

Summary of the last parallel session



Dedicated to the Recycling Cavities (RC) design

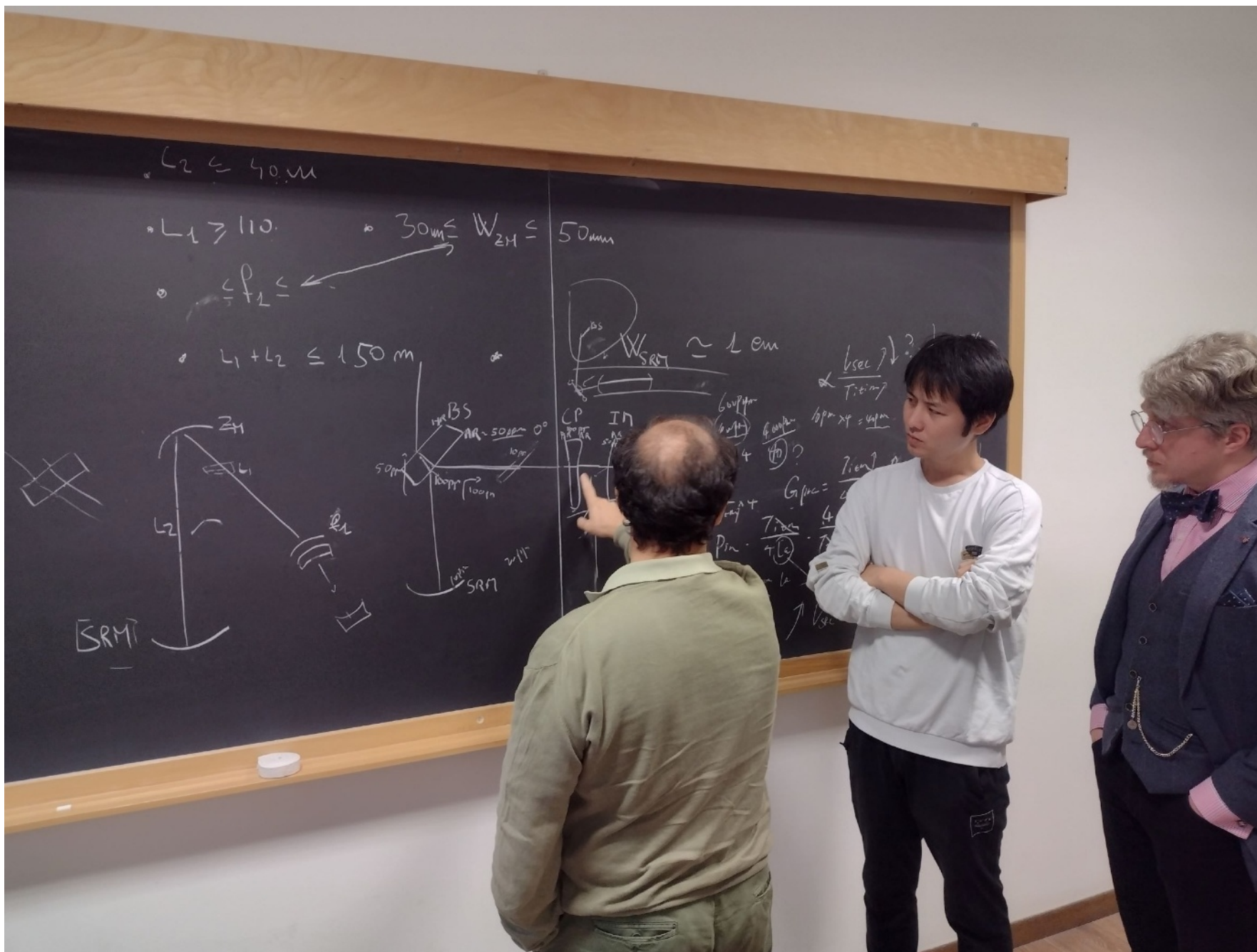
Working space added at the end of:

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

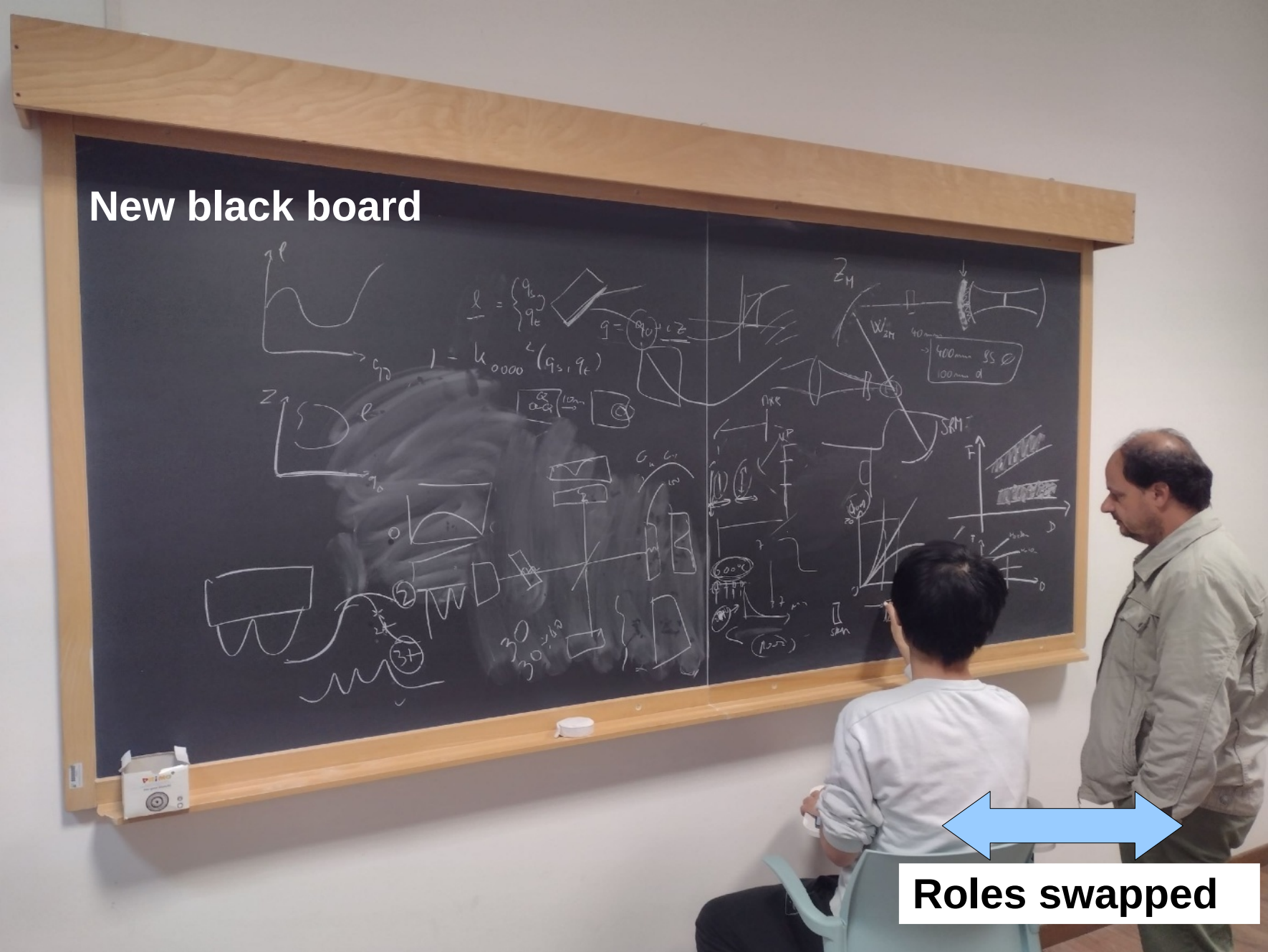
7.1 Problems to be tackle in smaller groups

