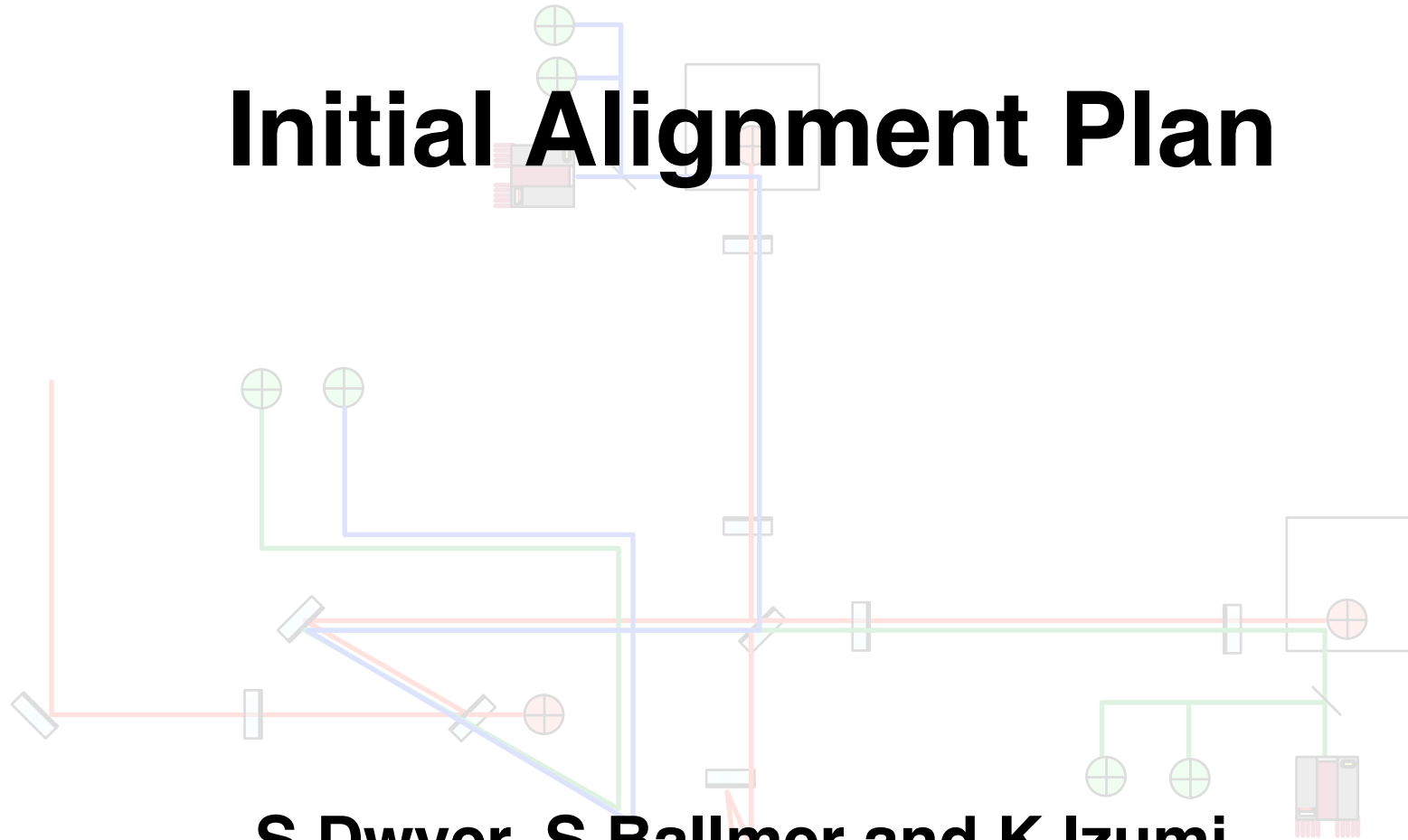


Initial Alignment Plan



S.Dwyer, S.Ballmer and K.Izumi

f2f commissioning meeting at LLO (12/Jun/2014)

LIGO-G1400193-v2

Update from v1

- ✓ **LLO developed a initial alignment sequence
(alog 12948) => some portion is incorporated in this plan**
- ✓ **IR WFSs are useful for the red pointing.
=> previously proposed as dither-based alignment
because of concern in the signal range**
- ✓ **Green/Red co-alignment in the Y arm seems critical**
- ✓ **Green WFSs are troublesome ?
-> LHO feeds signals back to input PZTs ...
-> AC control on test masses in LLO ...**
- ✓ **What is a good alignment procedure ?**

