SECOND YEAR ANNUAL EXAM

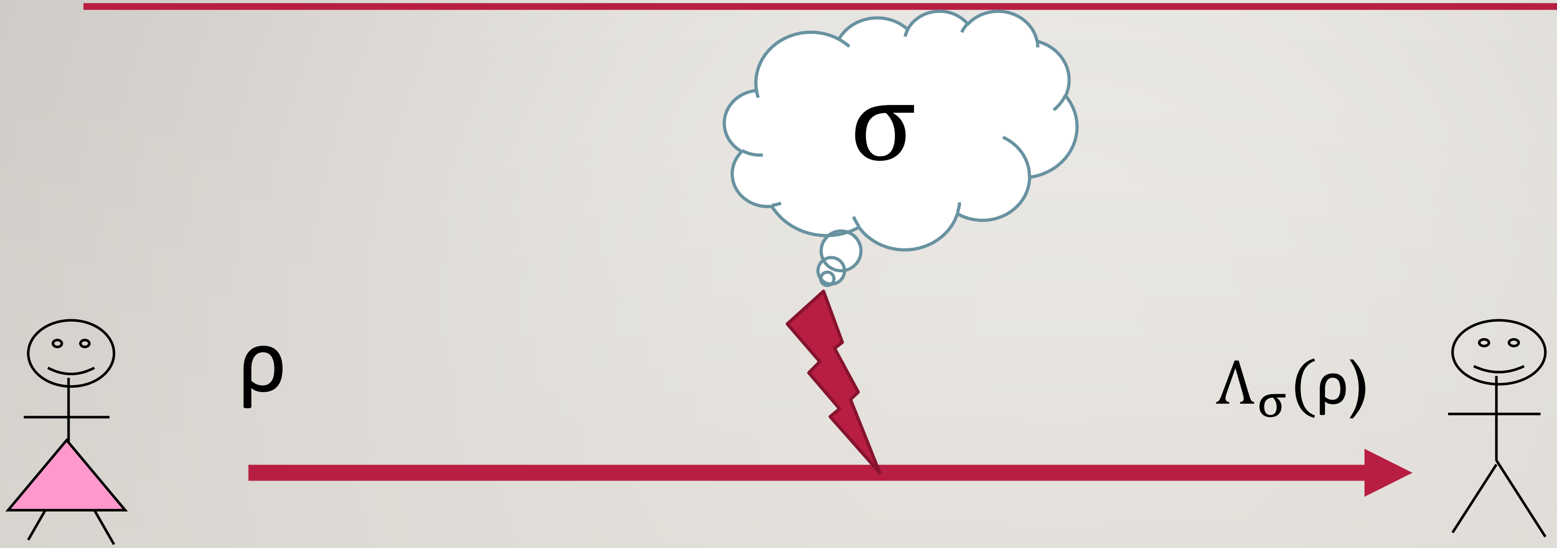
PRESENTED BY FARZAD KIANVASH

SUPERVISED BY PROFESSOR GIOVANNETTI

LIST OF SCIENTIFIC ACTIVITIES

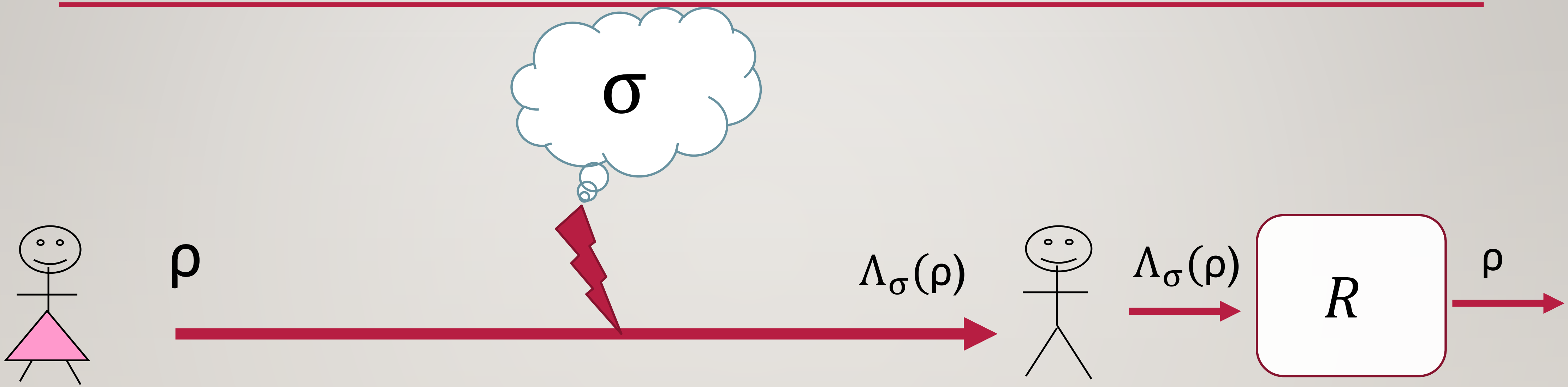
- Articles
  - Kianvash, F., Fanizza, M., & Giovannetti,V. (2019). **Optimal quantum subtracting machine**. *Physical Review A*, *99*(5), 052319.
  - Fanizza, M., Kianvash, F., & Giovannetti,V. **Quantum flags, and new bounds on the quantum capacity of the depolarizing channel.** (to be published on arxiv)