- brainstorming on recycling cavity design (where/how to focus)
- simple code to calculate the round trip Gouy phase in the recycling cavities, ABCD matrix/Finesse
- minimal beam size on the arm cavity mirrors (already done, see below)
- maximum astigmatism in the RC, could be defined as coupling loss for the arm cavity
- estimate of the beamsplitter transmissive thermorefractive noise
- Does it matter to not have the waist at the beam splitter position ?

It generates a lot of exchange (Tuesday)



It generates a lot of exchange (yesterday)



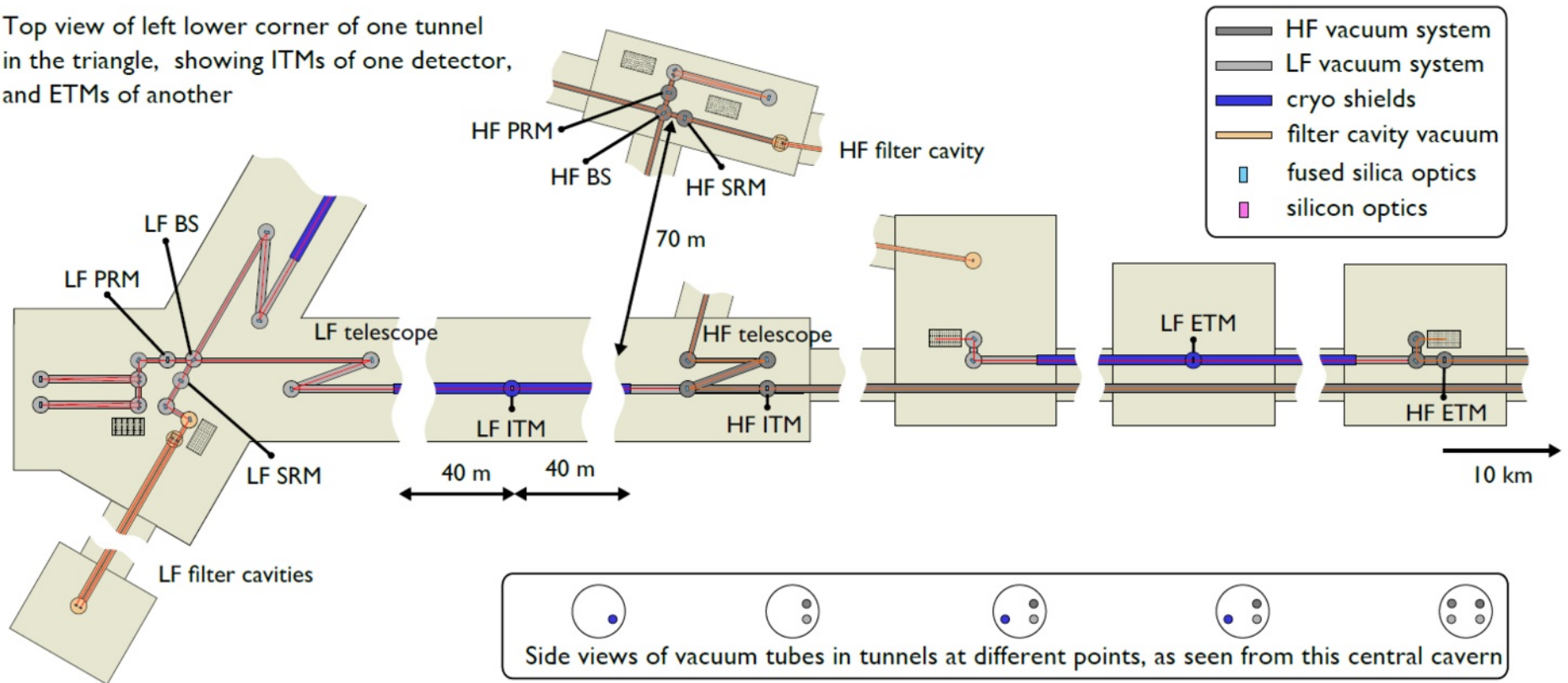
New black board

Roles swapped

The starting point

From the previous design

Top view of left lower corner of one tunnel in the triangle, showing ITMs of one detector, and ETMs of another

