chapter 3

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1 3.1

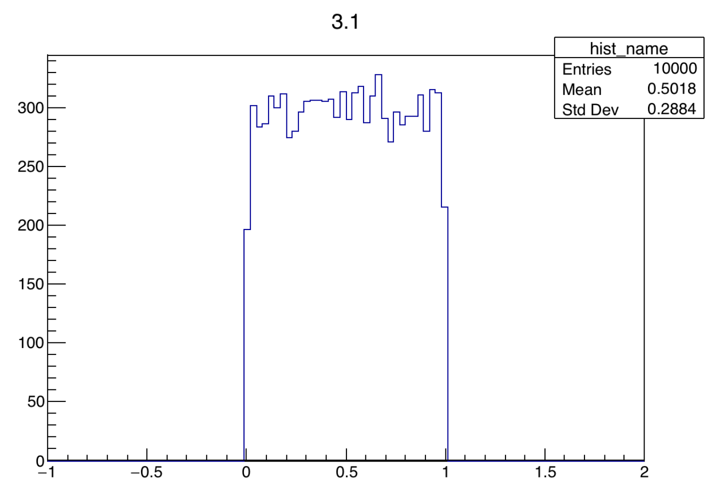

Figure 1: Uniform distribution

2 3.2

(a)

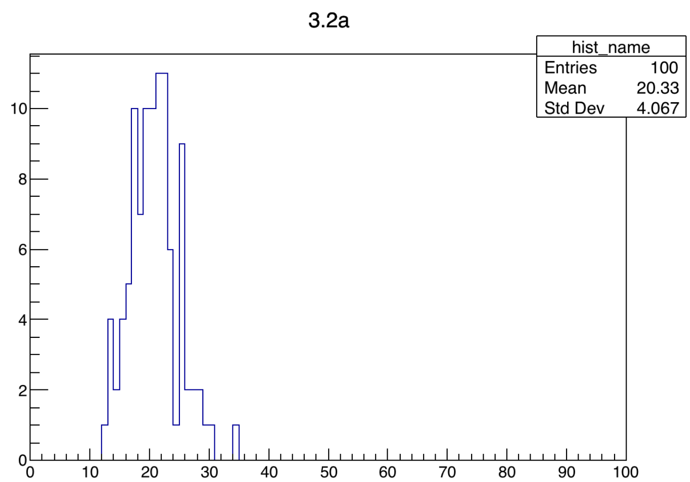

Figure 2: Binomial distribution

(b)

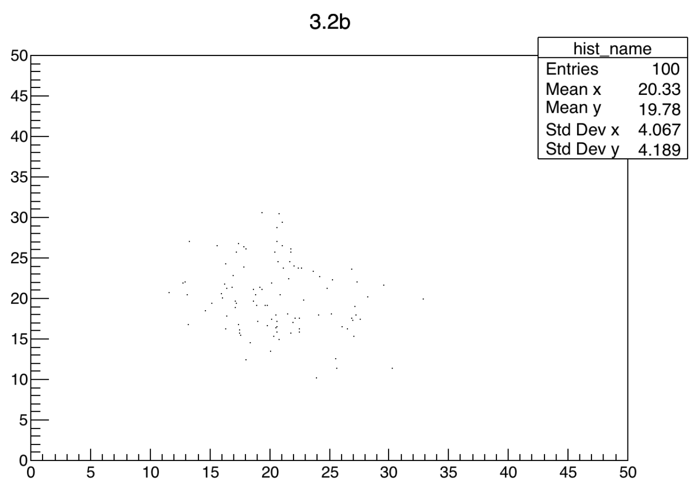

Figure 3: two dimension histogram

3 3.3

(a)

