Student:

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Department:

ACIGA Gravitational Wave Research Facility
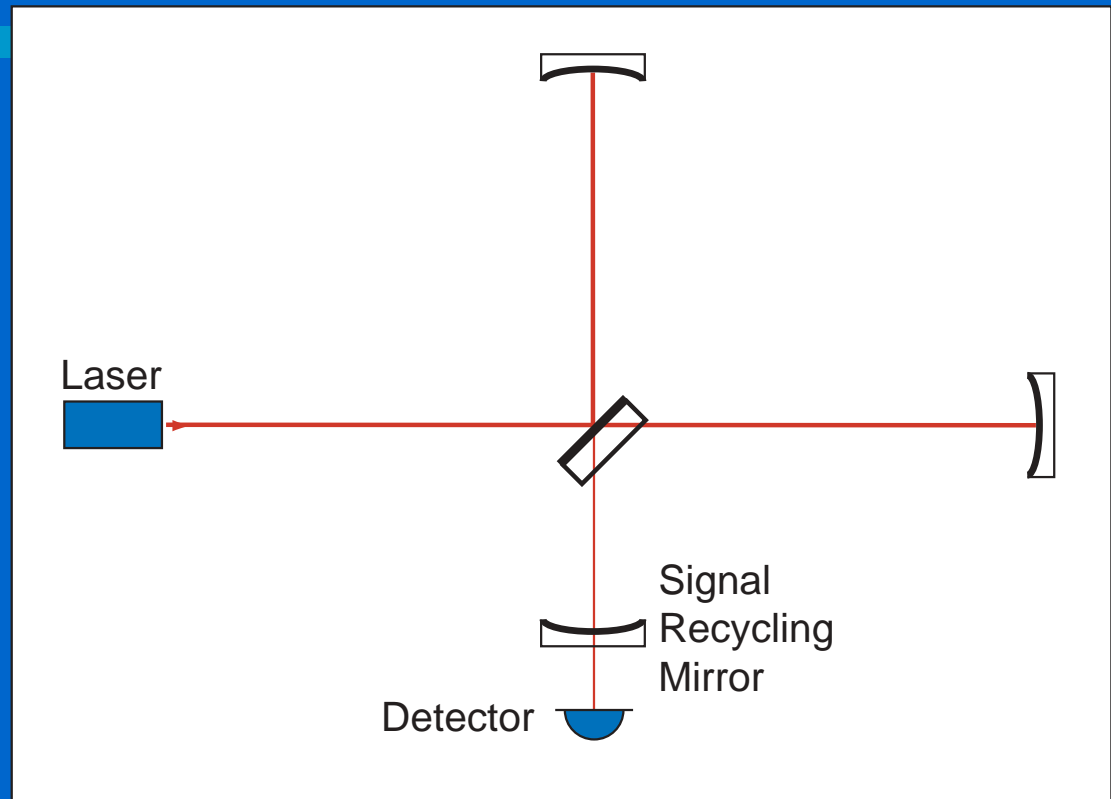
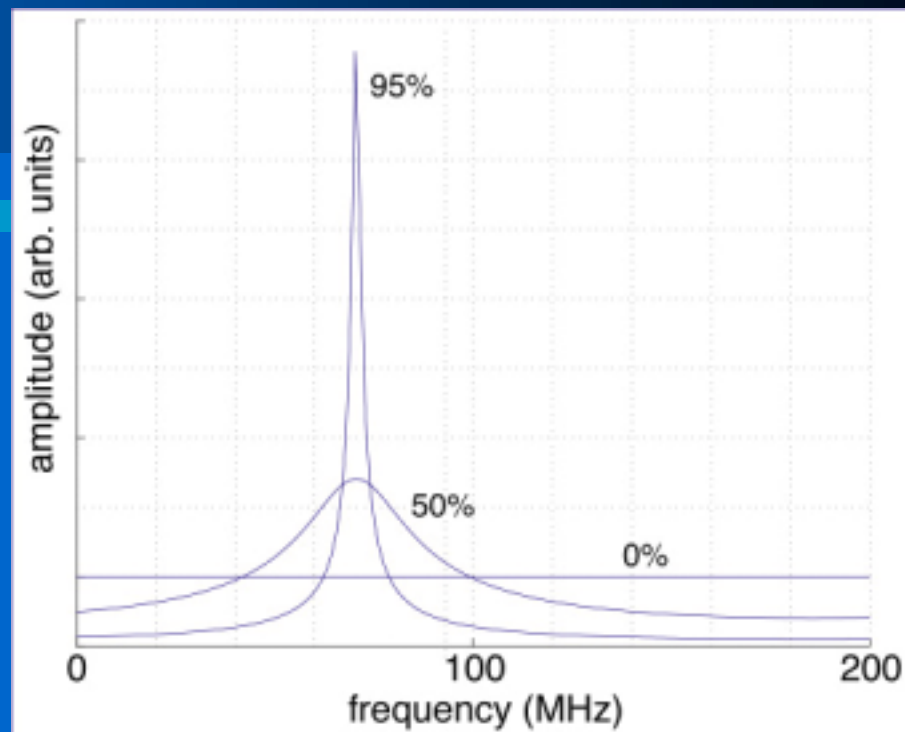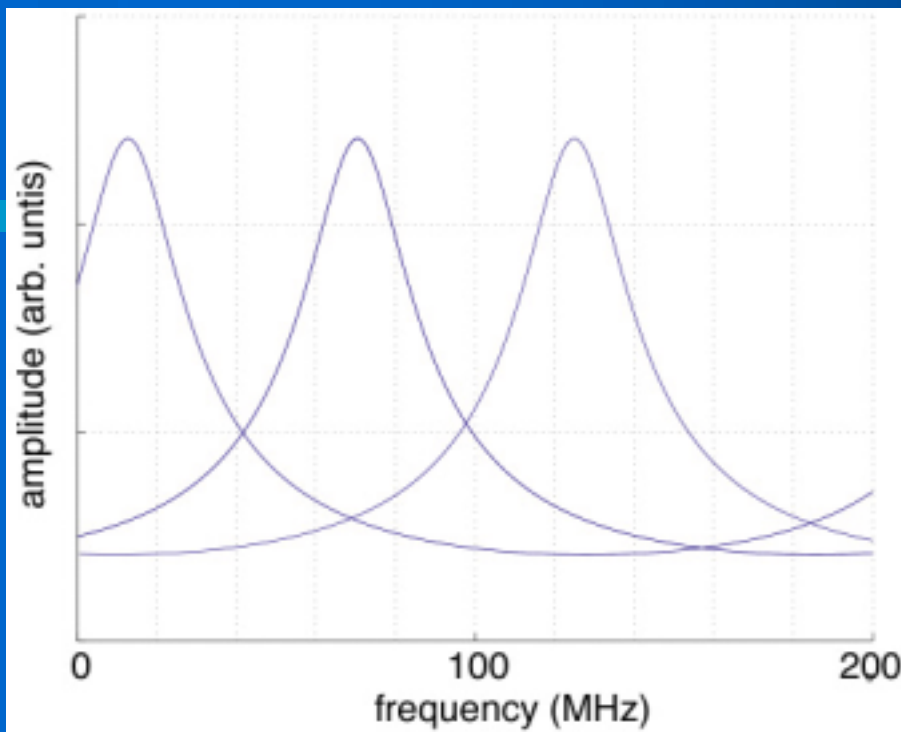*Department of Physics*

