

# Horizontal NDRC Optical Design Status

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# systematic scan done of cavity lengths

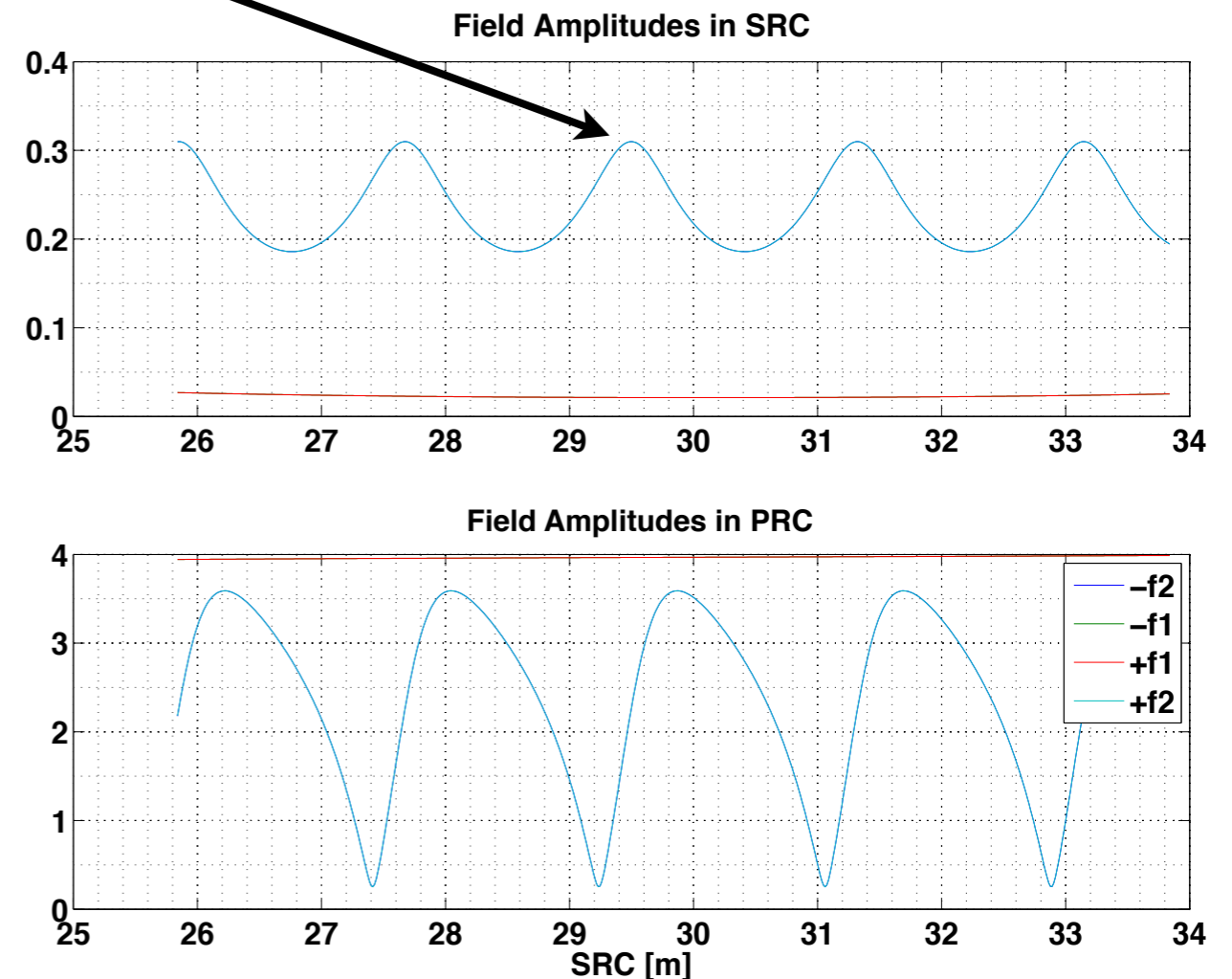
- Limited by mode cleaner MC2 tower displacement (tried for less than 2.8 meters in either direction).
- Tried to keep both PRC and SRC between about 29.5 and 30.5 m in overall length.
- Assumed some flexibility in location of (P|S)R2 within PR tank.
- One scenario investigated here, which keeps IM positions from baseline, with mod frequencies near arm cavity half-FSRs.

# Lengths & Modulations

SRCL length set to maximize  $f_2$  amplitude. Scan done in Optickle.