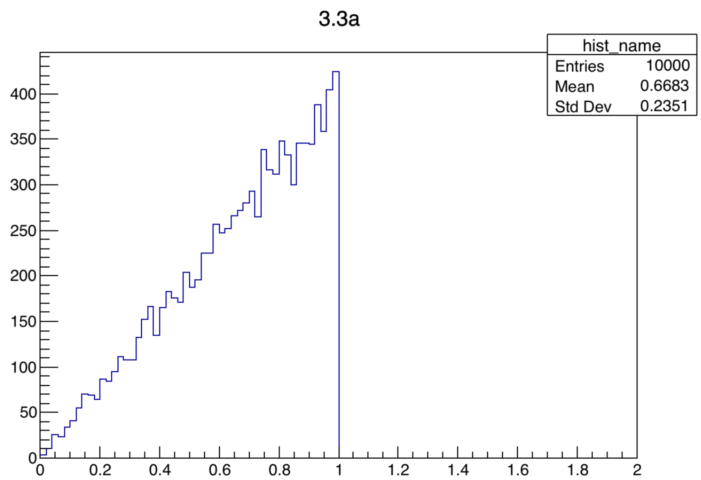

Figure 4: Histogram

(b)

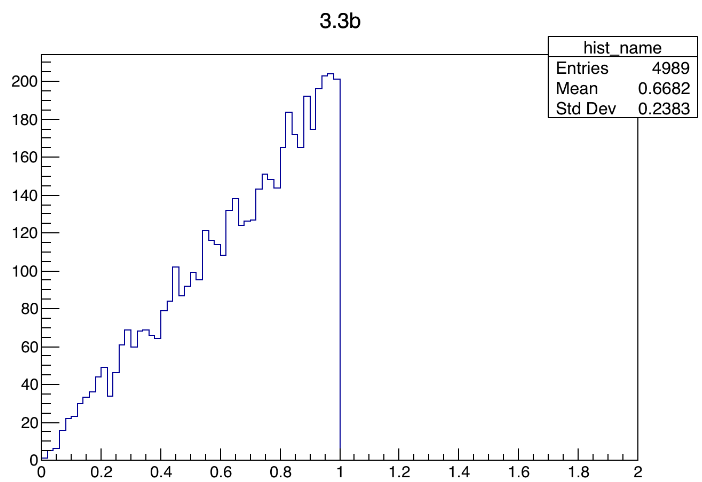

Figure 5: Histogram

4 3.4

(a)

$$E(y) = \sum_{i=1}^{n} E(x_i) = \frac{n}{2} \tag{1}$$

$$V(y) = nV(x) = \frac{n}{12} \tag{2}$$

$$\begin{aligned}E(z) &= E\left(\frac{\sum_{i=1}^{n} x_i - \frac{n}{2}}{\sqrt{n/12}}\right) \\ &= \frac{\sum_{i=1}^{n} E(x_i) - \frac{n}{2}}{\sqrt{n/12}} \\ &= 0\end{aligned} \tag{3}$$

$$V(z) = 1 \tag{4}$$

(b)

