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Optical/Electrical Components Needed for iKAGRA IMC Servo

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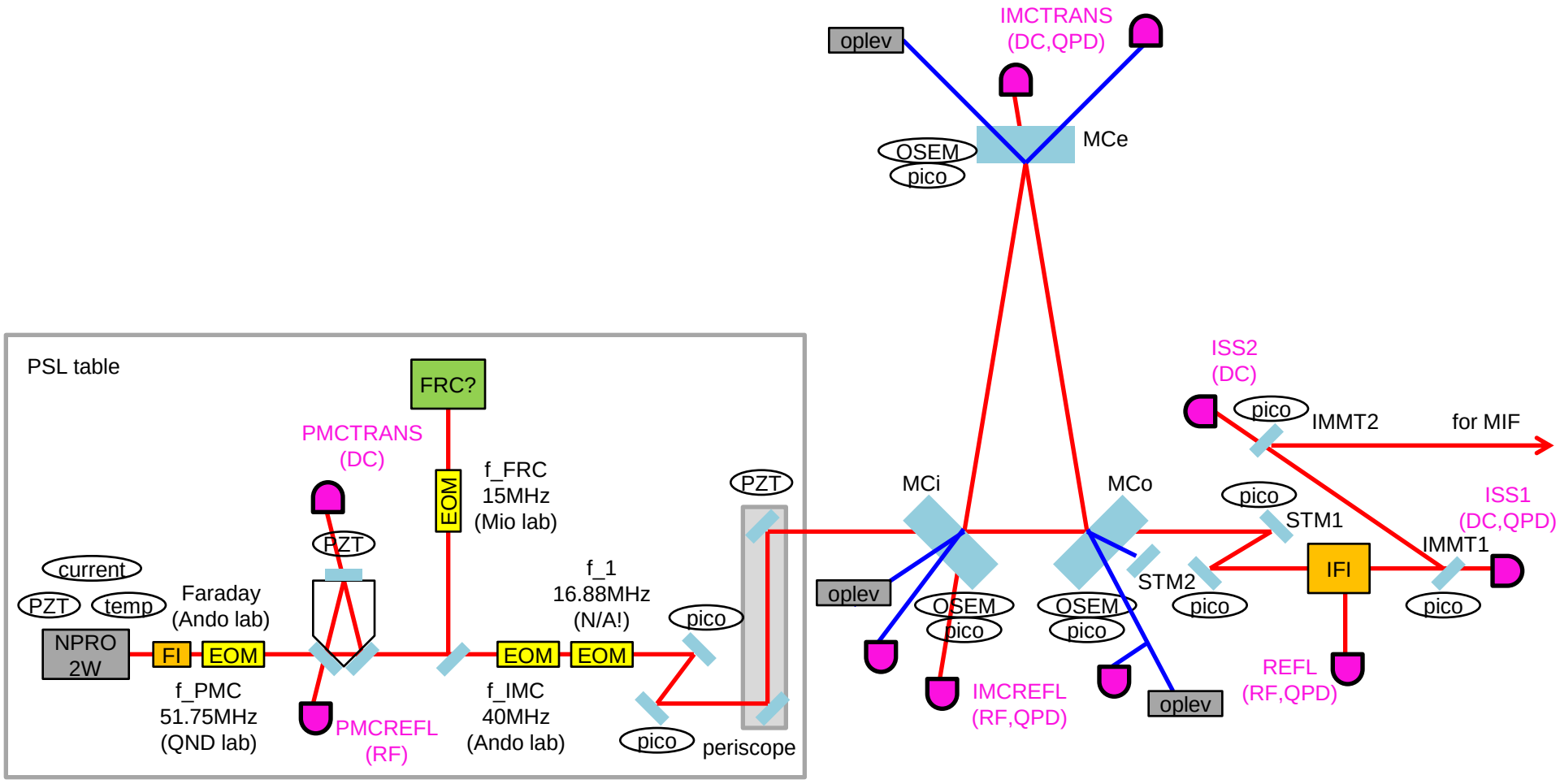
Scope

