

# Filter Cavities

## The experimental challenges

Patrick Kwee et al.

GWADW, May 16<sup>th</sup> 2012

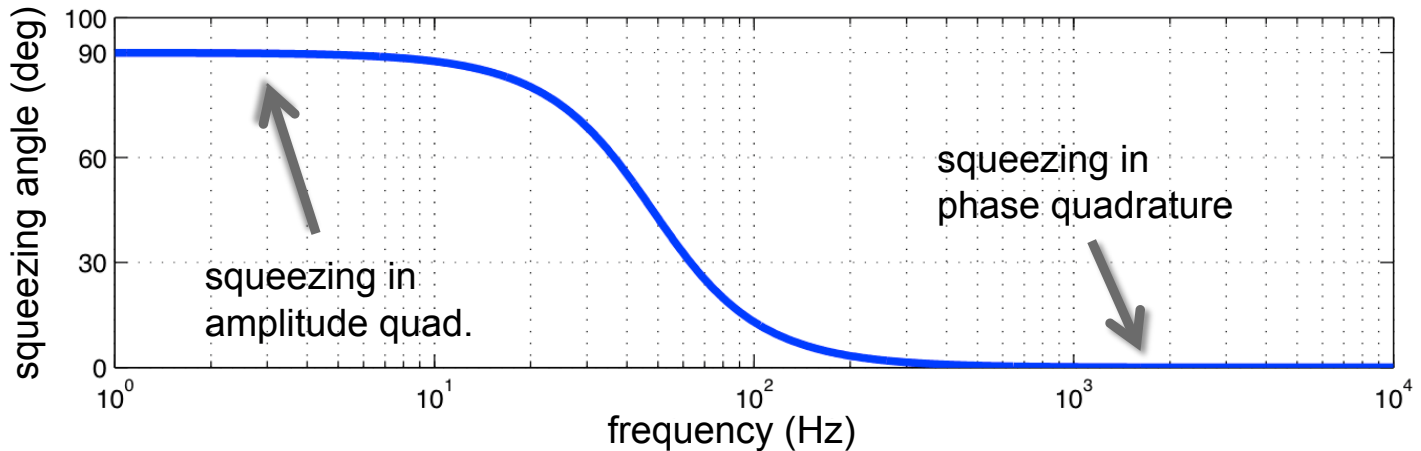
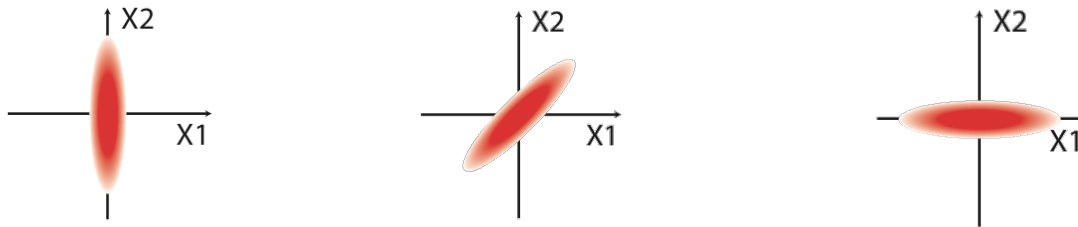
LIGO-G1200553



