

Abstract

We discuss experimental unconditional observations of nonclassical light emitted from trapped Calcium ions [1, 2]. The nonclassicality is proved by the conventional intensity correlation function and is evaluated in detail using more general operational criteria proposed by Lachman et al. [3] applicable for unambiguous detection of nonclassicality of light from an arbitrarily **large ensemble of independent single-photon emitters**. We were able to observe the nonclassicality of light emitted from ensemble of **more than four hundred trapped ions** corresponding to input mean photon number per analyzed time bin of more than 200.

Motivation

Definition of nonclassicality:

$$\rho \neq \int P(\alpha) |\alpha\rangle \langle \alpha| d^2\alpha$$

$$P_0 - \sqrt{P_{00}} > 0$$

criterion [3]

Sufficient conditions:

$$g^2(0) < 1$$

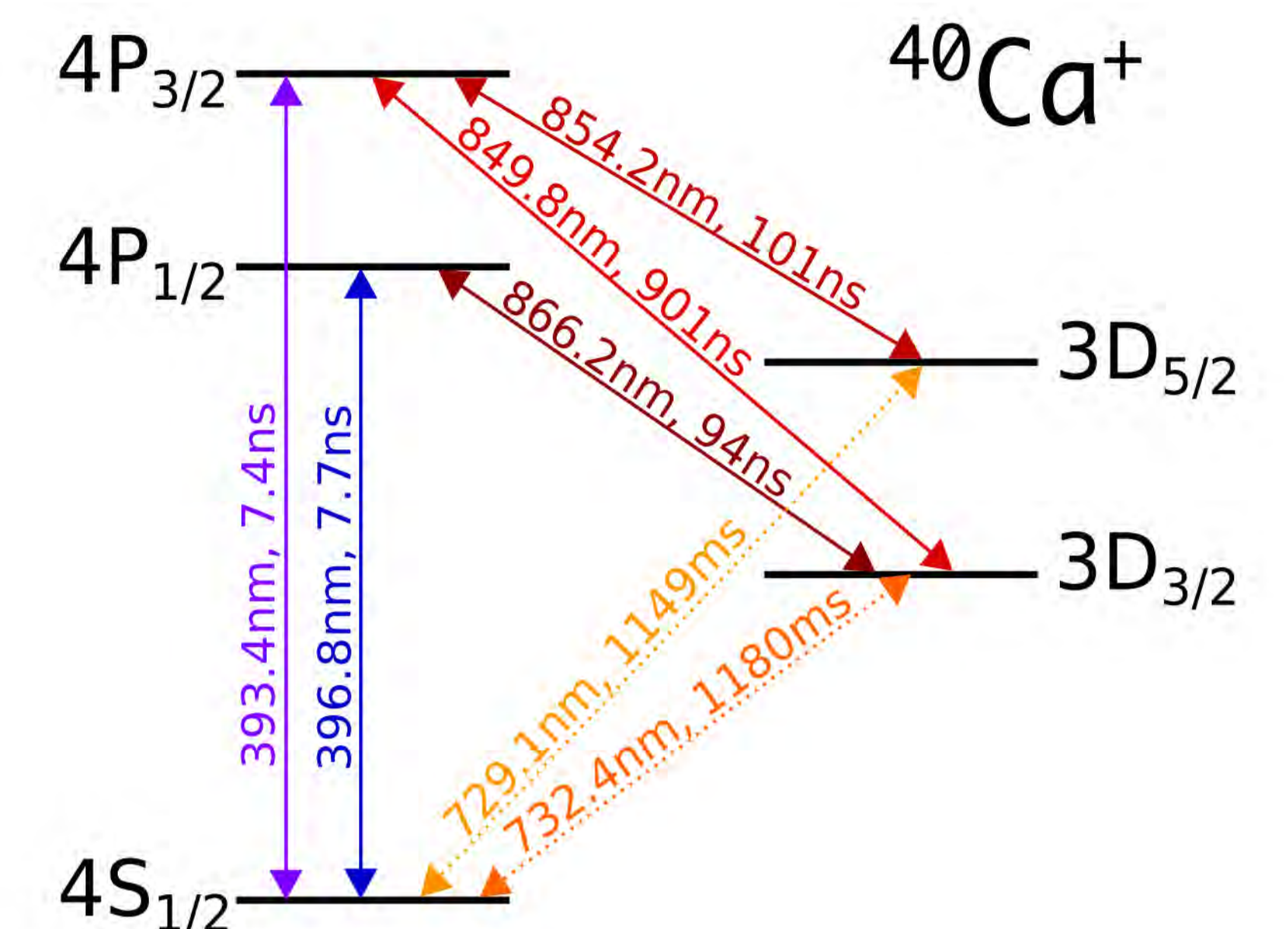
theoretical expression

$$\alpha = \frac{p_c}{p_a p_b} < 1$$

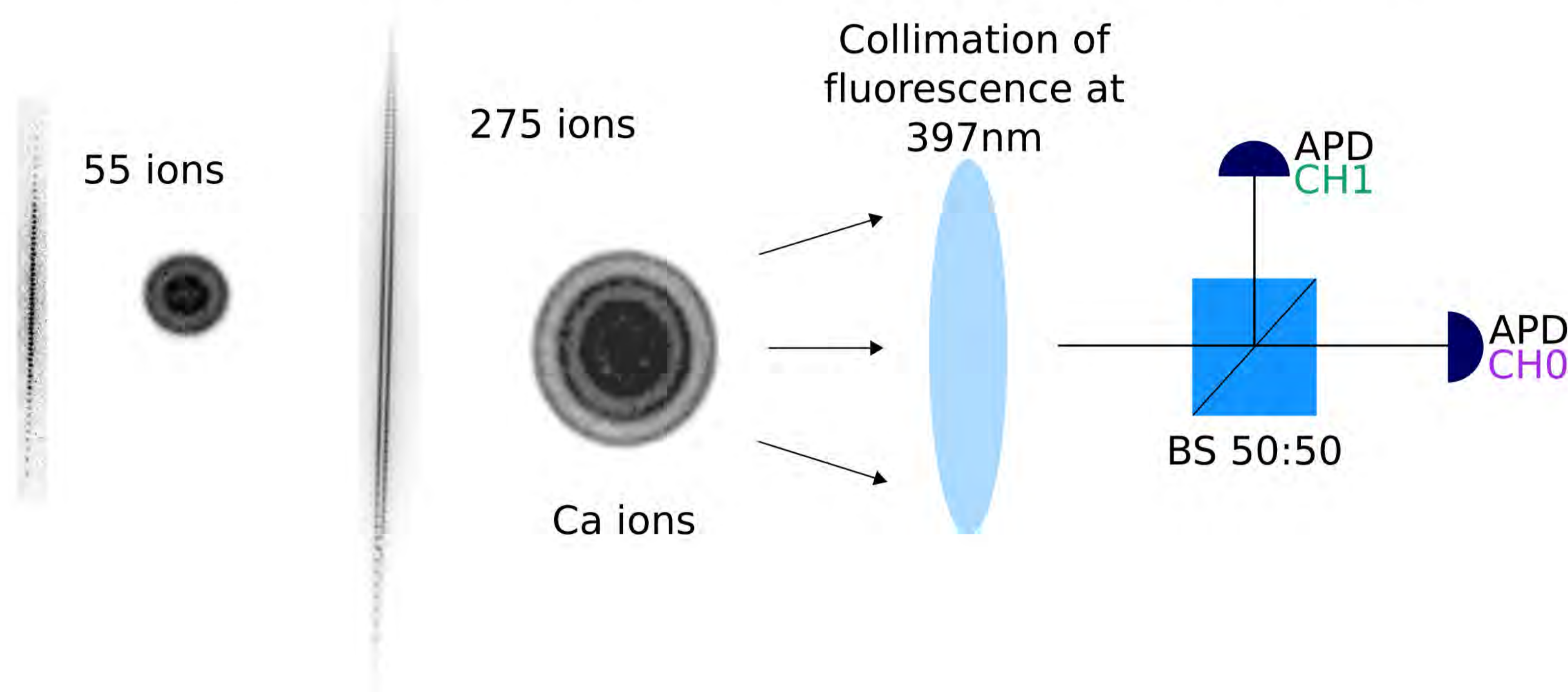
approximation $\langle n \rangle \ll 1$

P_{00} - probability of no click any of APDs
 P_0^1 - probability of no click APD 1

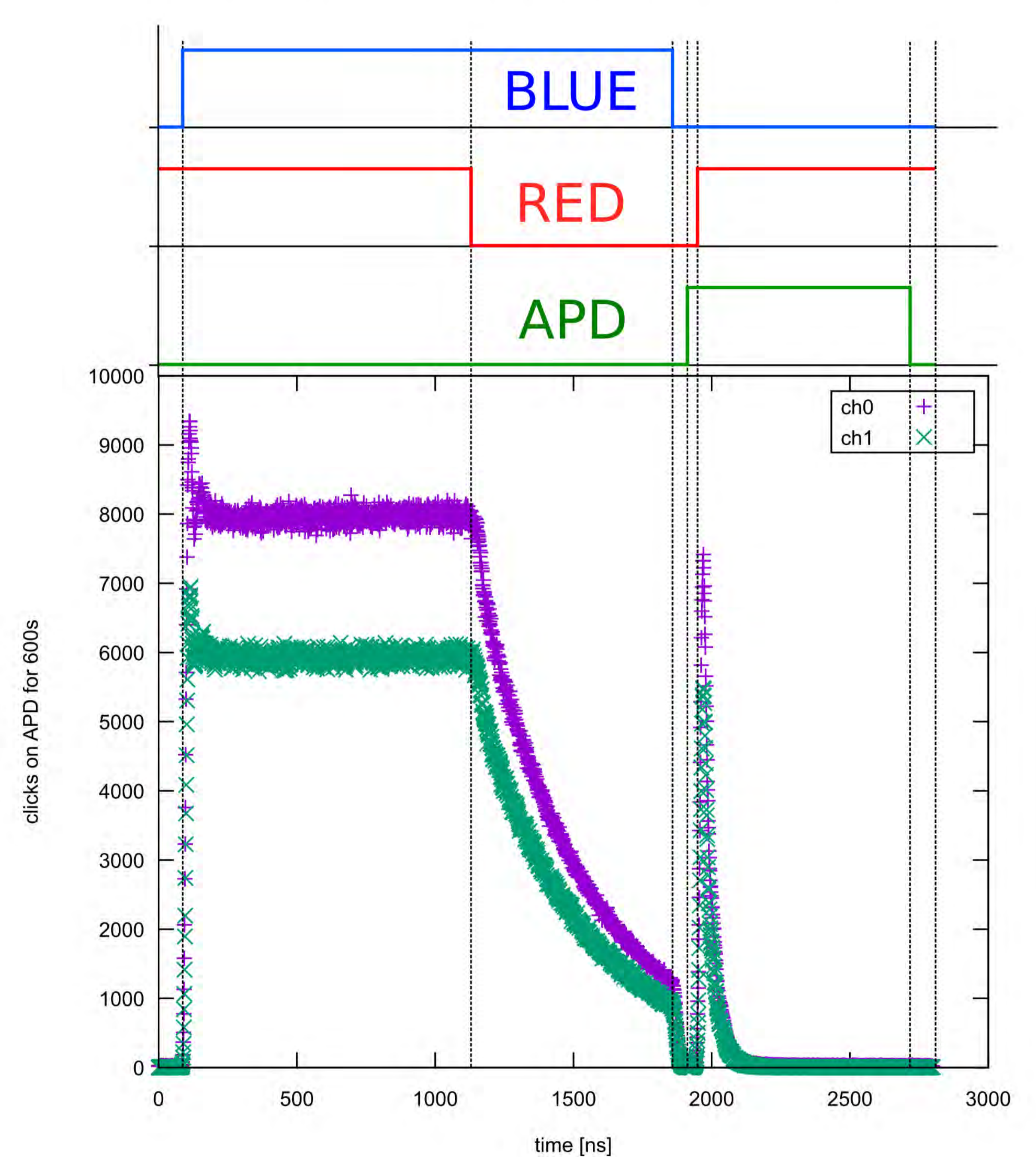
exact - no approximation
criterion uses measurable quantity



