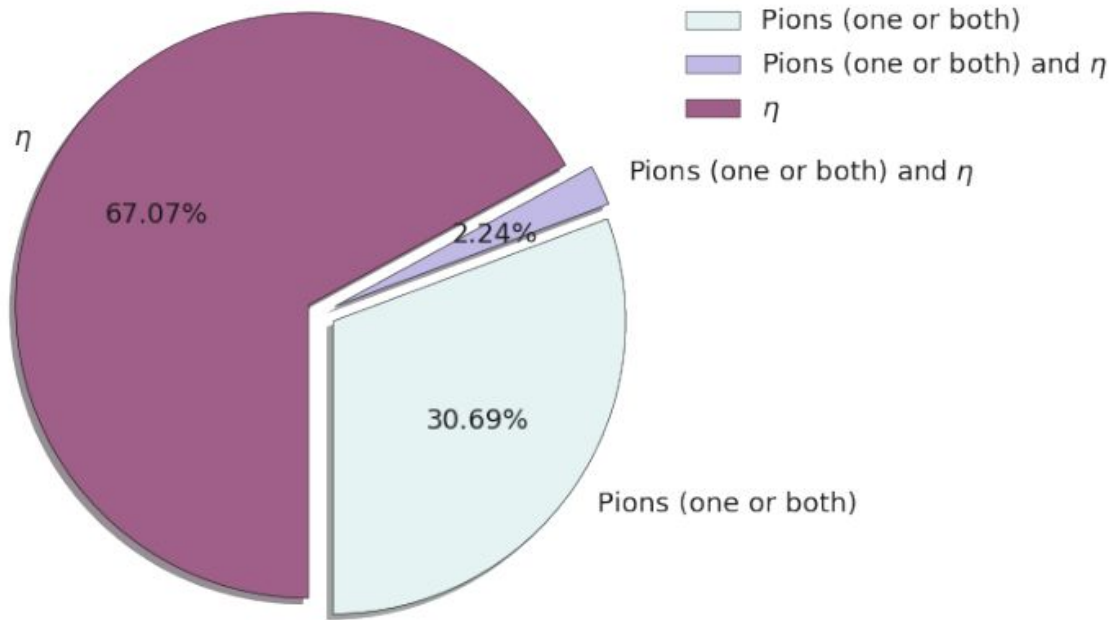
Particle	NaN counts
η	13175
η and pions	440
pions	6028

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B⁺ -> η' (->η (γγ) π⁺π⁻) K⁺

- Background (MC13b) 10/fb + 35 signal events from MC13a signal dataset
- 1D fit for Mbc and DeltaE separately.
  - Injected 35
  - Seen37 +/- 7 (Mbc) - 34 +/-6 DeltaE

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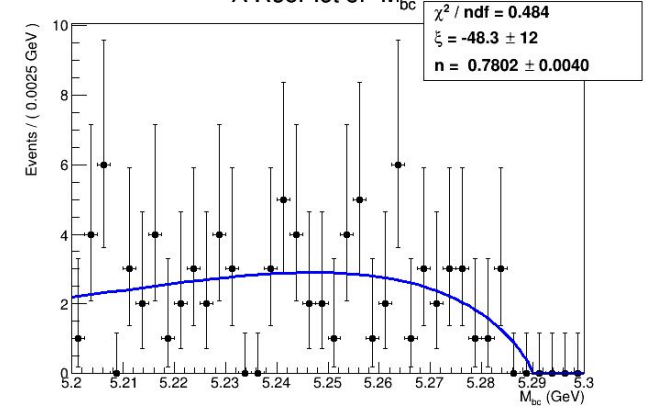
Pdf for 2D fit

A RooPlot of "M_bc"

χ² / ndf = 6.614
f_C = 0.9944 ± 0.0010
μ_C = 5.279220 ± 0.000013 G
μ_T = 5.27235 ± 0.00088 GeV
σ_C = 0.0026727 ± 0.0000098
σ_T = 0.00681 ± 0.00041 GeV

A RooPlot of "ΔE"

χ² / ndf = 5.717
f_C = 0.8672 ± 0.0050
μ_C = -0.0025647 ± 0.000099
μ_T = -0.017747 ± 0.00082 GeV
σ_C = 0.01688 ± 0.00011 GeV
σ_T = 0.04831 ± 0.00077 GeV

A RooPlot of "M_bc"

χ² / ndf = 0.484
ξ = -48.3 ± 12
n = 0.7802 ± 0.0040

A RooPlot of "ΔE"