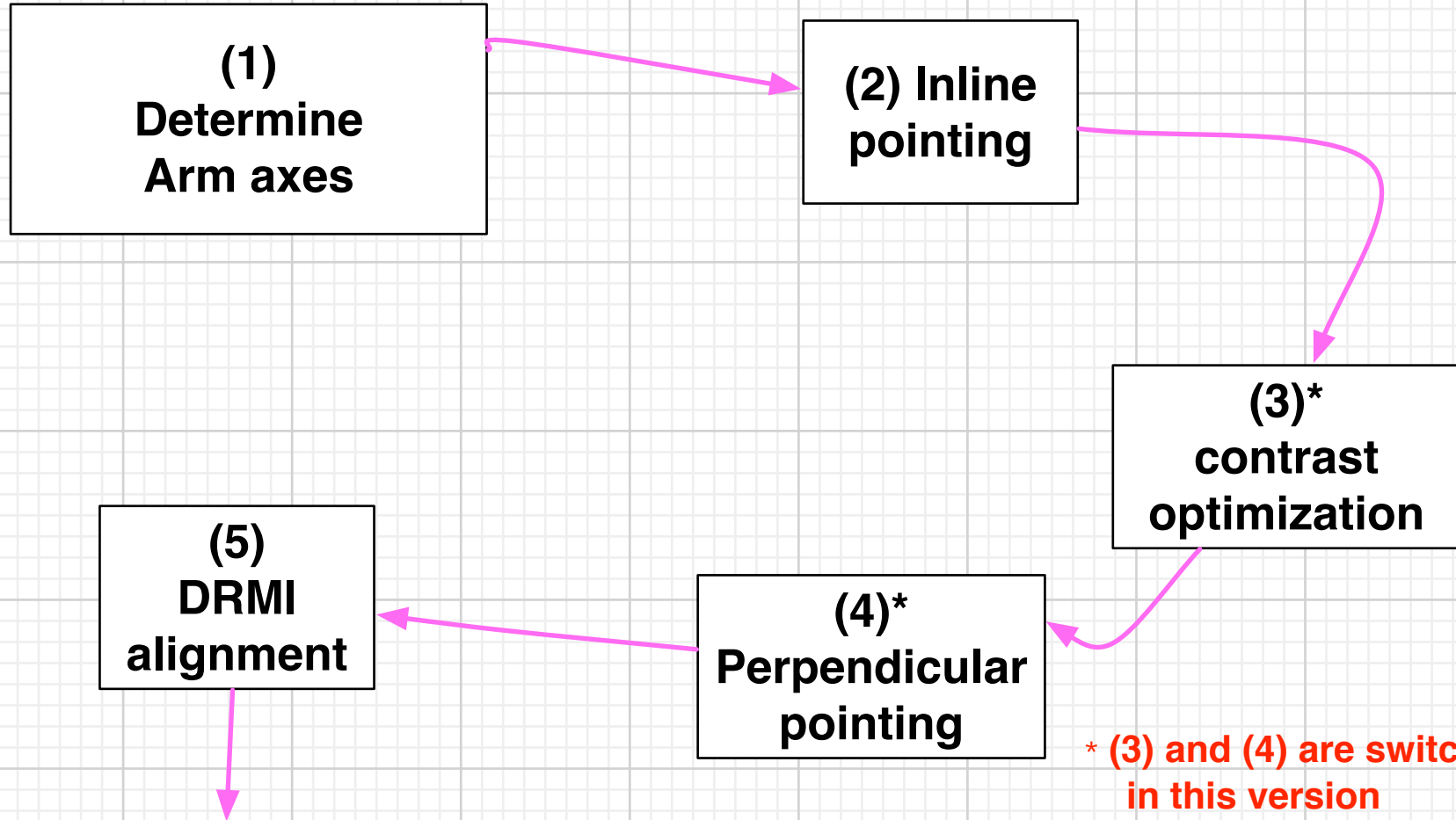
Concepts

- ✓ This is for initial alignment that can be done on a **daily basis**.
- ✓ This process can be **a part of the locking sequence**
=> no need to disengage ALS in any of the steps.
- ✓ This **reduces the alignment downtime** during commissioning.
- ✓ This expands the number of people who can align the IFO.
(i.e. **the process should be automated**)
- ✓ It is OK to skip some steps if the alignment doesn't drift so much.

Assumption

- ✓ **Coarse alignment had been already done:**
 - **TMSs are in a good position/alignment**
so that the beam spot on ETMs is centered.
 - **IMs' alignment is good**
so that the beam spot on PRM is centered.

