DC06 Phi Studies

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DC06 Decay File

- Uses SVV_HELAMP model
- A little calculus is needed

$$A_0 = H^0$$
$$A_{\parallel} = \frac{1}{\sqrt{2}}(H^+ + H^-)$$
$$A_{\perp} = \frac{1}{\sqrt{2}}(H^+ - H^-)$$

$$|H^+| = 0$$
$$arg(H^+) = 0$$
$$|H^0| = 1.0$$
$$arg(H^0) = 0.0$$
$$|H^-| = 0.6$$
$$arg(H^-) = 0.5$$

$$|A_0| = 1.0$$
$$arg(A_0) = 0.0$$
$$|A_{\parallel}| = |A_{perp}| = \frac{0.6}{\sqrt{2}}$$
$$arg(A||) = 0.5$$
$$arg(A\perp) = 0.5 + \pi$$

New ToyMC

- Transversal description
- No explicit time dependence(time integrated)

$$L(\theta_1, \theta_2, \varphi) = L_{sig}(\theta_1, \theta_2, \varphi)$$

$$L_{sig}(t, \theta_1, \theta_2, \varphi) = N * \sum_{n=1}^{6} K_n f_n(\theta_1, \theta_2, \varphi)$$

$$N = \frac{9}{8\pi} \frac{1}{|A_0|^2 + |A_{\|}|^2 + |A_{\perp}|^2}$$

$$K_1 = |A_0|^2$$
$$K_2 = |A_{\|}|^2$$
$$K_3 = |A_{\perp}|^2$$

$$K_4 = Re[A_0^* A_{\|}]$$
$$K_5 = Im[A_0^* A_{\perp}]$$
$$K_6 = Im[A_{\|}^* A_{\perp}]$$

$$f_1(\theta_1, \theta_2, \varphi) = \cos^2\theta_1 \cos^2\theta_2$$

$$f_2(\theta_1, \theta_2, \varphi) = \frac{1}{2} \sin^2\theta_1 \sin^2\theta_2 (1 + \cos 2\varphi)$$

$$f_3(\theta_1, \theta_2, \varphi) = \frac{1}{2} \sin^2\theta_1 \sin^2\theta_2 (1 - \cos 2\varphi)$$

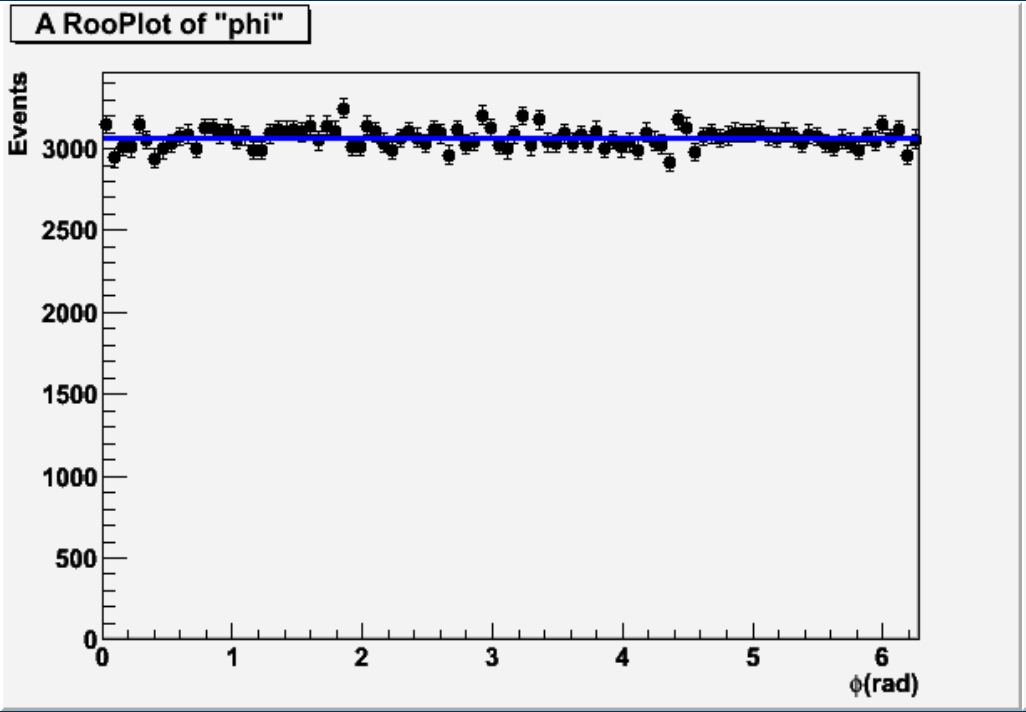
$$f_4(\theta_1, \theta_2, \varphi) = \frac{1}{2\sqrt{2}} \sin 2\theta_1 \sin 2\theta_2 \cos\varphi$$

