

Measurement of Ω_c^0 lifetime with the prompt production

Ao Xu

Tsinghua University

Ω_c^0 lifetime measurement meeting

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- The Redecay MC production has (almost) finished

Data and simulation

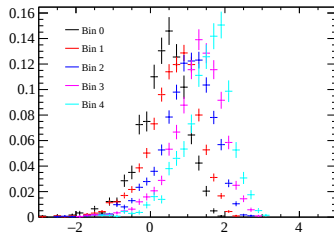
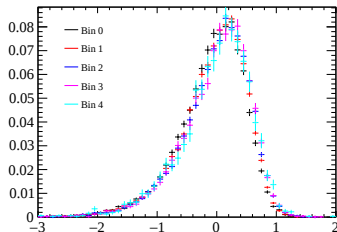
		Data	MC	MC Status
signal	$\Omega_c^0 \rightarrow p K^- K^- \pi^+$	Turbo	ReDecay $\tau = 250 \text{ fs}, 500 \text{ fs}$	Done
normalization	$\Xi_c^0 \rightarrow p K^- K^- \pi^+$	Turbo	ReDecay	Done
control	$D^{*+} \rightarrow D^0 (\rightarrow K^- K^+ \pi^- \pi^+) \pi^+$	Turbo	ReDecay	Done
control	$\Omega_b^- \rightarrow \Omega_c^0 (\rightarrow p K^- K^- \pi^+) \pi^-$	Stripping	Full	Processed
control	$B^+ \rightarrow \bar{D}^0 (\rightarrow K^+ K^- \pi^+ \pi^-) \pi^+$	Stripping	Full	Processed

Prompt yield extraction

- Discriminating variables: $\log_{10}(\chi_{\text{IP}}^2)$ 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 $\log_{10}(\chi_{\text{IP}}^2)$ distribution
 - Background $\log_{10}(\chi_{\text{IP}}^2)$ shape from kernel estimation 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]

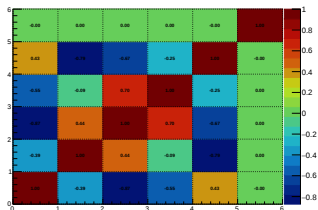
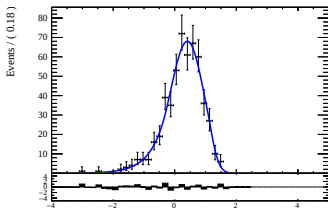
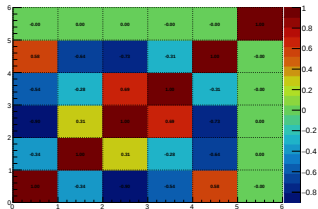
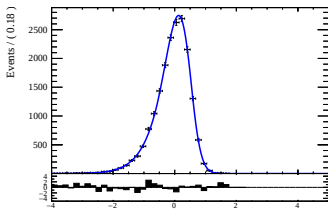
Before the fit

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



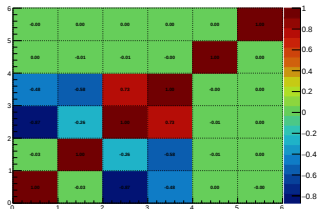
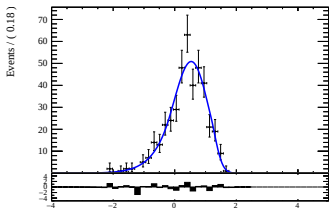
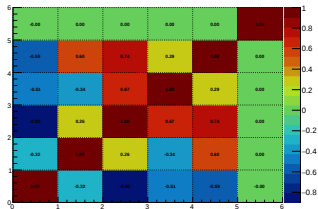
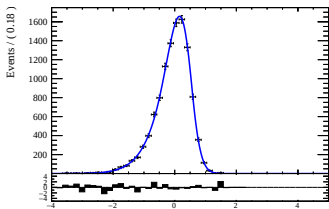
Fit with all parameters free