	length [m]	$\Delta$ [m]
PRCL	30.099	
SRCL	29.498	
IMCL	140.462	-3.04
Schnupp	.10	

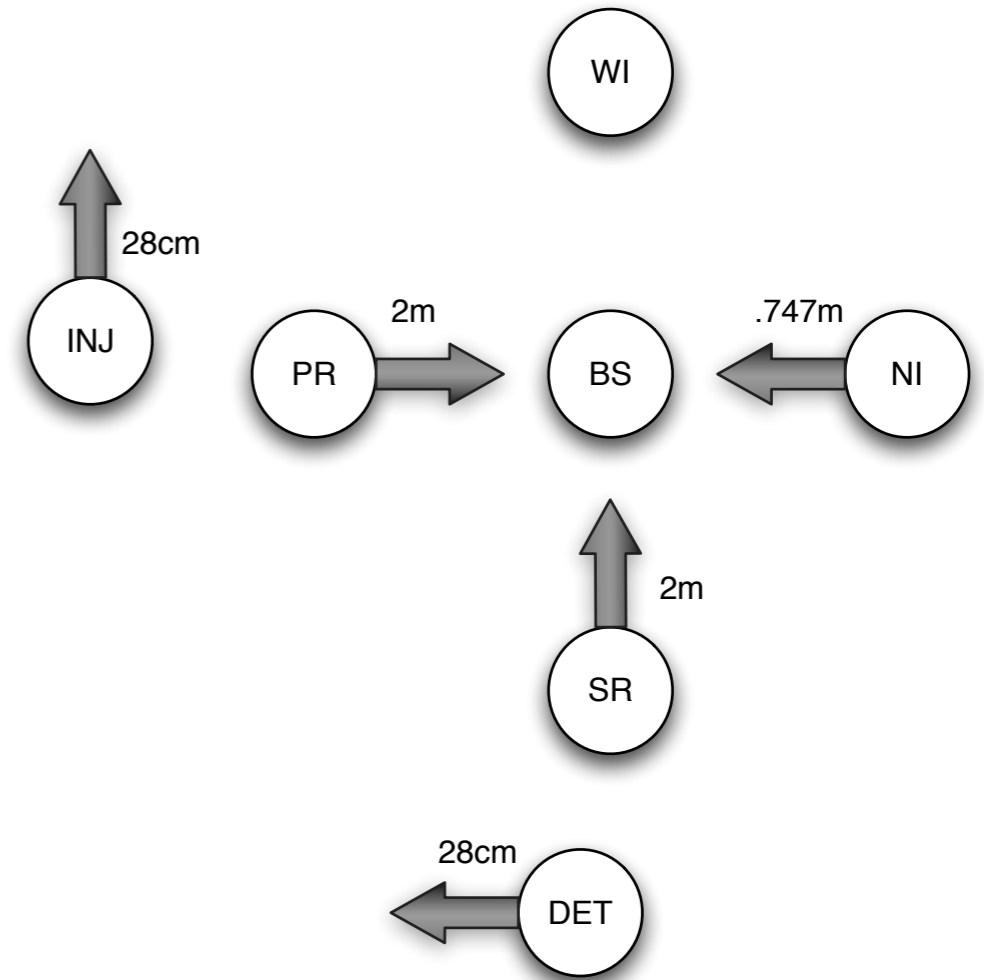
Mod	Hz	nFSR
$f_1$	7470160	149.497
$f_2$	82171760	1644.463



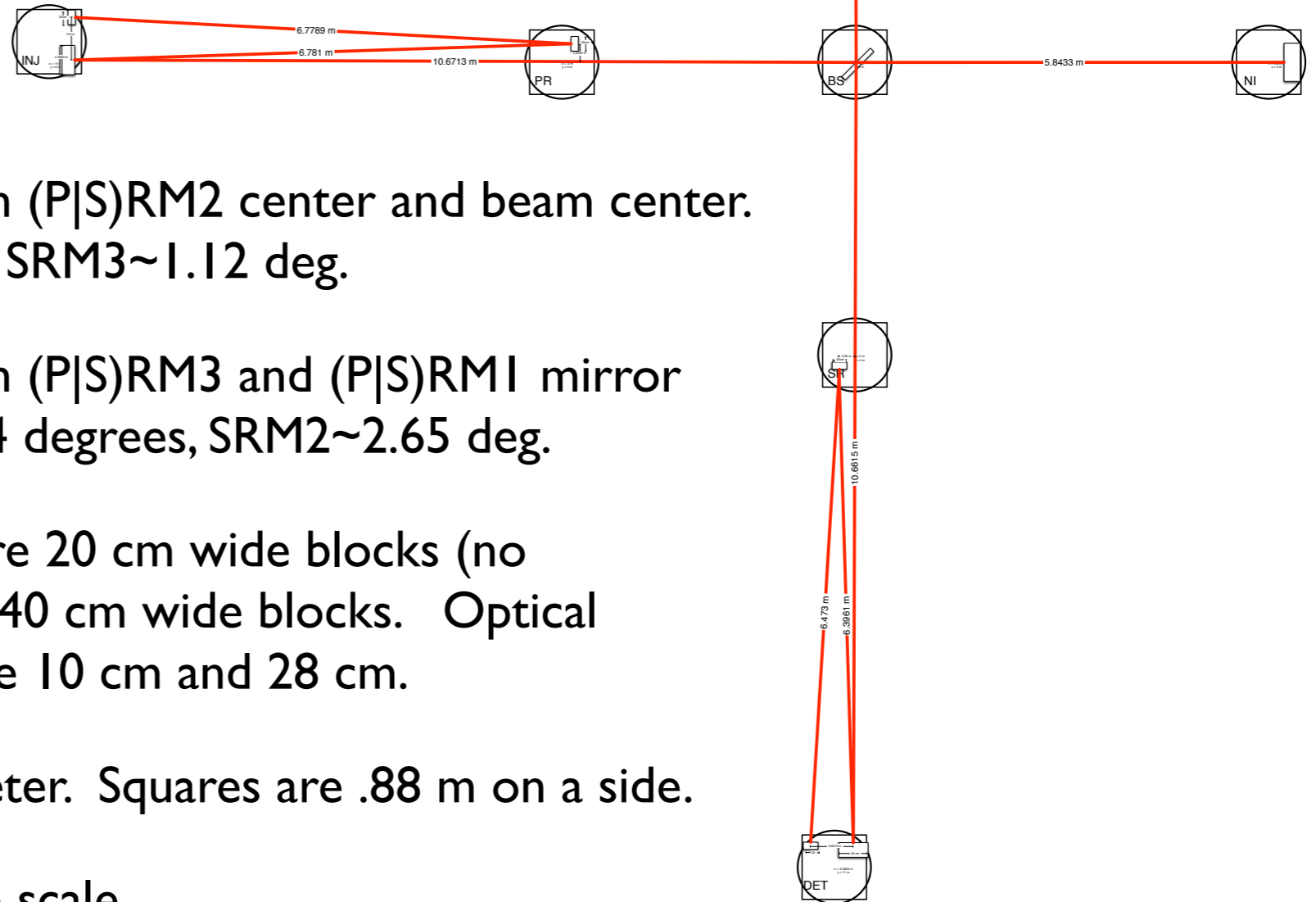
Input desired from ISC on choice of Schnupp length and  $f_2/f_1$  ratio.

