# Notes on IMMT1,2 Transmission

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# Scope

- IMMT1 transmission is currently used for the intensity stabilization (ISS) and IMC ASC

- There was some complicated history behind IMMT1,2 transmission and here I will summarize the story

- Also, suggestions for the beam splitter design for IMMT1 transmission is discussed

- References
    JGW-T1302068: Optical Design of the Input Mode Matching Telescope
    JGW-T1706953: Cartoon of the optical layout around IMC, IFI and IMM
    JGW-L1706994: Setting of pick off mirrors to see light transmitted through IMMT2
    JGW-G2112943: About the IMMT1T setup

# Plan as of 2013 JGW-T1302068

- ## No STM1,2 for IFI

- ## IMMT1T for ISS

  Transmission specified to be 1500 < T < 2000ppm considering 200 mW is necessary for ISS and 75 W input (75 W input was the design at that time; JGW-T1302068). This calculation was WRONG and corrected to 2700ppm < T < 3200ppm in 2016; see [kagra-ioo 03678] and related emails. 100 mW for in-loop, 100 mW for out-of-loop, some for extra for margin)
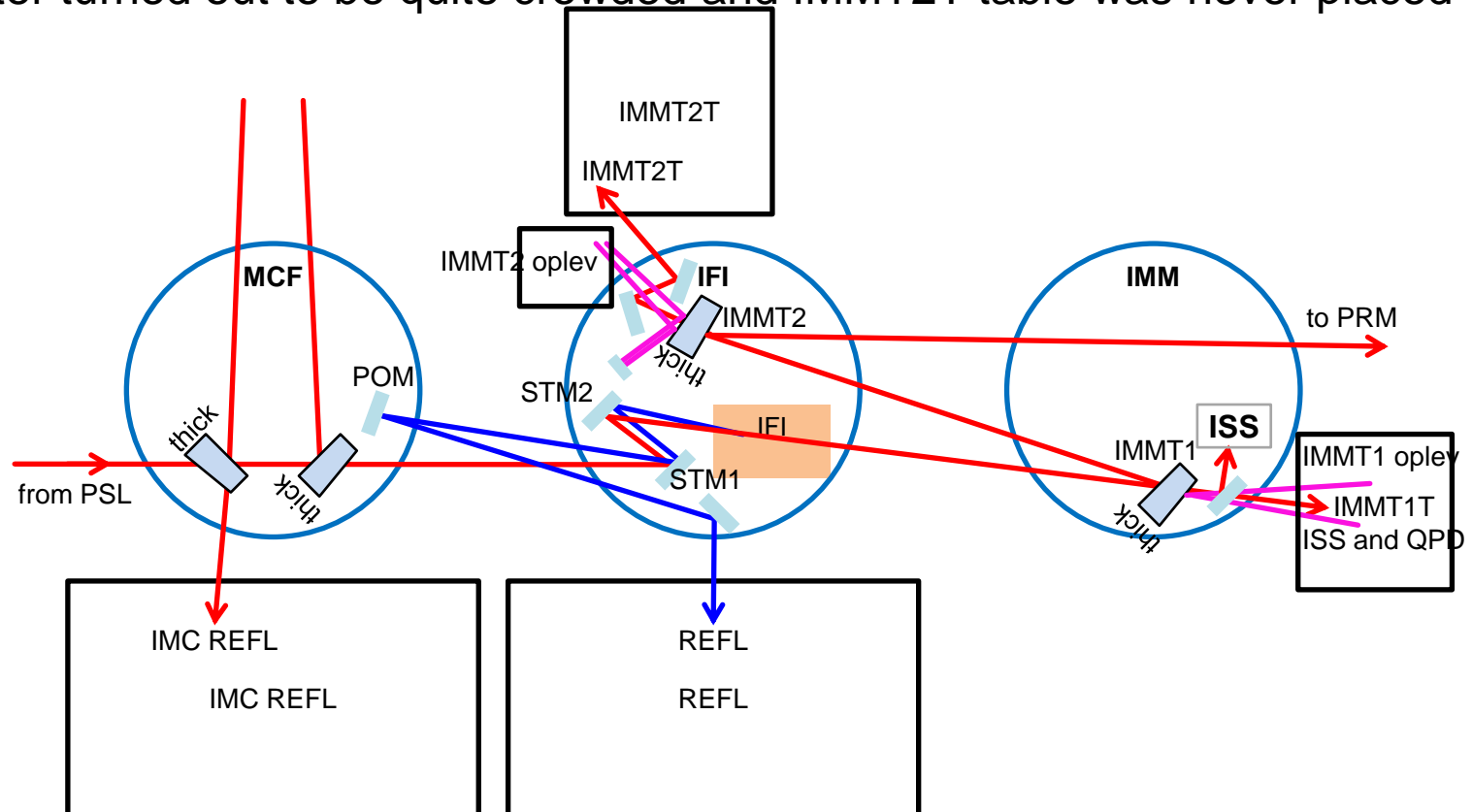
- ## IMMT2 for DC QPDs

