

BeNL ET Modelling Workshop

Workshop on modelling for ET

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Introduction

ET-HF

- i. ET-HF will feature 3 MW of optical power
- ii. High power drives optomechanical phenomenon such as PI and Sidges-Sigg
- iii. This presents open questions in terms of angular control

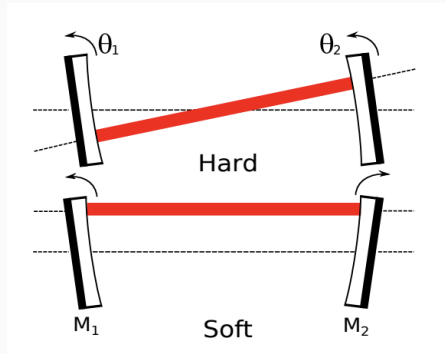


Illustration of Hard and Soft mode. Courtesy of Liu Jian - Angular instability in high optical power suspended cavities. Copy in git repository.

Existing body of work

- i. A study has been done for ET-LF.
- ii. The following noise projection flow was used
- iii. However:
 - No suspension model exists for ET-HF
 - The single wire suspension is very soft in yaw
 - ET-HF operates with considerable power
- iv. As such, we propose a study on the HF angular controlability

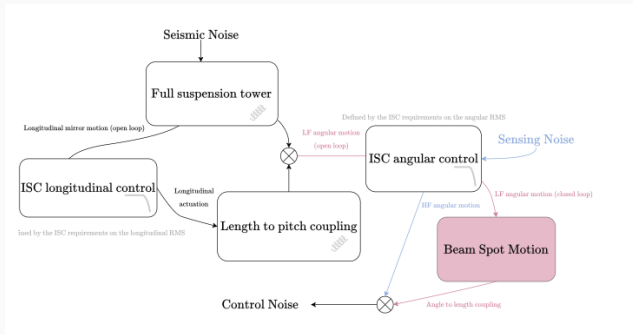


Illustration of LF approach. Courtesy of Artem - ET-0327B-25. Copy in git repository.

Objectives

Session objectives

- i. Define a mechanical model for the ET-HF test mass suspension: Tools: Femto
- ii. Export the mechanical model to Finesse and show that the model is converted successfully: Tools, Femto & Finesse
- iii. Model the angular motion to $h(t)$ as a function of beam spot position for the following degrees of freedom: CHARD, CSOFT, DHARD, DSOFT.

Individual objectives

- i. Learn how to do advanced modelling in FINESSE3 including
 - Control schemes
 - Mechanics
 - Advanced transfer functions
- ii. Learn how to model mechanics in Femto

Proposed plan

Objectives - Team 1 - 200 Kg test mass

- i. A model of a BHQS exists here in Femto:
`https://git.ligo.org/robin.cornelissen/femto`
- ii. Redefine the model to accommodate a 200 Kg test mass
- iii. Plot the transfer functions.

Objectives - Team 2 - Export from Femto to Finesse

- i. Follow the example notebook:

```
https://gitlab.et-gw.eu/et/isb/active-noise-mitigation/lfcontrolnoise/-/  
blob/main/sensing_noise_projection_single_cavity_model/Finesse_  
mechanical_plant_from_state_space.ipynb
```

- ii. Write a script to plot the transfer functions in Matlab, export the data to Finesse and then compare against the Finesse generated state-space model

Objectives - Team 3 - Angular Noise to DARM

- i. Download the ET models from Anna:
`https://gitlab.et-gw.eu/et/isb/interferometer/et-finesse-models`
- ii. Compute angular noise to DARM
- iii. Vary beam-spot offset and recompute

Plan for the rest of the day

- i. 2h30 → 17h00, work in teams in the git repository together
`https://gitlab.et-gw.eu/aaron.jones1/benl26-hackathon`
- ii. 17h00 → 18h10 report back to everyone and share your work.