Further studies on the IPCHI2 fit

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Ω_c^0 *lifetime measurement meeting*

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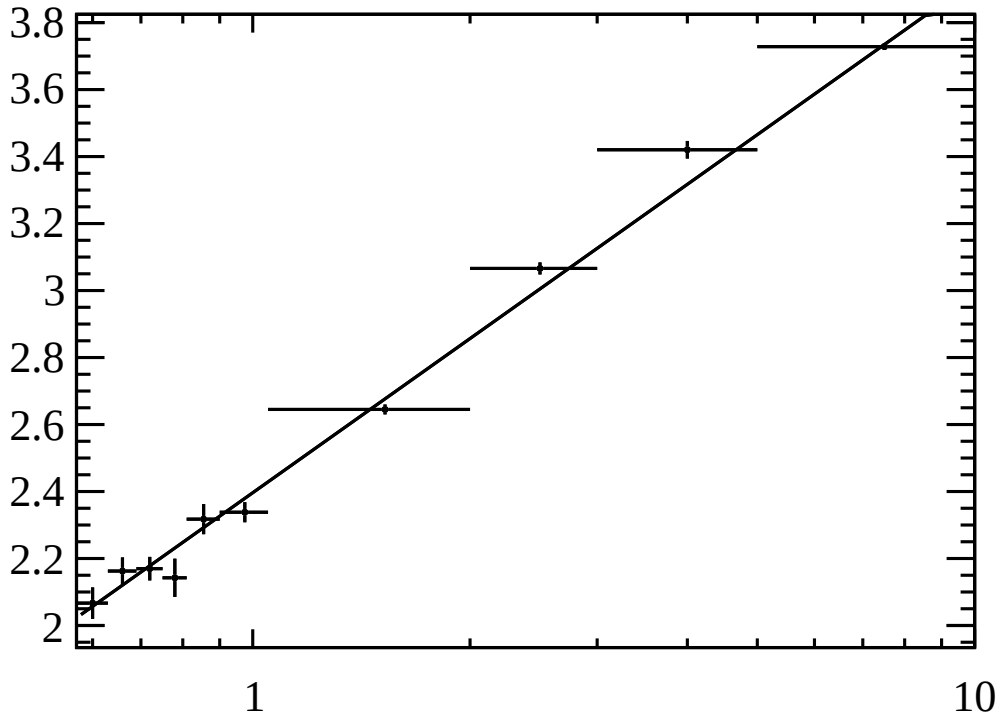
μ in different decay-time bins for D^0 decay mode

- Model with $\mu(t) = a\ln(t) + b$



Fit procedure

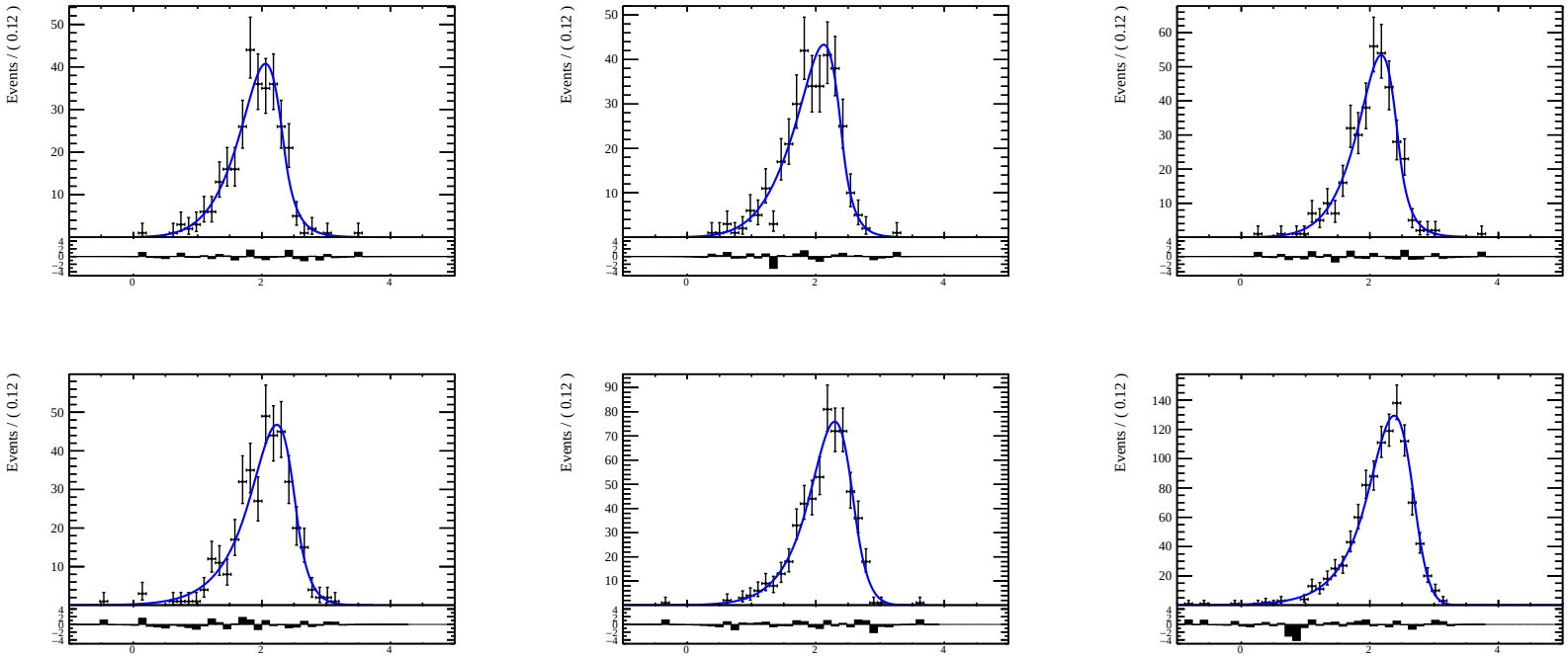
- Fit logIPCHI2 x with decay-time t as conditional variable

$$\mathcal{P}(x) = f(x|t) \times g(t)$$

  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
- Model1: a and b fixed to values from the fit to $\mu(t)$ of nominal fits
- Model2: a and b float in different decay-time bins

