

Notes on IMMT1,2 Transmission

Yuta Michimura

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

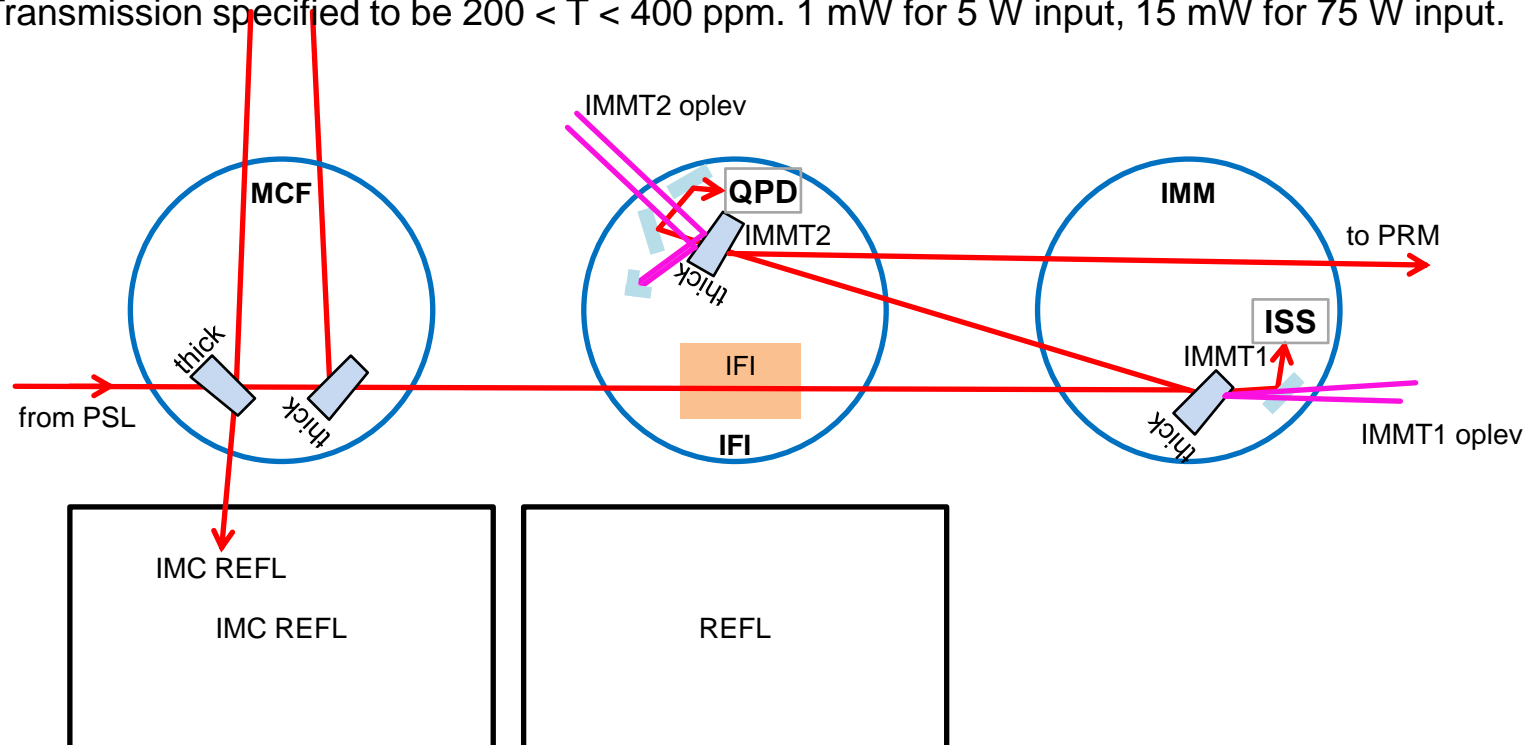
[JGW-T1302068](#)

- No STM1,2 for IFI
- IMMT1T for ISS

Transmission specified to be $1500 < T < 2000$ ppm 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 2700 ppm $< T < 3200$ ppm 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

