Statistical approach to the investigation of dark counts in SNSPDs.

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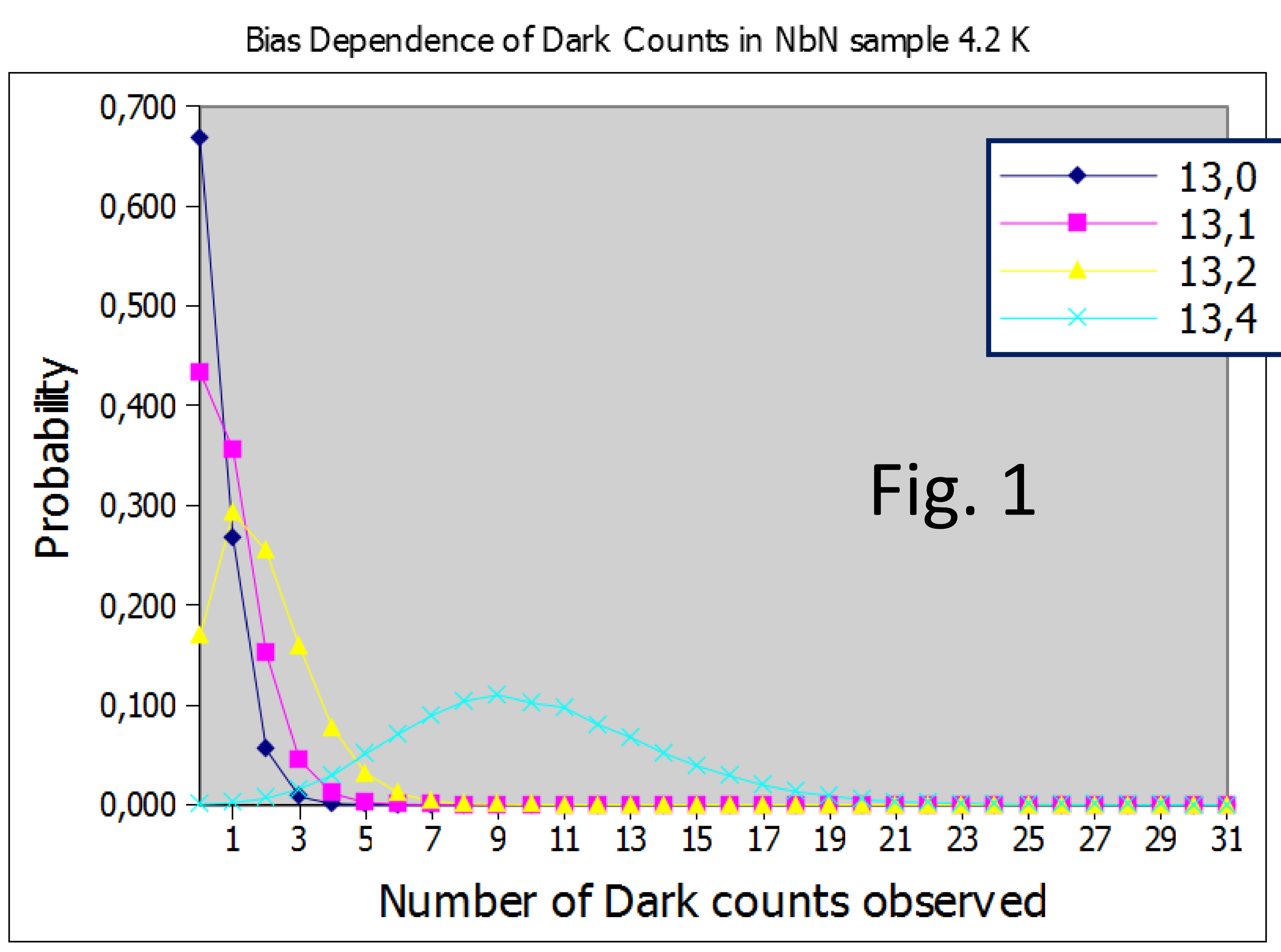
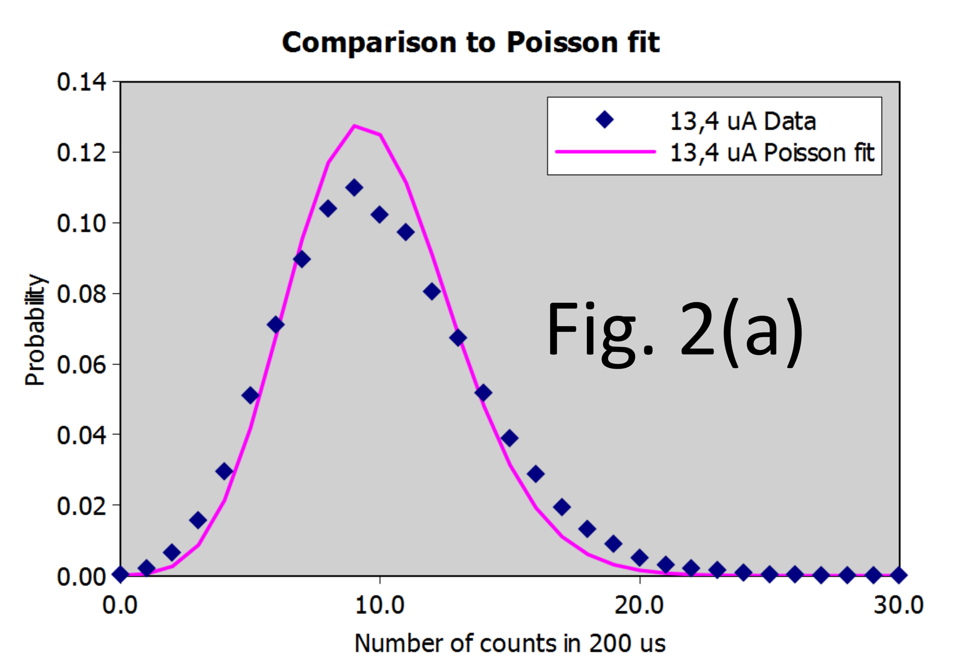
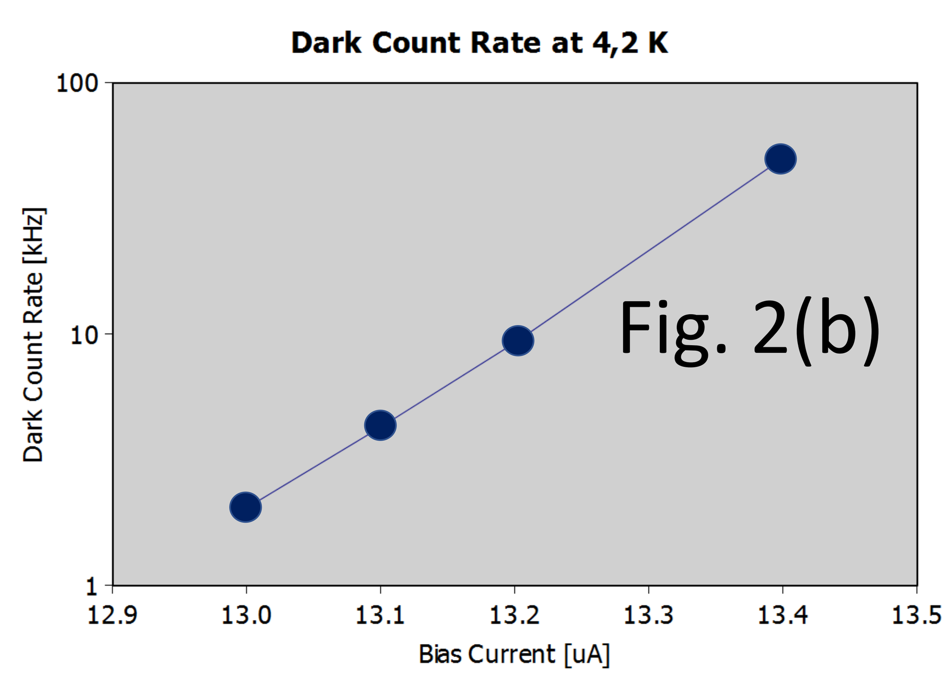