- Conferences
  - Quantum Measurement Conference in April in Trieste (poster presented)
  - Quantum Information Conference in June in Benasque
  - Italian Quantum Information Conference In September in Milan (poster presented)
- Course
  - Scientific English Course by Professor Wallwork

QUANTUM COMMUNICATION AND RECOVERY



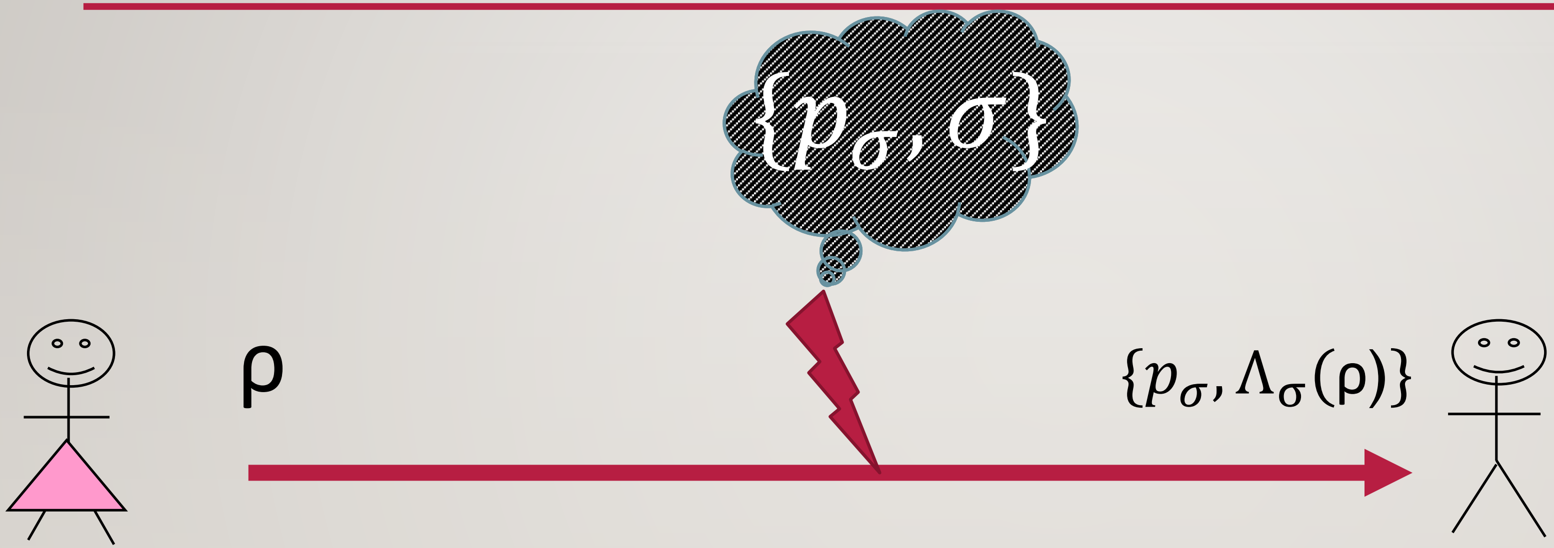
Λ_σ is a completely positive trace preserving (CPTP) map depending on the state of the environment σ.

