

Interferometer for LCGT

**1st Korea-Japan Workshop on LCGT
@ Korea University
Jan. 13, 2012
Seiji Kawamura (ICRR, Univ. of Tokyo)**

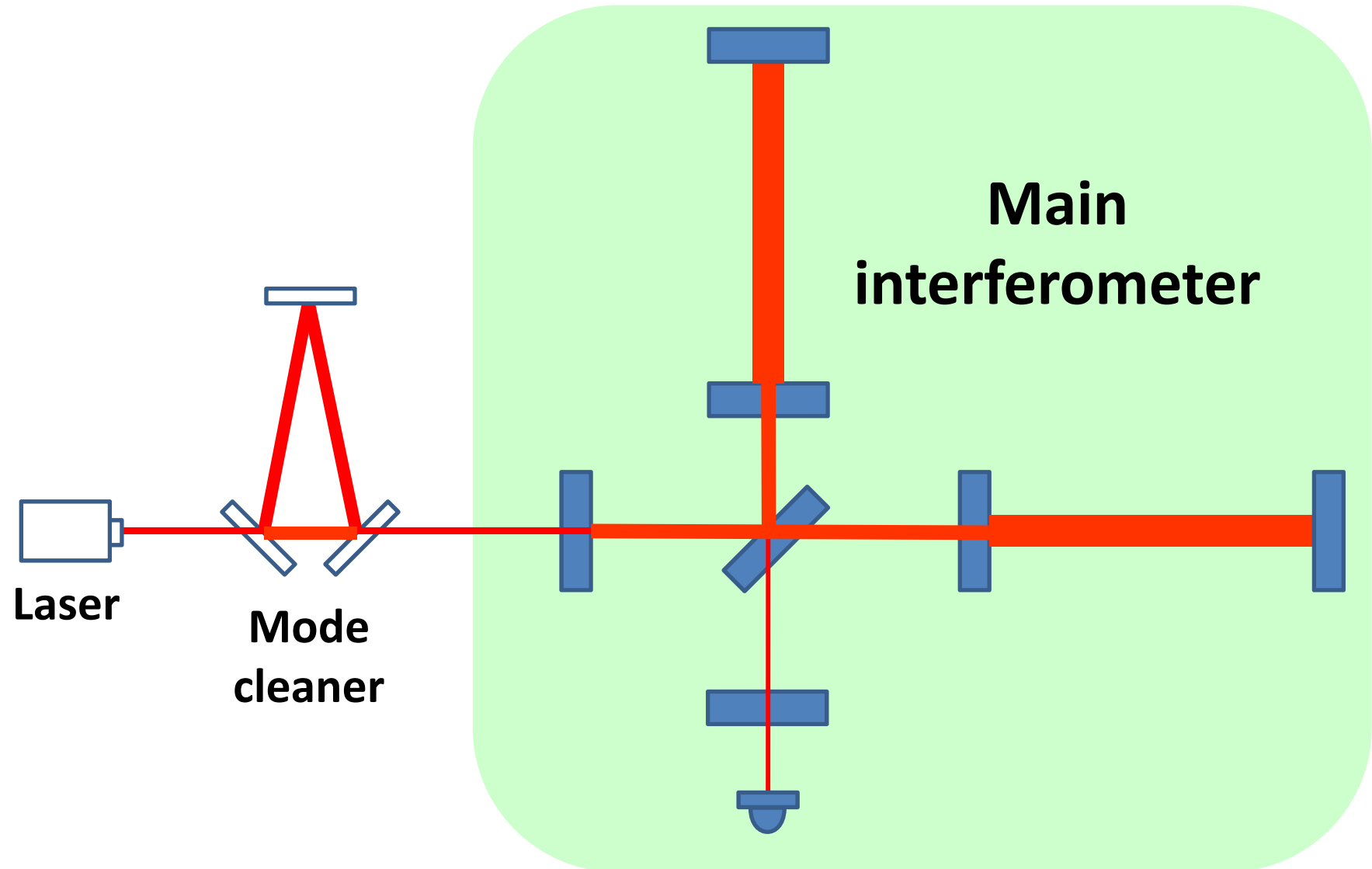
Outline

- **Resonant Sideband Extraction interferometer**
- **Length sensing and control system**
- **Alignment sensing and control system**
- **Detuning optimization**
- **Curvature of the mirrors**
- **Lock acquisition**
- **Noise coupling reduction**
- **Quantum noise optimization**
- **Summary**

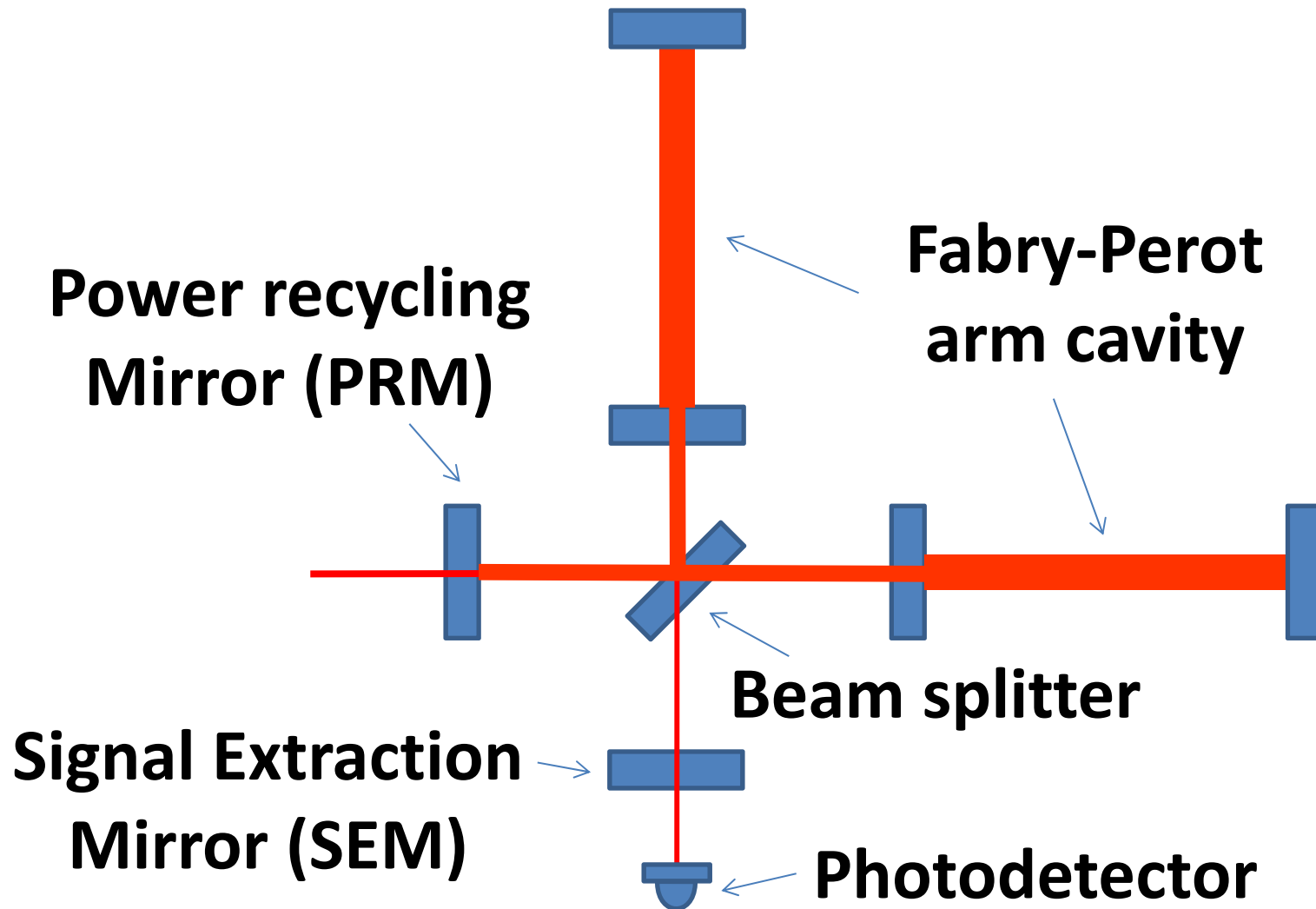
Outline

- Resonant Sideband Extraction interferometer
- ~~Length sensing and control system~~
- ~~Alignment sensing and control system~~
- ~~Detuning optimization~~
- ~~Curvature of the mirrors~~
- ~~Lock acquisition~~
- ~~Noise coupling reduction~~
- ~~Quantum noise optimization~~
- Summary