# Tower displacements

- PR - 2 meters towards BS
- SR - 2 meters towards BS
- INJ - 28 cm towards MC2
- DET 28 cm south
- MC2 tower 2.76 m east



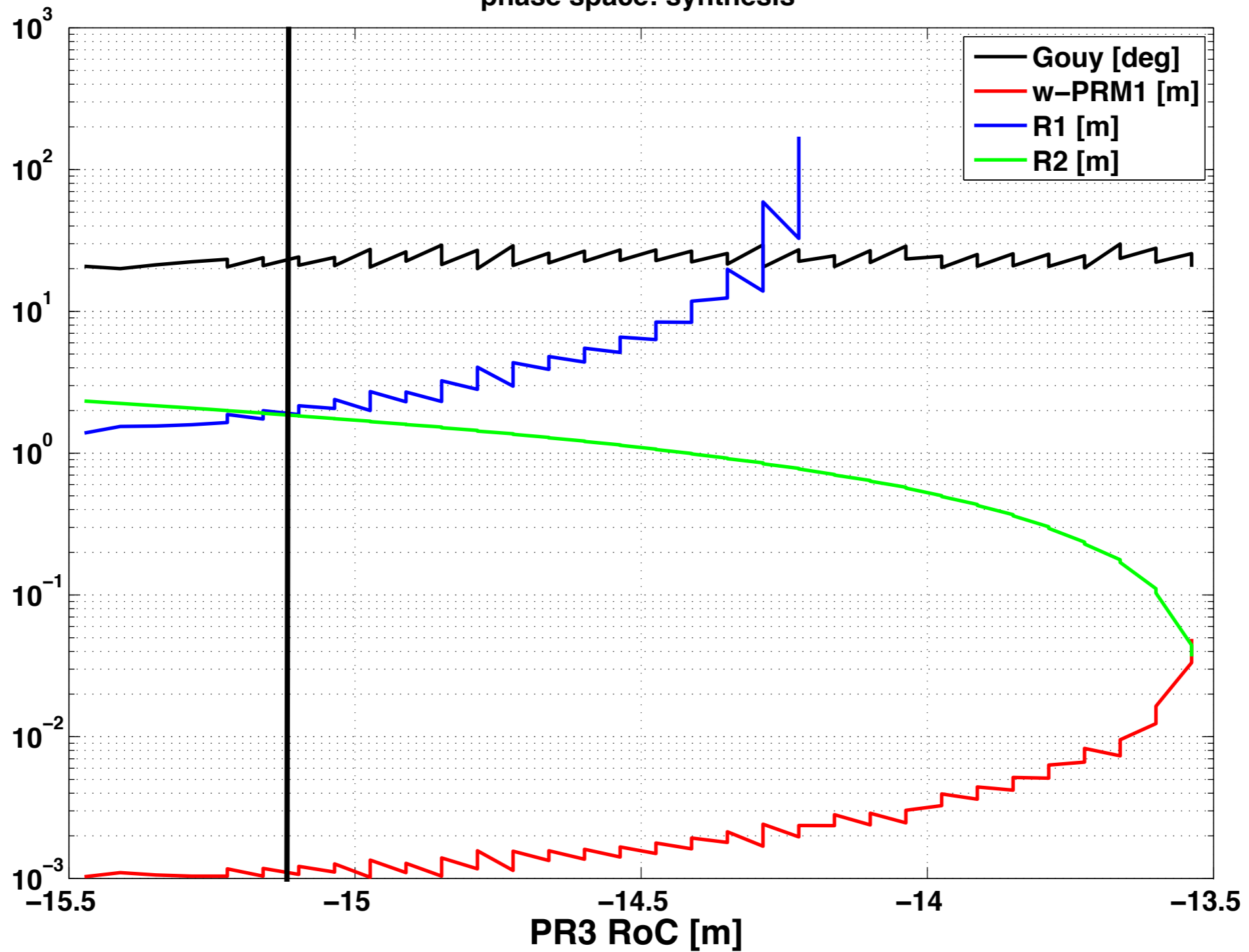
# Layout



- 25 cm separation between (P|S)RM2 center and beam center. AOI: PRM3~1.06 degrees, SRM3~1.12 deg.
- 60 cm separation between (P|S)RM3 and (P|S)RM1 mirror centers. AOI: PRM2~2.54 degrees, SRM2~2.65 deg.
- (P|S)RM1 and (P|S)RM2 are 20 cm wide blocks (no reference). (P|S)RM3 are 40 cm wide blocks. Optical apertures in simulation are 10 cm and 28 cm.
- Circles are 1 meter diameter. Squares are .88 m on a side.
- Drawing approximately to scale.