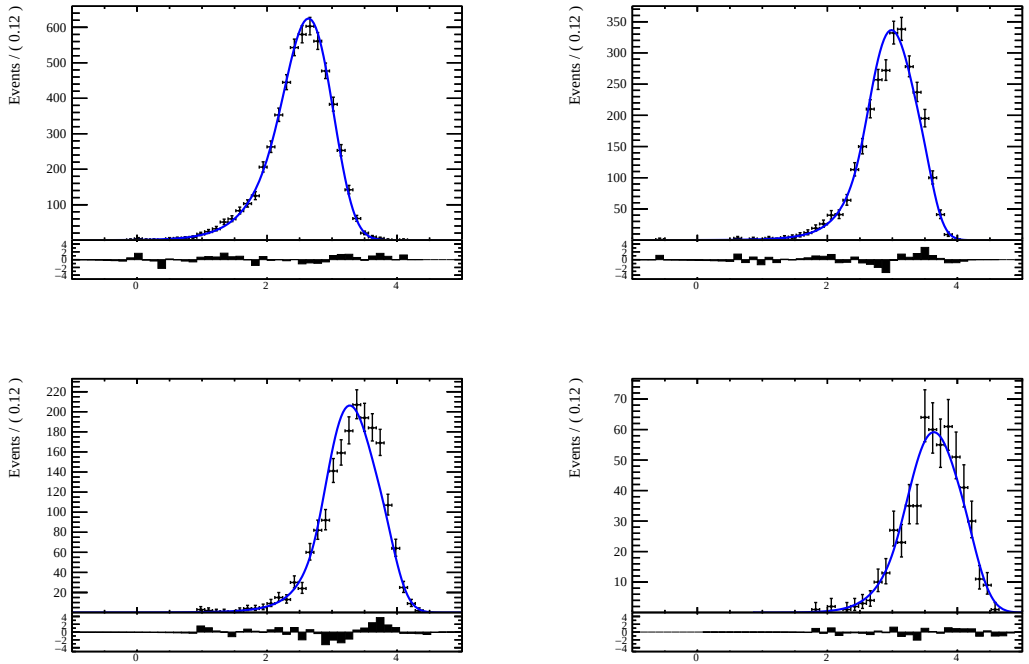
Fit with fixed a and b

- Projection on logIPCHI2: bin 0 to 5



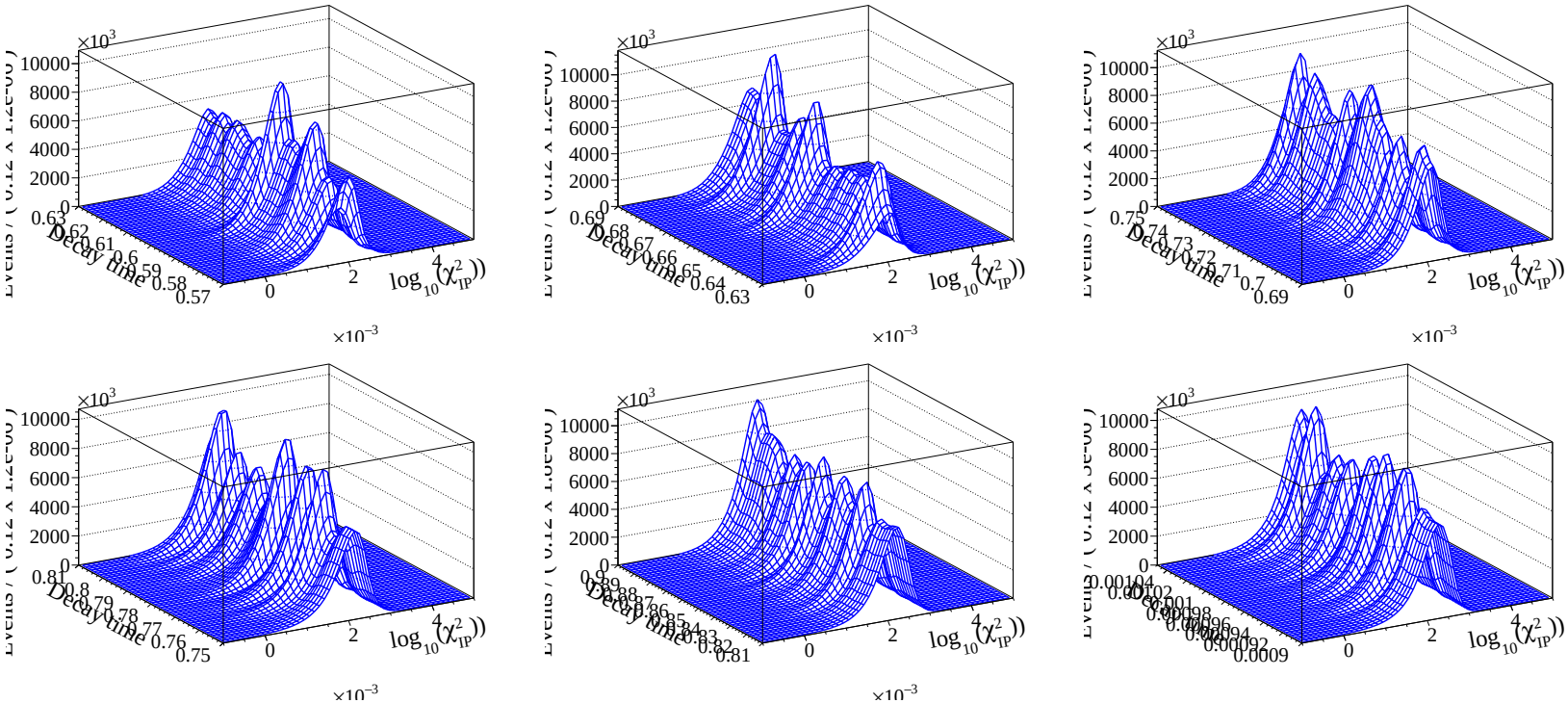
Fit with fixed a and b

- Projection on logIPCHI2: bin 6 to 9



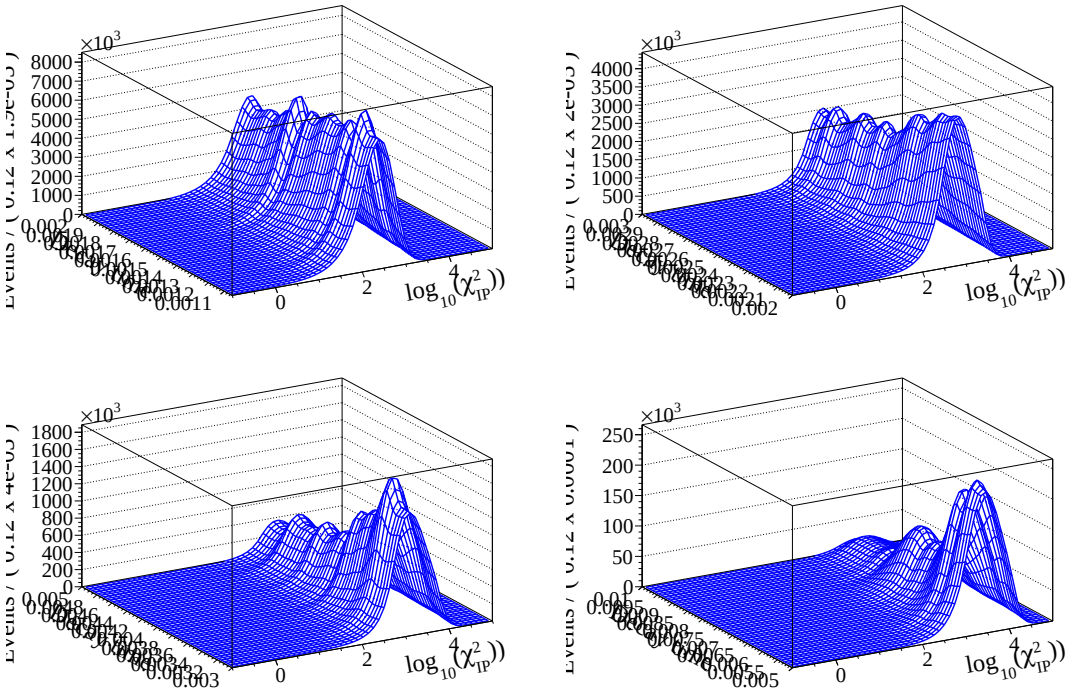
Fit with fixed a and b

- 2D view: bin 0 to 5



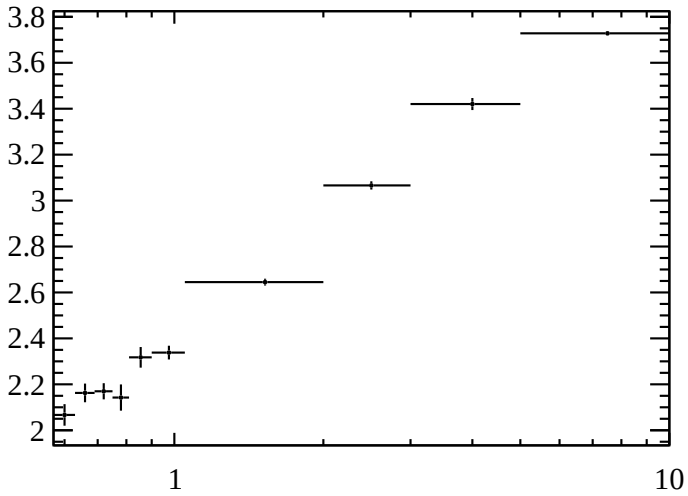
Fit with fixed a and b

