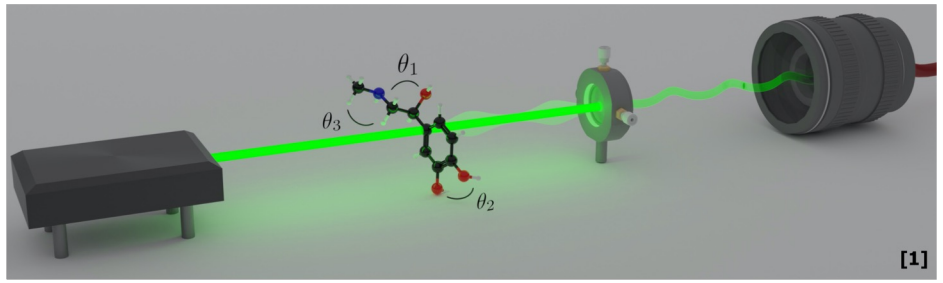
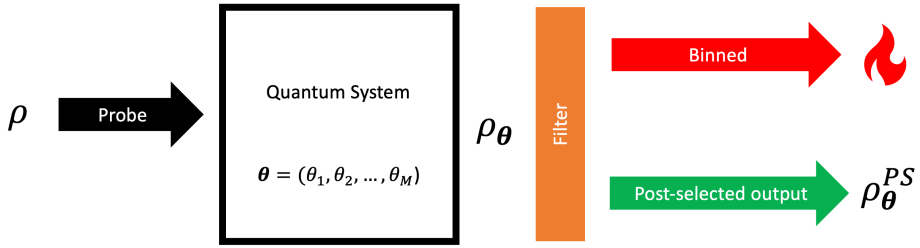
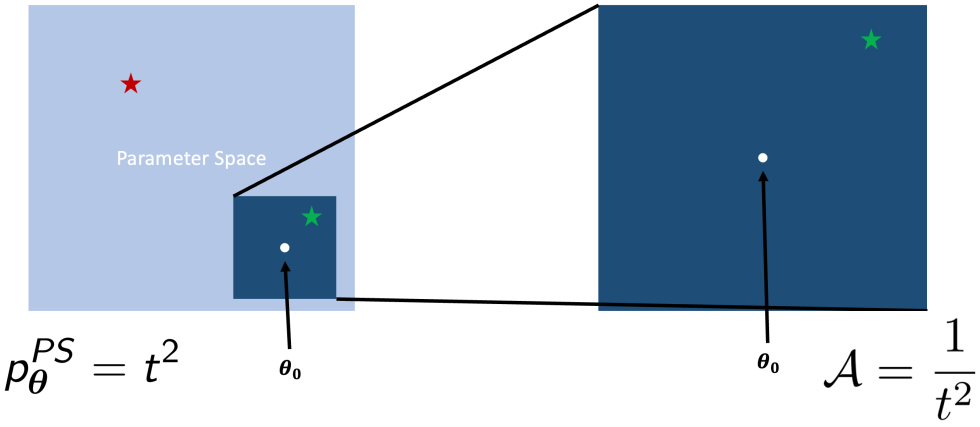




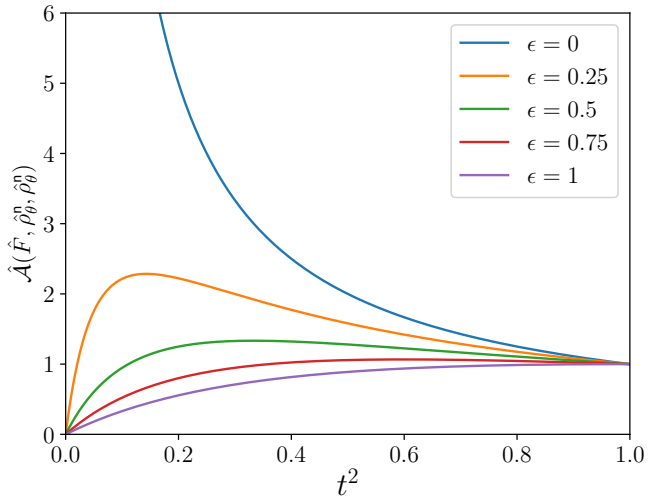
Filter using the POVM $\{\hat{F}_1 = \hat{F}, \hat{F}_2 = \hat{1} - \hat{F}\}$

$$\hat{F} = (t^2 - 1)\hat{\rho}_{\boldsymbol{\theta}_0} + \hat{1}$$



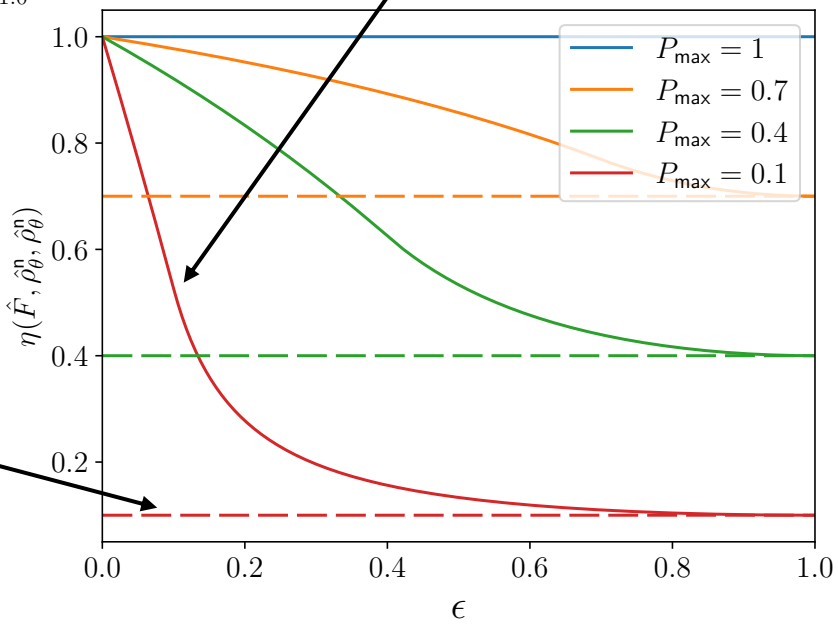
$$p_{\boldsymbol{\theta}}^{PS} = t^2 \qquad \mathcal{A} = \frac{1}{t^2}$$

What allows $\mathcal{I}_{i,j}(\boldsymbol{\theta}|\hat{\rho}_{\boldsymbol{\theta}}^{\mathrm{PS}})$ to be arbitrarily large? Negative quasiprobabilities



$$\left\{Q_{k,l}^{\hat{\rho}}\right\} \equiv \left\{\frac{q_{k,l,m=1}^{\hat{\rho}}}{\sum_{k,l,m=1} q_{k,l,m}^{\hat{\rho}}}\right\} = \left\{\mathrm{Tr}\left[\hat{\Pi}_k^{(i)} \hat{F} \hat{\Pi}_l^{(j)} \hat{\rho}\right] / p_{\boldsymbol{\theta}}^{\mathrm{ps}}\right\}$$

Our noise-optimised filter



Näive classical filter

$$\hat{F}_{\mathrm{nav}} = P_{\mathrm{max}}\,\hat{1}$$

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