# PRC design

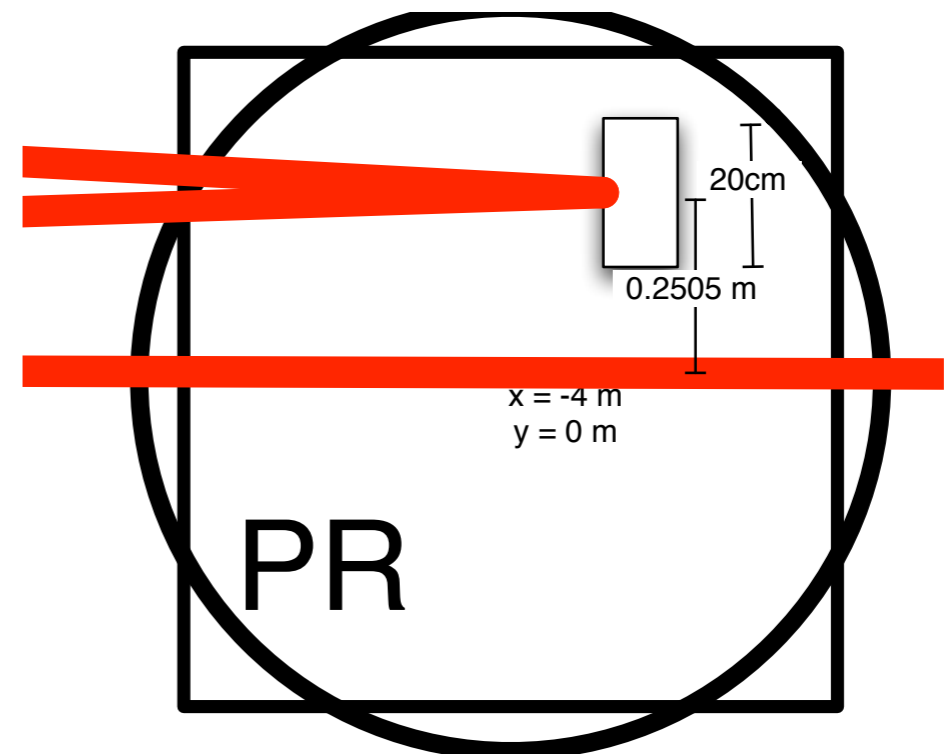
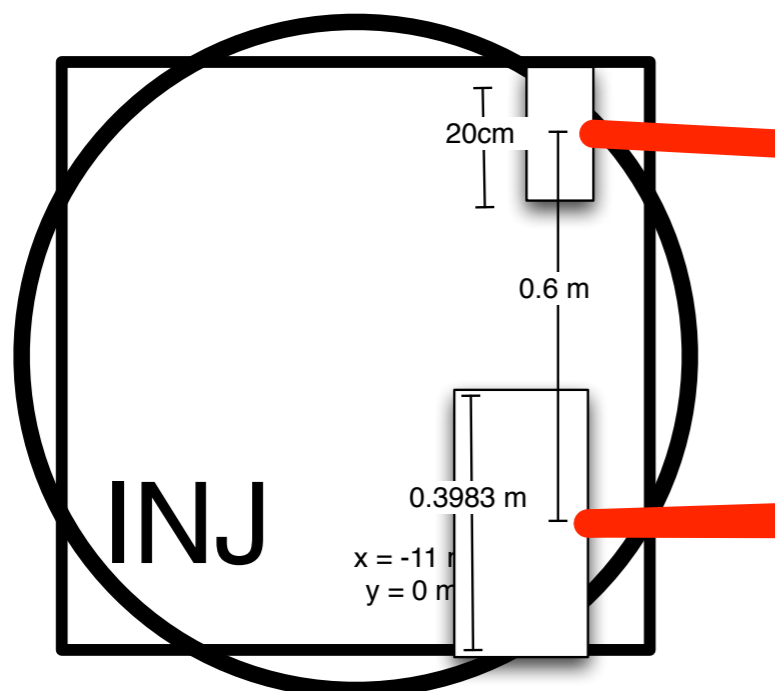
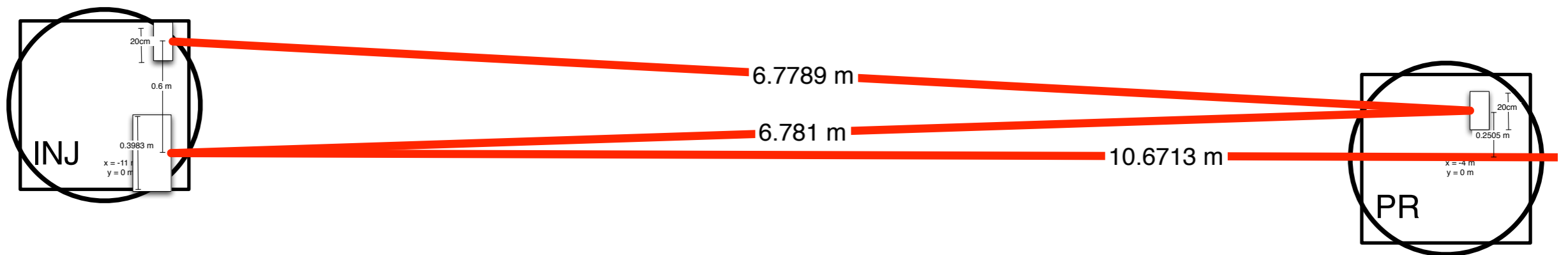
phase space: synthesis



