Macroscopic Teleportation with LIGO/VIRGO

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Teleportation

- **Classical teleportation** is easy:
  A. Build the same system in another place
  B. Precisely **measure** the state of the source system, then **impose** it to the target system
- **Quantum teleportation**
  A. **Still needs to be done!!**
  B. Impossible case-by-case, because a systems quantum state cannot be measured in one go!!
  C. We must **transport the quantum state without measuring it!!**

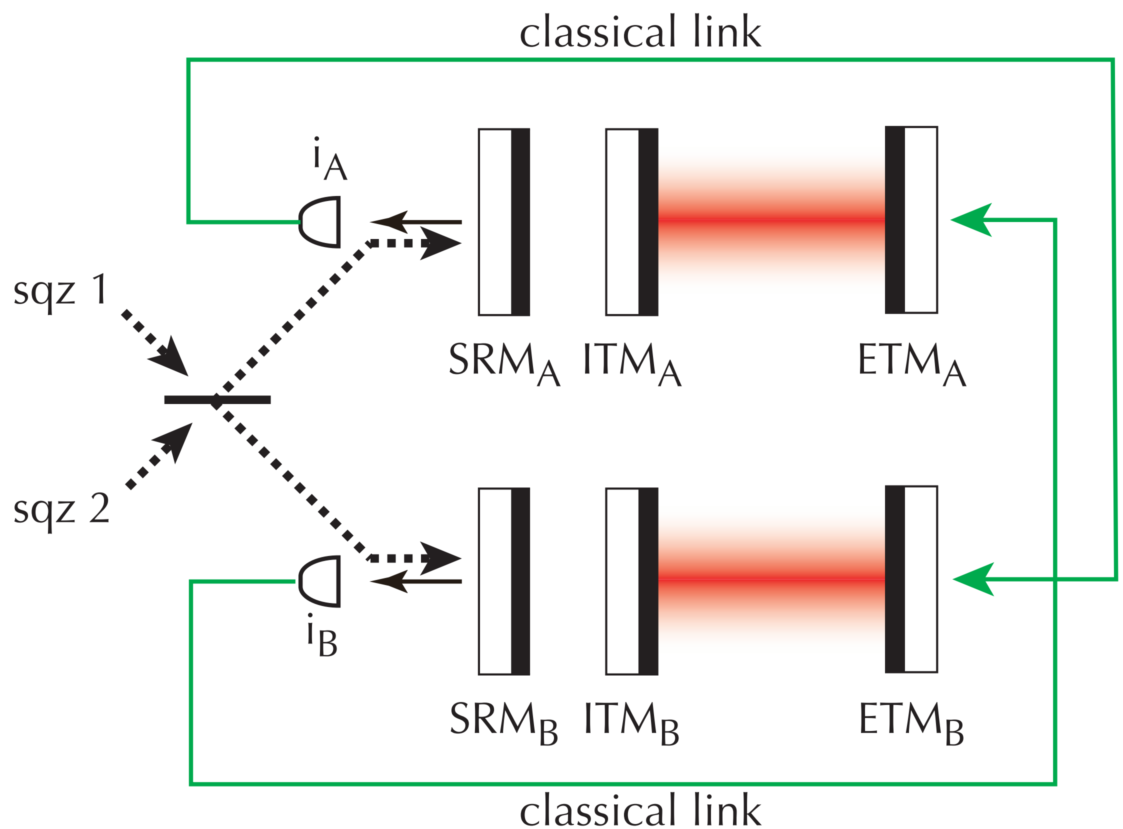
HOW?

Teleportation of oscillator state

- Let us consider two weakly coupled oscillators
  - common and differential mode have slightly different frequencies
  - after some time, they will exchange their states (“sloshing time”)

- This coupling must only arise from **local** sensing and control --- but how do we prevent noise?

