Measurement of Ω_c^0 lifetime with the prompt production

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Ω_c^0 *lifetime measurement meeting*

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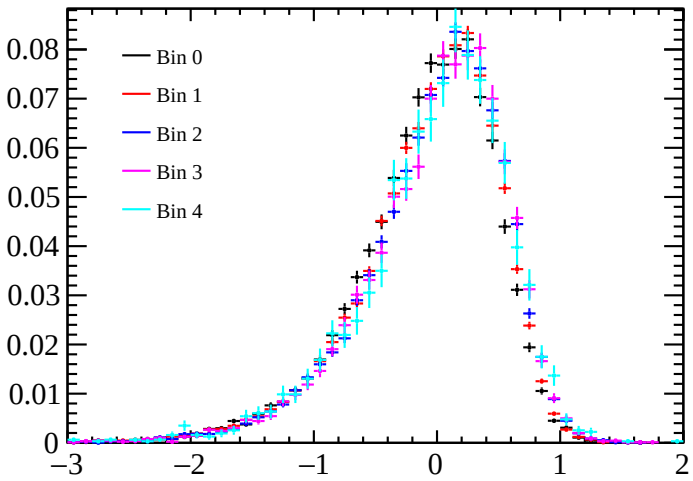
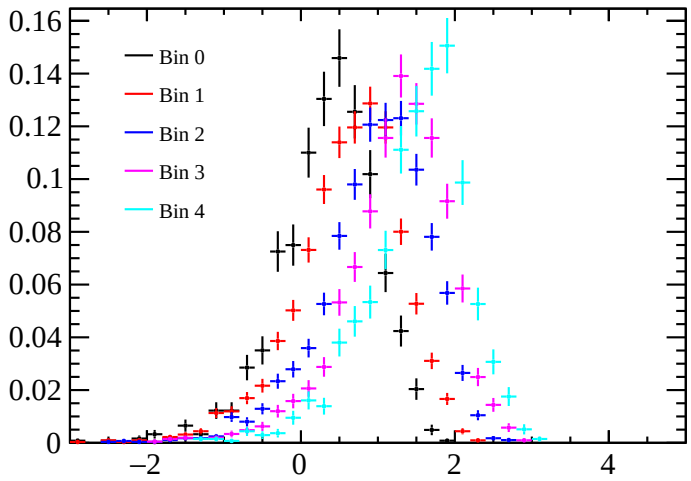
Prompt yield extraction

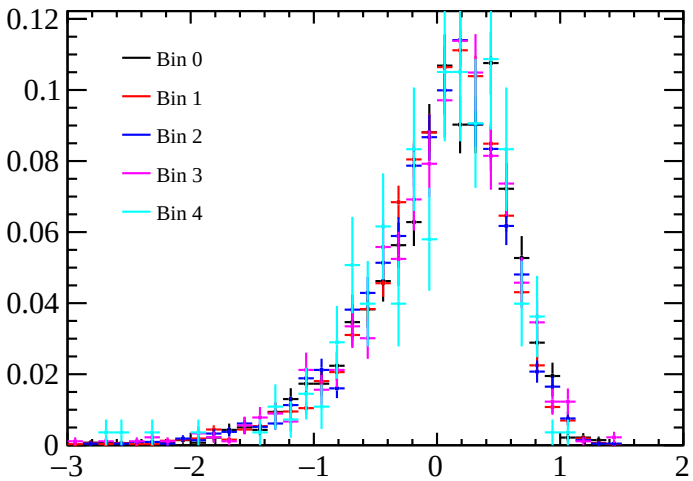
- Discriminating variables: $\log_{10}(\chi^2_{\text{IP}})$ and TIP seem to be widely used. Focus on the former, but use the later as cross-check
- Models:
  - Bulkin function to describe both prompt and secondary $\log_{10}(\chi^2_{\text{IP}})$ distribution
  - Background $\log_{10}(\chi^2_{\text{IP}})$ shape from kernel esitimation and the number of backgrounds constrained
  - Use ReDecay MC to study the modelling of prompt and secondary components in decay time bins
    - Apply turbo and BDT1 cuts (BDT2 cut not applied)
    - Require `abs(TRUE_MOTHER_ID)==4` for prompt and `abs(TRUE_MOTHER_ID)>4` for secondary
    - Binning scheme [ps]:
      [0.1, 0.45, 0.52, 0.57, 0.63, 0.69, 0.75, 0.81, 0.9, 1.05, 2.0]

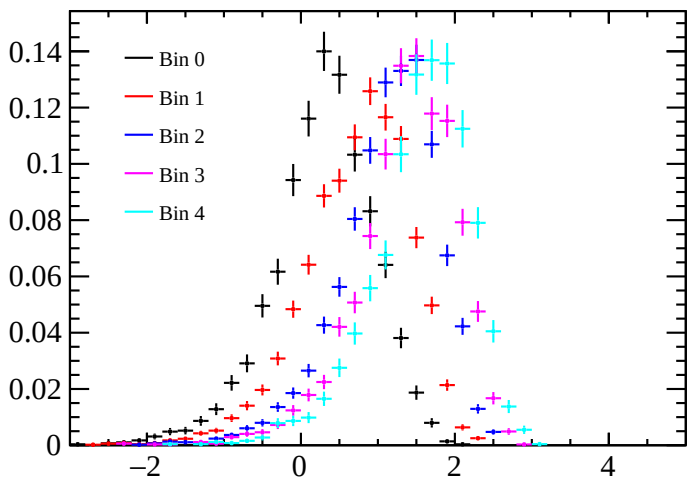
Before the fit

- (left) Prompt and (right) secondary $\log_{10}(\chi^2_{\text{IP}})$ distributions in even bins for (top) Ω_c^0 and (bottom) Ξ_c^0