Alignment Steps

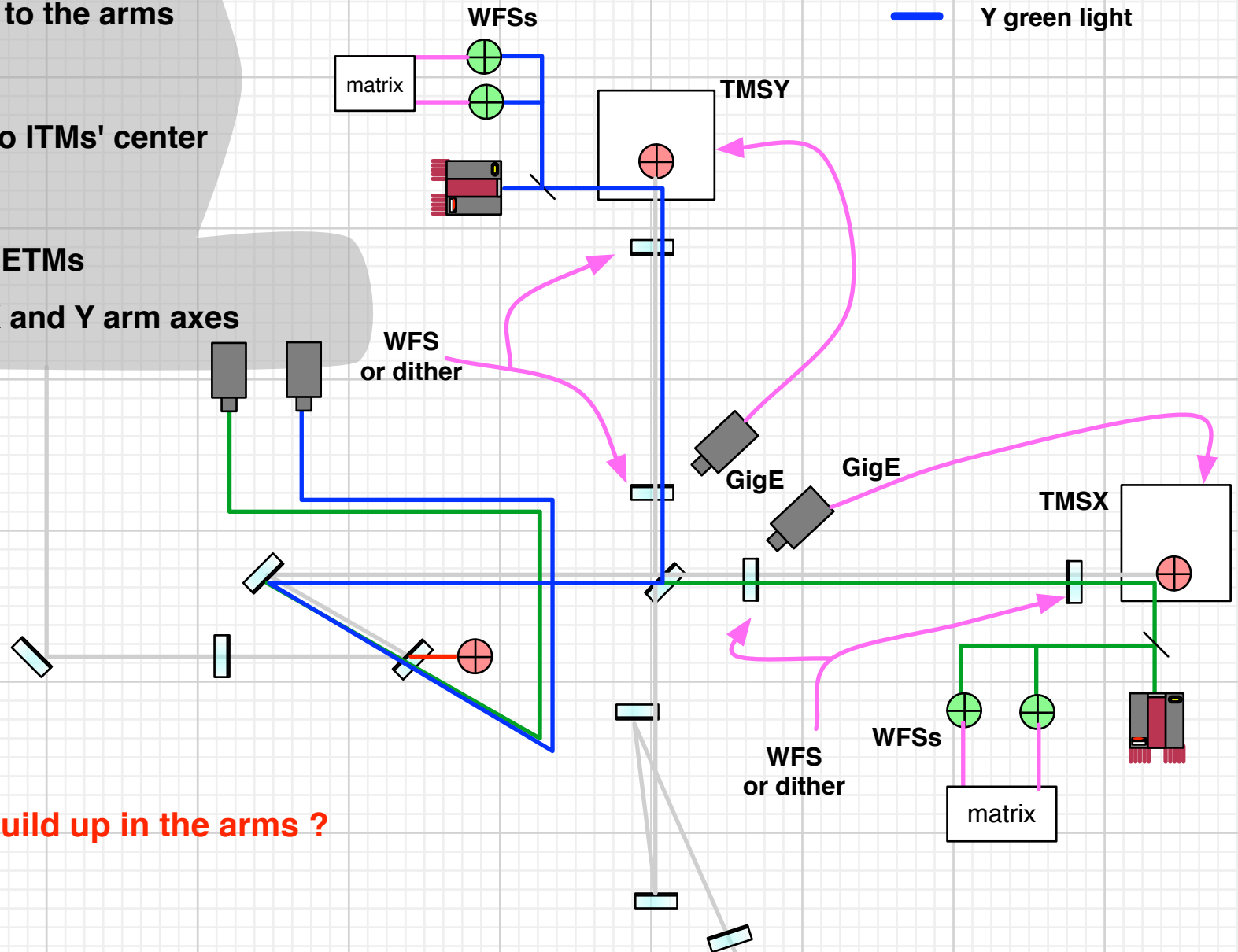


Now you can enjoy happy commissioning time!

(1.1) Determination of Arm axes

- Lock the green lasers to the arms
 - No red light required
 - GigEs to steer TMSs to ITMs' center
 - Get a high build up
- by steering ITMs and ETMs
- This determines the X and Y arm axes

