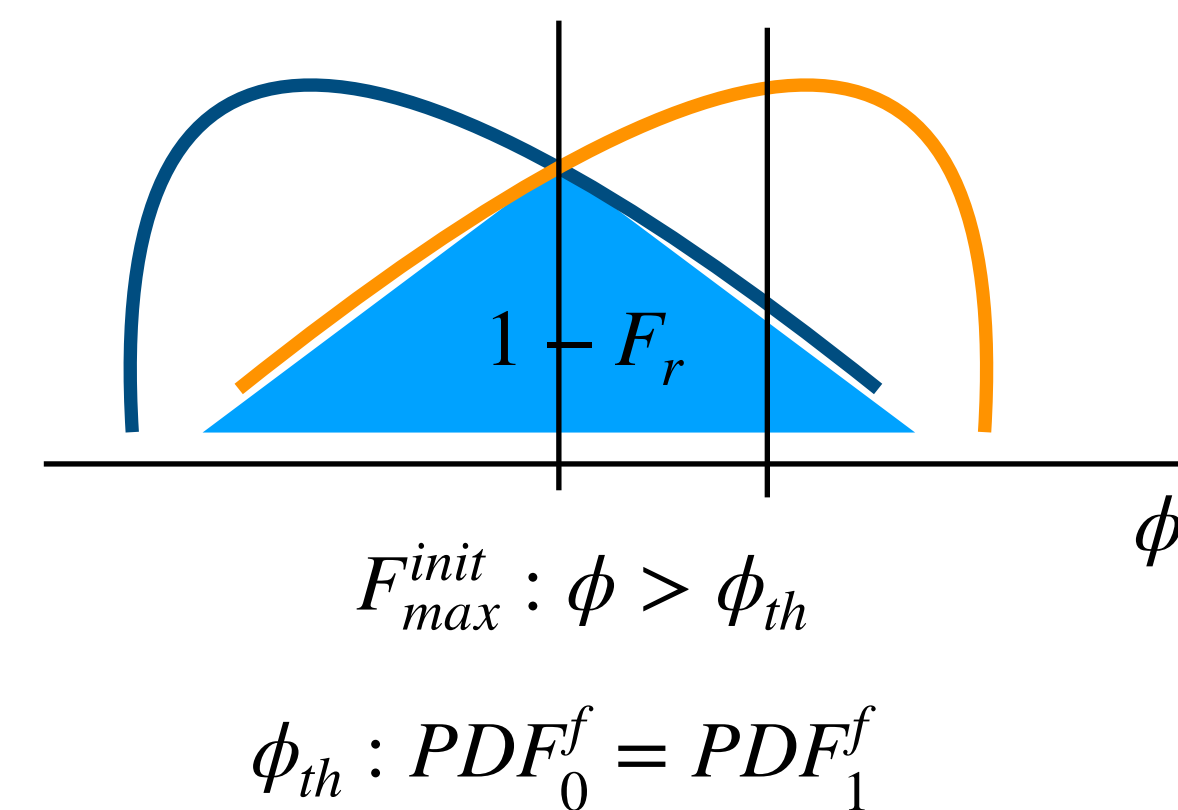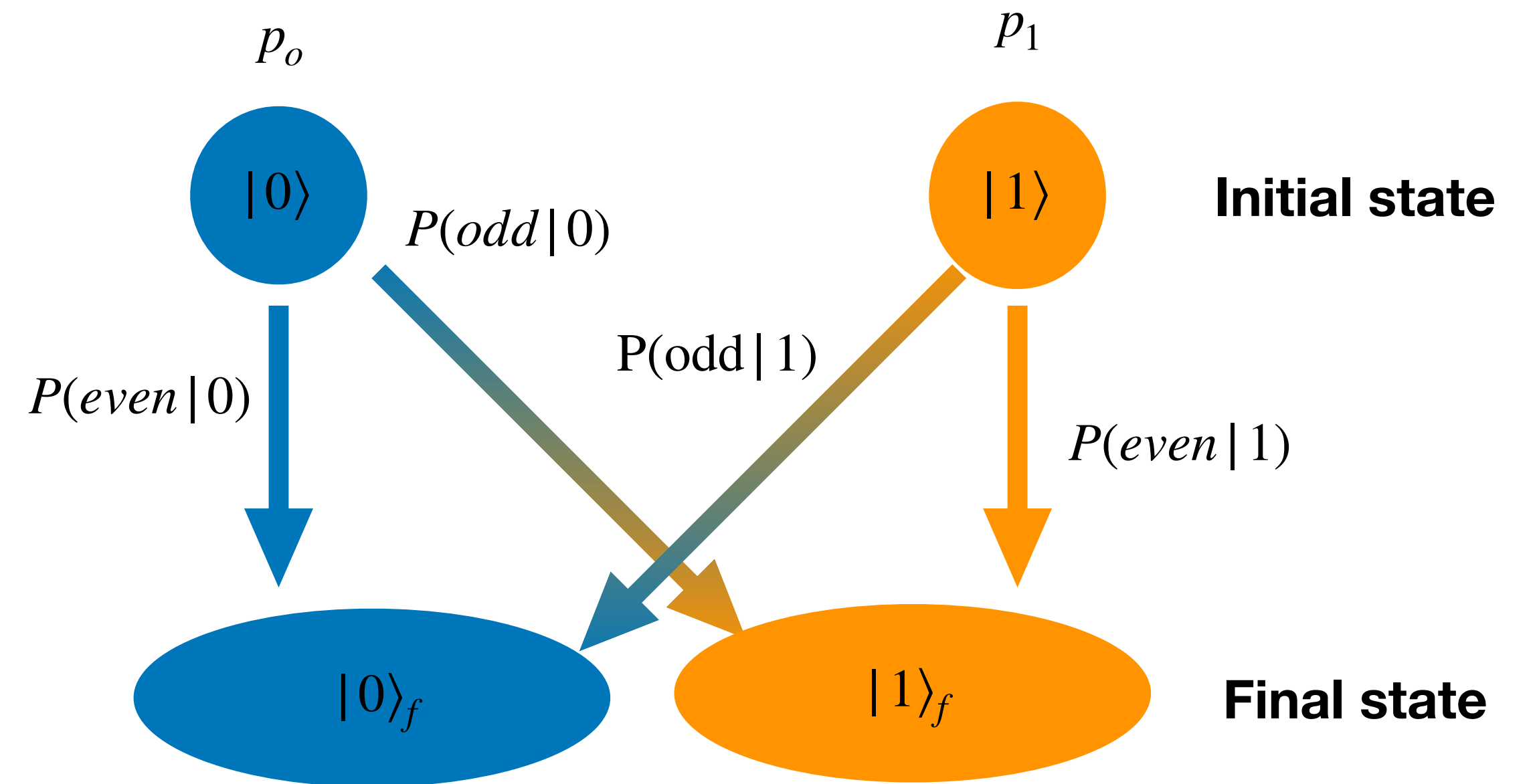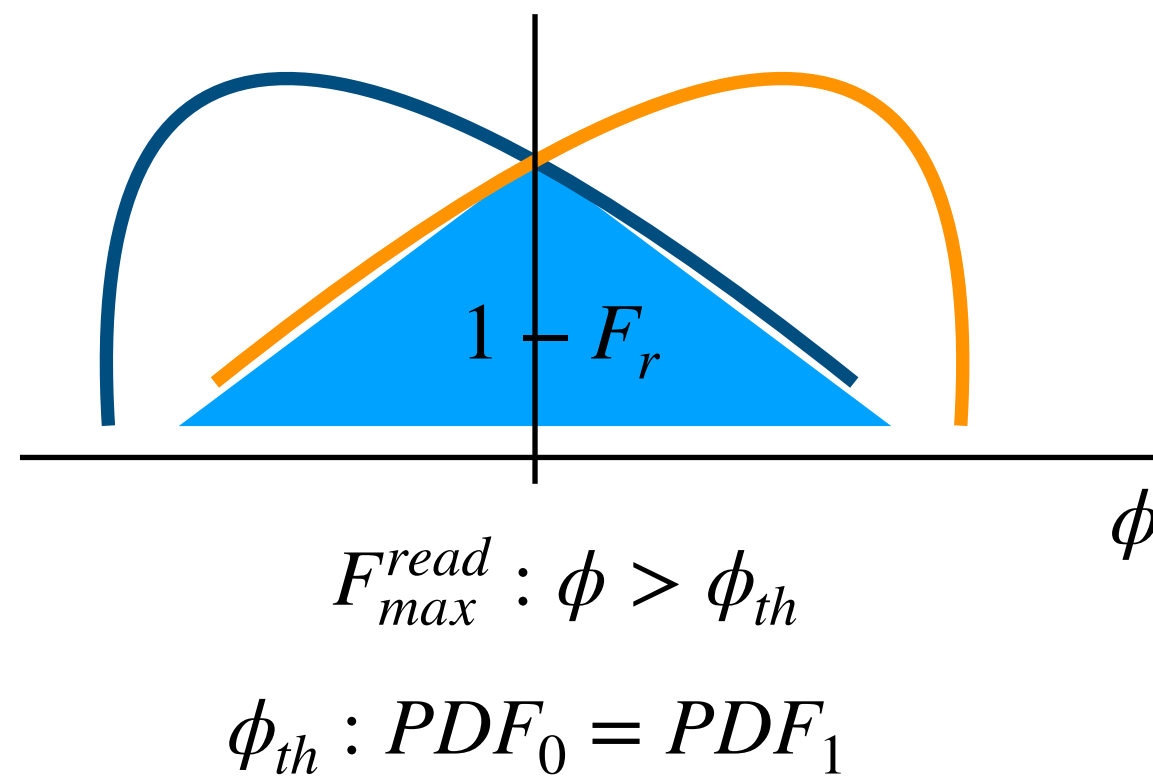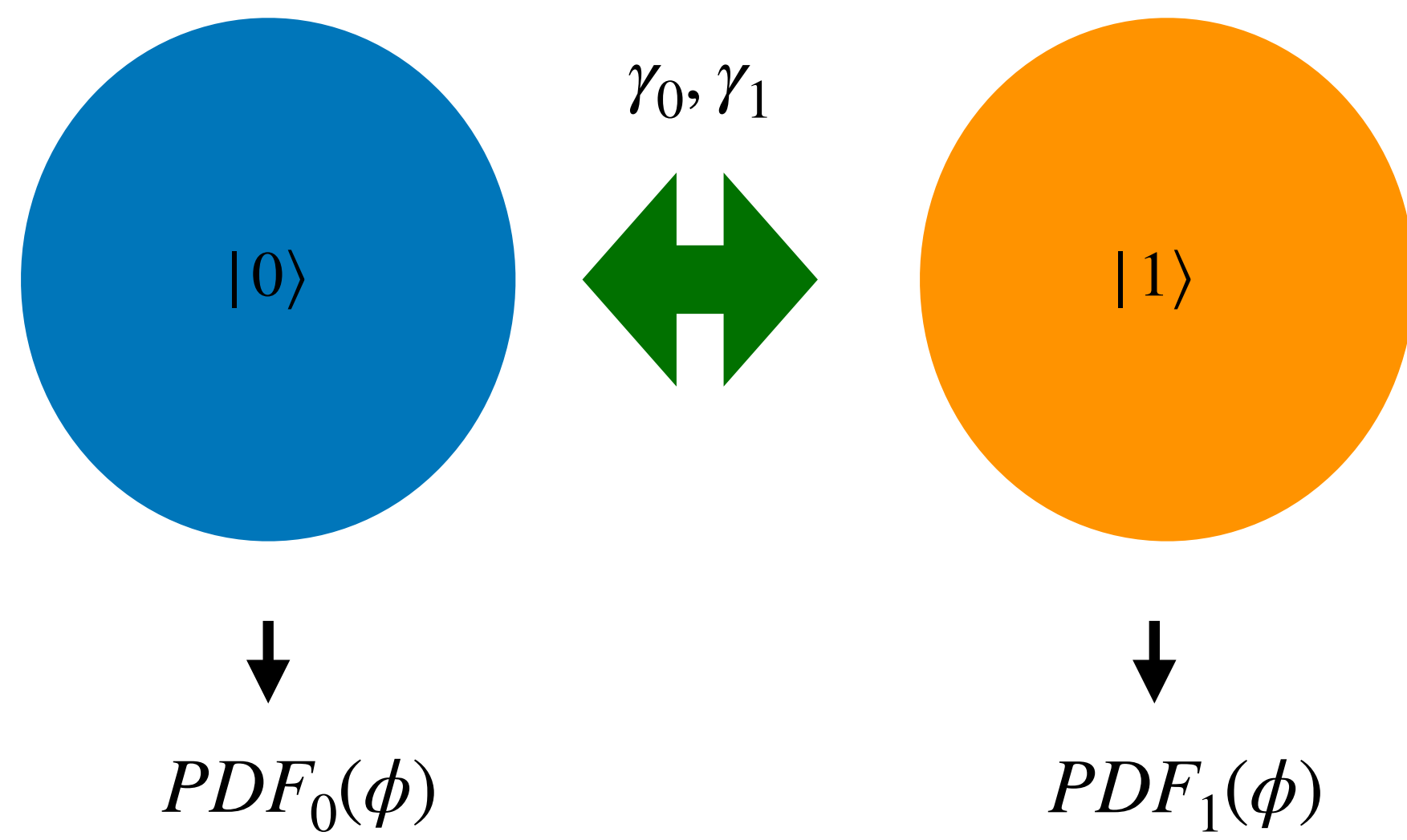# Punch