

ET-ISB

Hot Topics

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- There is a series of topics that are under hot debate for one reason or another (e.g. several competing designs, no proof of concept ...).
- Idea of this session:
 - a. Identify hot topics with large impact on infrastructure/cost
 - b. Trigger workshop/activity/discussions on pushing these forward (over this week?)
 - c. Have a discussion of what is needed (conceptual design? full demonstrator? etc) for us to treat such a technology/design/concept as reference/baseline design for ET?

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- **Topics that come to mind could be:**
 - Vacuum tube diameter and space required in the tunnel cross-section?
 - Cleanrooms under the test masses?
 - Cryogenic cooling technique?
 - Size/length of caverns vs flexibility to shift towers around?
 - Do we really need 17m tall superattenuators (can we deal with their tilt coupling?)
 -

Recycling cavity design

<https://doi.org/10.1103/PhysRevD.103.023004>

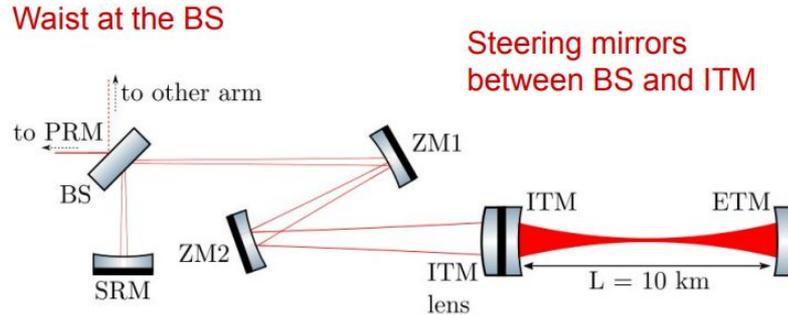
Current telescope design

Readonly overleaf:

<https://www.overleaf.com/read/yvxxmxnsmnbfy>

Overleaf document above which contains many thoughts and questions that need answering about the telescope design - please read and comment!

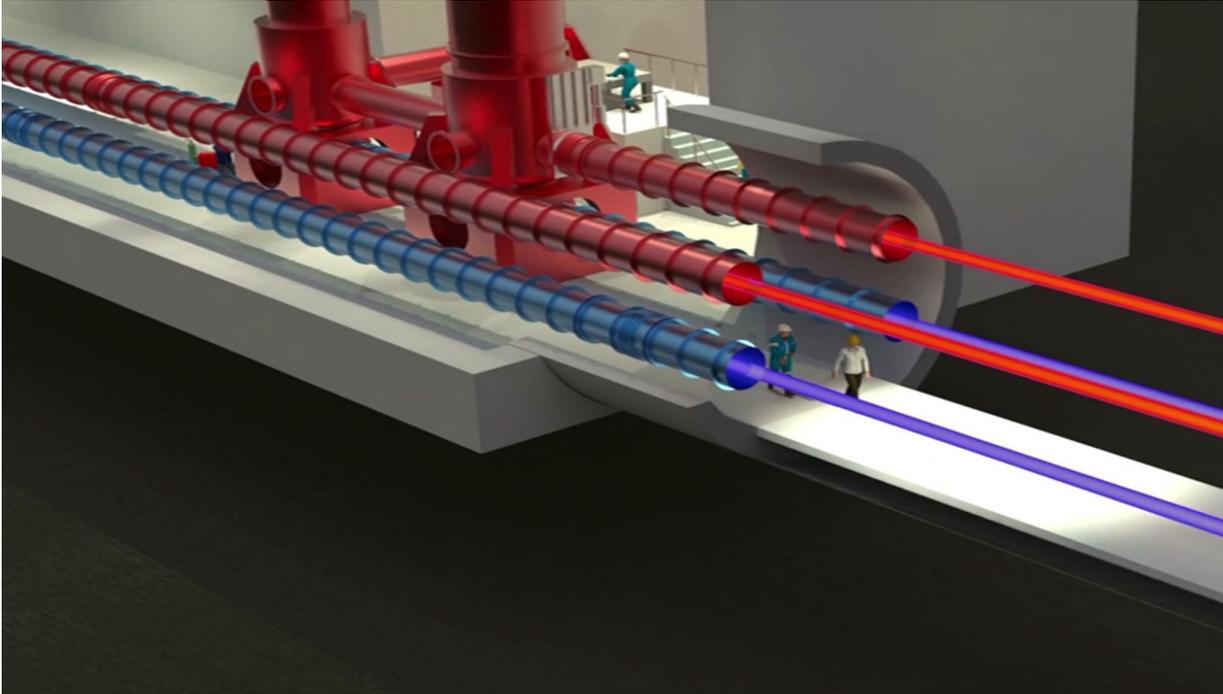
Slide by D Brown @ ISB workshop



Compensation plate shaped like a lens

Optic		SRM	BS	ZM1	ZM2		
ROC [m]	LF	-9410	inf	-50	-82.5		
	HF	-630			-63.2		
Beam radius [mm]	LF	6.1	6.2	8.9	30		
	HF	6.3	6.4	8.3	38		
Space		SRM-BS	BS-ZM1	ZM1-ZM2	ZM2-ITM		
Length [m]	LF	10	70	50	52.5		
	HF			80			
Gouy phase [deg]	LF	7.5	39	5.3	0.6	Total accumulated	52
	HF	4.8	26	4.9	0.2	Gouy phase [deg]	36

