in the "Real World"

How does it work? | Modal Model

Modes are used to represent perturbations to a perfect beam

Represent the beam with different spatial basis functions by a series expansion:

$$E(t,x,y,z) = \sum_j \sum_{n,m} a_{jnm} \; u_{nm}(x,y,z) \; \exp\left(i\left(\omega_j t - k_j z\right)\right)$$

is our basis function choice, typically we use
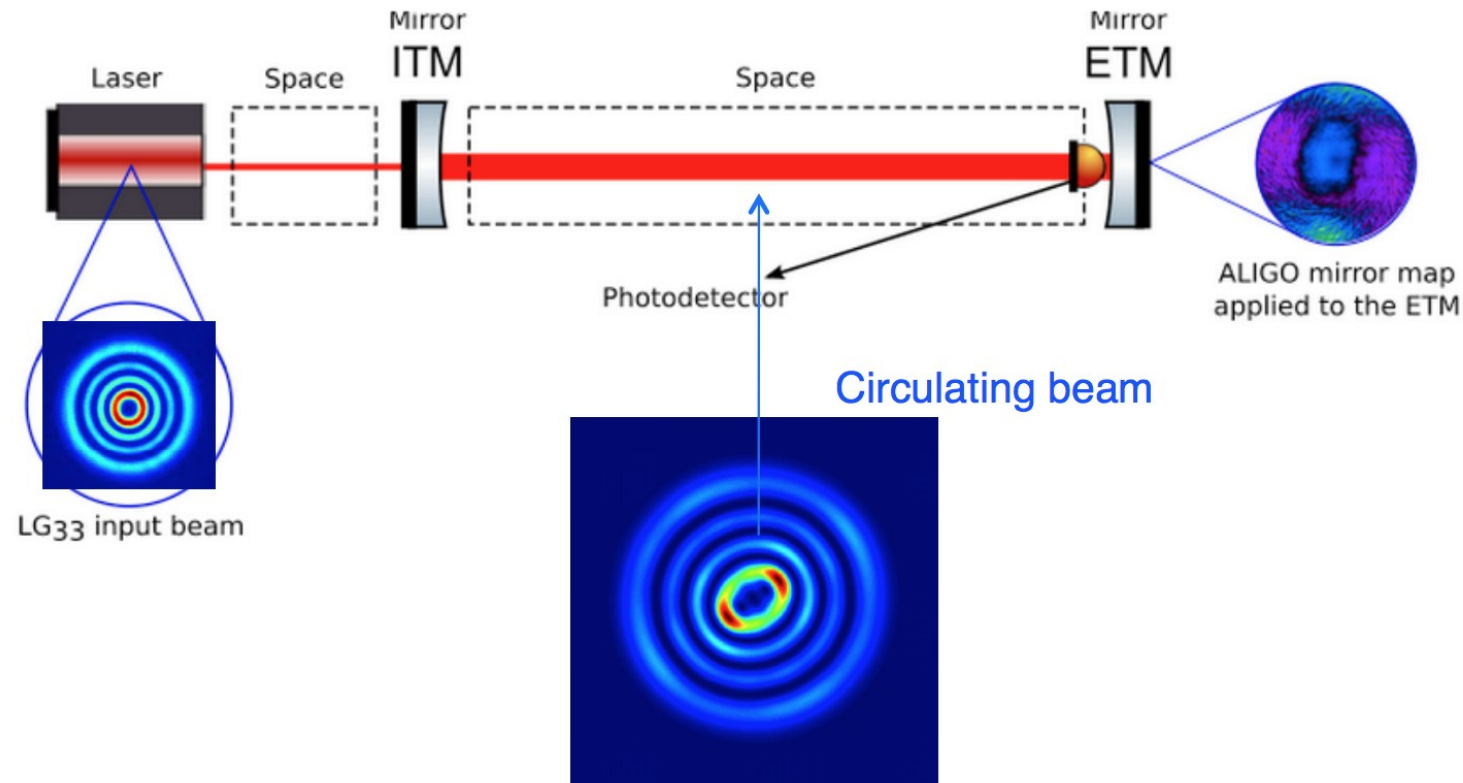Hermite-Gauss (HG) modes: Rectangular symmetric
Laguerre-Gauss (LG) modes: Cylindrically symmetric