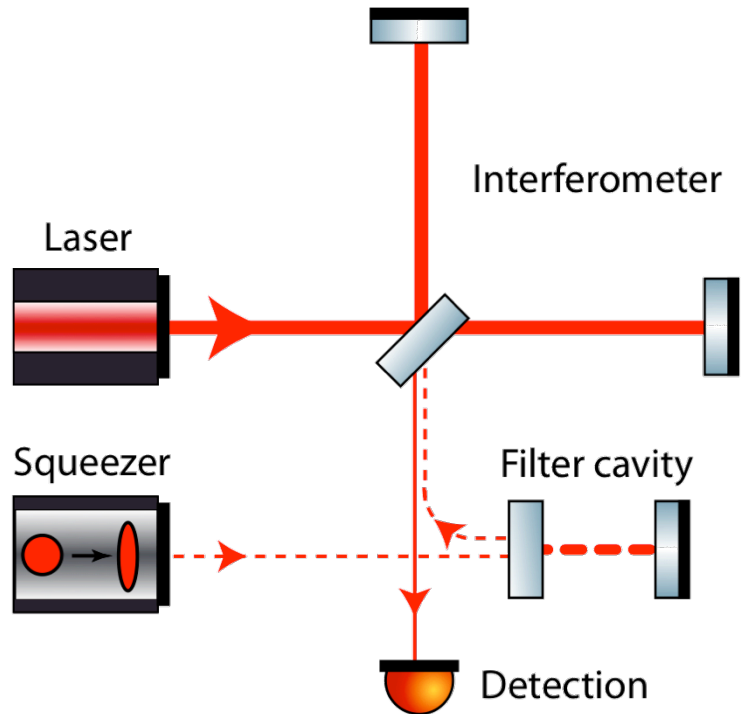
# Frequency Dependent Squeezing



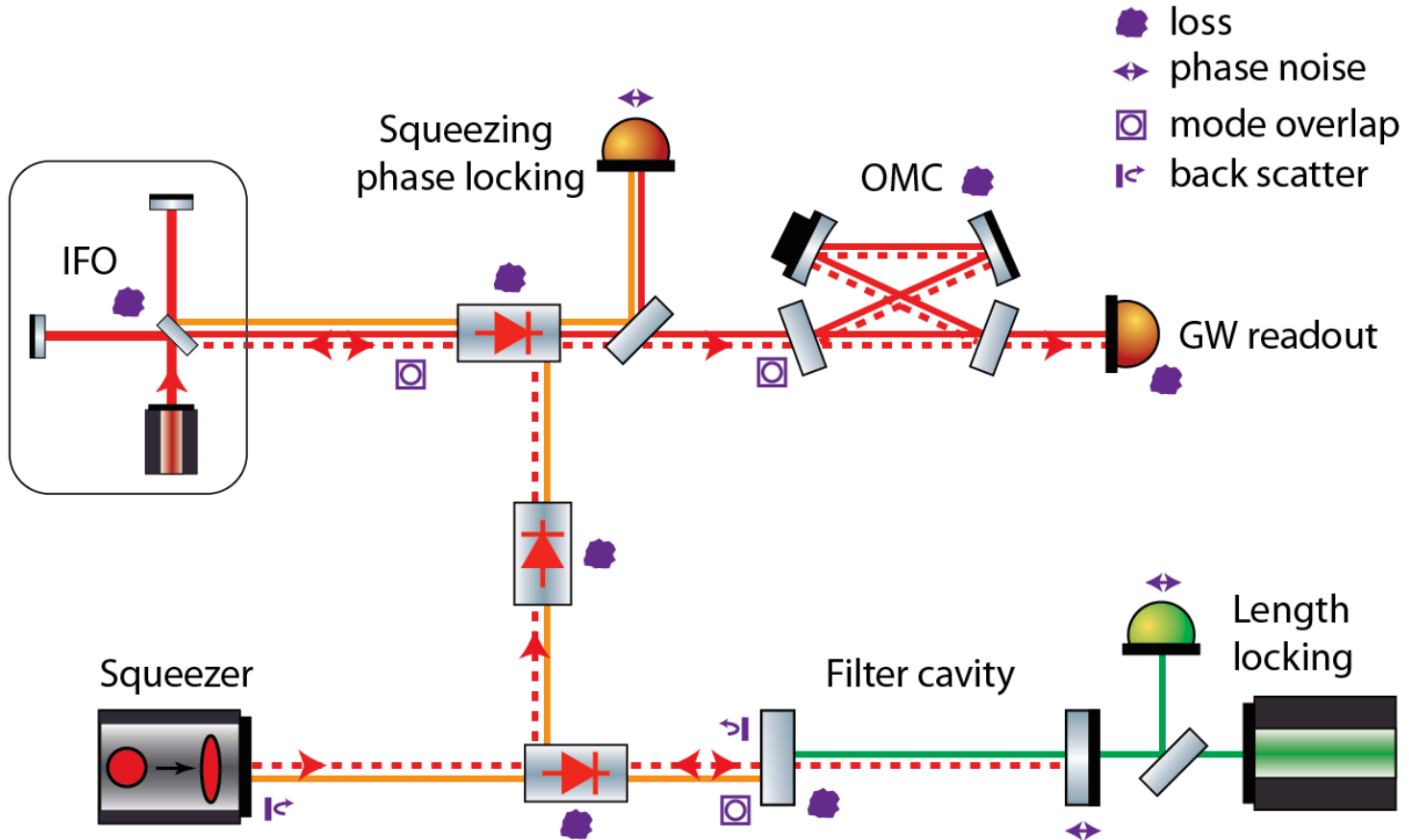
- Advanced GWDs will be radiation pressure limited
- Frequency dependent rotation of squeezing ellipse