THE AUSTRALIAN
NATIONAL UNIVERSITY

Signal Recycling [1]

- **Creates 'signal' cavity with interferometer**
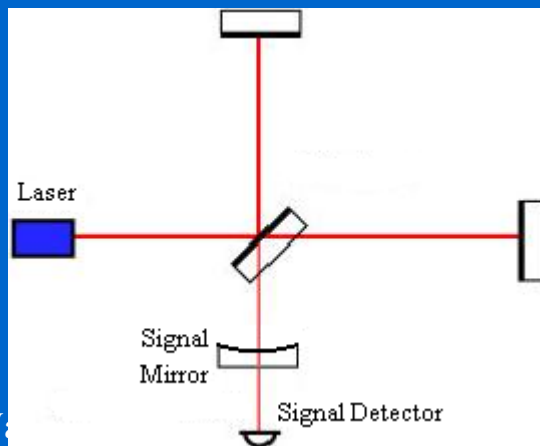- **Manipulate frequency response & enhance GW signal sidebands**

Laser

Signal Recycling Mirror

Detector

[1] B. J. Meers, Phys. Rev. D, (1988)

Signal Recycled theoretical freq. responses

- **Peak frequency**

   detuning:

- **mirror position is**

   changed

- **Bandwidth tuning:**

   - **mirror reflectivity**

- **mirror must be**

   changed

Signal recycling experimental layout

Variable Reflectivity Signal Mirrors
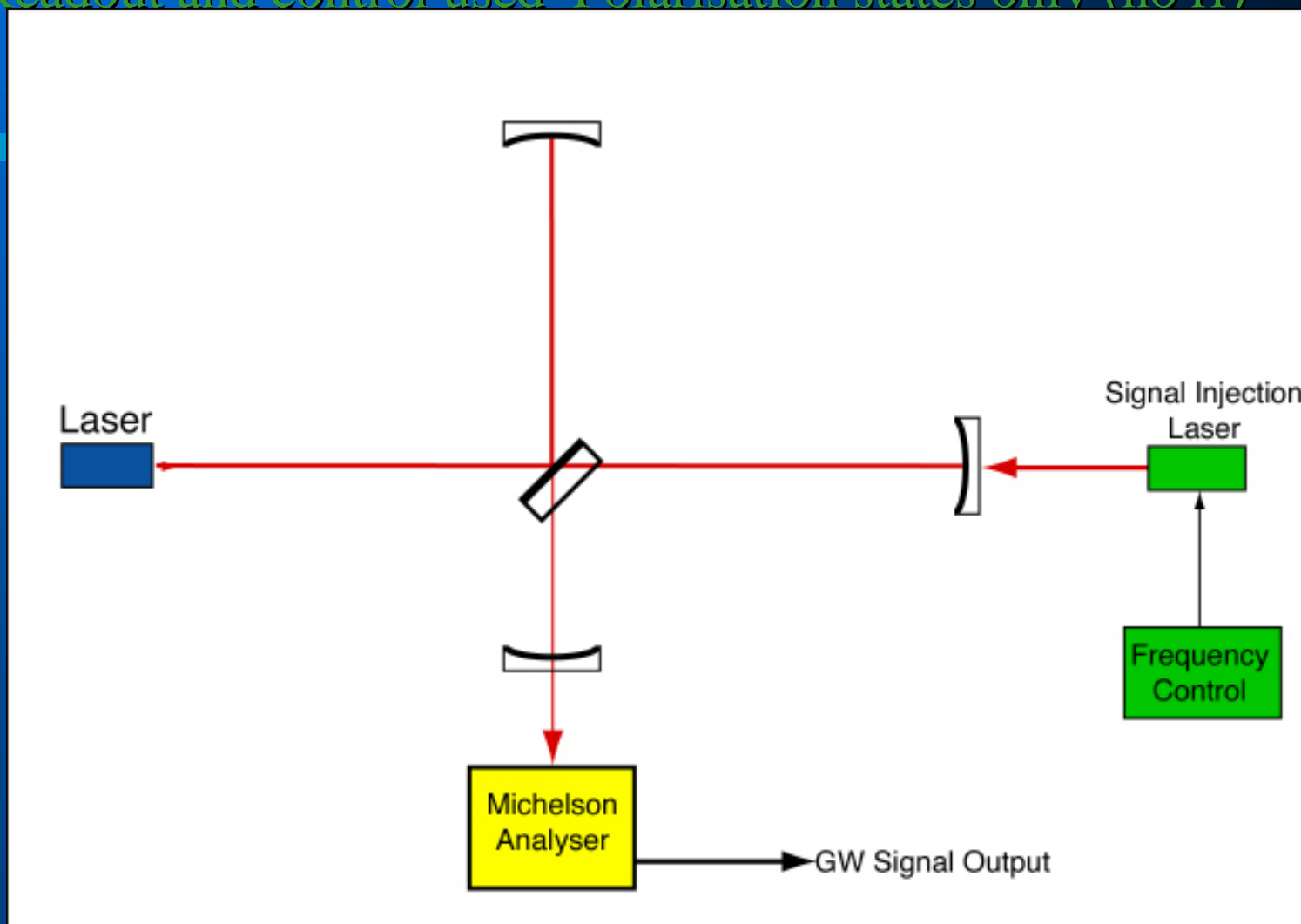
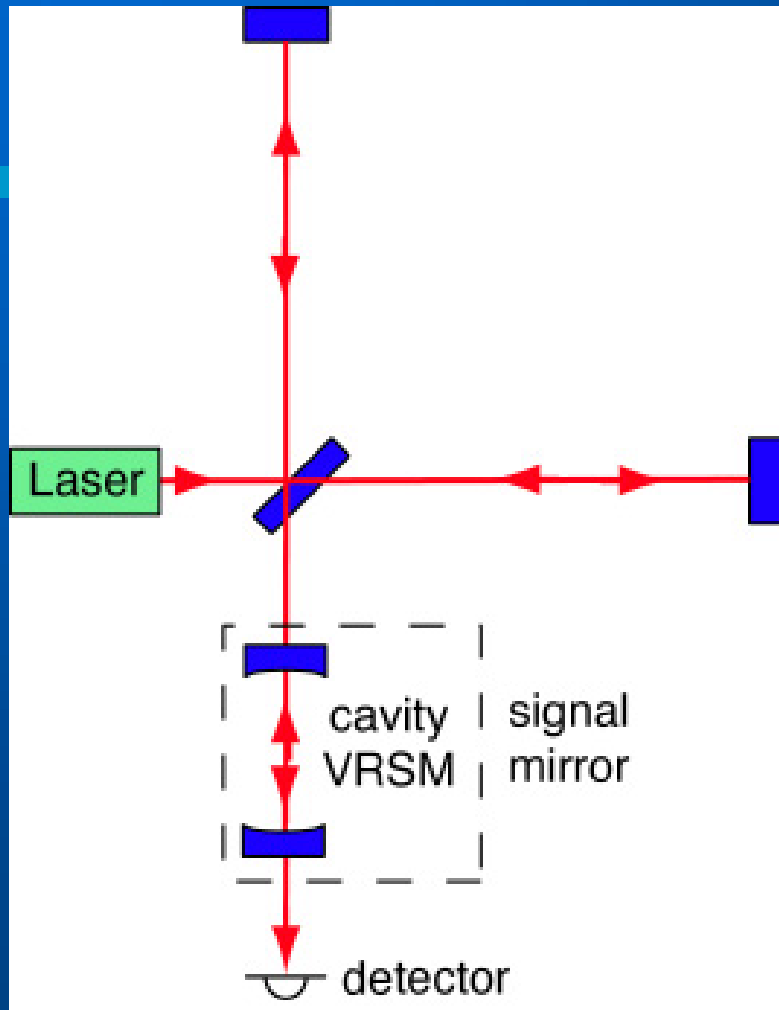# Experimental Signal Response Plots