Modal model only deals with paraxial beams and small distortions, what we would expect in our optical systems.
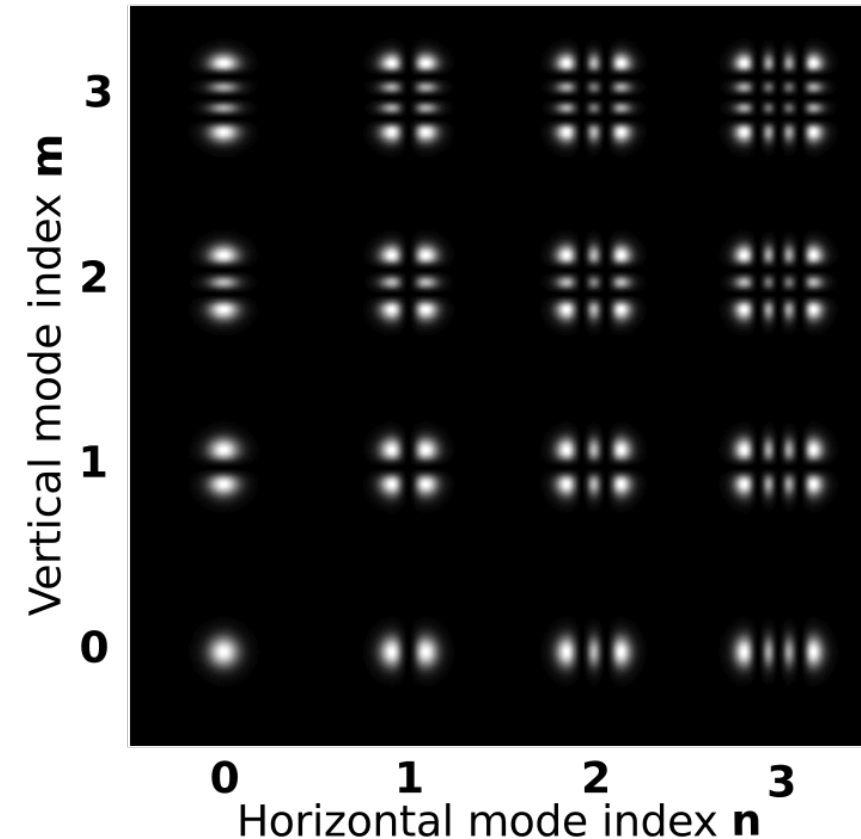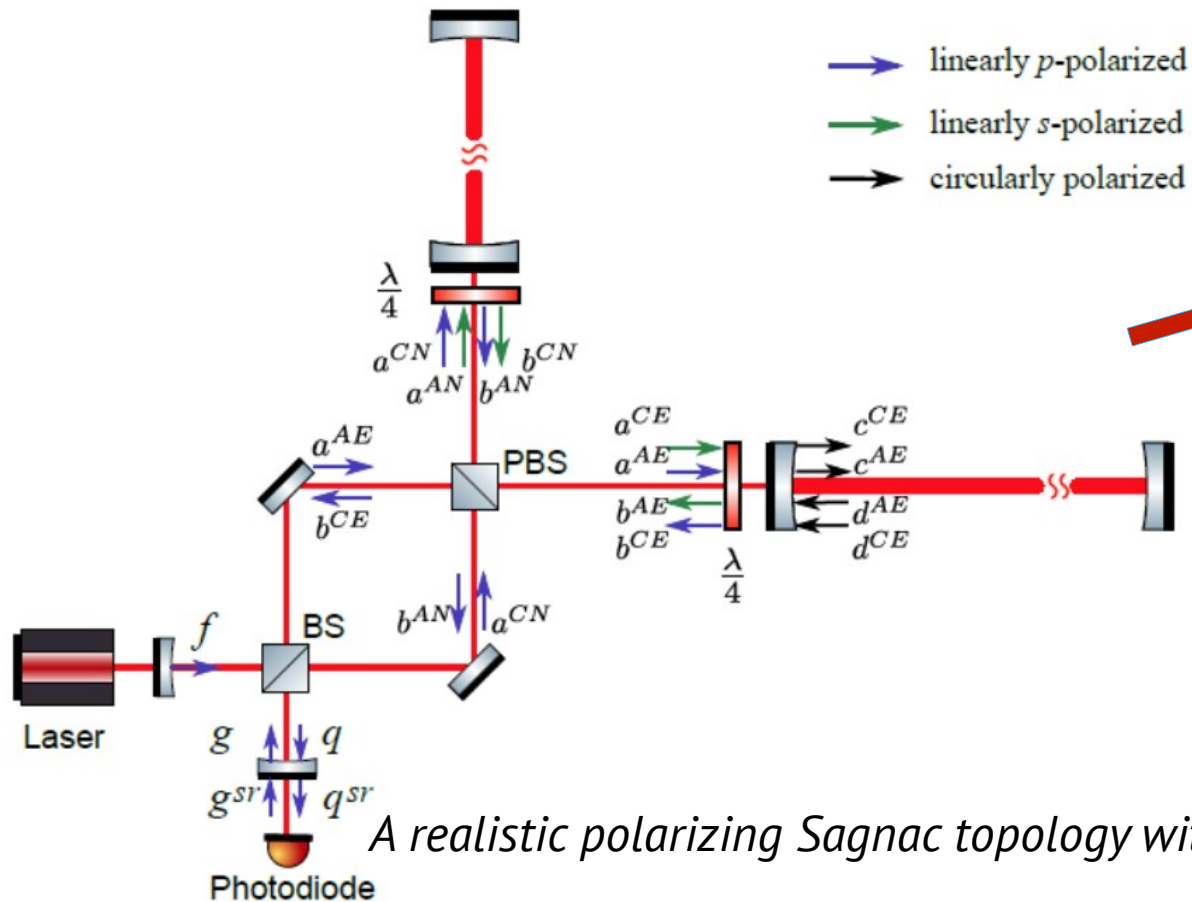
Example: Mirror maps with LG33 mode