Beam pipe design



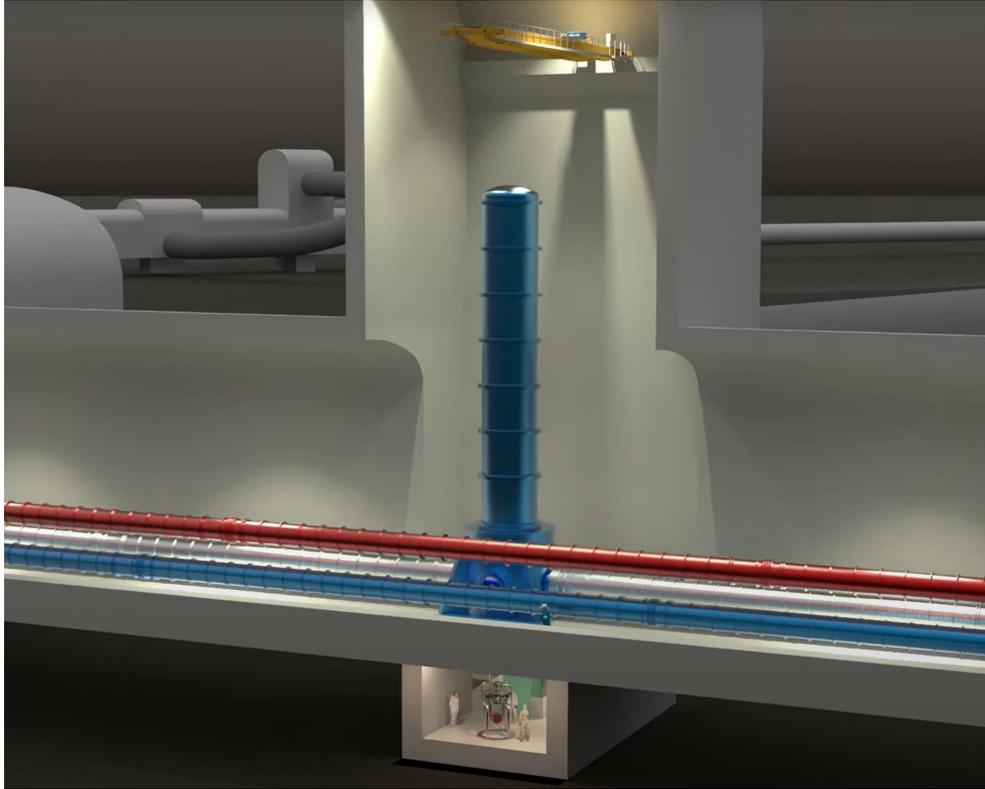
Baffles

Diameter

Pressure

Dust

Cleanrooms under test masses



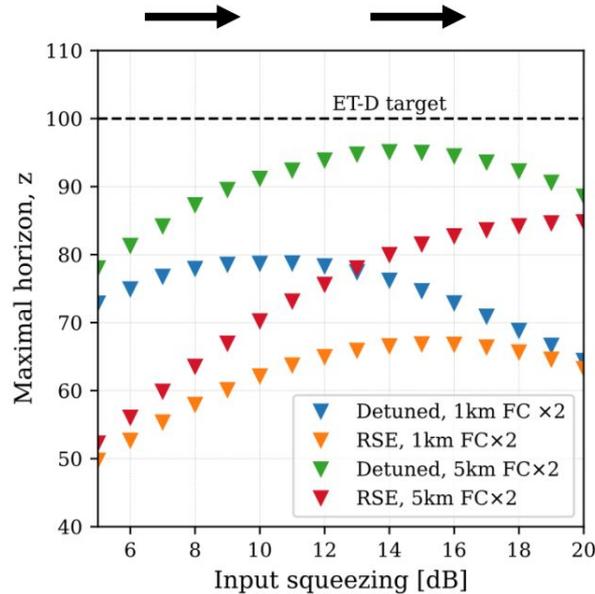
Why do we need them?

What are possible negative impacts on detector?

Quantum noise optimisation



Detuned SEC



Except loss of squeezing, detuned SEC is especially sensitive to the anti-squeezing induced from dephasing (originating from FC loss & phase noise).

$$S_{\pm} \equiv (1 - \Xi'(\Omega))e^{\pm 2r} + \Xi'(\Omega)e^{\mp 2r}$$

$$\sqrt{\Xi(\Omega)} \approx \Lambda_{fc}/T_{fc}$$

Consider only FC loss effect here for the lower bound estimation.

To be updated:
Included also the FC phase noise.

Slide by T Zhang @ ISB workshop

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