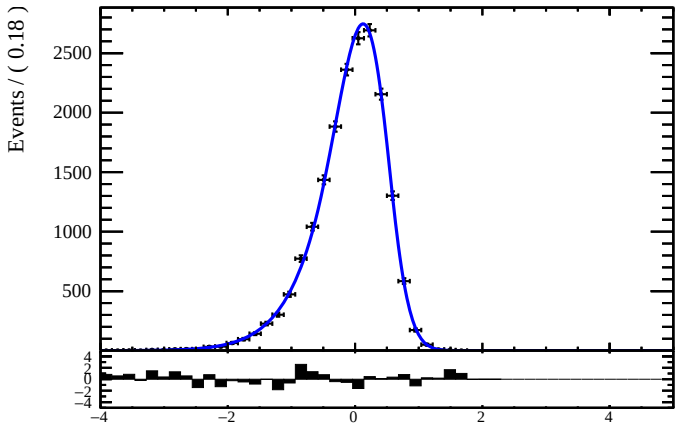


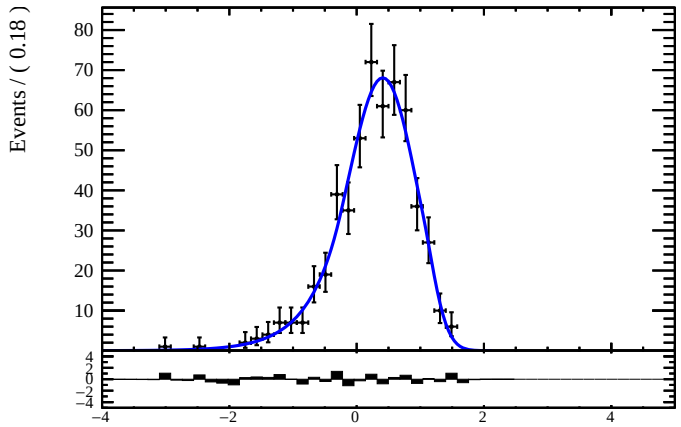


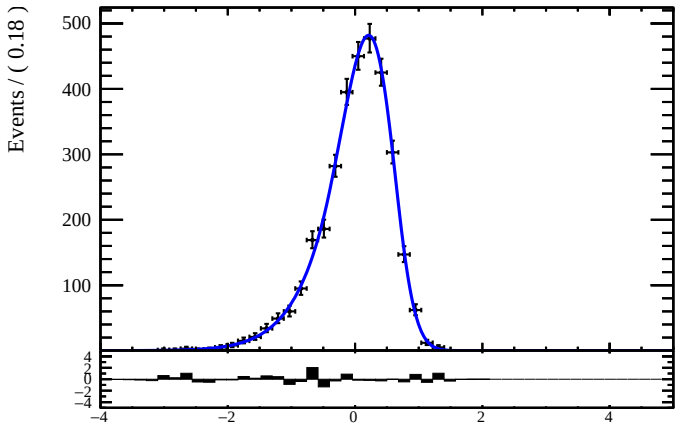


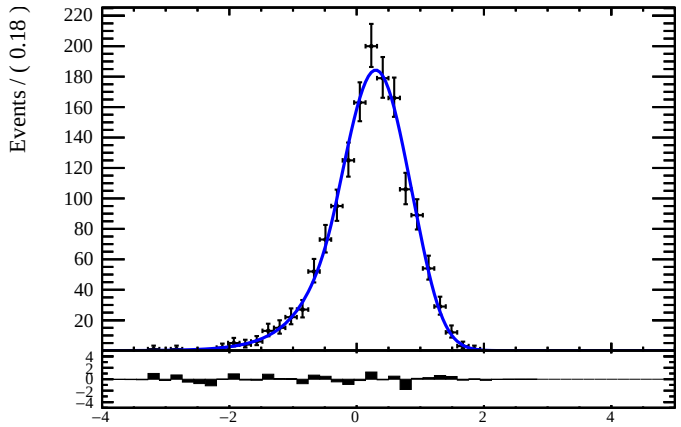
Fit with all parameters free: bin 0

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



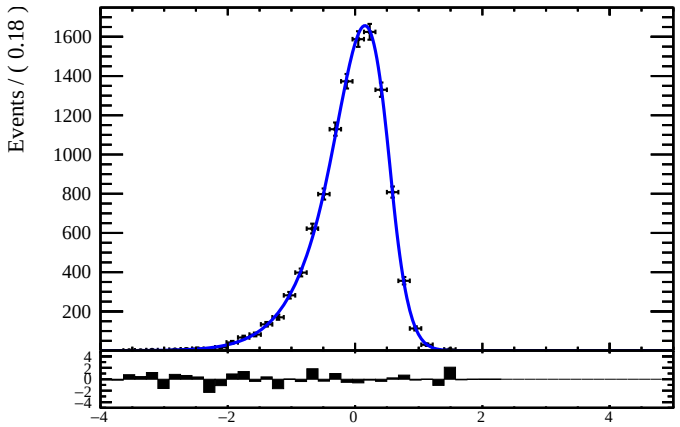


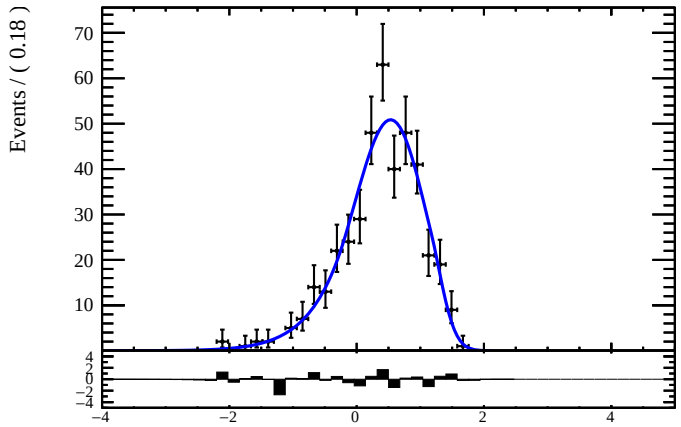


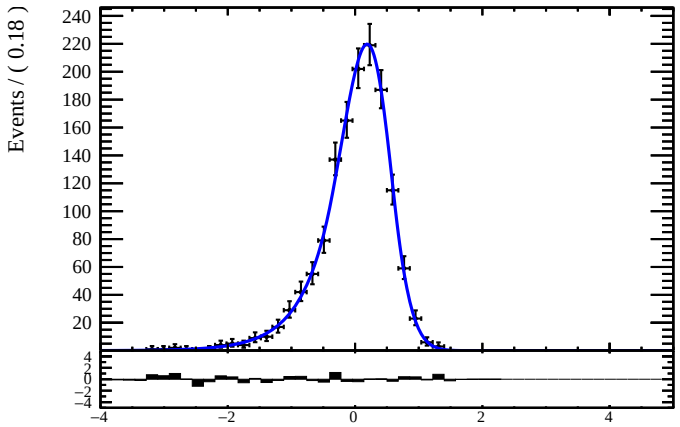


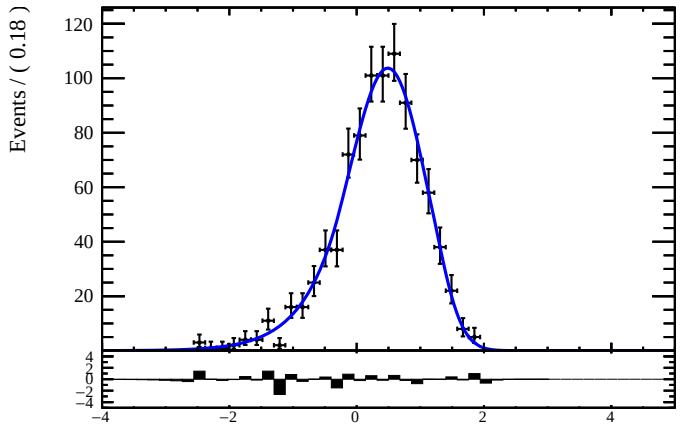
Fit with all parameters free: bin 1

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



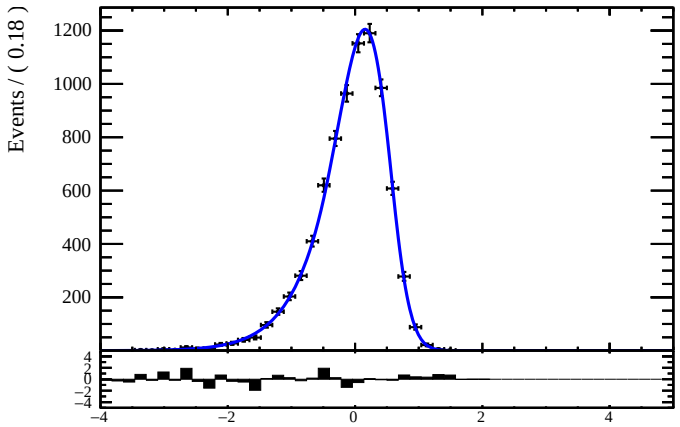


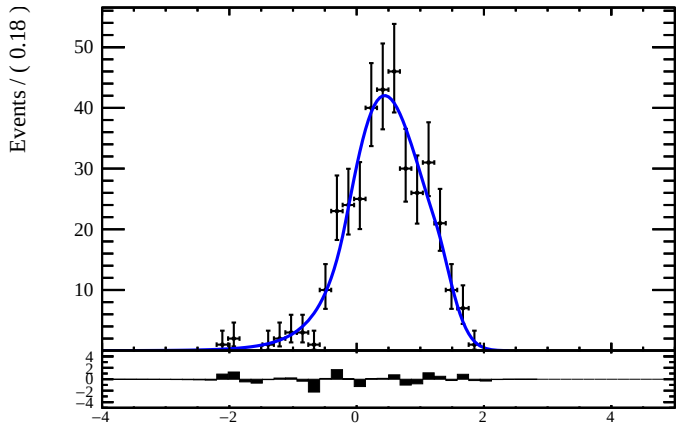


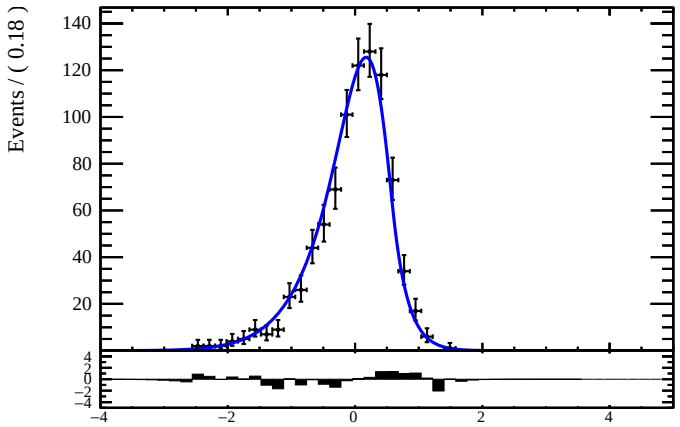


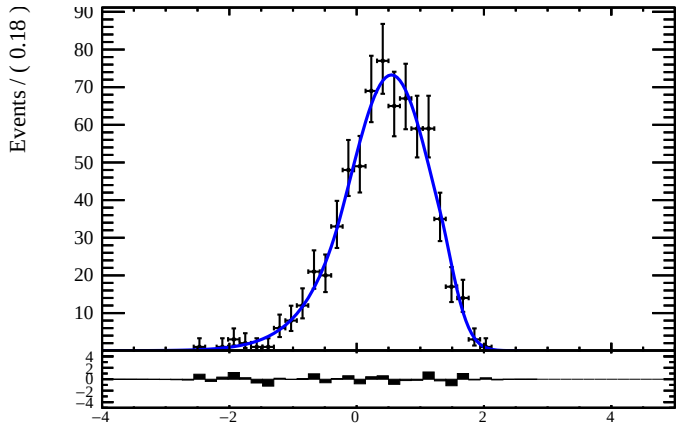
Fit with all parameters free: bin 2

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



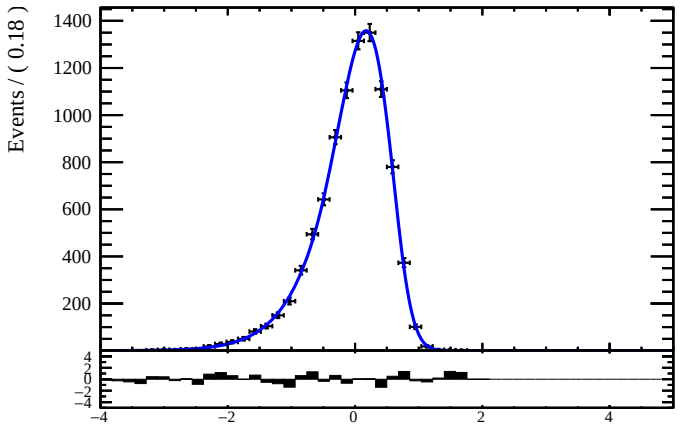


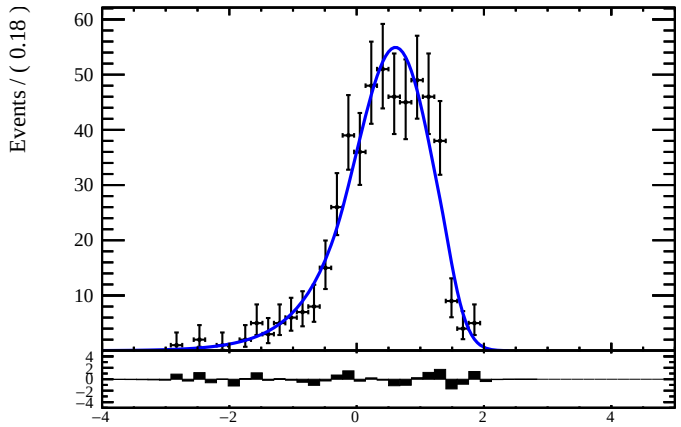


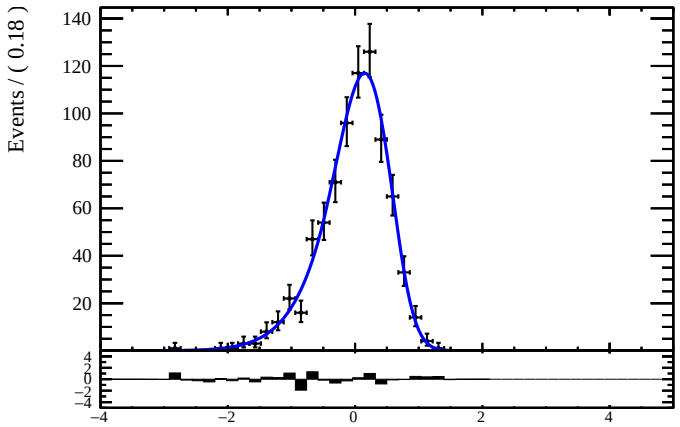


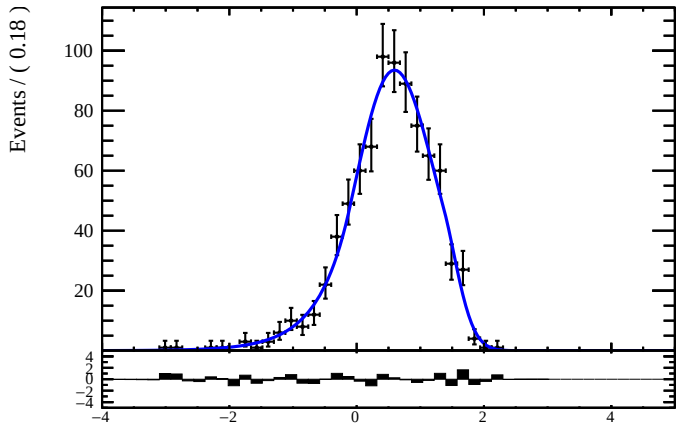
Fit with all parameters free: bin 3

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



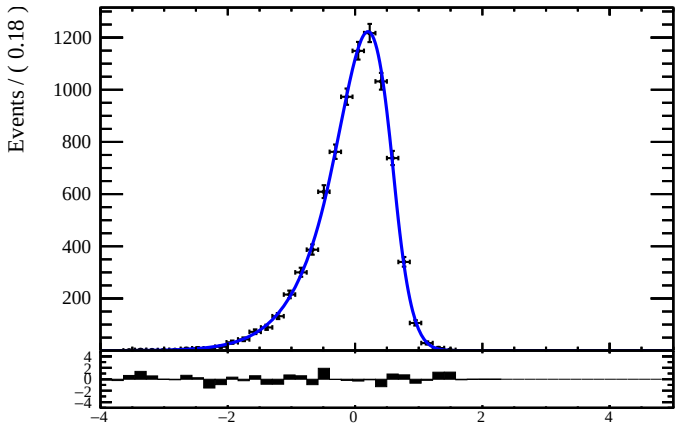


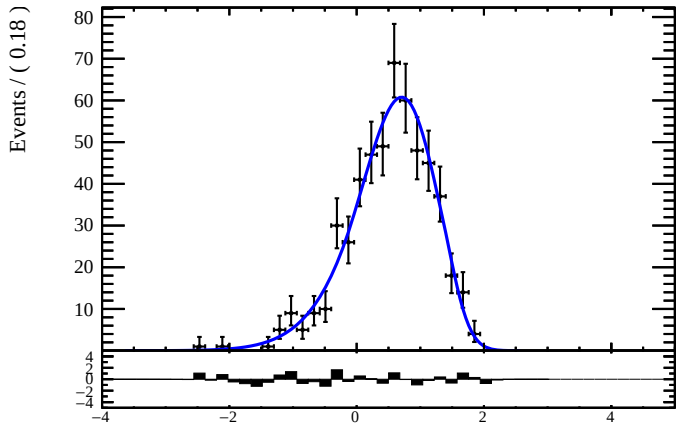


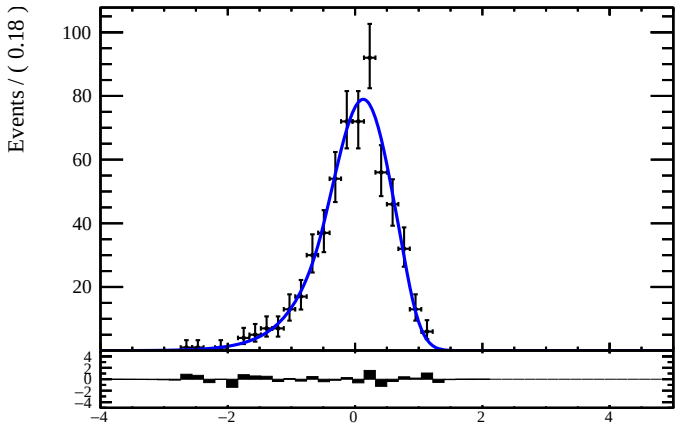