QUANTUM COMMUNICATION AND RECOVERY



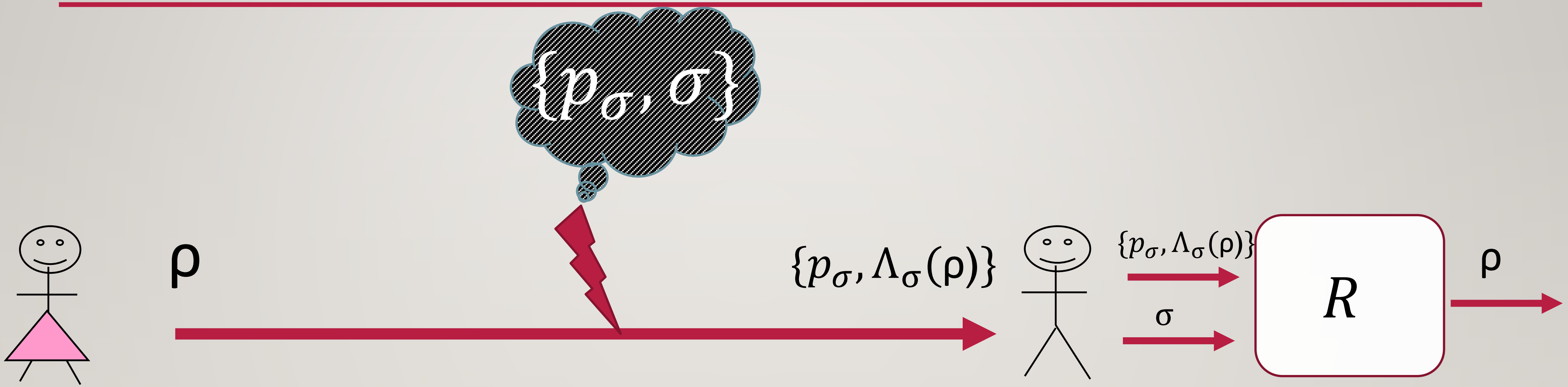
Λ_σ is a completely positive trace preserving (CPT) map depending on the state of the environment σ.

RECOVERY WHEN ENVIRONMENT IS NOT KNOWN EXACTLY



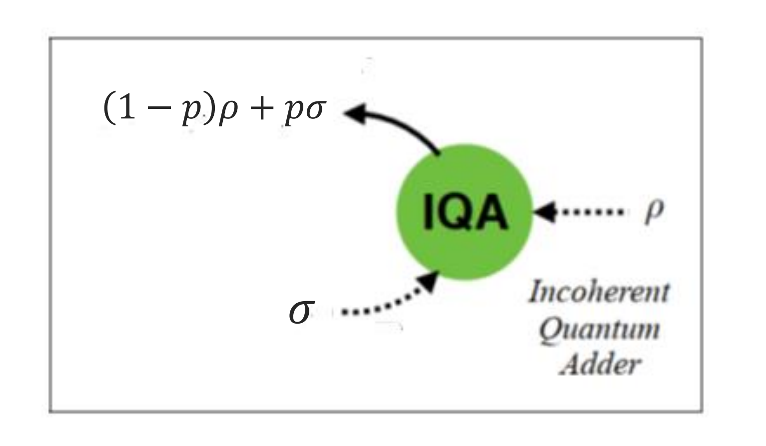
In this setting Bob doesn't know the state of the environment exactly instead he collects some copies of the environment.
The motivation is that we cannot always track the environment.