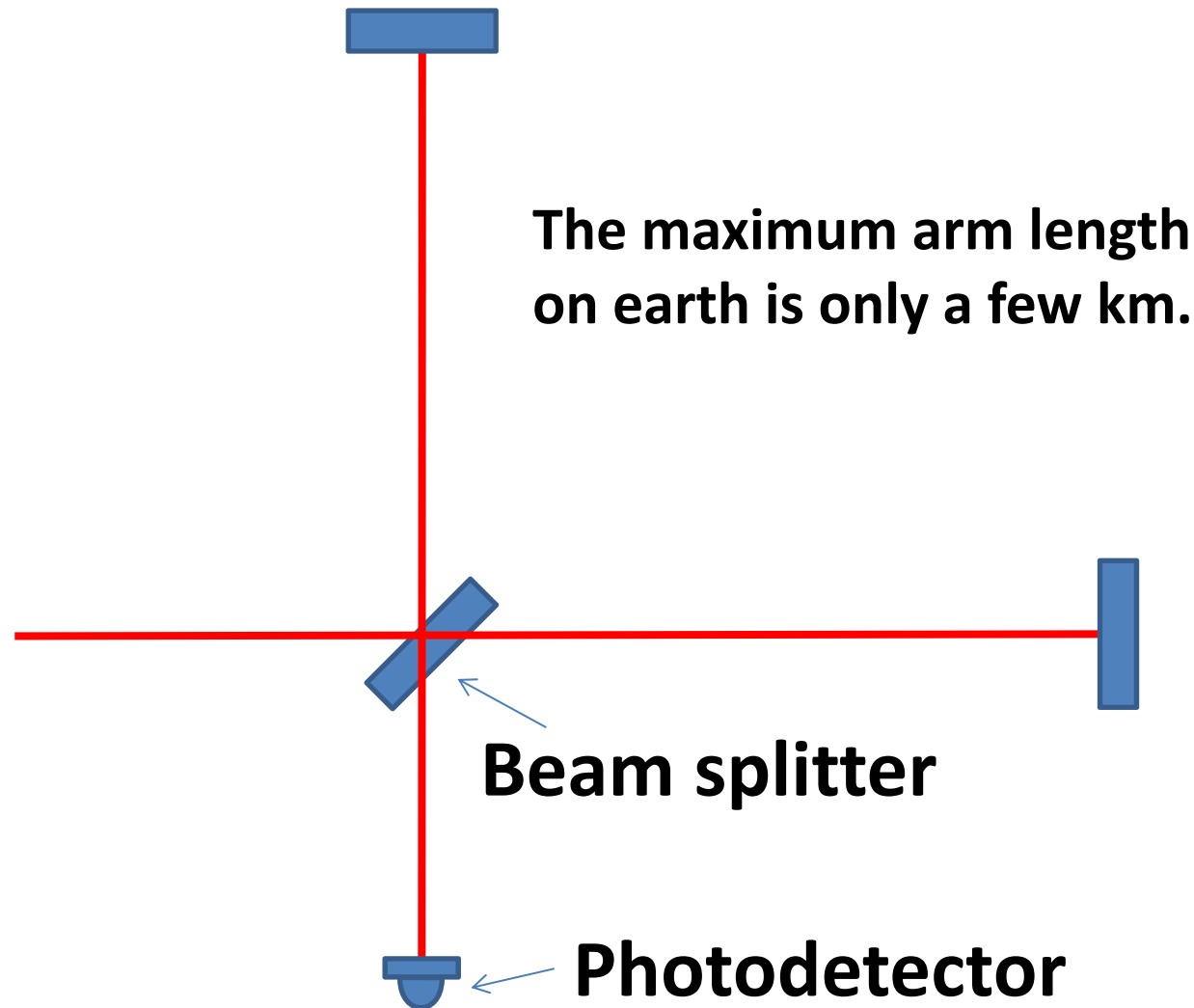
Interferometer for LCGT



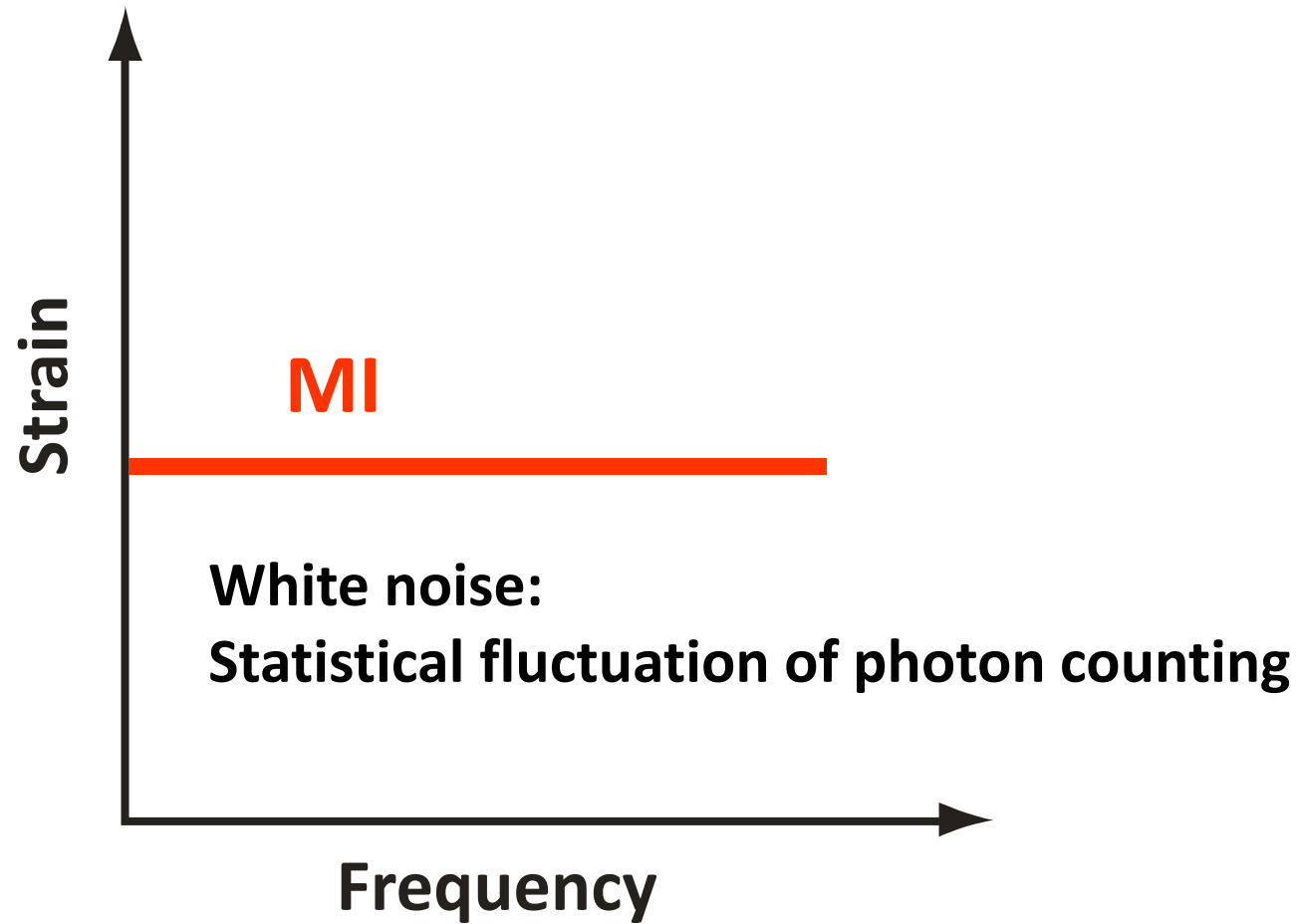
Resonant Sideband Extraction (RSE) interferometer



Michelson interferometer (MI)