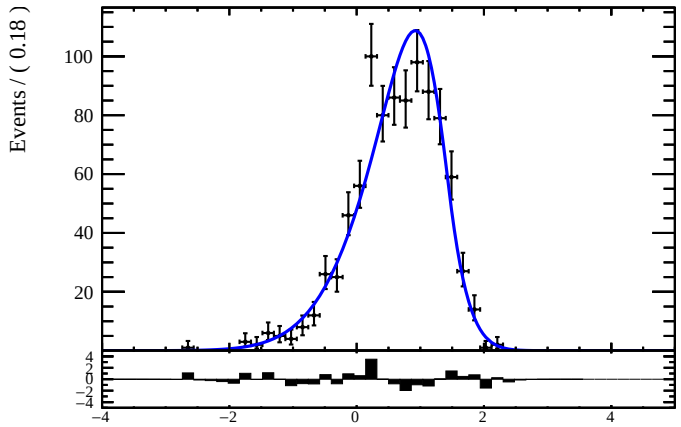
Fit with all parameters free: bin 4

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



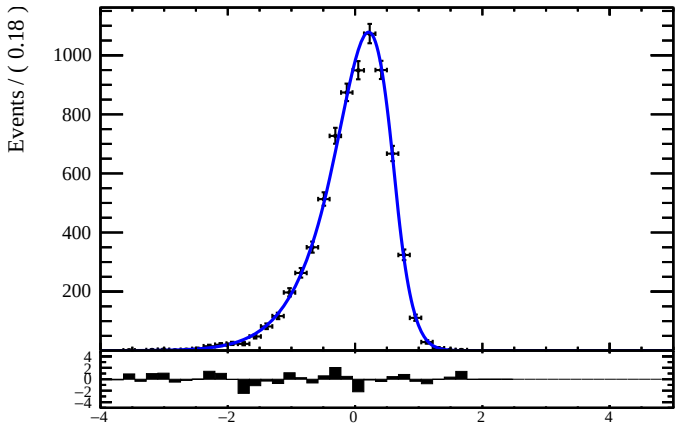


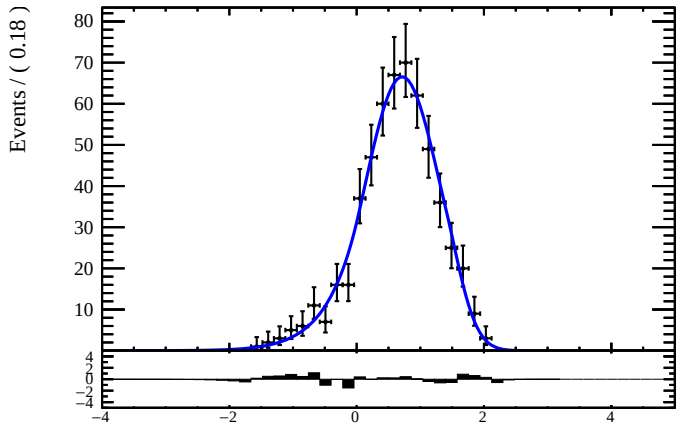


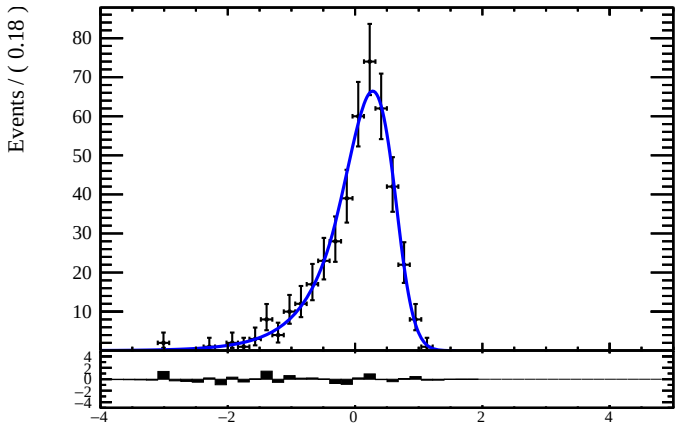


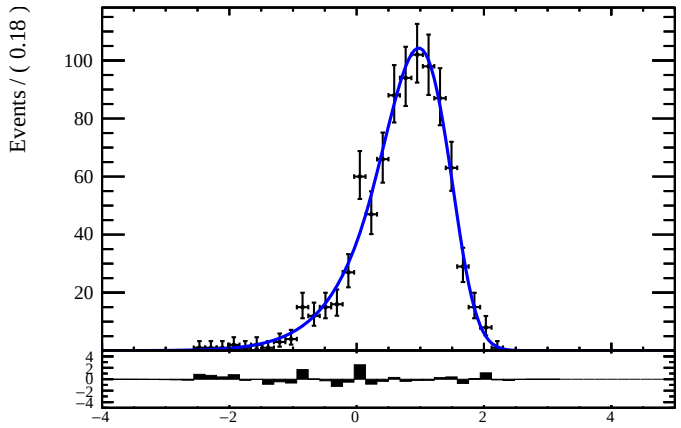
Fit with all parameters free: bin 5

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



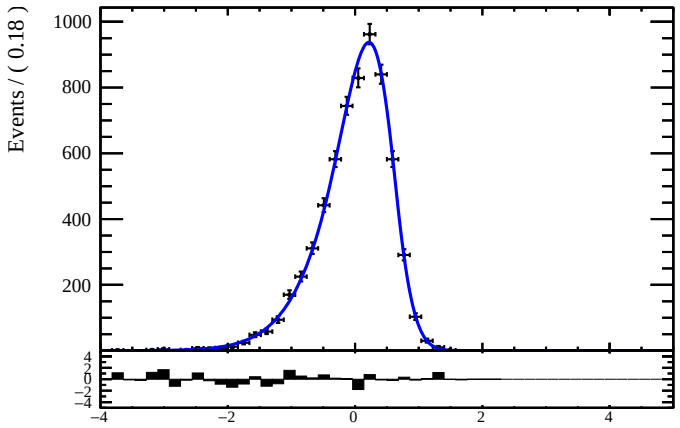


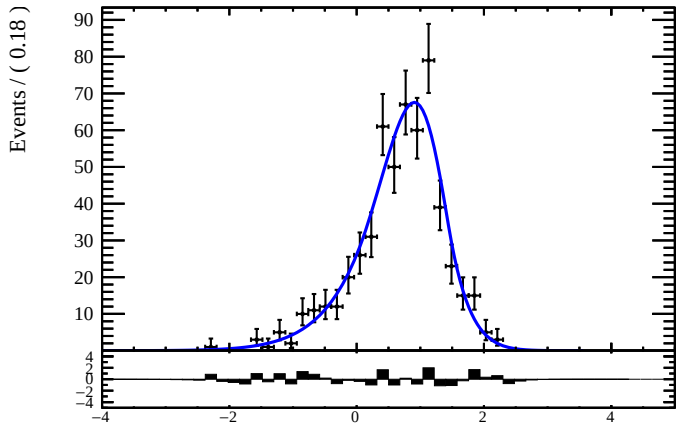


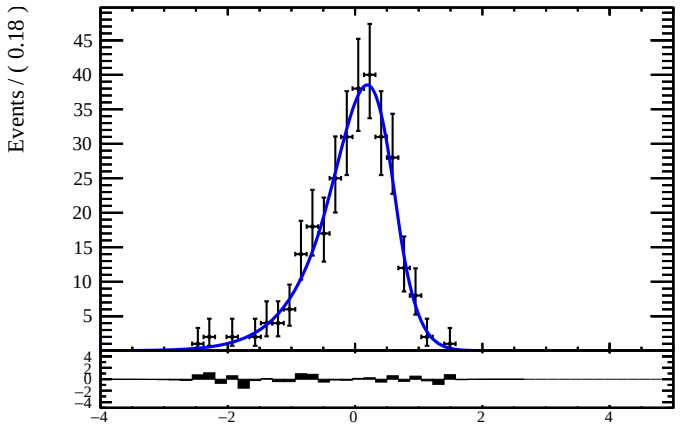


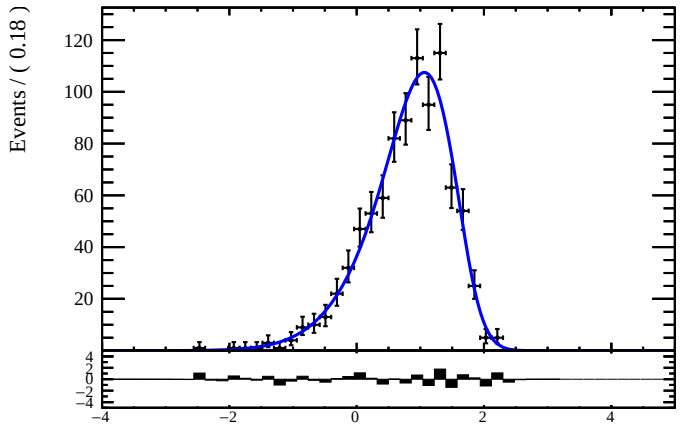
Fit with all parameters free: bin 6

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



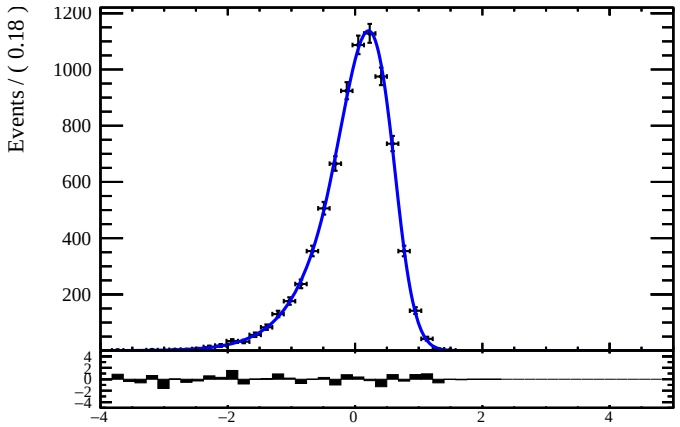


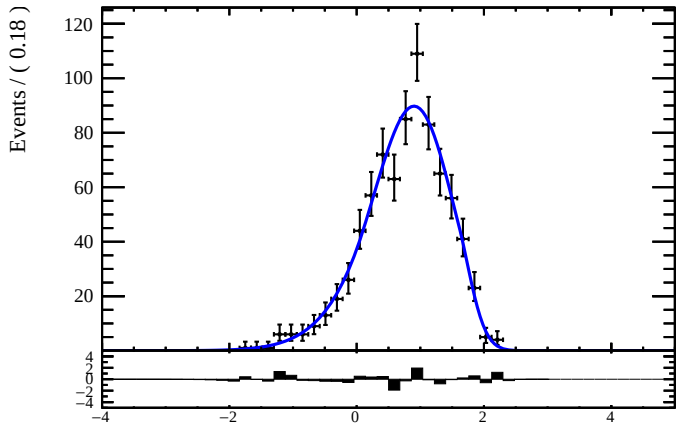


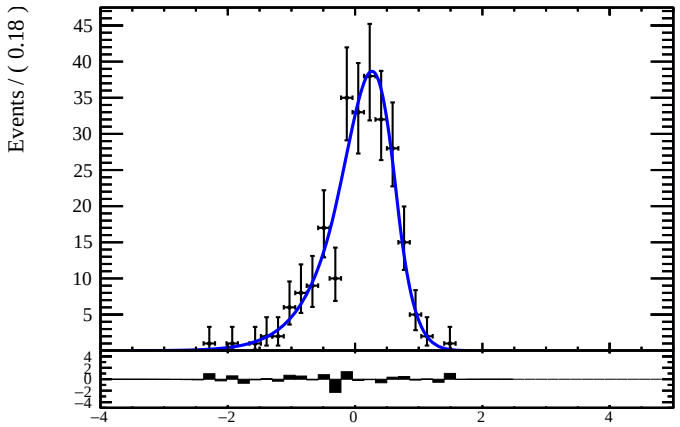


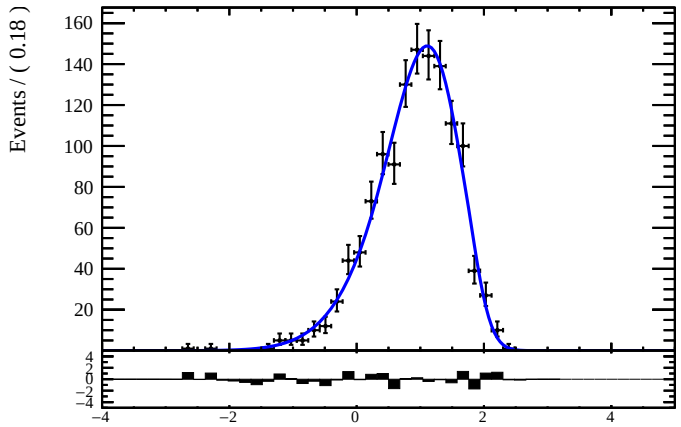
Fit with all parameters free: bin 7

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



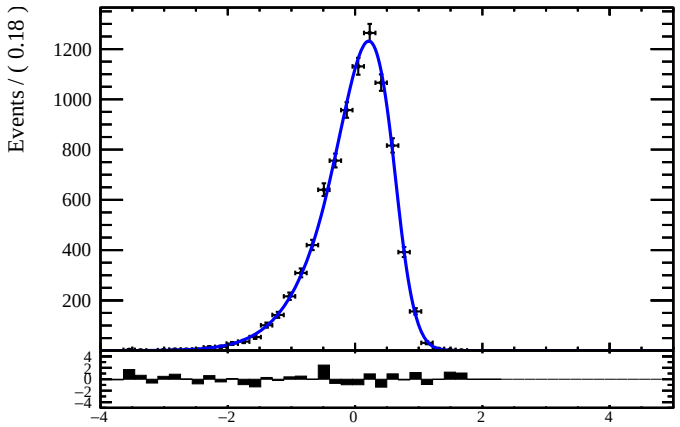


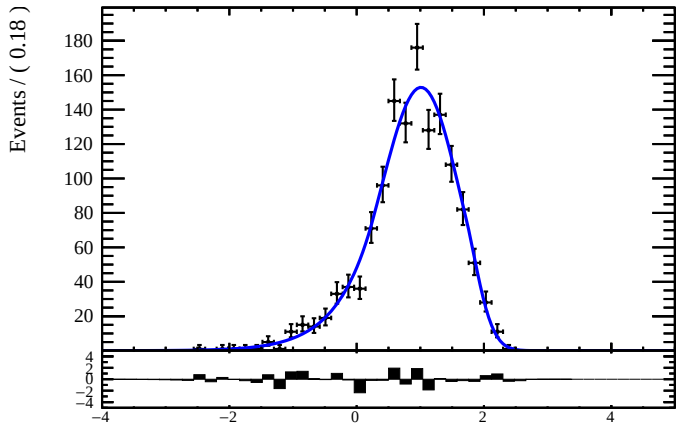


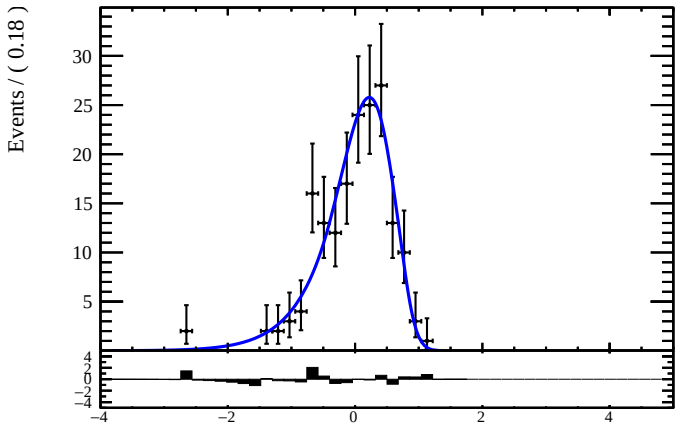


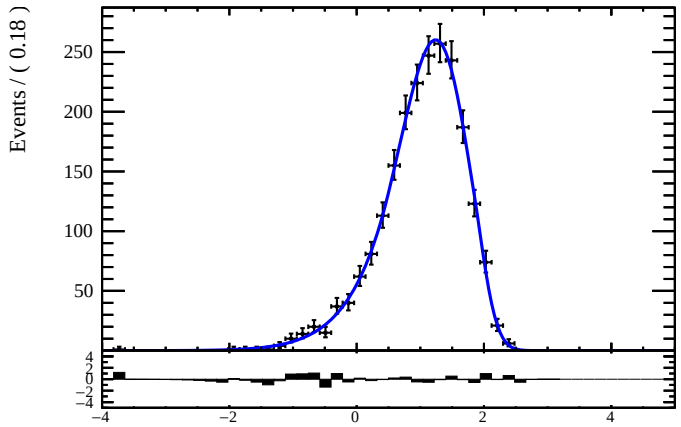
Fit with all parameters free: bin 8

