Statistical approach to the investigation of dark counts in SNSPDs.

We present measurements of NbN-SNSPD in the range from 4.2K to 60 mK. The data are analyzed using an innovative statistical approach.

- **At 4.2 K** we show the current bias dependence of the dark count rate. We present the statistical distribution of the dark events and compare this to the Poisson distribution that is expected from a pure stochastic model. Deviations indicates the presence of other mechanisms.
- **In the range 60 - 650 mK** no dark count events were observed.
- **The same statistical approach is used to analyze the counting signals in the presence of 1550 nm laser light at various attenuations of the intensity.** These measurements are made to establish the quality of the approach.

The method
- Sequences of about $3 \times 10^5$ pulses are recorded in temporal intervals of 30 sec. (purple trace in fig.4).
- They are assembled in blocks of 200 \( \mu \)s. How many pulses a block contains are then counted. A histogram of blocks with the same number of pulses is created. (Yellow plot in fig.4).
- The probability \( P(n) \) to have \( n \) pulses in a temporal interval of 0.2ms is \( f(n) \) is the number of blocks with \( n \) pulses and \( N \) is the total number of blocks. In the example in the panel, \( P(4) = 0.177 \) since \( f(4) = 11,548 \) and \( N = 65,431 \).
- Count rate can be obtained and its average values is hence calculated with high accuracy. The latter is the value plotted in fig. 2(b) and 3(b)

![Image](image.png)

**Fig. 1**

Dark counts in temporal blocks of 200 \( \mu \)s at \( I = 13.4 \) \( \mu \)A. Deviations from the Poisson distribution can be observed in blocks with low and high number of counts per block. They could be due to fluctuations in the bias current.

**Fig. 2(a)**

**Fig. 2(b)**

**Fig. 3(a)**

**Fig. 3(b)**

**Fig. 4**