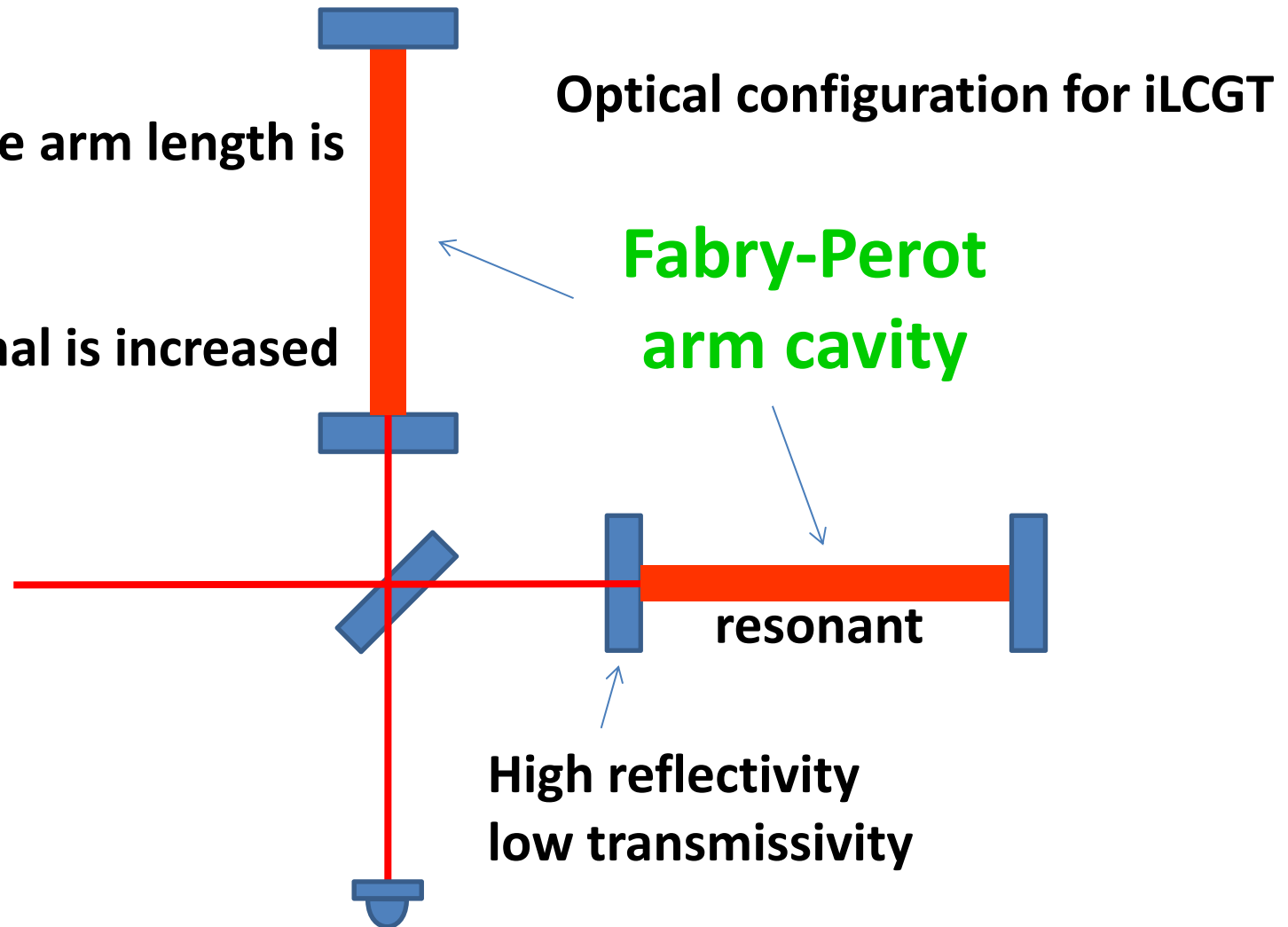
Shot noise of MI



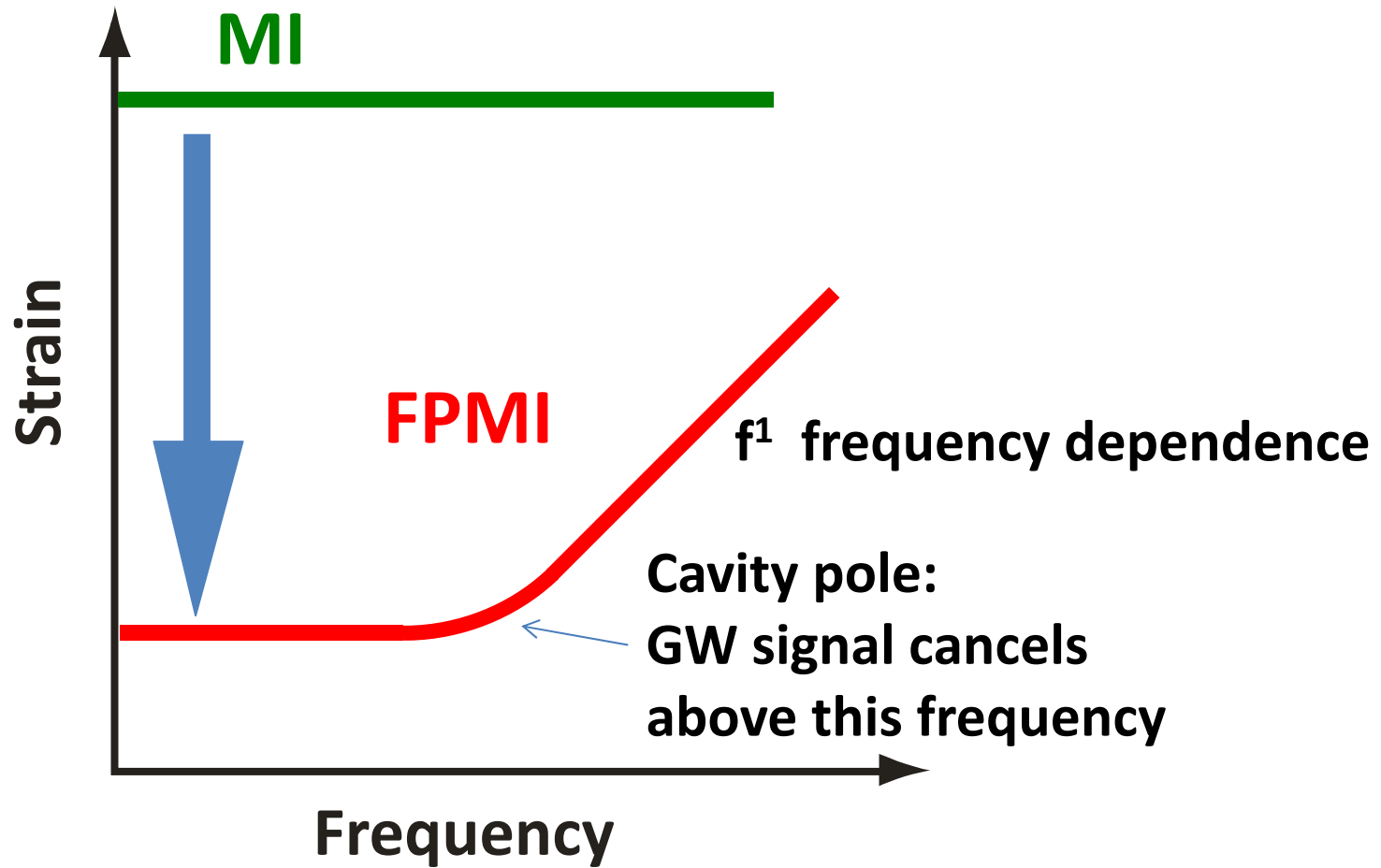
Fabry-Perot Michelson interferometer (FPMI)