line:
Postselection fidelity for non-QND measurements
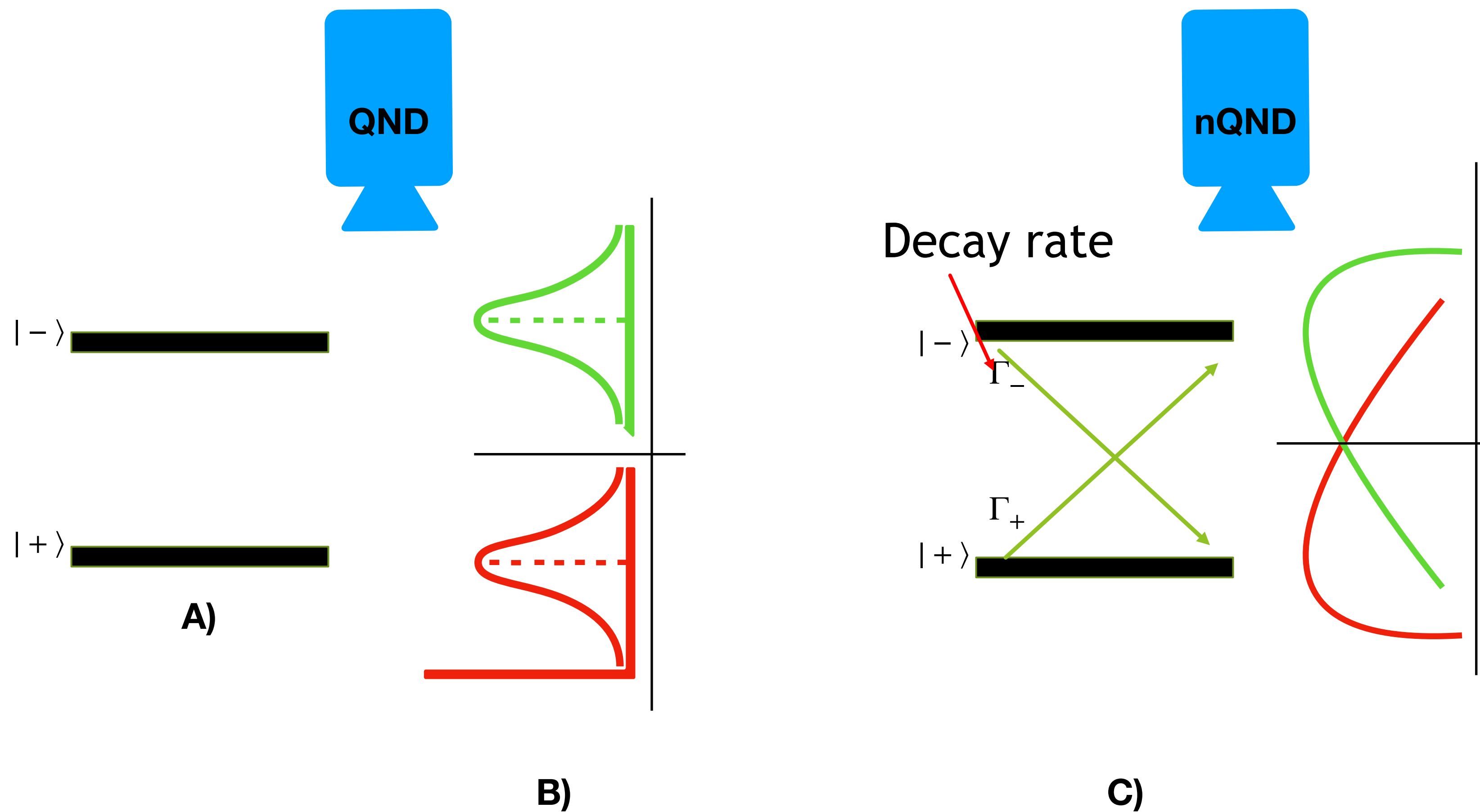
State classification problem