- Bin 0: (top) Prompt and parameter correlations and (bottom) secondary and parameter correlations (μ , σ , ξ , ρ_1 , ρ_2 , N_{sig})



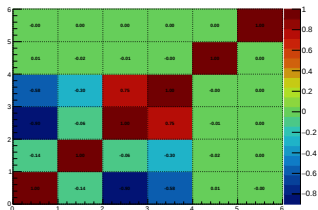
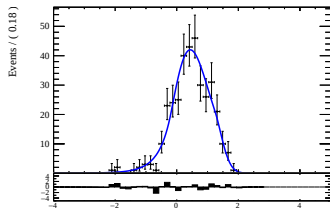
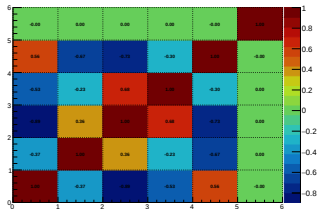
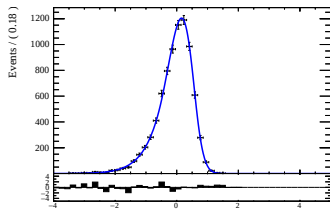
Fit with all parameters free

- Bin 1: (top) Prompt and parameter correlations and (bottom) secondary and parameter correlations (μ , σ , ξ , ρ_1 , ρ_2 , N_{sig})



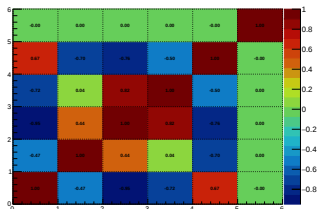
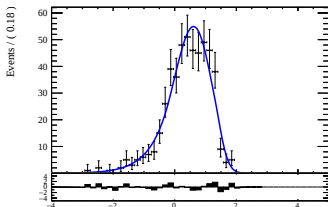
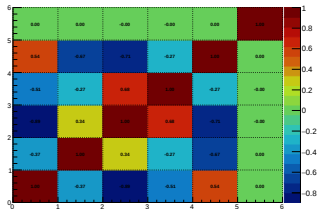
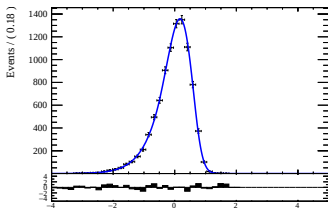
Fit with all parameters free

- Bin 2: (top) Prompt and parameter correlations and (bottom) secondary and parameter correlations (μ , σ , ξ , ρ_1 , ρ_2 , N_{sig})



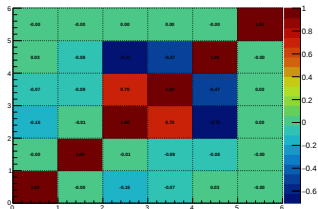
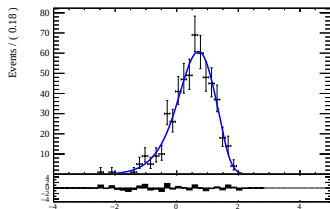
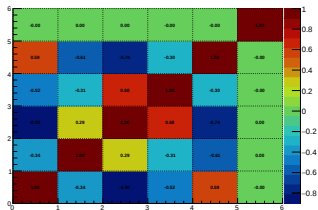
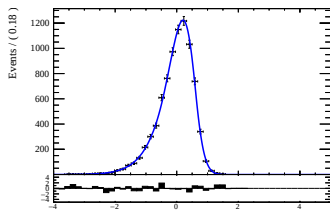
Fit with all parameters free

- Bin 3: (top) Prompt and parameter correlations and (bottom) secondary and parameter correlations (μ , σ , ξ , ρ_1 , ρ_2 , N_{sig})