# PRC design

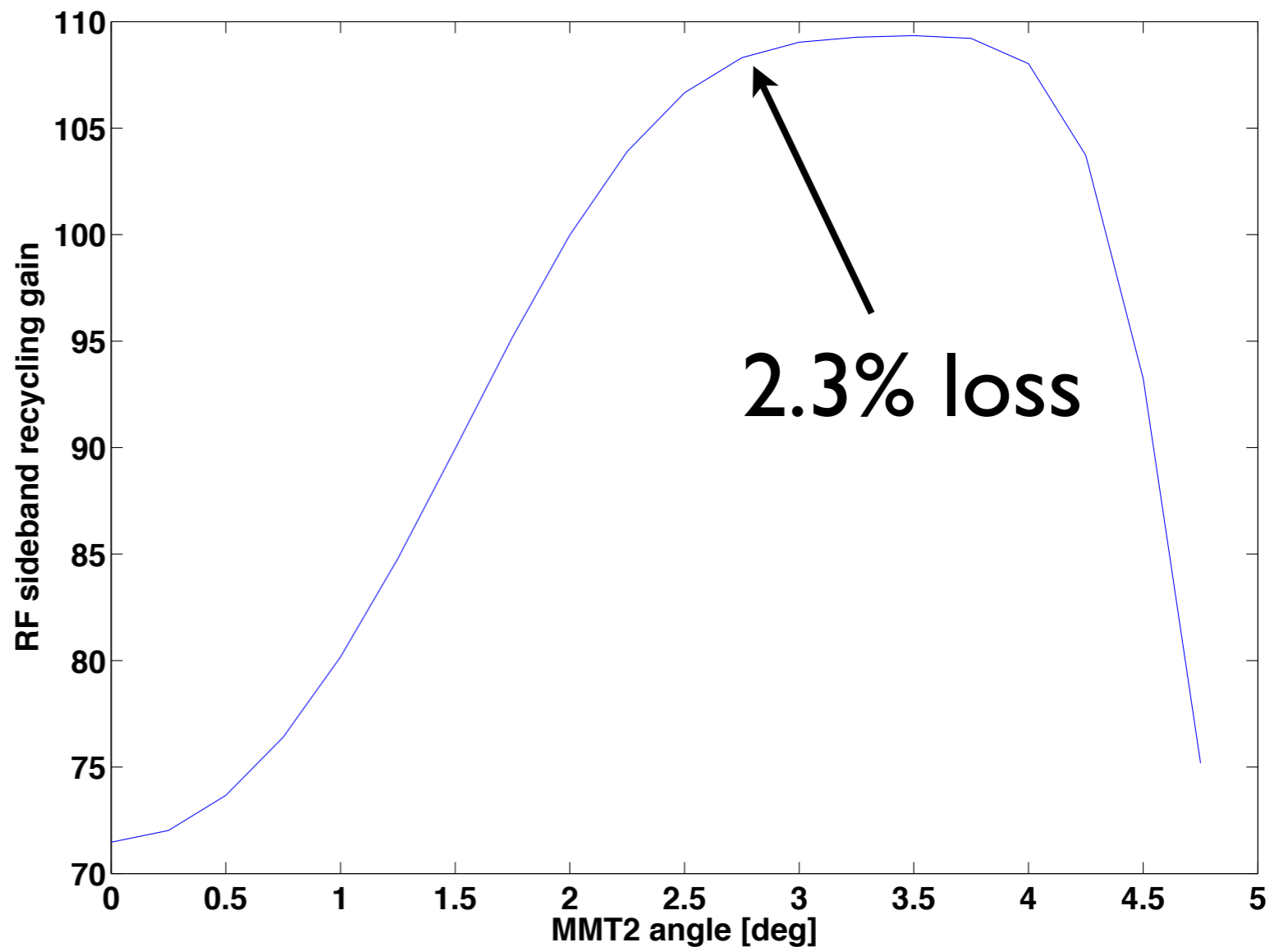
$$\Phi_{Gouy} = 24.179 \text{ deg}$$

	RoC [m]	$w$ [mm]	L [m]	angle [deg]
PRM3	15.098	49.5	10.7	1.06
PRM2	-1.837	5.38	6.78	2.54
PRM1	-1.875	1.07	6.78	0



# RF sidebands in PRC

- RF sideband recycling gain vs PRM2 incident angle.
- PRM3 incident angle is 1.06 degrees.