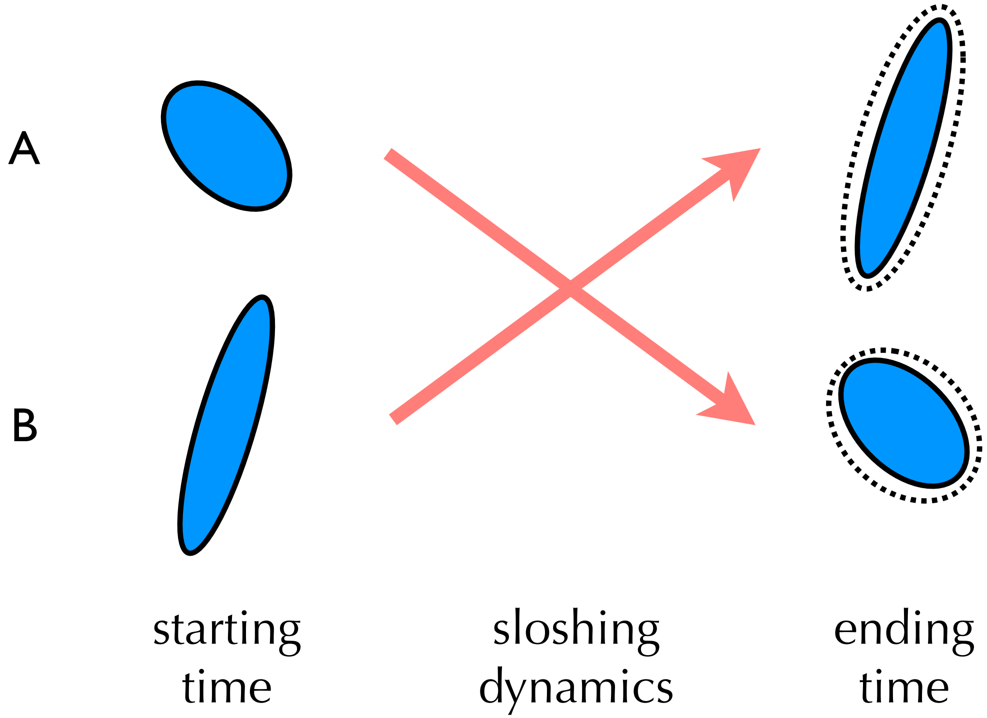
Configuration

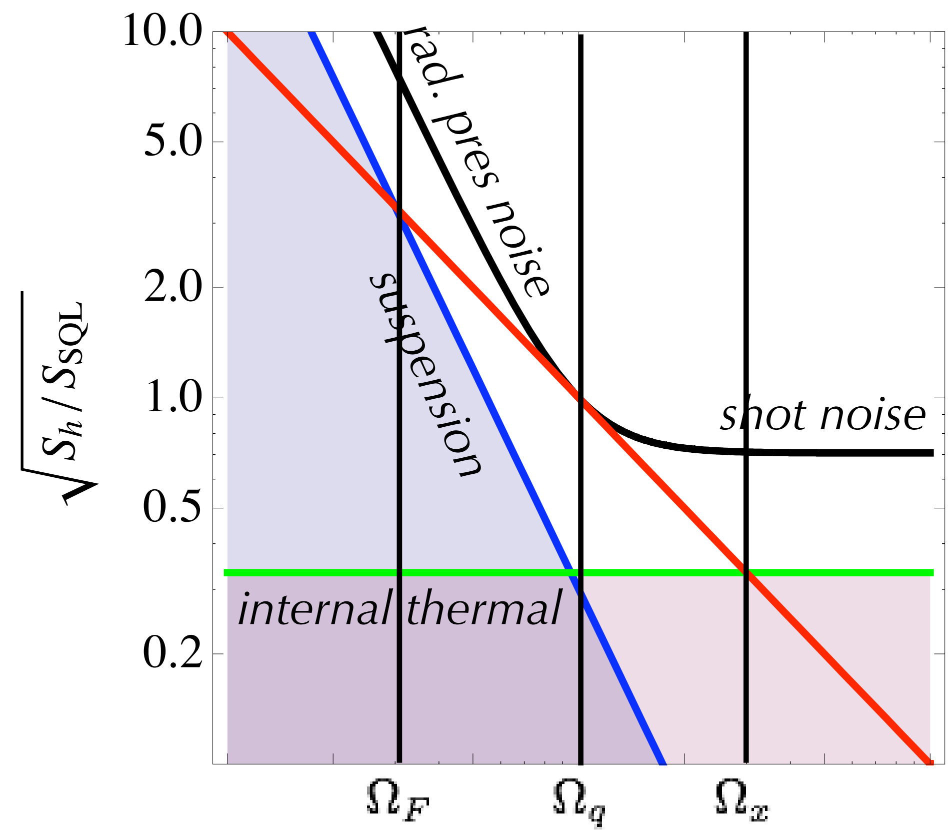


- Injecting entangled input vacuum allows protection against loss of quantum coherence
- This implies we cannot measure quantum states of these mirrors!

Measure of Teleportation Efficiency

- In terms of additional noise ...





$$N_x = e^{-2q} + 2\zeta_x^2\,, \quad N_F = e^{-2q} + 2\zeta_F^2$$

$$\sigma_{\rm add} \propto \sqrt{N_F N_x}$$