Cosmic Explorer Length Sensing and Control R&D

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Overview

1. Frequency stabilization
2. Noise budget with technical noises
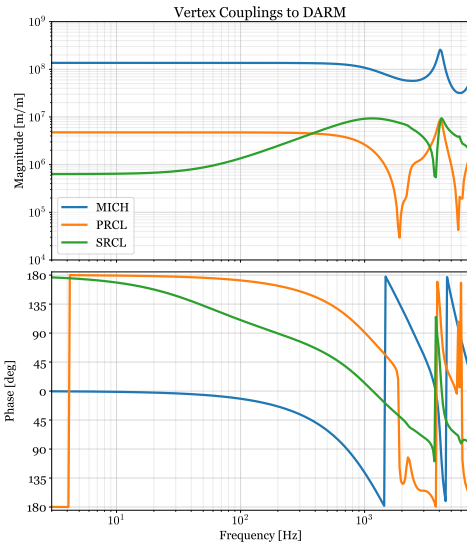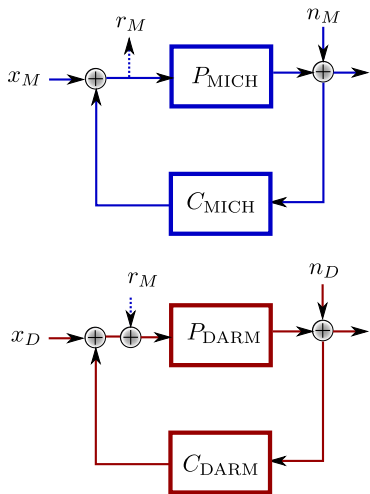3. Radiation pressure actuator

Frequency Stabilization

- In LIGO, the laser frequency is stabilized in three steps. In the last step the frequency is stabilized to the common arm length of the interferometer with a loop with a bandwidth of about 20 kHz.

- FSR of LIGO is 37.5 kHz but for CE is 3.75 kHz.

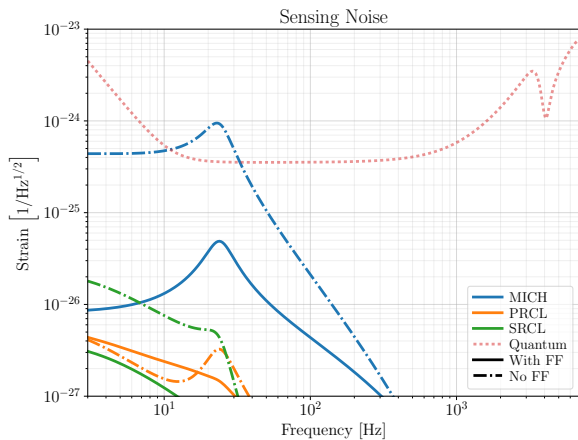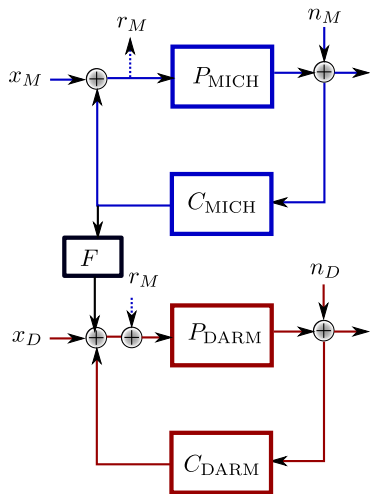- Right half-plane zeros at the FSR makes this difficult to control.