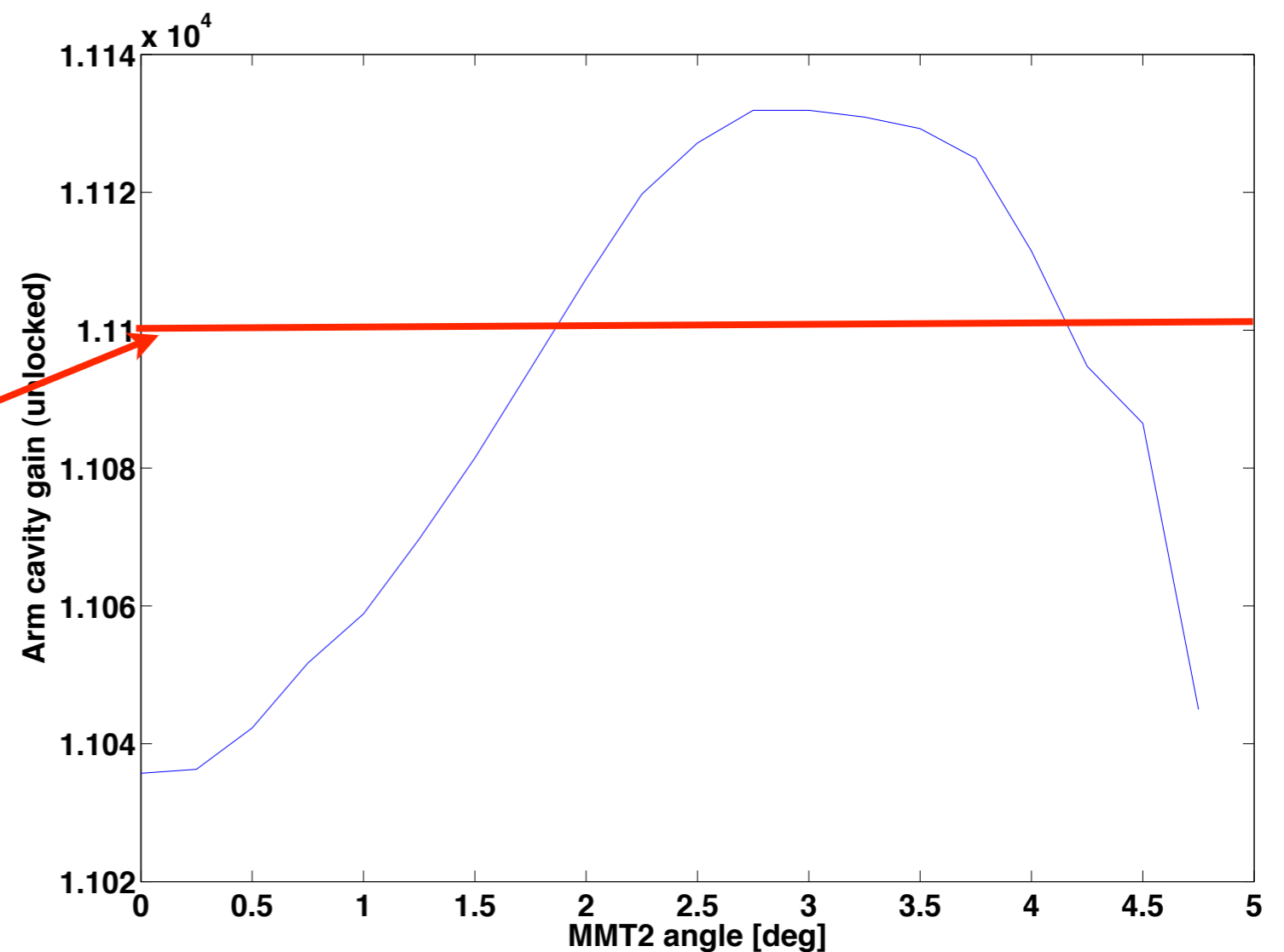


SIS coupled cavity



# Carrier in arms

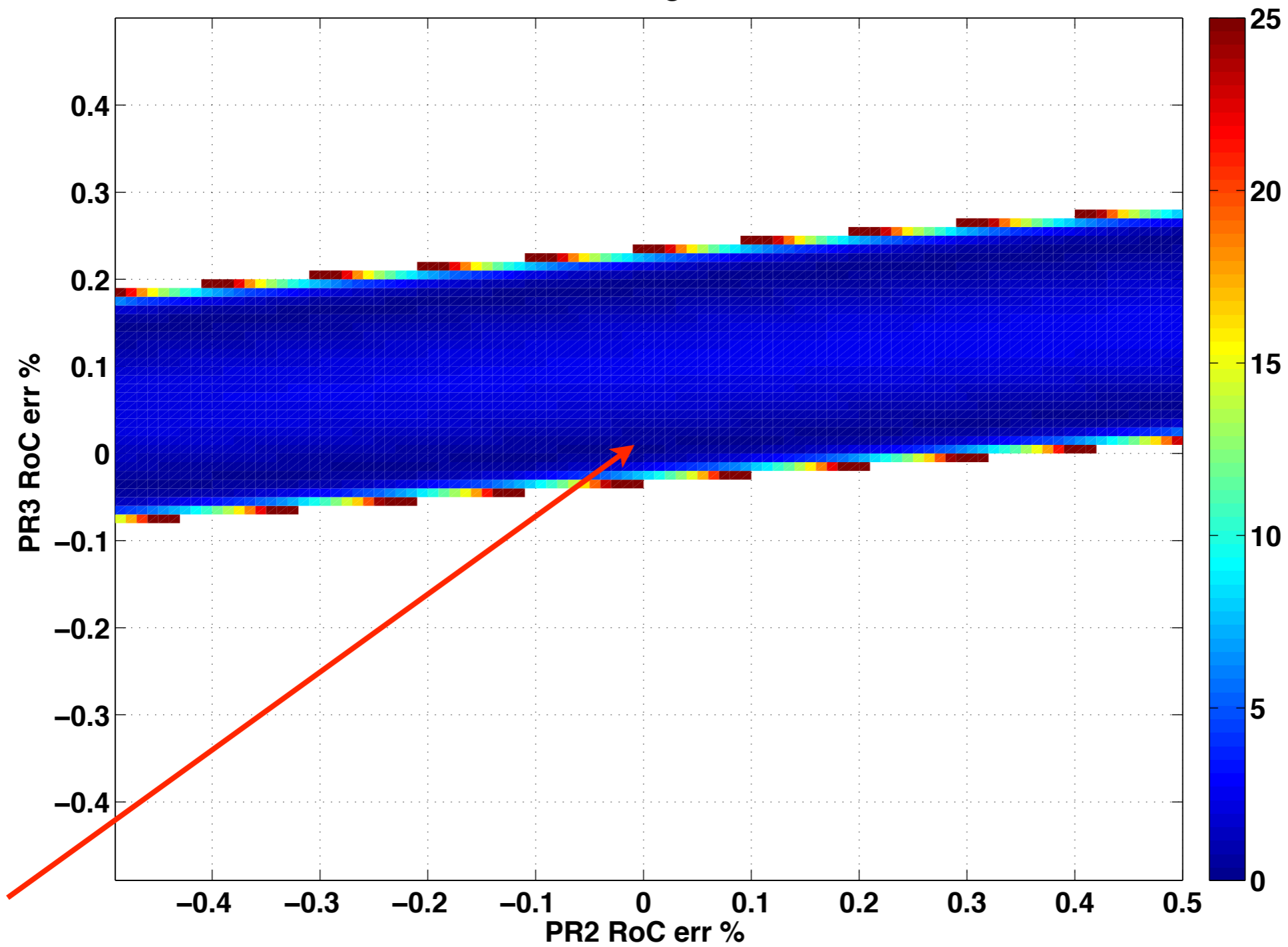
- carrier gain increases
- power with zero incident angle in recycling cavity
- total variation less than 1%



