Description of the code noisyqpa.f

The purpose of this code is to simulate the quantum privacy amplification protocol (QPA) [1] with a noisy apparatus. All possible single-qubit noise channels are considered. Details about the theoretical analysis are given in [2].

The input variables in the code (file noisyqpa.in) are:

- FALPHA, the intrusion parameter f_α characterizing the isotropic copying machine used by the eavesdropper;
- NMAP number of map iterations;
- NCHAN selects the noise channel
  - Noiseless channel for NCHAN=0
  - Bit flip channel for NCHAN=1
  - Phase flip channel for NCHAN=2
  - Bit-phase flip channel for NCHAN=3
  - Rotation about x-axis of the Bloch spher for NCHAN=4
  - Rotation about y-axis for NCHAN=5
  - Rotation about z-axis for NCHAN=6
  - Displacement of the Bloch sphere along the $+z$ axis for NCHAN=7
  - Displacement of the Bloch sphere along the $-z$ axis for NCHAN=8
  - Displacement of the Bloch sphere along the $+x$ axis for NCHAN=9
  - Displacement of the Bloch sphere along the $-x$ axis for NCHAN=10
  - Displacement of the Bloch sphere along the $+y$ axis for NCHAN=11
  - Displacement of the Bloch sphere along the $-y$ axis for NCHAN=12
  - Depolarizing channel for NCHAN=13
- THETA angle determining the noise strength

Note that the three columns of the output file noisyfido.dat give the number n of map iterations, $F(n)$ and $1 - F(n)$, while the three columns of the output file noisyeff.dat give n, P and $P/2^n$.

An example of a run of the program is shown in Fig. 1.

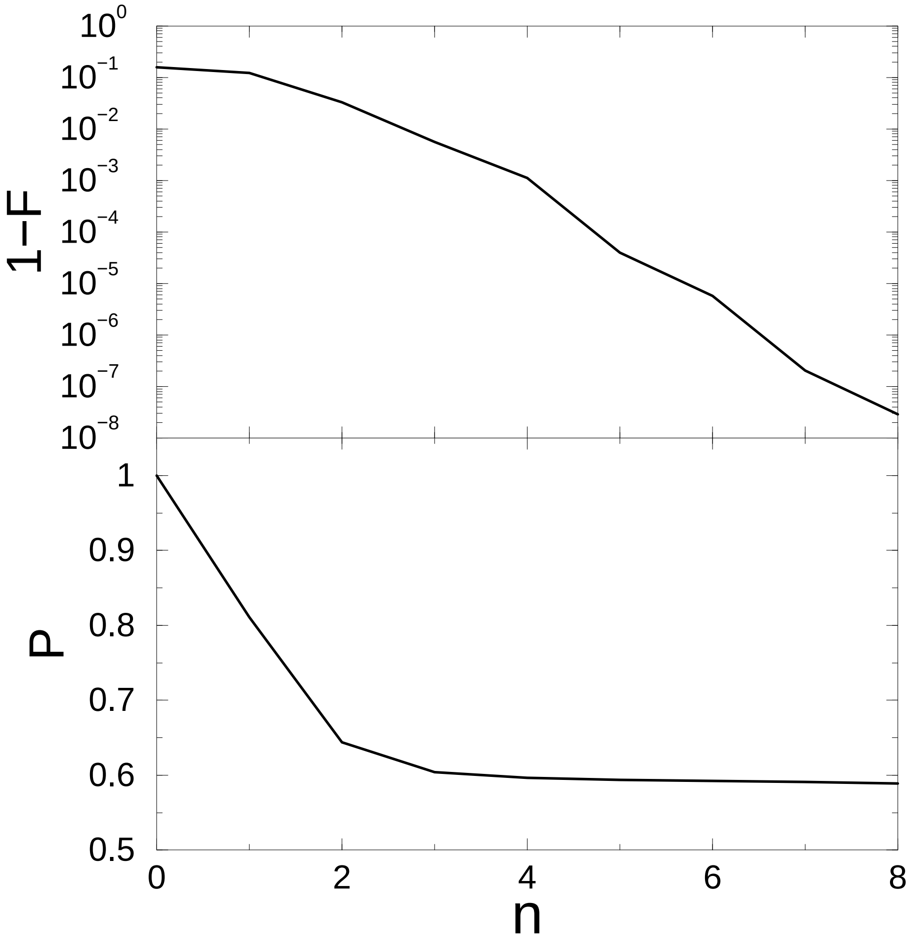

Figure 1: Deviation $1 - F$ of the fidelity F from the ideal case $F = 1$ (top) and the survival probability P (see definitions in Ref.[2]) as a function of the number n of steps of the QPA map, for FALPHA=0.95 and for the bit flip channel (NCHAN=1) at THETA=0.1.

References

[1] D. Deutsch, A. Ekert, R. Jozsa, C. Macchiavello, S. Popescu, and A. Sanpera, Phys. Rev. Lett. **77**, 2818 (1996).

[2] G. Benenti, S. Felloni and G. Strini, *Effects of single-qubit quantum noise on entanglement purification*, preprint quant-ph/0505177, to be published in Eur. Phys. J. D.