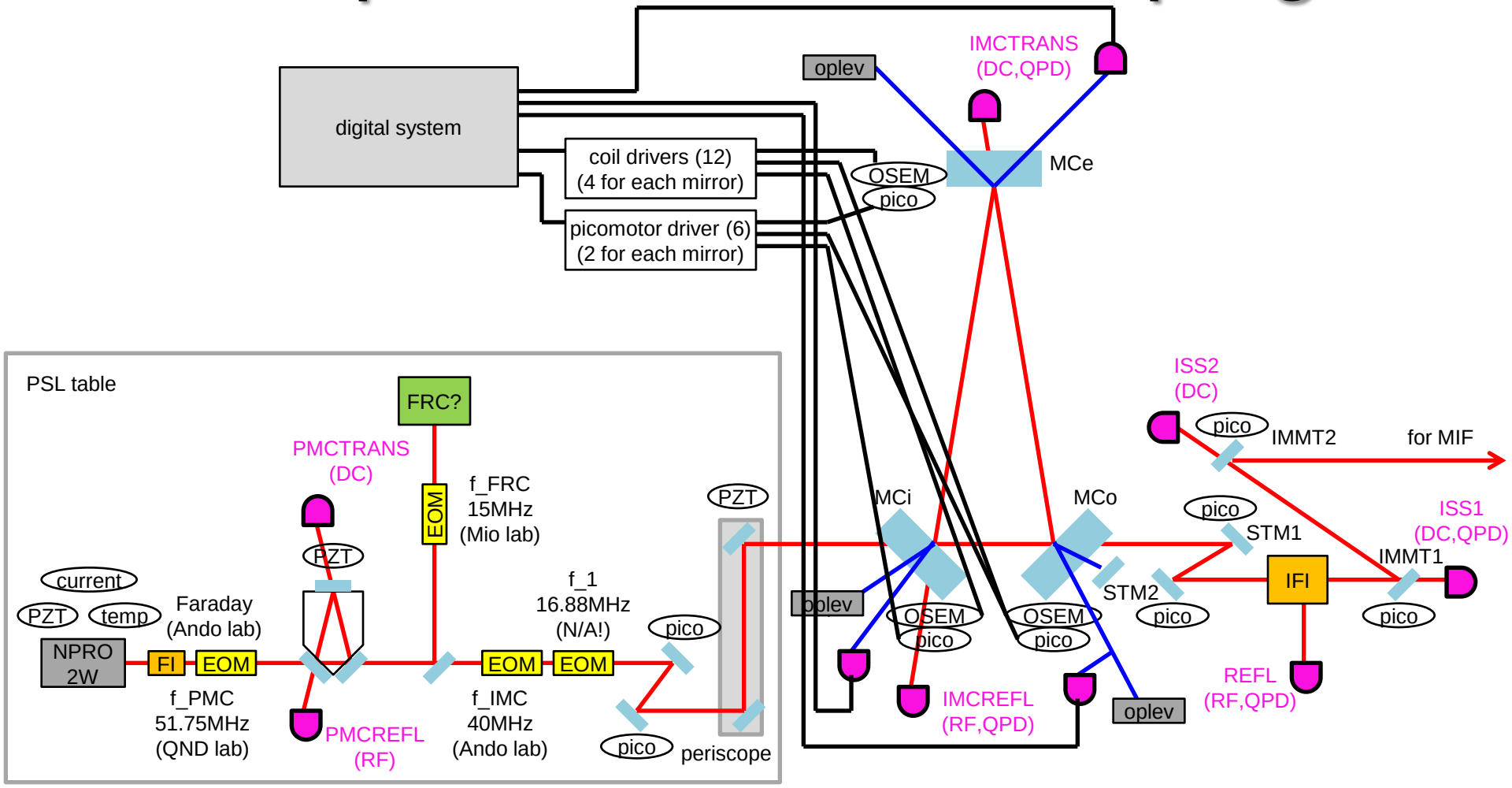
- Start discussion on listing up what we need for iKAGRA IMC (and PSL) servo
- Focus mainly on optical and electrical components

- References:
  - JGW-T1402349 (iKAGRA PMC study)
  - JGW-G1402302 (FSS modeling)
  - (GWADW2014 IOO poster by Nakano)
  - JGW-D1402507 (IOO 3D drawing)
  - JGW-T1302068 (layout around IMMT)
  - JGW-D1402492 (IMC suspension cabling)
- Acronyms:
  - FSS: frequency stabilization servo
  - ISS: intensity stabilization servo