SIS coupled cavity

# tolerances

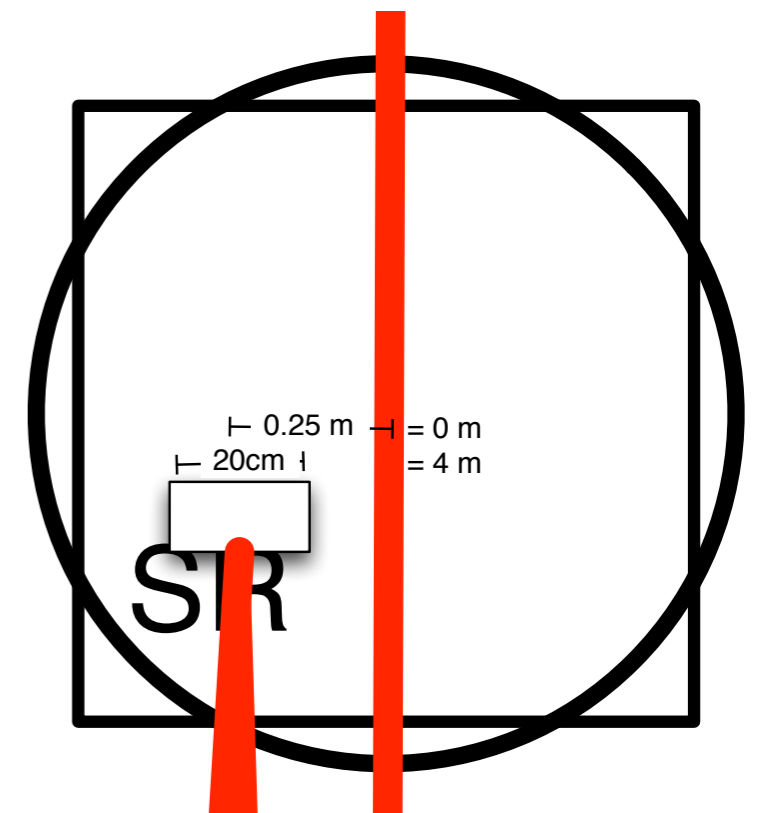
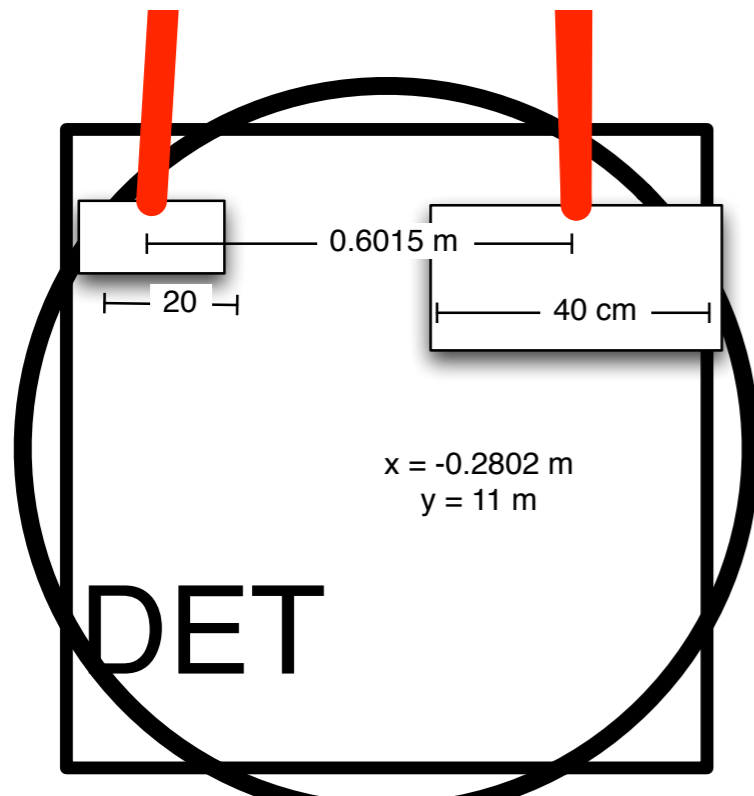
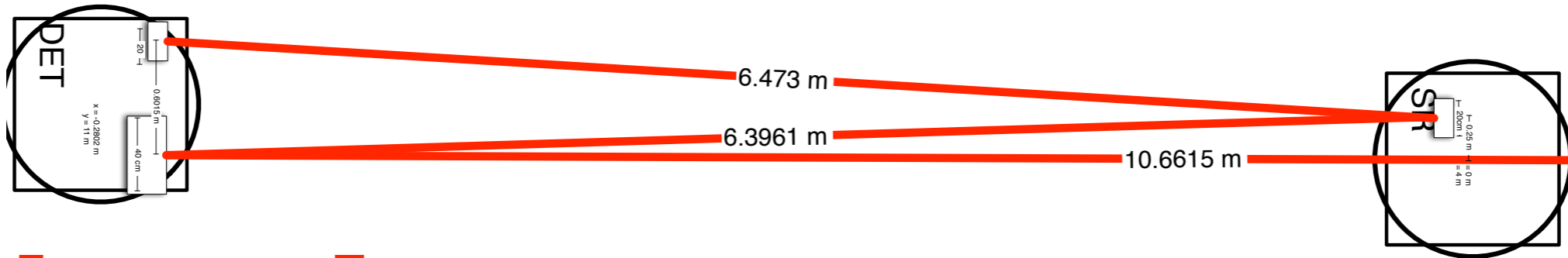
FP matching loss %