You can...Study mode purity and degeneracy in a cavity with realistic mirrors
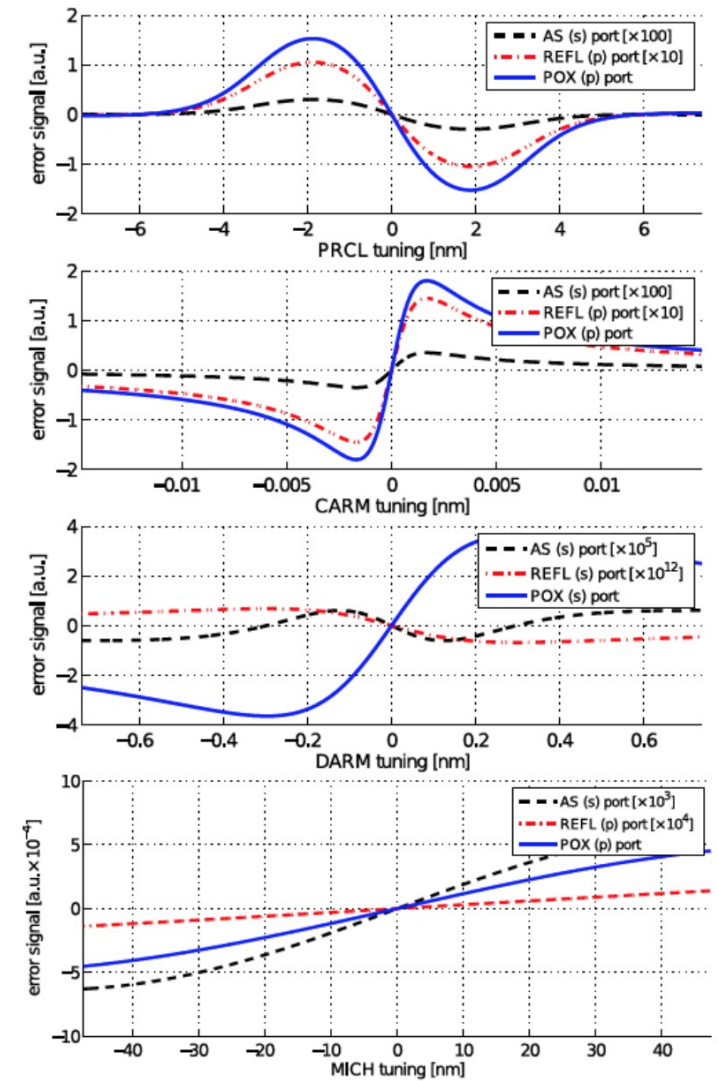

