Further studies on IPCHI2 fit

Ao Xu

Tsinghua University

Ω_c^0 *lifetime measurement meeting*

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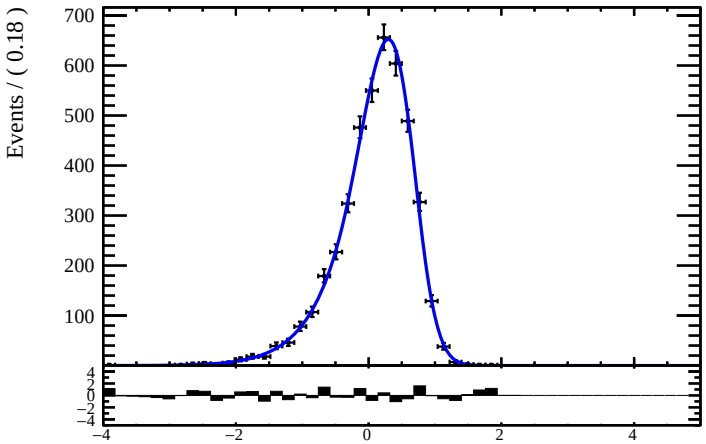
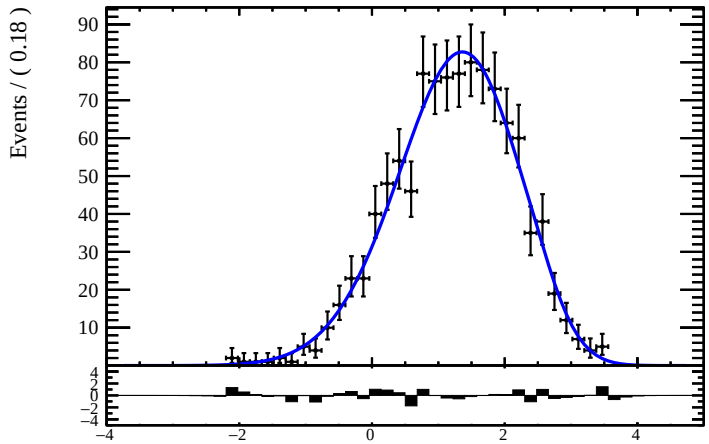
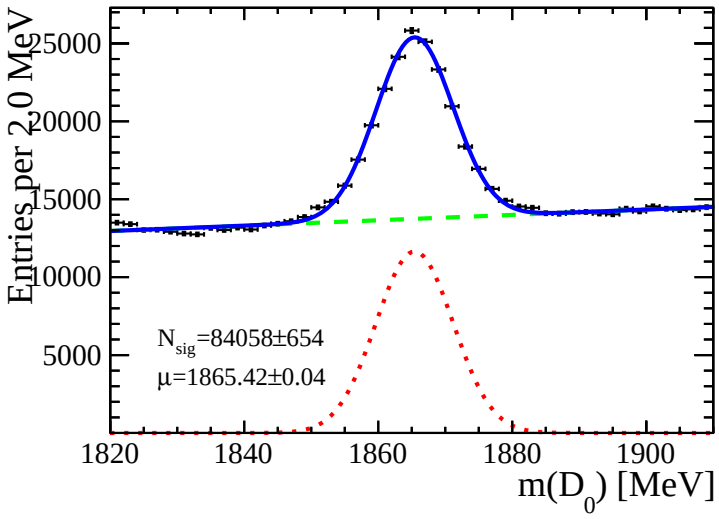
Cut-based selections

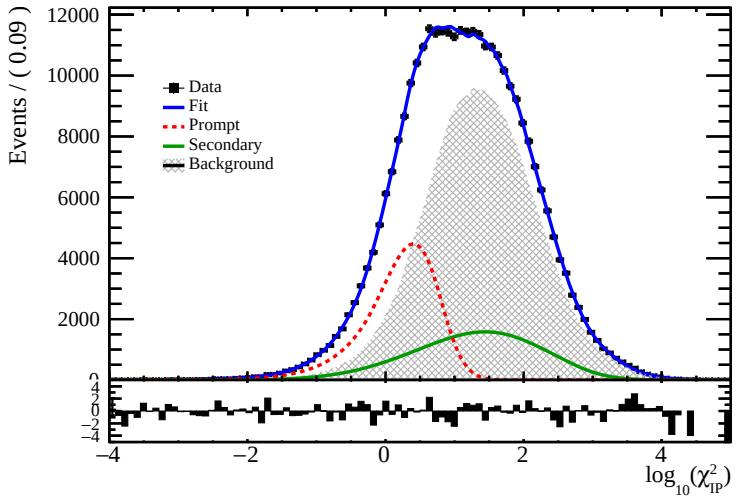
- Keep the lifetime-related cuts to be the same as Ω_c
  - `DIRA > cos(0.01), daughters' IPCHI2 > 4, max IPCHI2 > 8`
- Fit to MC: Prompt component (left) and secondary component (right)