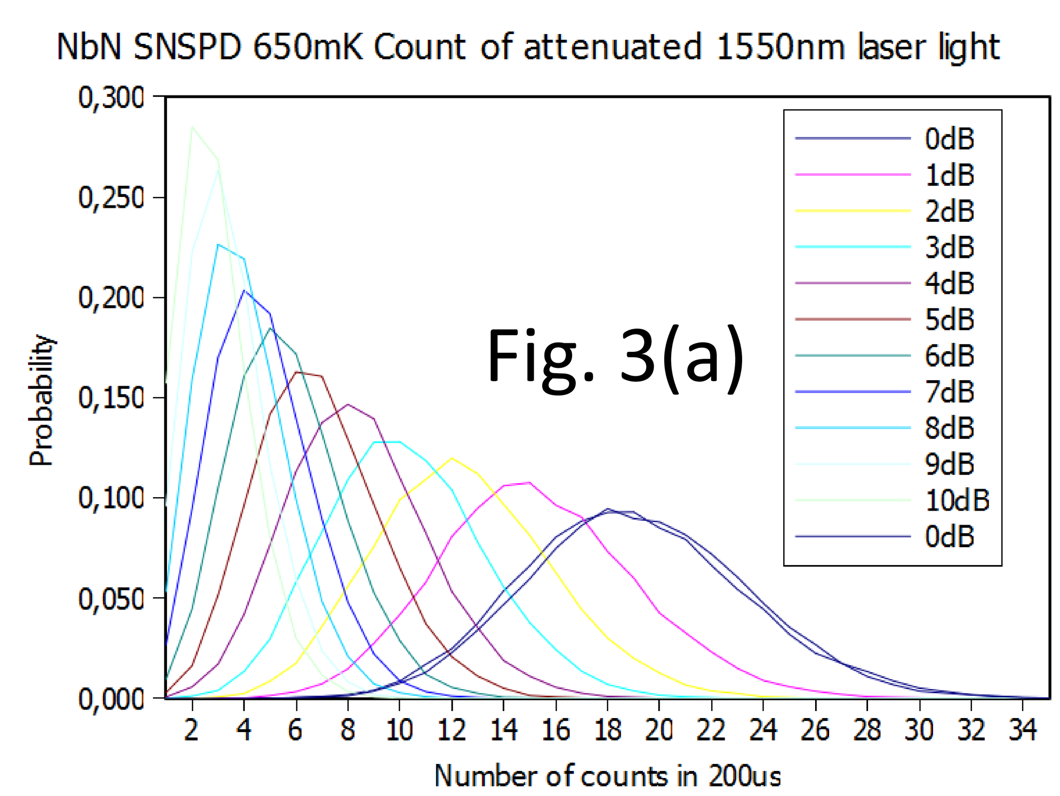
We present measurements of NbN-SNSPD in the range from 4.2K to 60 mK.
The data are analyzed using an **innovative statistical approach**.

- **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.



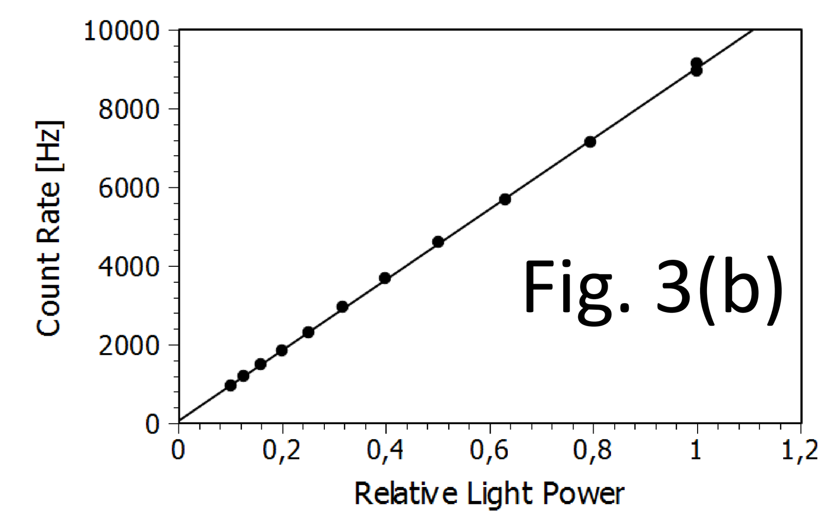
Dark counts in temporal blocks of 200 µs at I = 13,4 µA. Deviations from the Poisson distribution can be observed in blocks with low and high number of counts per block. They could be due to fluctuations in the bias current.