- detuning 50% reflectivity
  signal mirror position

- bandwidth change for
  50% and 95% mirrors
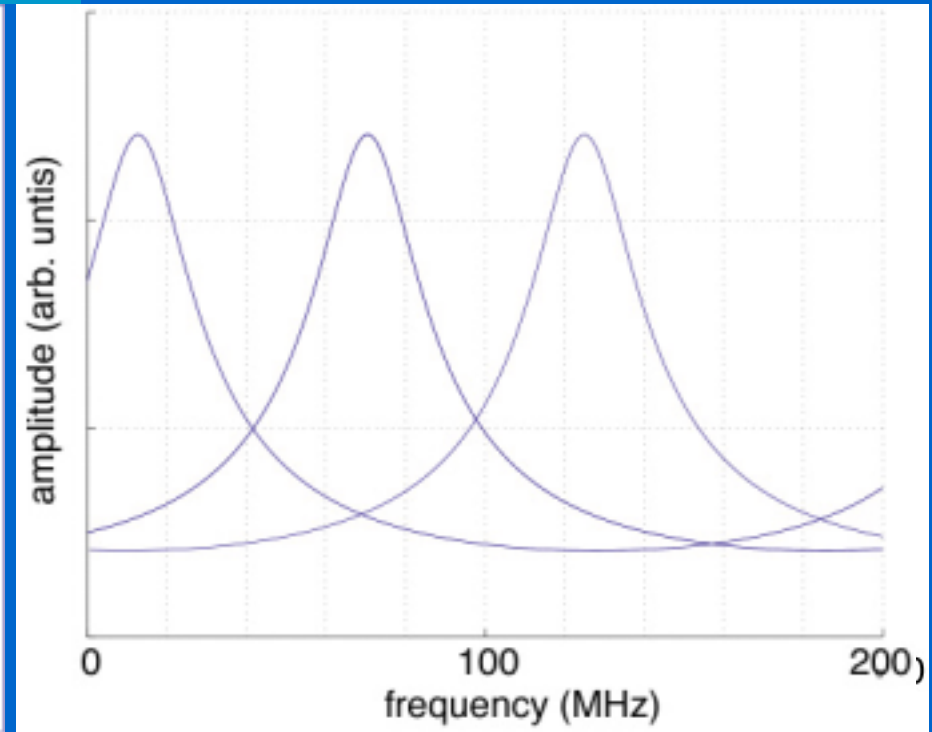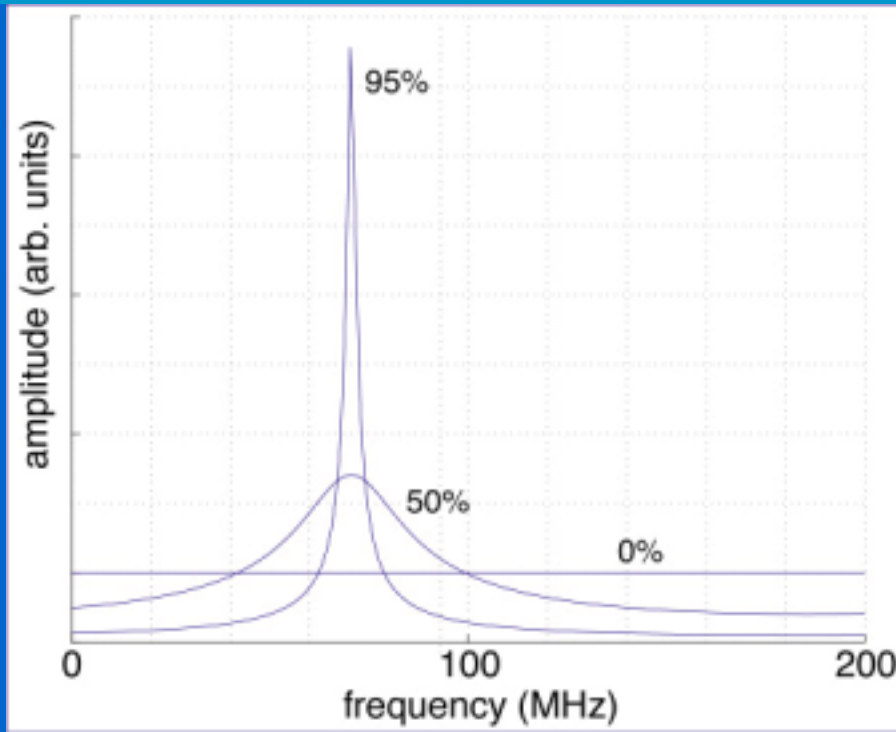
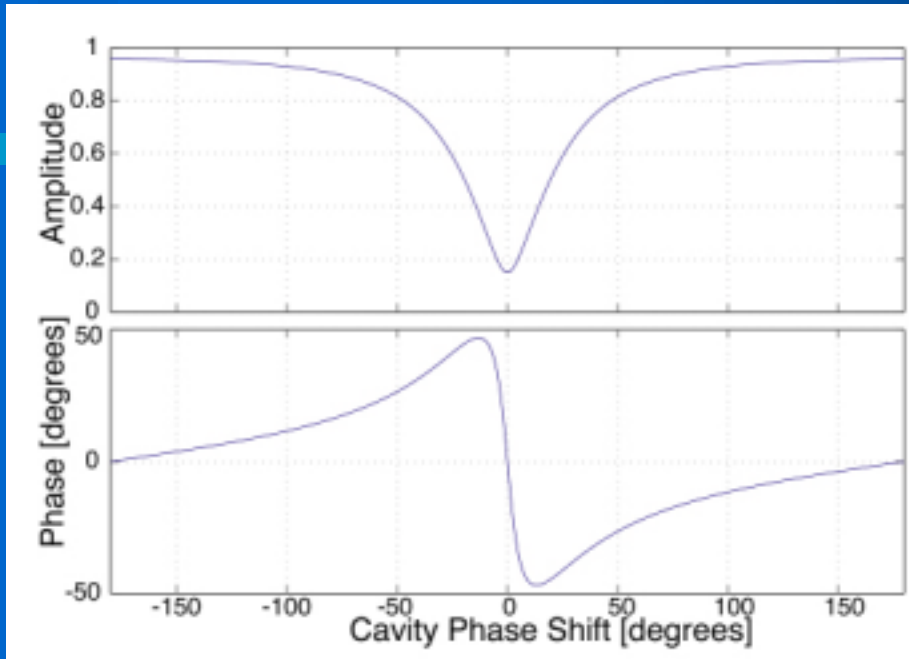
- qualitative agreement with theoretical plots
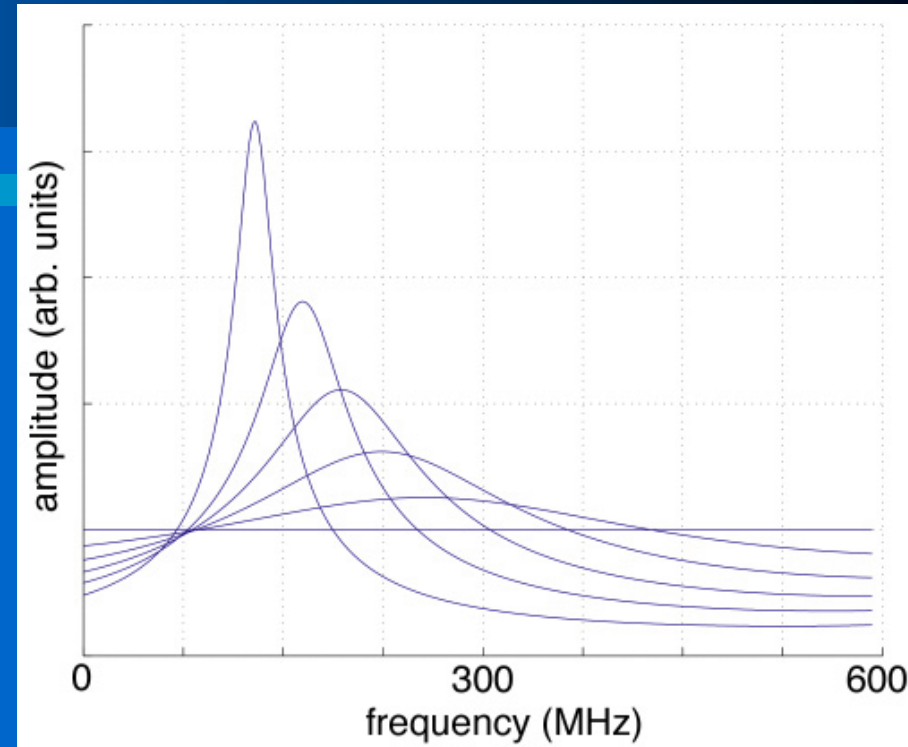
Variable Reflectivity Signal Mirrors