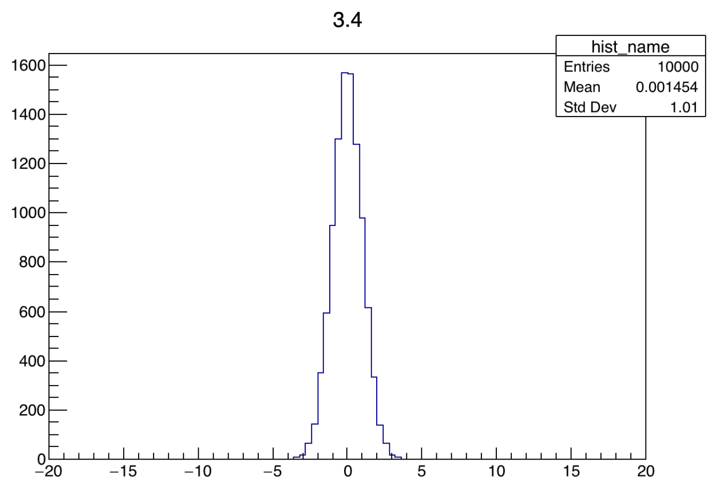

Figure 6: Gaussian distribution

5 3.5

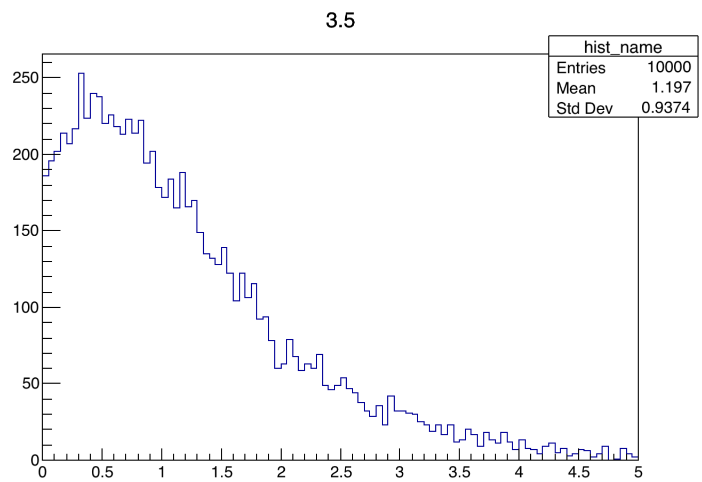

Figure 7: Decay time distribution

6 3.6

(a)

$$\begin{aligned}
&\int_{-\infty}^{x(r)} f(x)dx = \int_0^r dr = r \\
&\frac{1}{\pi}arctan(x) + \frac{1}{2} = r \\
&x(r) = tan(\pi(r - \frac{1}{2}))
\end{aligned} \tag{5}$$

(b)

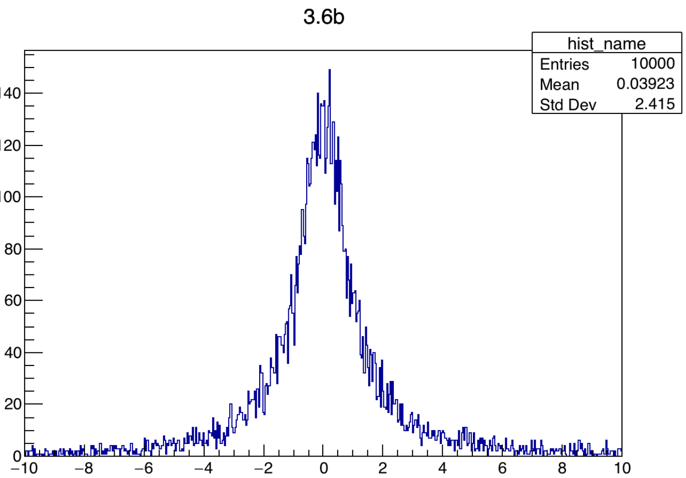

Figure 8: Cauchy distribution

(c)

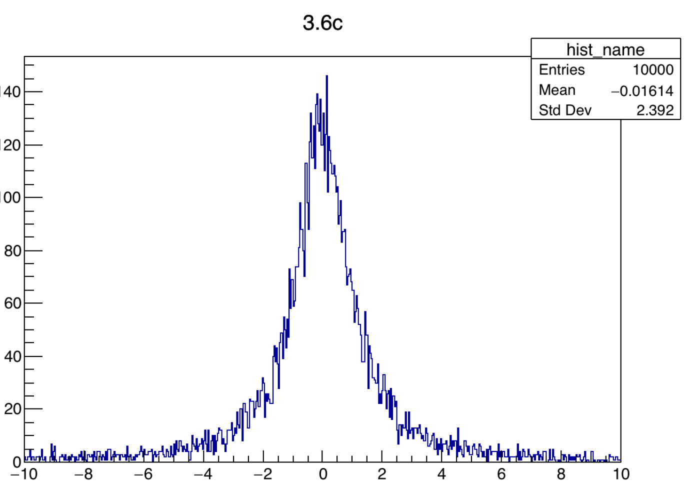

Figure 9: Cauchy distribution

7 3.7

(a)