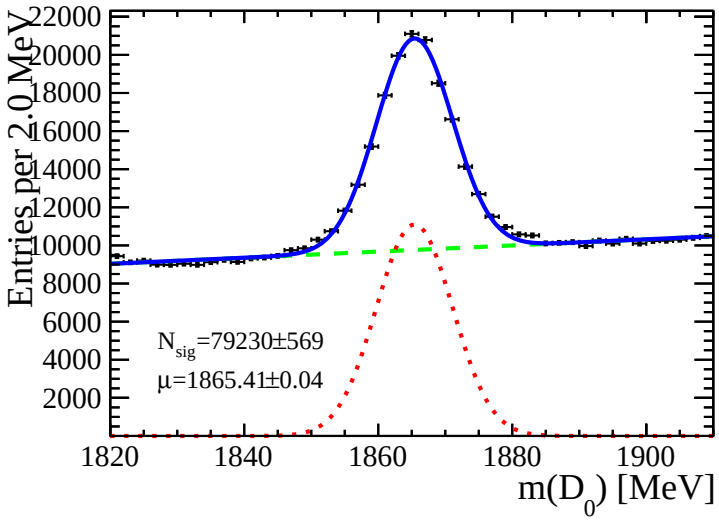
Fit results: bin 0

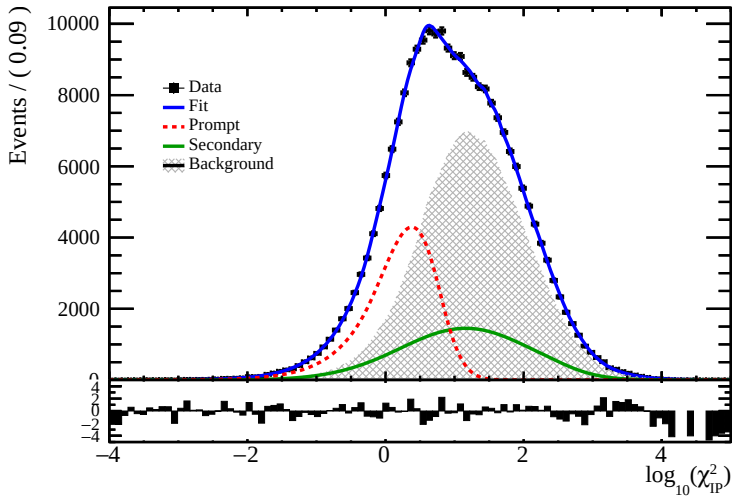




		MC	config 1	config 2
Prompt	μ	0.30 ± 0.02	0.40 ± 0.01	0.40
	σ	0.45 ± 0.01	0.43 ± 0.00	0.45
	ξ	-0.16 ± 0.03	-0.18 ± 0.01	-0.16
	ρ_1	-0.05 ± 0.03	-0.12 ± 0.04	-0.05
	ρ_2	-0.91 ± 0.25	-0.81 ± 0.17	-0.91
Secondary	μ	1.36 ± 0.09	1.33 ± 0.02	1.44 ± 0.04
	σ	0.93 ± 0.04	1.01 ± 0.04	0.95 ± 0.01
	ξ	-0.04 ± 0.08	-0.08 ± 0.02	-0.07 ± 0.02
	ρ_1	-0.52 ± 0.26	-0.42 ± 0.14	-0.62 ± 0.17
	ρ_2	-1.58 ± 0.78	-1.48 ± 0.18	-1.48 ± 0.14

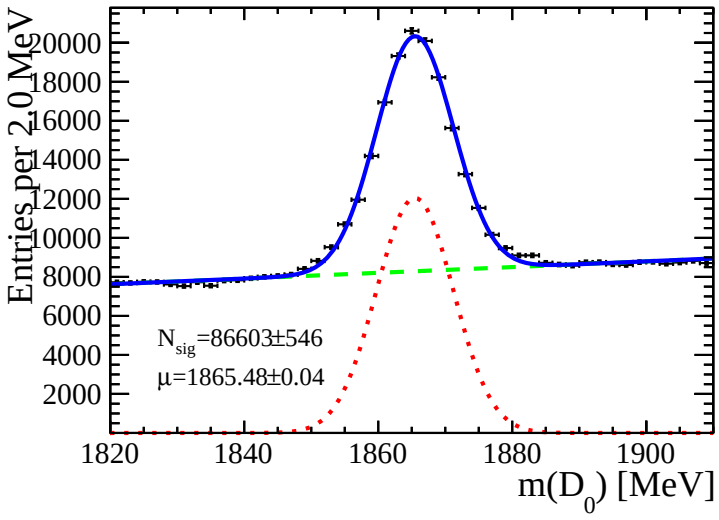
Fit results: bin 1

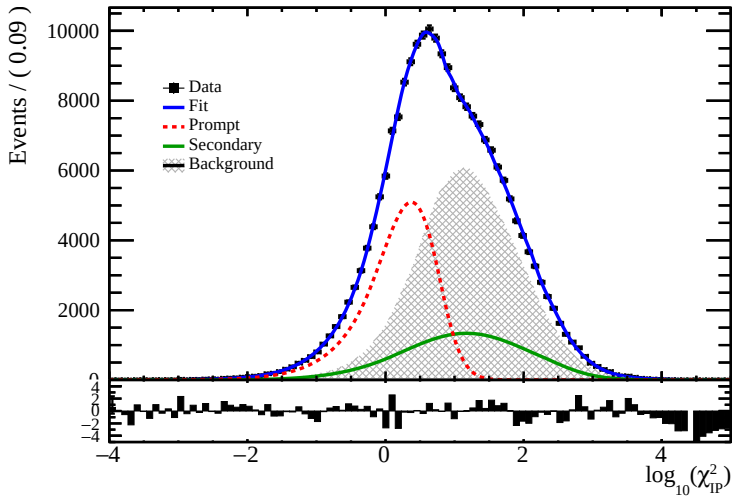




		MC	config 1	config 2
Prompt	μ	0.30 ± 0.02	0.38 ± 0.01	0.38
	σ	0.45 ± 0.01	0.44 ± 0.01	0.45
	ξ	-0.16 ± 0.03	-0.12 ± 0.01	-0.16
	ρ_1	-0.05 ± 0.03	-0.15 ± 0.03	-0.05
	ρ_2	-0.91 ± 0.25	-1.01 ± 0.17	-0.91
Secondary	μ	1.36 ± 0.09	1.16 ± 0.02	1.16 ± 0.01
	σ	0.93 ± 0.04	1.06 ± 0.01	0.95 ± 0.01
	ξ	-0.04 ± 0.08	-0.09 ± 0.01	-0.01 ± 0.00
	ρ_1	-0.52 ± 0.26	-0.62 ± 0.14	-0.59 ± 0.06
	ρ_2	-1.58 ± 0.78	-1.48 ± 0.15	-1.49 ± 0.18

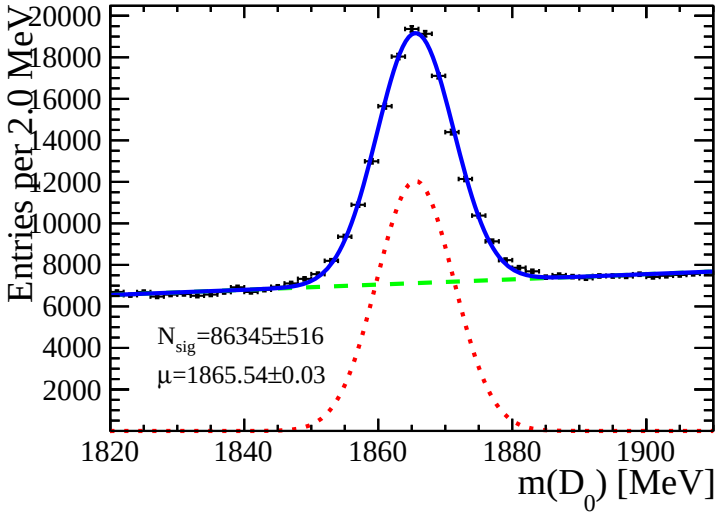
Fit results: bin 2

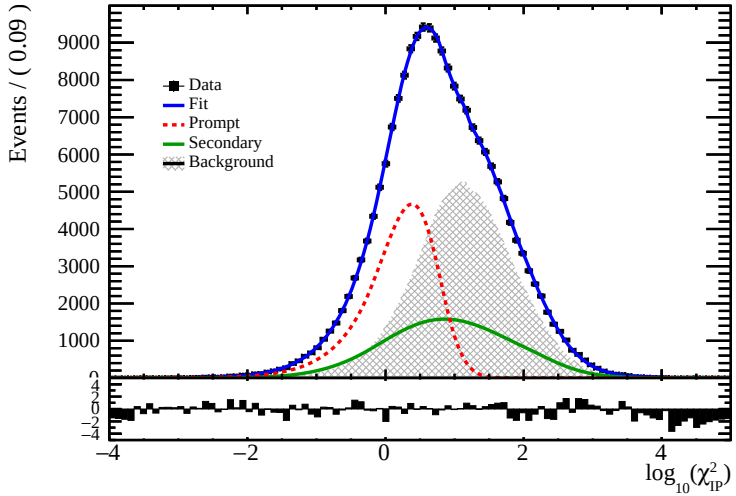




		MC	config 1	config 2
Prompt	μ	0.30 ± 0.02	0.37 ± 0.01	0.37
	σ	0.45 ± 0.01	0.44 ± 0.01	0.45
	ξ	-0.16 ± 0.03	-0.16 ± 0.02	-0.16
	ρ_1	-0.05 ± 0.03	-0.11 ± 0.00	-0.05
	ρ_2	-0.91 ± 0.25	-0.83 ± 0.13	-0.91
Secondary	μ	1.36 ± 0.09	1.11 ± 0.01	1.17 ± 0.03
	σ	0.93 ± 0.04	1.08 ± 0.01	0.93 ± 0.01
	ξ	-0.04 ± 0.08	-0.06 ± 0.01	0.00 ± 0.00
	ρ_1	-0.52 ± 0.26	-0.42 ± 0.02	-0.42 ± 0.03
	ρ_2	-1.58 ± 0.78	-1.68 ± 0.12	-1.53 ± 0.11