- **To control peak frequency and bandwidth with one configuration:**

- **Fabry-Perot cavity**
- **proposed by Meers in 1988 [1]**

- **This has never been demonstrated.**

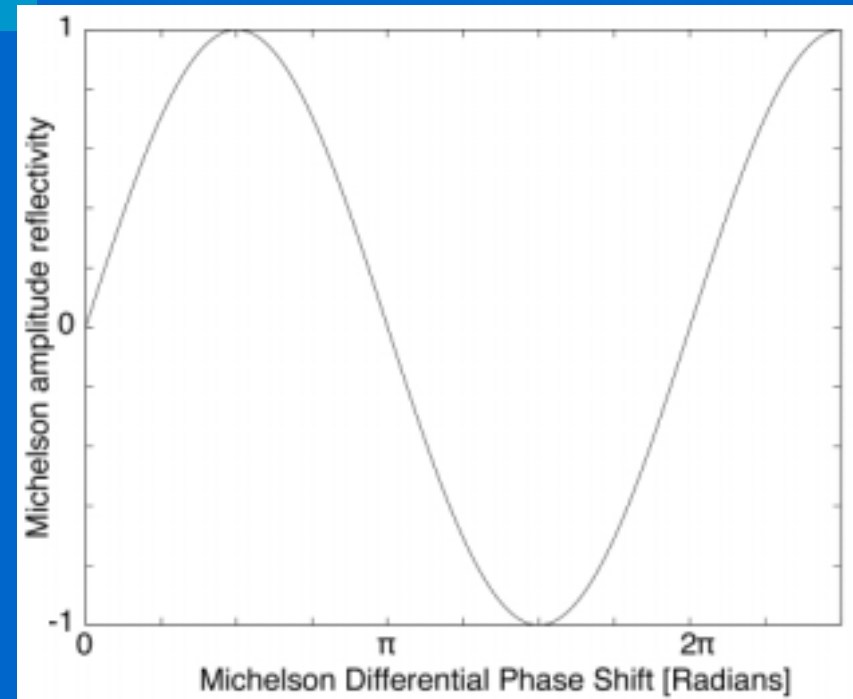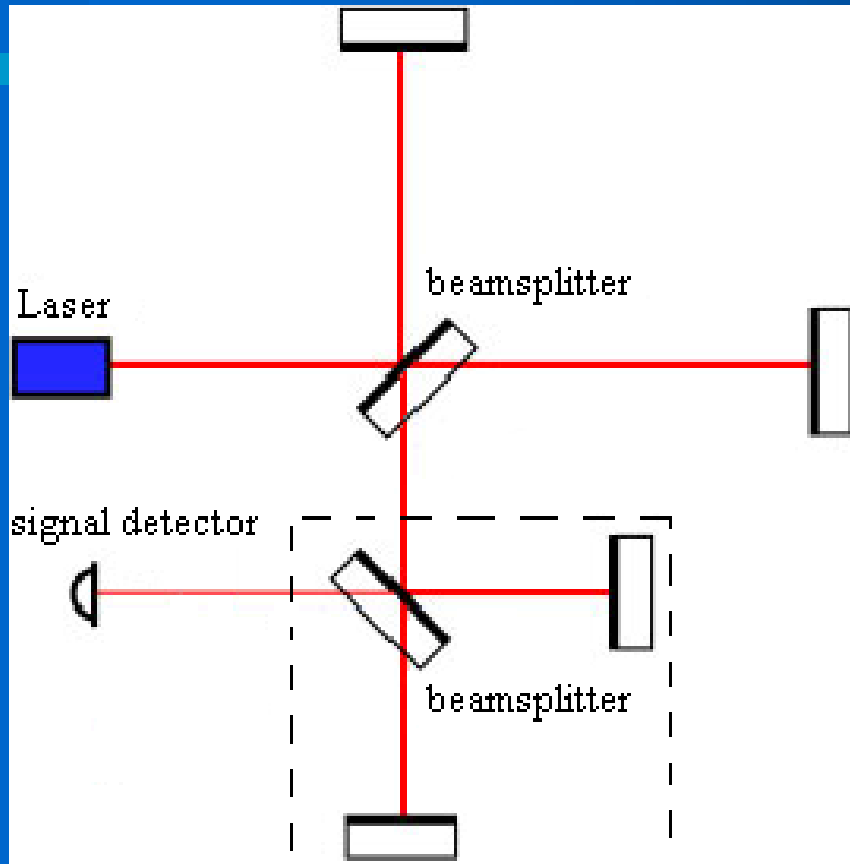[1] B.J. Meers, Phys. Rev. D, (1988)