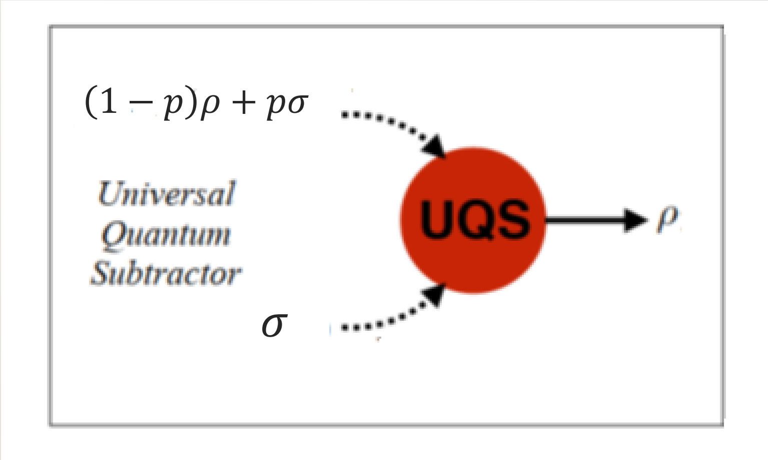
RECOVERY WHEN ENVIRONMENT IS NOT KNOWN EXACTLY



In this setting Bob doesn't know the state of the environment exactly instead he collects some copies of the environment.
The motivation is that we cannot always track the environment.