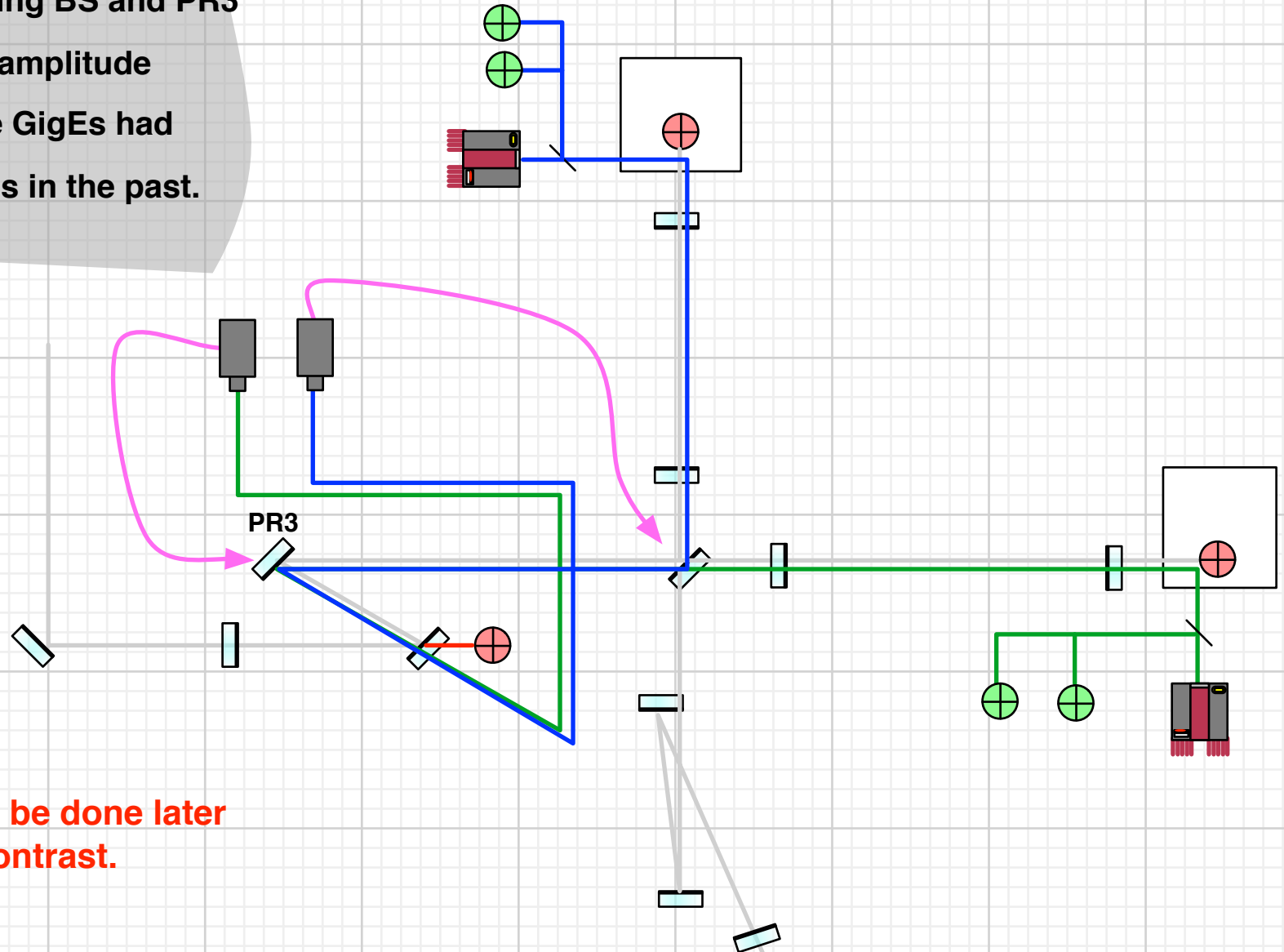
— X green light
— Y green light



● How to get a high build up in the arms ?
WFS or dither ?

(1.2) Determination of Arm axes

- ISCT1 GigEs for steering BS and PR3 to get a high beatnote amplitude
- This assumes that the GigEs had been set as references in the past.