The effective arm length is increased

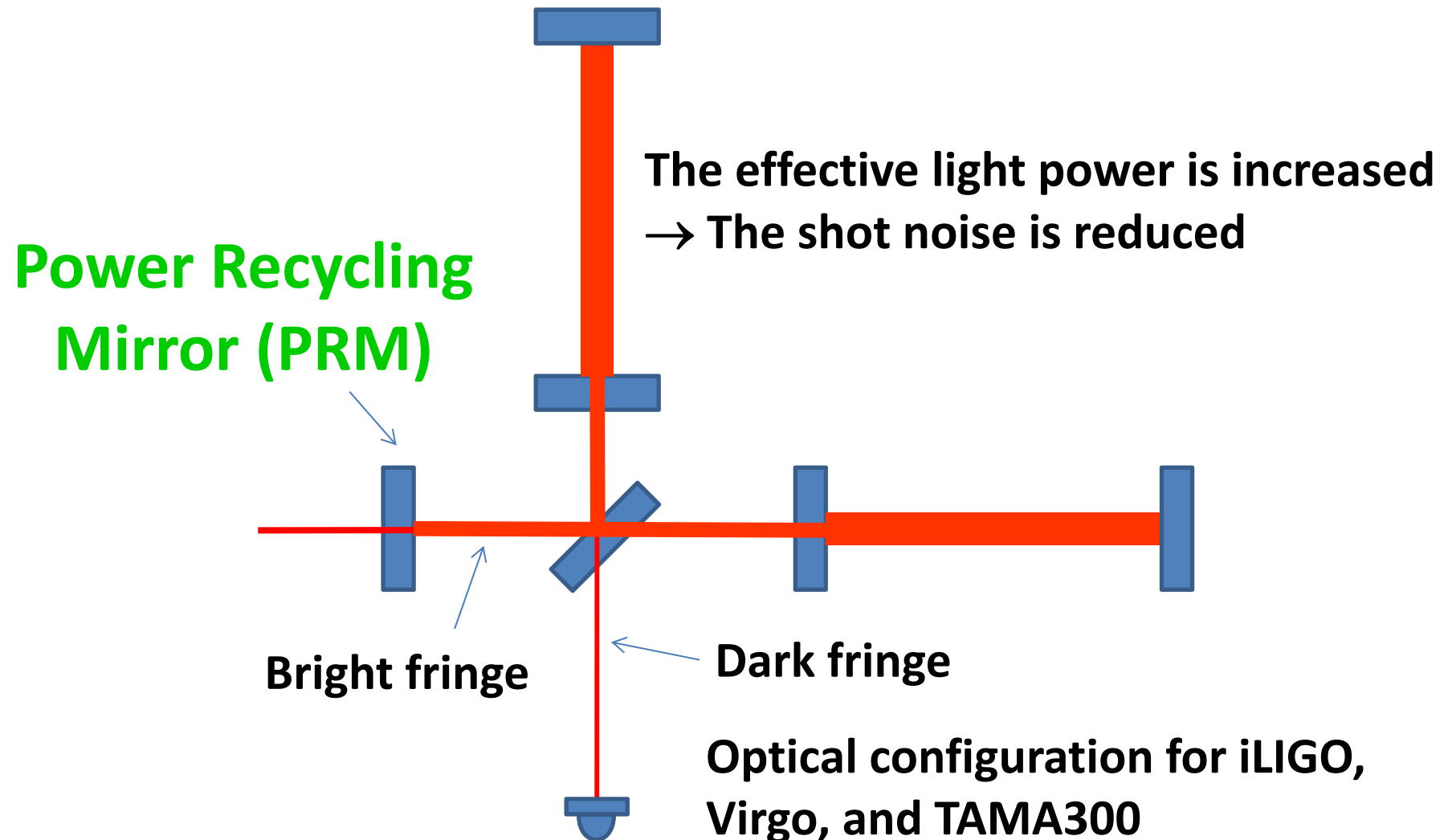
→ GW signal is increased



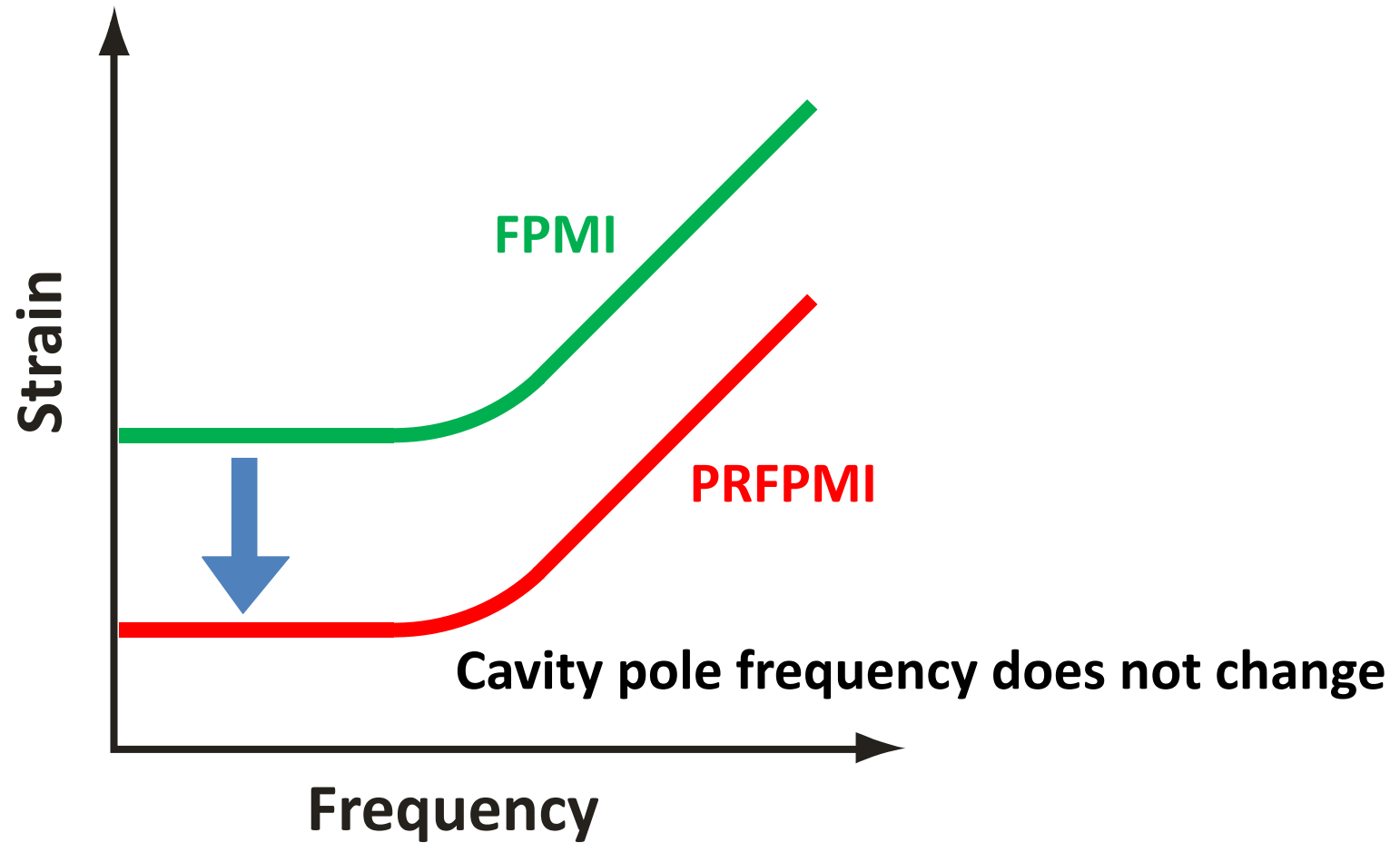
Shot noise of FPMI



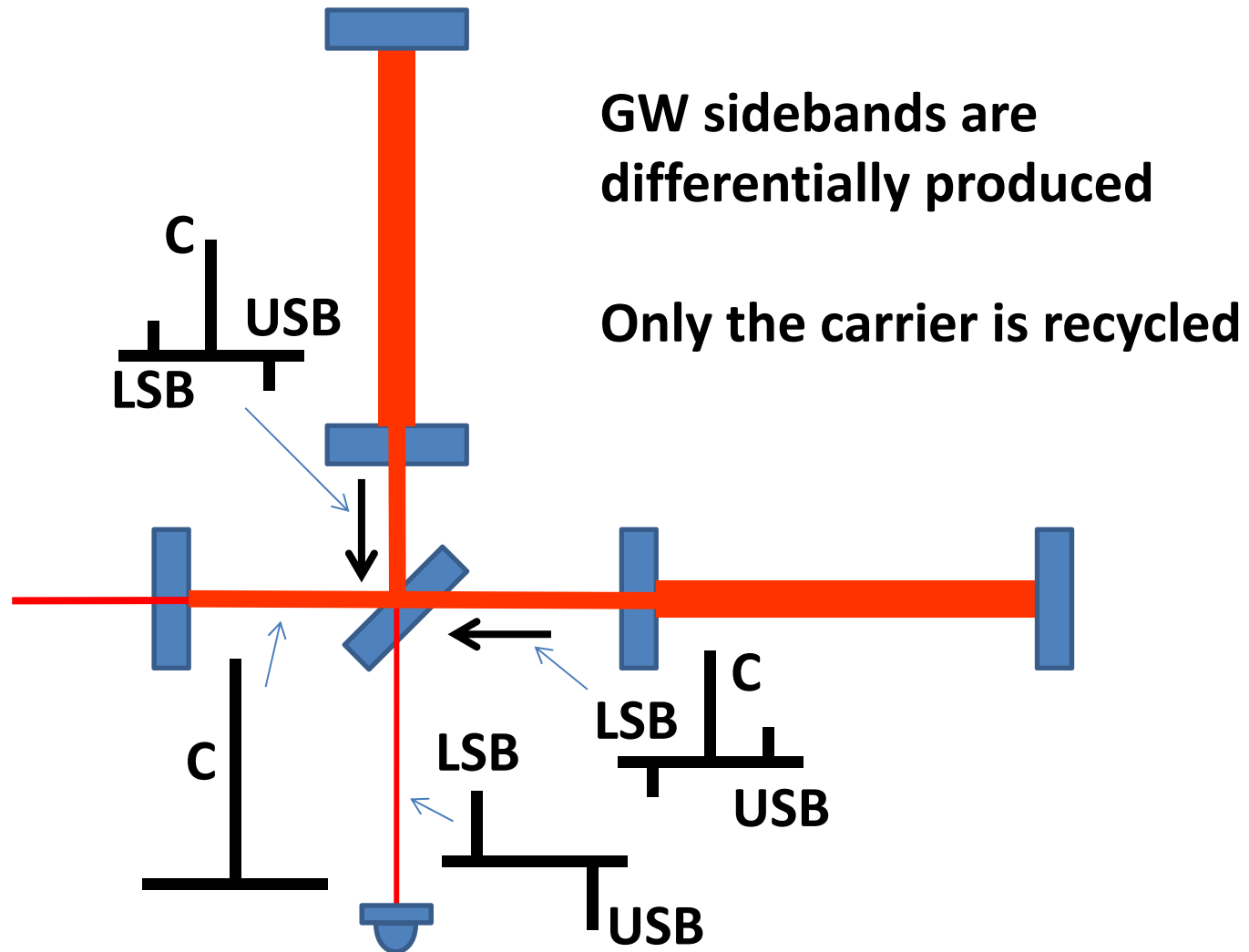
Power-recycled Fabry-Perot Michelson interferometer (PRFPMI)