  Transmission specified to be 200 < T < 400 ppm. 1 mW for 5 W input, 15 mW for 75 W input.
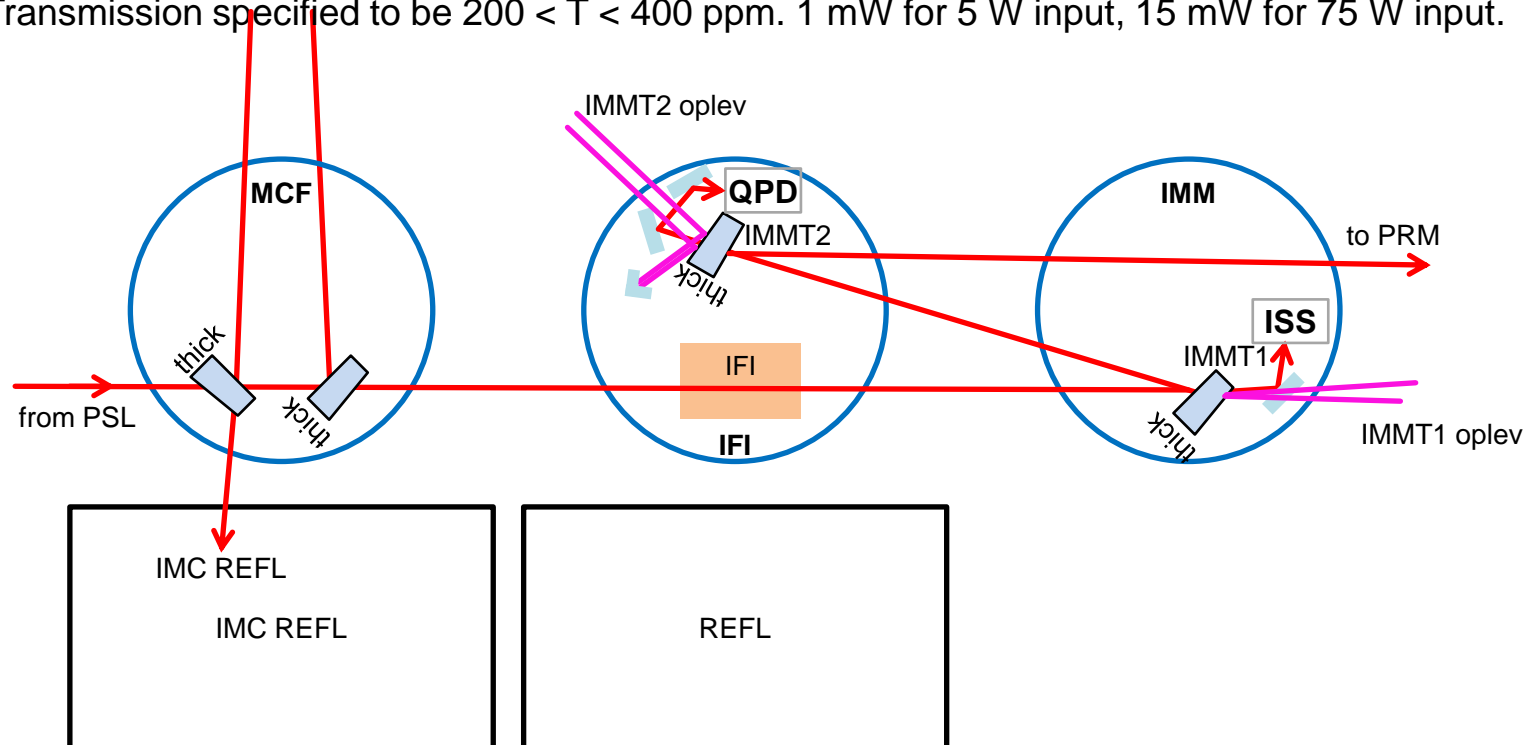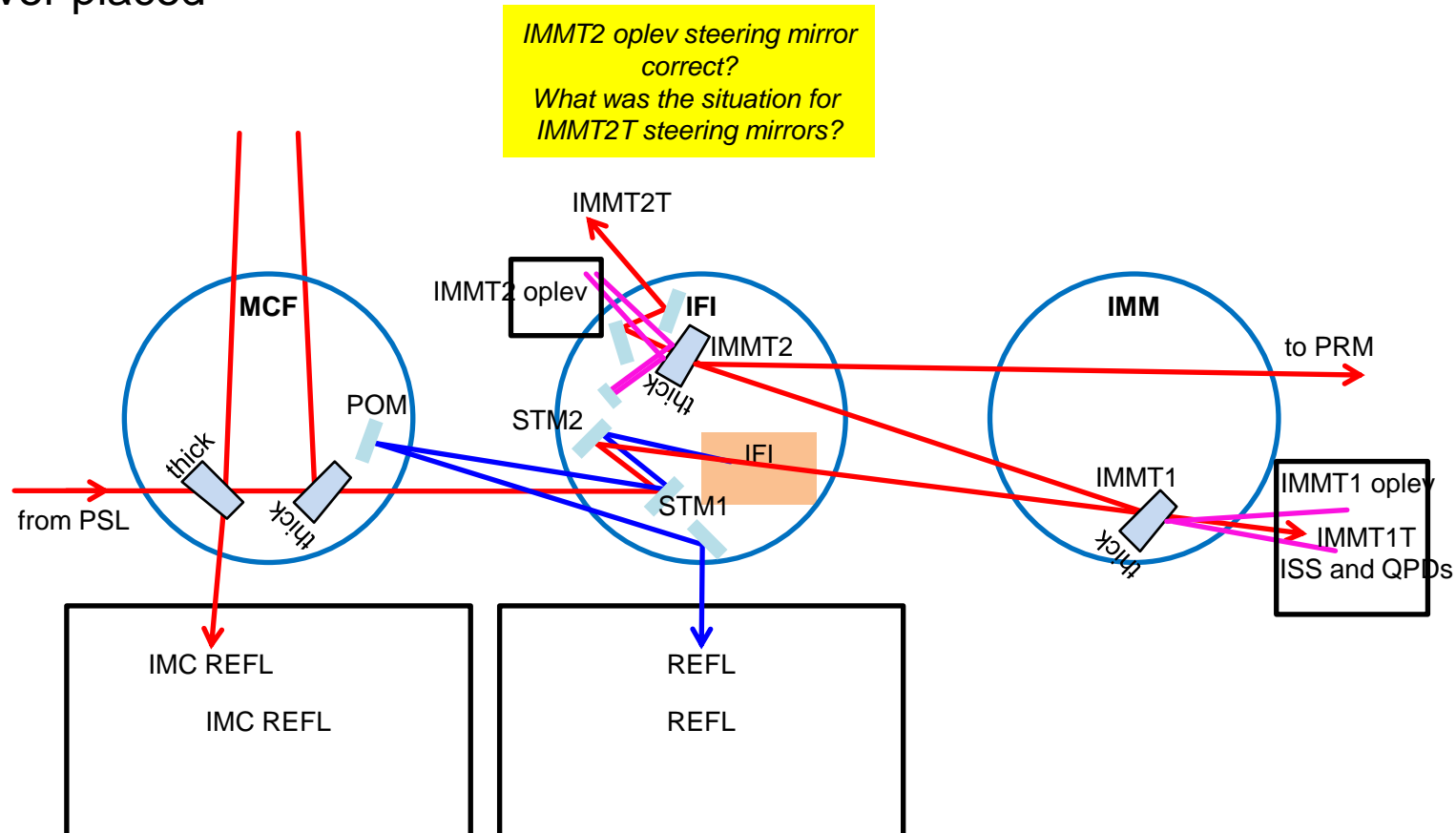
# Plan as of 2017