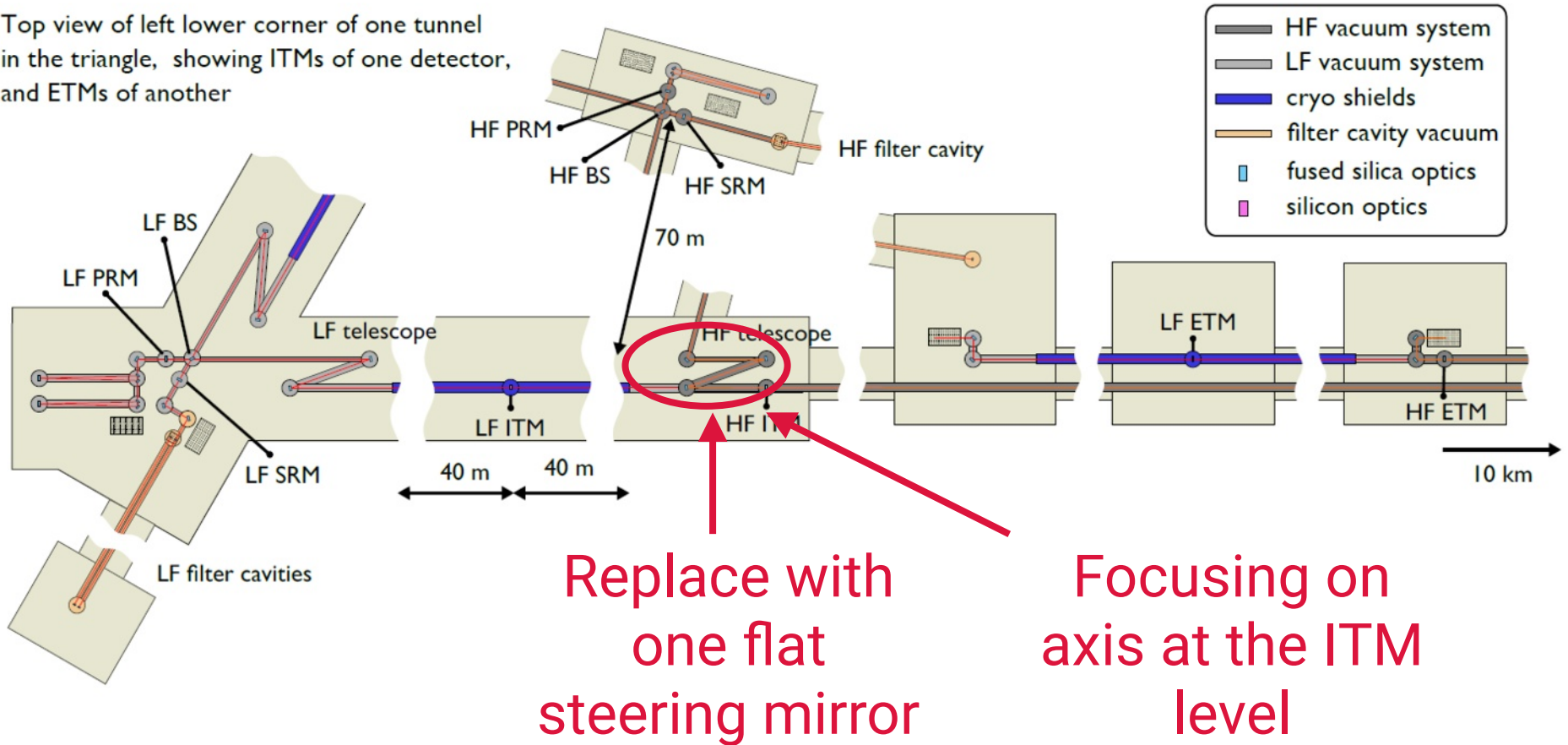


The starting point



From the previous design

Top view of left lower corner of one tunnel in the triangle, showing ITMs of one detector, and ETMs of another

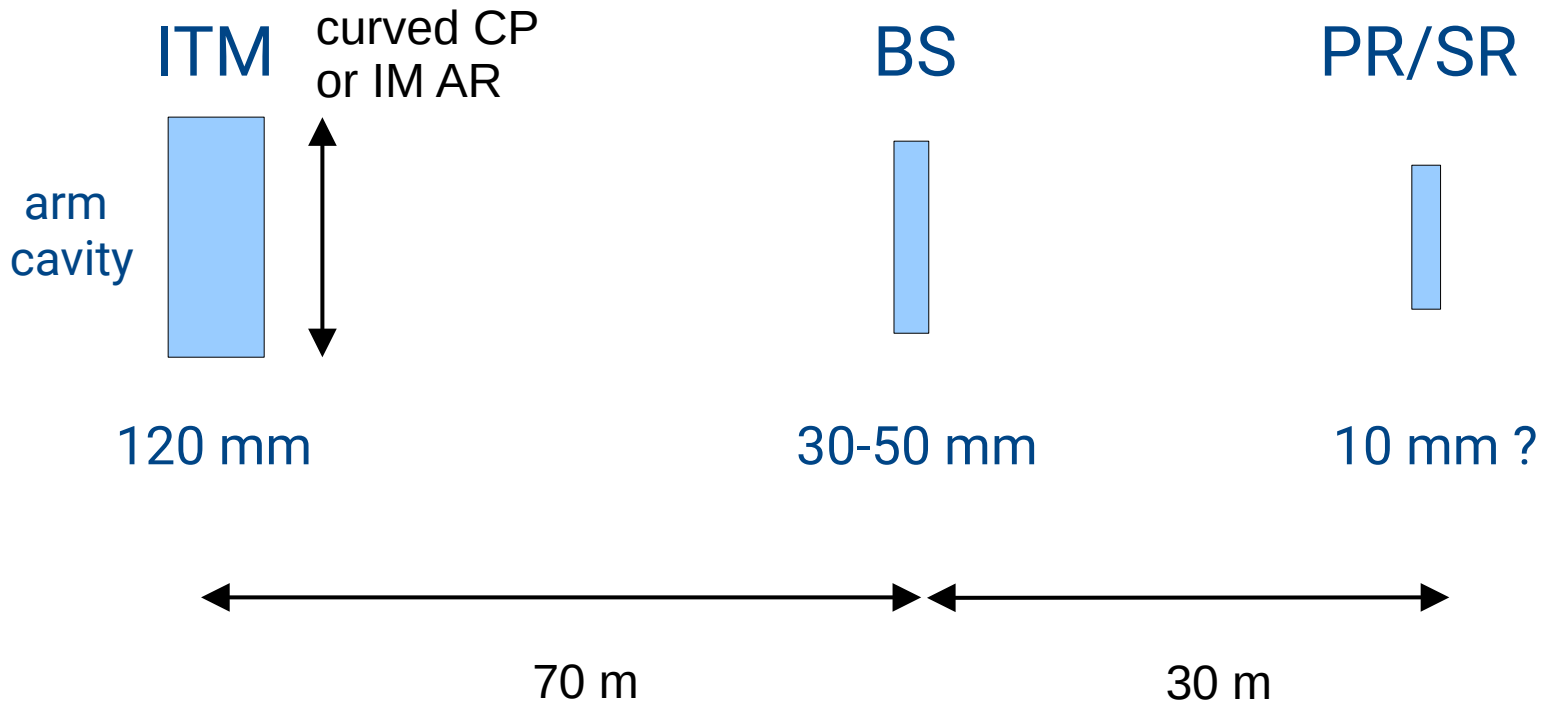


Optimised SRC length:
80 – 120 m
(depending on finesse arm cavity)

