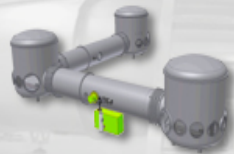


# Discussion on the starting configuration of the AEI-10m



AEI 10m Prototype



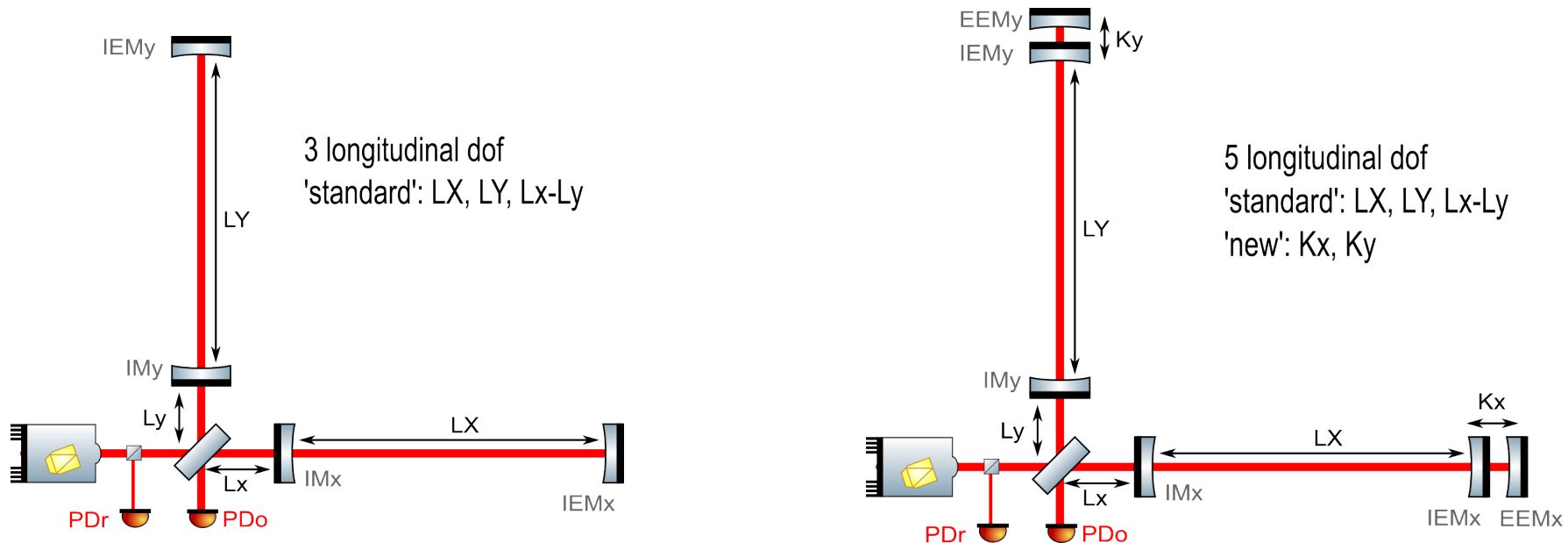


## Some more words on cavity stability

- g-factors of the AEI-10m will be extremely challenging, i.e. **0.9986** for the FP-arm cavities and larger **0.9999** for the Khalili cavities. Let's try to get a feeling for these numbers:
- Advanced LIGO:  $L=3996\text{m}$ , ITM ROC = 1934m, ETM ROC = 2245m,  $g = 0.832$ .
- Advanced Virgo Baseline design:  $L = 3000\text{m}$ , ITM ROC = 1416 m, ETM ROC = 1646m,  $g = 0.92$ .
- Advanced Virgo Baseline change:  $L = 3000\text{m}$ , ITM ROC = 1420m, ETM ROC = 1683m,  $g = 0.87$ .
- ET-B design:  $L=10\text{km}$ ,  $w_1 = 12\text{cm}$ , symmetric ROCs = 5070m (1.4% away from instability),  $g=0.945$ .
- ET-B with  $g=0.999$ :  $L=10\text{km}$ , symmetric ROCs = 5001.25m (0.025% away from instability),  $w_1 = 33\text{cm}$ , i.e required mirror diameter of 165cm.
- ET-B with  $g=0.9999$ :  $L=10\text{km}$ , symmetric ROCs = 5000.12m,  $w_1 = 60\text{cm}$ , i.e. required mirror diameter of  $>300\text{cm}$ .
- *Please keep in mind: Mirror will have lots of non-spherical surface figure errors.*



# Question: Do we want to start with the full configuration?



- ➔ So far there was no 'hard' decision on whether to start with or without the Khalili cavities.
- ➔ So far took both concepts forward, but we are now at a point where it would be helpful to decide on which configuration to concentrate on for the near term future.