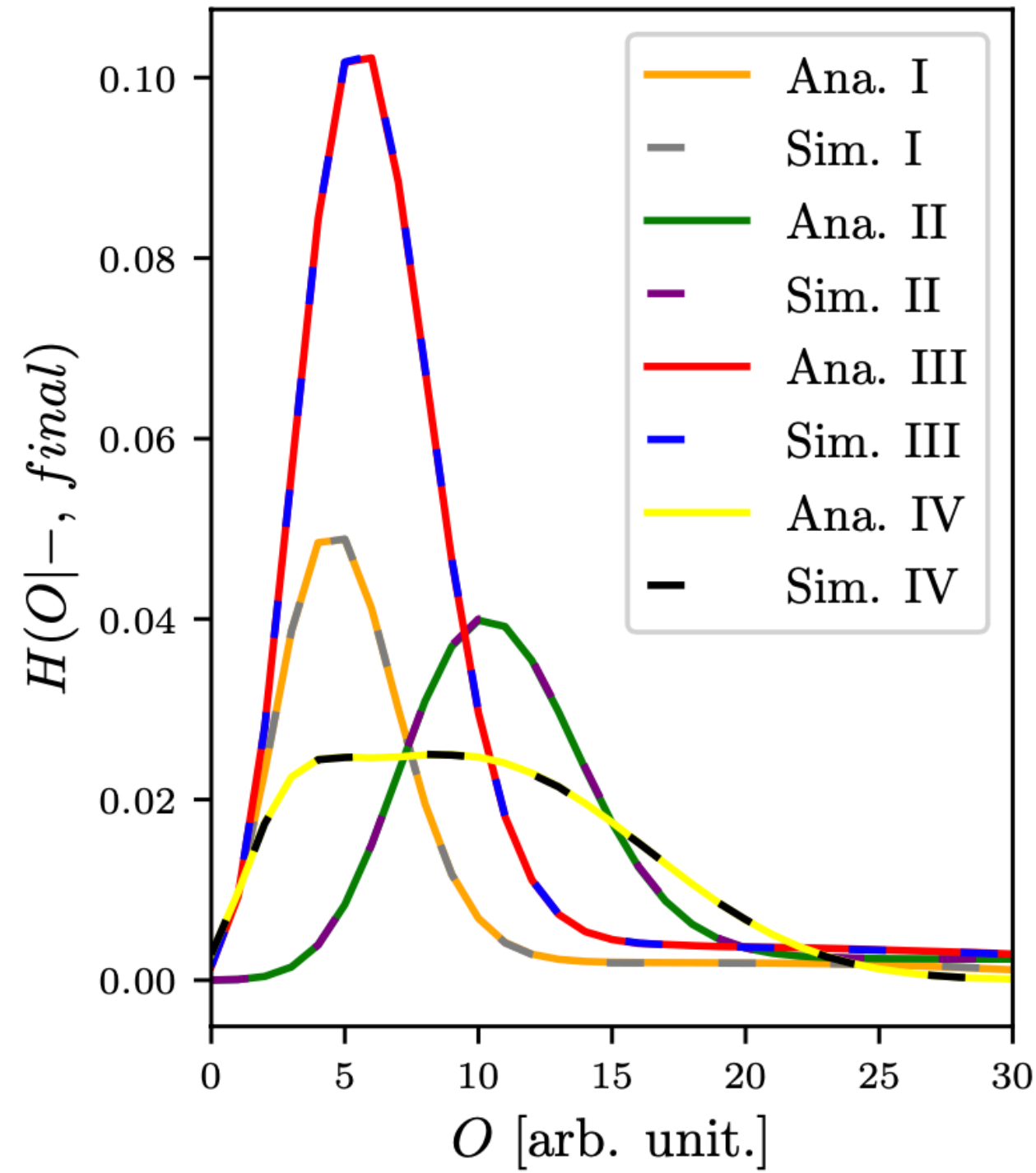A) Quantum system, Init by B) ideal QND measurement C) non-ideal QND