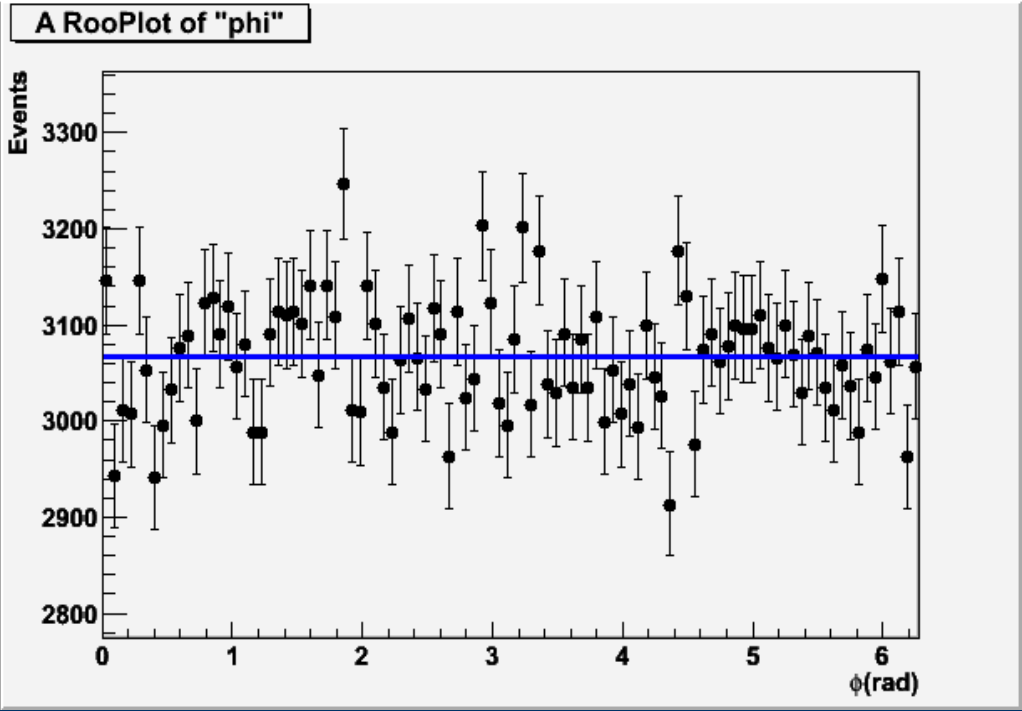
$$f_5(\theta_1, \theta_2, \varphi) = \frac{-1}{2\sqrt{2}} \sin 2\theta_1 \sin 2\theta_2 \sin\varphi$$

$$f_6(\theta_1, \theta_2, \varphi) = -\sin^2\theta_1 \sin^2\theta_2 \sin 2\varphi$$

Tranversal ToyMC

- Entries vs angle (in degrees), imposed P.d.f.





- Flat! (306k events)

Transversal ToyMC

- Bad choice of helicity amplitudes
- No phi oscillation contributions
- Time-dependent ToyMC formula needs careful revision

$$|A_0| = 1.0$$
$$arg(A_0) = 0.0$$
$$|A_{||}| = |A_{perp}| = \frac{0.6}{\sqrt{2}}$$
$$arg(A||) = 0.5$$
$$arg(A\perp) = 0.5 + \pi$$

$$K_3 = |A_\perp|^2 = |A_{||}|^2 = K_2$$
$$K_6 = Im[A_{||}^* A_\perp] = 0$$

$$\int_{-1}^{1} \sin 2\theta d(cos\theta) = \int_{-1}^{1} 2sin\theta cos\theta d(cos\theta) =$$
$$= \int_{-1}^{1} 2\sqrt{1 - cos^2\theta} cos\theta d(cos\theta) = -\frac{2}{3}(1 - cos^2\theta)^{3/2}|_{-1}^{1} = 0$$