χ² / ndf = 0.279
p_1 = 0.2 ± 1.2

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8

B$^+$ -> η' (->η (γγ) π$^+$π$^-$) K$^+$
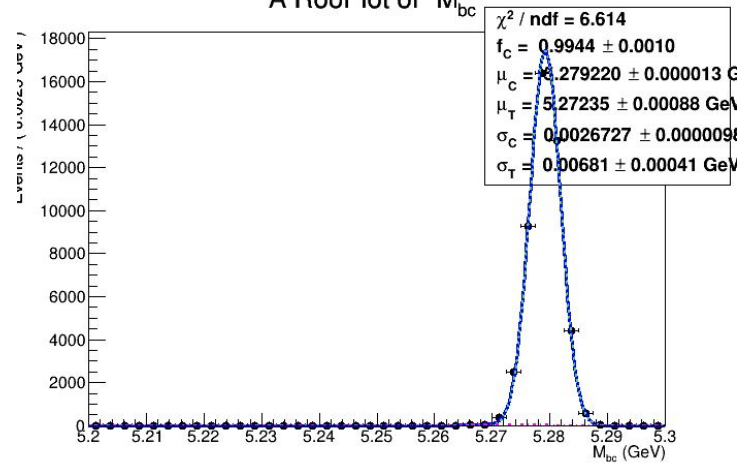
A RooPlot of "M$_{bc}$"

A RooPlot of "ΔE"
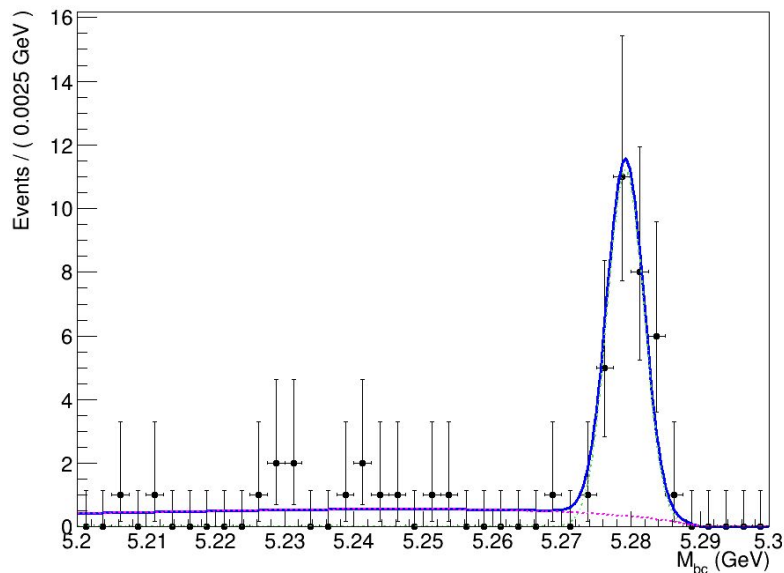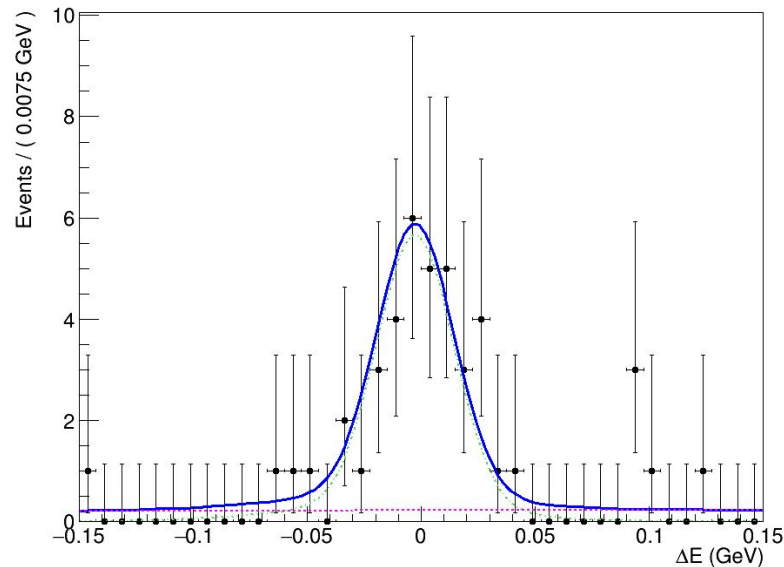
- 2D fit for Mbc and DeltaE separately.
  - Injected 35
  - Fit result: 35.6 +/- 6.3