Fabry-Perot cavity VRSM

Cavity reflectivity amplitude change is accompanied by an undesirable phase change

Theoretical responses showing coupling of peak frequency and bandwidth.

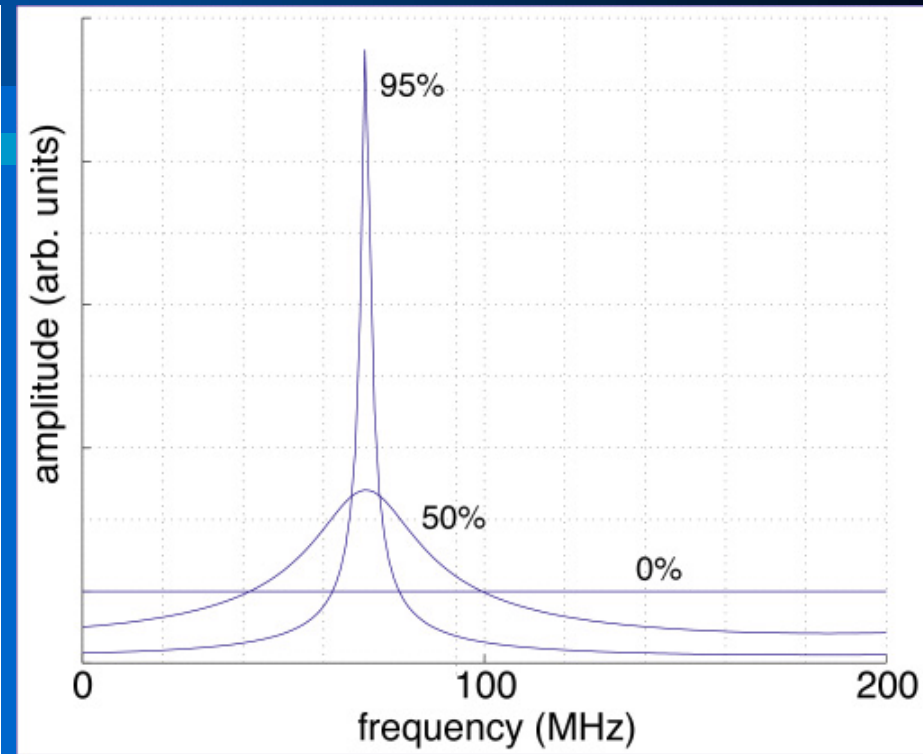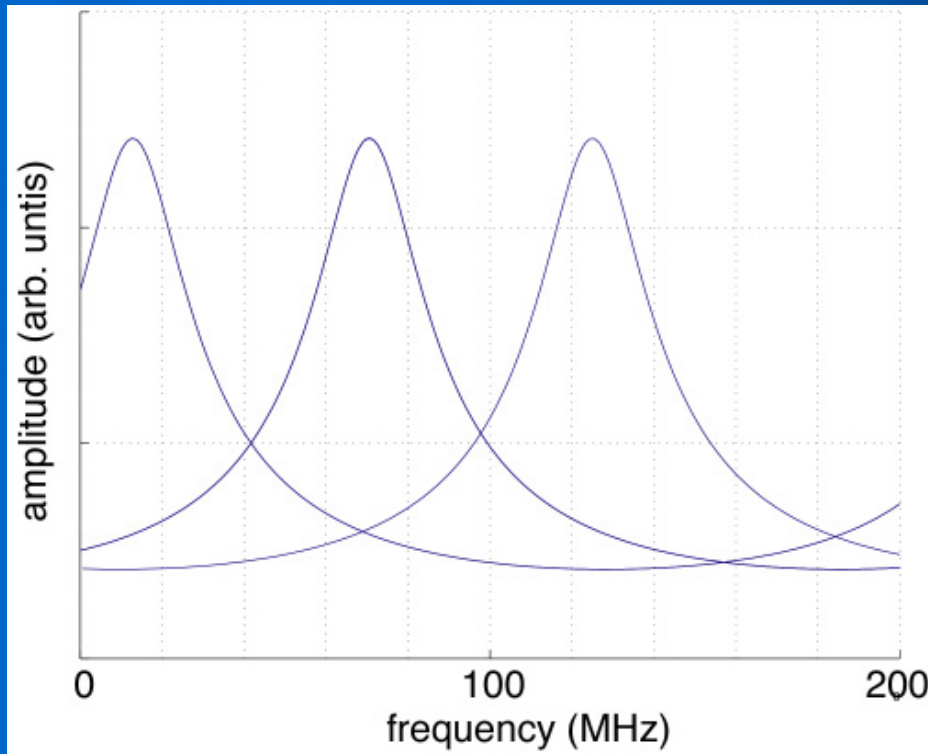# The Michelson Interferometer as a VRSM