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



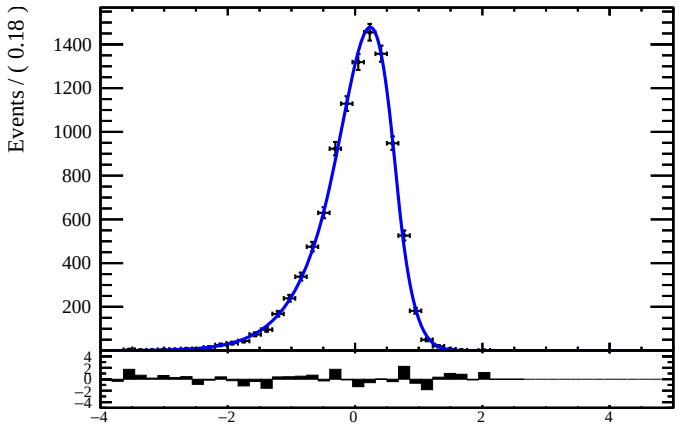


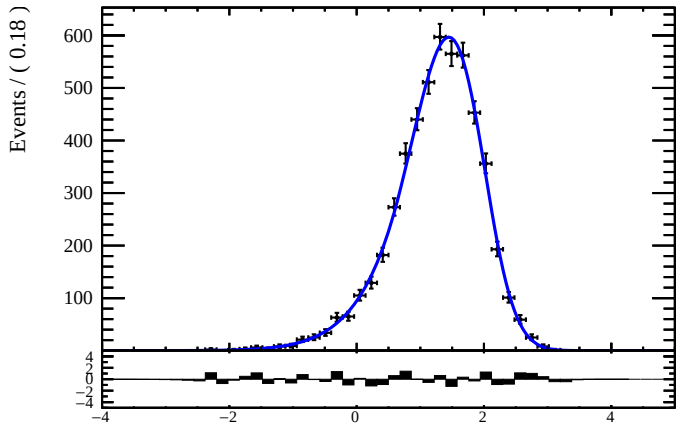


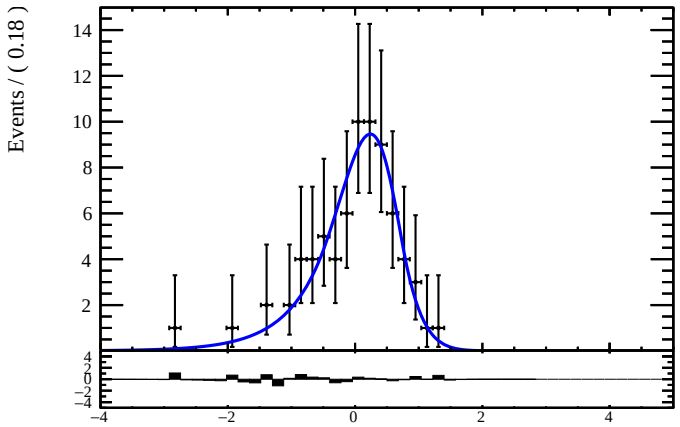


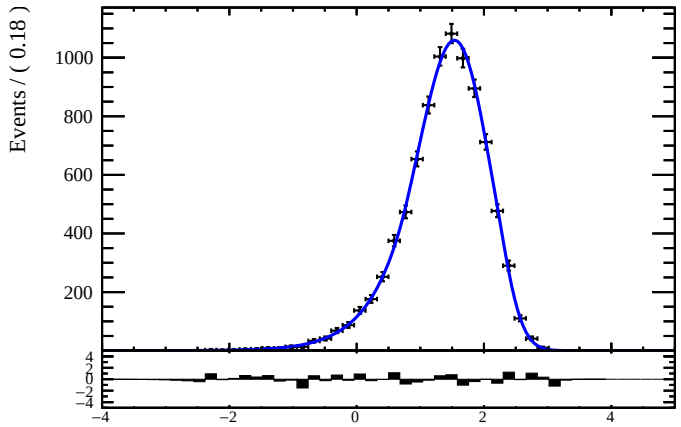
Fit with all parameters free: bin 9

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



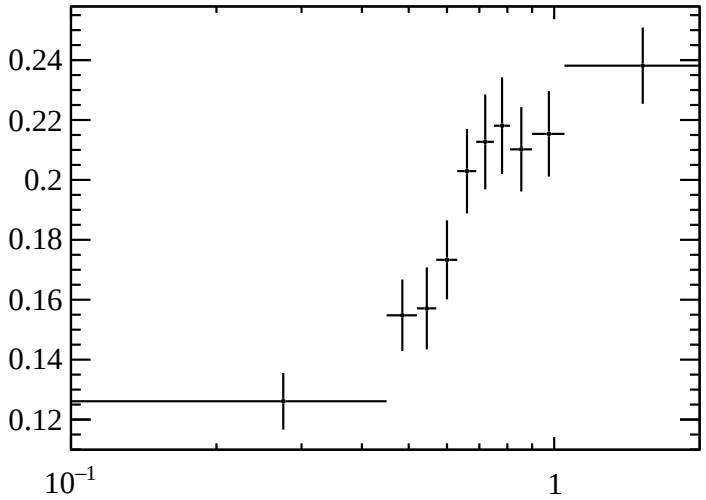


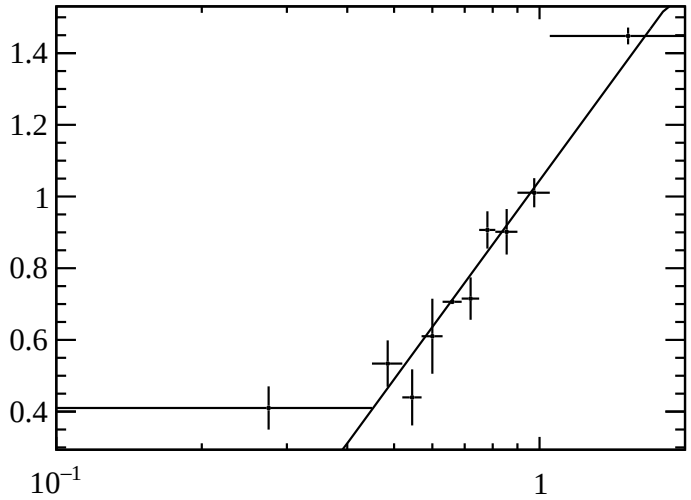


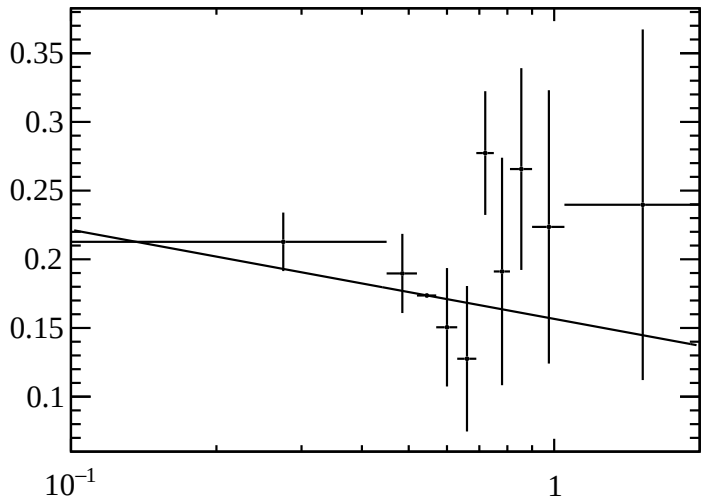


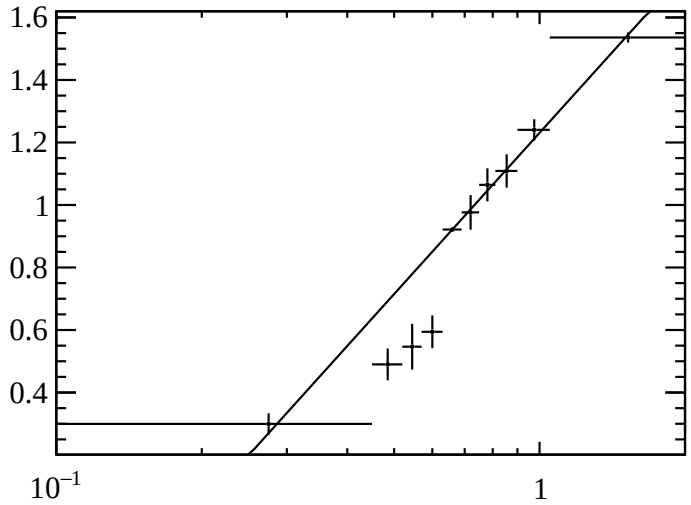
Fit results in decay-time bins μ

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



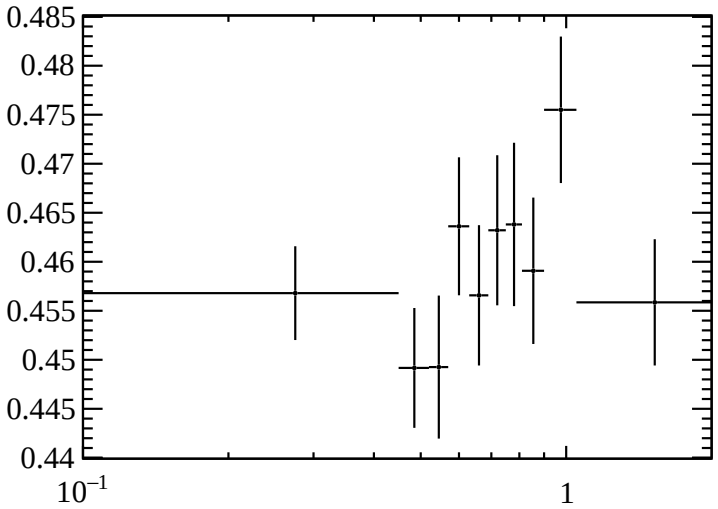


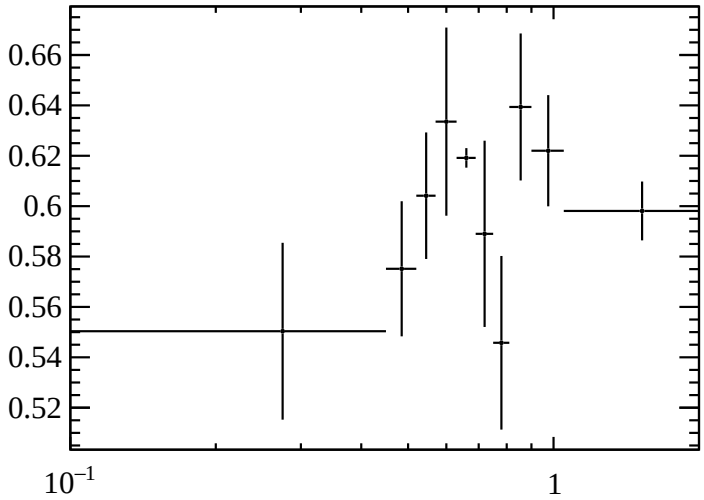


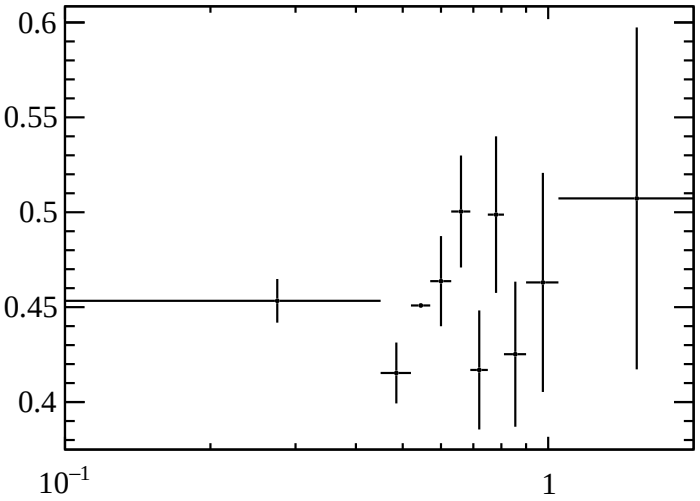


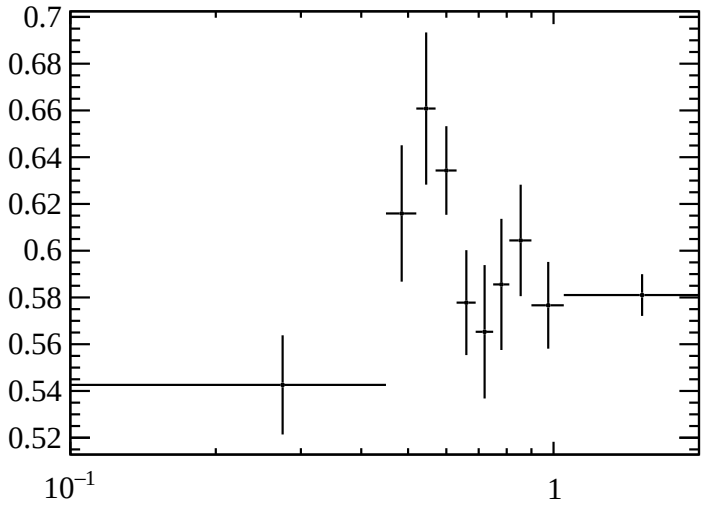
Fit results in decay-time bins σ

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



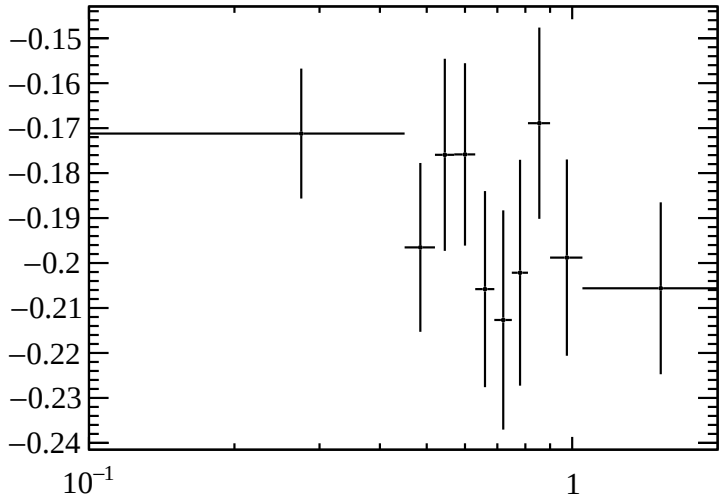


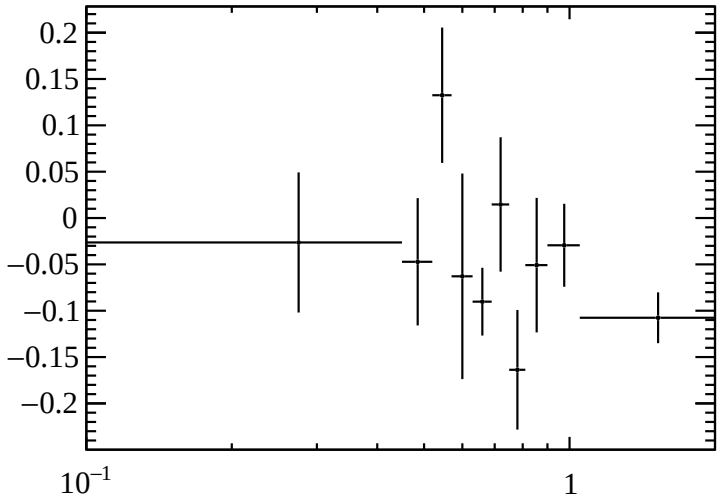


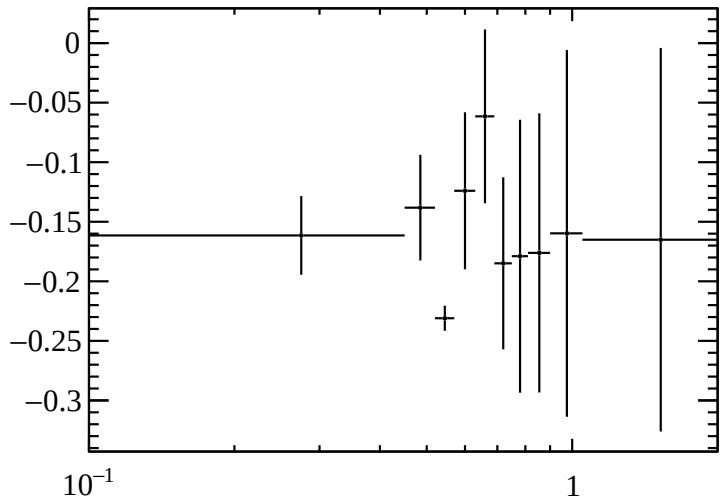


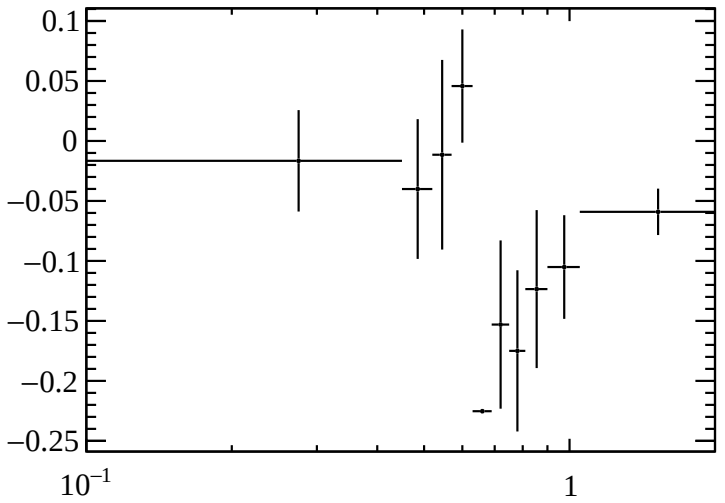
Fit results in decay-time bins ξ

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



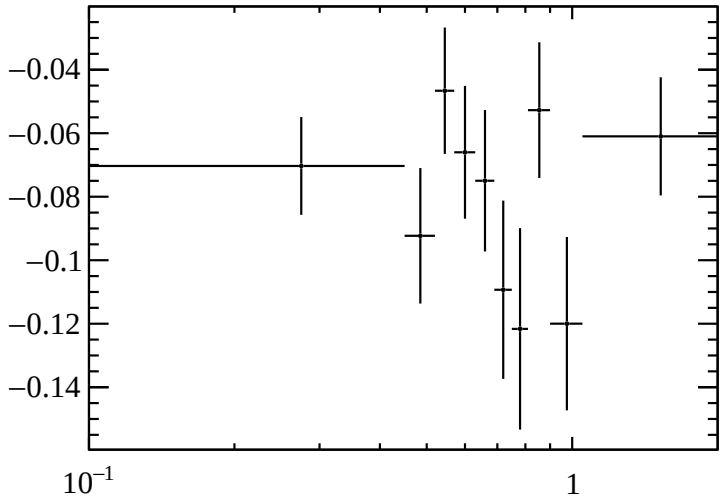


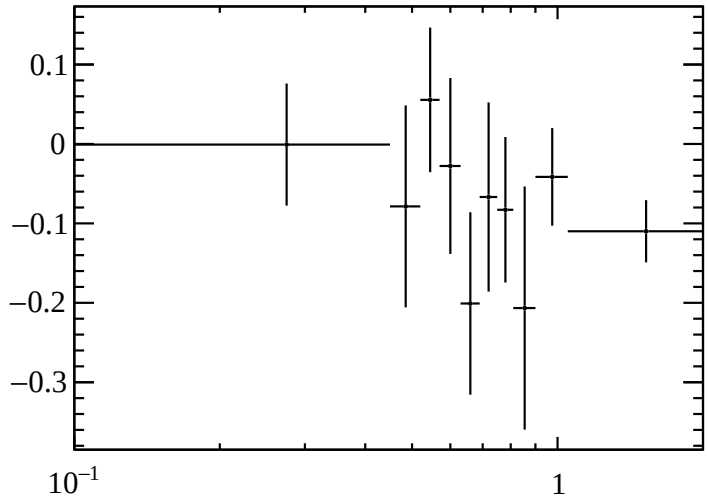