Readout fidelity vs Init fidelity

Init fidelity is not readout fidelity! Simple decay is not accurate.
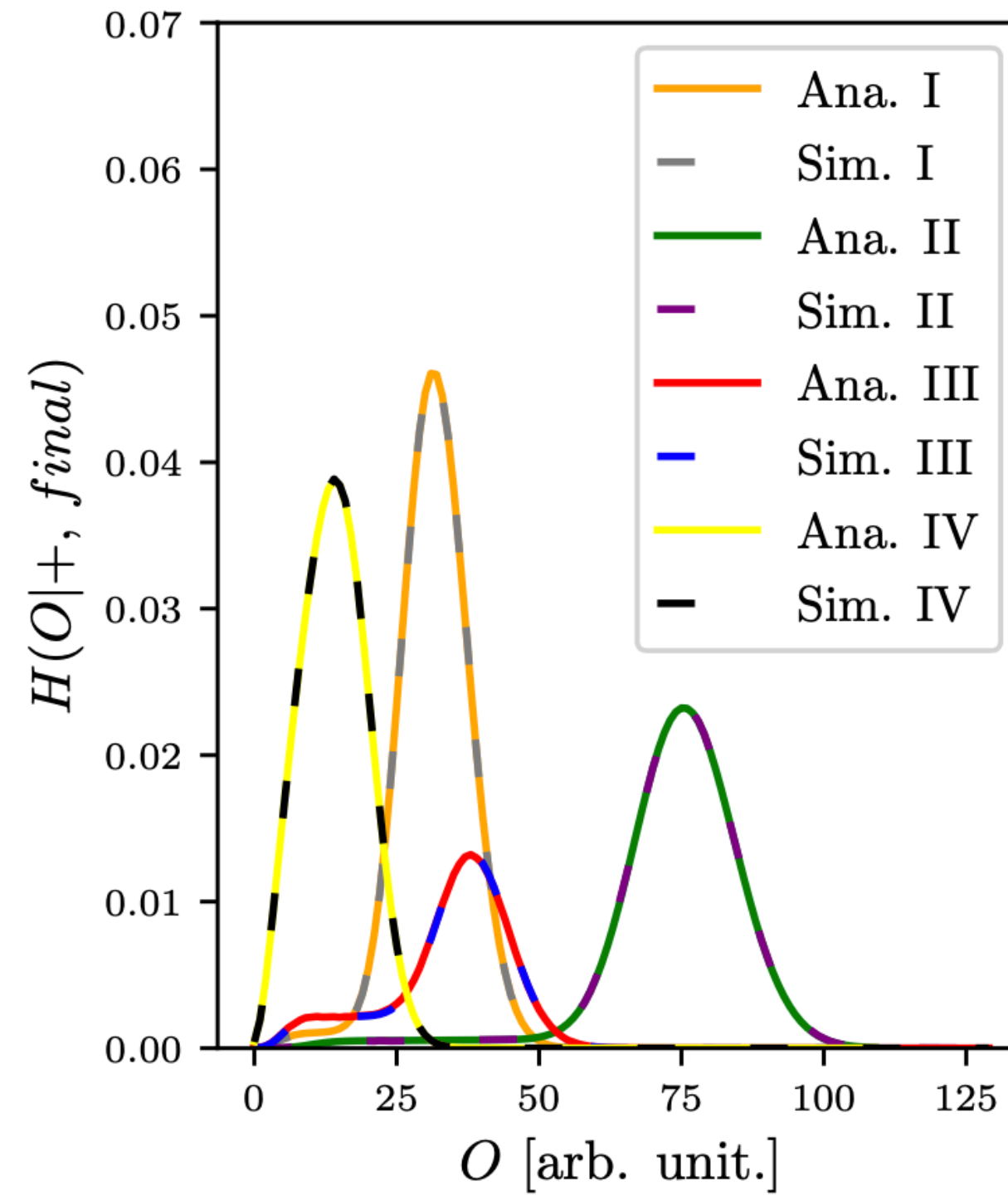
Photon counting statistics for postselection
Model vs Theory:
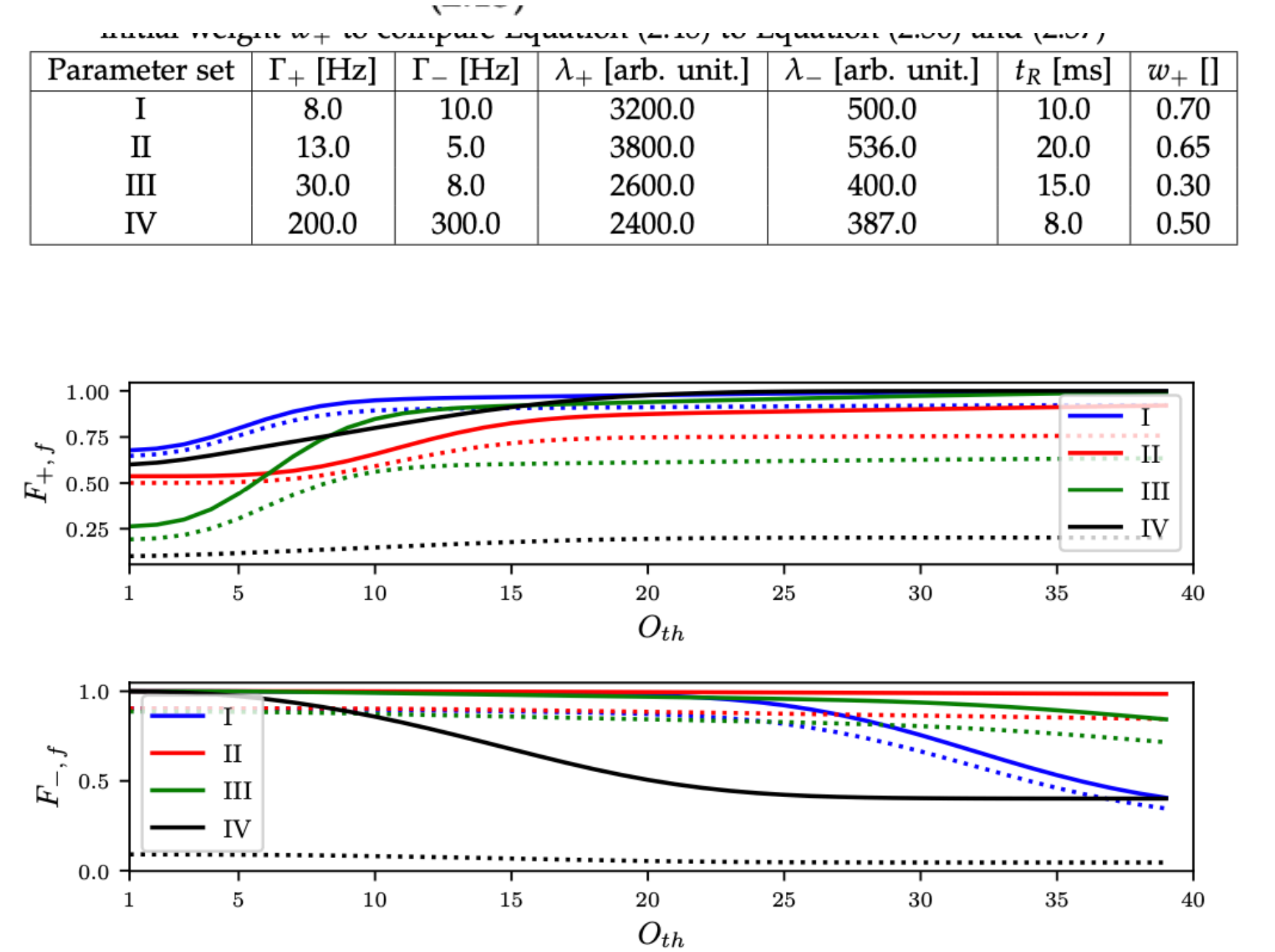
$$H(O|+_f) = w_+ P(O|+, even) + w_- P(O|-, odd) .$$

Parameter set	Γ_+ [Hz]	Γ_- [Hz]	λ_+ [arb. unit.]	λ_- [arb. unit.]	t_R [ms]	w_+ []
I	8.0	10.0	3200.0	500.0	10.0	0.70
II	13.0	5.0	3800.0	536.0	20.0	0.65
III	30.0	8.0	2600.0	400.0	15.0	0.30
IV	200.0	300.0	2400.0	387.0	8.0	0.50

(a)   (b)

Figure 7: Visualisation of the fidelities $F_{\pm,f}(t_R, O_{th})$ to initialize a quantum state by a projective measurement with post-selection on different thresholds O_{th} correctly. Solid lines represent the results of Equation (2.36) and (2.37) and dotted lines those of Equation (2.48). As parameters, the sets from Table 1 were used.

Table 2: ionisation Γ_{NV^-}, recombination Γ_{NV^0} and average fluorescence rates λ_{NV^-}, λ_{NV^0} of the NV-Center under orange laser illumination of different power P. The parameters were extracted using the fit model of Equation (2.16).

