• **Binomial distribution**

For \( p \) – probability of success, getting \( n \) successes in \( N \) trials is described by discrete probability distribution

\[
P_p(n \mid N) = \frac{N!}{n!(N-n)!} p^n (1-p)^{N-n}
\]

• **Poisson distribution**

It is an approximation to the binomial distribution for small sample sizes \( n \ll N \) (for a limited detector size, the number of hits \( n \) is much smaller than the total number of quanta emitted by the source). Introducing a parameter \( \bar{n} = Np \) – expected (average) number of successes (detected particles)

\[
P_n = \lim_{N \to \infty} P_p(n \mid N) = \frac{\bar{n}^n e^{-\bar{n}}}{n!}
\]

• **Gaussian distribution**

For a large number of counts (\( n, \bar{n} \gg 1 \), but still \( \ll N \)) using Stirling’s formula, the definition of \( n = \bar{n} + \delta n \) and neglecting terms \( \sim \delta n^2 \) we obtain

\[
P(N) = \frac{1}{\sqrt{2\pi n}} \frac{e^{-(n-\bar{n})^2/2\bar{n}}}{\sqrt{2\pi}} = \frac{1}{\sigma \sqrt{2\pi}} e^{-(n-\bar{n})^2/(2\sigma^2)}
\]

You can consult [http://mathworld.wolfram.com/BinomialDistribution.html](http://mathworld.wolfram.com/BinomialDistribution.html) and related pages for the derivations