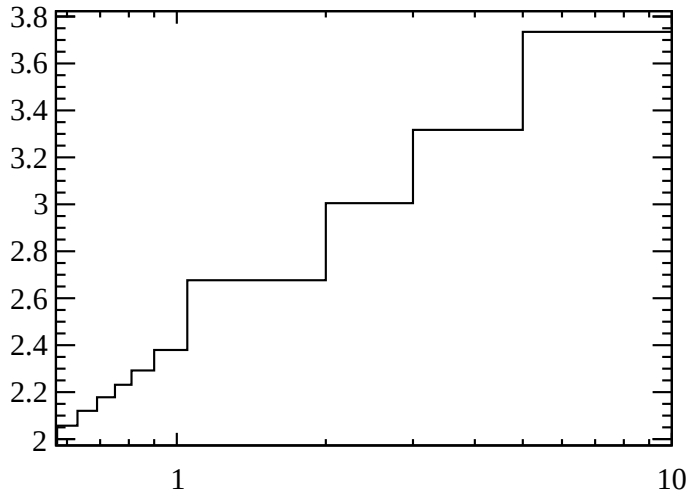
- 2D view: bin 6 to 9



Fit with fixed a and b

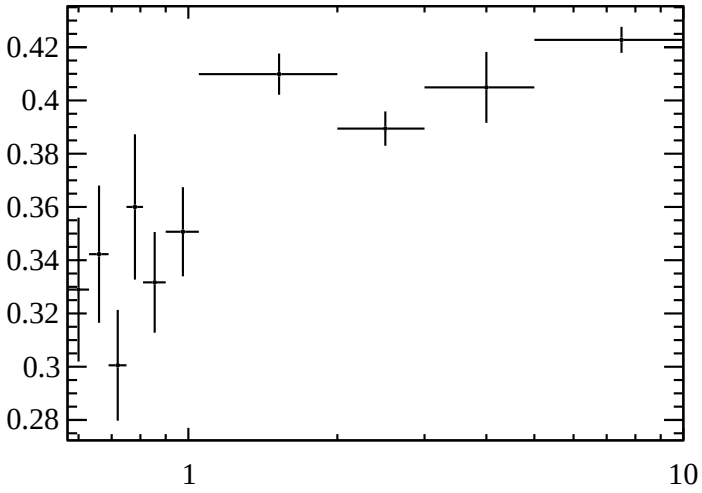
- $\mu(t)$: (left) nominal fit vs. (right) conditional fit

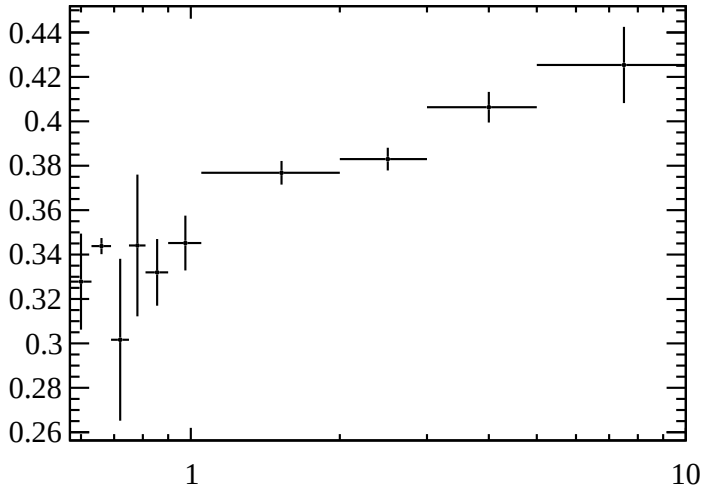




Fit with fixed a and b

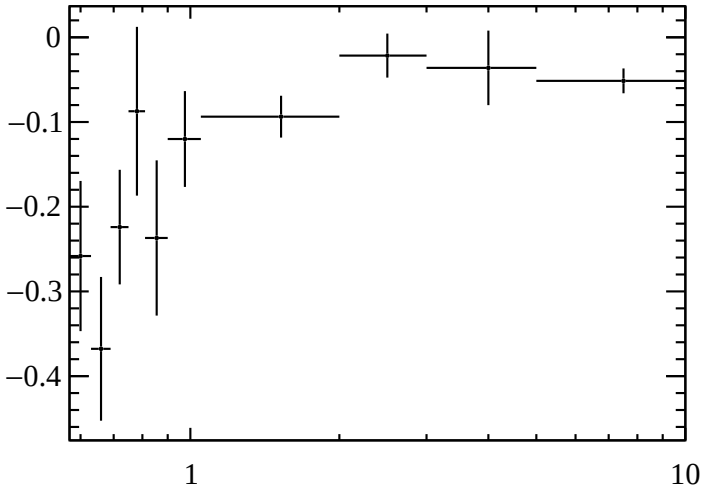
- $\sigma(t)$: (left) nominal fit vs. (right) conditional fit