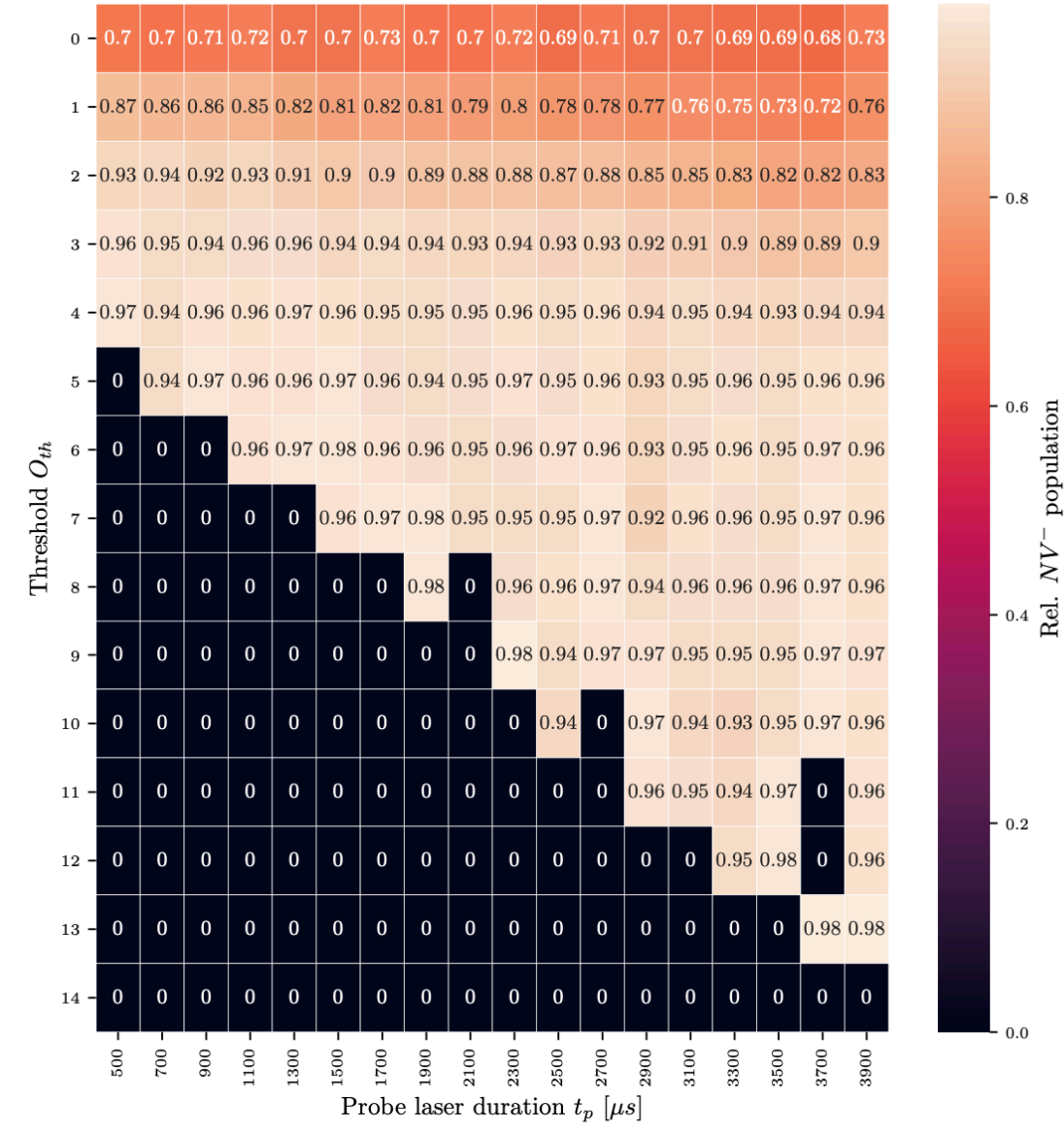| P [μW]	Γ_{NV^-} [Hz]	Γ_{NV^0} [Hz]	λ_{NV^-} cps	λ_{NV^0} cps
1.0	0.008	0.0005	3515.15	474.21
5.0	5.888	0.9375	10494.24	1311.68
12.0	254.880	30.5531	26309.98	3304.55
22.5	761.829	92.9501	42909.85	5534.73

(a)

(b)

(c)