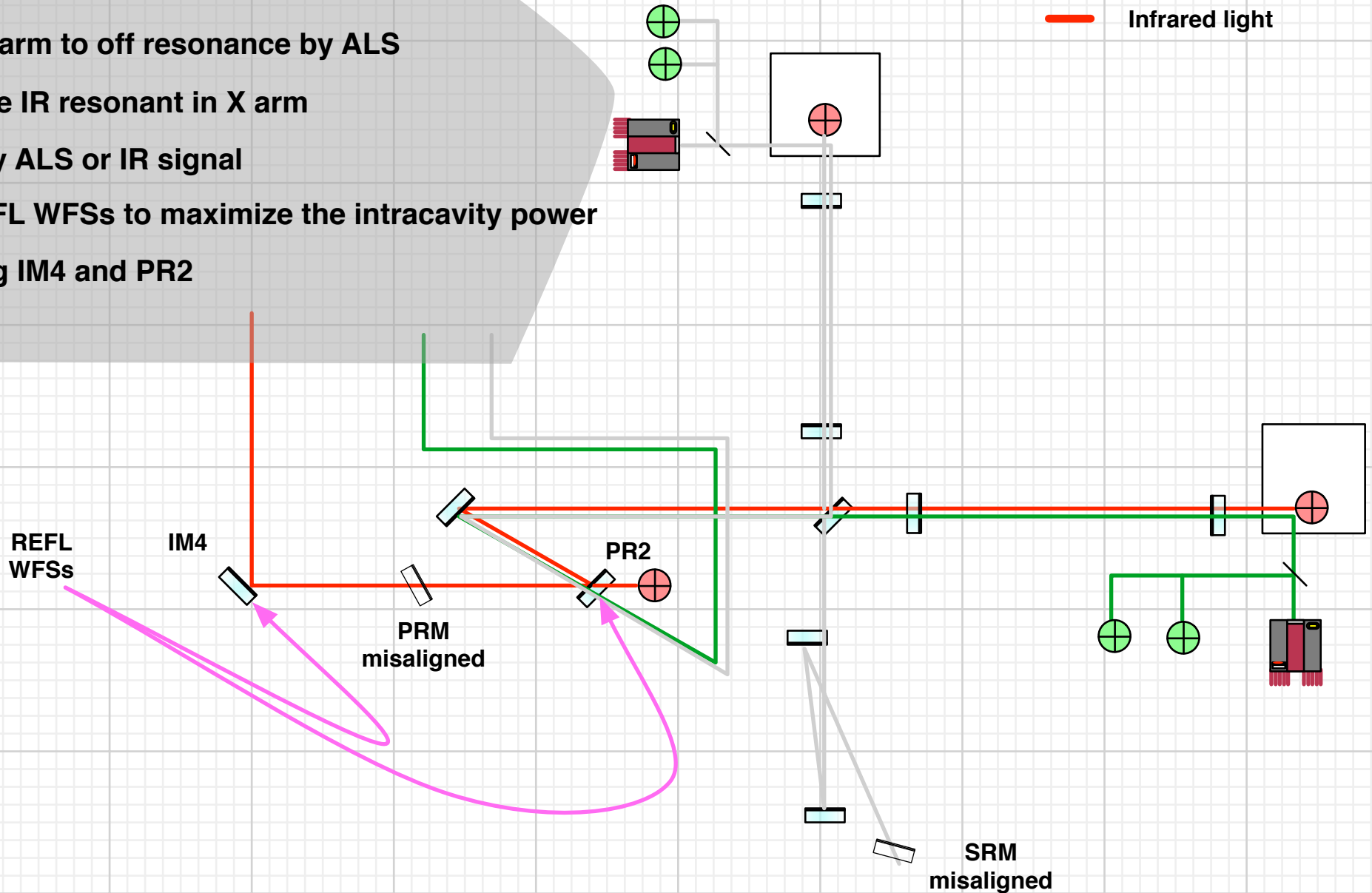


- BS fine tuning will be done later by optimizing the contrast.

(2.1) Inline beam pointing

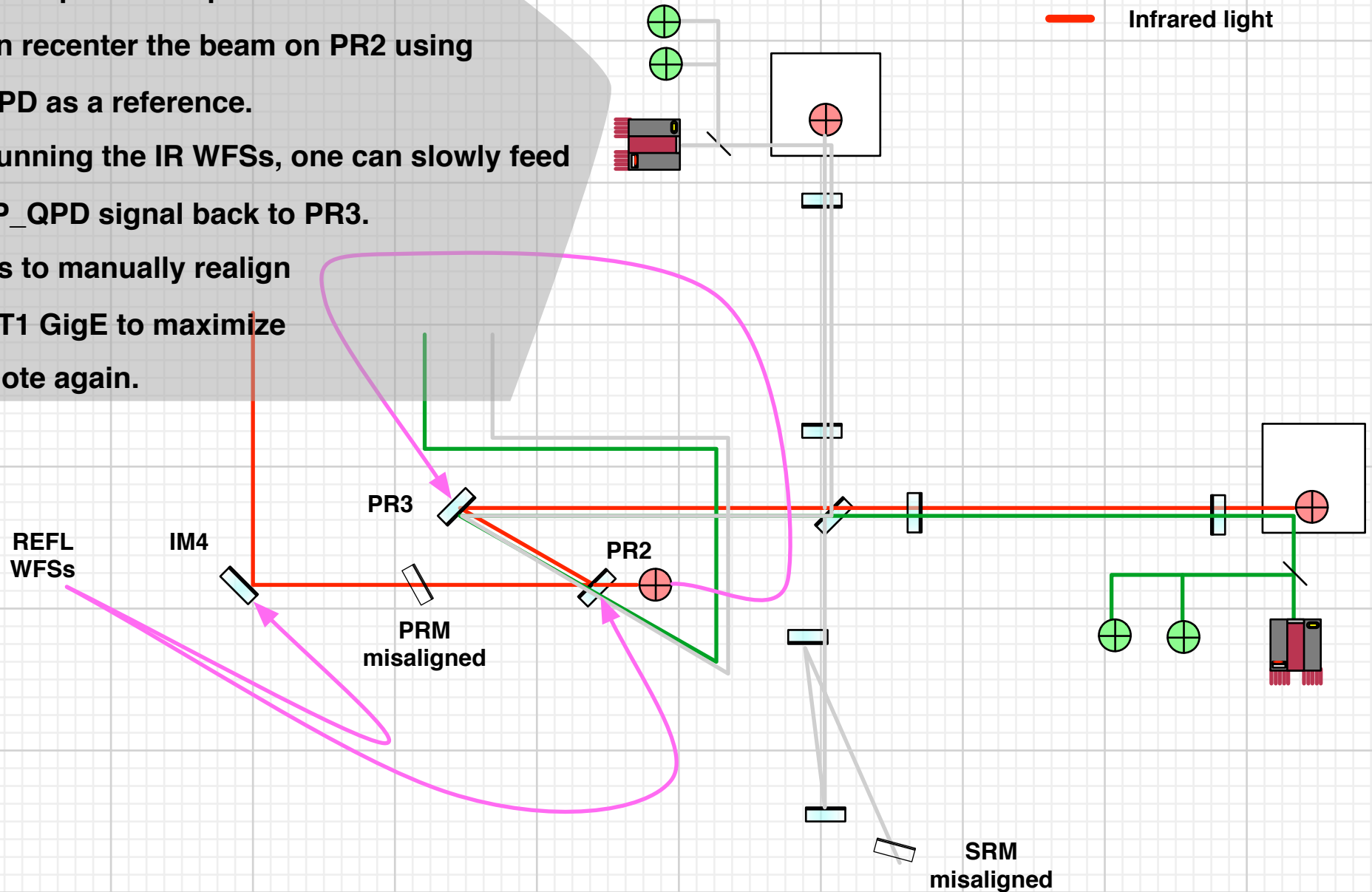
- Misalign SRM and PRM
- Bring Y arm to off resonance by ALS
- Make the IR resonant in X arm
either by ALS or IR signal
- Use REFL WFSs to maximize the intracavity power
by steering IM4 and PR2