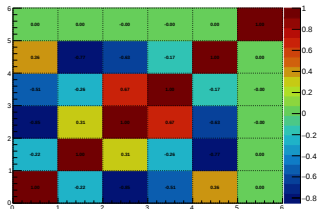
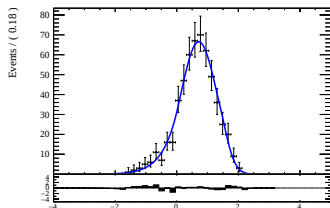
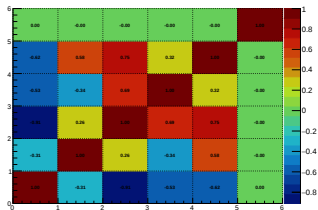
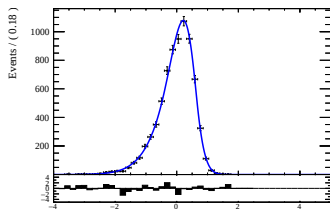
Fit with all parameters free

- Bin 4: (top) Prompt and parameter correlations and (bottom) secondary and parameter correlations (μ , σ , ξ , ρ_1 , ρ_2 , N_{sig})



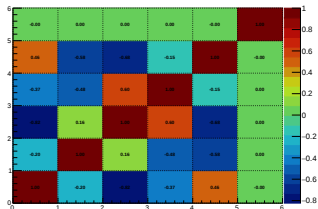
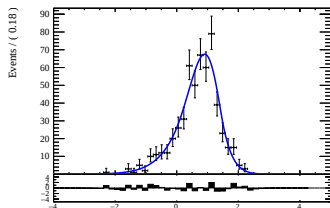
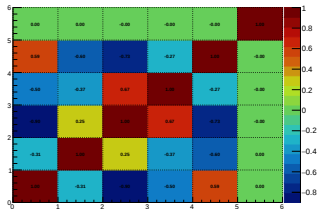
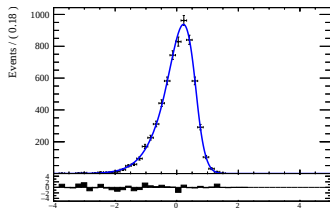
Fit with all parameters free

- Bin 5: (top) Prompt and parameter correlations and (bottom) secondary and parameter correlations (μ , σ , ξ , ρ_1 , ρ_2 , N_{sig})



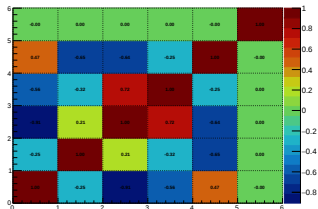
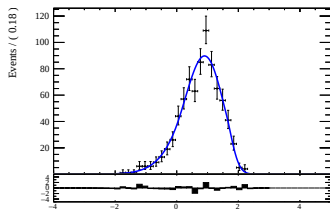
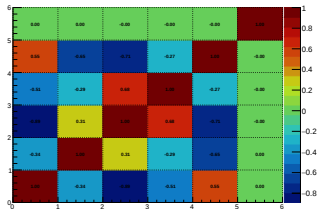
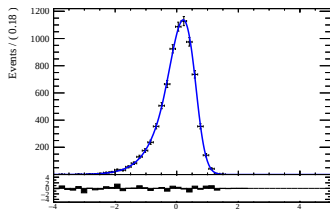
Fit with all parameters free

- Bin 6: (top) Prompt and parameter correlations and (bottom) secondary and parameter correlations (μ , σ , ξ , ρ_1 , ρ_2 , N_{sig})



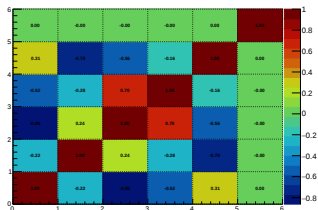
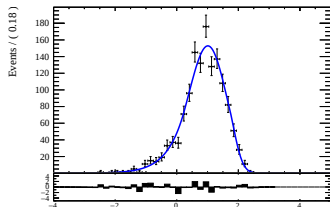
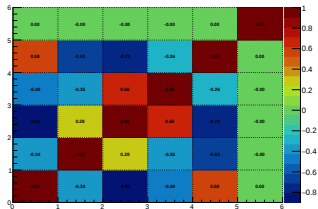
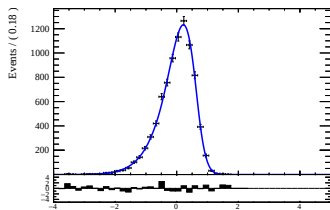
Fit with all parameters free