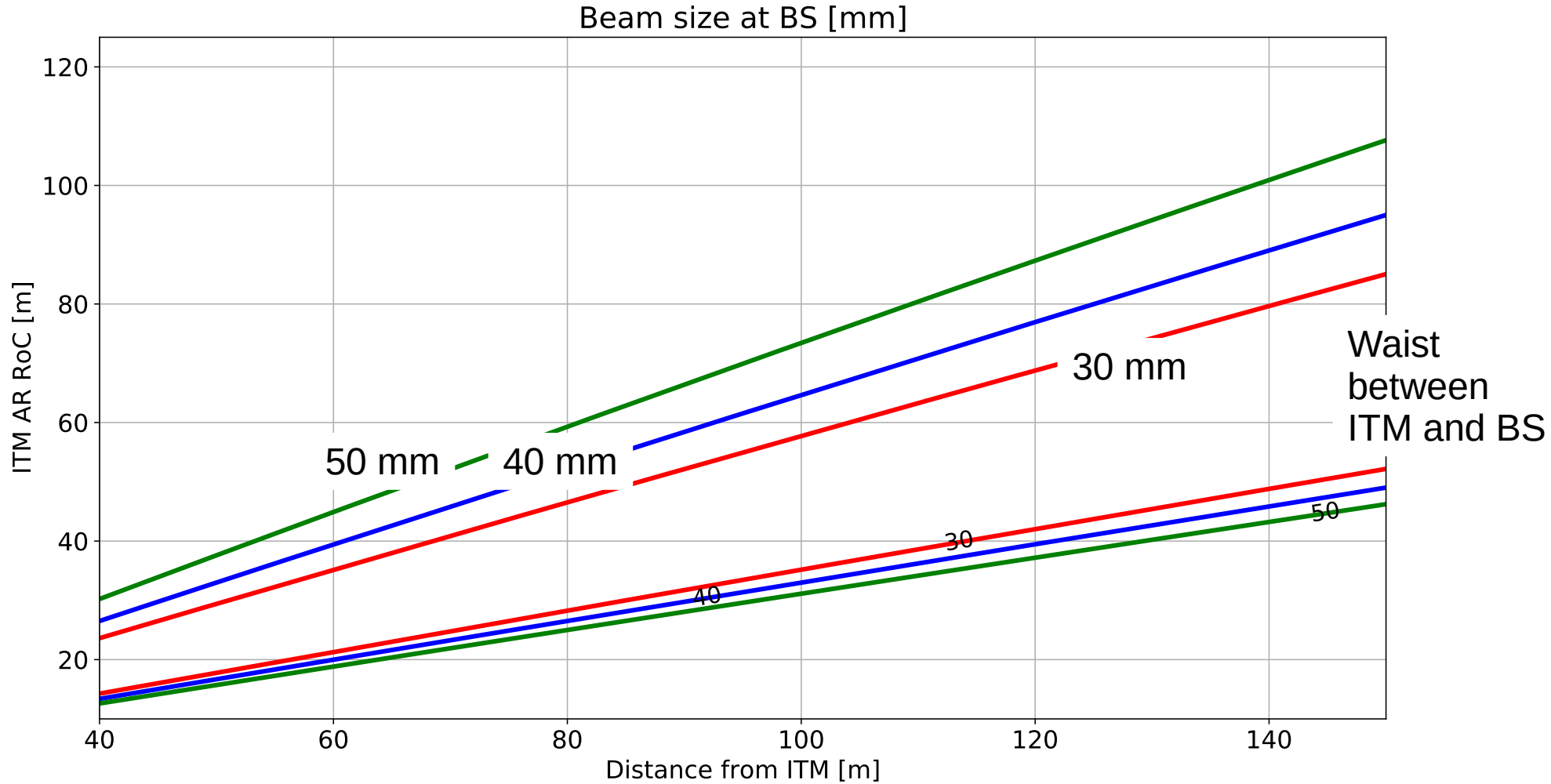
The starting point



Laser beam radius on the recycling cavities (ET-HF)

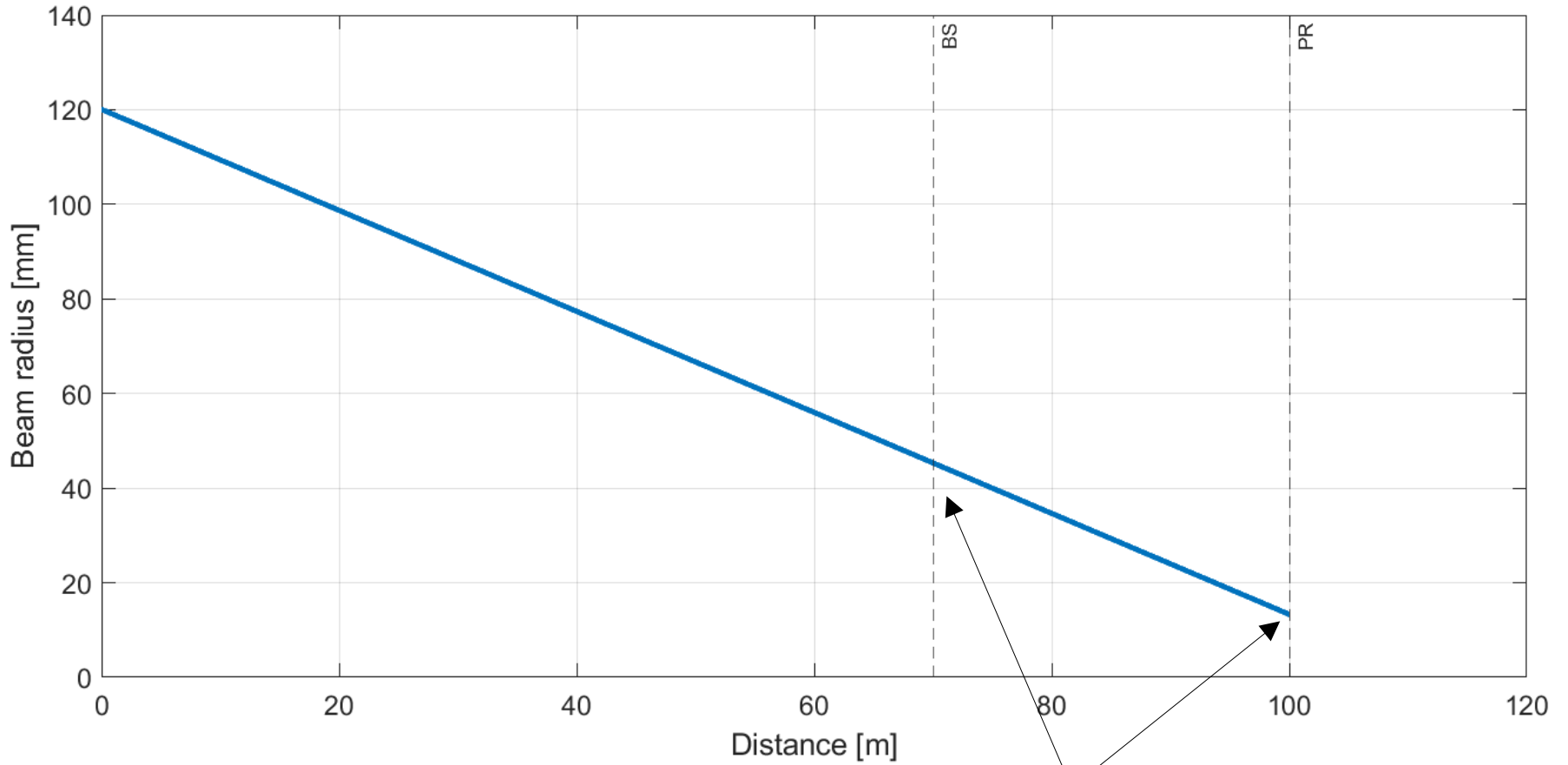


Studying the parameter space



Choose a beam size you want at the BS, then the distance ITM – BS (horizontal scale) and read the required ITM AR RoC