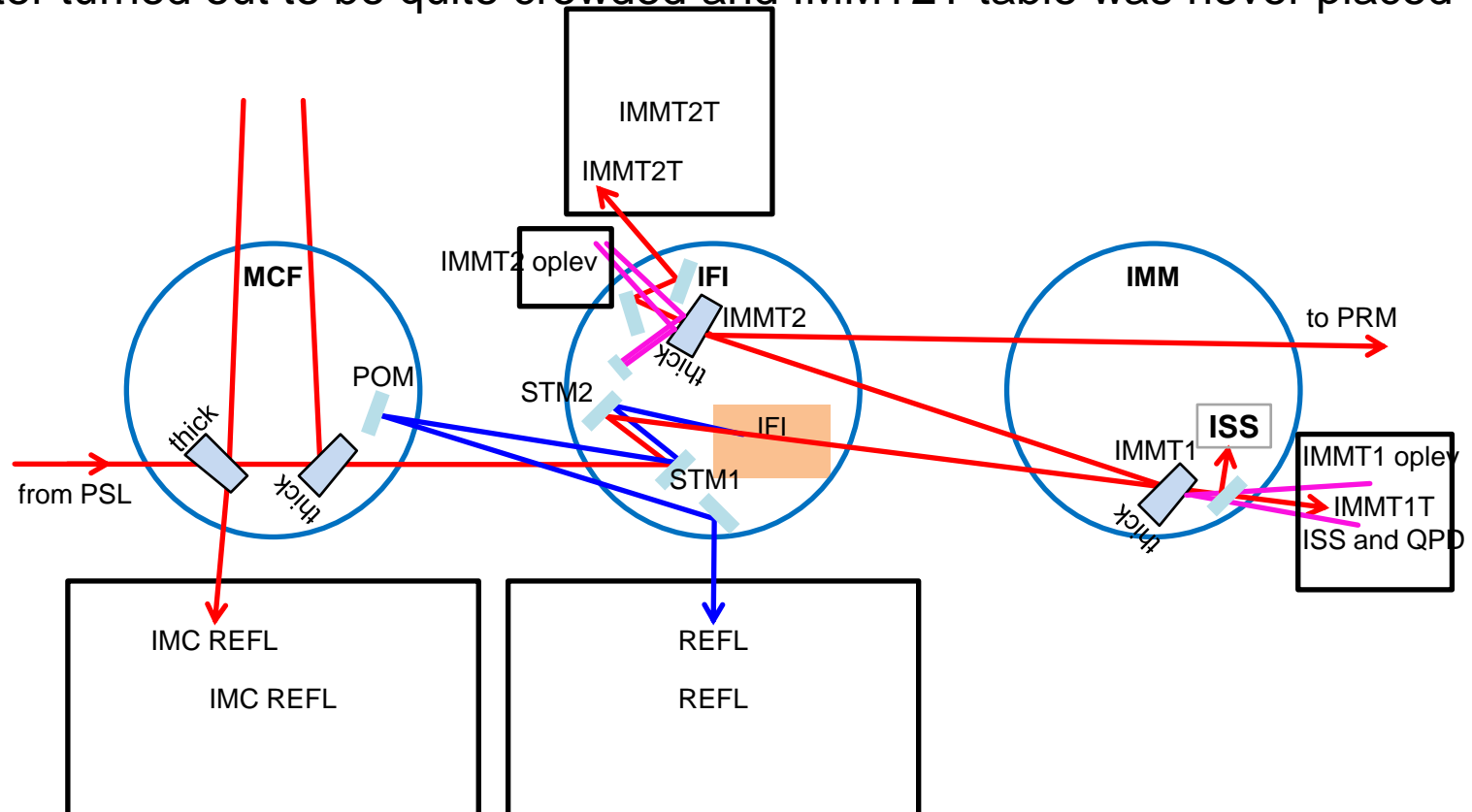
Transmission specified to be $200 < T < 400$ ppm. 1 mW for 5 W input, 15 mW for 75 W input.