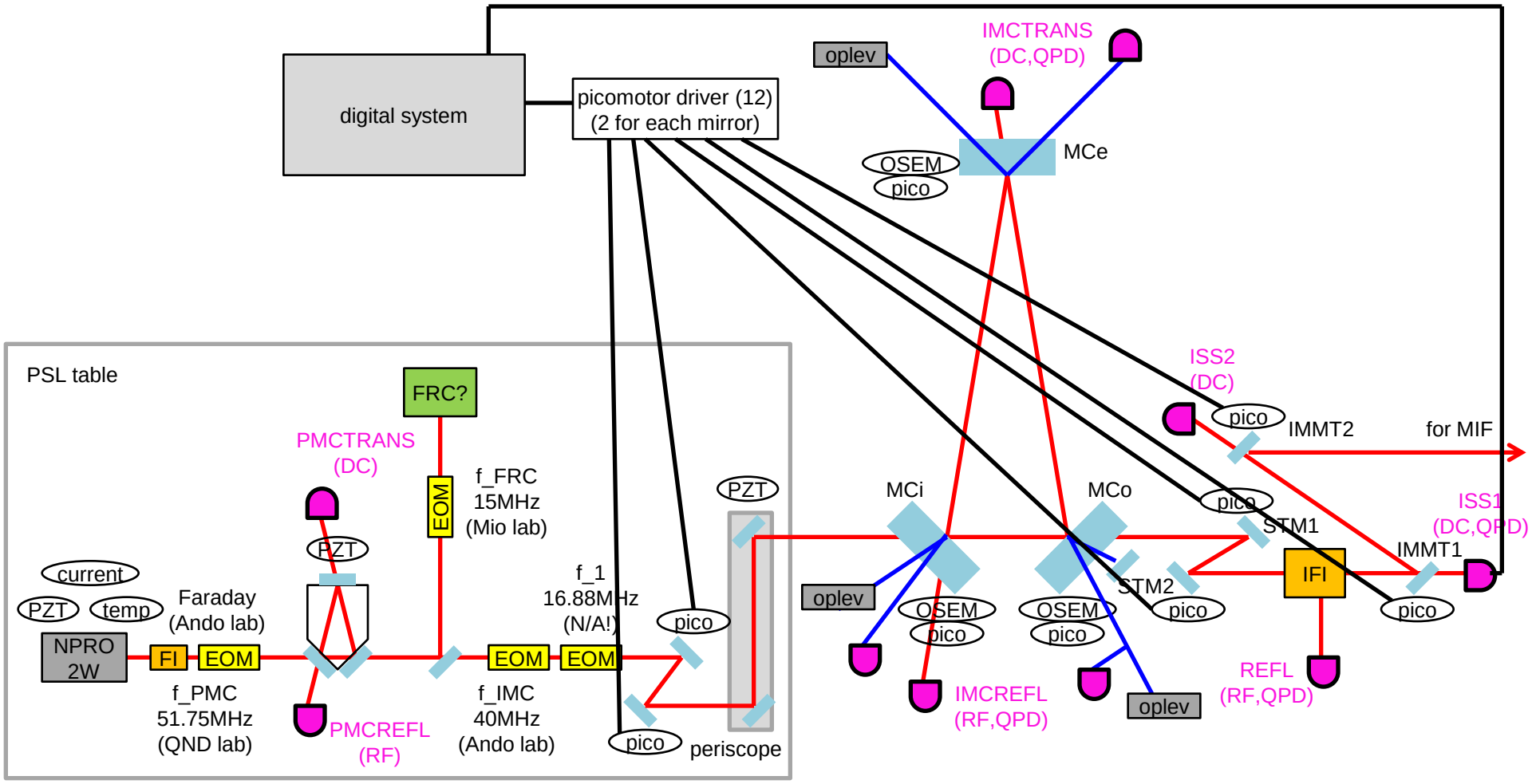
Optical Configuration



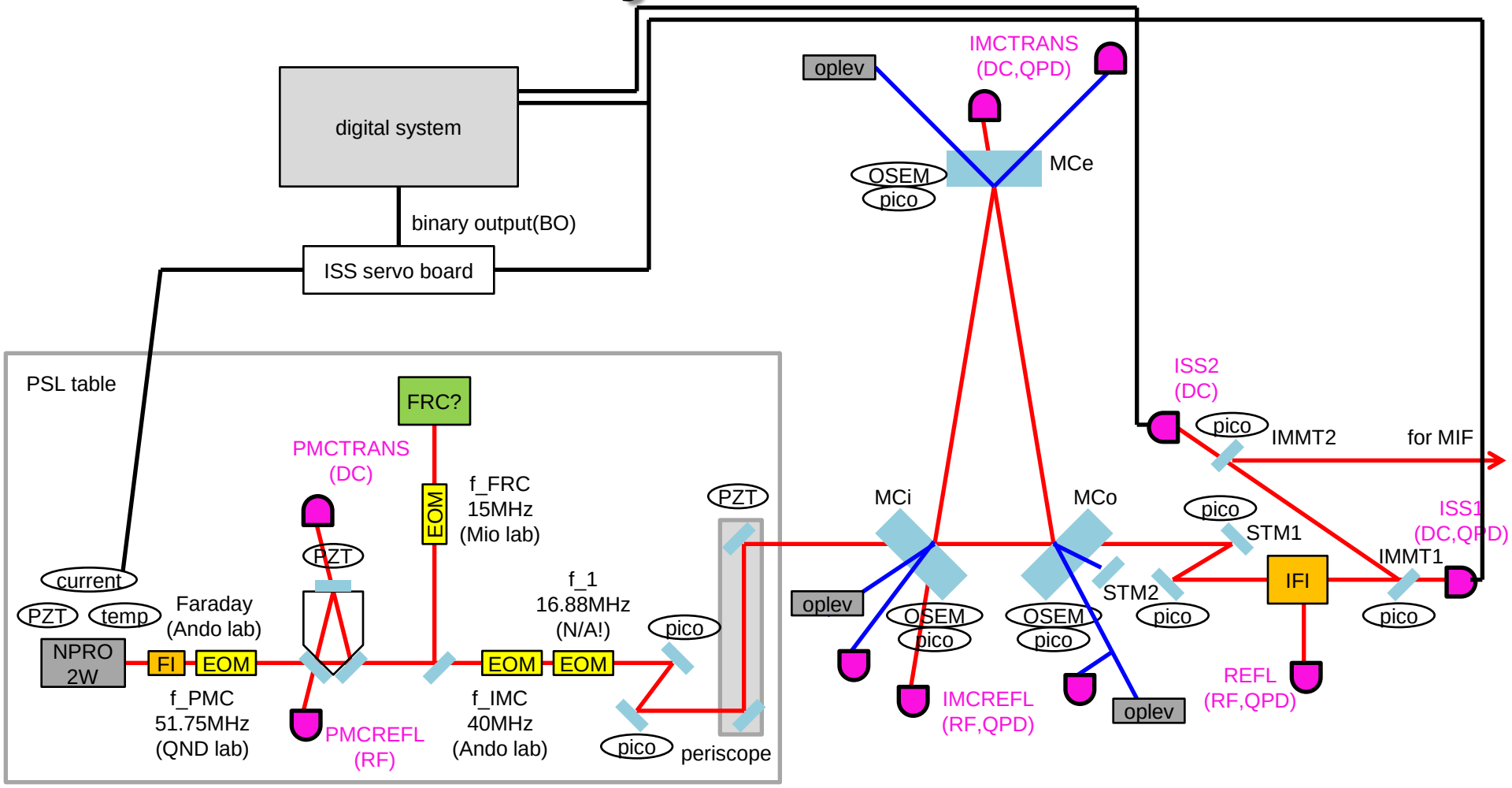
Suspension Local Damping



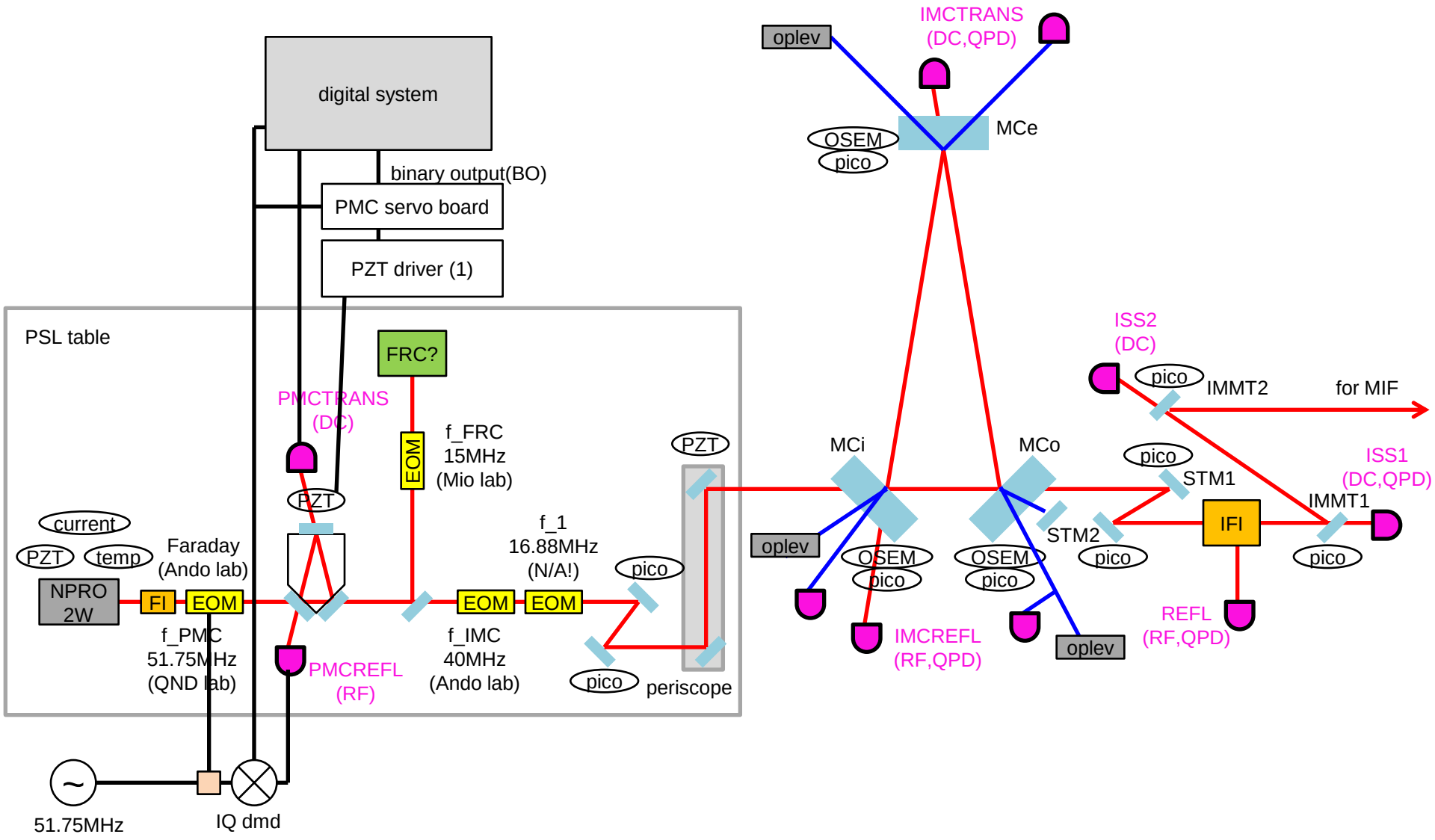
Initial Alignment



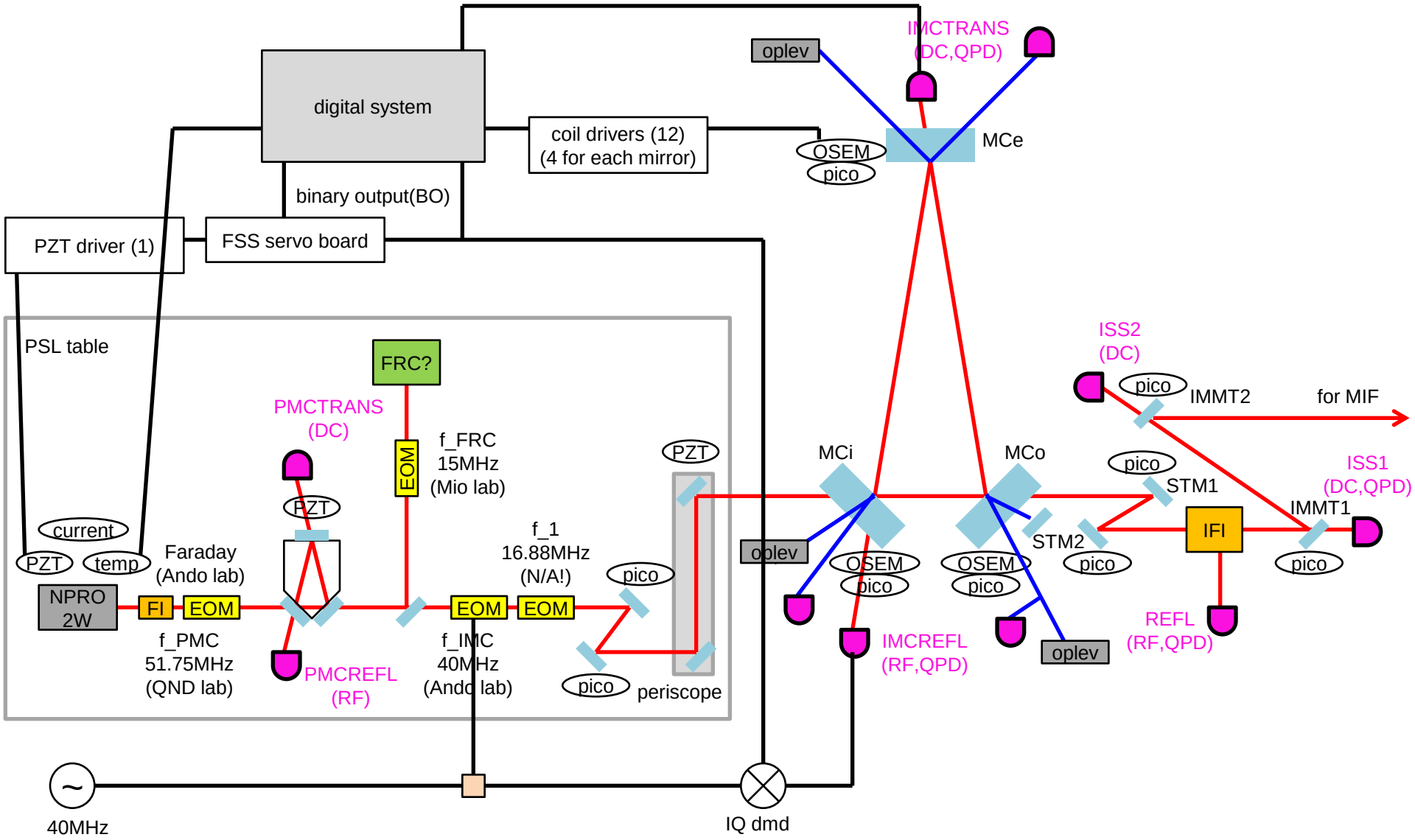
Intensity Stabilization



PMC Servo