- X green light
- Y green light
- Infrared light



(2.2) Inline beam pointing

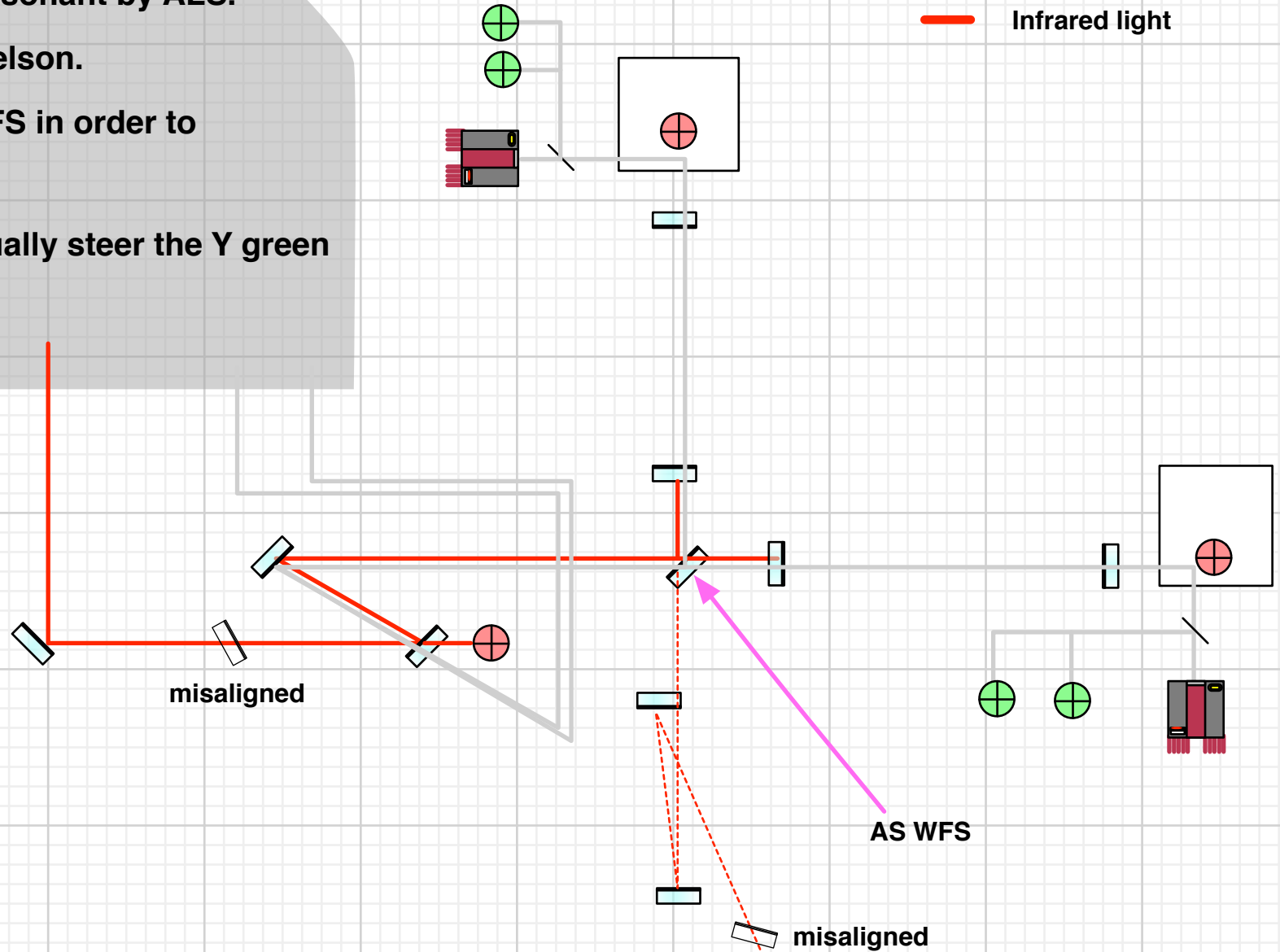
- This is an optional step
- One can recenter the beam on PR2 using POP_QPD as a reference.
- While running the IR WFSs, one can slowly feed the POP_QPD signal back to PR3.
- One has to manually realign the ISCT1 GigE to maximize the beatnote again.