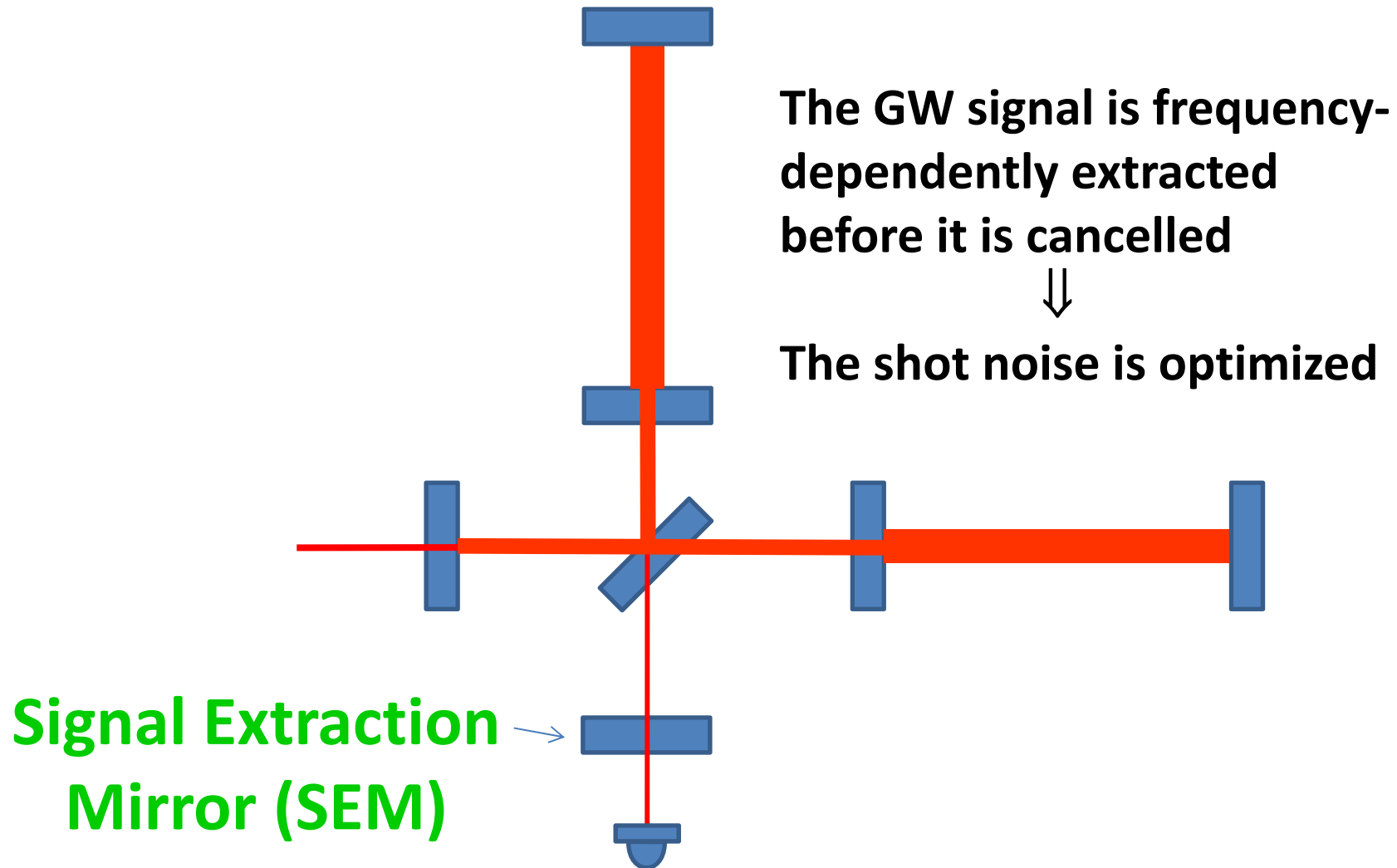
Shot noise of PRFPMI



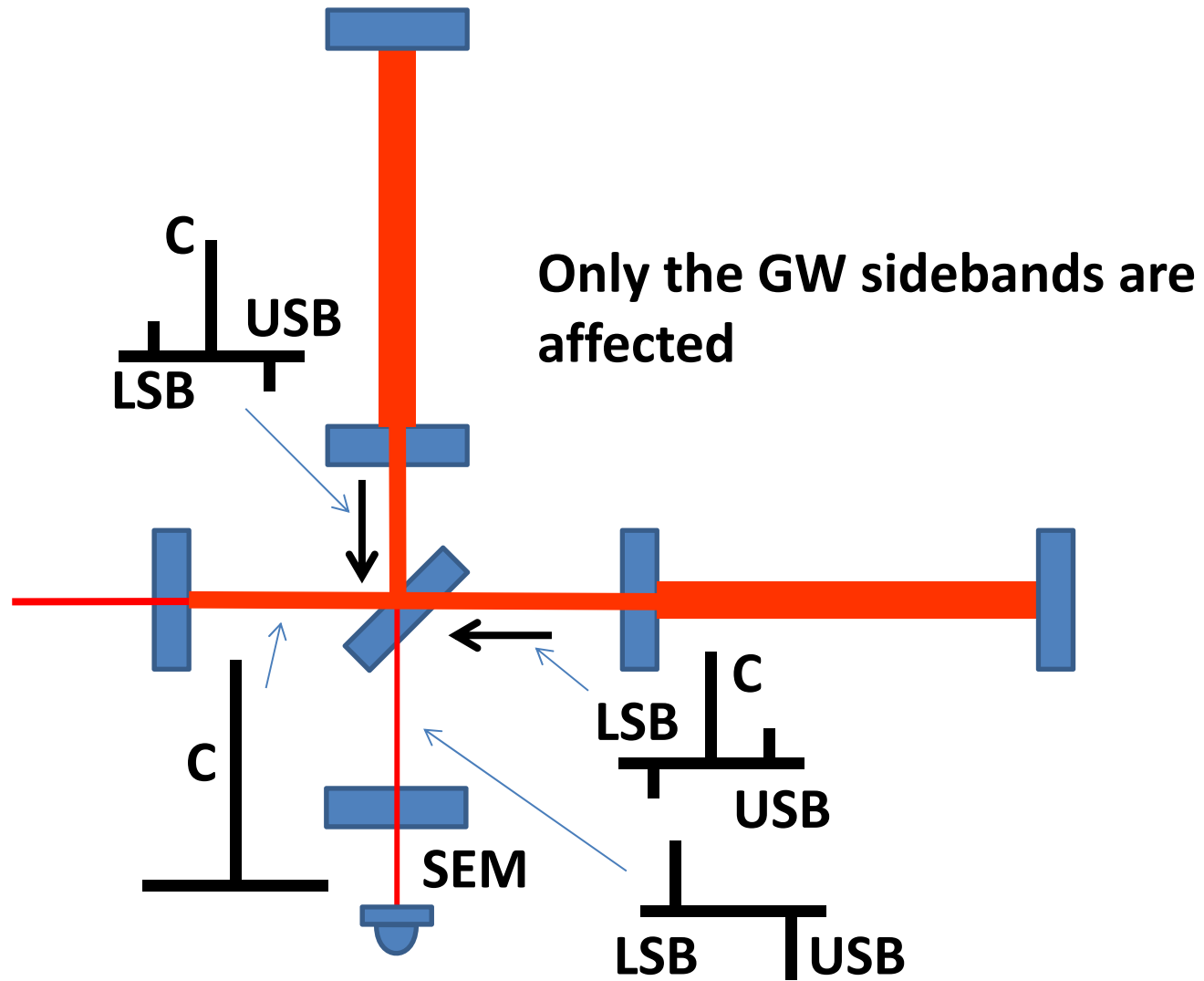
PRFPMI



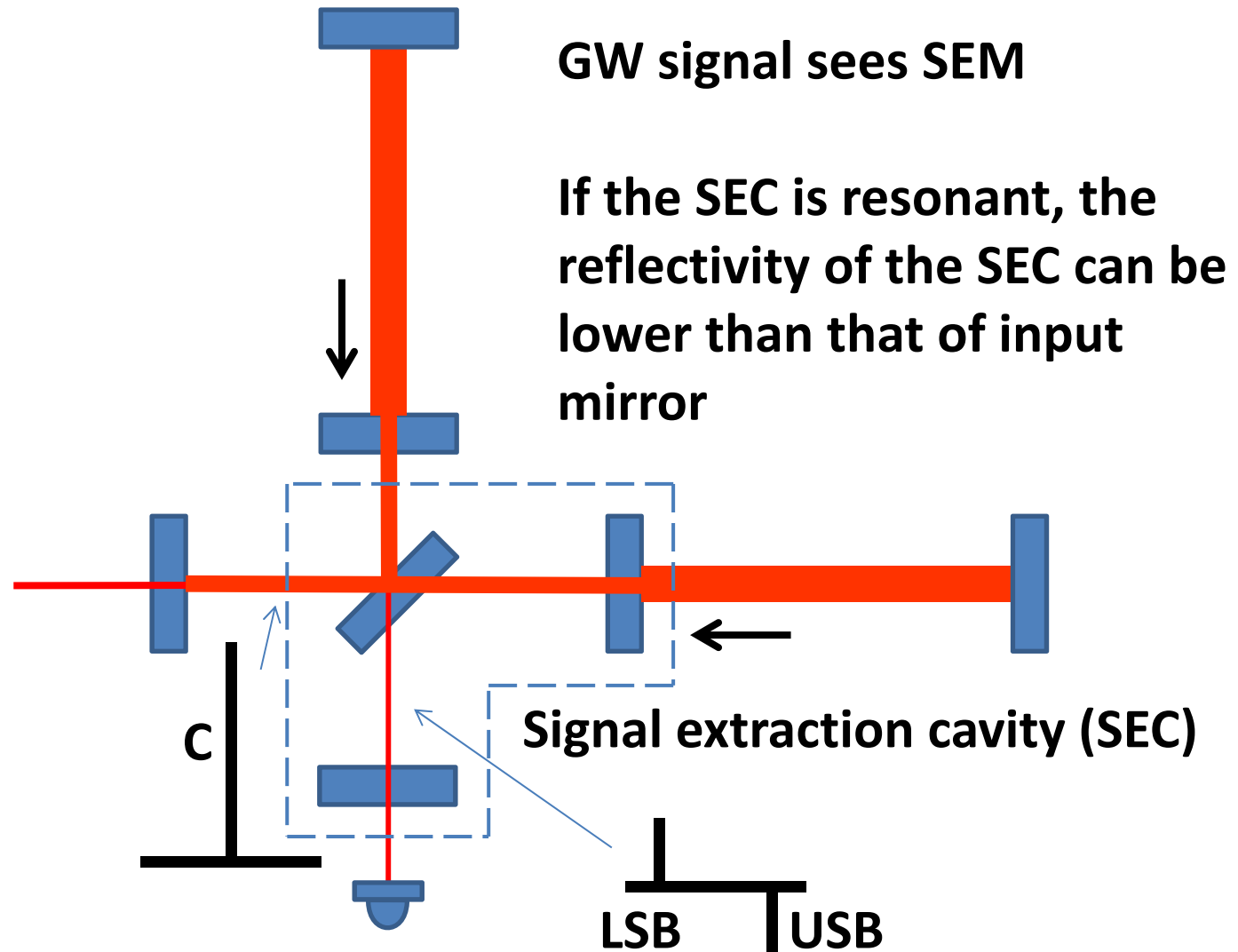
RSE interferometer