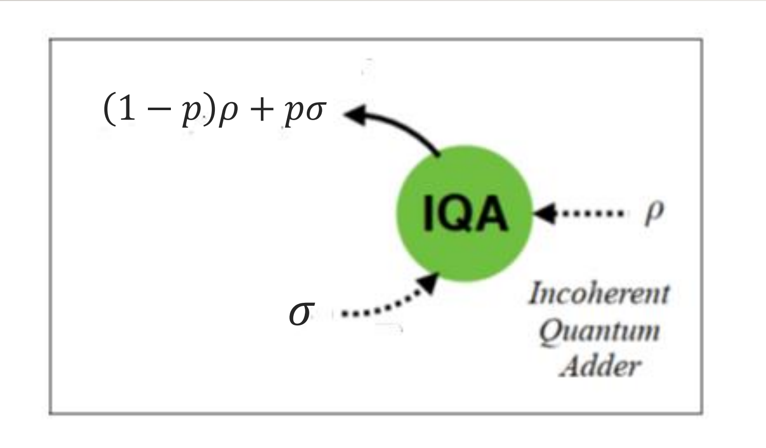
AN EXAMPLE: QUANTUM SUBTRACTING MACHINE



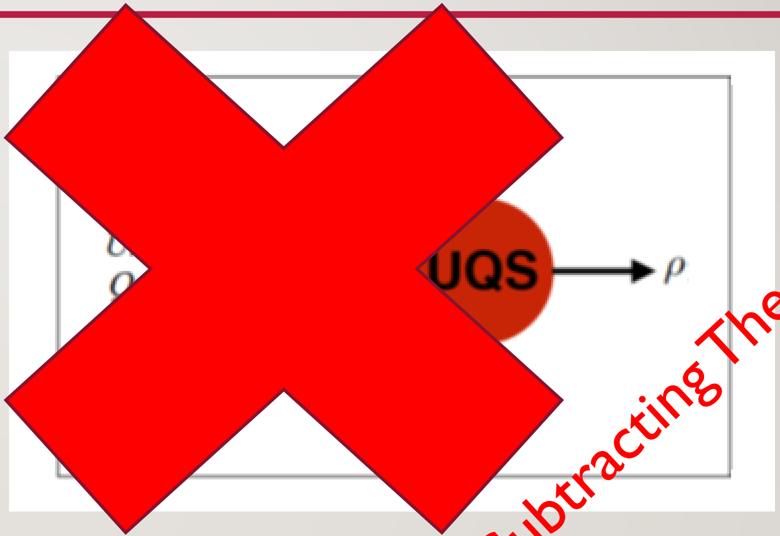


U. Alvarez-Rodrigueze, et al, Sci. Rep. **5**, 11983 (2015)

AN EXAMPLE: QUANTUM SUBTRACTING MACHINE



U. Alvarez-Rodrigueze, et al, Sci. Rep. **5**, 11983 (2015)



No Subtracting Theorem: $\bar{F} < 1$

$$\bar{F} = \max_{R} \int F\big(R\big[\big((1-p)\rho + p\sigma\big)\otimes\sigma\big], \rho\big)\, d\rho\, d\sigma,$$

Where $F(\rho_1, \rho_2) := \left(Tr\left[\sqrt{\sqrt{\rho_1}\rho_2\sqrt{\rho_1}}\right]\right)^2.$

A TOY MODEL: DEPOLARIZING CHANNEL WITH QUANTUM FLAGS

- Depolarizing Channel is

$$\Lambda(\rho) = (1-p)\rho + p\frac{\mathrm{I}}{2}$$

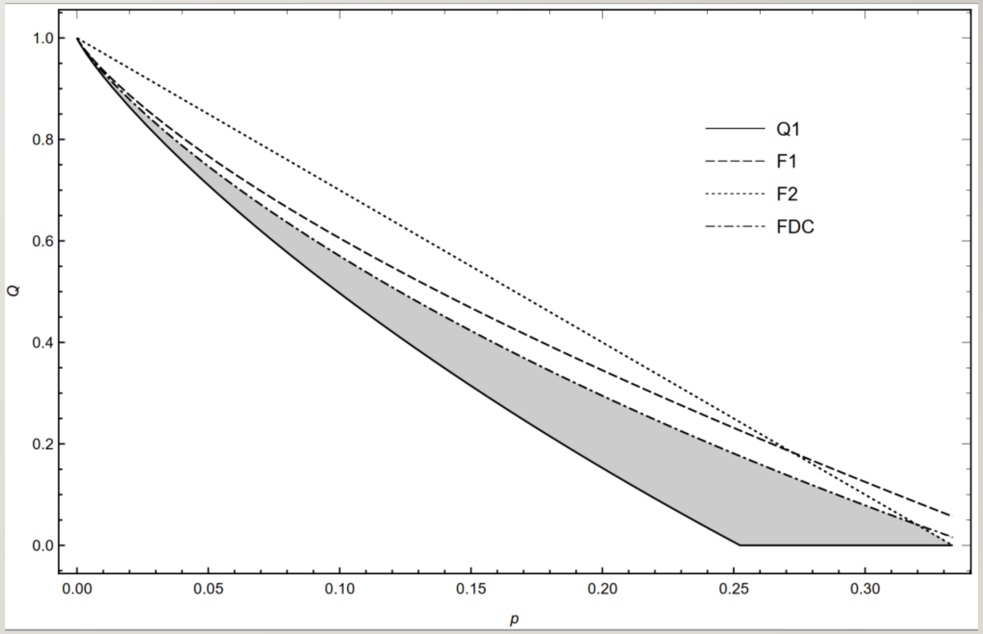
- Depolarizing Channel with Quantum Flags

$$\Lambda(\rho) = (1-p)\rho\otimes\sigma_1 + p\frac{\mathrm{I}}{2}\otimes\sigma_2$$