Higher order Laguerre-Gauss mode degeneracy in realistic, high finesse cavities, C. Bond et. al. (2011)
arxiv.org/abs/1107.3812

Example: RF Control Signals

You can...Calculate length control signals for a new interferometer topology
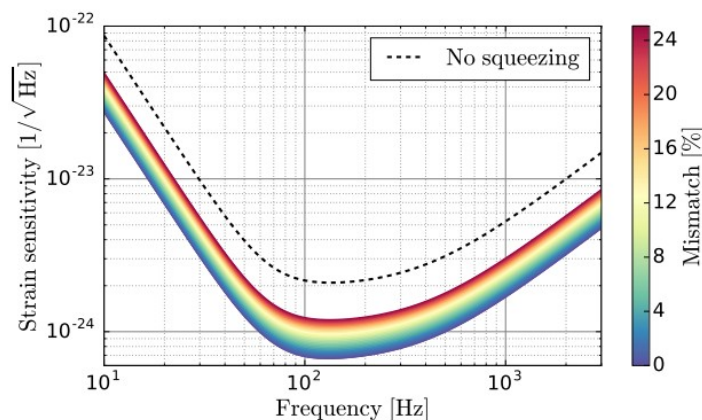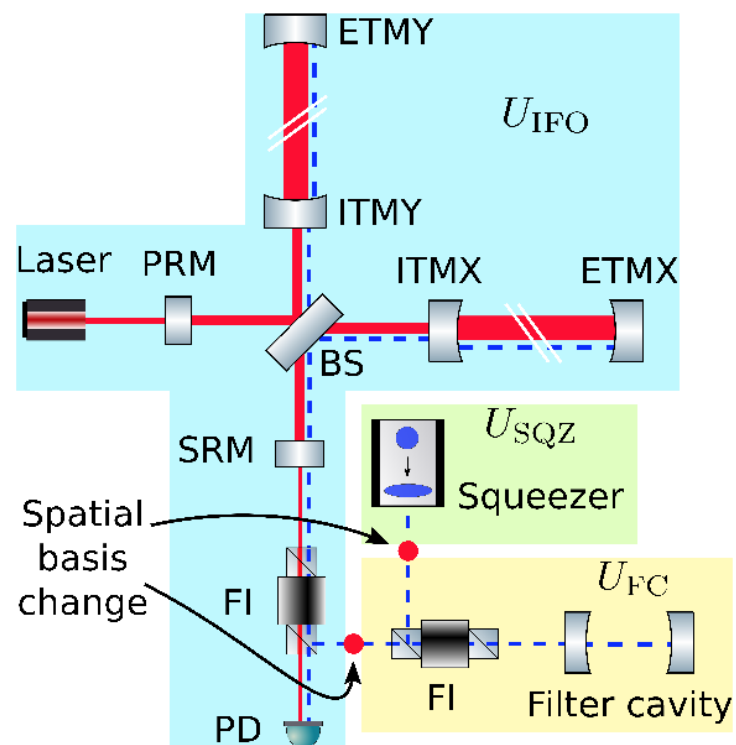