- ## A newer proposal [1] - use another Michelson

- no phase shift introduced

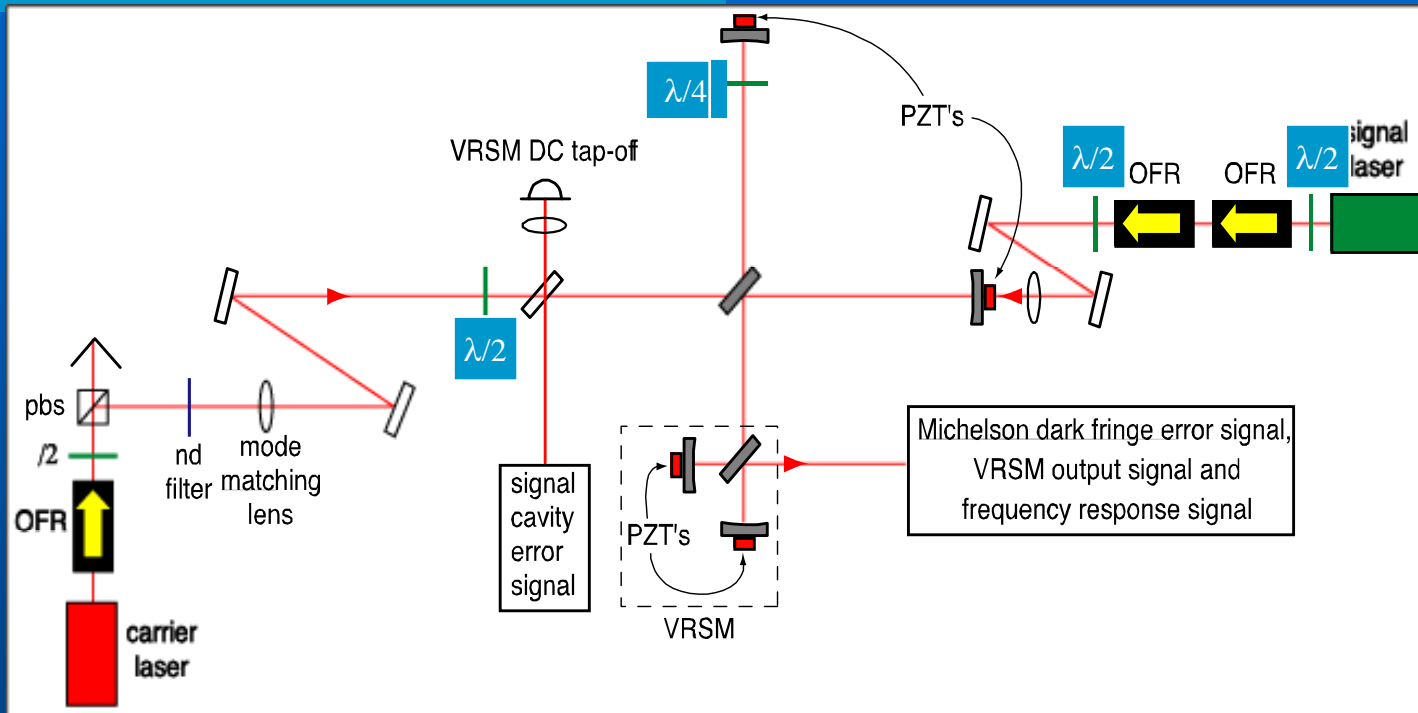[1] G. de Vine, accepted for publication in Class. & Quant. Grav.
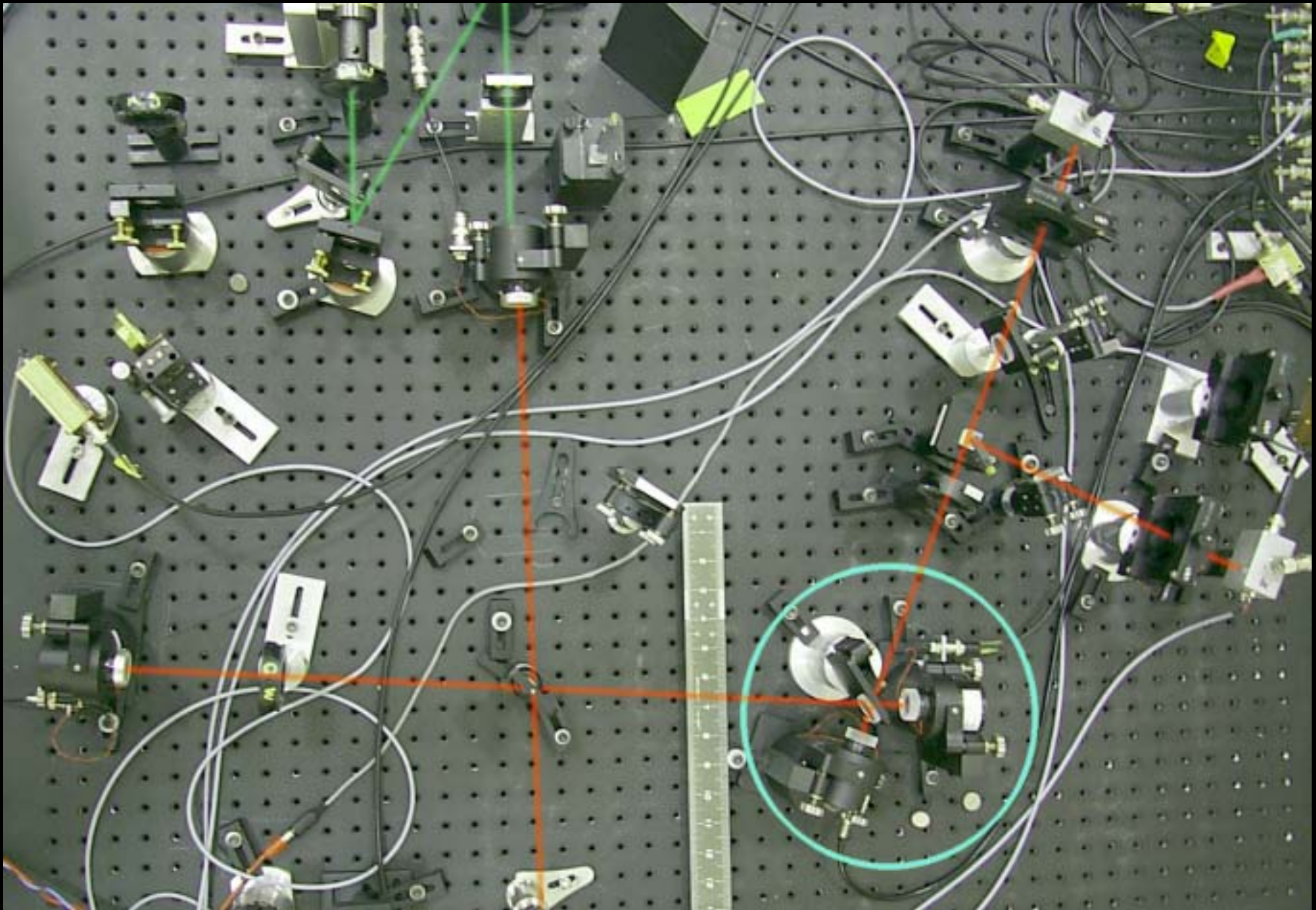
Theoretical Michelson VRSM Plots