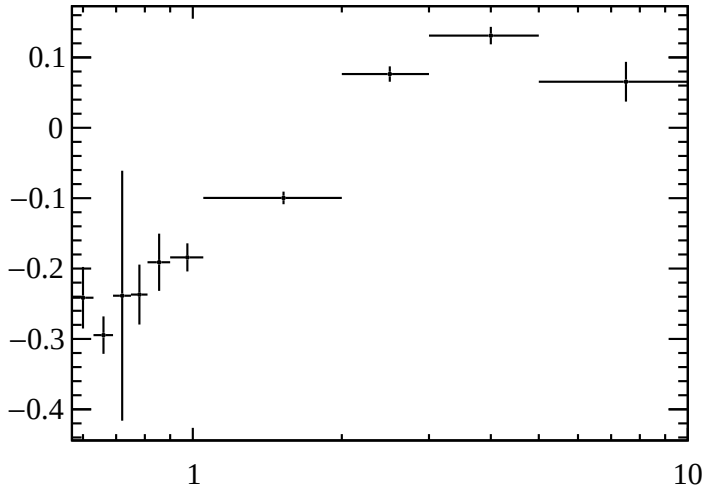




Fit with fixed a and b

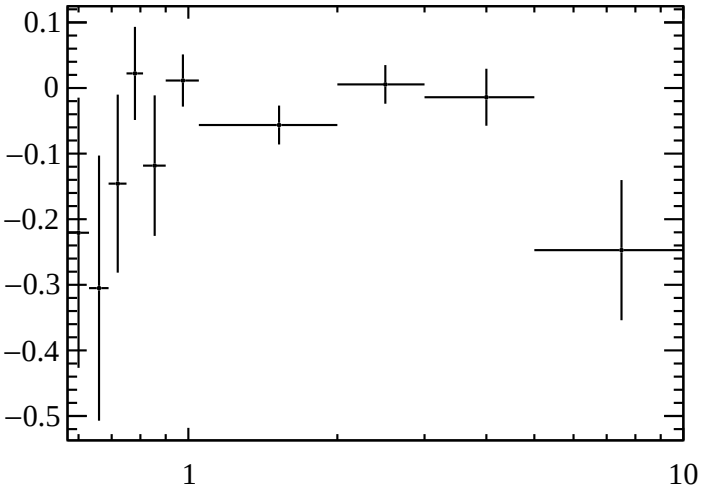
- $\xi(t)$: (left) nominal fit vs. (right) conditional fit

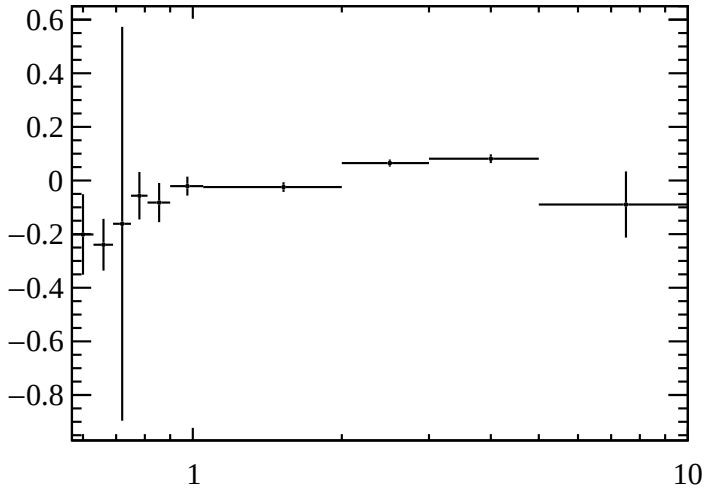




Fit with fixed a and b

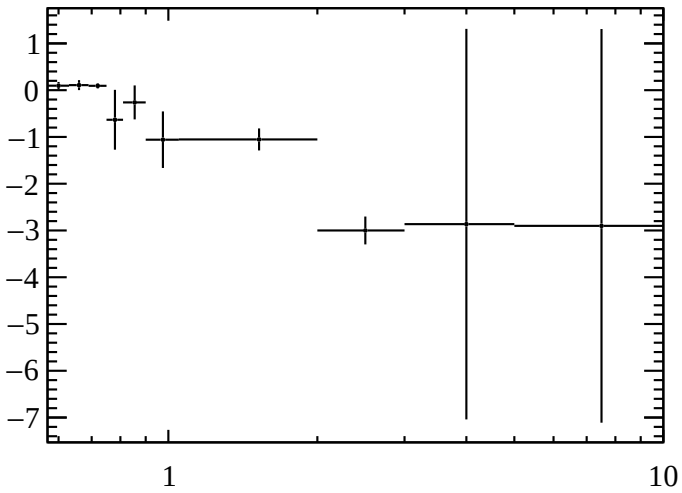
- $\rho_1(t)$: (left) nominal fit vs. (right) conditional fit