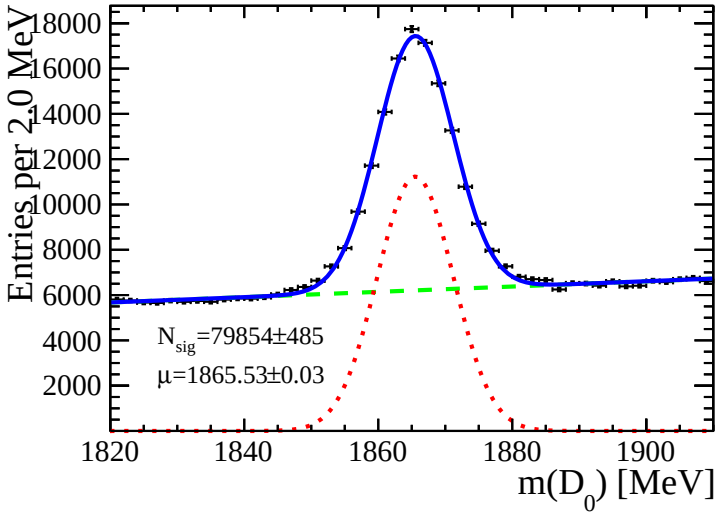
Fit results: bin 3

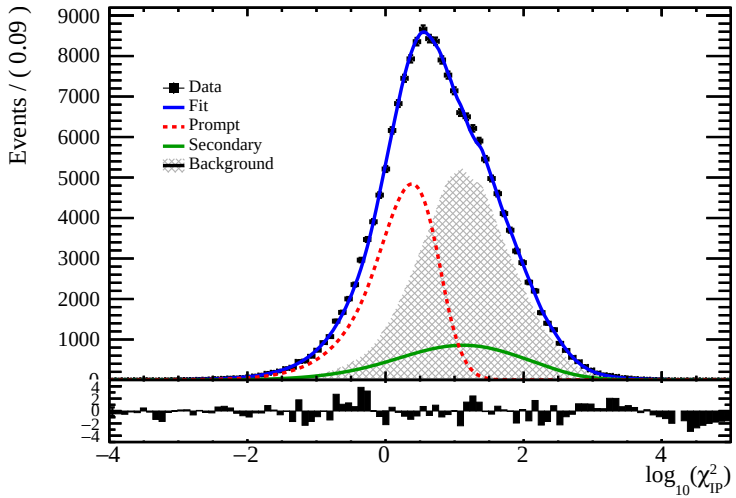




		MC	config 1	config 2
Prompt	μ	0.30 ± 0.02	0.38 ± 0.01	0.38
	σ	0.45 ± 0.01	0.47 ± 0.01	0.45
	ξ	-0.16 ± 0.03	-0.14 ± 0.01	-0.16
	ρ_1	-0.05 ± 0.03	-0.13 ± 0.13	-0.05
	ρ_2	-0.91 ± 0.25	-0.81 ± 0.04	-0.91
Secondary	μ	1.36 ± 0.09	1.16 ± 0.01	0.86 ± 0.04
	σ	0.93 ± 0.04	1.03 ± 0.04	0.96 ± 0.01
	ξ	-0.04 ± 0.08	-0.07 ± 0.03	0.06 ± 0.01
	ρ_1	-0.52 ± 0.26	-0.42 ± 0.18	-0.56 ± 0.06
	ρ_2	-1.58 ± 0.78	-1.68 ± 0.19	-1.48 ± 0.13

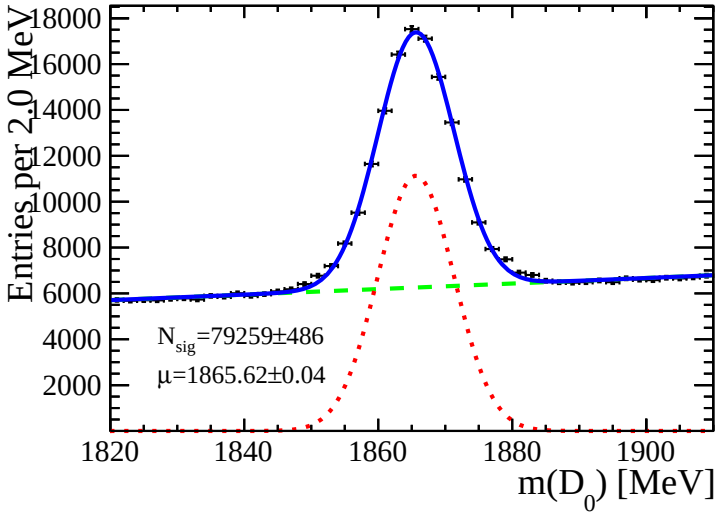
Fit results: bin 4

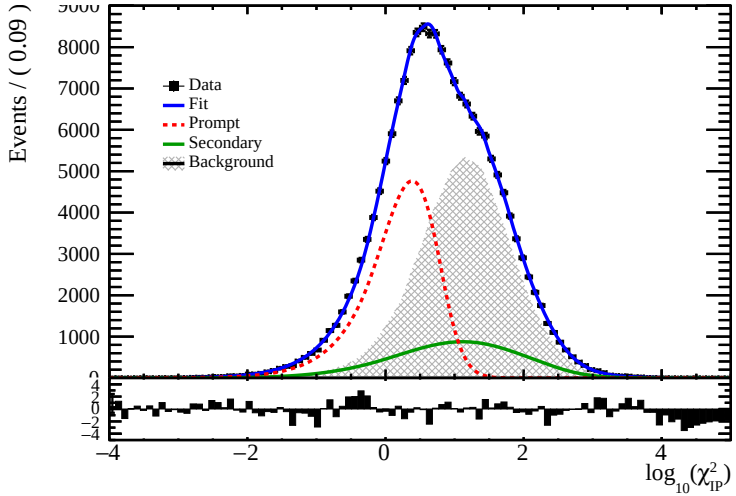




		MC	config 1	config 2
Prompt	μ	0.30 ± 0.02	0.38 ± 0.00	0.38
	σ	0.45 ± 0.01	0.45 ± 0.00	0.45
	ξ	-0.16 ± 0.03	-0.17 ± 0.00	-0.16
	ρ_1	-0.05 ± 0.03	-0.15 ± 0.00	-0.05
	ρ_2	-0.91 ± 0.25	-0.81 ± 0.01	-0.91
Secondary	μ	1.36 ± 0.09	1.05 ± 0.00	1.12 ± 0.05
	σ	0.93 ± 0.04	1.04 ± 0.00	0.94 ± 0.03
	ξ	-0.04 ± 0.08	-0.07 ± 0.00	-0.04 ± 0.02
	ρ_1	-0.52 ± 0.26	-0.42 ± 0.00	-0.45 ± 0.04
	ρ_2	-1.58 ± 0.78	-1.48 ± 0.14	-1.51 ± 0.15