- Reflection at detuned optical cavity, so-called filter cavity
- Theoretical well understood...
- But experimentally challenging



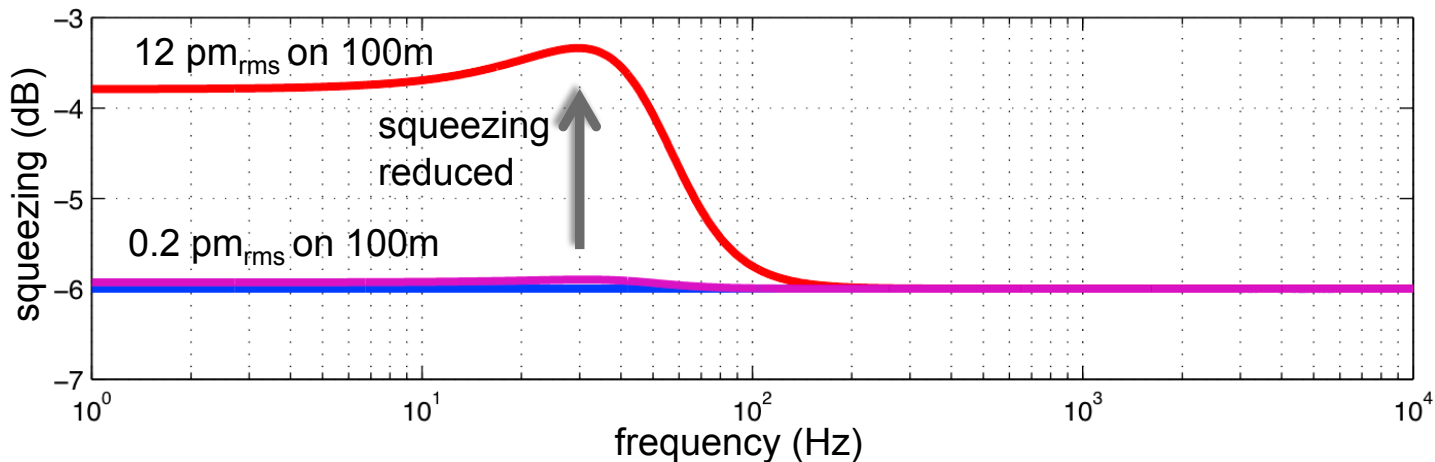
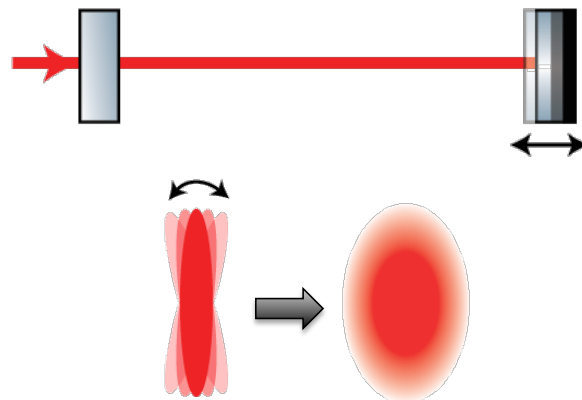
# Experimental challenges