## Scenario 1: Learn with 3DOF then do 5DOF

- ➔ Start with 3DOF and then 'just' change over to 5DOF.
- ➔ What would you need to change when going from 3 to 5 DOF:
  - Take EM out and replace it by IEM.
  - Add EEM (full new suspension etc).
  - Cannot start 3DOF with IEM as EM (completely undercoupled)
  - Cannot start 3DOF with EEM as EM and then later insert IEM (cavity stability, mode matching etc).
- ➔ Going from 3DOF to 5DOF is NOT a small change, but a major rebuild.
- ➔ Starting with 3 DOF allows to learn how to handle a system with large g-factor.
- ➔ Is it a problem that the 3DOF configuration is 'less fancy'/'standard'?



## Scenario 2: Start with the full 5DOF configuration

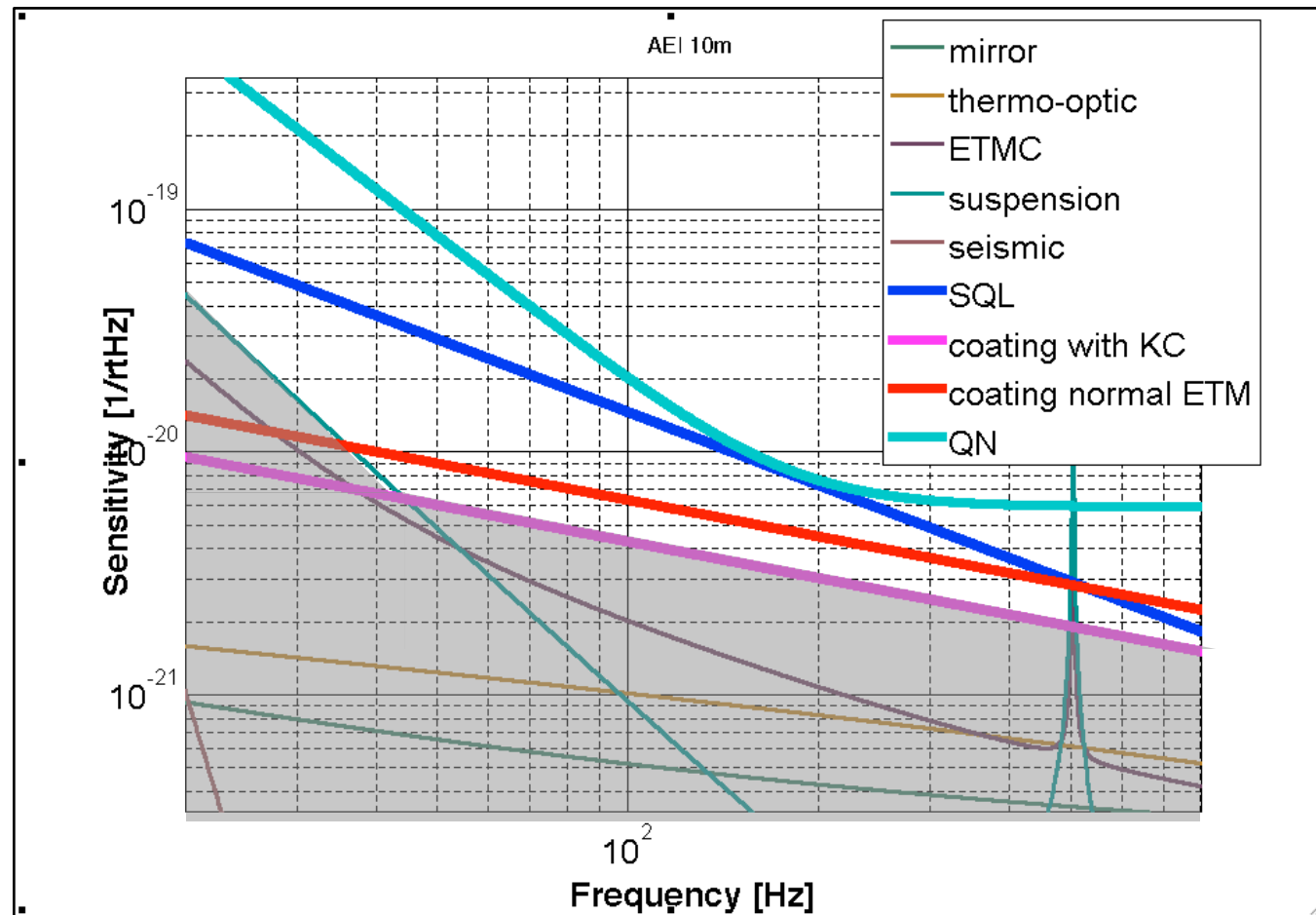
- ➔ Very challenging: extremely large g-factor of Khalili cavity, quite a lot of DOF ...
- ➔ In the end this requires less intermediate hardware.
- ➔ Lot's of new aspects - good for PhD students?
- ➔ Will it ever work? Potential frustration level?
- ➔ Would provide more space to beat the SQL.





# Sensitivity with and without Khalili-cavities

- Improvement from Khalili cavities about a factor 1.5 in coating noise.
- Even without Khalili-cavities there is some space to bet the SQL.
- What is our primary science target?





# Discussion