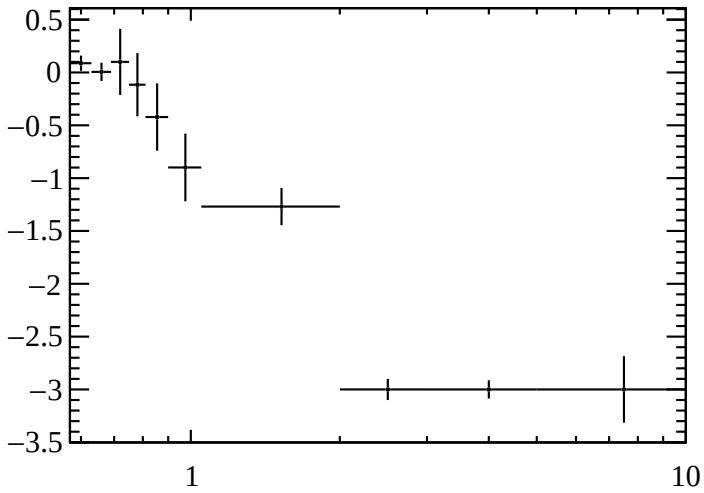




Fit with fixed a and b

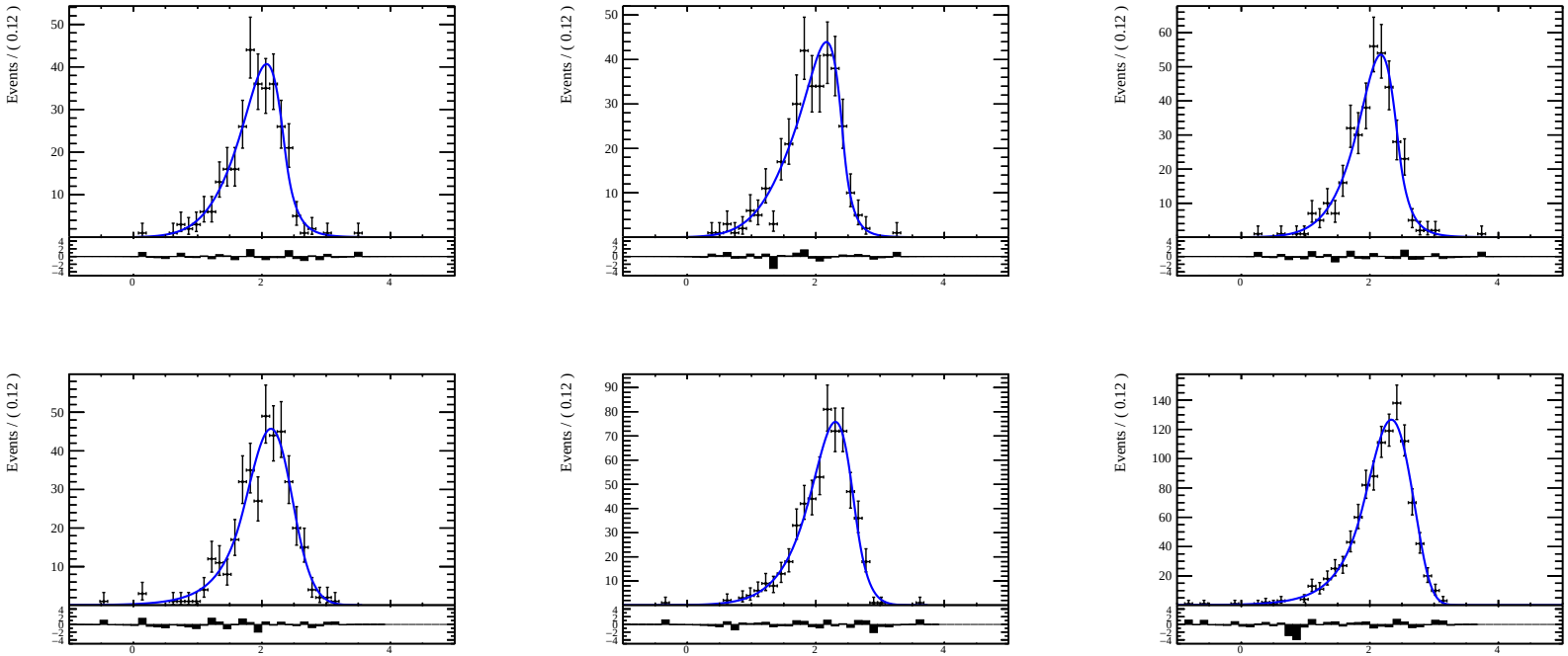
- $\rho_2(t)$: (left) nominal fit vs. (right) conditional fit