A realistic polarizing Sagnac topology with DC readout for the Einstein Telescope M.Wang et. al. (2013)
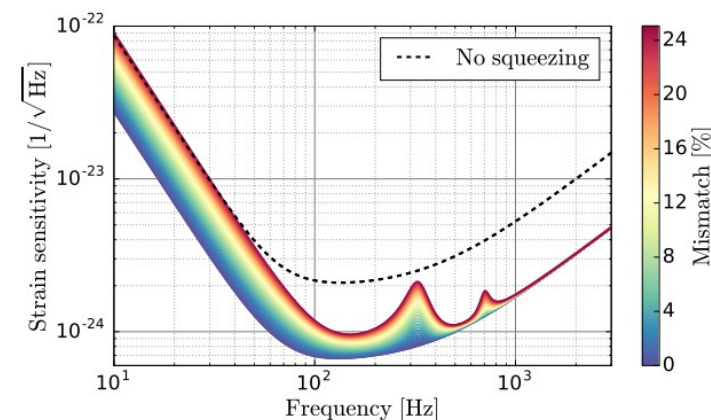arxiv.org/abs/1303.5236

Example: Multimode Squeezing

You can…Design a new frequency-dependent squeezing scheme which is more robust to mode mismatch

Squeezer matched to filter cavity, filter cavity mismatched to IFO

Squeezer matched to IFO, filter cavity mismatched to IFO

Multi-spatial-mode effects in squeezed-light-enhanced interferometric gravitational wave detectors
D. Töyrä et. al. (2017) arxiv.org/abs/1704.08237