The count rate plot shows a single-photon behaviour.

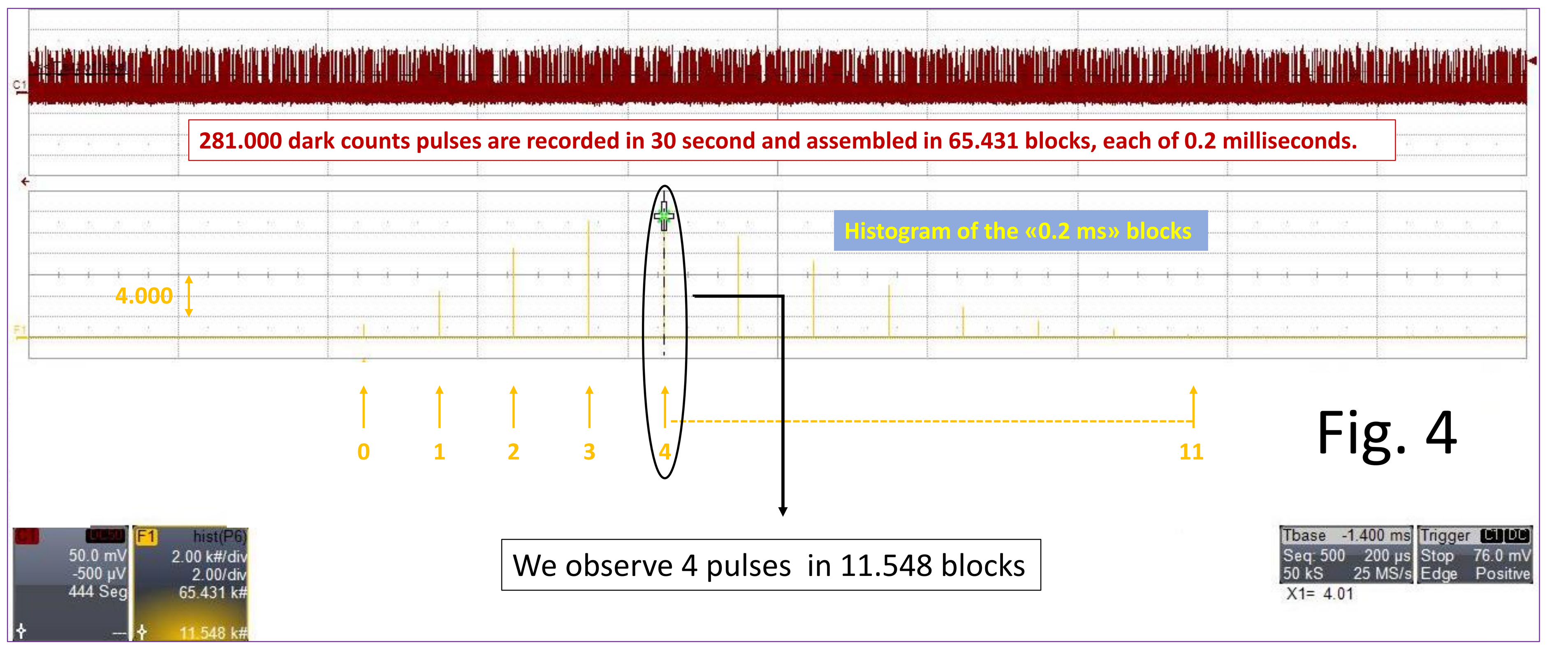
The very good linear dependence is the result of high statistical accuracy. Each point in the plot is the statistical average over tens of thousands recorded signals.
(See Method below).



The method

- Sequences of about 3x10⁵ pulses are recorded in temporal intervals of 30 sec. (purple trace in fig.4).
- They are assembled in blocks of 200 µs. 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)



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