- IFI layout updated

- IMMT1T for ISS and 1 DC QPD
  in-vac ISS planned for later phase

- IMMT2T for RF AM monitor (RF PD) and 2 DC QPDs
  later turned out to be quite crowded and IMMT2T table was never placed



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# Situation as of O3GK

- IMMT1T for ISS (2 DC PDs) and 2 DC QPD
  in-air BS splitting beam for ISS (trans) and QPDs (refl) was Thorlabs BSF10-C

- IMMT2T not used
  later turned out to be quite crowded (JGW-L1706994) and IMMT2T table was never placed

*IMMT2 oplev steering mirror correct?*
*What was the situation for IMMT2T steering mirrors?*

IMMT2T

IMMT2 oplev

IFI

IMM

to PRM

MCF

POM

STM2

IMMT2

thick

IFI

IMMT1

IMMT1 oplev

IMMT1T
ISS and QPDs

thick

from PSL

thick

STM1

thick

IMC REFL

IMC REFL

REFL

REFL

# Update for O4

- IMMT1T for ISS and 1 or 2 DC QPD
  in-vac BS for splitting ISS path and ISS setup on +Y side (JGW-G2012232)

- IMMT2T ???



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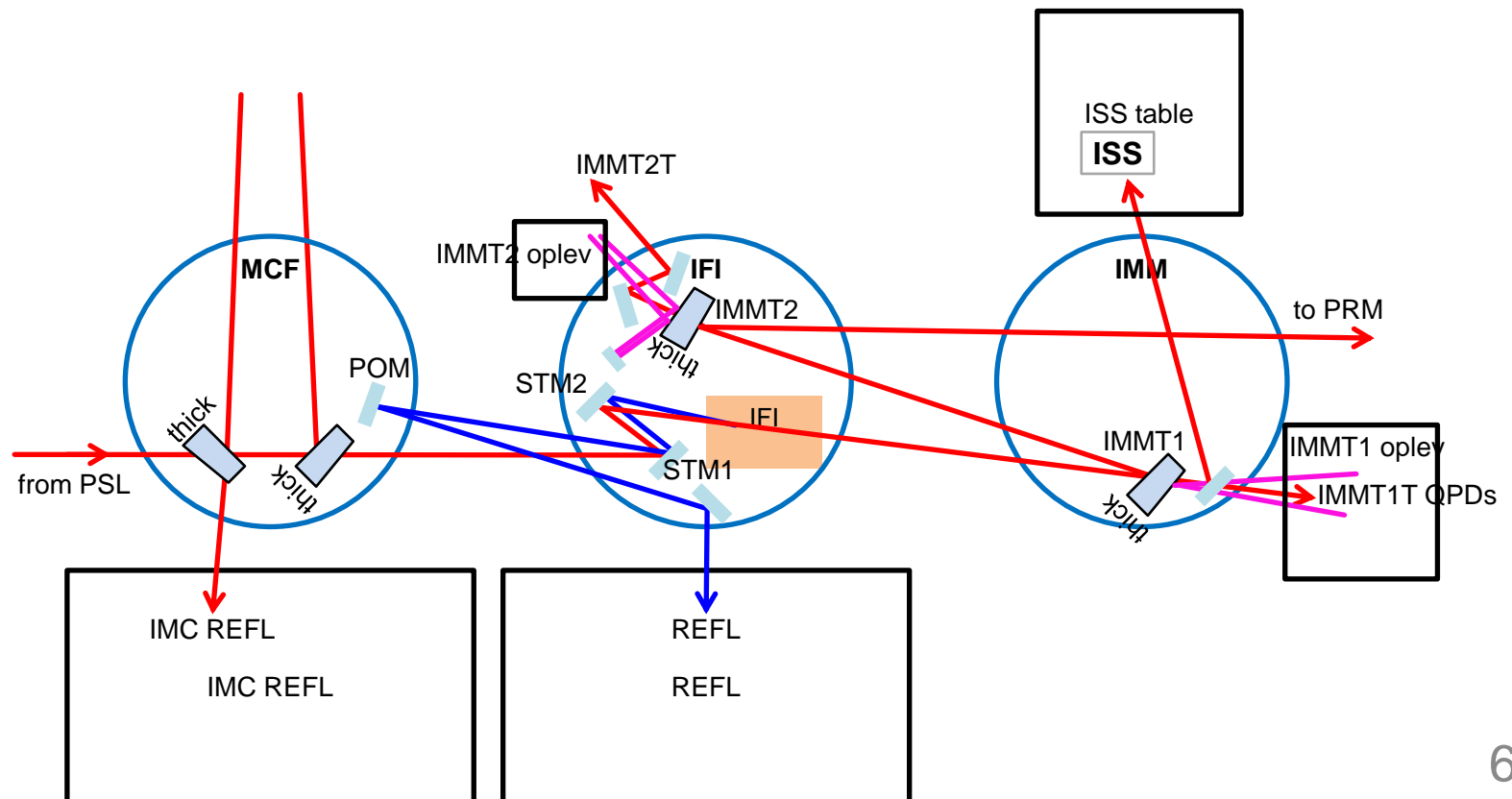
# Suggestions for BS Spec

- IMMT1 transmission measured to be 0.22% ([klog #16728](#))
  *Is this consistent with MIR measurement?*

- In O3GK, IMMT1 had 3-5 W input and ISS out-of-loop PD had 7 mW input. Shot noise limit was RIN of 1e-8 /rtHz. Best achieved was x3 to shot noise ([JGW-G2012322](#)). Most of IMMT1T power went to ISS since we used [Thorlabs BSF10-C](#)

- Input power could be 3-100 W, which gives 6.6-220 mW at IMMT1T.

- 200 mW in total is necessary for ISS path to achieve RIN of 1e-9 /rtHz requirement

- 90% reflection, 10% transmission BS seems reasonable.
  This gives 0.66-22 mW for QPD path

ISS

IMM

to PRM

IMMT1

thick

IMMT1 opley

IMMT1T QPDs

This BS