First iteration



RoC AR ITM = 50 m

Size ok

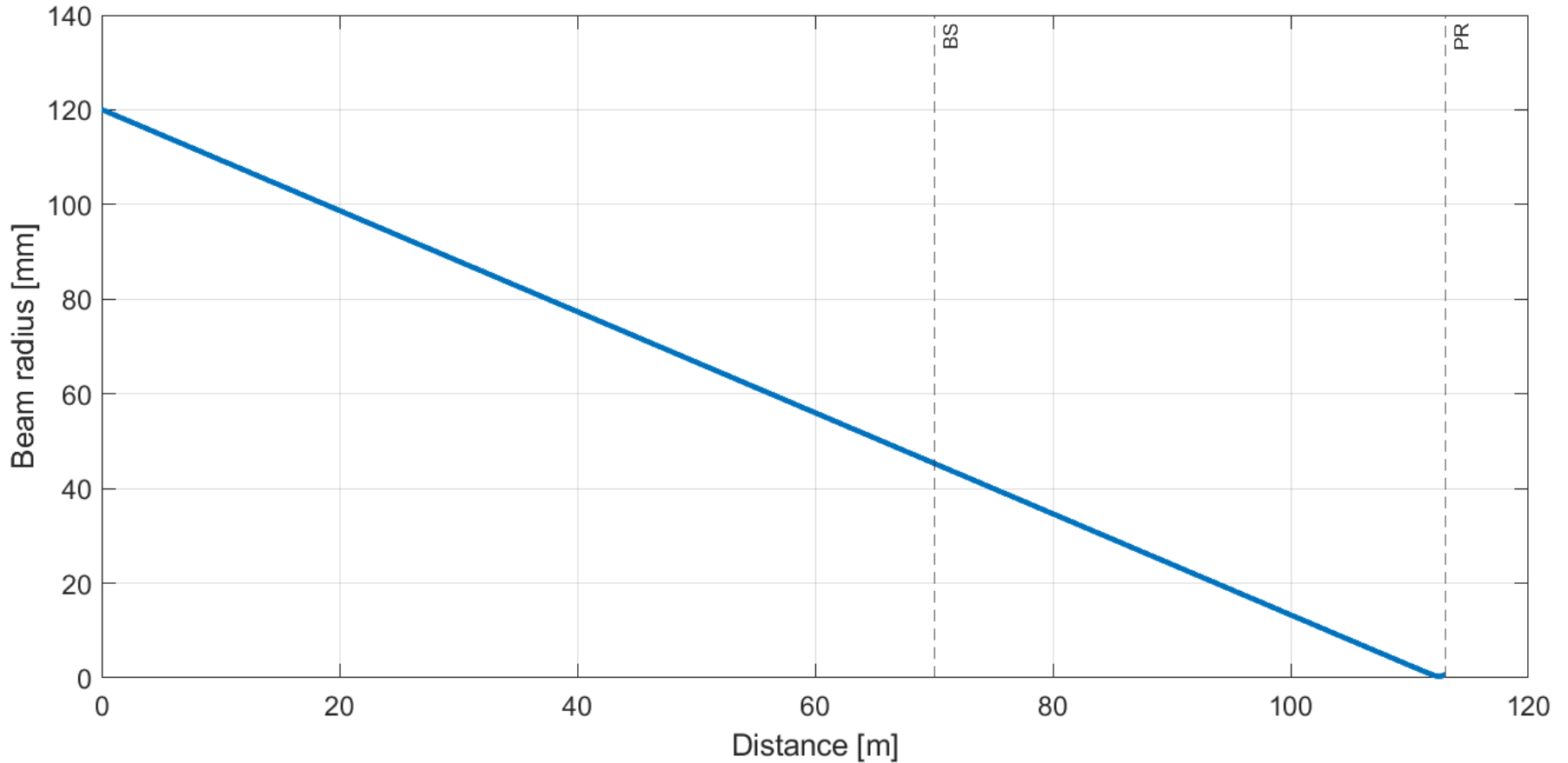
First iteration



RoC AR ITM = 50 m

Size ok

Longer PRC/SRC cavity



RoC AR ITM = 50 m

Cavity 13m longer

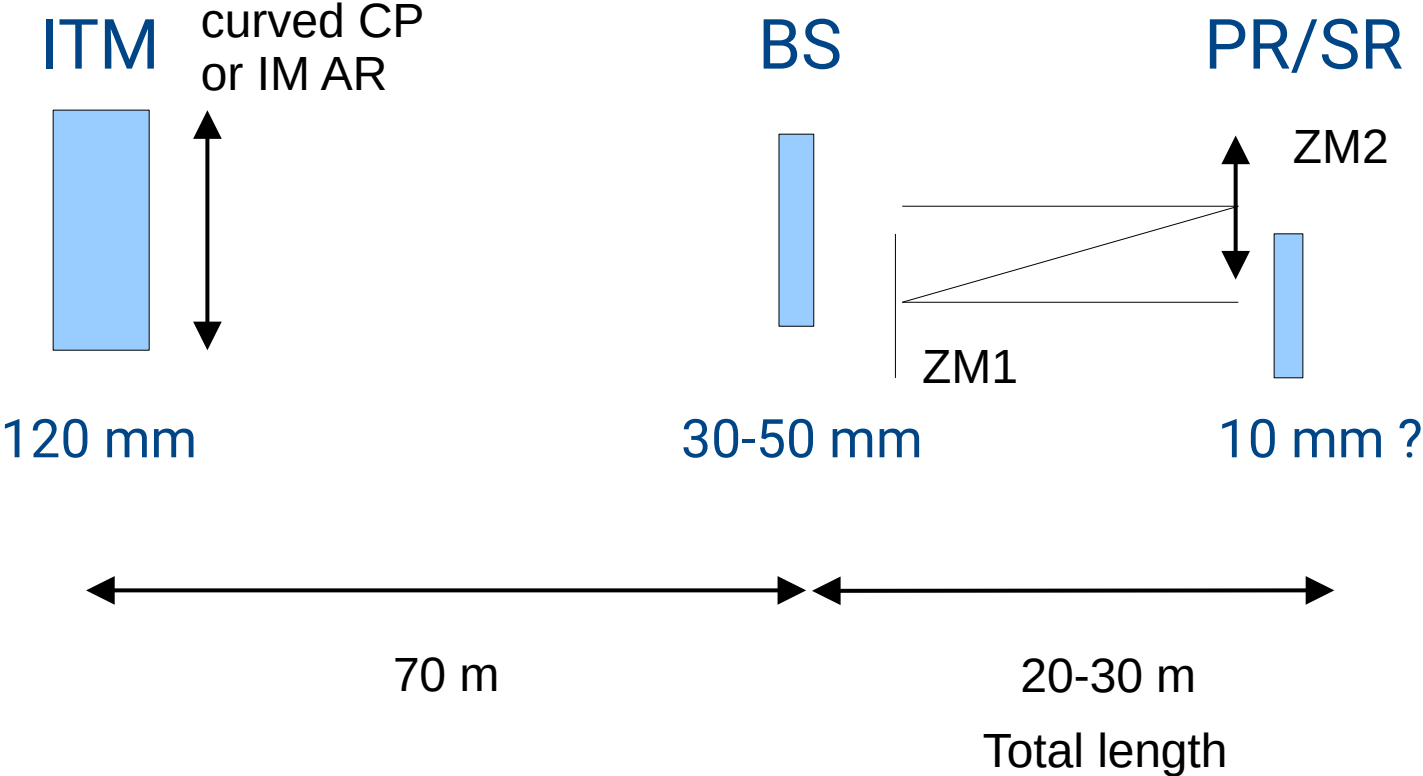
Enough Gouy phase but:

