

SIMULATIONS FOR COMMISSIONING AND FUTURE DETECTORS

Matt & Lisa LIGO-MIT

OUTLINE

Problems that we should solve

Some concrete actions to take

EXAMPLE PROBLEMS



GWINC-NOISE BUDGET MODEL

 Intermediate between GWINC (fundamental noises) and noise budget (measured noises)

Modeled and parameterized noise sources and couplings



THERMAL DISTORTIONS COUPLING TO CONTROL SIGNALS (ASC AND LSC)

- Thermal model of mirrors, and resulting phase distortions
- Spatially resolved field (modal model? FFT?)
- Alignment signals (length and alignment think eLIGOTCS)
- Cold / Hot interferometer (Kate's talk)



Aidan Brooks: Commissioning Workshop 2013

PARAMETRIC INSTABILITIES

- FEA of mirrors (acoustic mode shapes, frequencies and Qs)
- Spatially resolved optical model, with real mirror apertures
- Radiation pressure
- (think cryo Si detectors)



Slawek Gras, MIT

HAIXING'S INTERFEROMETERS

- Wide variety of optical configurations (multiple wavelengths)
- Non-linear optics (squeezing)
- Complicated quantum noise



ACTION ITEMS



FULL FFT SIMULATION OF DRFPMI

- Variety of thermal states (need some speed)
- Complicated scenarios (need both recycling cavities)
- Optical Wave-front distortions (search for sweet-spot)
- ▶ FOG? SIS? ...

MODAL MODEL WITH RADIATION PRESSURE

- Computationally challenging (very large matrix inversion)
- Possibly limit radiation pressure to carrier, to test-masses, and to only some HOMs
- Finesse? MIST?

LINEAR MODEL WITH SQUEEZING AND MULTIPLE WAVELENGTHS

- Full radiation pressure (OMIT)
- Non-linear optics (SHGs, OPOs, Kerr media, ...)
- Multiple wavelengths (optical properties a function of wavelength)
- Optickle?

THE MESSAGE

- We asked for the uber-model... not possible
- We asked for unified input files... not practical
- Let's learn how to tweak the models we have, and combine the outputs, to answer some important unsolved problems
- Example: use a thermal model to compute a variety of thermal states of the optics, then use an FFT/modal model to compute transfer functions for LSC and ASC signals (time domain locking?)
- Example: use an FEA model to compute acoustic mode frequencies as a function of temperature, optical model with radiation pressure and higher-order modes to compute parametric gains