We can compute the quantum capacity of the

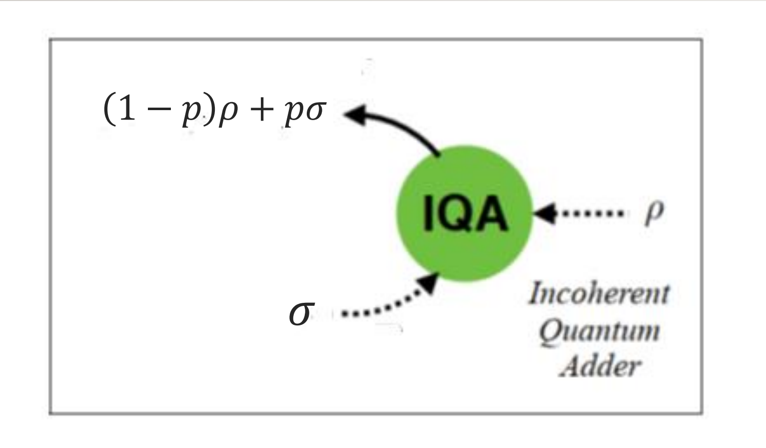
the channel with flags, and we get an upper bound on

the quantum capacity of depolarizing channel.

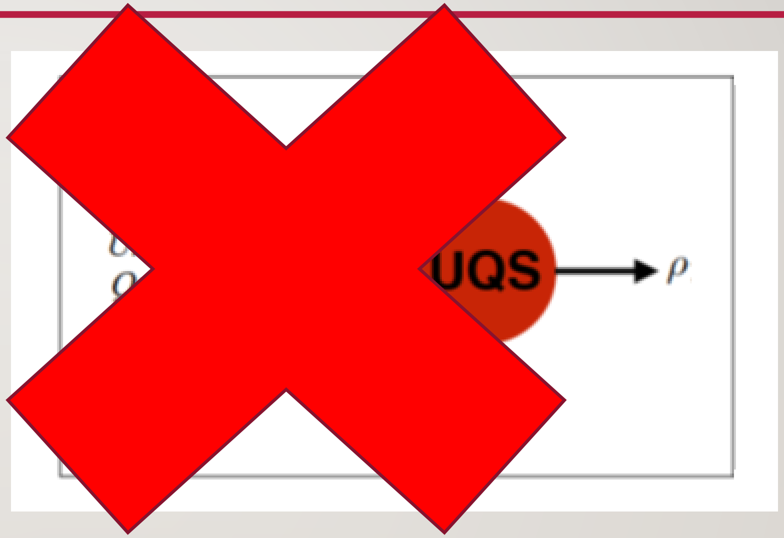


Smith, G., & Smolin, J. A. (2008, May). Additive extensions of a quantum channel. In *2008 IEEE Information Theory Workshop* (pp. 368-372). IEEE.