(d)
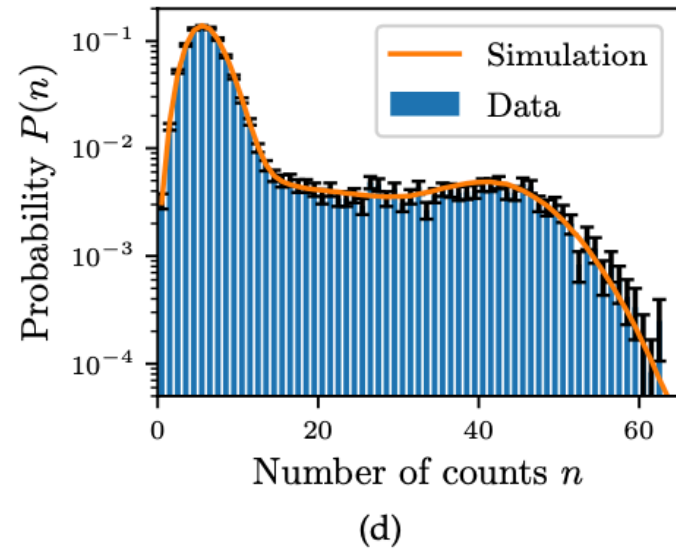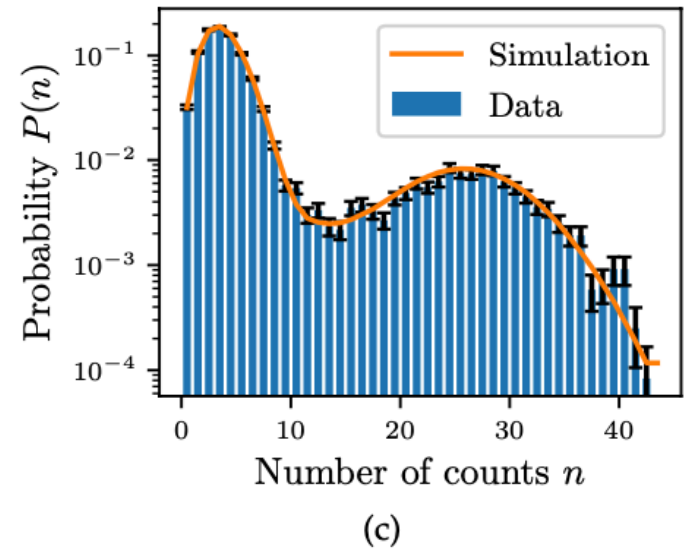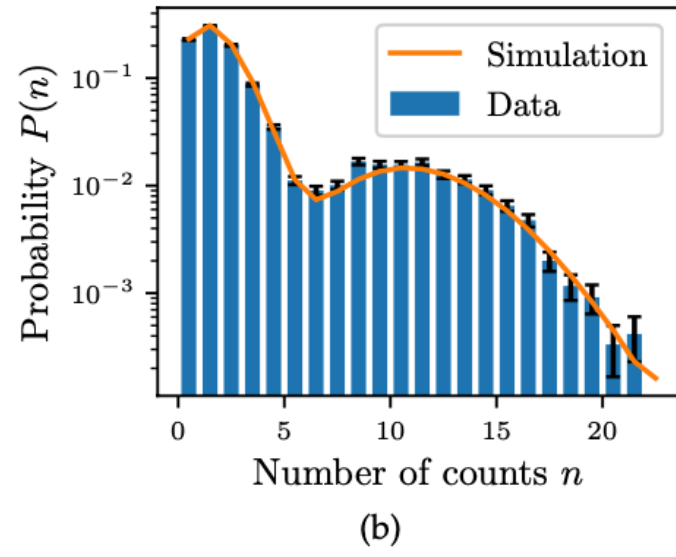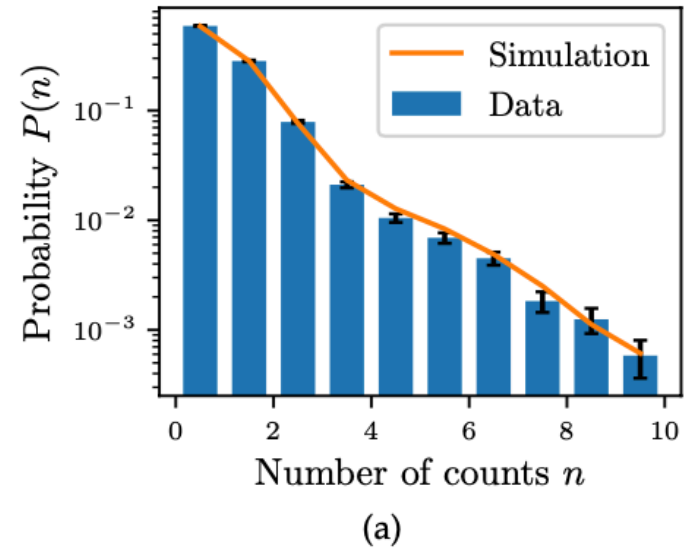
Figure 23: Relative NV$^-$ population for varying probe laser durations t_p and thresholds O_{th} at a power of 200 nW. The