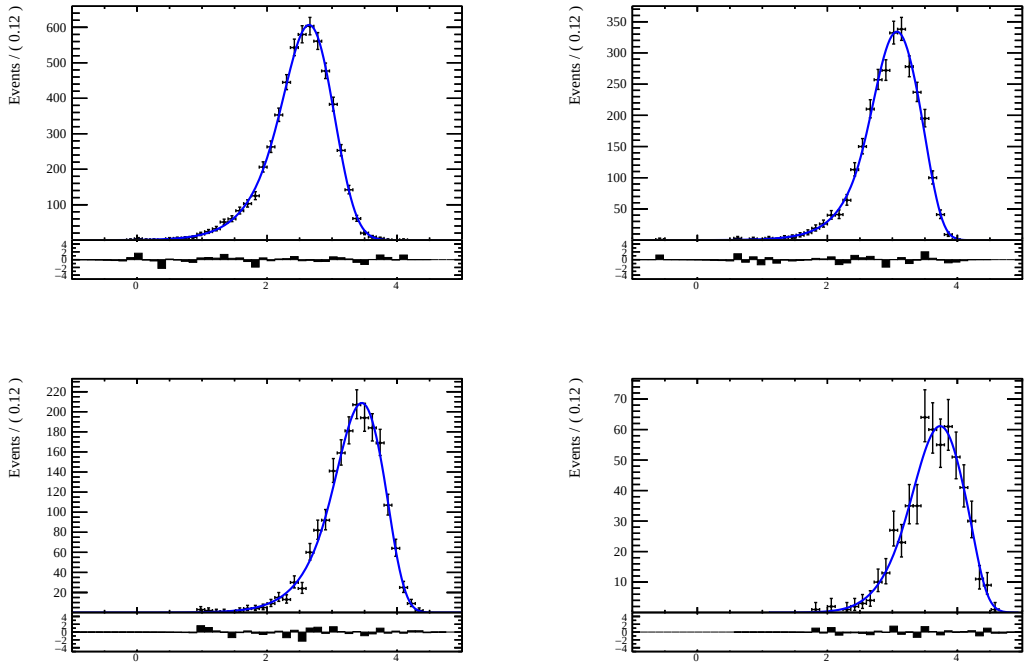
Fit with float a and b

- Projection on logIPCHI2: bin 0 to 5



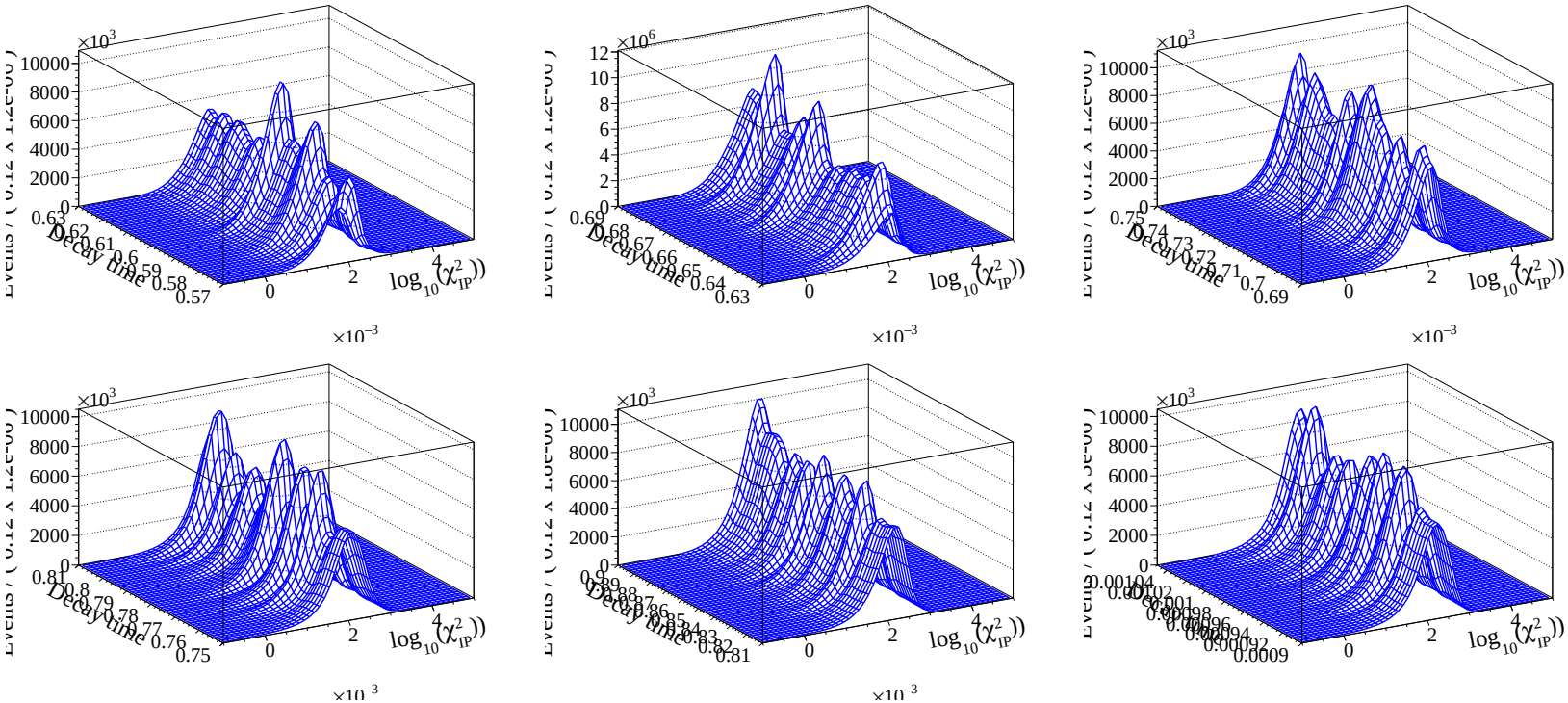
Fit with float a and b

- Projection on logIPCHI2: bin 6 to 9



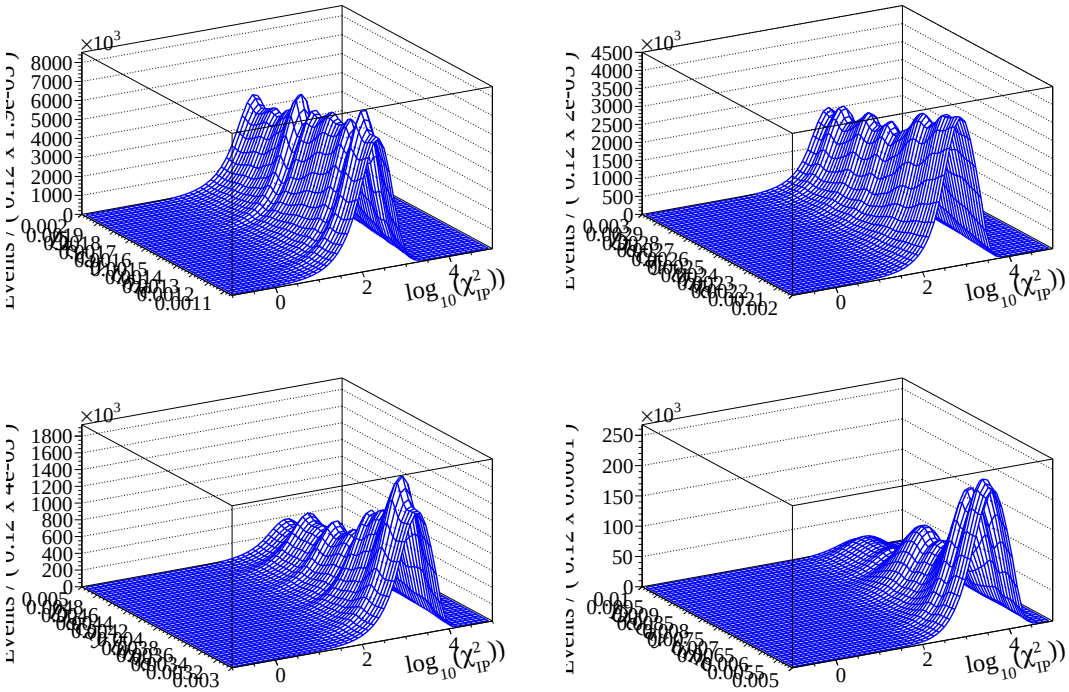
Fit with float a and b

- 2D view: bin 0 to 5



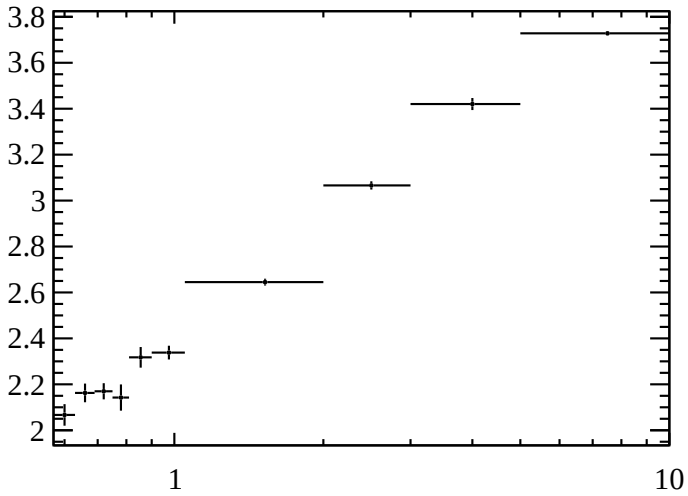
Fit with float a and b

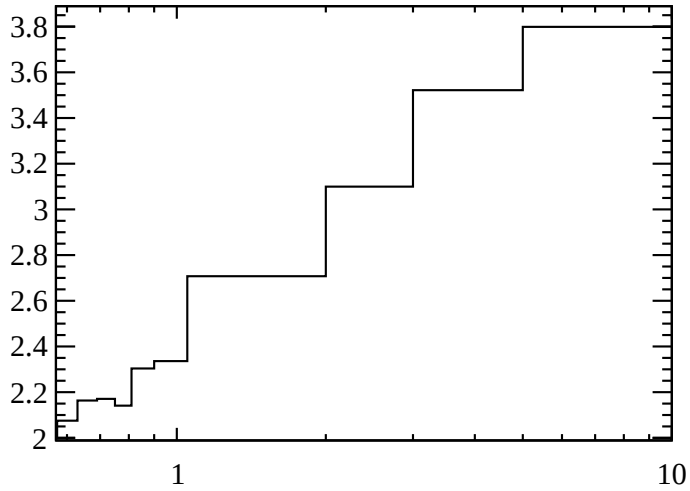
- 2D view: bin 6 to 9



Fit with float a and b