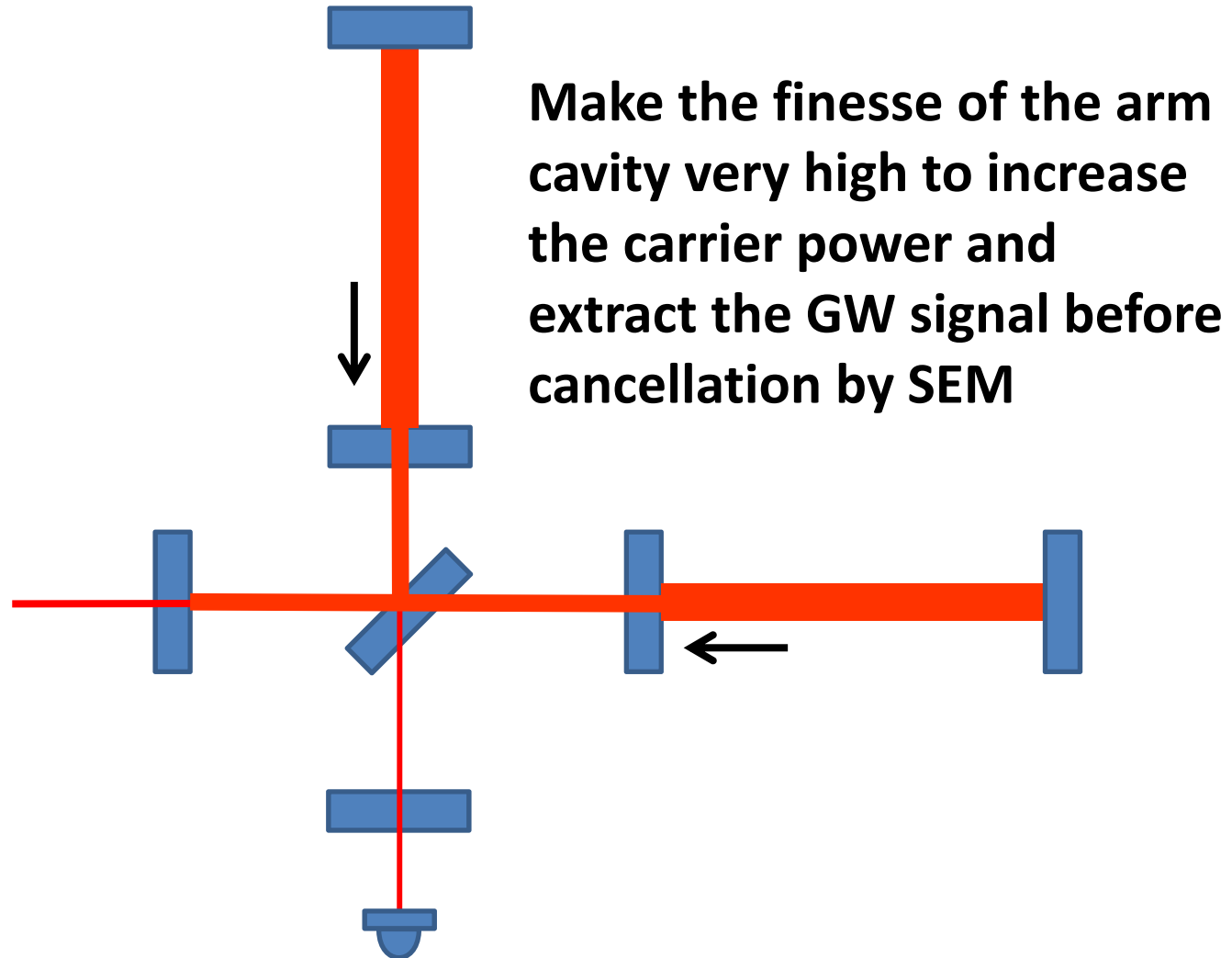
RSE



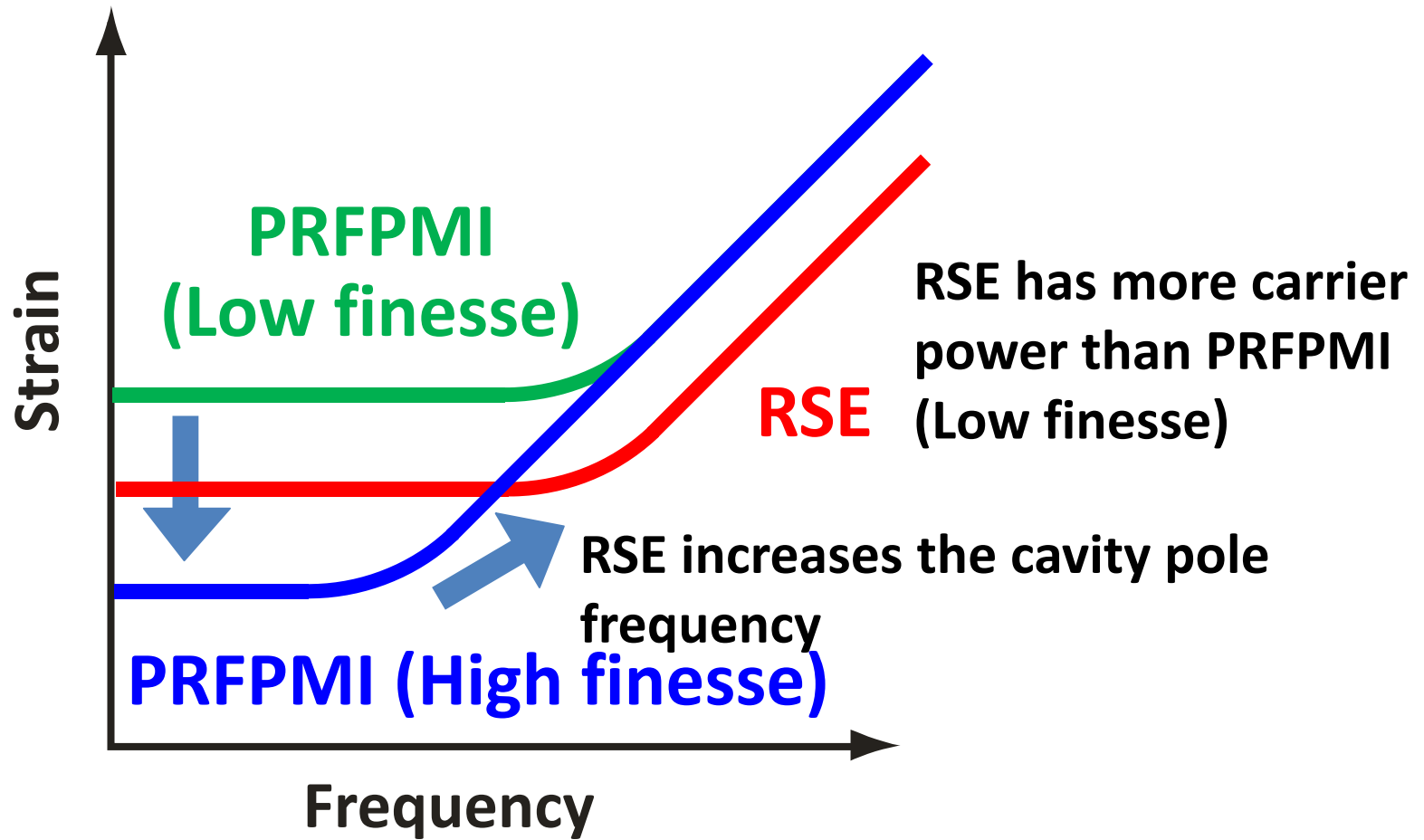
RSE



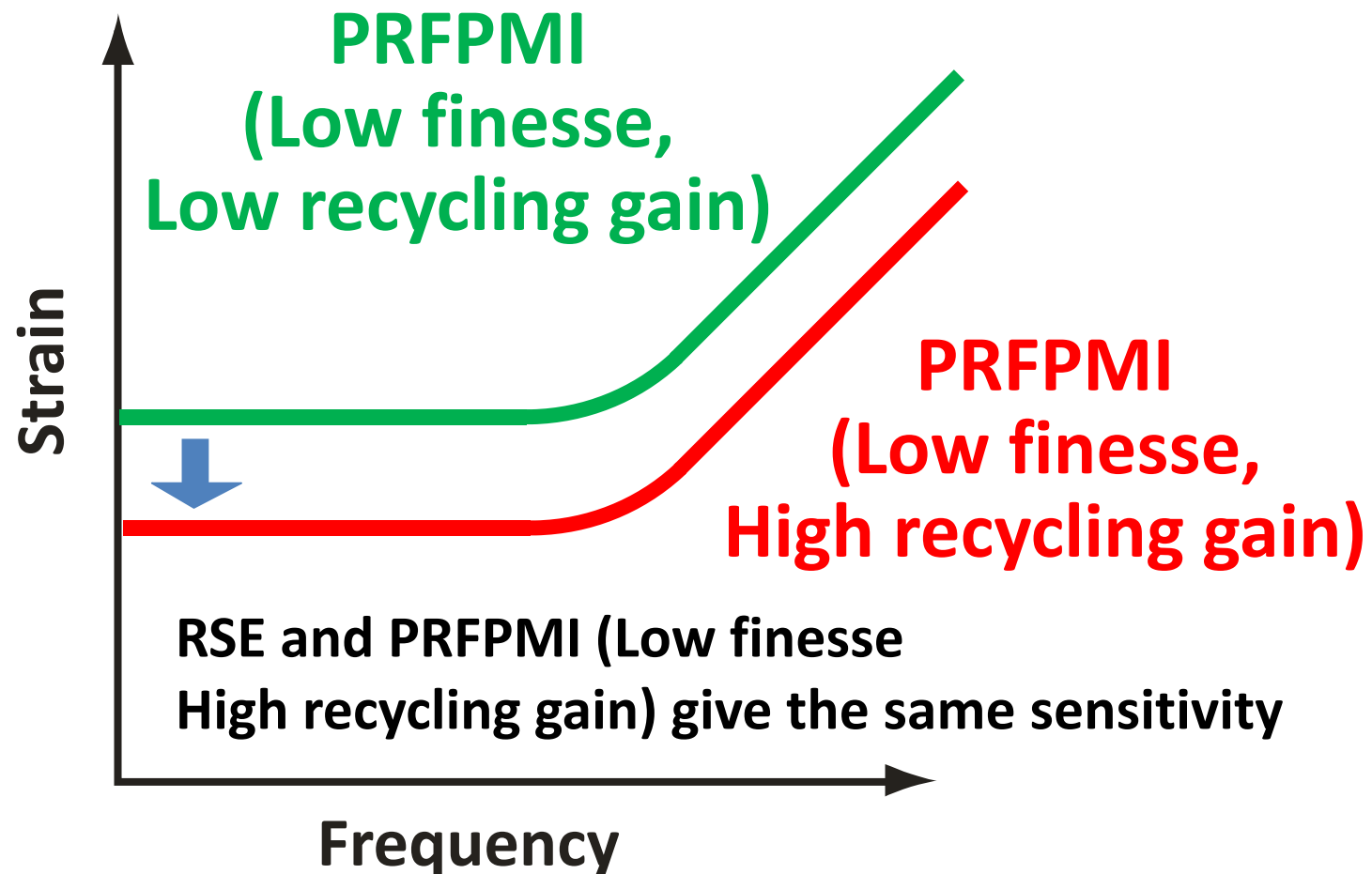
RSE



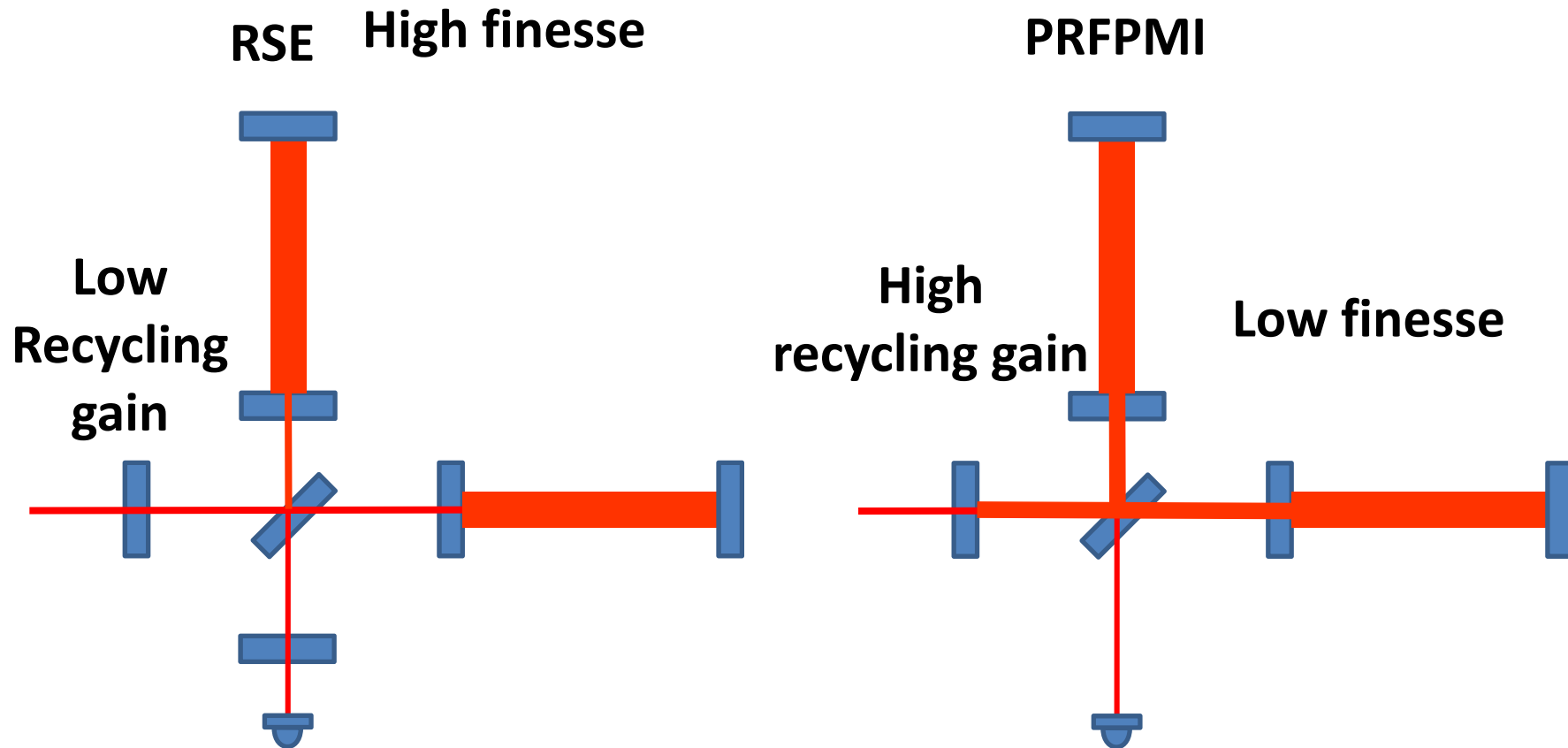