**Small beam size on PRM/SRM
(~ 1.5 mm)**

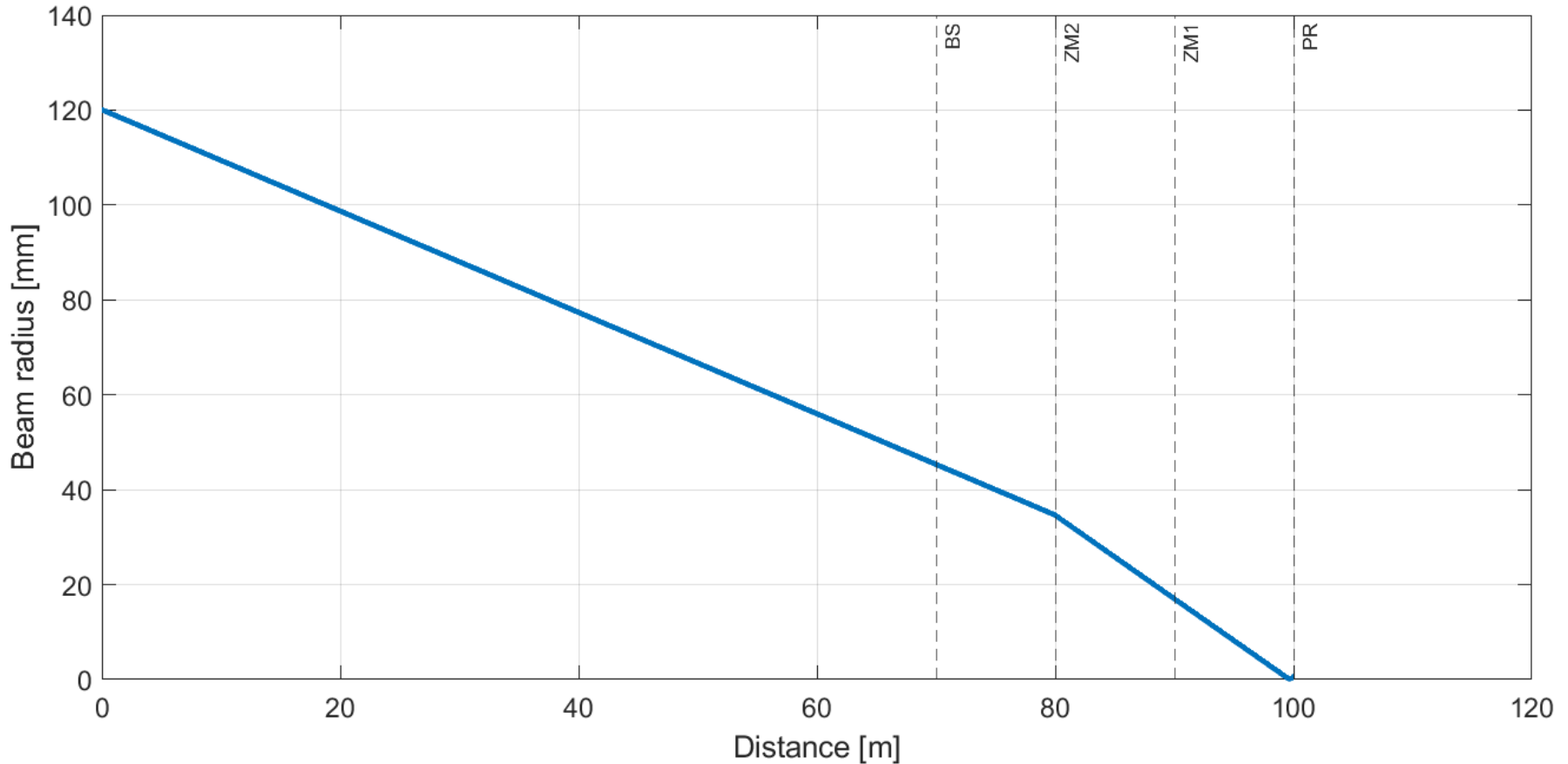
More focusing before PR/SR



Laser beam radius on the recycling cavities (ET-HF)



More focusing before PR/SR



Similar conclusion as longer cavity, you should be near the waist to acquire enough Gouy phase.