duration of the readout laser was $t_r = 5400\,\mu s$. Zeros are inserted at points, where there was not enough data available or the fit gave inaccurate results.
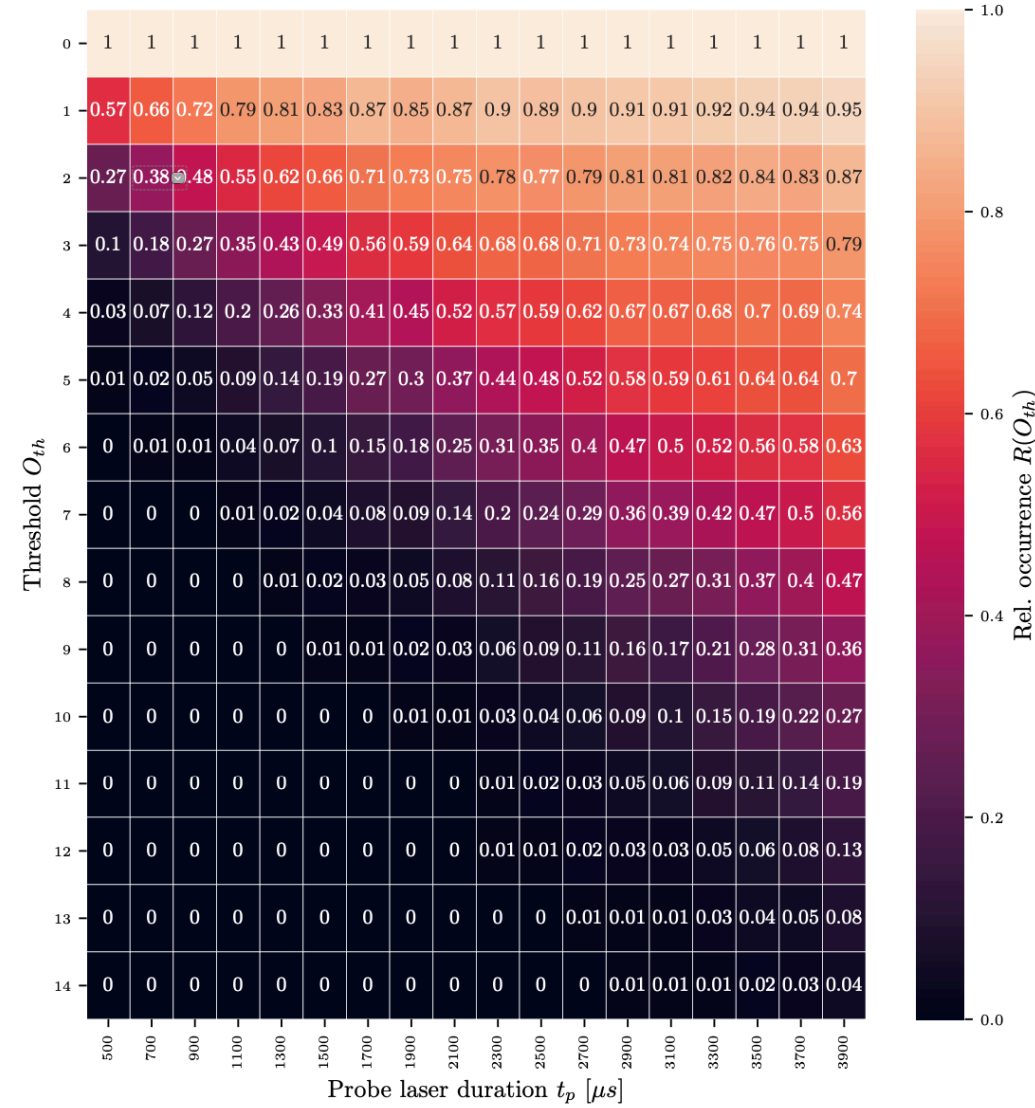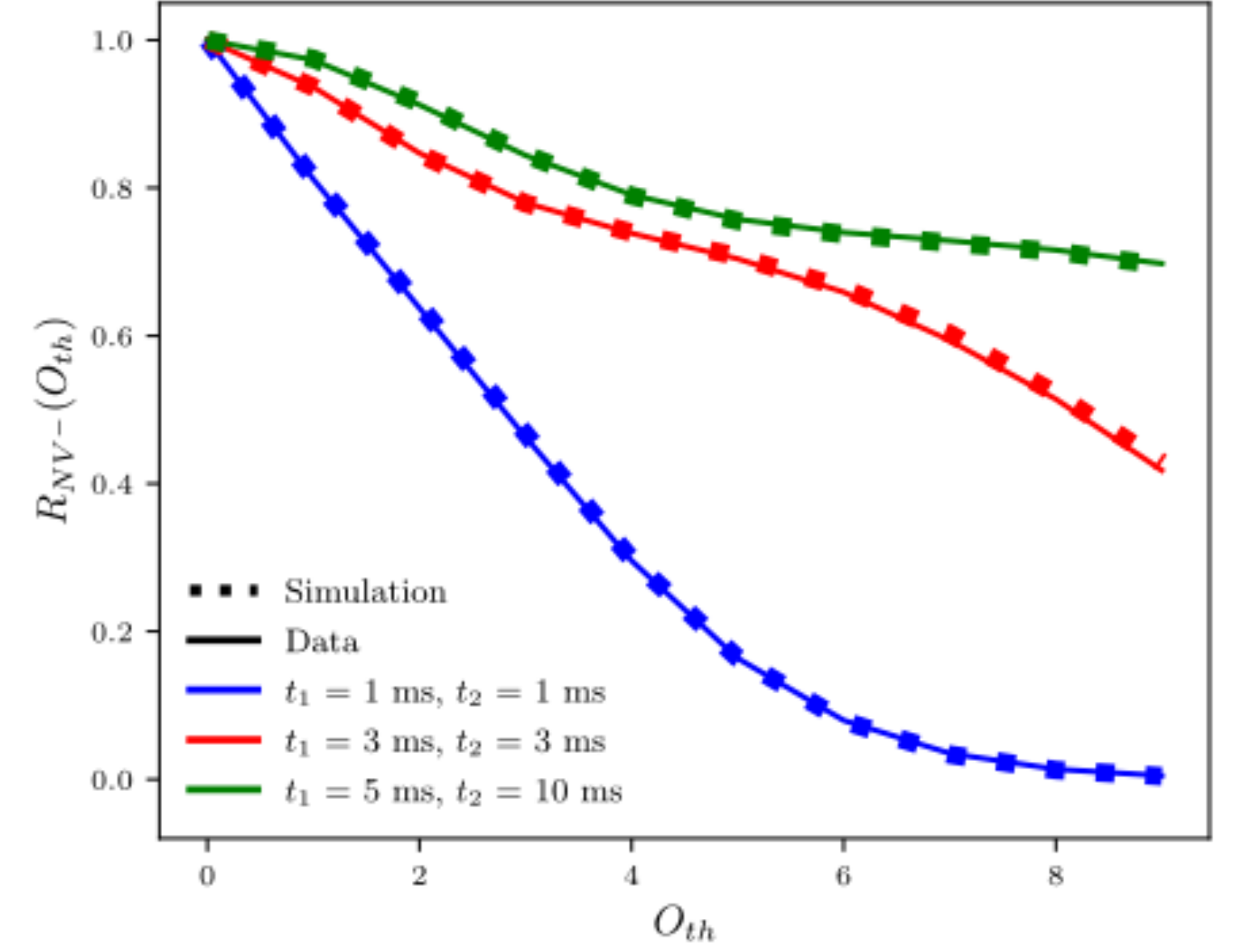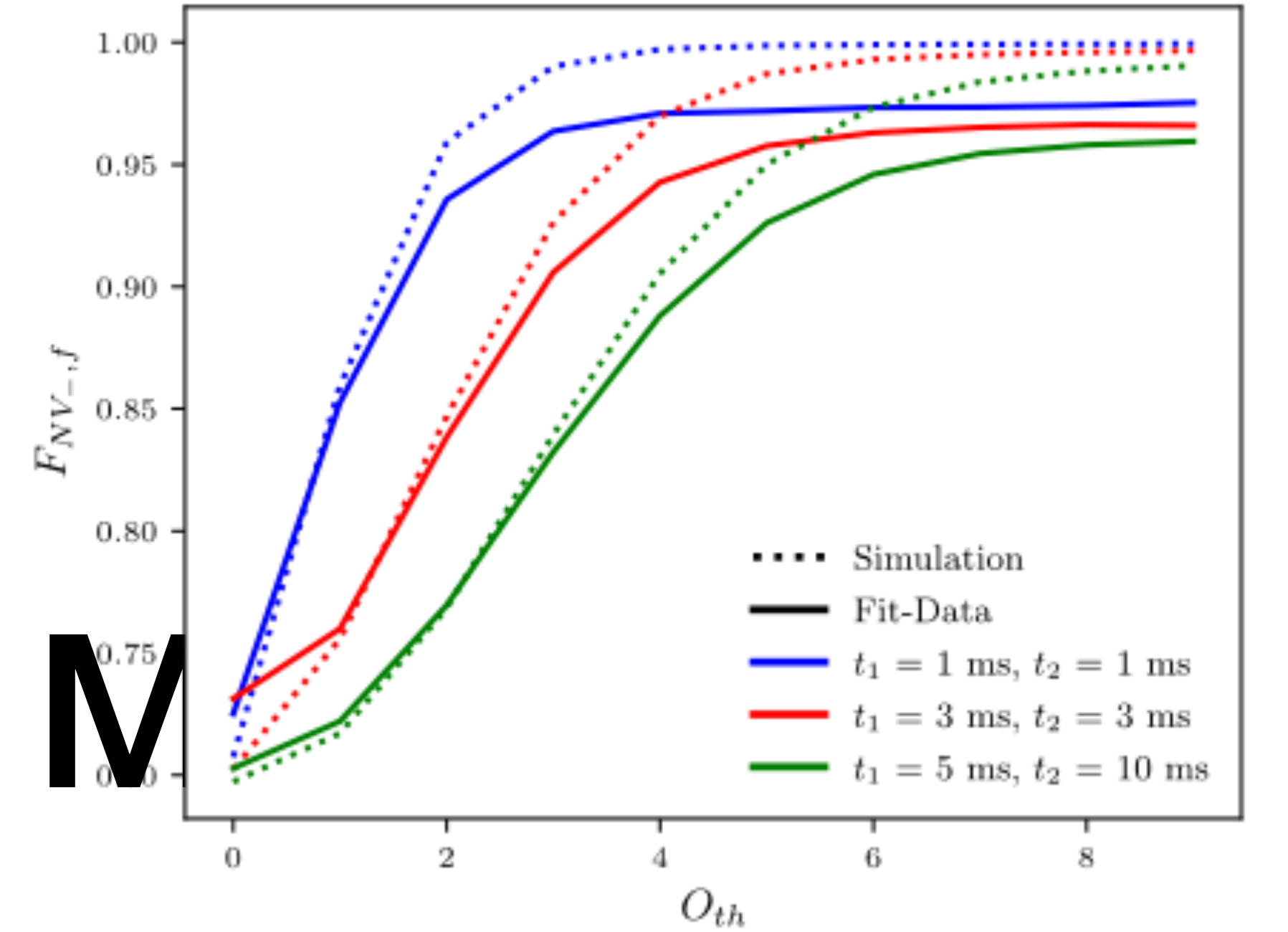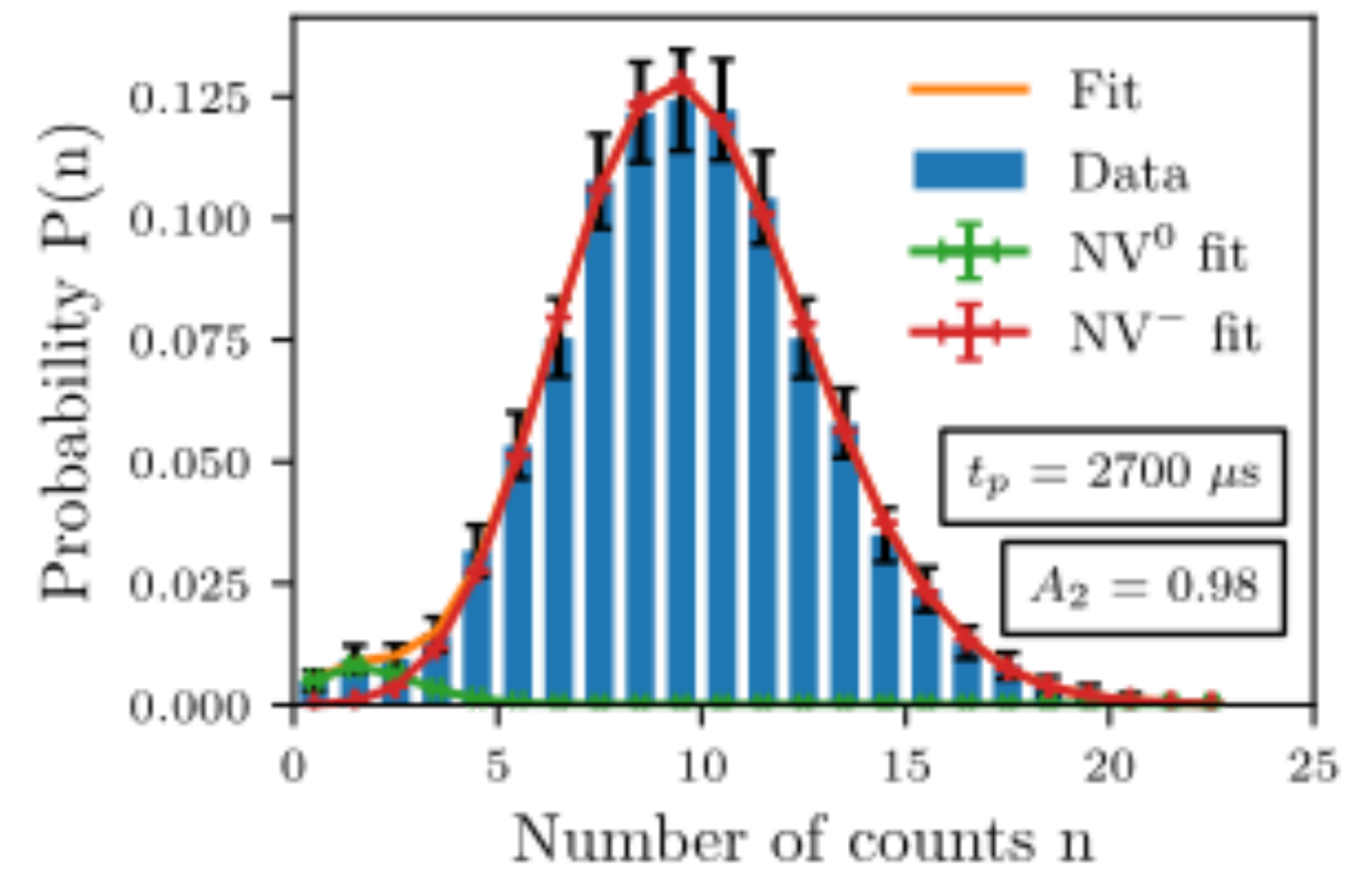