Shot noise of RSE



Shot noise of PRFPMI (High recycling gain)

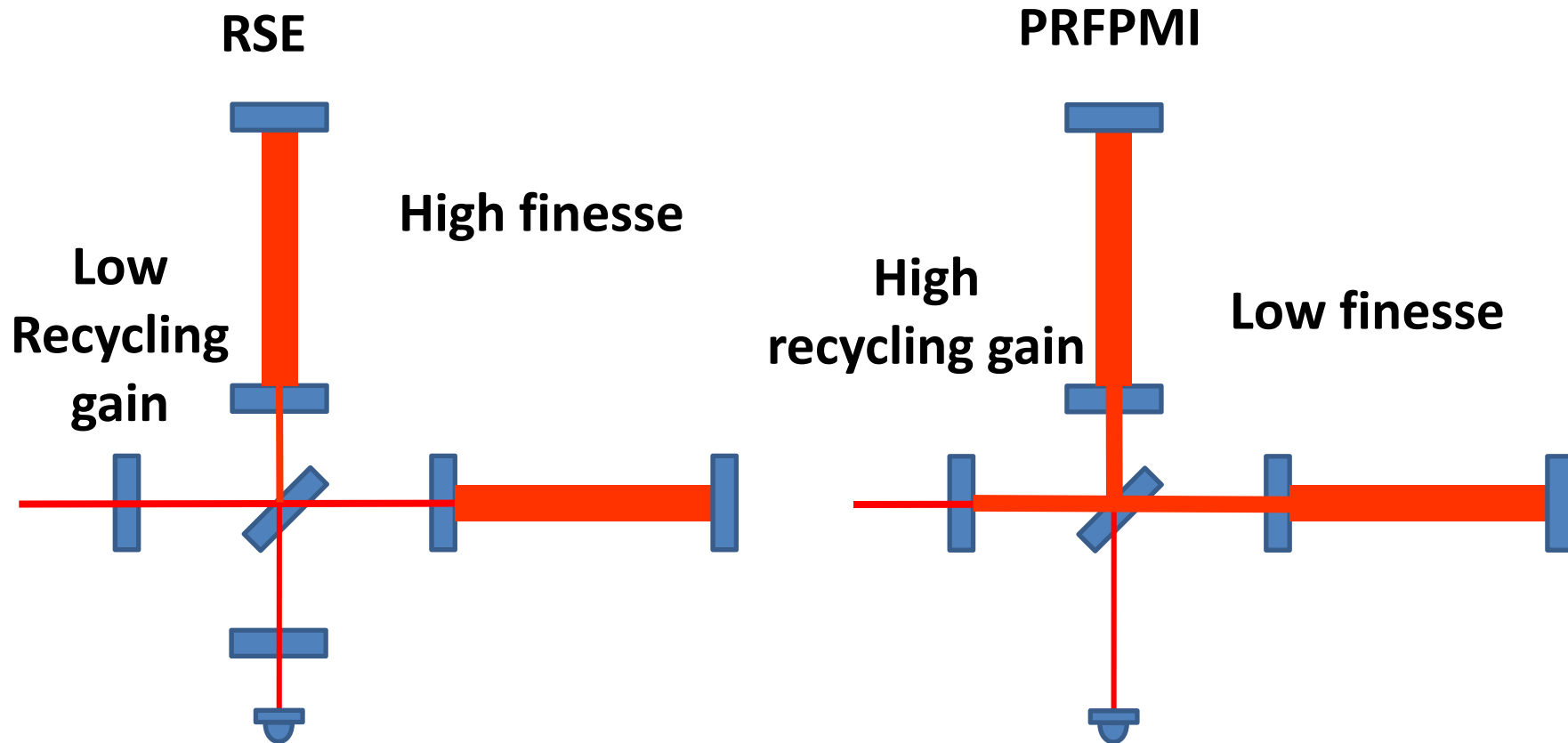


RSE and PRFPMI (Low finesse, High recycling gain)