# Phase noise



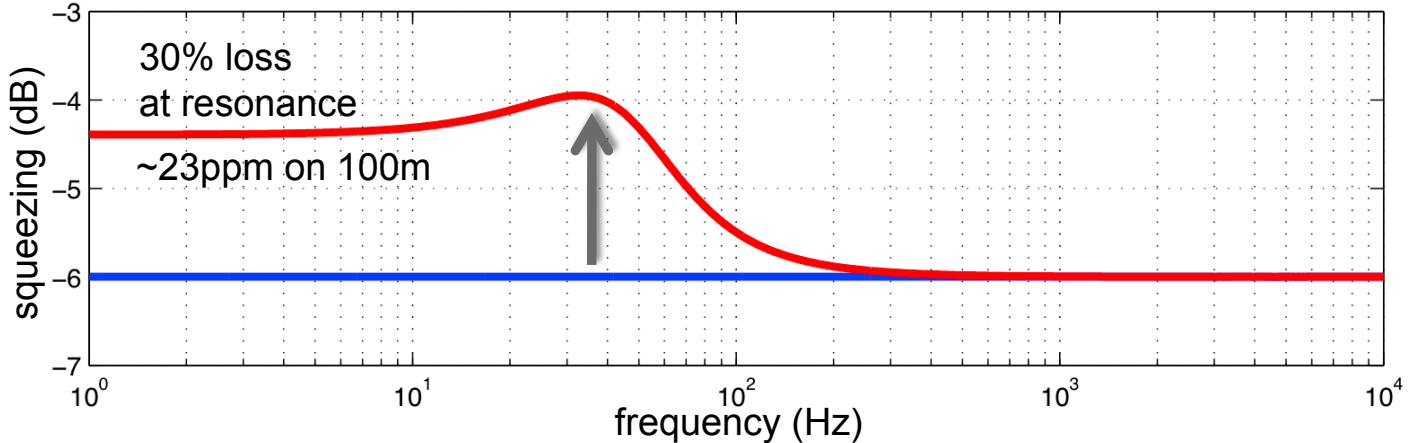
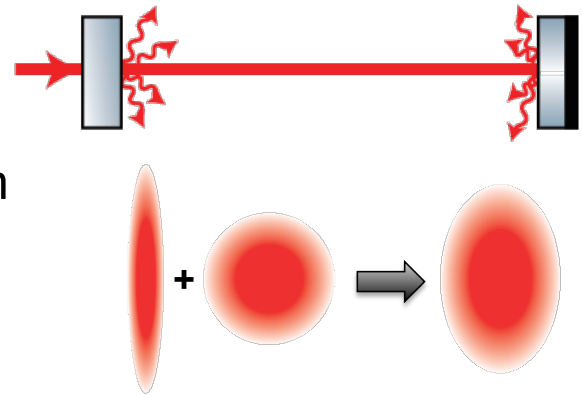
- Residual length noise
- Squeezing angle fluctuates
- Observed squeezing reduced