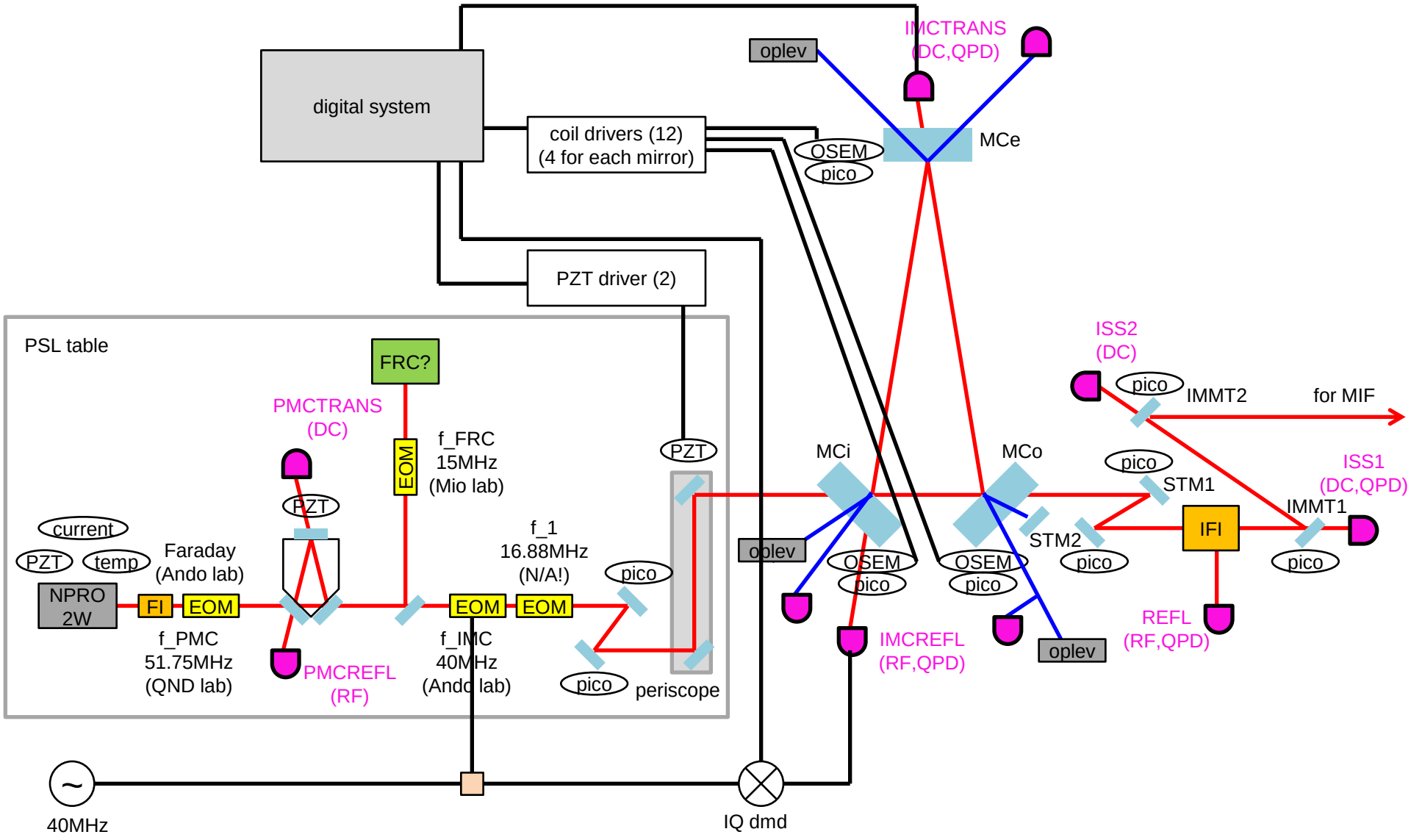

digital system
binary output(BO)
PMC servo board
PZT driver (1)
PSL table
FRC?
PMCTRANS
(DC)
PZT
EOM
f_FRC
15MHz
(Mio lab)
PZT
current
PZT
temp
Faraday
(Ando lab)
NPRO
2W
FI
EOM
f_PMC
51.75MHz
(QND lab)
PMCREFL
(RF)
f_1
16.88MHz
(N/A!)
EOM
EOM
f_IMC
40MHz
(Ando lab)
pico
pico
periscope
PZT
51.75MHz
IQ dmd
oplev
IMCTRANS
(DC,QPD)
OSEM
pico
MCe
MCi
MCo
oplev
OSEM
pico
OSEM
pico
IMCREFL
(RF,QPD)
oplev
ISS2
(DC)
pico
IMMT2
for MIF
pico
STM1
ISS1
(DC,QPD)
IMMT1
STM2
IFI
pico
pico
REFL
(RF,QPD)