- Bin 7: (top) Prompt and parameter correlations and (bottom) secondary and parameter correlations (μ , σ , ξ , ρ_1 , ρ_2 , N_{sig})



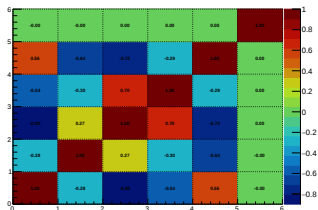
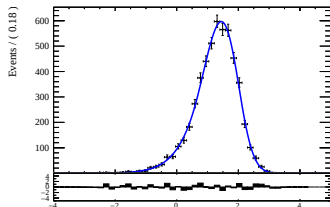
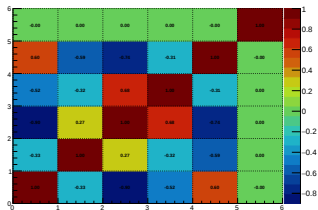
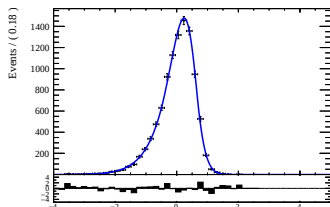
Fit with all parameters free

- Bin 8: (top) Prompt and parameter correlations and (bottom) secondary and parameter correlations (μ , σ , ξ , ρ_1 , ρ_2 , N_{sig})



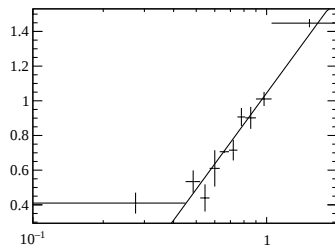
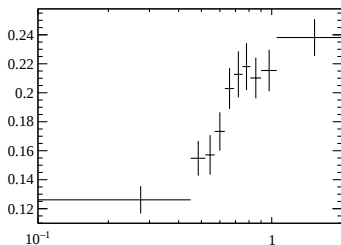
Fit with all parameters free

- Bin 9: (top) Prompt and parameter correlations and (bottom) secondary and parameter correlations (μ , σ , ξ , ρ_1 , ρ_2 , N_{sig})



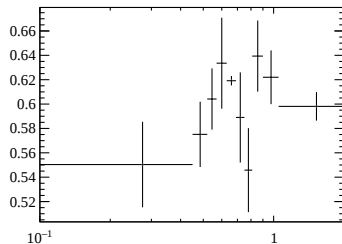
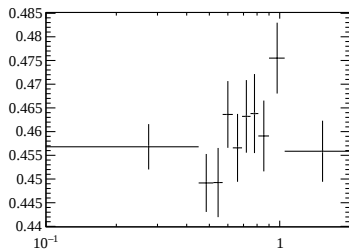
Fit results in decay-time bins

■ μ



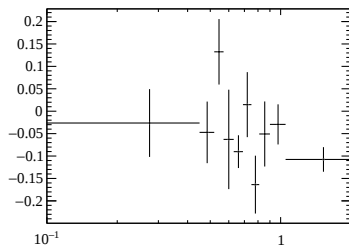
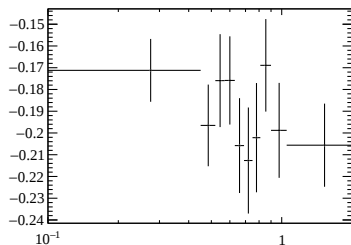
Fit results in decay-time bins