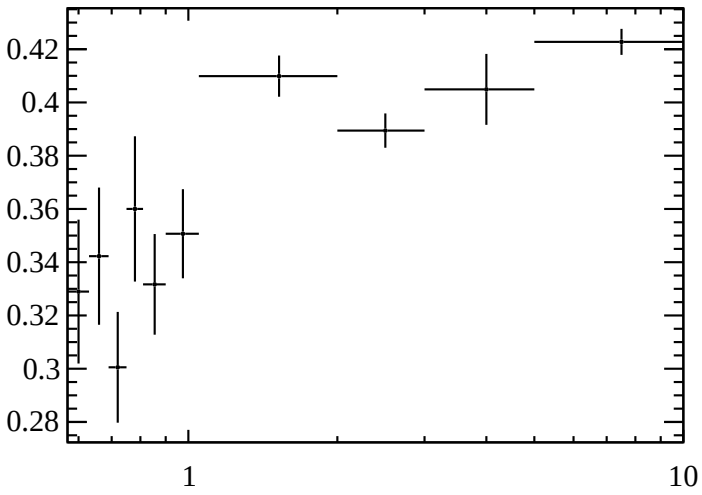
- $\mu(t)$: (left) nominal fit vs. (right) conditional fit

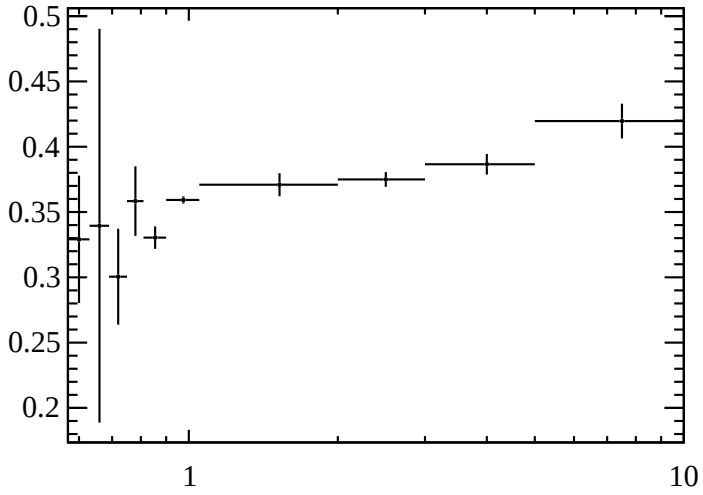




Fit with float a and b

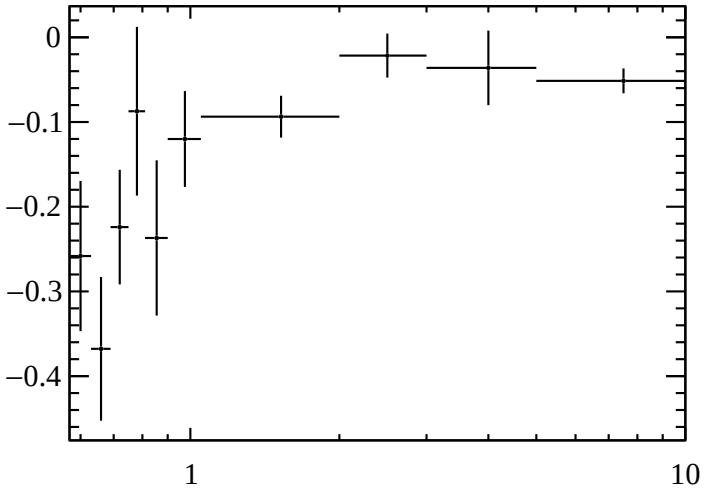
- $\sigma(t)$: (left) nominal fit vs. (right) conditional fit

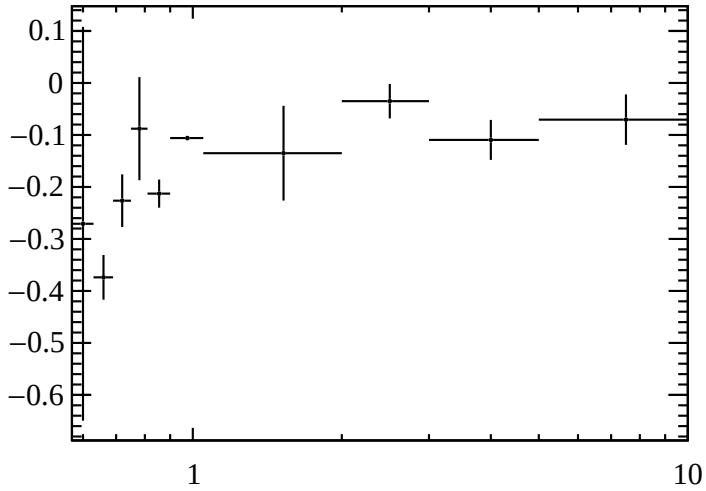




Fit with float a and b

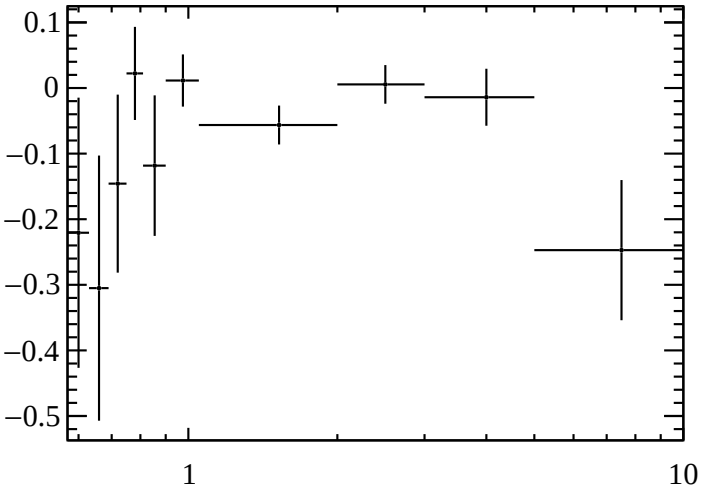
- $\xi(t)$: (left) nominal fit vs. (right) conditional fit