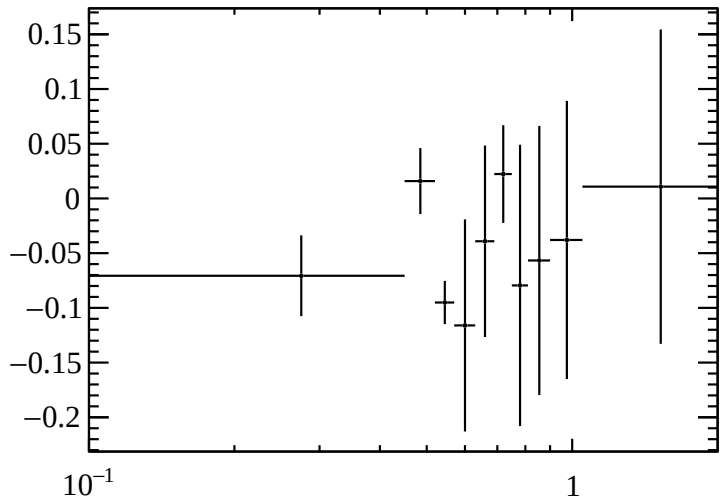


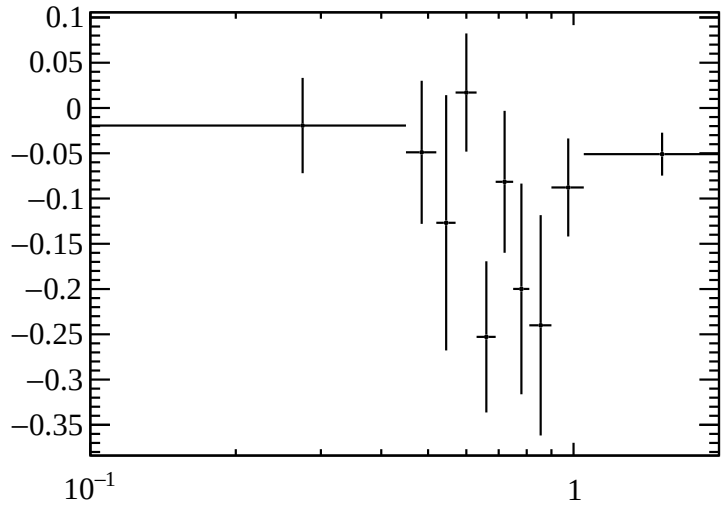
Fit results in decay-time bins ρ_1

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



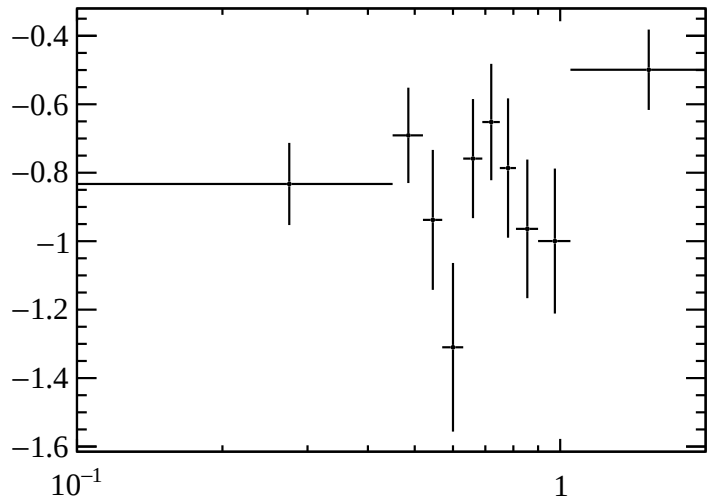


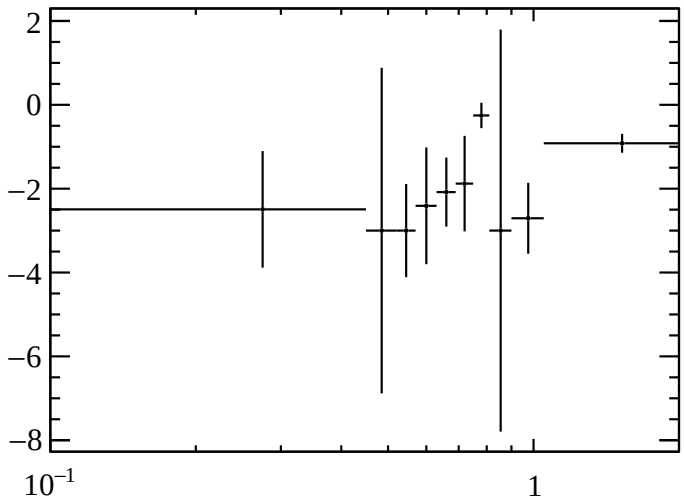


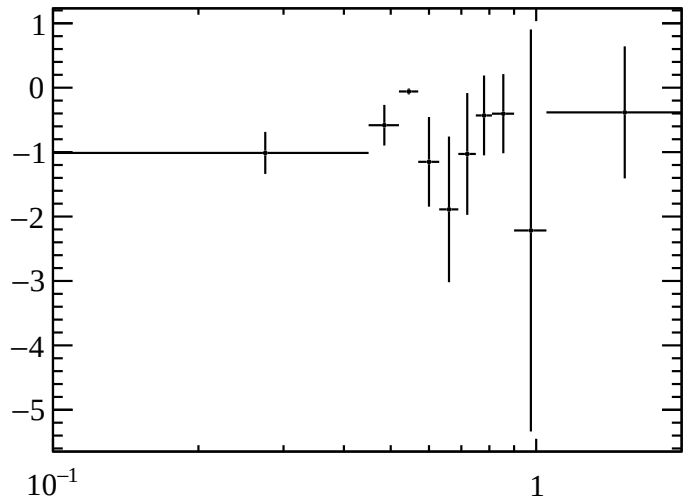


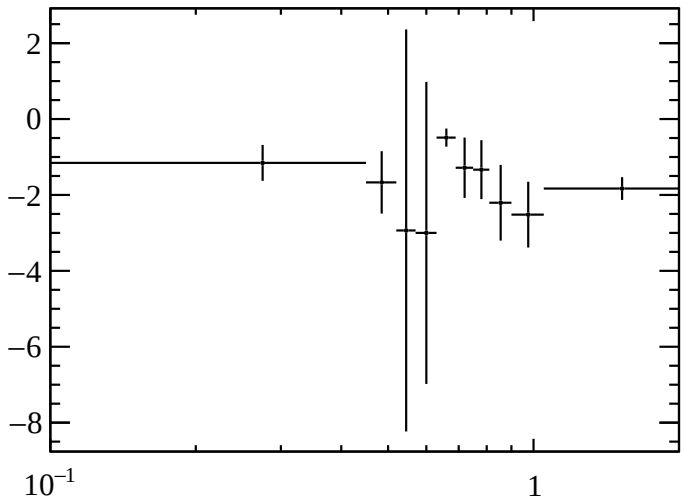
Fit results in decay-time bins ρ_2

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0









Simultaneous fit

- Fit $x \equiv$ logIPCHI2 with decay-time t as conditional variable

$$\mathcal{P}(x, t; N, a, b, \sigma, \xi, \rho_1, \rho_2) = f(x|t; N, a, b, \sigma, \xi, \rho_1, \rho_2) \times g(t)$$

  where $f(x|t)$ is the Bukin function with $\mu(t) = a\ln(t) + b$ and $g(t)$ is the empirical p.d.f. from RooHistPdf to describe data

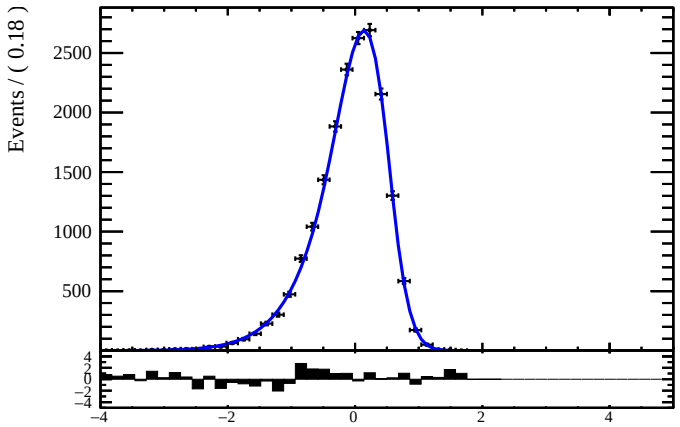
- Simultaneous fit of data sets seperated according to decay time

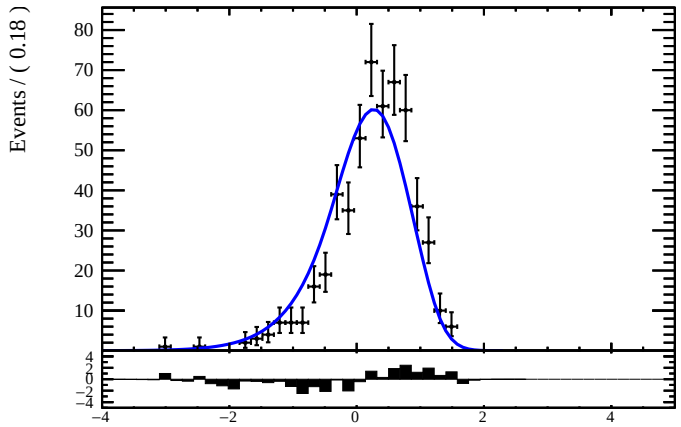
$$-\ln L = \sum_j \sum_i \ln \mathcal{P}(x_i, t_i; a, b, N, \sigma, \xi, \rho_1, \rho_2)$$

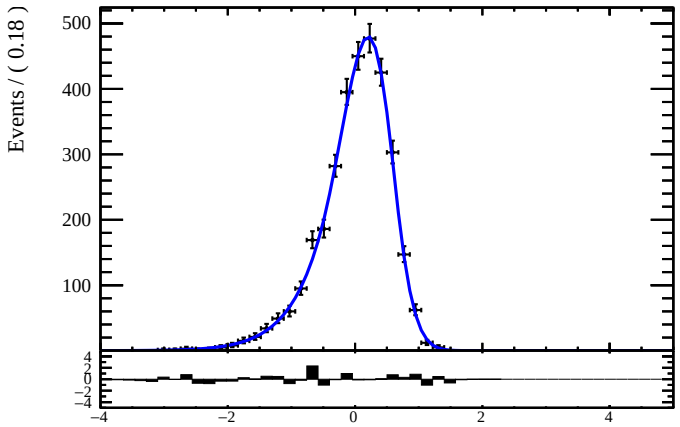
  where $a, b, \sigma, \xi, \rho_1, \rho_2$ are free and shared in each data set