Parallel session work organisation



Fill all the parallel slots, and also work in parallel within the session

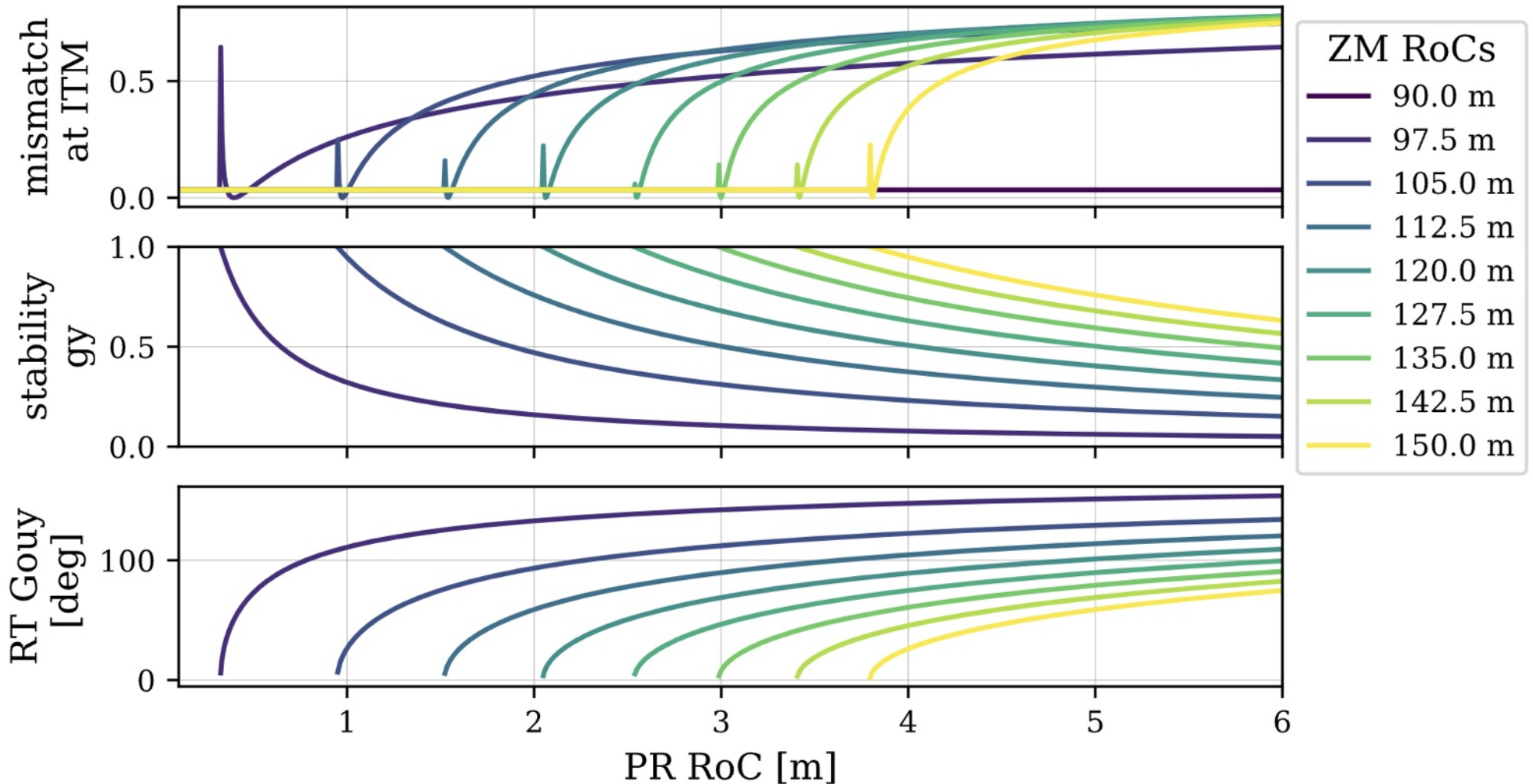
- model RC, one way propagation, find the best design :
 - with ABCD matrix
 - with Finesse
 - with OSCAR
- } cross-checking and build blocks for larger models, check Gouy phase
- Resurrect the ET full finesse model

Done!

[Illustration] complicated plot



Change ZM2 RoC and find the optimal PR RoC (Finesse)

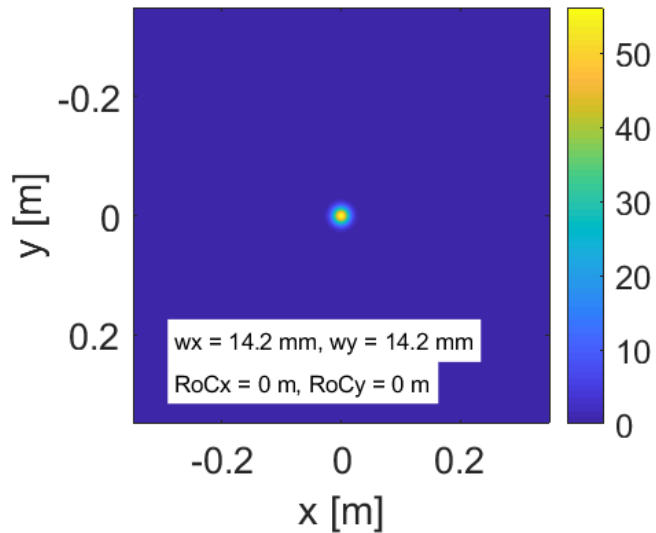


[Illustration] Checking the astigmatism

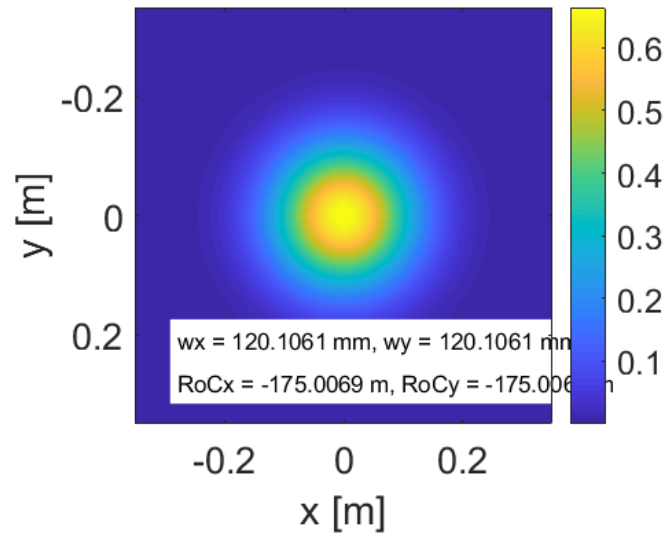


RoC ITM HR = 5070 m, RoC ITM AR = -75 m, RoC ZM = 100 m, RoC SRM = 1e+99 m
distance ITM-ZM = 90 m, distance ZM-SRM = 10 m, angle of incidence on ZM = 5 degrees