# SRC design

$$\Phi_{Gouy} = 20.5 \text{ deg}$$

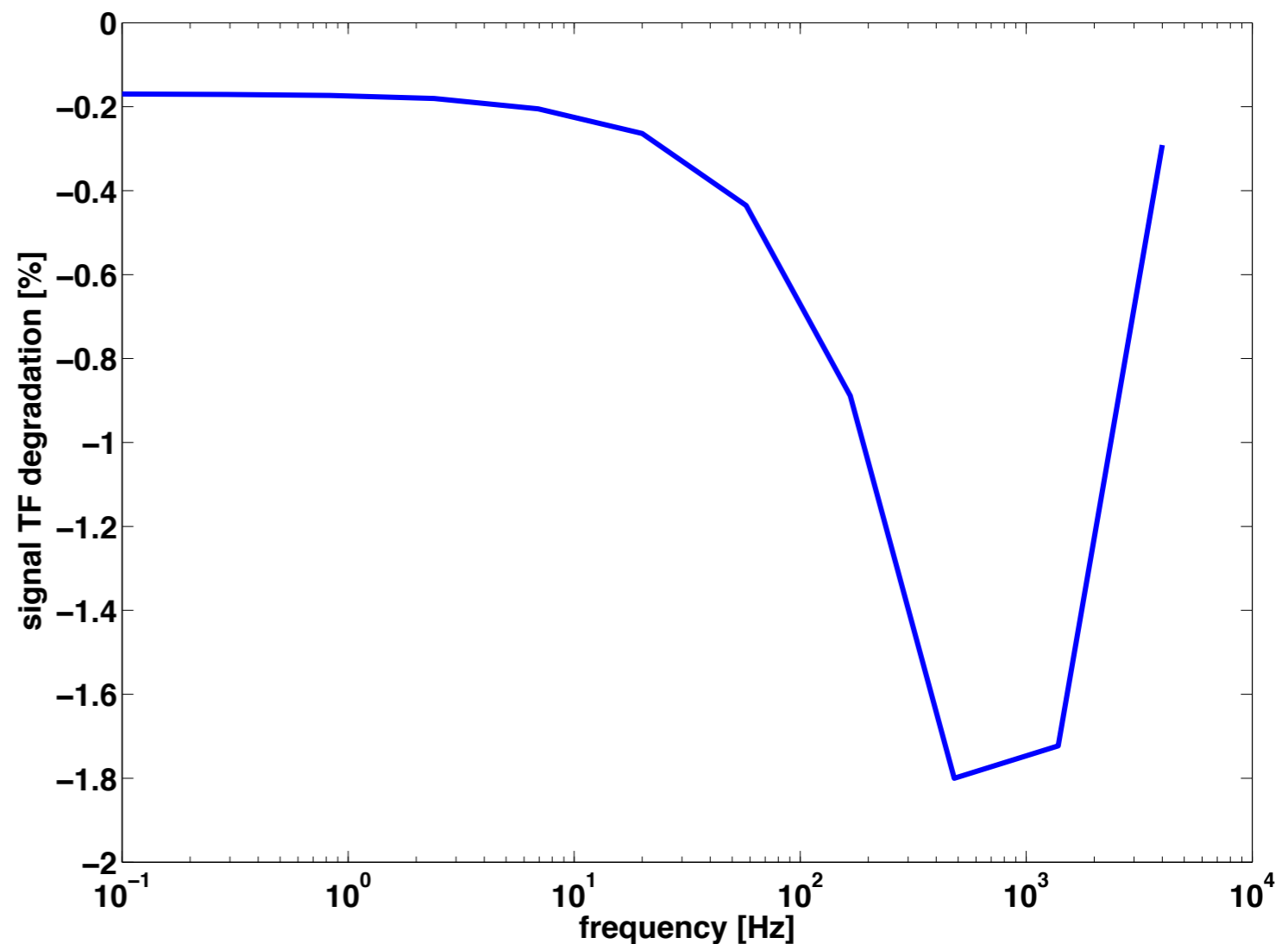
	RoC [m]	$w$ [mm]	L [m]	angle [deg]
SRM3	14.291	49.5	10.7	1.12
SRM2	-1.781	5.51	6.395	2.655
SRM1	-1.878	1.17	6.473	0



# signal losses

- Percent difference of transfer functions in AOI=0 case and this scenario.

$$TF = \frac{\text{output field amplitude}}{\text{arm cavity field amplitude}}$$



SIS coupled cavity

# next

- Check astigmatism in designs with larger/smaller RoC on (P|S)R2.
- Check behavior of f2 RF sideband in PRC/SRC.
- Check sensing matrices with different Schnupp lengths and choices for f2/f1 ratio.
- Accurate Optic+RM sizes for layout constraints.
- Suggestions.