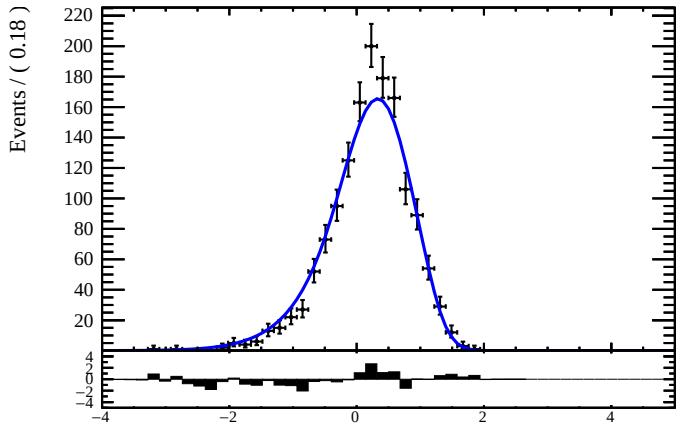
Simultaneous fit: bin 0

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



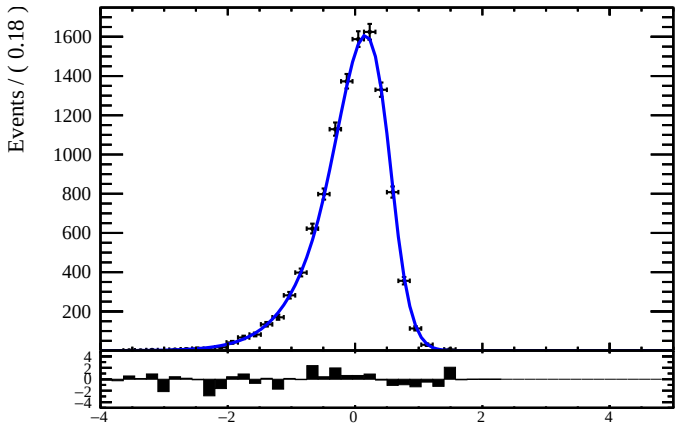


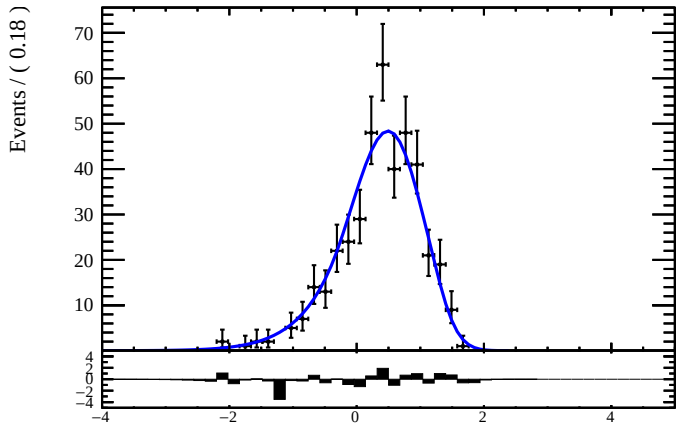


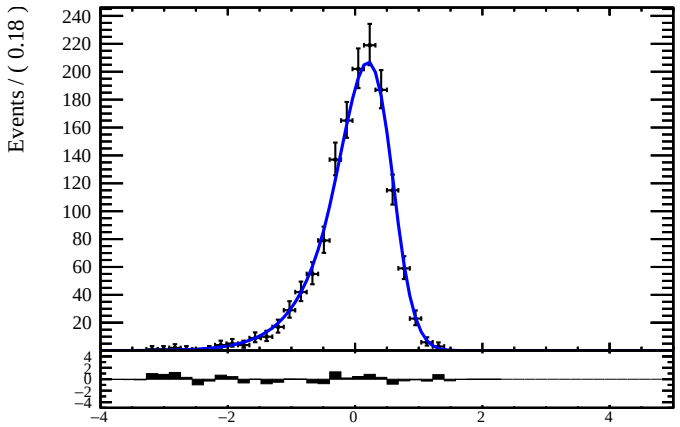


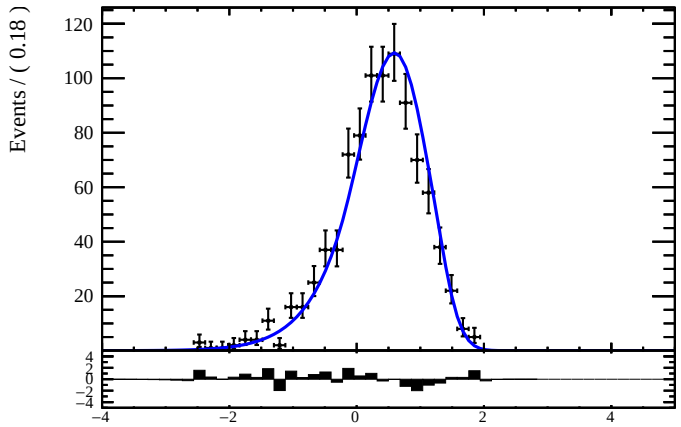
Simultaneous fit: bin 1

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



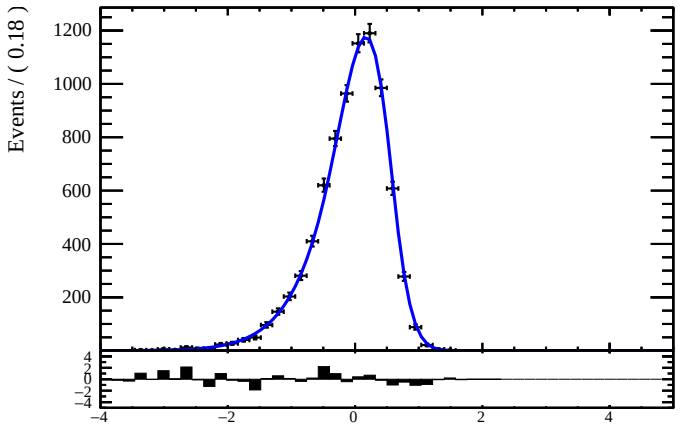


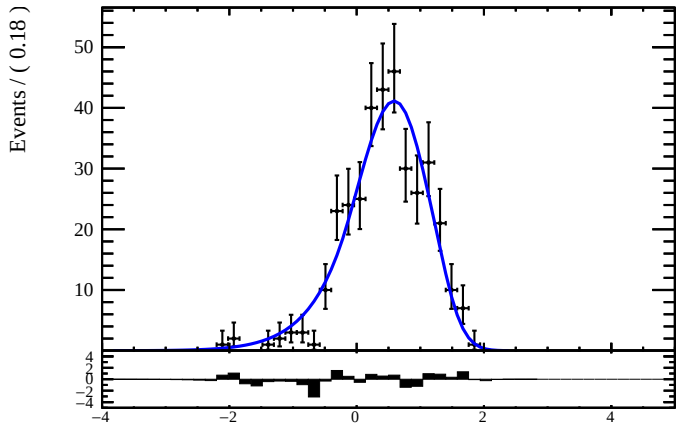


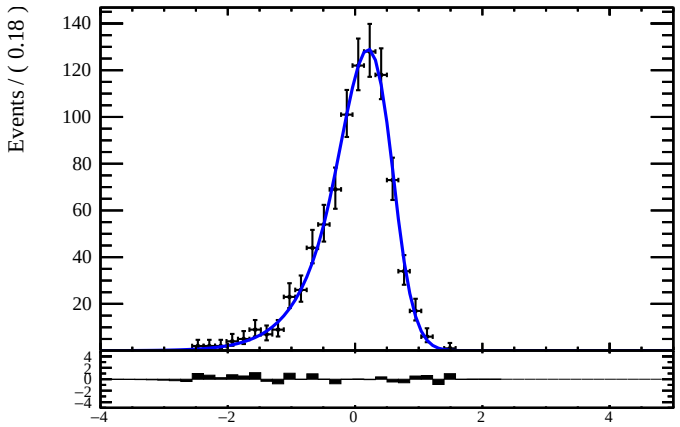


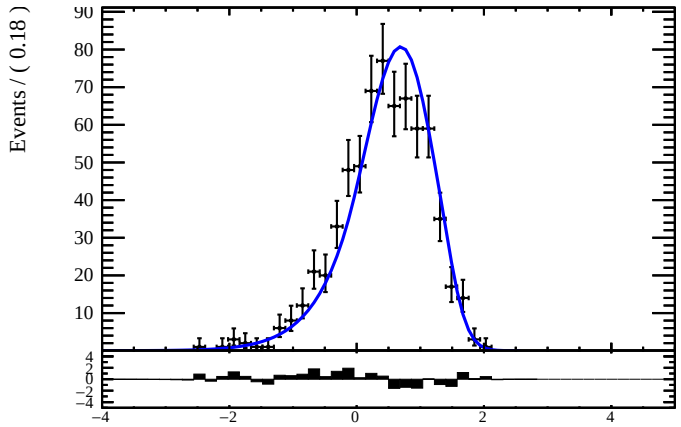
Simultaneous fit: bin 2

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



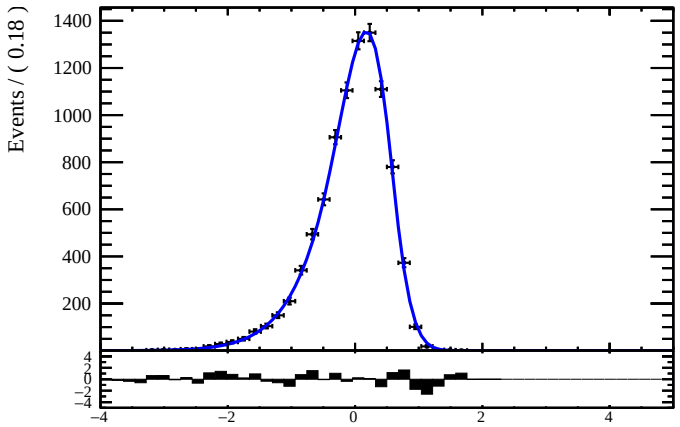


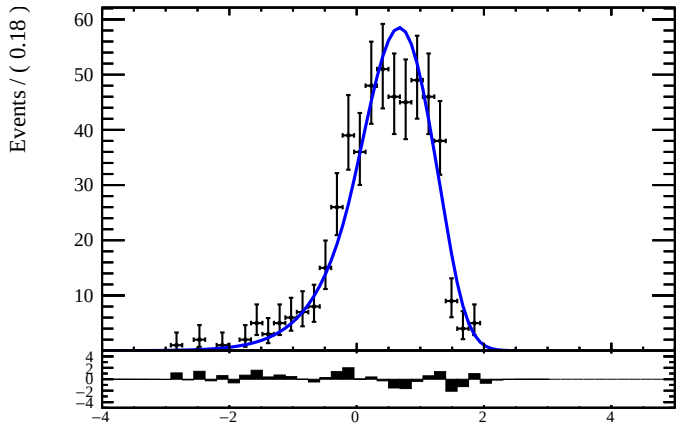


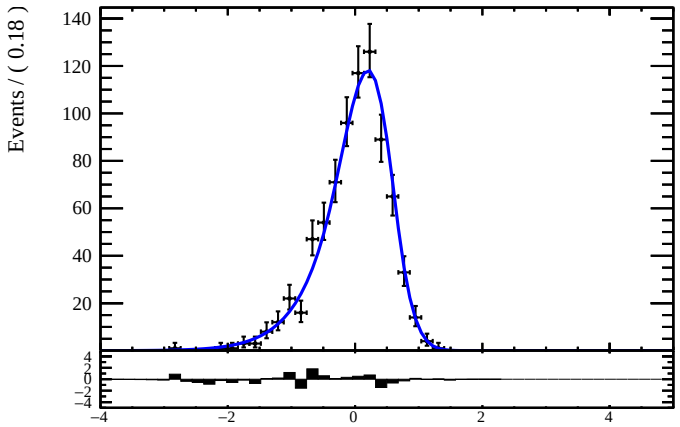


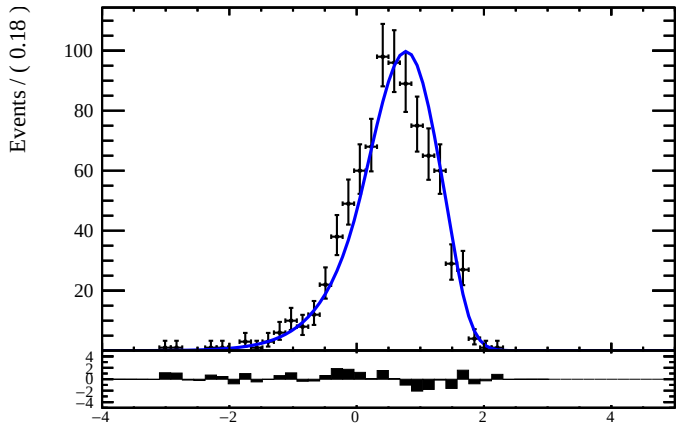
Simultaneous fit: bin 3

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



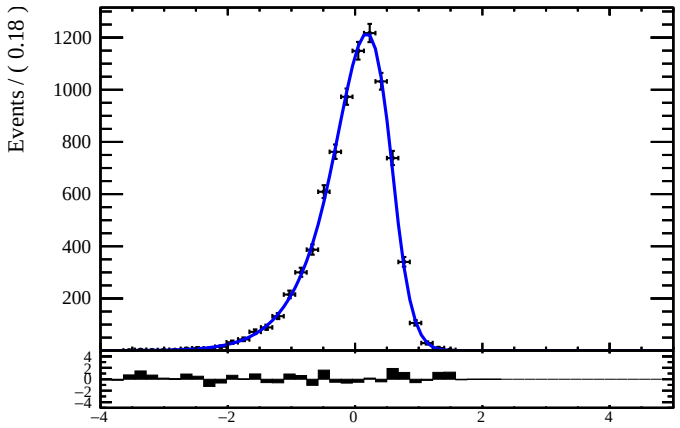


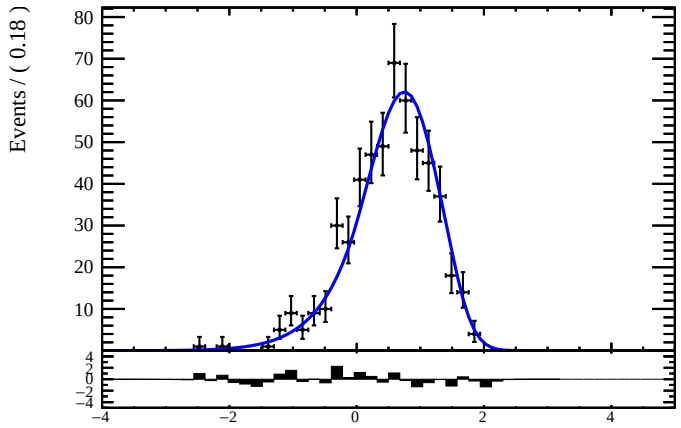


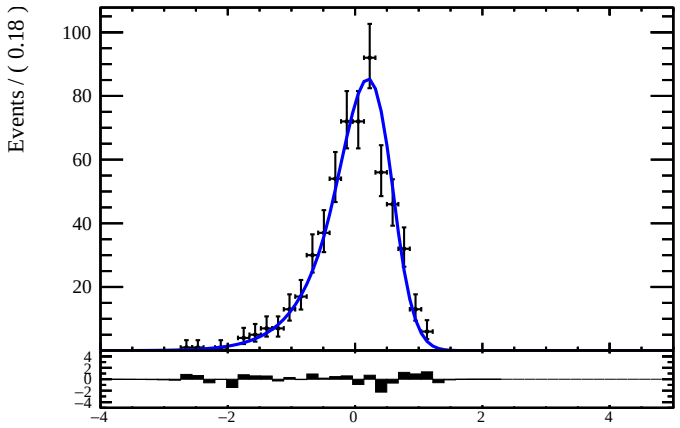


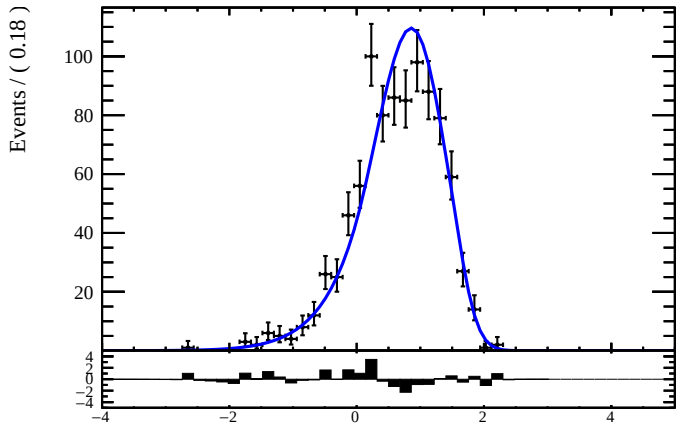
Simultaneous fit: bin 4

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



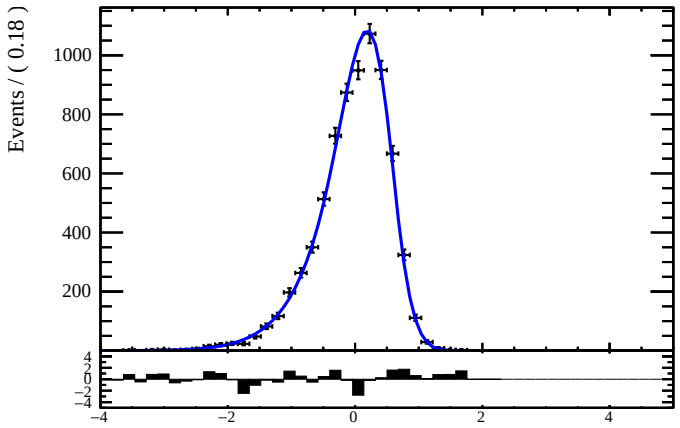


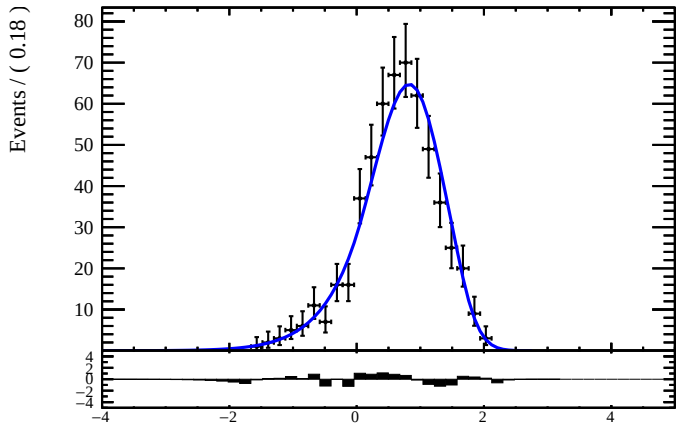


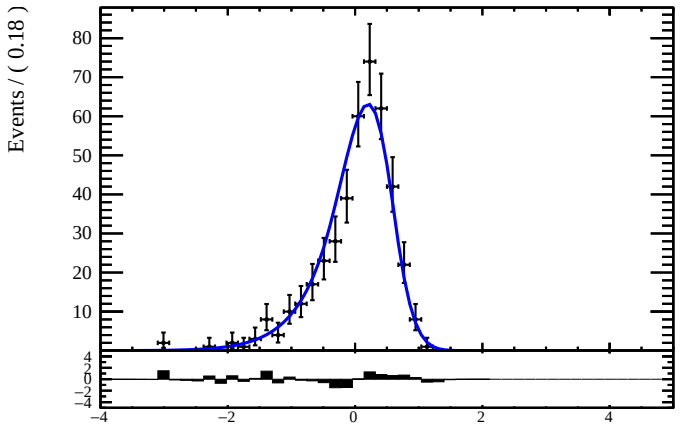


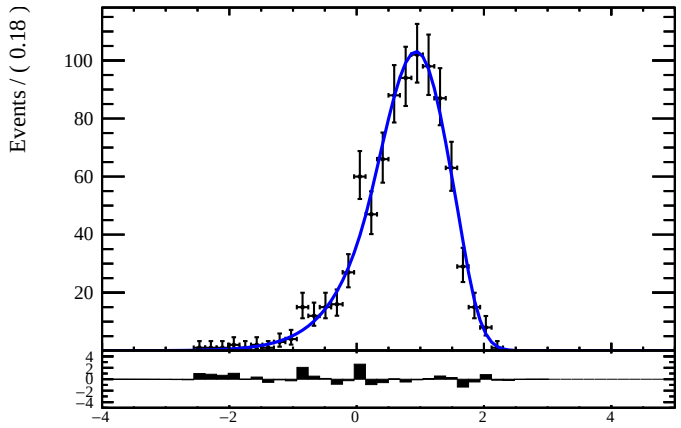
Simultaneous fit: bin 5

