

5.2.03-11 Poisson's distribution and Gaussian distribution of radioactive decay with Cobra3 – Influence of the dead time of the counter tube



What you can learn about ...

- Poisson's distribution
- Gaussian distribution
- Standard deviation
- Expected value of pulse rate
- Different symmetries of distributions
- Dead time
- Recovering time and resolution time of a counter tube

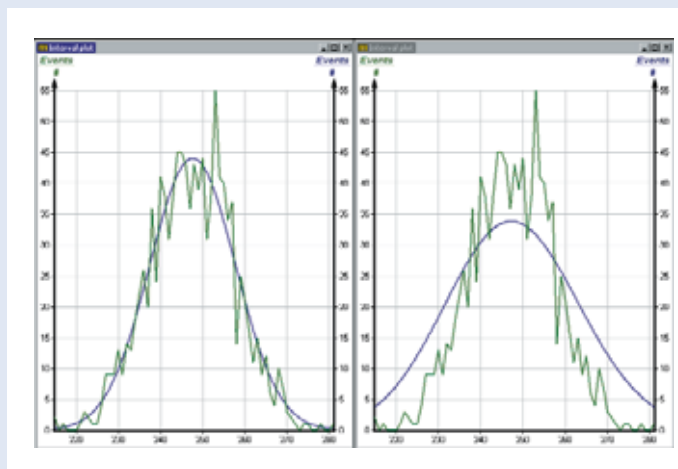
Principle:

1) The aim of this experiment is to show that the number of pulses counted during identical time intervals by a counter tube which bears a fixed distance to a long-lived radiation emitter correspond to a Poisson's distribution. A special characteristic of the Poisson's distribution can be observed in the case of a small number of counts $n < 20$: The distribution is unsymmetrical, i.e. the maximum can be found among

What you need:

Counter tube, type A, BNC	09025.11	1
Screened cable, BNC, $l = 750$ mm	07542.11	1
Cobra3 BASIC-UNIT	12150.00	1
Power supply 12V/2A	12151.99	1
Software Cobra3 Radioactivity	14506.61	1
Data cable 2 x SUB-D, plug/socket, 9 pole	14602.00	1
Cobra3 measuring Module GM counting tube	12106.00	1
Base plate for radioactivity	09200.00	1
Counter tube holder on fixing magnet	09201.00	1
Source holder on fixing magnet	09202.00	1
Plate holder on fixing magnet	09203.00	1
Americium-241 source, 370 kBq	09090.11	1
PC, Windows® 95 or higher		

Complete Equipment Set, Manual on CD-ROM included
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Pulse rate distribution for high pulse rate (248 pulses/s) with an adapted Gaussian curve (left window) and a Poisson's curve (right window).

smaller numbers of pulses than the mean value. In order to show this unsymmetry the experiment is carried out with a short counting period and a sufficiently large gap between the emitter and the counter tube so that the average number of pulses counted becomes sufficiently small.

2) Not only the Poisson's distribution, but also the Gaussian distribution which is always symmetrical is very suitable to approximate the pulse distribution measured by means of a long-lived radiation emitter and a

counter tube arranged with a constant gap between each other. A premise for this is a sufficiently high number of pulses and a large sampling size.

The purpose of the following experiment is to confirm these facts and to show that the statistical pulse distribution can even be approximated by a Gaussian distribution, when (due to the dead time of the counter tube) counting errors occur leading to a distribution which deviates from the Poisson's distribution.

3) If the dead time of the counter tube is no longer small with regard to the average time interval between the counter tube pulses, the fluctuation of the pulses is smaller than in the case of a Poisson's distribution. In order to demonstrate these facts the limiting value of the mean value (expected value) is compared to the limiting value of the variance by means of a sufficiently large sampling size.