- peak freq. Tuning
- VRSM common

- bandwidth tuning
- VRSM differential

Experimental layout for Michelson-Michelson experiment
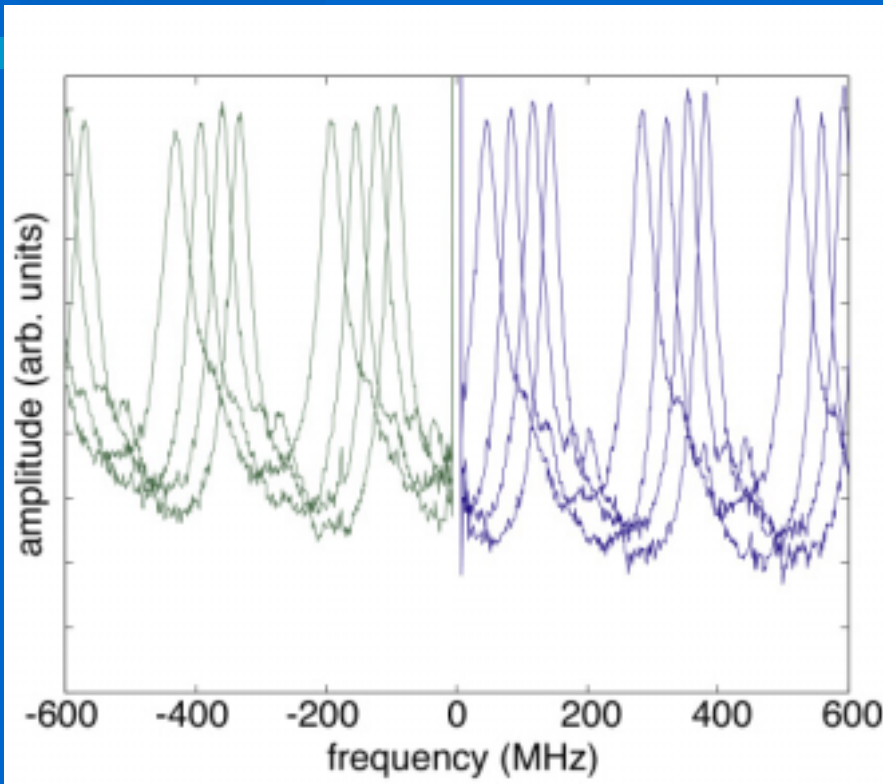## dc polarisation control and readout used
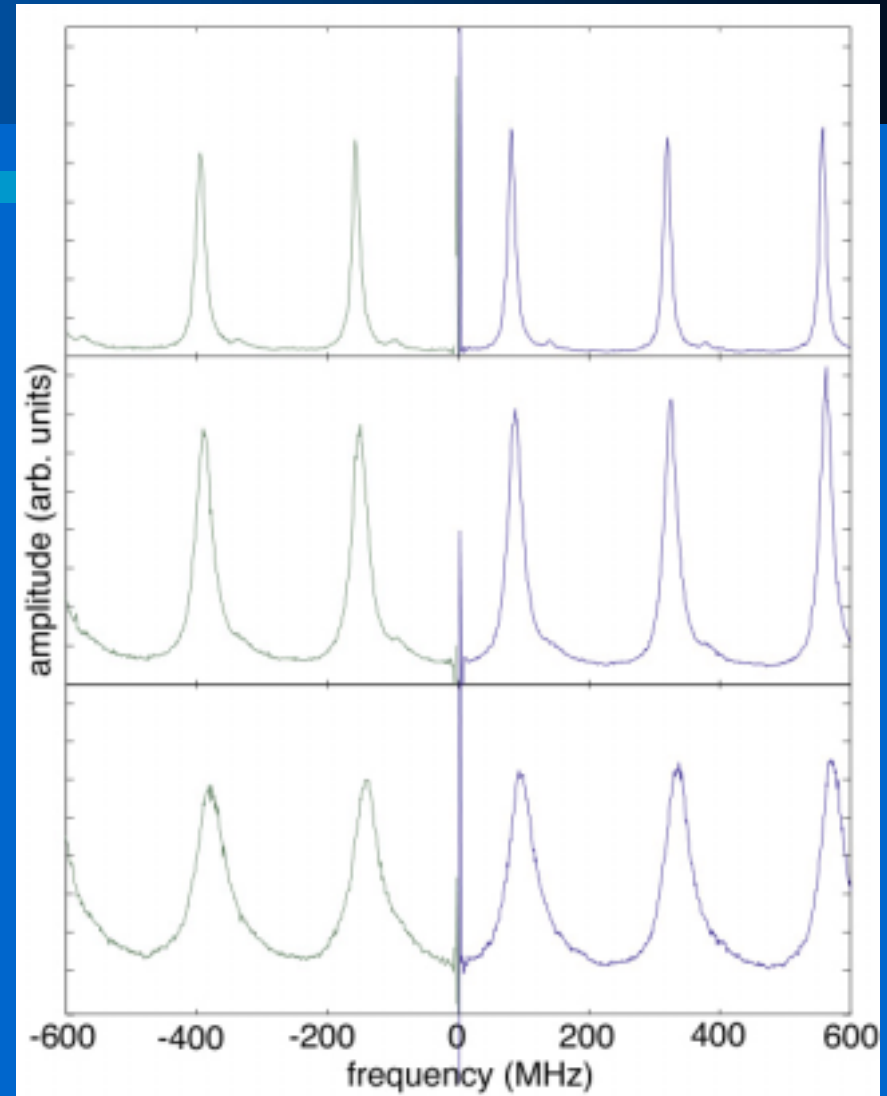
Variable Reflectivity Signal Mirrors