■ σ



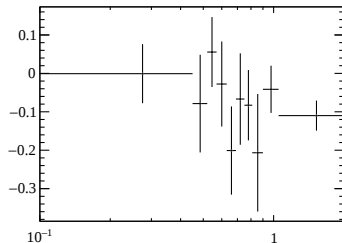
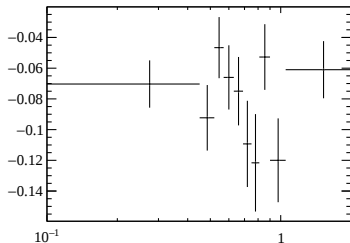
Fit results in decay-time bins

■ ξ



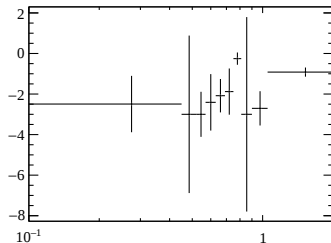
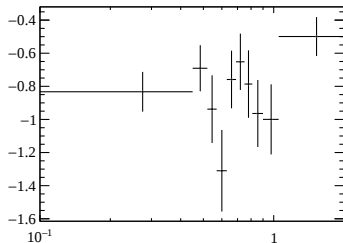
Fit results in decay-time bins

■ ρ_1



Fit results in decay-time bins

■ ρ_2



- Fit $x \equiv \text{logIPCHI2}$ 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 separated according to decay time

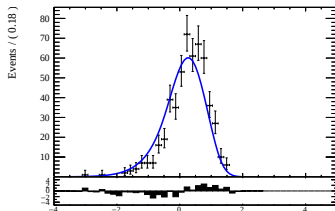
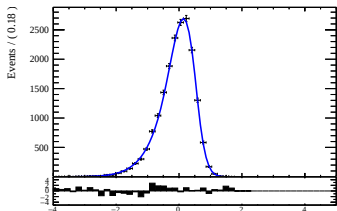
$$-\ln L = \sum_j \sum_i \ln \mathcal{P}(x_i, t_i; a, b, N, \sigma, \xi, \rho_1, \rho_2)$$

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

- Prompt: ERR MATRIX NOT POS-DEF
Secondary: STATUS=OK with good error matrix

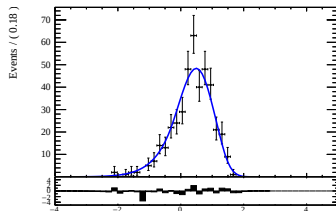
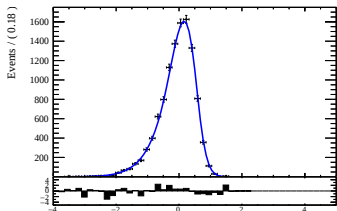
Simultaneous fit

- Bin 0: (left) Prompt and (right) secondary



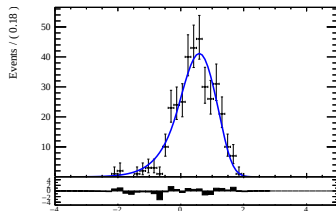
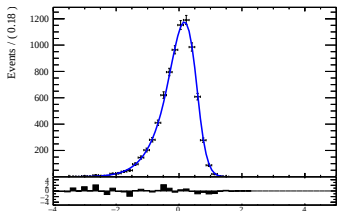
Simultaneous fit

- Bin 1: (left) Prompt and (right) secondary



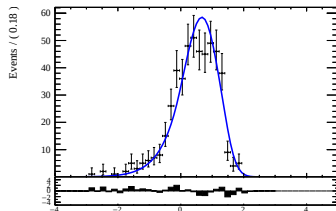
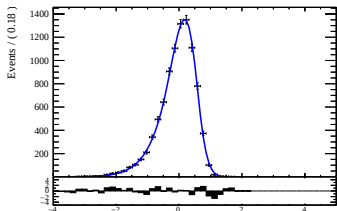
Simultaneous fit