QUANTUM SUBTRACTING MACHINE



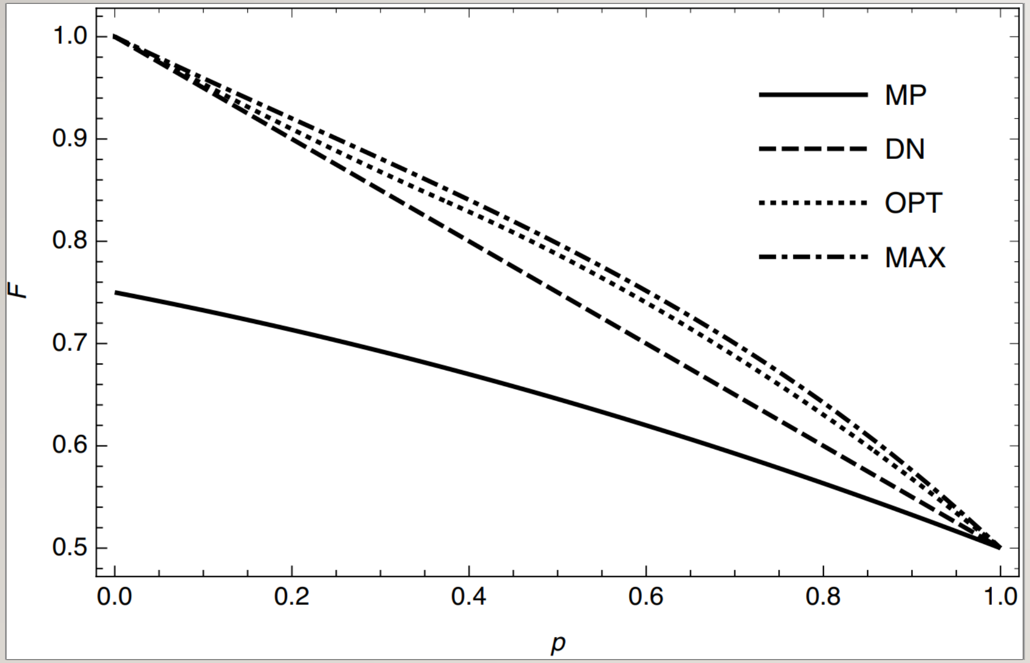
U. Alvarez-Rodrigueze, et al, Sci. Rep. **5**, 11983 (2015)



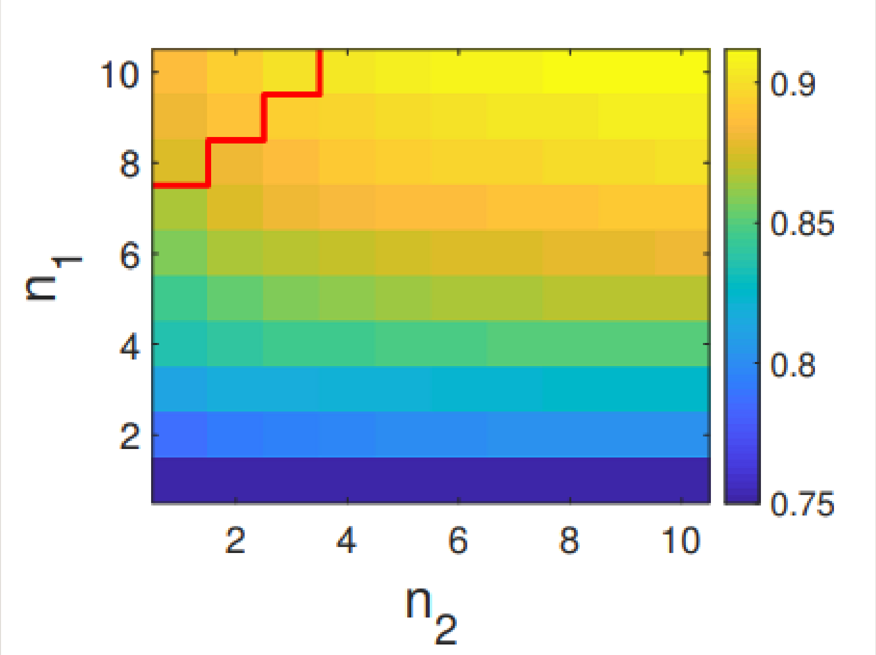
$$\overline{F_{n_1,n_2}} = \max_R \int F\left(R_{n_1,n_2}\left[\left((1-p)\rho + p\sigma\right)^{\otimes n_1} \otimes \sigma^{\otimes n_2}\right], \rho\right)\, d\rho\, d\sigma,$$

Where $F(\rho_1, \rho_2) := \left(Tr\left[\sqrt{\sqrt{\rho_1}\rho_2\sqrt{\rho_1}}\right]\right)^2.$

ANALYTICAL AND NUMERICAL RESULTS



$n_1 = 2, n_2 = 1$



$p = 0.5$