Transversal ToyMC

$$\frac{d^3\Gamma}{\Gamma d\cos\theta_1 d\cos\theta_2 d\phi} = \frac{9}{8\pi}\frac{1}{|A_0|^2+|A_\parallel|^2+|A_\perp|^2}$$

$$\times\Big[|A_0|^2\cos^2\theta_1\cos^2\theta_2 + |A_\parallel|^2\frac{1}{2}\sin^2\theta_1\sin^2\theta_2\cos^2\phi$$

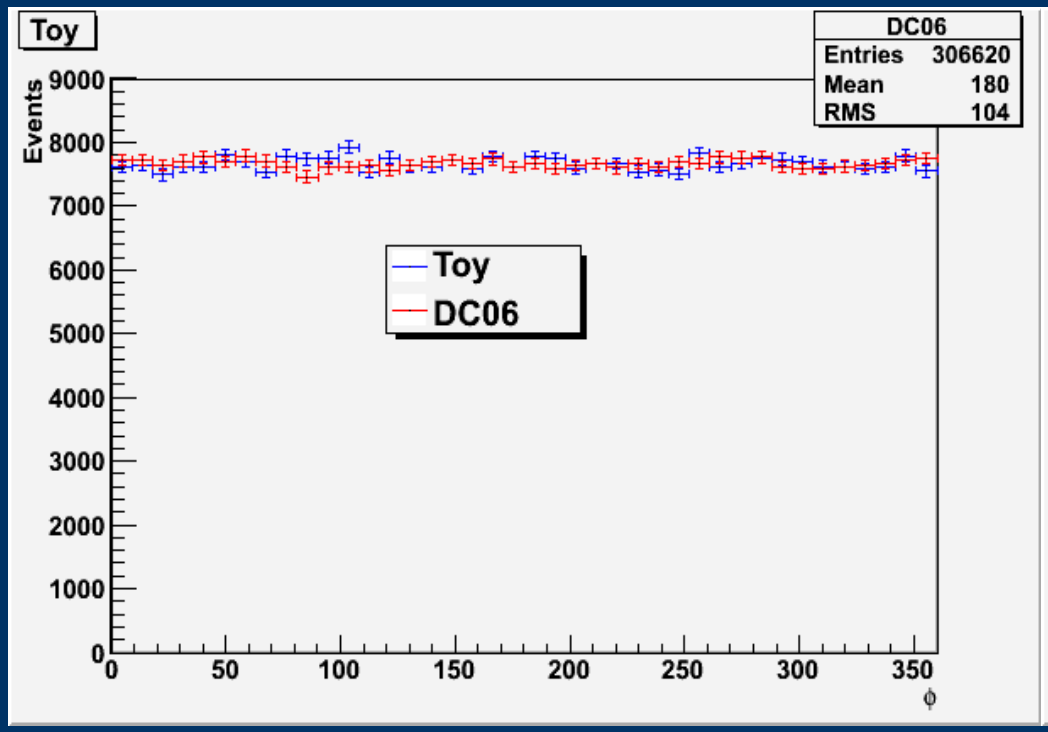
$$+|A_\perp|^2\frac{1}{2}\sin^2\theta_1\sin^2\theta_2\sin^2\phi + \mathrm{Re}[A_0^*A_\parallel]\frac{1}{2\sqrt{2}}\sin 2\theta_1\sin 2\theta_2\cos\phi$$