Frequency Stabilization

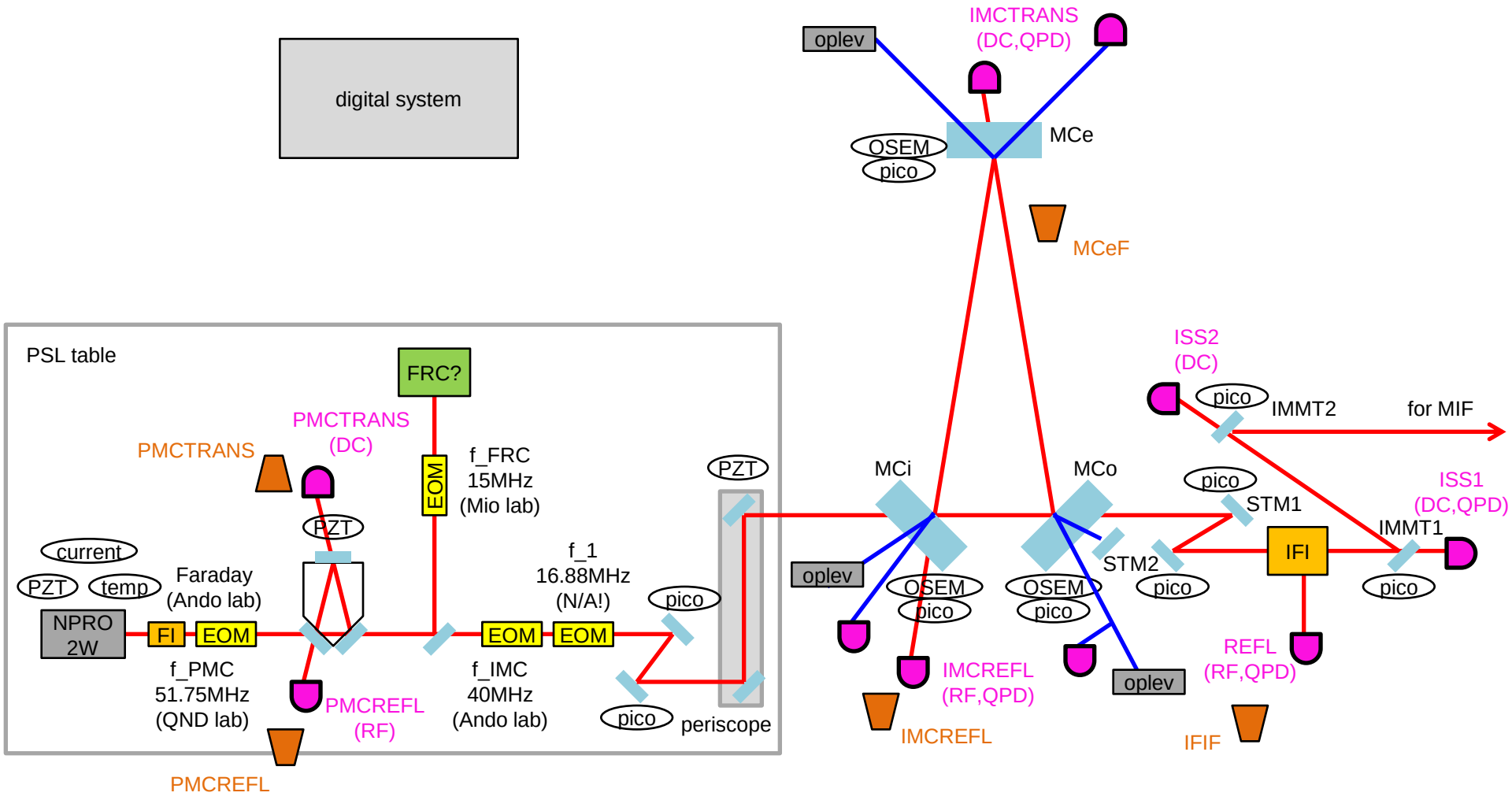


FRC is not included in this FSS diagram

Alignment Sensing and Control



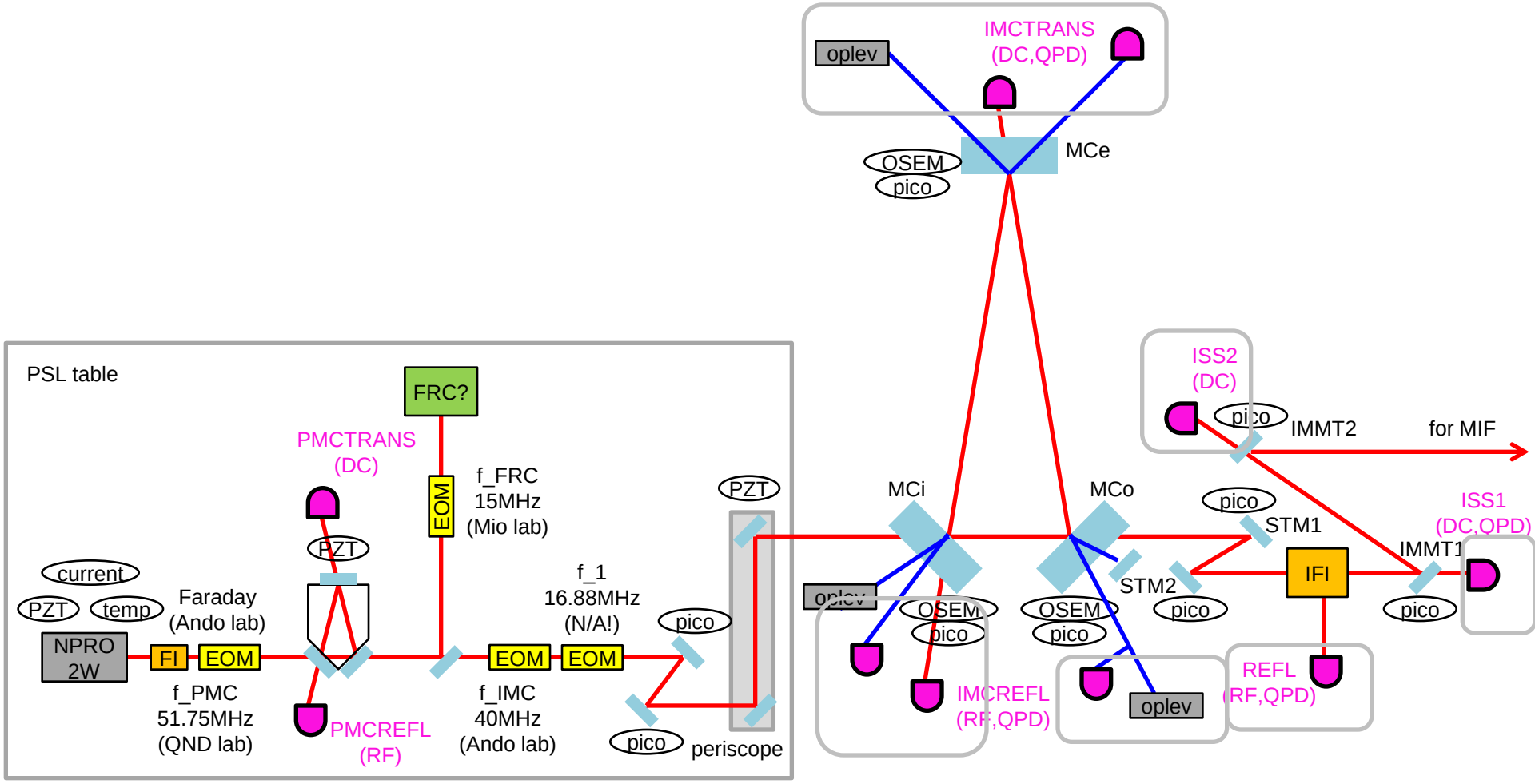
Cameras



5 cameras?

How do we put their signals in the digital system?

Optical Tables and Pylons



Where and how many do we have them?
What are the sizes of the tables?
Do we need periscopes for them?

Gouy Phase Telescopes

- We need two QPDs for each port we want to monitor the beam alignment
- It would be nice to have standardized Gouy phase telescopes for each port