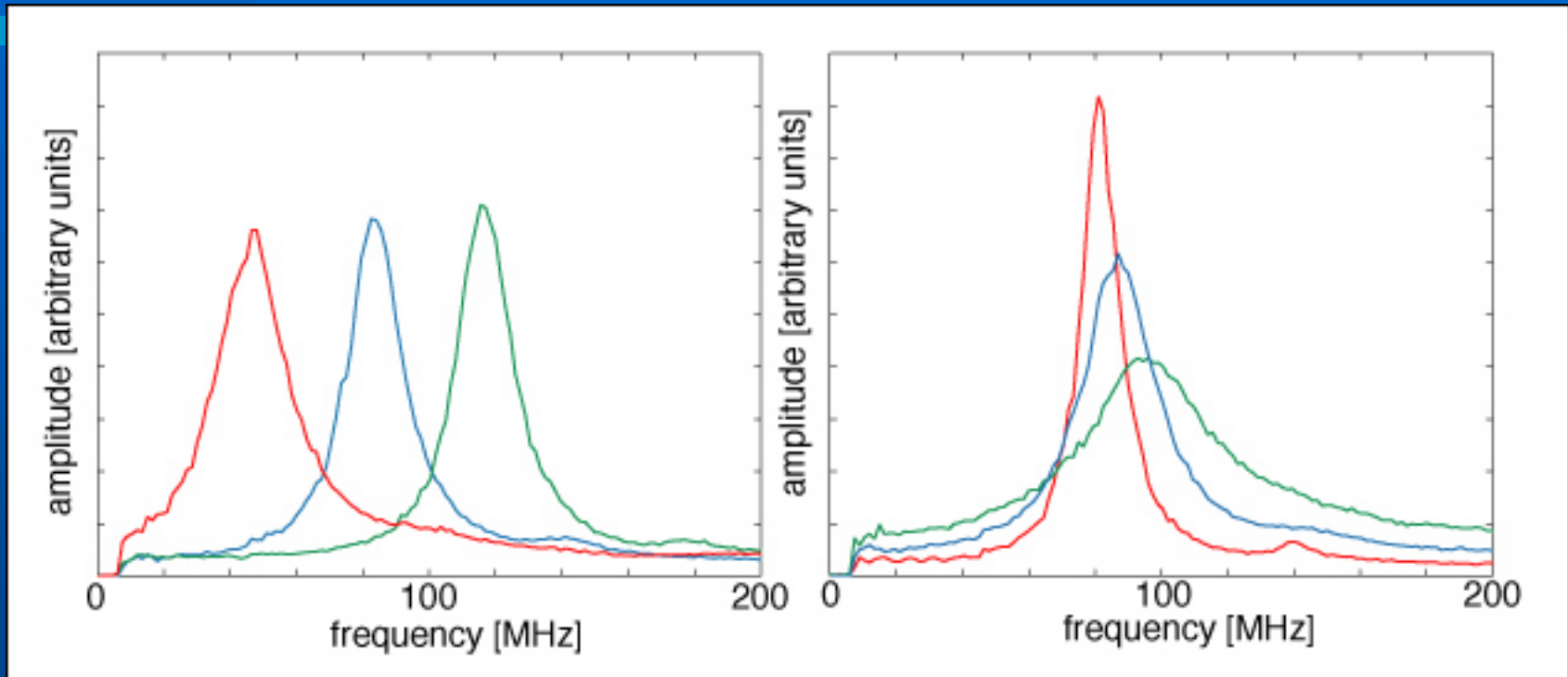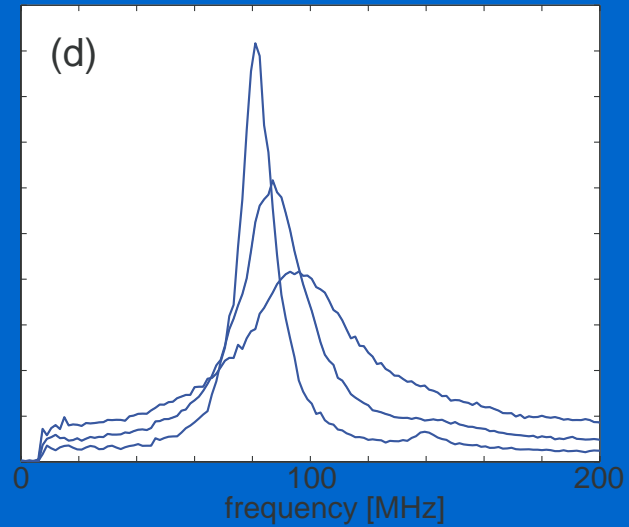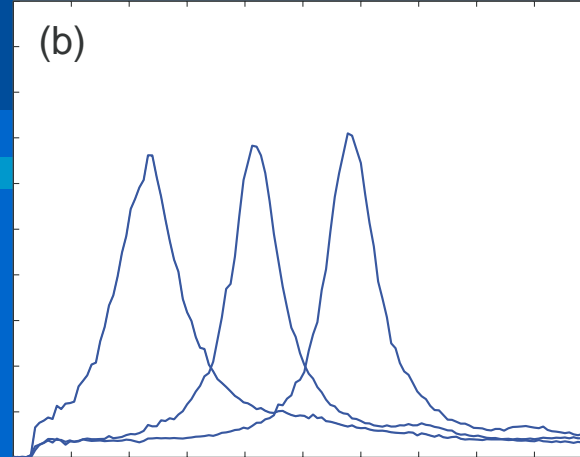# Michelson VRSM Experimental Results

- peak freq. tuning (below)

- bandwidth tuning (right)

Measured VRSM Signal Response

Variable Reflectivity Signal Mirrors
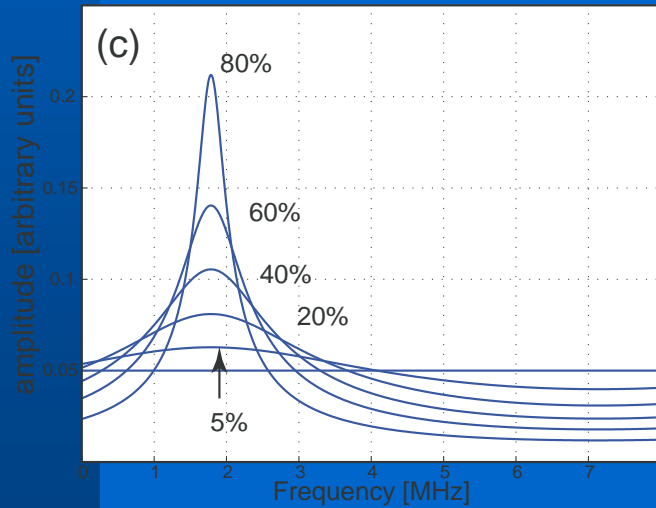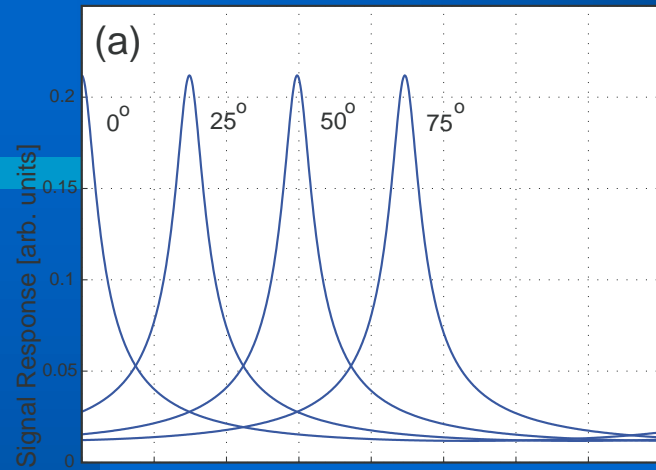
Conclusions and Future Work

- Demonstrated and obtained signal responses of a VRSM Michelson interferometer for the 1st time

- Developed a dc control and readout scheme using polarisation states

- The Future:

 - full-scale demonstration in (in Aust., US, Scotland)

 - further investigation for application of polarisation control scheme

 - solid (monolithic) Michelson VRSM