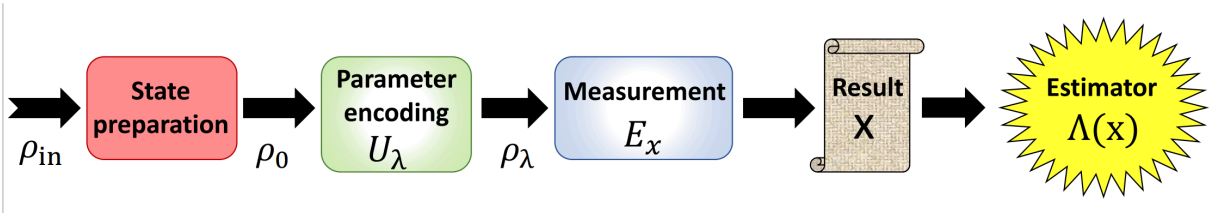
Notes on Quantum Metrology

The general paradigm of single parameter Quantum Metorlogy is as follows.



For a quantum system with parameter λ of interest, an initial probe is prepared in a state ρ_0 (density matrix).

This probe interacts with the quantum system and undergoes an evolution U_λ. The evolution is described as $\rho_\lambda = U_\lambda \rho_0 U_\lambda^\dagger$. We are effectively transcribing the information in the wanted system to the probe.

The probe is then measured by a POVM E_x, which can be optimized using a method of which I am not familiar...

The measurement outcome x is then used to estimate the parameter λ. It can be modeled as a conditional probability $p(x|\lambda)$. We use various methods to construct the best estimator, two of which are Beyesian estimation and Maximum Likelihood estimation.