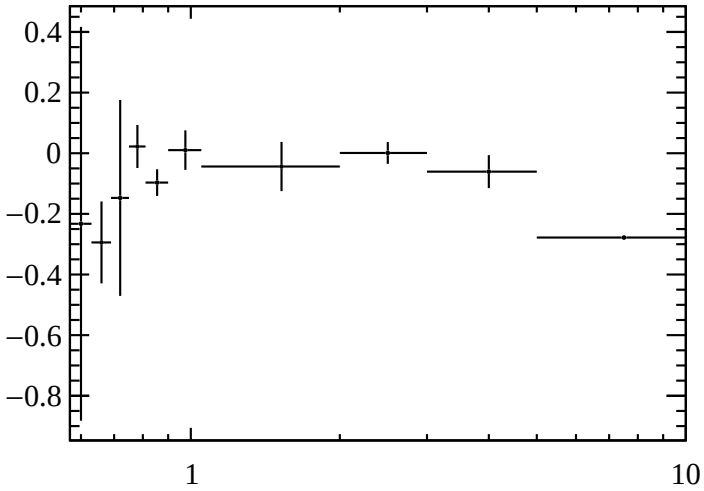




Fit with float a and b

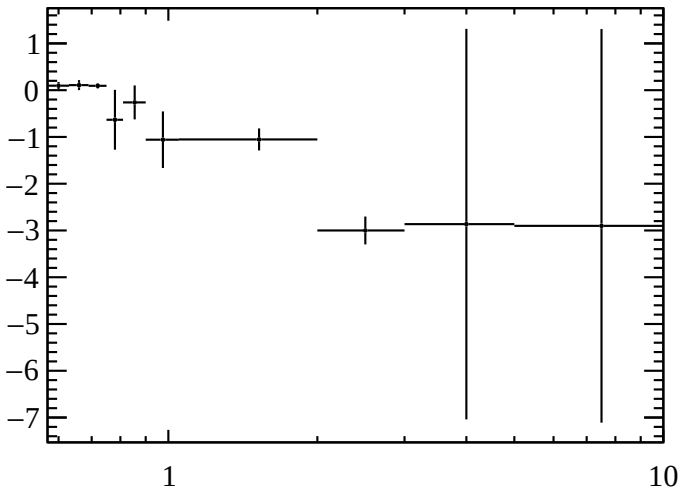
- $\rho_1(t)$: (left) nominal fit vs. (right) conditional fit

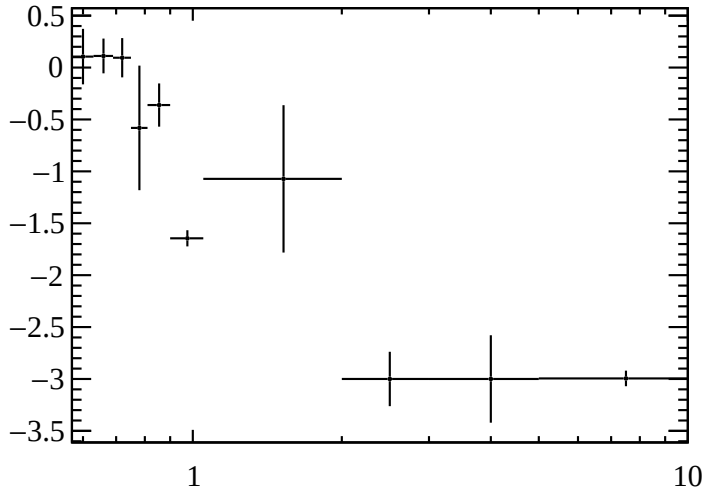




Fit with float a and b

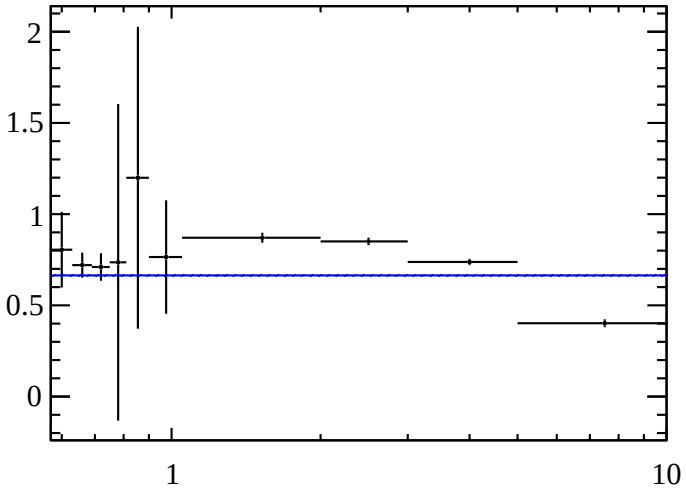
- $\rho_2(t)$: (left) nominal fit vs. (right) conditional fit



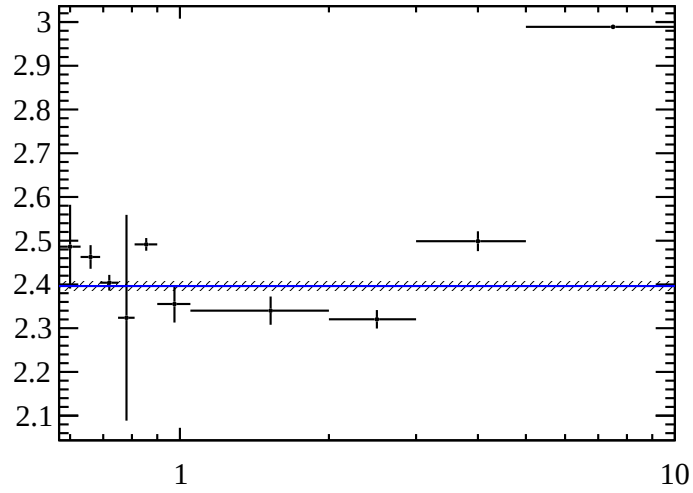


Fit with float a and b

- $a(t)$ and $b(t)$



$a(t)$



$b(t)$

Backup

MC samples used in this study

- 2016 MC samples

EventType	Decay mode	$\tau(b)$	$\tau(c)$
12165031	$B^+ \to \bar{D}^0(\to K^+K^-\pi^+\pi^-)\pi^+$	1.638 ps	0.410 ps
16265034	$\Omega_b^- \to \Omega_c^0(\to pK^-K^-\pi^+)\pi^-$	$1.1^{+0.5}_{-0.4}$ ps	0.069 ps

- Stripping
  - `B2D0PiD2HHHHBeauty2CharmLine`
  - `Omegab2Omegac0Pi0megac02PKKPiBeauty2CharmLine`

Fit procedure

- Calculate decay time w.r.t. PV

$$t = \frac{\vec{p} \cdot \vec{r}}{p^2} \times m$$

- Decay-time bins are partially overlapped with the signal mode
  - `[ 0.57, 0.63, 0.69, 0.75, 0.81, 0.9, 1.05, 2.0, 3.0, 5.0, 10.0 ]` ps
- Fit to log(IPCHI2) with the Bukin function with all parameters free

$\log \chi^2_{IP}$ 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 $\mu = 0, \sigma = 1, \rho_1 = 0$