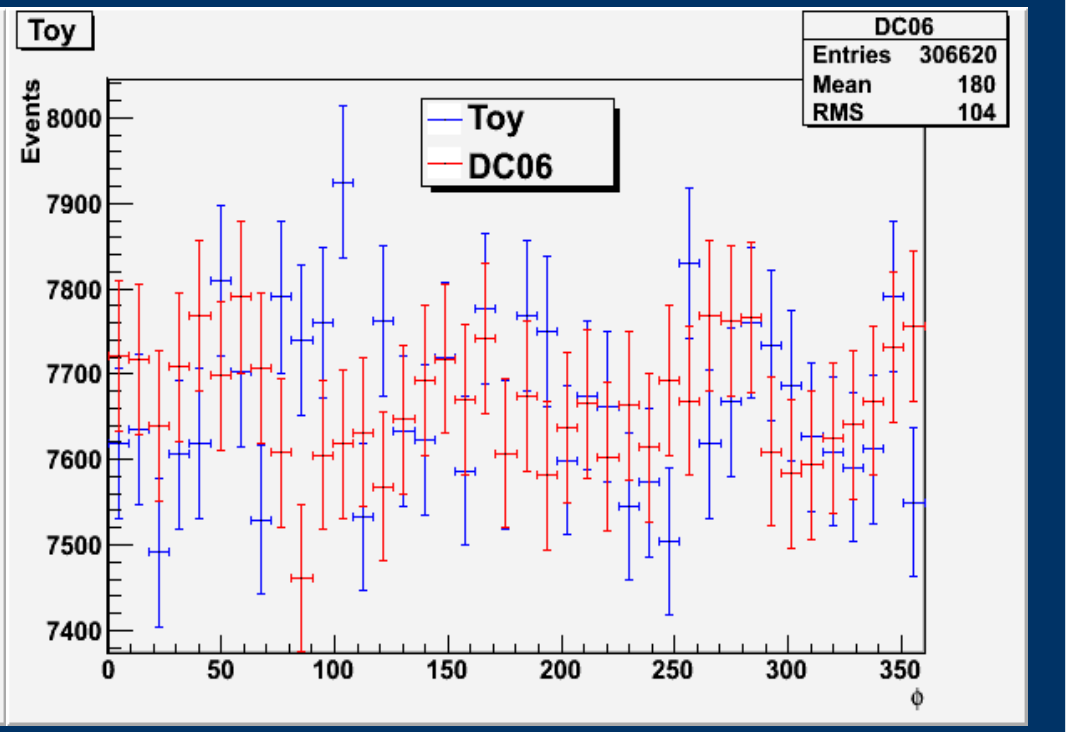
$$+\mathrm{Im}[A_0^*A_\perp]\frac{-1}{2\sqrt{2}}\sin 2\theta_1\sin 2\theta_2\sin\phi + \mathrm{Im}[A_\parallel^*A_\perp]\frac{-1}{2}\sin^2\theta_1\sin^2\theta_2\sin 2\phi\Big]$$