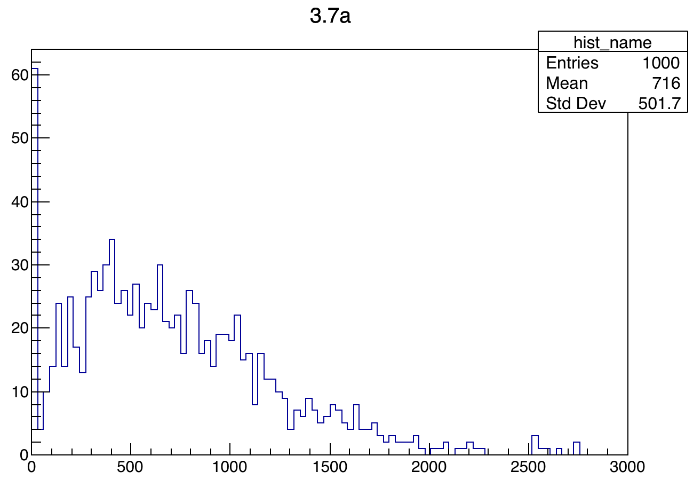

Figure 10: 1000 photon electron distribution

the mean value is 716, is very close to the theory mean value 729.
But the variance is 501.7, the theory variance of the poisson distribution is 729.

$$n_{out} = \prod_{i=1}^{6} n_{out,i} \tag{6}$$

So we should use the Generating Funtions formula:

$$\begin{aligned} V_{n_{out}}^2 &= V_{n_{out,1}}^2 + \frac{V_{n_{out,2}}^2}{E(n_{out,1})} + \frac{V_{n_{out,3}}^2}{E(n_{out,1})E(n_{out,2})}.... \\ \sigma_{n_{out}} &= \sqrt{364 * 729} = 515 \end{aligned} \tag{7}$$

This answer is far away from the poisson distribution which the mean value is 729.
(b) Compare with the figure in (a), $\frac{\sigma_{n_{out}}}{\bar{n}_{out}}$ is smaller. From the formula in (a), We know $V_{n_{out,1}}^2$ is the biggest one in $V_{n_{out}}^2$.

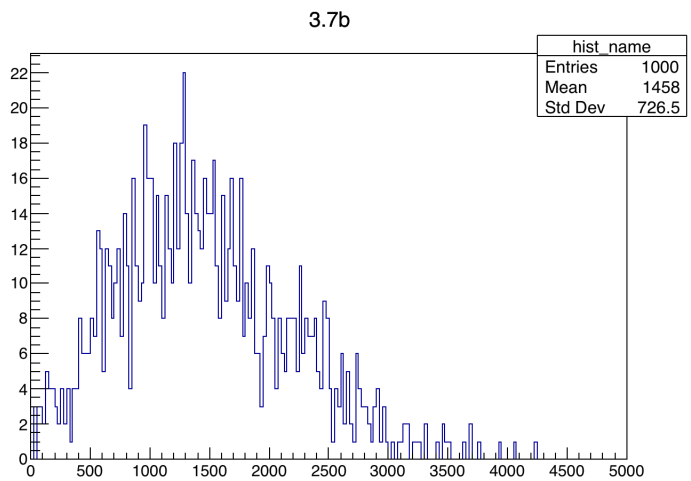

Figure 11: 1000 photon electron distribution

(c)

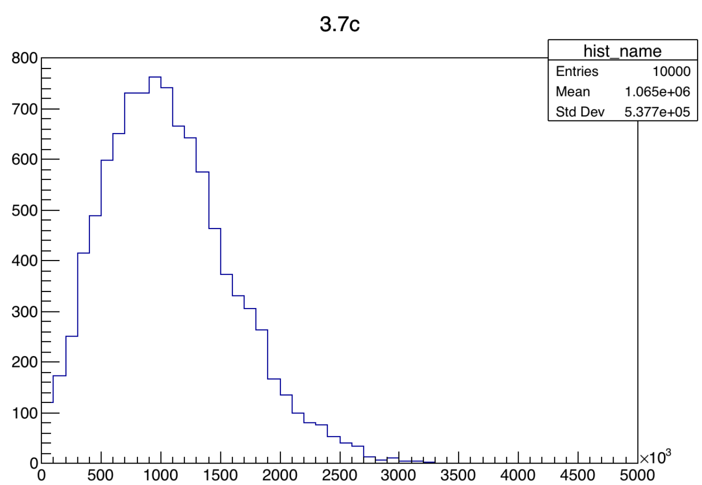

Figure 12: 10000 photon electron distribution