- Below is an example aLIGO one (~ 15 cm x 55 cm) LIGO-T1000247

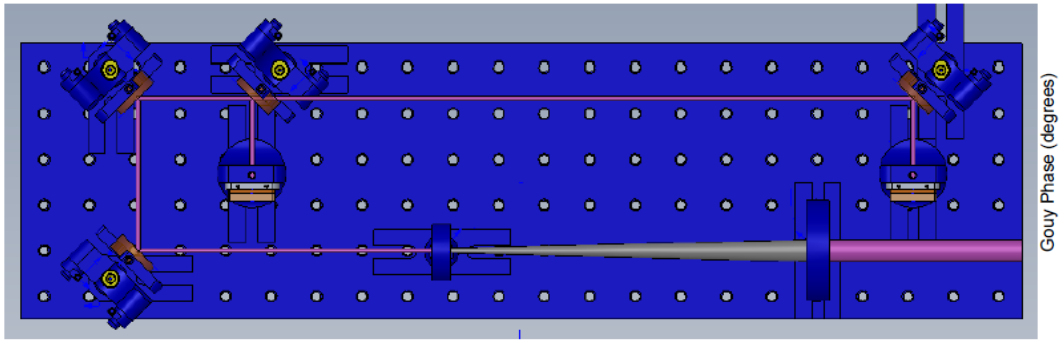


Figure 2: The REFL port QPD layout.

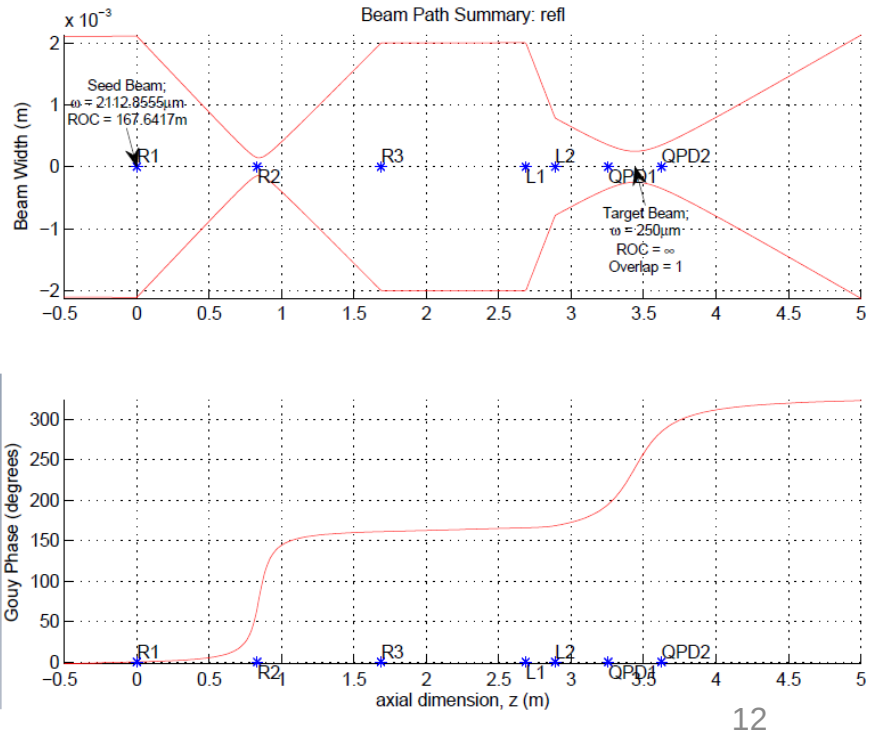


Figure 1: The REFL port telescope beampath.

Optical Components Missing

- EOM for f_1 sidebands
- PSL periscope
  - we have dumped rods available in Ando Lab
    http://www.newport.com/Heavy-Duty-Optical-Support-Rods/144454/1033/info.aspx
- Gouy phase telescopes and other optical components for each port
  - we can buy flat mirrors and mounts with a rough estimate of numbers, but what do we do for lenses?