- Bin 2: (left) Prompt and (right) secondary



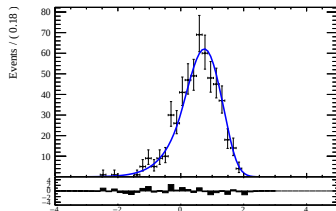
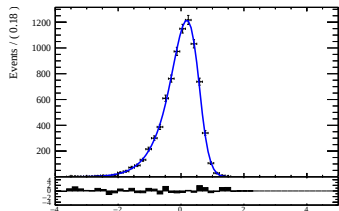
Simultaneous fit

- Bin 3: (left) Prompt and (right) secondary

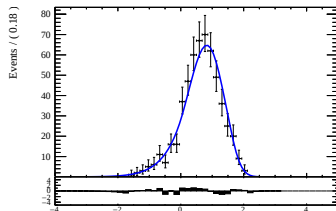
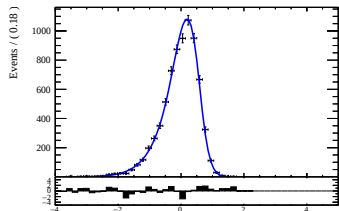


Simultaneous fit

- Bin 4: (left) Prompt and (right) secondary

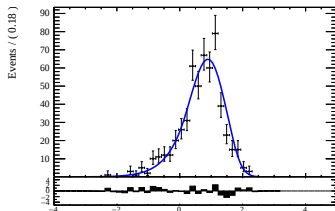
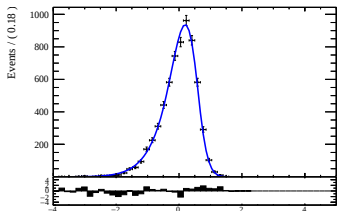


- Bin 5: (left) Prompt and (right) secondary



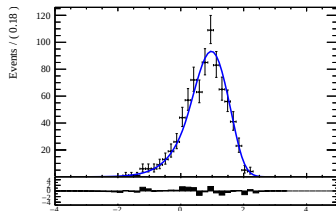
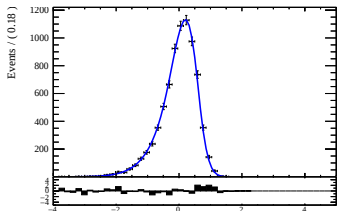
Simultaneous fit

- Bin 6: (left) Prompt and (right) secondary



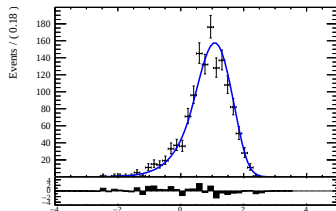
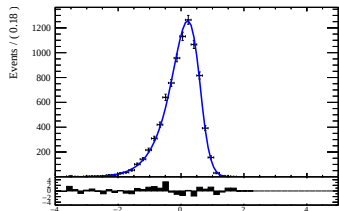
Simultaneous fit

- Bin 7: (left) Prompt and (right) secondary



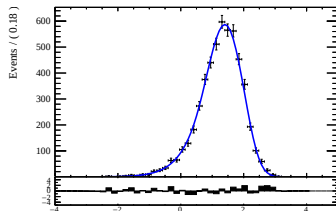
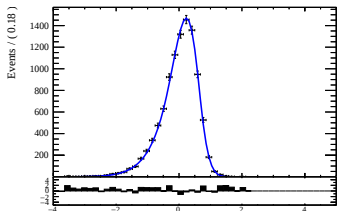
Simultaneous fit

- Bin 8: (left) Prompt and (right) secondary



Simultaneous fit

- Bin 9: (left) Prompt and (right) secondary



- Tried to fit the combined (prompt+secondary) logIPCHI2 with all parameters free
- Failed when b-fraction very small ($< 10\%$)
- Need to fix some parameters

- Finish the sanity check
- Validate the model with D^0 decay mode
- Fit the real data of signal mode