CARM Response
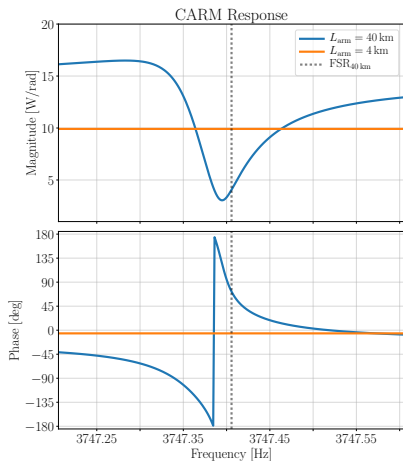
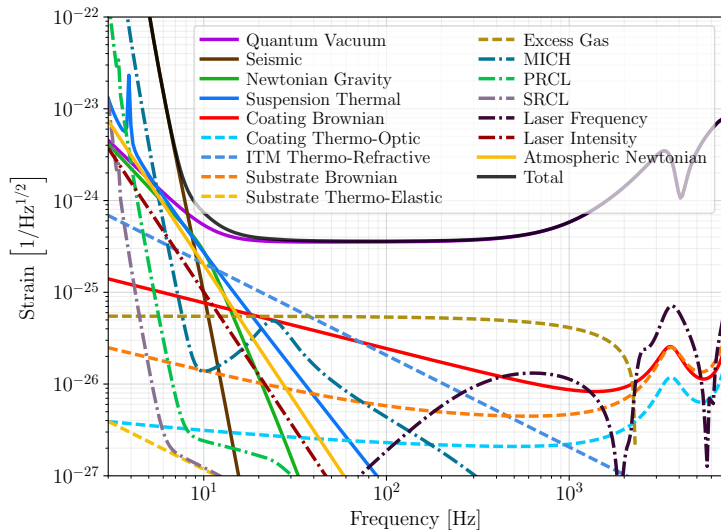# Undercoupling leads to left half plane zeros
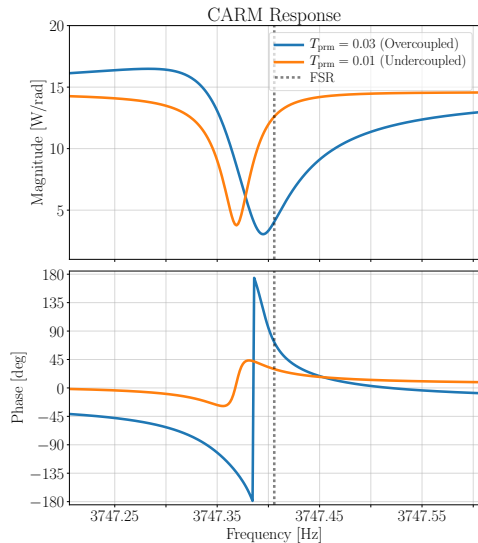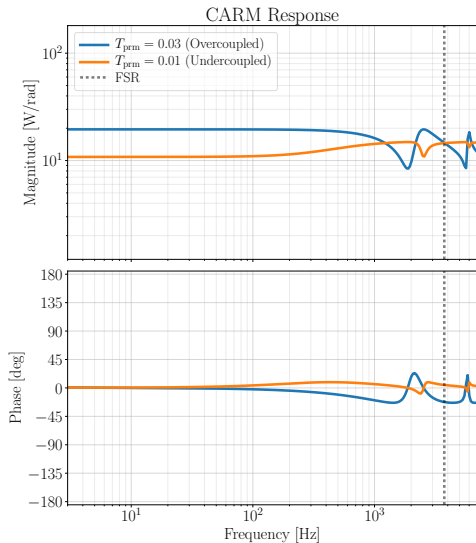
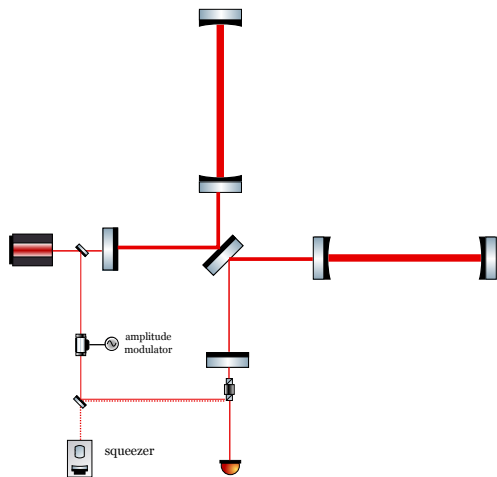# Cross Coupling of Vertex Degrees of Freedom

Feedforward Subtraction

CE Noise Budget with Technical Noises

Radiation Pressure Actuator

- ▶ Inject amplitude modulated light through the dark port.
- ▶ Actuation strength

$$\Delta L_- =$$

$$\frac{7\,\text{fm}}{f^2} \left(\frac{320\,\text{kg}}{M} \right) \sqrt{\left(\frac{P_{\text{arm}}}{1\,\text{MW}} \right) \left(\frac{P_a}{1\,\text{nW}} \right)} \frac{\delta P_a}{P_a}$$