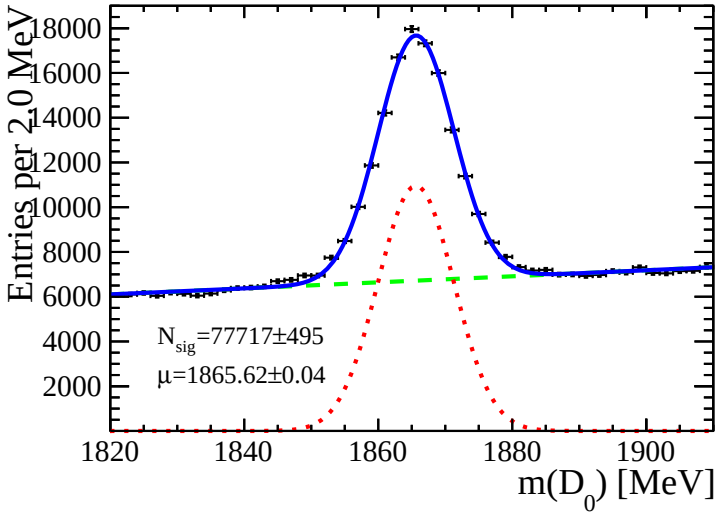
Fit results: bin 5

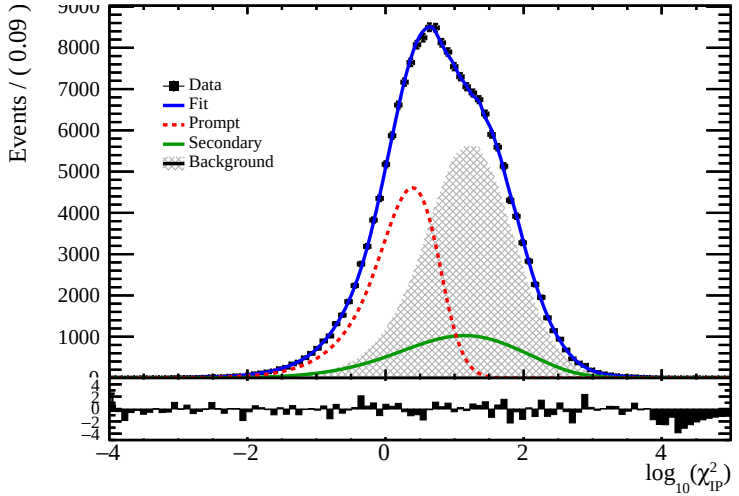




		MC	config 1	config 2
Prompt	μ	0.30 ± 0.02	0.39 ± 0.01	0.39
	σ	0.45 ± 0.01	0.44 ± 0.01	0.45
	ξ	-0.16 ± 0.03	-0.14 ± 0.01	-0.16
	ρ_1	-0.05 ± 0.03	-0.15 ± 0.01	-0.05
	ρ_2	-0.91 ± 0.25	-1.01 ± 0.15	-0.91
Secondary	μ	1.36 ± 0.09	0.87 ± 0.12	1.12 ± 0.00
	σ	0.93 ± 0.04	1.03 ± 0.01	0.94 ± 0.01
	ξ	-0.04 ± 0.08	-0.03 ± 0.04	-0.04 ± 0.00
	ρ_1	-0.52 ± 0.26	-0.42 ± 0.12	-0.42 ± 0.20
	ρ_2	-1.58 ± 0.78	-1.48 ± 0.15	-1.48 ± 0.00

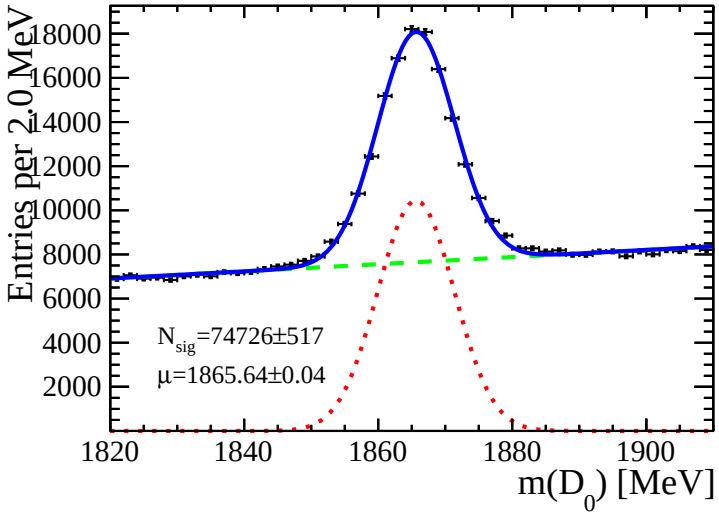
Fit results: bin 6

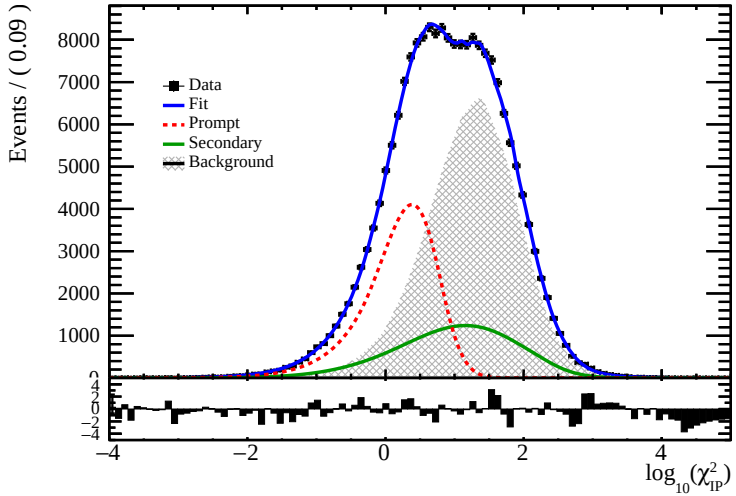




		MC	config 1	config 2
Prompt	μ	0.30 ± 0.02	0.39 ± 0.00	0.39
	σ	0.45 ± 0.01	0.46 ± 0.00	0.45
	ξ	-0.16 ± 0.03	-0.14 ± 0.00	-0.16
	ρ_1	-0.05 ± 0.03	-0.12 ± 0.00	-0.05
	ρ_2	-0.91 ± 0.25	-1.01 ± 0.00	-0.91
Secondary	μ	1.36 ± 0.09	1.09 ± 0.00	1.14 ± 0.12
	σ	0.93 ± 0.04	1.01 ± 0.00	0.91 ± 0.04
	ξ	-0.04 ± 0.08	-0.09 ± 0.01	-0.06 ± 0.02
	ρ_1	-0.52 ± 0.26	-0.43 ± 0.15	-0.43 ± 0.01
	ρ_2	-1.58 ± 0.78	-1.68 ± 0.00	-1.56 ± 0.03