(3) Contrast Optimization

- Make both arms off-resonant by ALS.
- Lock the simple Michelson.
- Steer BS using AS WFS in order to optimize the contrast.
- We may need to manually steer the Y green light at ISCT1.

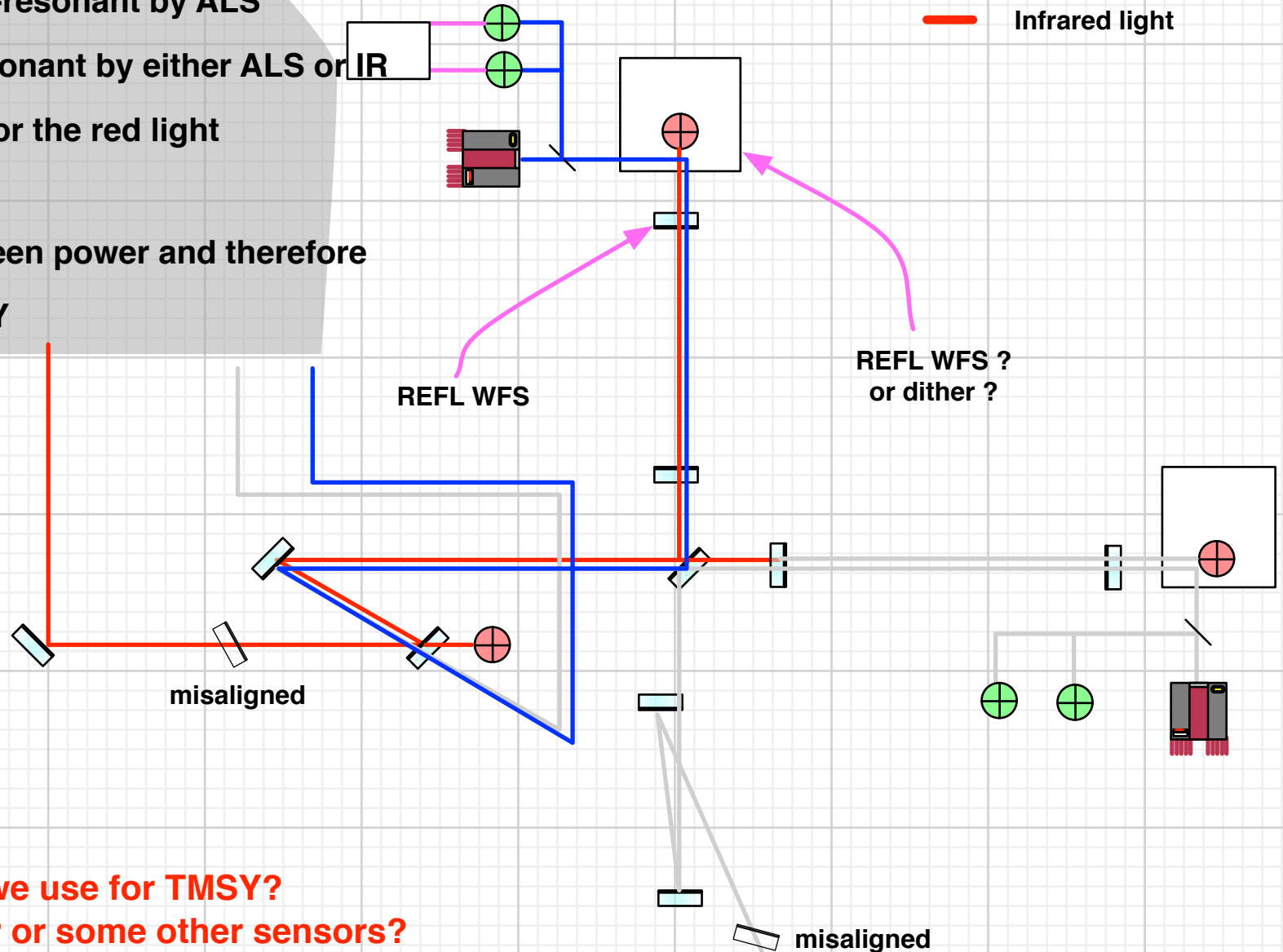
- X green light
- Y green light
- Infrared light