Scheme for detection of nonclassicality



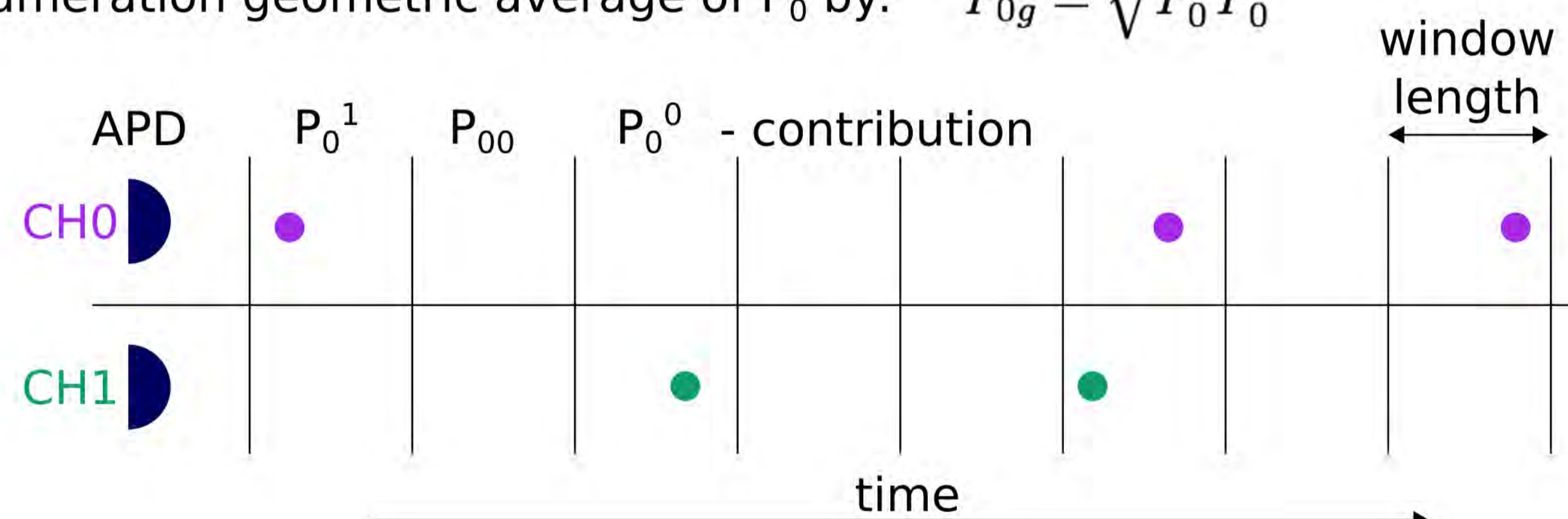
Measurement in pulse sequence



Processing of measured data

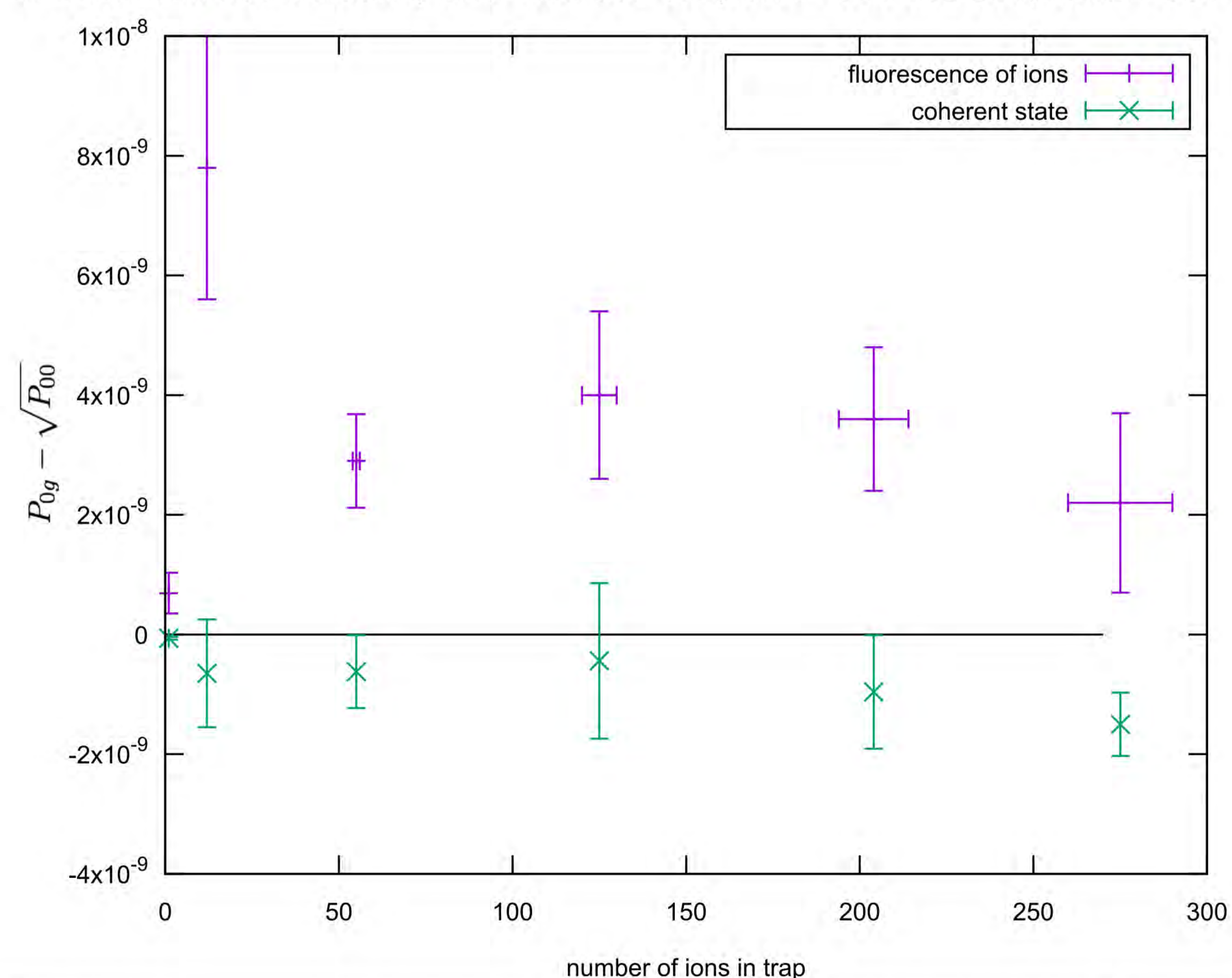
From number of single-clicks and no-clicks calculate probability

Enumeration geometric average of P_0 by: $P_{0g} = \sqrt{P_0^0 P_0^1}$



Results from continual sequence

For 275ions, 5 hours measurement and 32nm window:
562 484 411 204 windows, CH0=662 997 081, CH1= 567 105 311, coinc.=667 381



Results from pulse sequence

For 275ions, 5 hours measurement and 2800nm sequence length:
6 428 392 108 windows, CH0=39 230 998, CH1= 34 895 172, coinc.=212 833