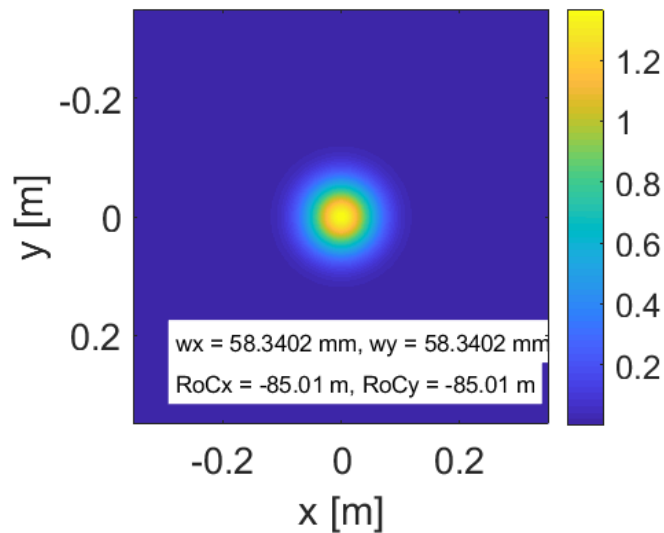
Beam at the waist



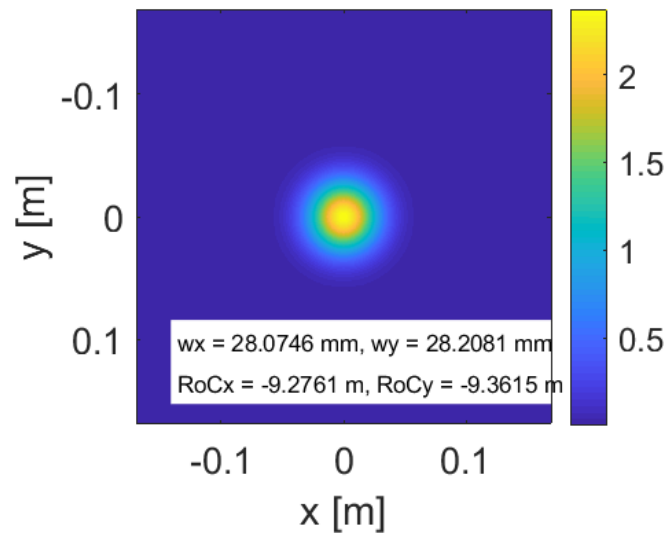
Beam at the ITM AR



Beam at ZM



Beam at the SRM



Done with
OSCAR

Recycling cavity design conclusion



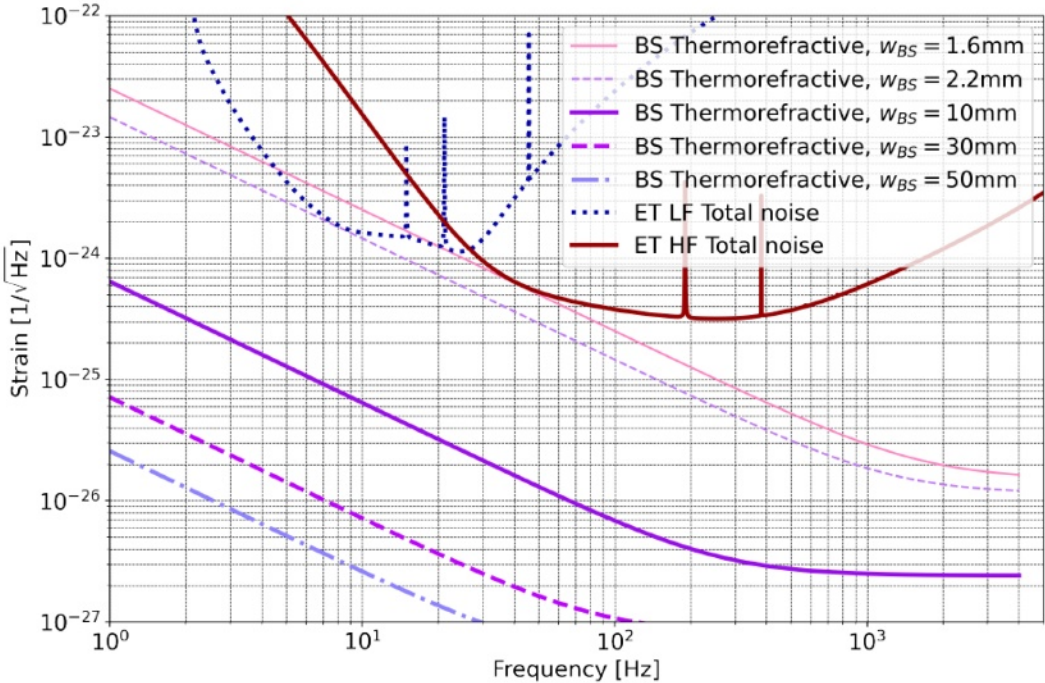
- no satisfactory design yet
- much better understanding of the issue, re-defining what we have to solve
- availability of simple and complicated tools to tackle the problem
- transverse work with noise budget and wavefront control system feedback from our design

Beamsplitter thermorefractive noise

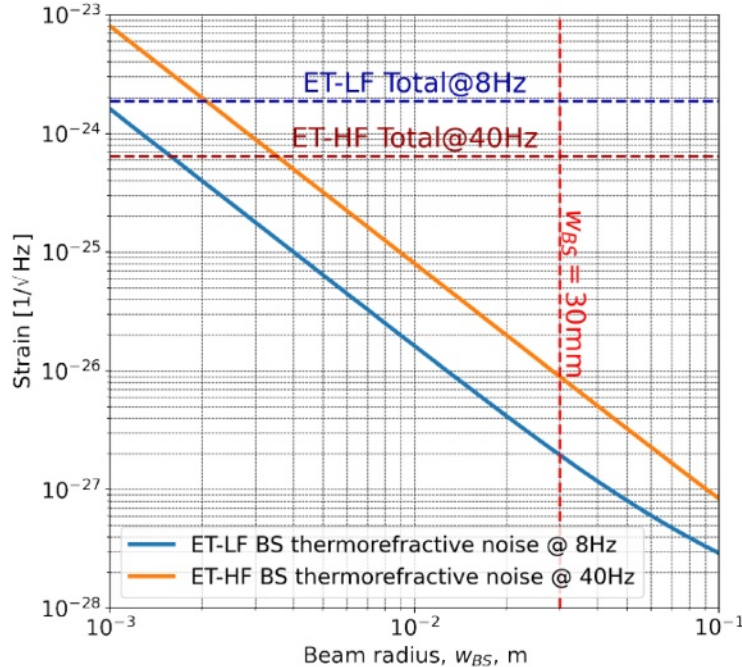


(some more definitive plots)

ET HF Thermorefractive noise of the BS vs. beam size. Material: SiO₂, Temp: 290K



Thermorefractive noise of BS vs. beam size



→
Larger beam

Personal conclusion



- very enjoyable workshop with productive parallel sessions
- provided a place to talk about optics around a black board (and beyond the the topic of the session)
- involvement of new people on the task, willing to continue to further work on the topic
- the difficulty now: keep the momentum and the link (role of division and WP chairs)

Dedicated
meeting spring
next year ?