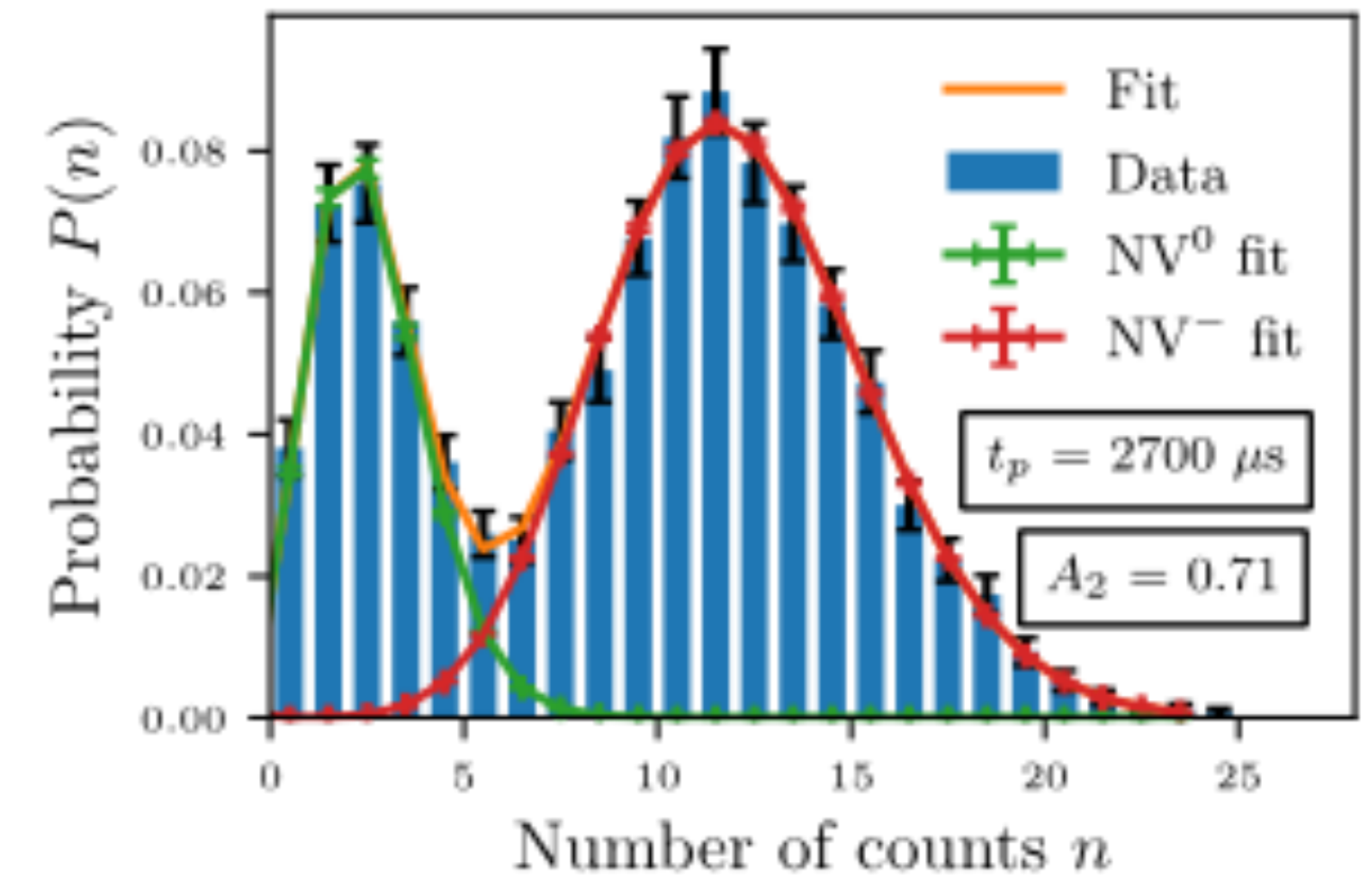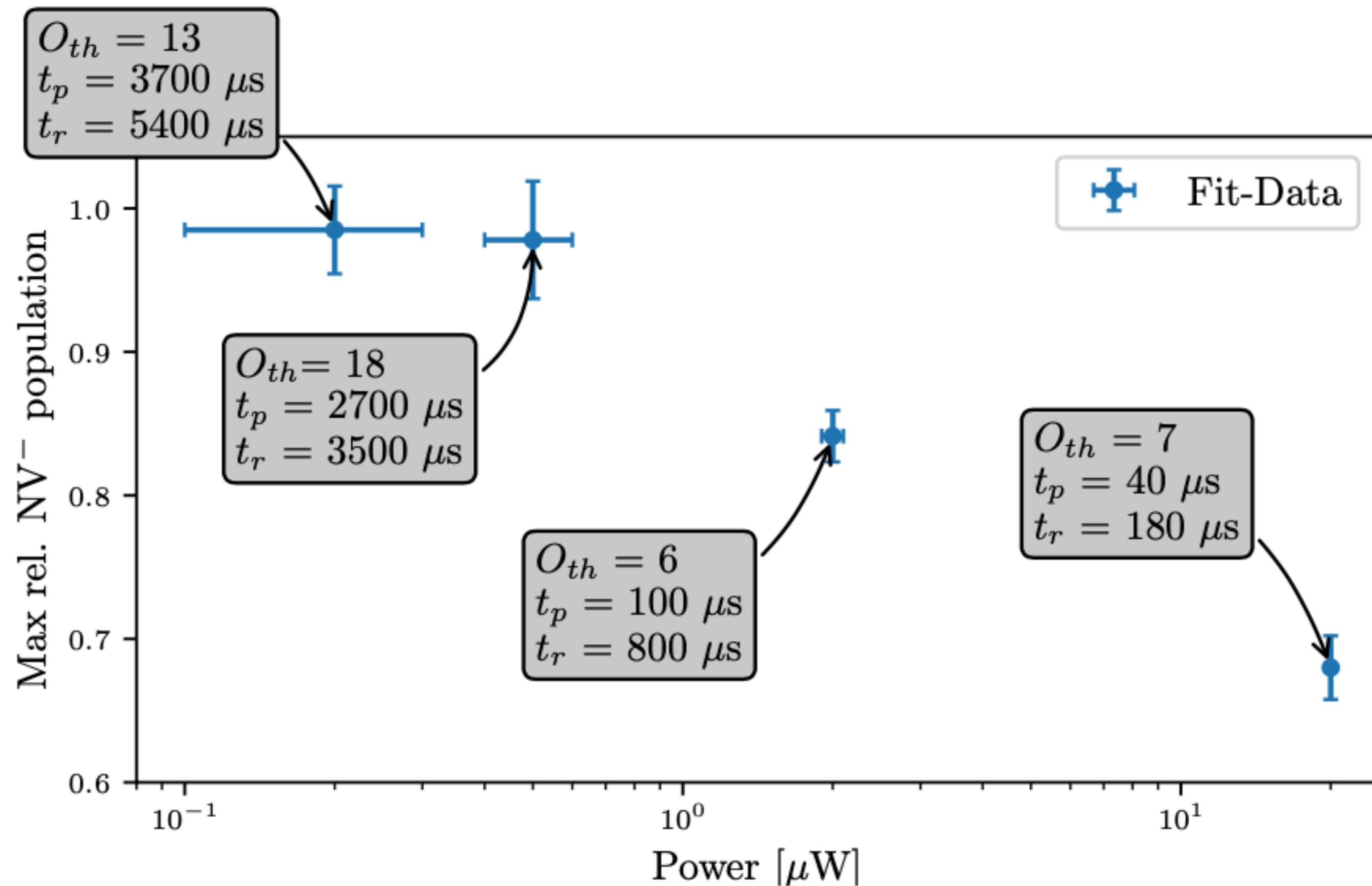

Figure 25: Rel. occurrences $R(O_{th})$ for varying probe laser durations t_p and thresholds O_{th} at a laser power of $P = 200$ nW.

Expe   s M

Real time initialization