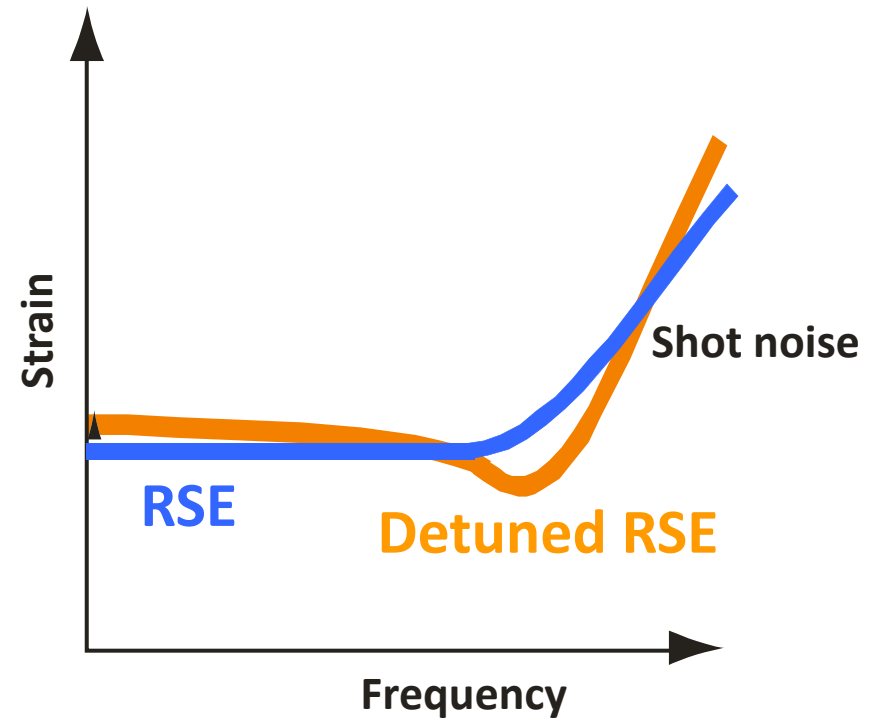
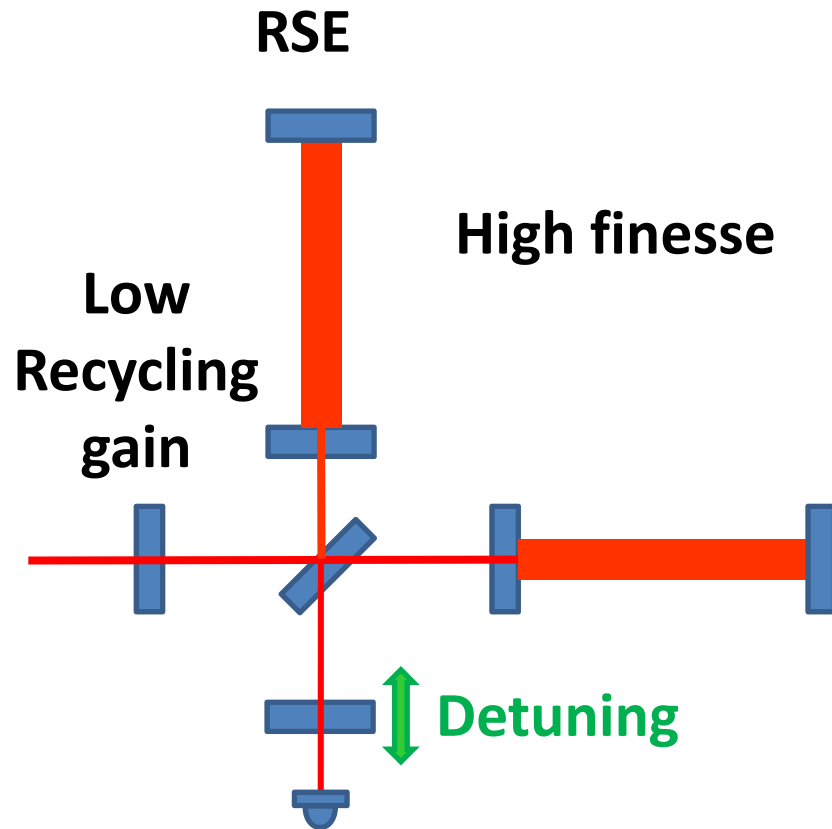
Combination of finesse and recycling gain is limited by the loss of the optics → the same sensitivity

Advantage of RSE (1)



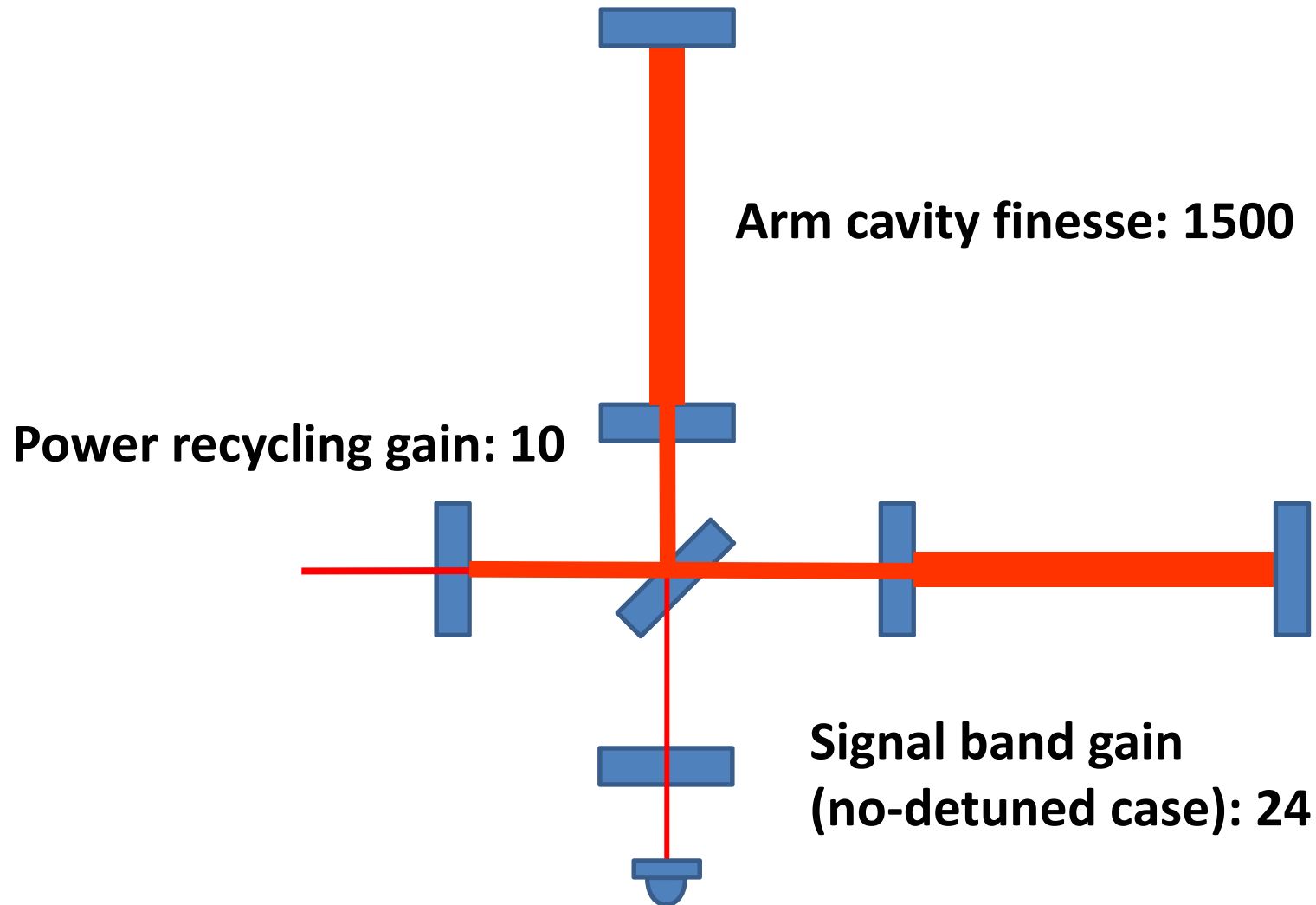
Lower Power at BS and Input Mirrors
→ Less Thermal Problem

Advantage of RSE (2)



Shot noise can be optimized

Optical parameters



Important subsystems/functions

- **Length sensing and control system**
- **Alignment sensing and control system**
- **Detuning optimization**
- **Curvature of the mirrors**
- **Lock acquisition**
- **Noise coupling reduction**
- **Quantum noise optimization**
- **Etc.**

Summary

- **We use RSE interferometer for LCGT**
- **RSE has advantages over PFPMI**
- **Many subsystems/functions have been already developed**