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



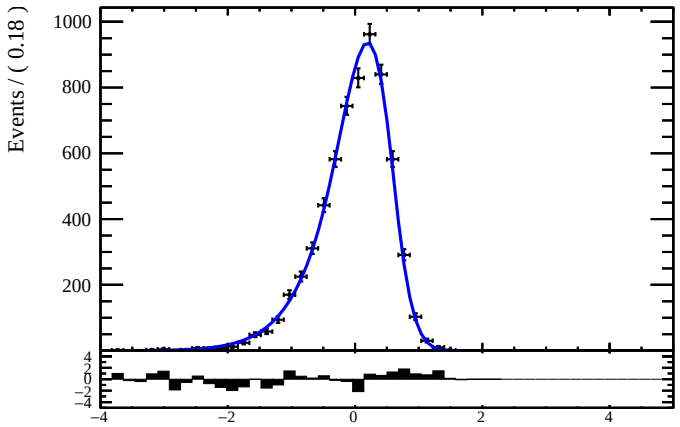


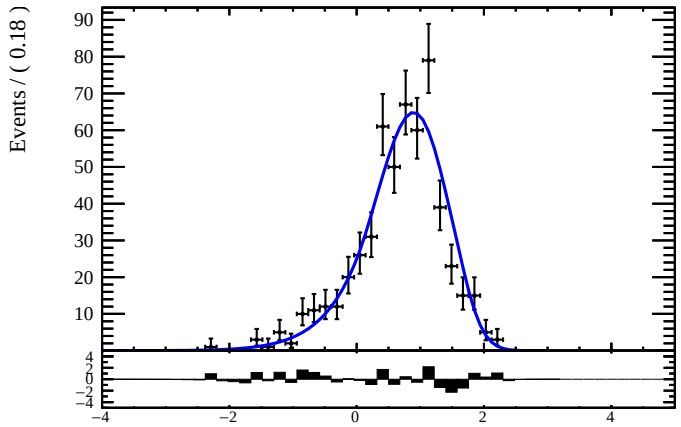


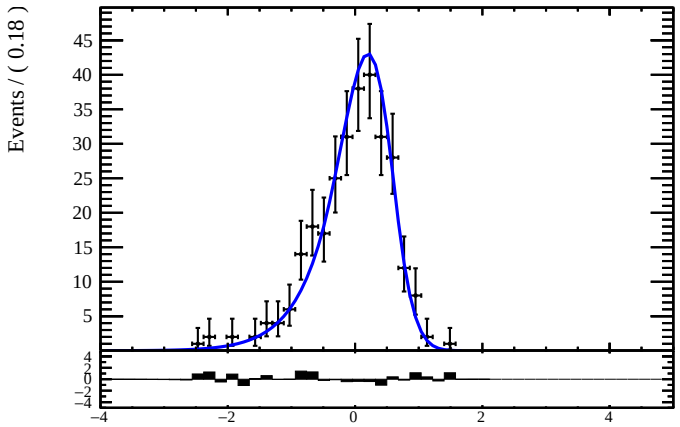


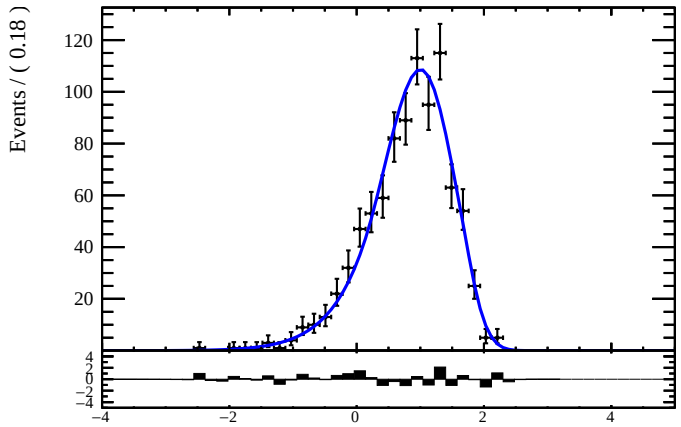
Simultaneous fit: bin 6

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



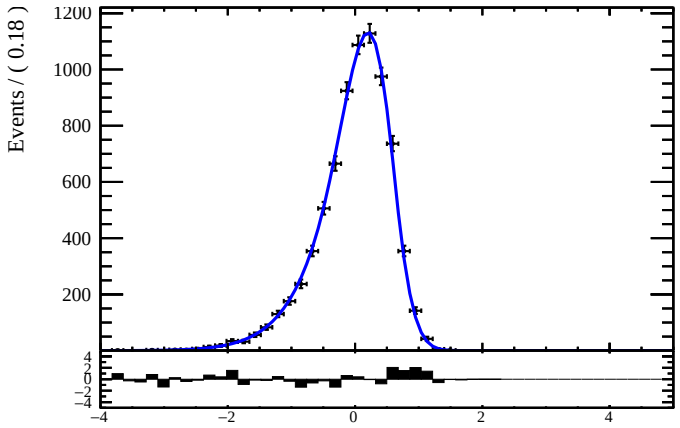


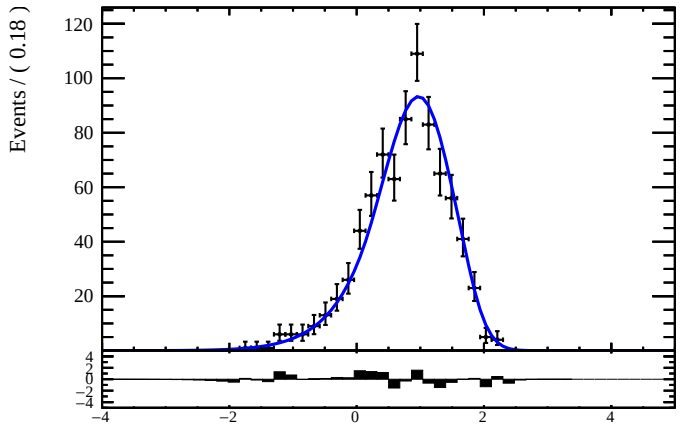


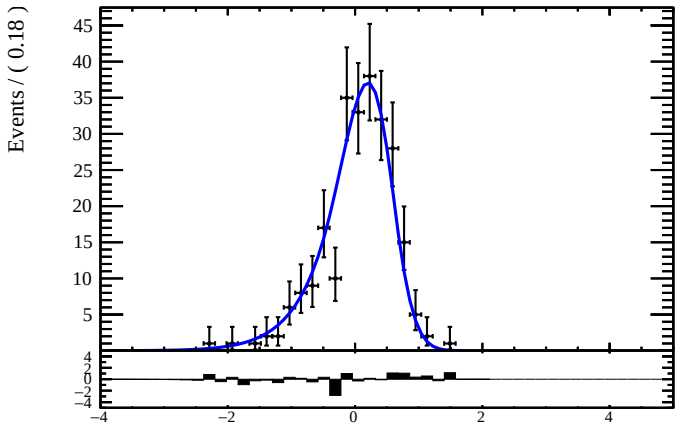


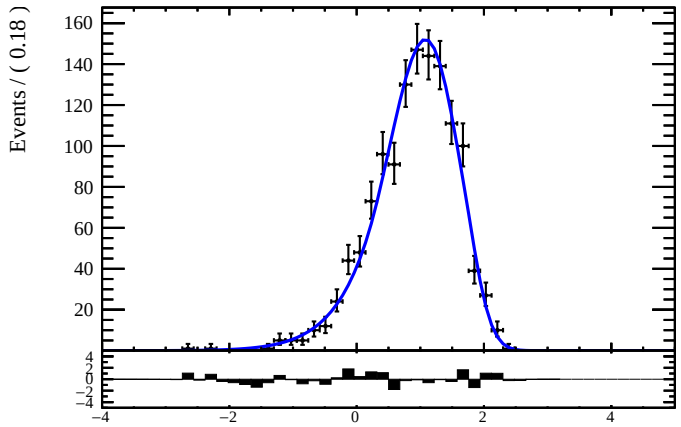
Simultaneous fit: bin 7

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



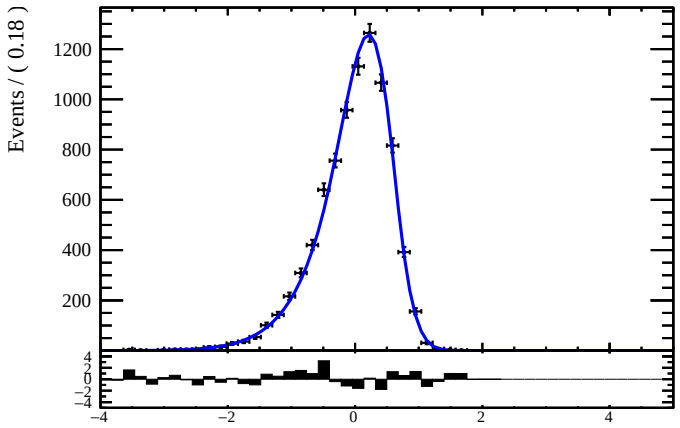


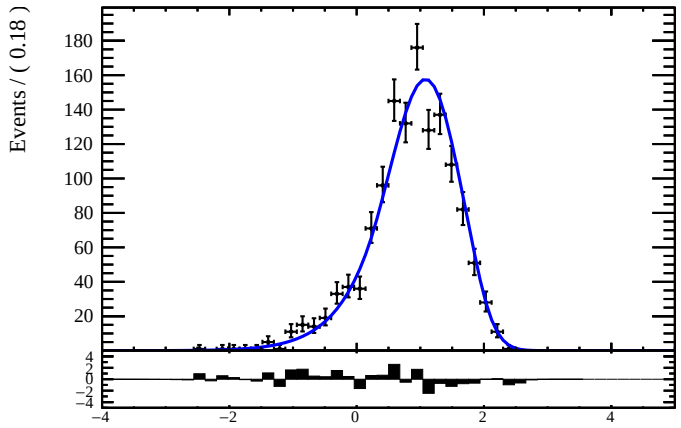


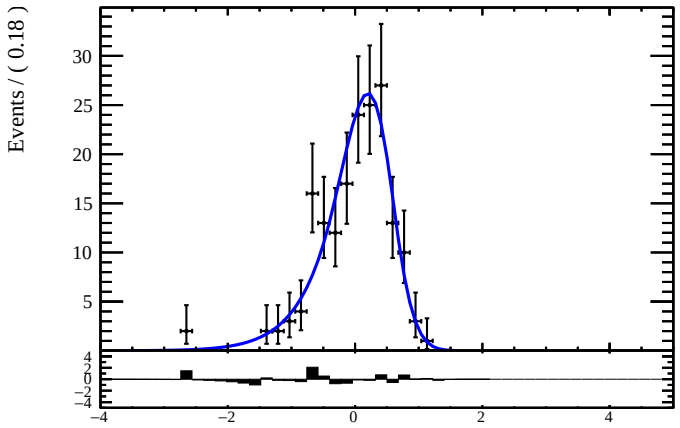


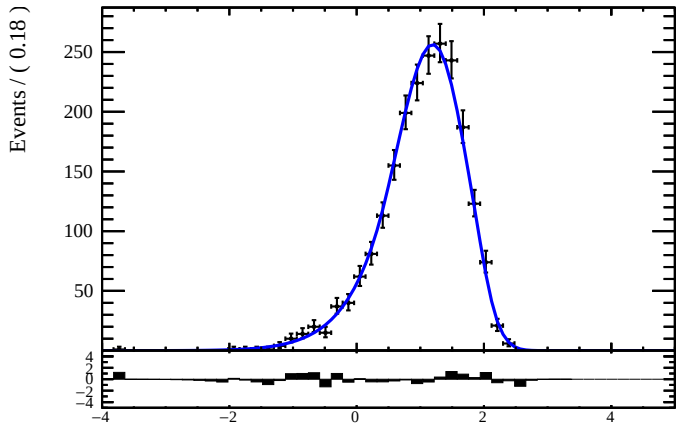
Simultaneous fit: bin 8

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0



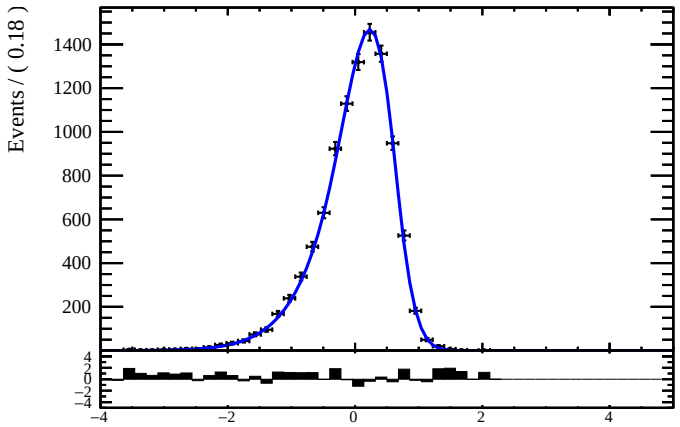


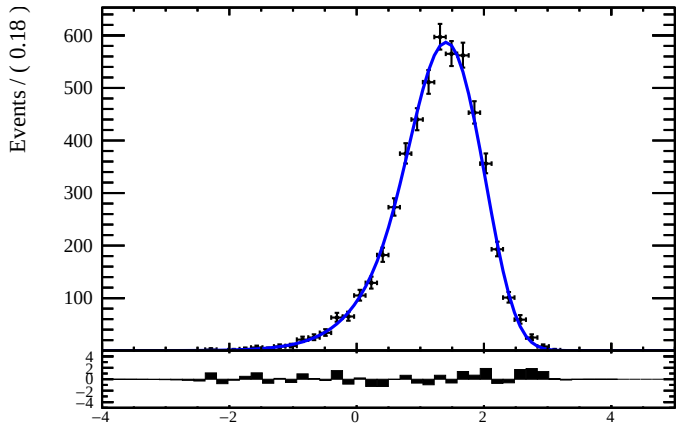


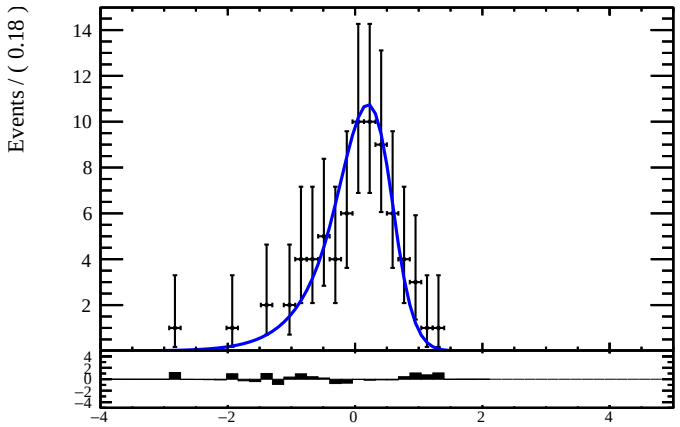


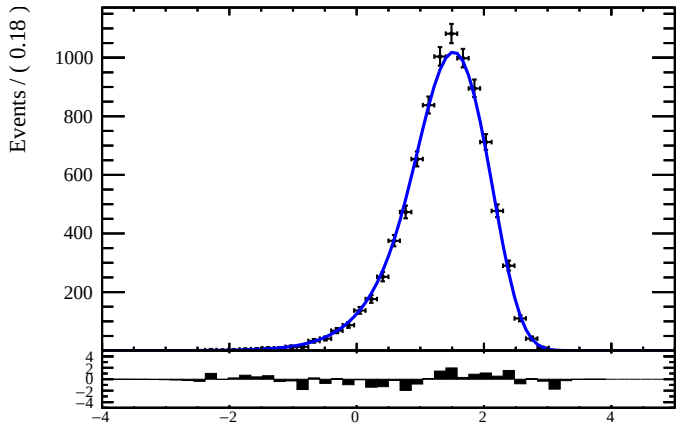
Simultaneous fit: bin 9

- (left) Prompt and (right) secondary for (top) Ω_c^0 and (bottom) Ξ_c^0







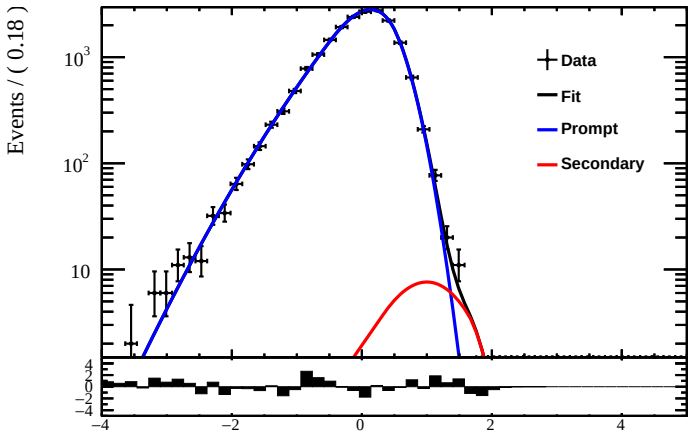


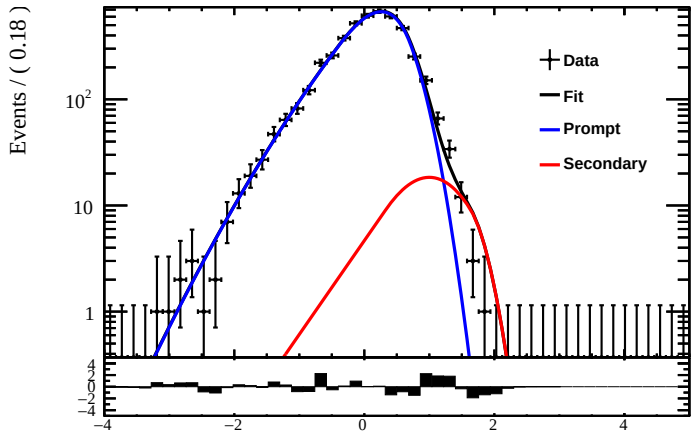
Sanity checks

- Fit the combined (prompt+secondary) MC with free μ while fixing other parameters
- Can reproduce the correct b-fraction