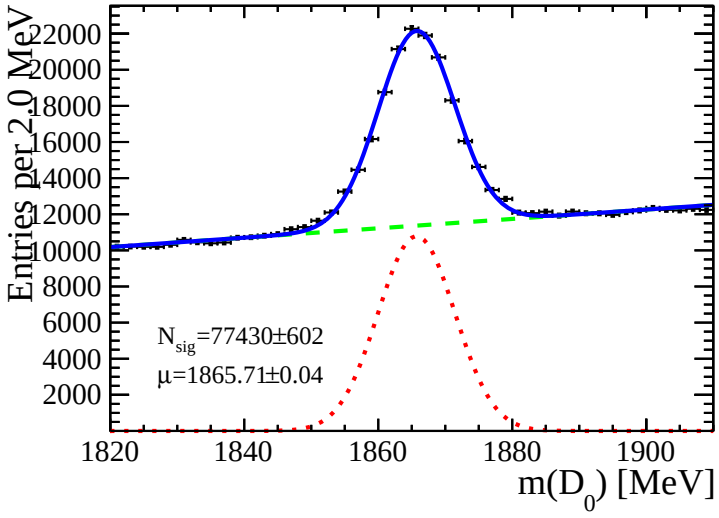
Fit results: bin 7

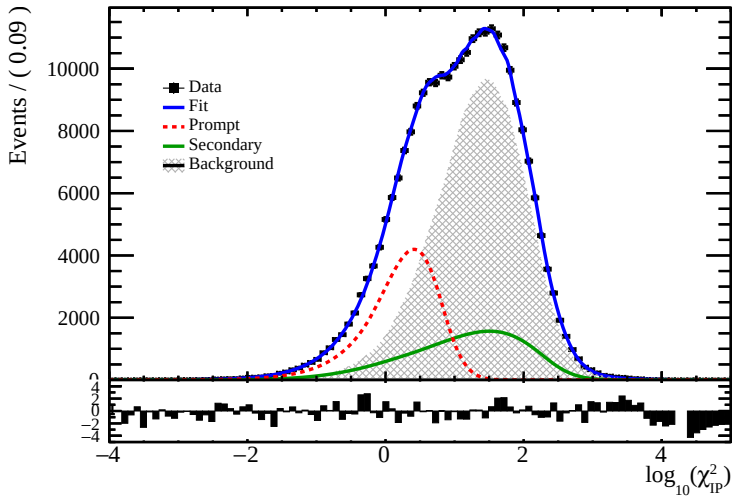




		MC	config 1	config 2
Prompt	μ	0.30 ± 0.02	0.38 ± 0.01	0.38
	σ	0.45 ± 0.01	0.42 ± 0.01	0.45
	ξ	-0.16 ± 0.03	-0.14 ± 0.02	-0.16
	ρ_1	-0.05 ± 0.03	-0.15 ± 0.01	-0.05
	ρ_2	-0.91 ± 0.25	-1.01 ± 0.18	-0.91
Secondary	μ	1.36 ± 0.09	0.97 ± 0.02	1.16 ± 0.06
	σ	0.93 ± 0.04	0.97 ± 0.04	0.88 ± 0.02
	ξ	-0.04 ± 0.08	-0.09 ± 0.03	-0.07 ± 0.08
	ρ_1	-0.52 ± 0.26	-0.61 ± 0.18	-0.42 ± 0.00
	ρ_2	-1.58 ± 0.78	-1.48 ± 0.15	-1.63 ± 0.11