- Amplitude terms balance out
- Interference terms do not contribute

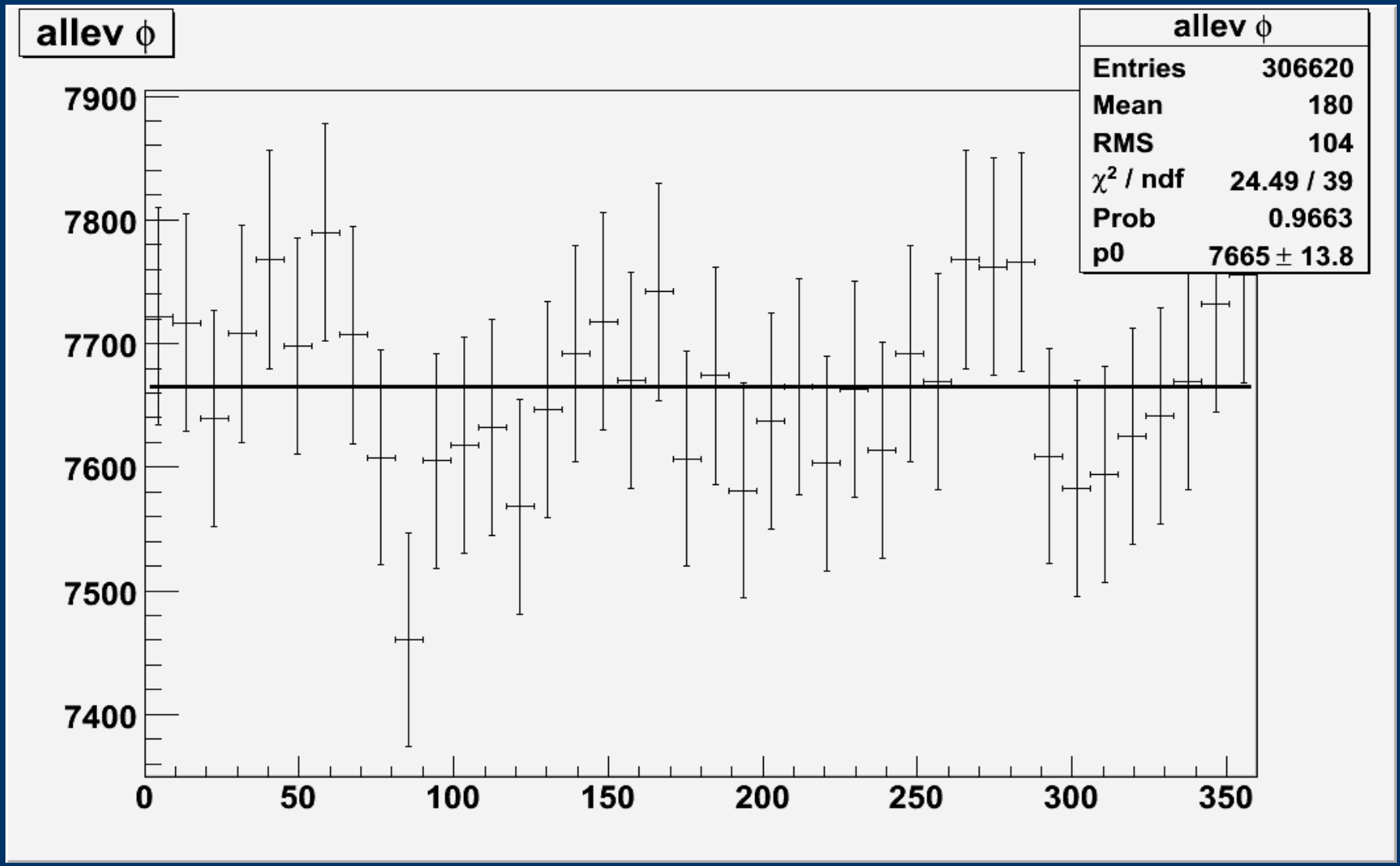
Trans. TOY vs DC06 MCTRUTH

- Entries vs angle (in degrees) (toyMC in blue, DC06 in red)