Example: Parametric Instabilities

You can...Show how higher order radiation pressure pressure effects are affected by the topology of the interferometer.
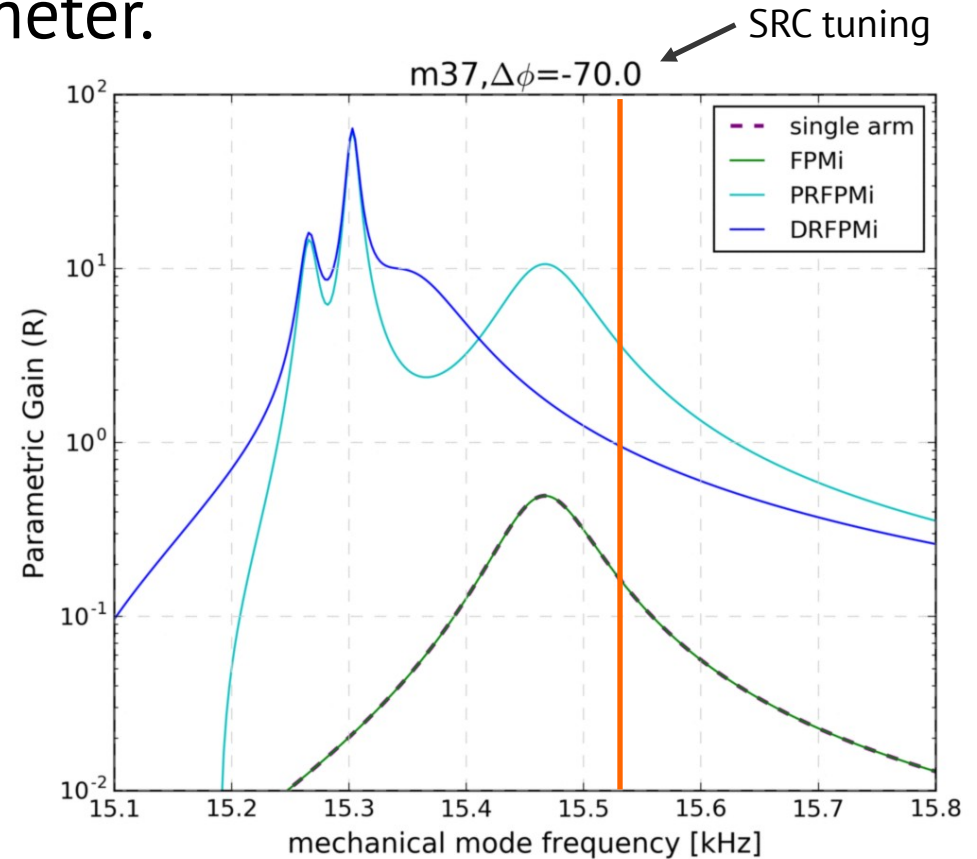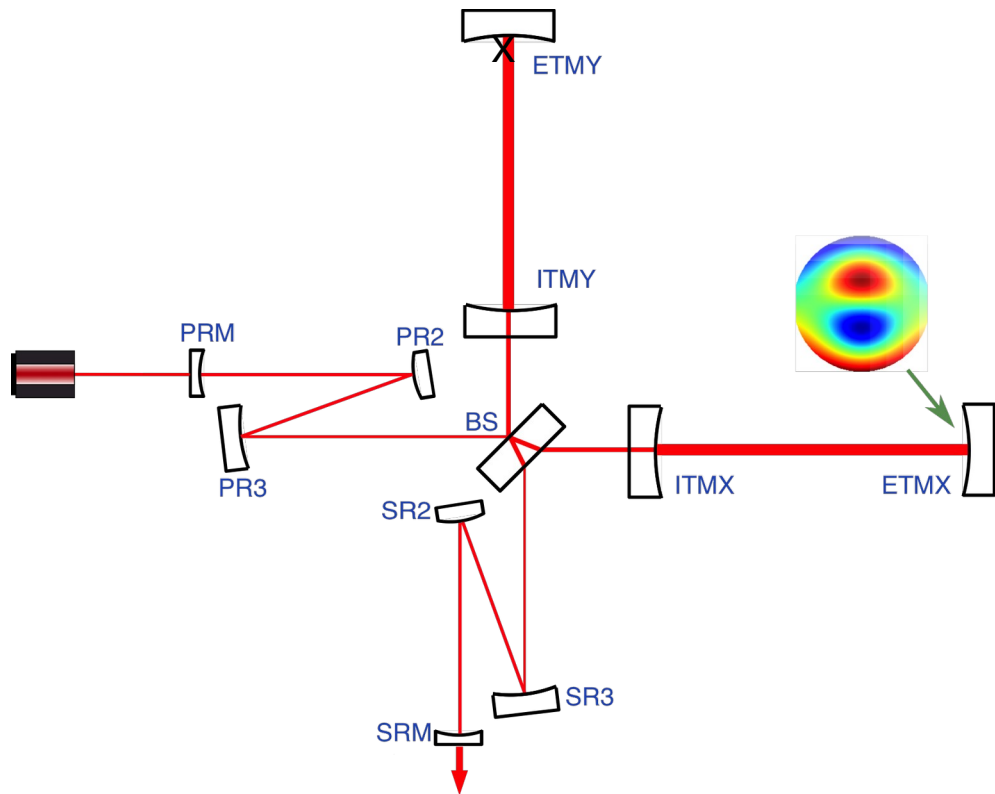
The Influence of Dual-Recycling on Parametric Instabilities at Advanced LIGO, A. Green et. al. (2017)
arxiv.org/abs/1704.08595

Example: Coupled Cavity Effects

You can... Highlight problems in analytical assumptions for future detectors.