9

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Toys studies

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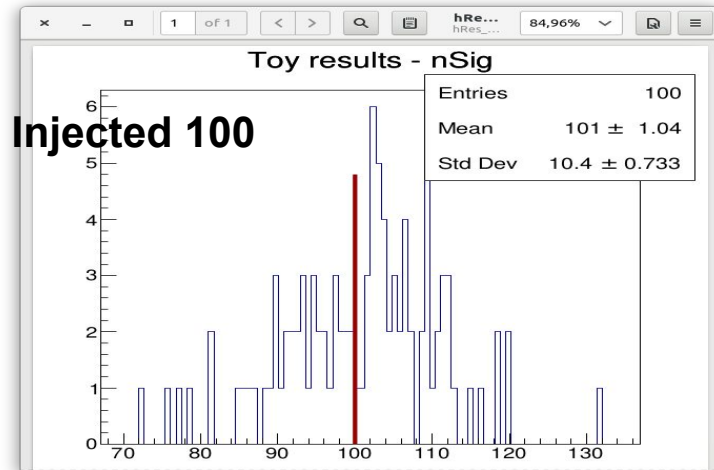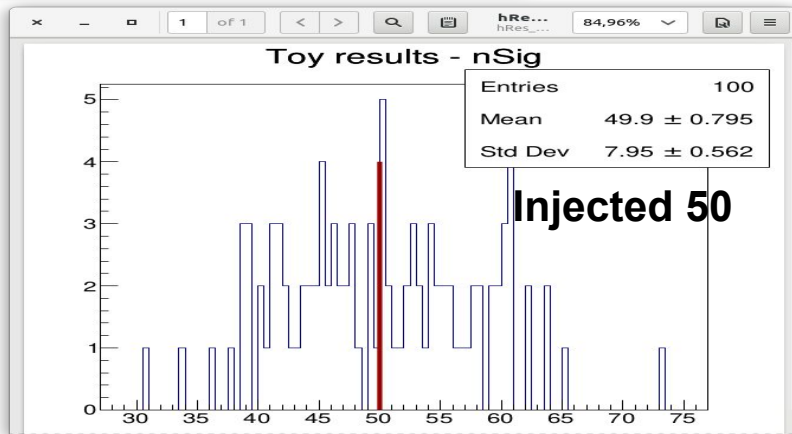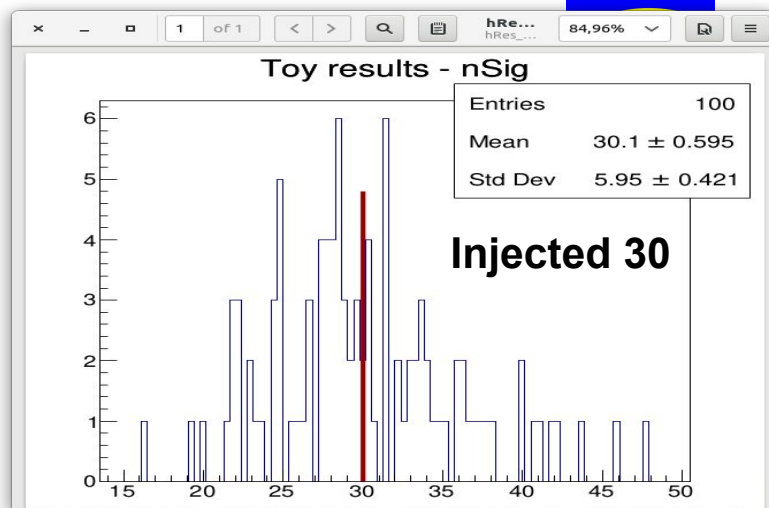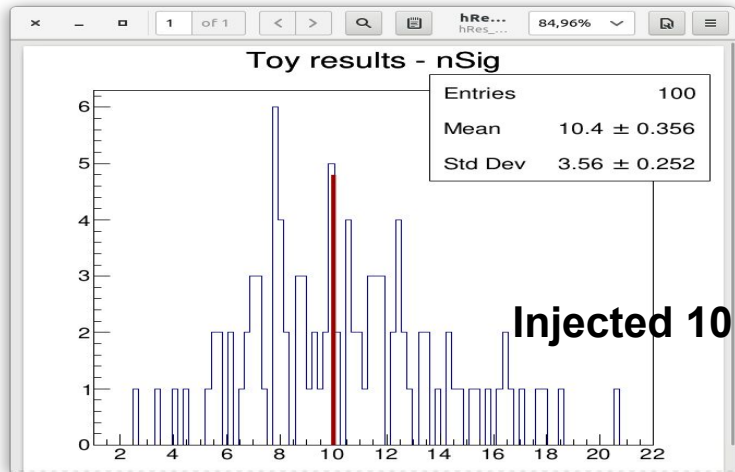
Conclusion and outlook

- **MC study on SxF**
  - **As expected most of the case eta' is wrong**
  - **Eta or pions from eta' responsible**
  - **Many NaN from Ks**
- **2D fit of Mbc and DeltaE implemented**
  - **Toys studies are fine**
  - **Will try to add SxF separately**
  - **Will try to add more variable (eg CS or Meta' etc to the fit)**
- Plan:
  - **Rediscovery aimed for ICHEP (summer 2020)**
  - Finalize signal selection
  - Finalize 2D fit
  - Repeat for neutral channels
  - Documentation

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Backup

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