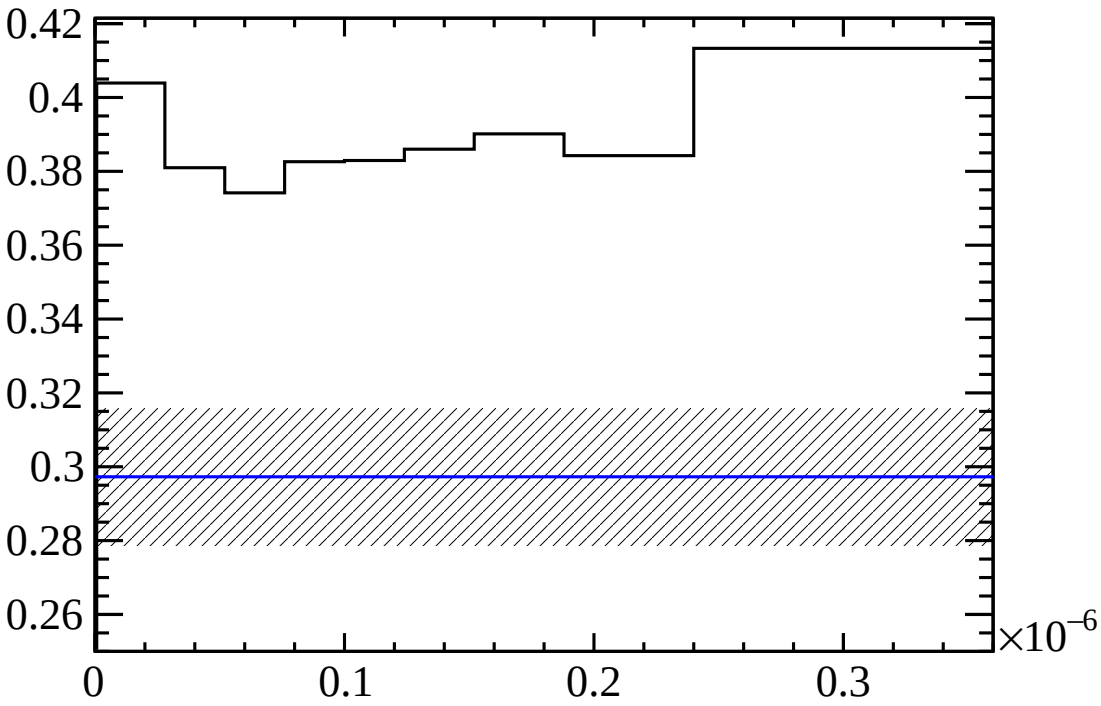
Fit results: bin 8



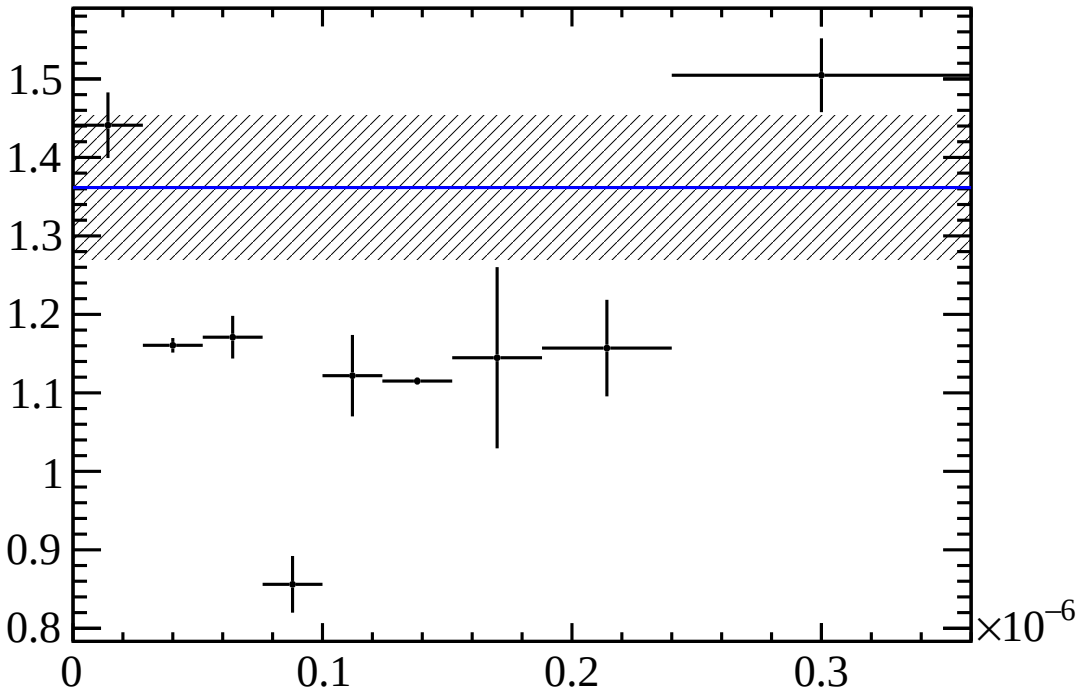


		MC	config 1	config 2
Prompt	μ	0.30 ± 0.02	0.41 ± 0.01	0.41
	σ	0.45 ± 0.01	0.43 ± 0.01	0.45
	ξ	-0.16 ± 0.03	-0.17 ± 0.02	-0.16
	ρ_1	-0.05 ± 0.03	-0.15 ± 0.14	-0.05
	ρ_2	-0.91 ± 0.25	-1.01 ± 0.14	-0.91
Secondary	μ	1.36 ± 0.09	1.41 ± 0.01	1.50 ± 0.05
	σ	0.93 ± 0.04	0.93 ± 0.02	0.85 ± 0.01
	ξ	-0.04 ± 0.08	-0.25 ± 0.01	-0.23 ± 0.03
	ρ_1	-0.52 ± 0.26	-0.62 ± 0.20	-0.62 ± 0.03
	ρ_2	-1.58 ± 0.78	-1.48 ± 0.13	-1.53 ± 0.17