Plan as of 2017

[JGW-T1706953](#)

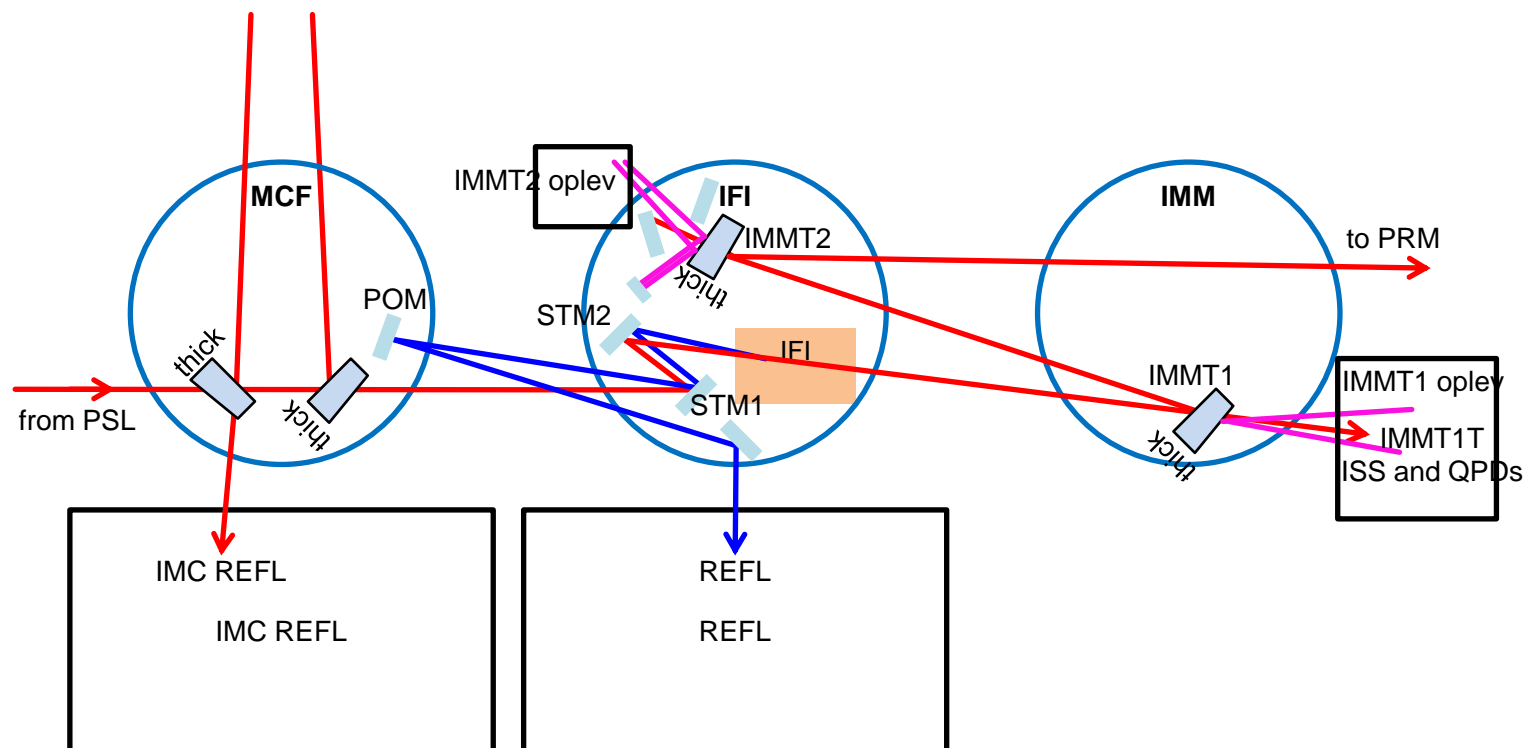
- IFI layout updated
- IMMT1T for ISS and 1 DC QPD
in-vac ISS planned for later phase
- IMMT2T for RF AM monitor (RF PD) and 2 DC QPDs
later turned out to be quite crowded and IMMT2T table was never placed



Situation as of O3GK

[JGW-G2112943](#)

- 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](#)). Steering mirrors were placed randomly ([klog #3268](#), [klog #6204](#), [JGW-T2012050](#)) and IMMT2T table was never placed.



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 $2.4e-9$ /rtHz bKAGRA requirement
- **90% reflection, 10% transmission BS seems reasonable.**
This gives 0.66-22 mW for QPD path
- This BS also should have high transmission for oplev beam (670 nm)