(4) Perpendicular pointing

- X green light
- Y green light
- Infrared light

- Make the X infrared off-resonant by ALS
- Make the Y infrared resonant by either ALS or IR
- Optimize ETMY angle for the red light using REFL WFSs
- This can reduce the green power and therefore one need to touch TMSY

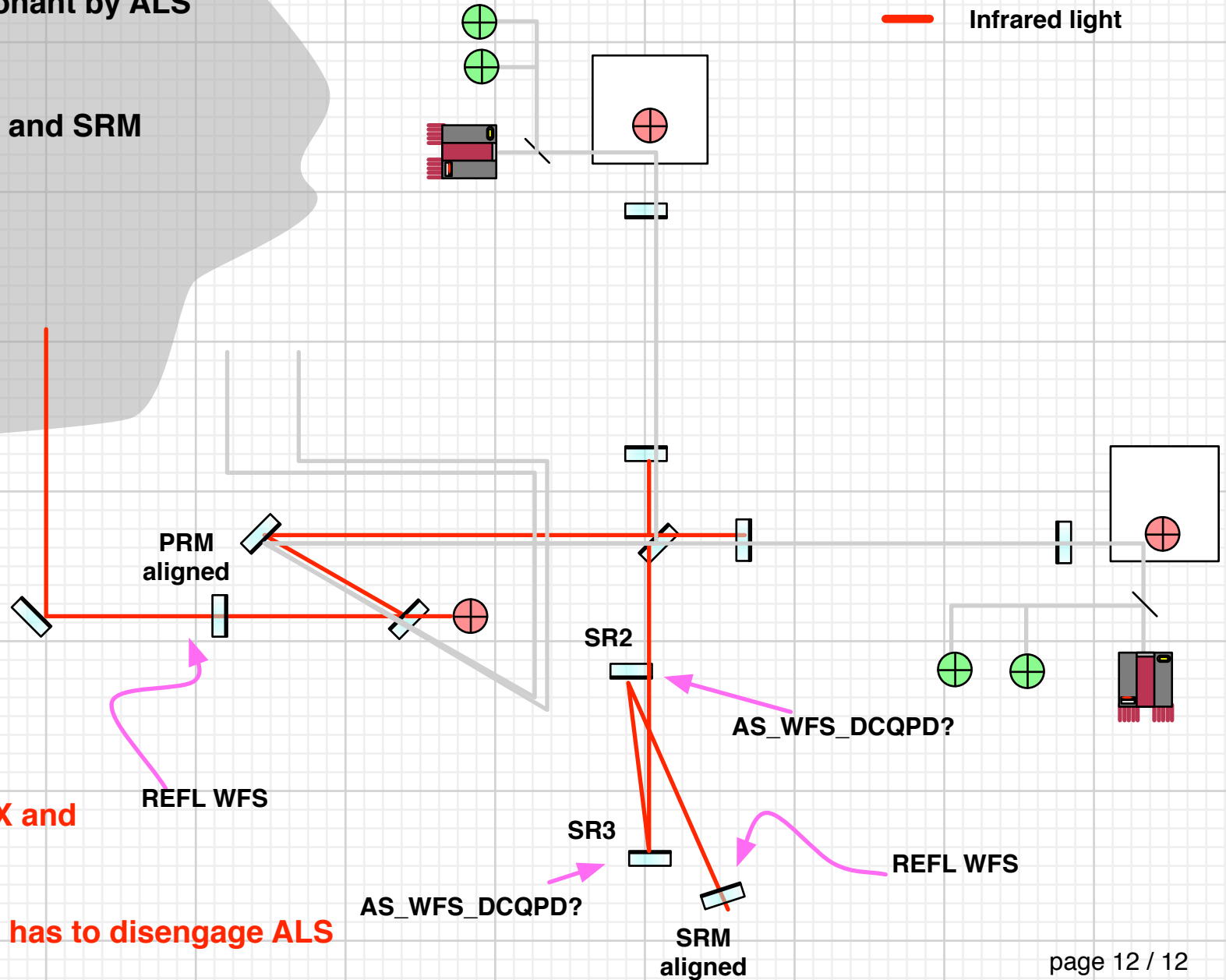


- What sensor do we use for TMSY?
REFL WFS, dither or some other sensors?

(5) DRMI alignment

- X green light
- Y green light
- Infrared light

- Make both arms off resonant by ALS
- Lock DRMI
- Use WFSs to align PRM and SRM



● Do we need to lock PRX and SRY instead ?

=> not so nice since one has to disengage ALS