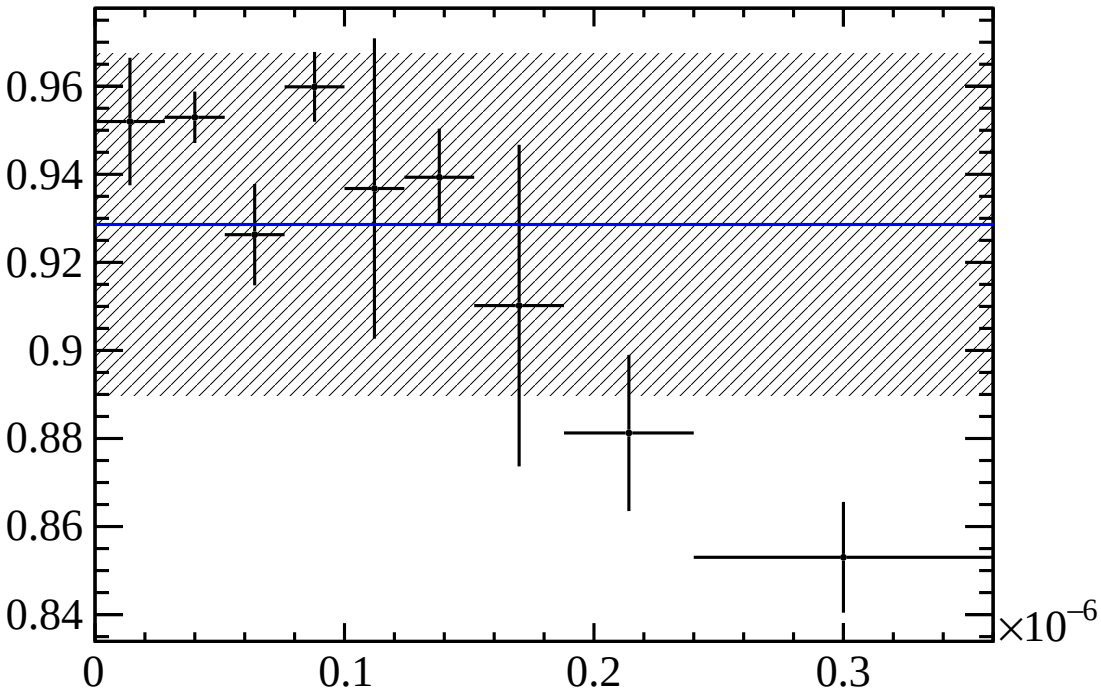
Fit results: prompt μ



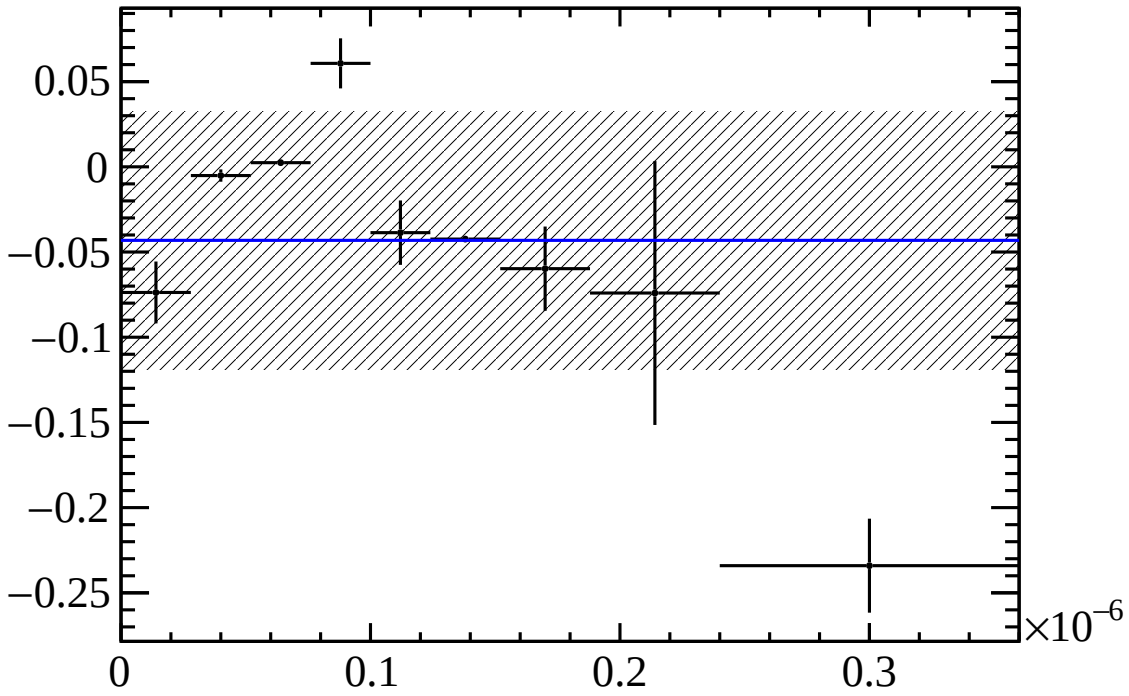
Fit results: secondary μ



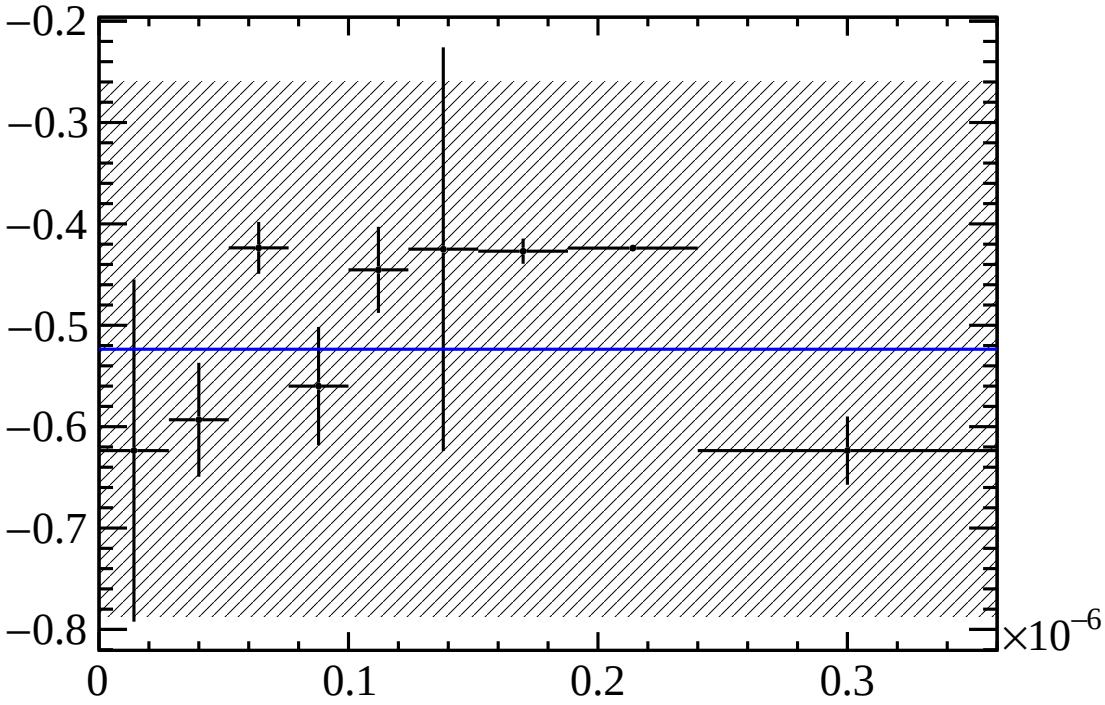
Fit results: secondary σ



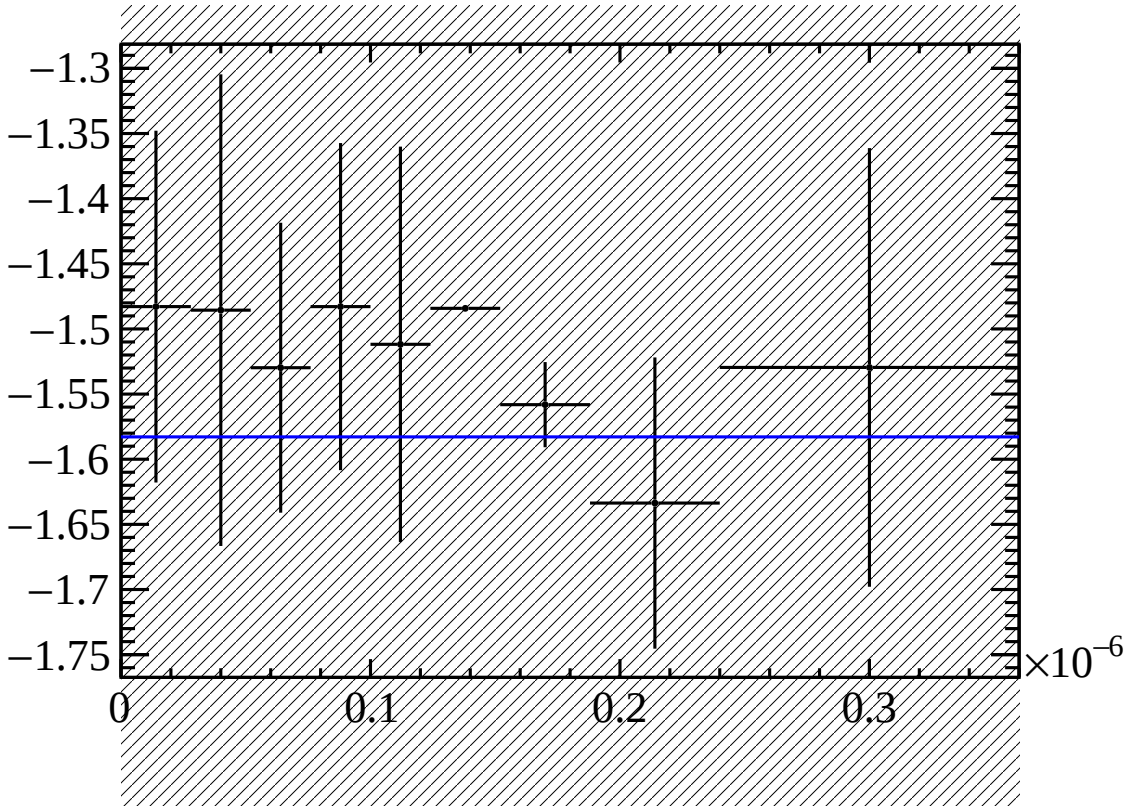
Fit results: secondary ξ



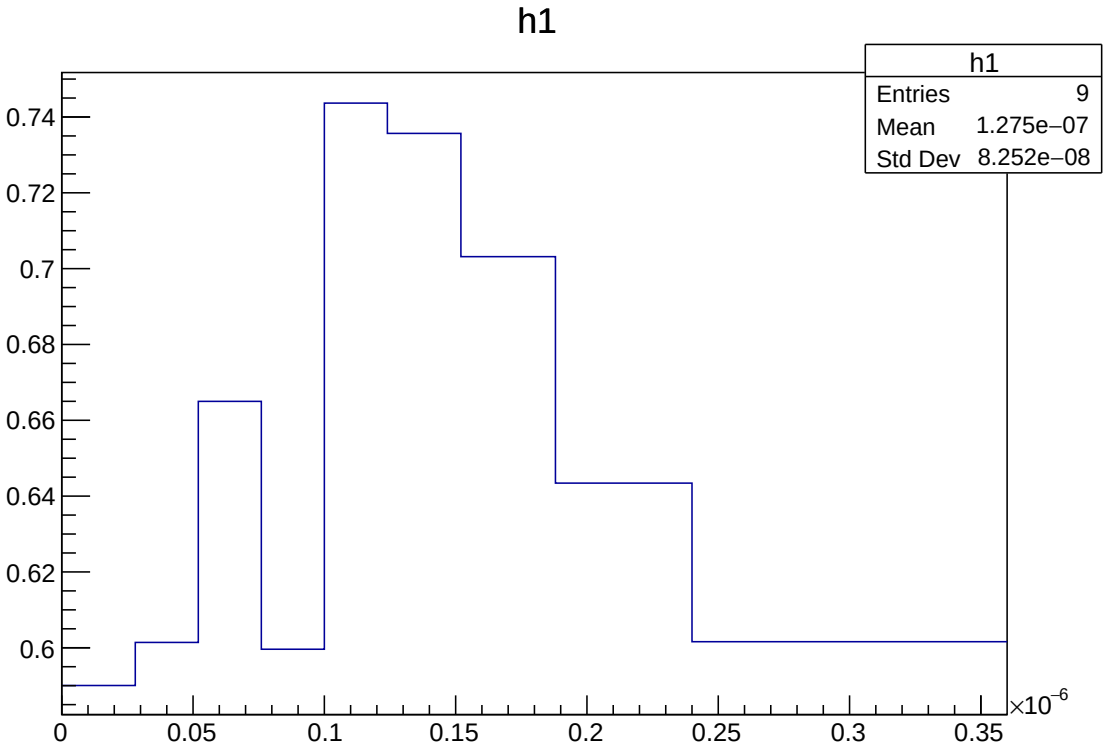
Fit results: secondary ρ_1



Fit results: secondary ρ_2



Fit results: prompt fraction



Backup

$\log \chi^2_{IP}$ modelling

- Bukin function, a modified Novosibirsk function with extended tail parameters

$$\mathcal{P}(x;\mu,\sigma,\xi,\rho_1,\rho_2) = \begin{cases} \exp\left\{ \dfrac{(x-x_1)\xi\sqrt{\xi^2+1}\sqrt{2\ln 2}}{\sigma\left(\sqrt{\xi^2+1}-\xi\right)^2 \ln\left(\sqrt{\xi^2+1}+\xi\right)} + \rho_1\left(\dfrac{x-x_1}{\mu-x_1}\right)^2 - \ln 2 \right\} & x \le x_1, \\ \exp\left\{ -\left[\dfrac{\ln\left(1+2\xi\sqrt{\xi^2+1}\dfrac{x-\mu}{\sigma\sqrt{2\ln 2}}\right)}{\ln\left(1+2\xi^2-2\xi\sqrt{\xi^2+1}\right)}\right]^2 \times \ln 2 \right\} & x_1 < x < x_2, \\ \exp\left\{ \dfrac{(x-x_2)\xi\sqrt{\xi^2+1}\sqrt{2\ln 2}}{\sigma\left(\sqrt{\xi^2+1}-\xi\right)^2 \ln\left(\sqrt{\xi^2+1}+\xi\right)} + \rho_2\left(\dfrac{x-x_2}{\mu-x_2}\right)^2 - \ln 2 \right\} & x \ge x_2. \end{cases}$$

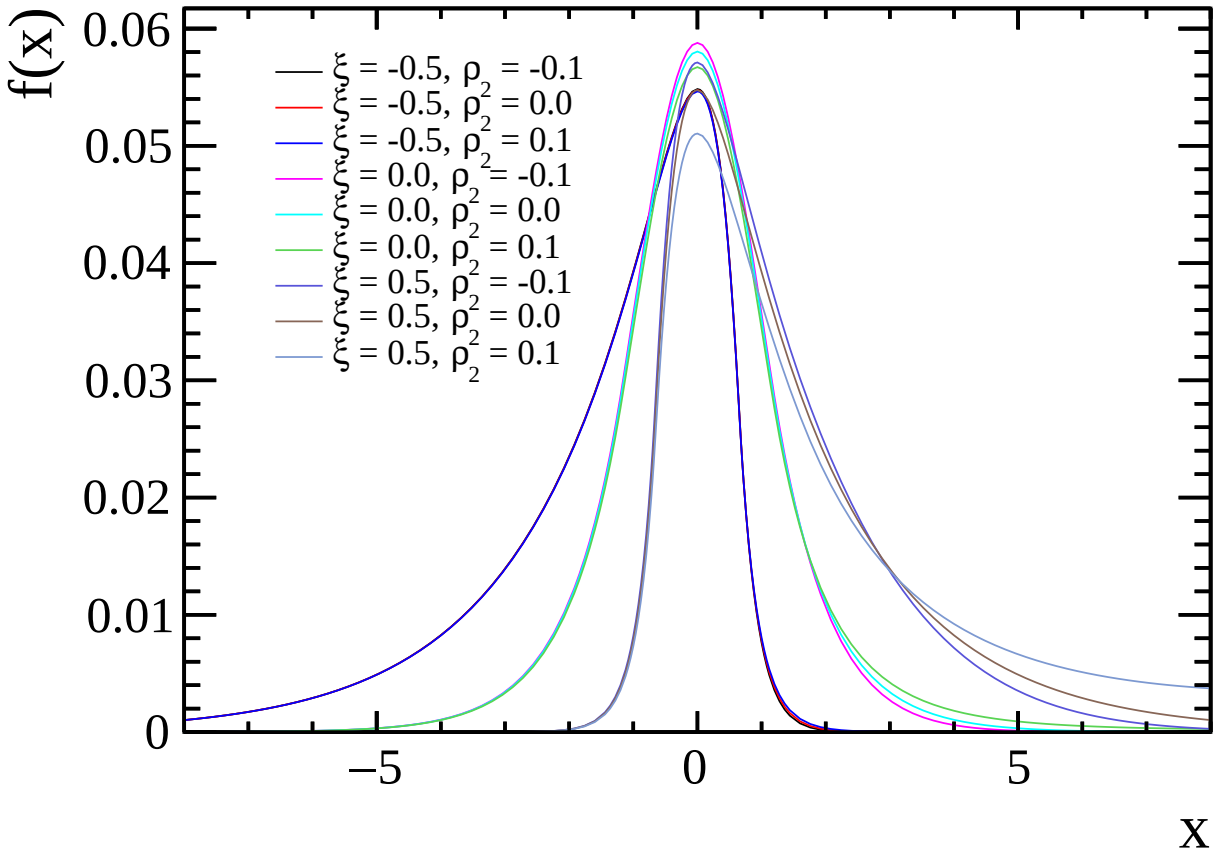
where

$$x_1 = \mu + \sigma\sqrt{2\ln 2}\left(\frac{\xi}{\sqrt{\xi^2+1}} - 1\right)$$

$$x_2 = \mu + \sigma\sqrt{2\ln 2}\left(\frac{\xi}{\sqrt{\xi^2+1}} + 1\right)$$

Illustration of Bukin functions

- Influence of asymetry and tail parameters with $\mu = 0, \sigma = 1, \rho_1 = 0$



Next to-do

- Cross check fit projections
  - Check whether the combined prompt and secondary log(IPCHI2) pdf is a good description of the overall yields of D^0 as a function of log(IPCHI2)
  - Split sample into bins of log(IPCHI2) and perform the mass fit
- Test the statistical precision and probe possible biases
  - Generate samples according to the fitted mass and log(IPCHI2) shapes for prompt, secondary and combinatorial components