Fit the combined MC: bin 0

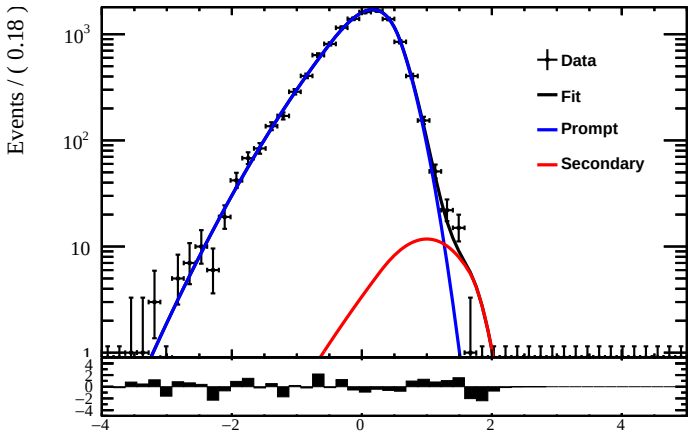
- (left) Ω_c^0 and (right) Ξ_c^0

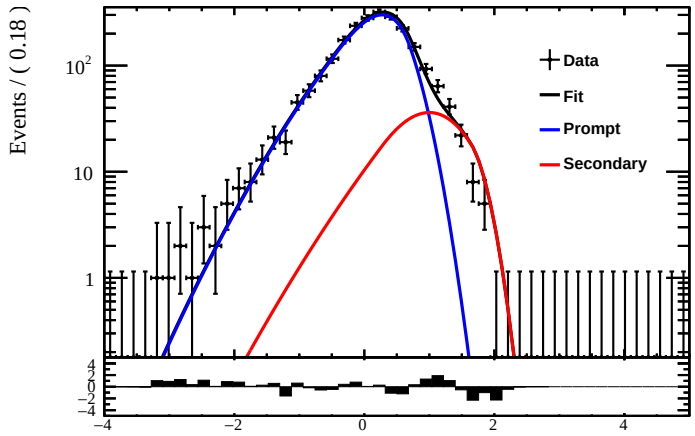




Fit the combined MC: bin 1

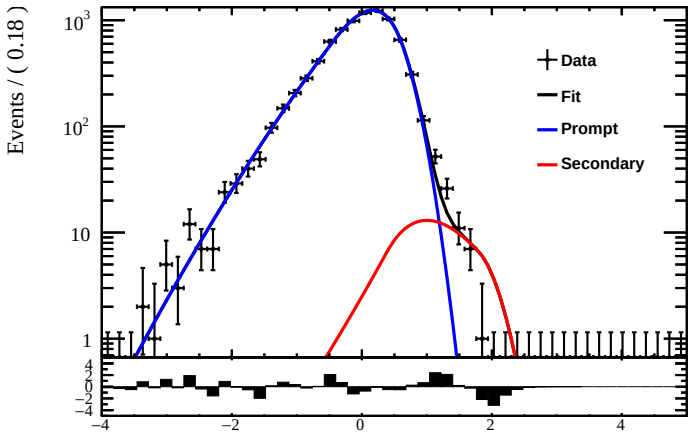
- (left) Ω_c^0 and (right) Ξ_c^0

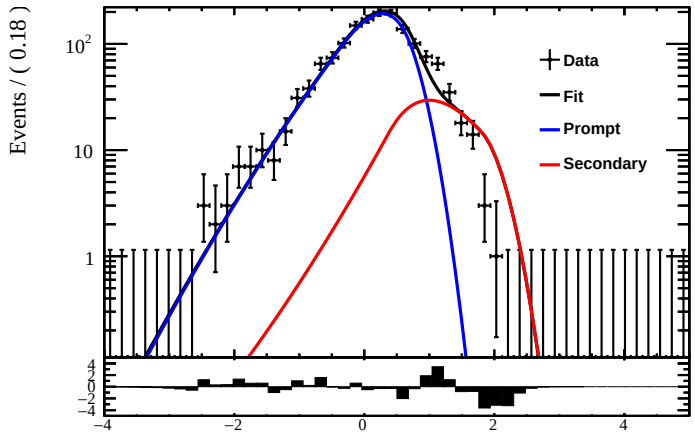




Fit the combined MC: bin 2

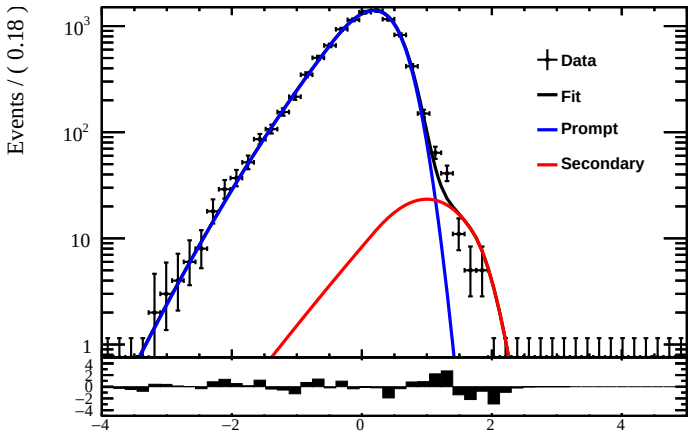
- (left) Ω_c^0 and (right) Ξ_c^0

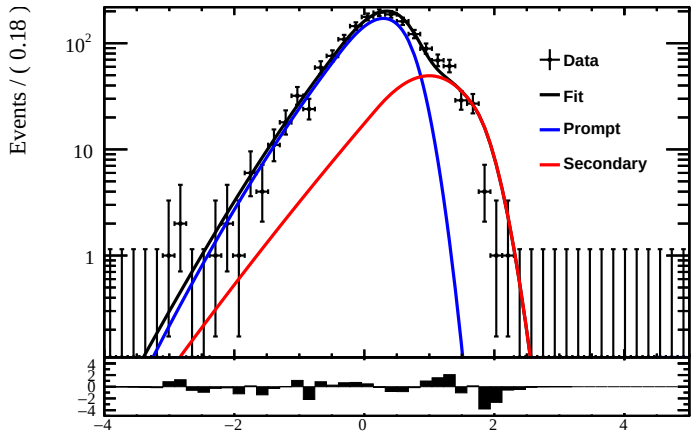




Fit the combined MC: bin 3

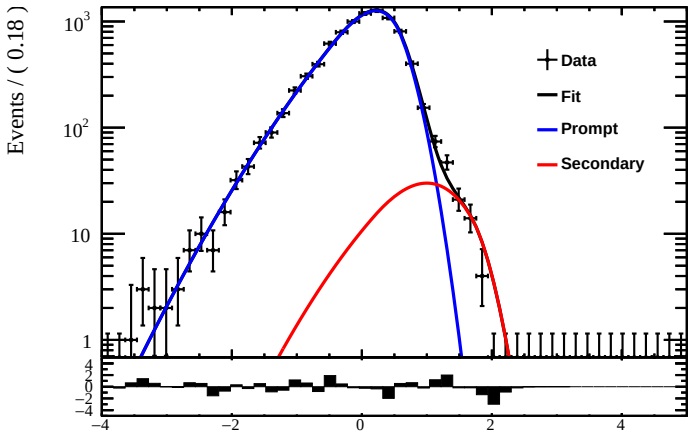
- (left) Ω_c^0 and (right) Ξ_c^0

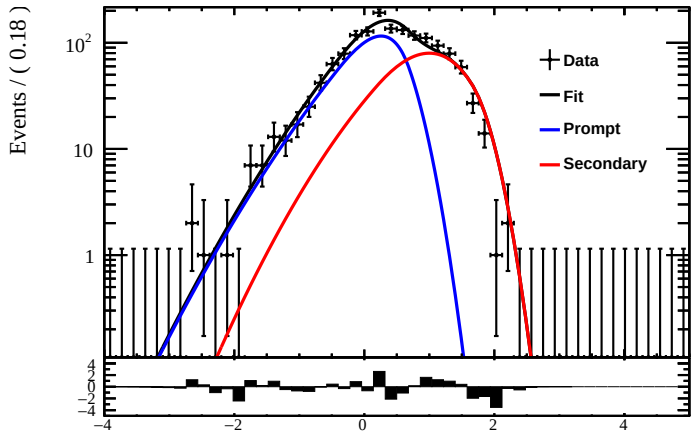




Fit the combined MC: bin 4

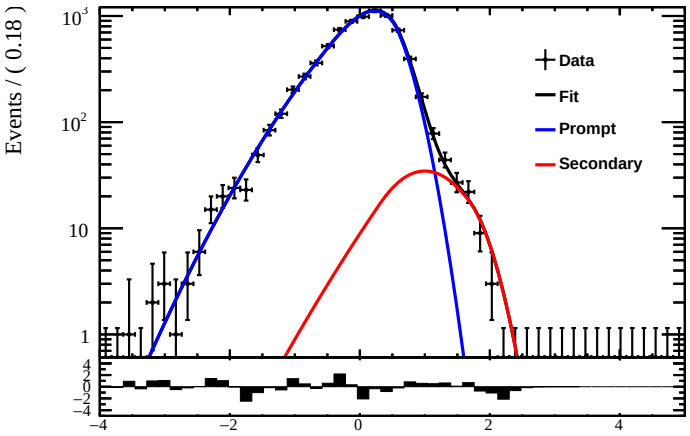
- (left) Ω_c^0 and (right) Ξ_c^0

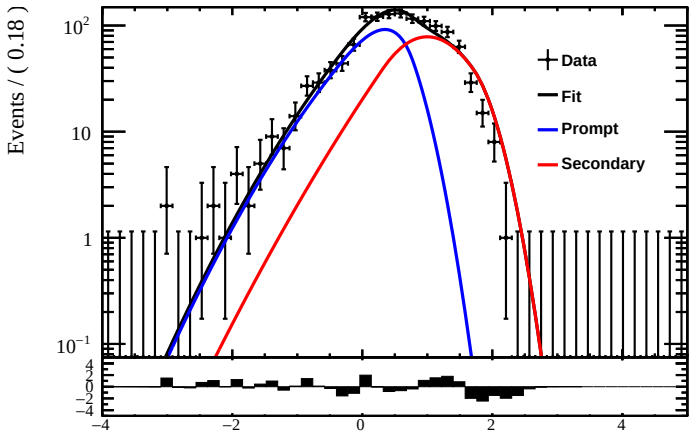




Fit the combined MC: bin 5

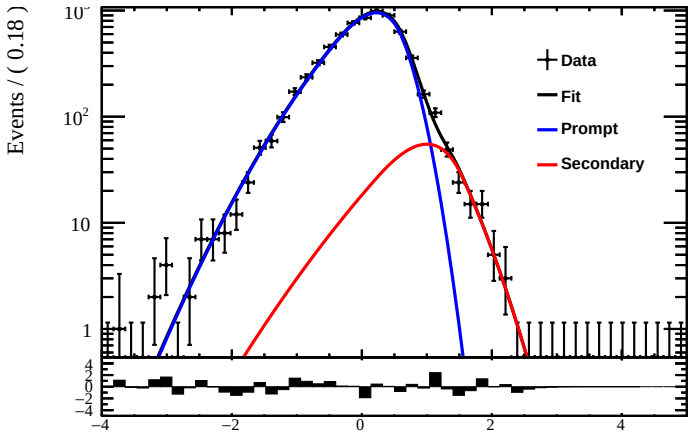
- (left) Ω_c^0 and (right) Ξ_c^0

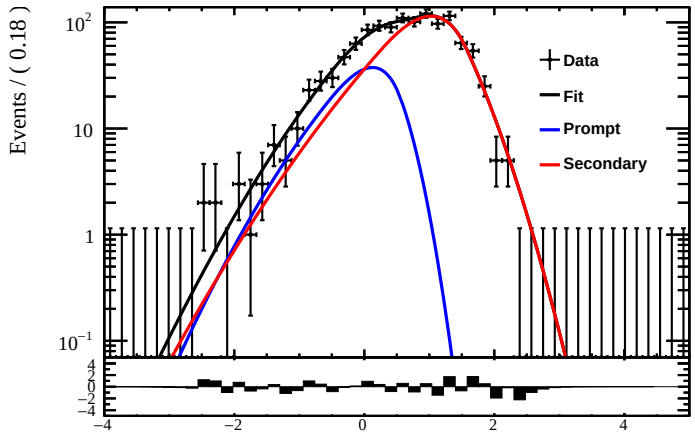




Fit the combined MC: bin 6

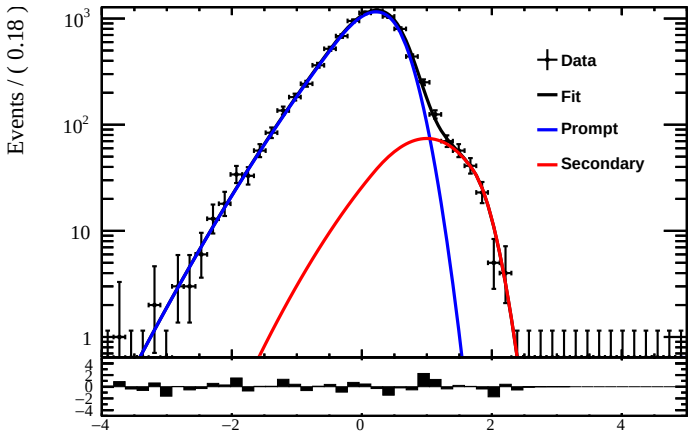
- (left) Ω_c^0 and (right) Ξ_c^0

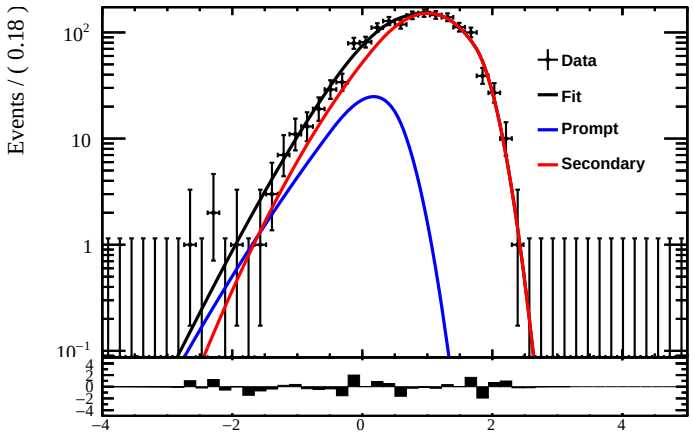




Fit the combined MC: bin 7

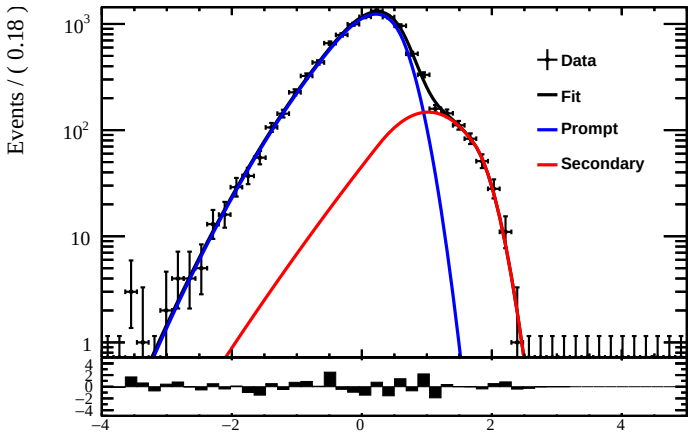
- (left) Ω_c^0 and (right) Ξ_c^0

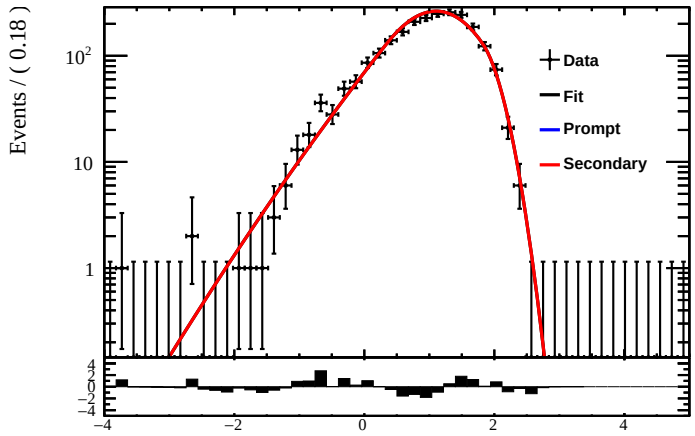




Fit the combined MC: bin 8

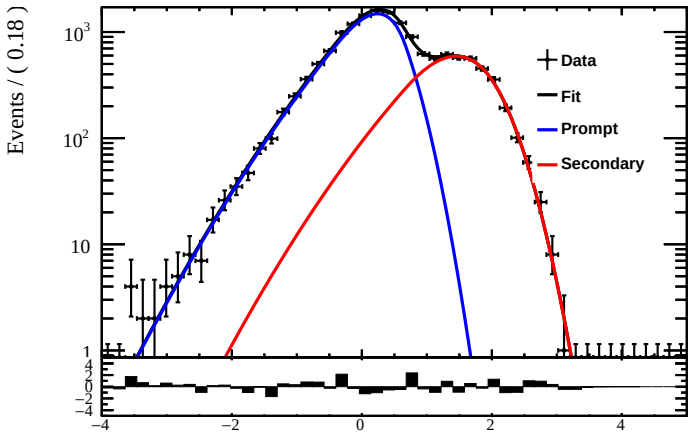
- (left) Ω_c^0 and (right) Ξ_c^0

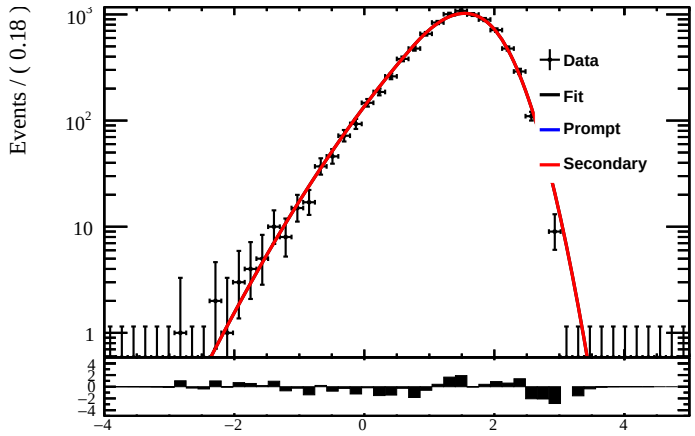




Fit the combined MC: bin 9

- (left) Ω_c^0 and (right) Ξ_c^0





To-do

- Fit the real data