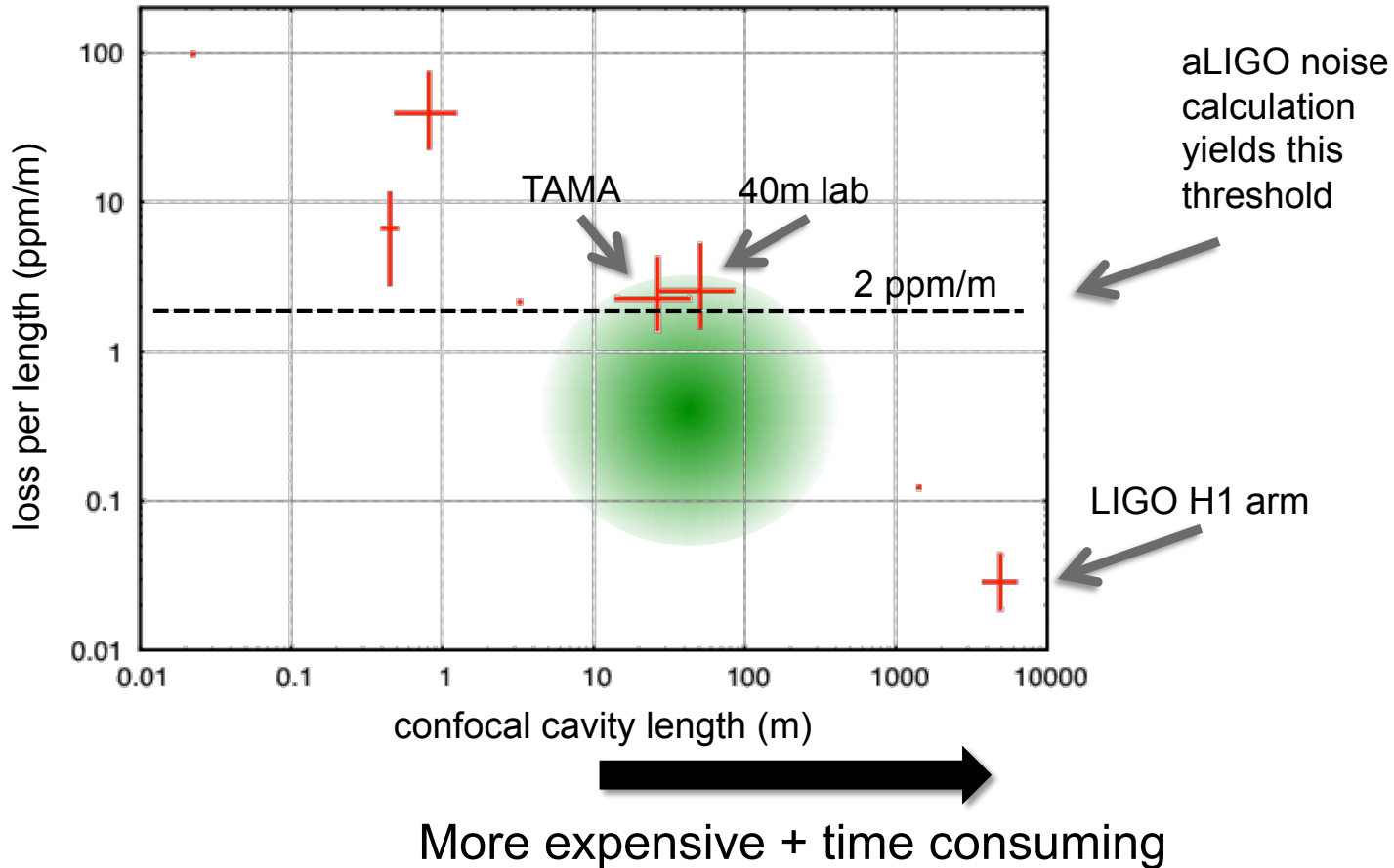
# Filter cavity loss



- Scattering loss
- Squeezing mixes with vacuum
- Observed squeezing reduced



# Scattering loss



## MIT

- Working on design for aLIGO upgrade
- Experiments to...
  - characterize high finesse cavities and scattering
  - test control scheme
- Projection of technical noise

## Caltech

- Optics and scattering simulations
- Measurement of mirror maps
- Cavity ring down at 40m



- Advanced GWDs will need a filter cavity
- Many technical problems need to be solved
- Biggest worry: Scattering loss in filter cavity
- Experiments and simulations starting now