Reminder: Flat Hypothesis

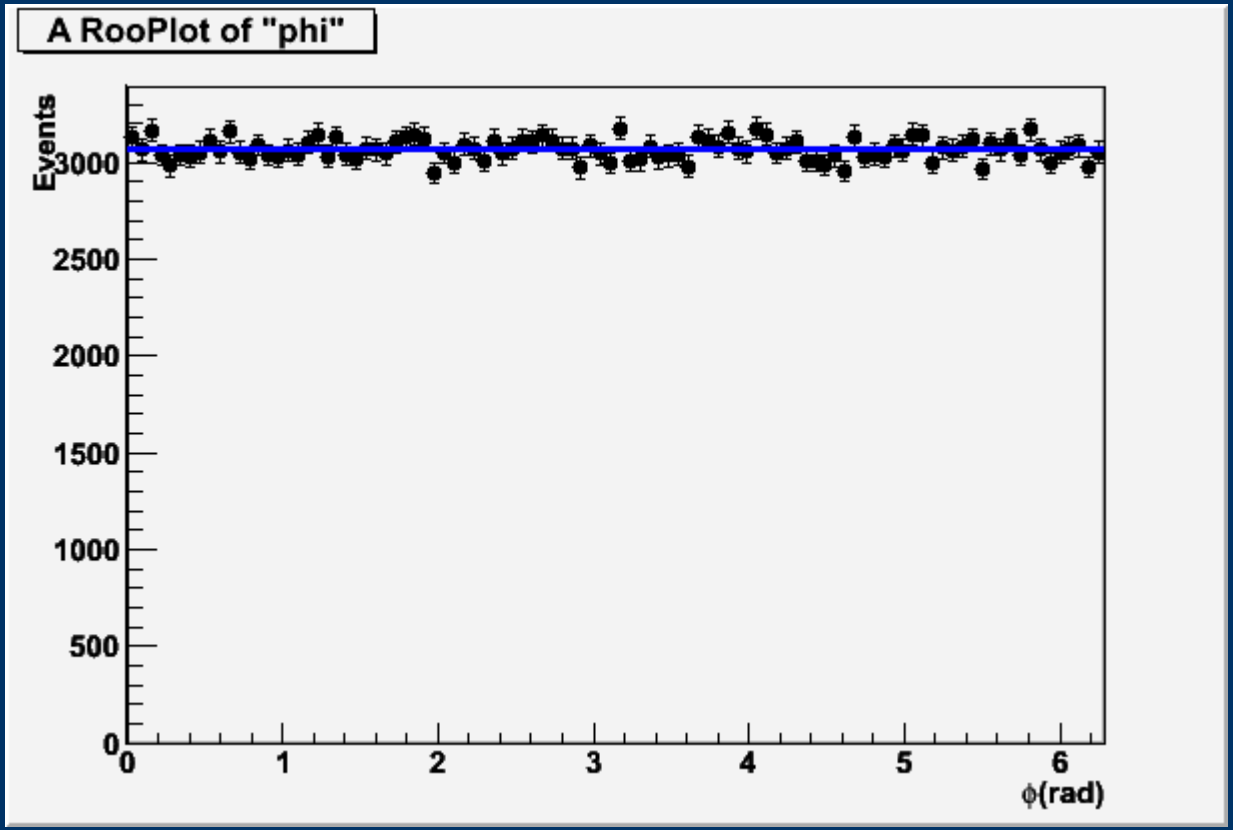


Revision of the Toy MC

- Parameters did not correspond to DC06
- DC06 used time-integrated parameters
- Toy MC used zero-time parameters
- Toy MC parameters were wrongly calculated, extracted from time integrated parameters.
- Requires recalculation (on the works)

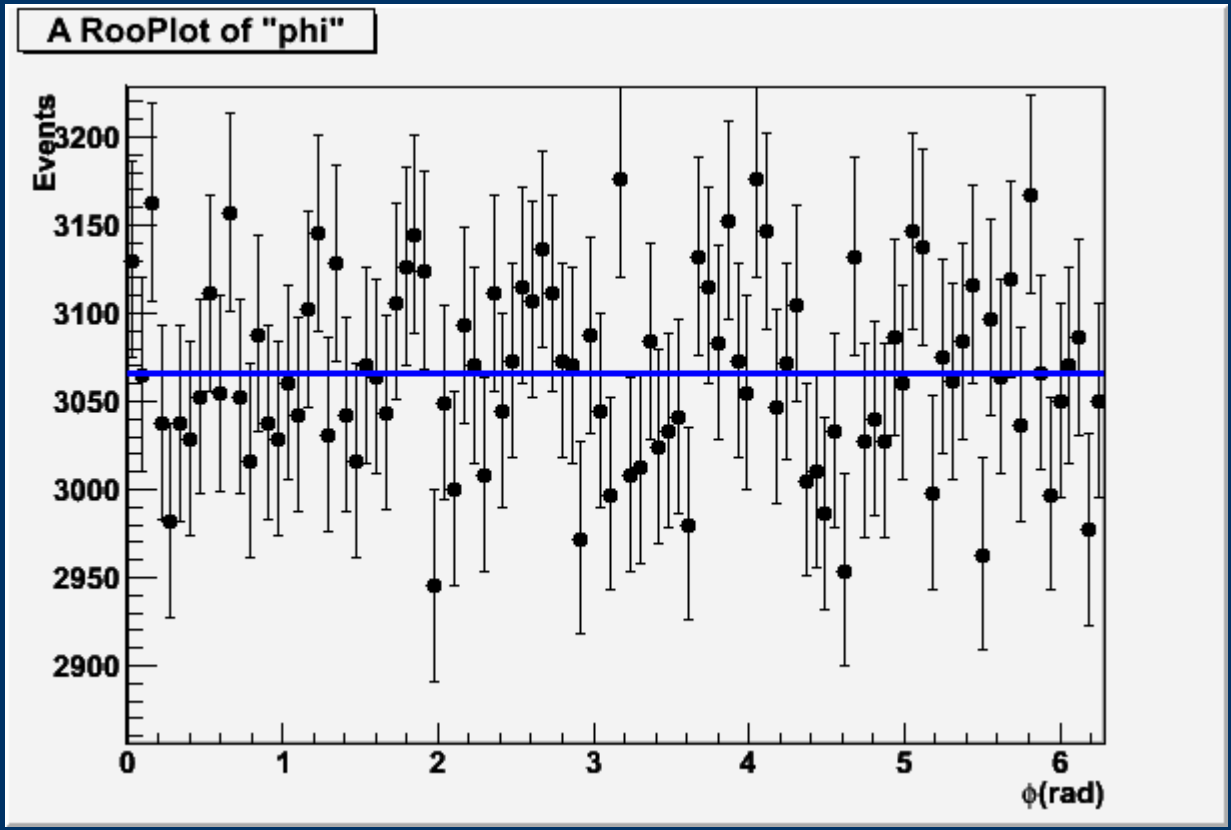
Backup Slides

Revision of the ToyMC



- Plot with ridicoulous time gap (0.001-0.002 τ)
- Zero parameters = Integrated time parameters
- Flat distribution (for 306k events)

Revision of the ToyMC



- Zoomed plot
- Flat distribution