- AOM for FRC?

- I suppose there are much more……

DGS Related

- standalone digital system is needed by Nov 2014
- it is not considered as a baseline DGS schedule
  - full digital system with networks will be available only from Jan 2015
- VIS will also need a standalone for IMC suspensions
  - maybe one standalone will do for VIS & IOO

AEL Related (FRC not fully included)

- PMC(1) / FRC(1) / IMC(1) / ISS(1) servo circuits
  IOO already got one for FRC?
- RF PD(3) / RF QPD(4) /DC PD(4) /DC QPD(4) (at least!)
  PMCREFL
  IMCREFL
  REFL
  IMCREFL A/B
  REFL A/B
  PMCTRANS
  IMCTRANS
  ISS1
  ISS2
  IMCTRANS A/B
  ISS1 A/B
  (it would be nice to have 2 more at PSL table for incident beam monitor)
- IQ demodulators(19ch) 1 for each RF PD, 4 for each RF QPD
- RF distributors f_PMC: split into 2 (EOM, PMCREFL)
  f_IMC: split into 10 (EOM, IMCREFL, 4xIMCREFLA/B)
  f_1: split into 21? (EOM, REFL, 4xREFLA/B, AS, 4xASA/B, POX?, POY?)
- RF source(3)

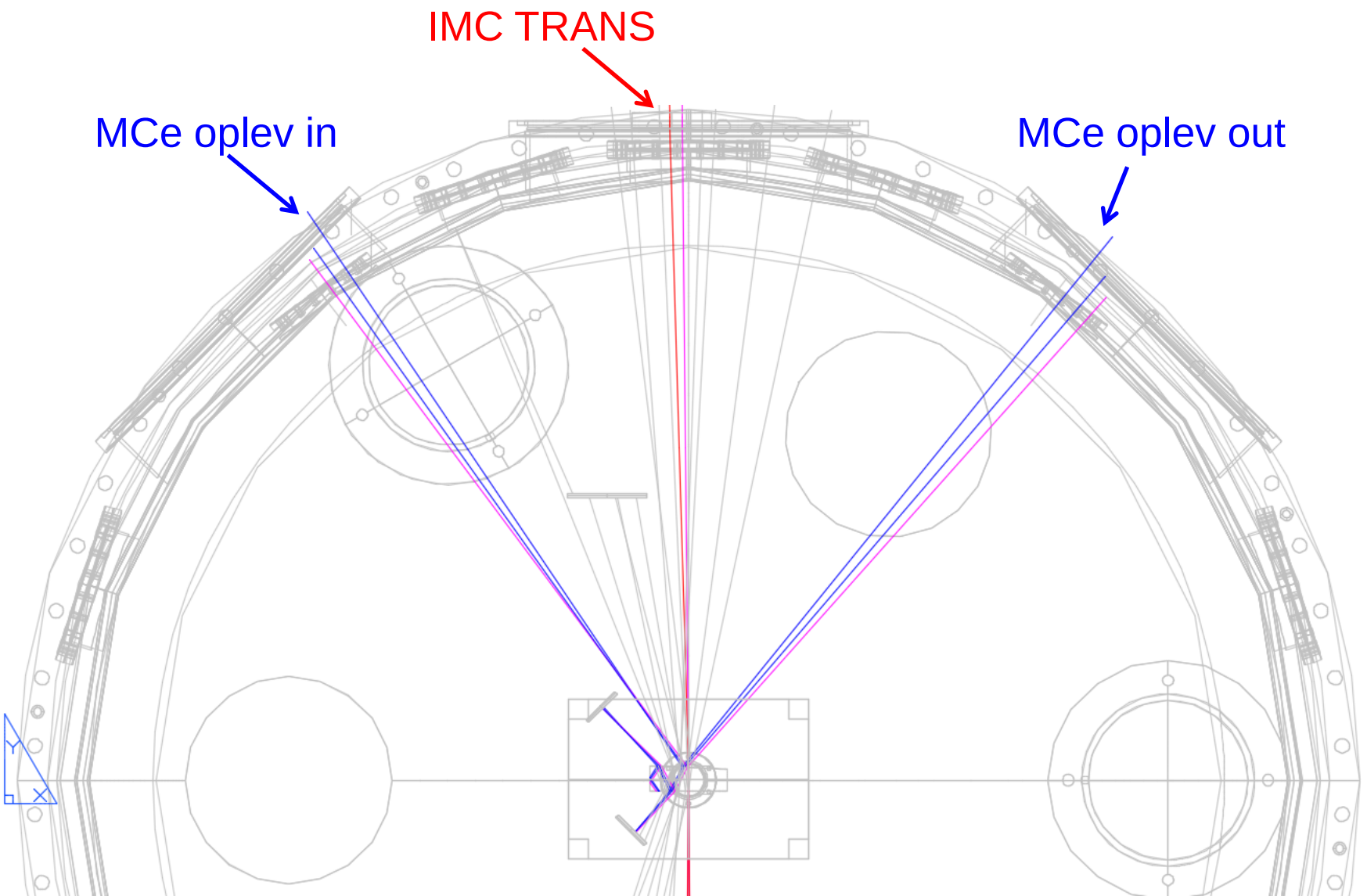
- picomotor driver interfaces ?
- picomotor drivers(18ch, at least!)
  2 for each mirror
  PSLSTM1/2
  STM1/2
  IMMT1/2
  MCi/e/o (top stage)
  (it would be nice to have 2 for each PD/QPD for aligning the beam into them)
- PZT drivers(4ch) 2 for periscope mirror
  1 for laser
  1 for PMC
- coil drivers(12ch) 4 for each MC mirror

Cables

- TBD
- JGW-D1402492 (IMC suspension cabling)

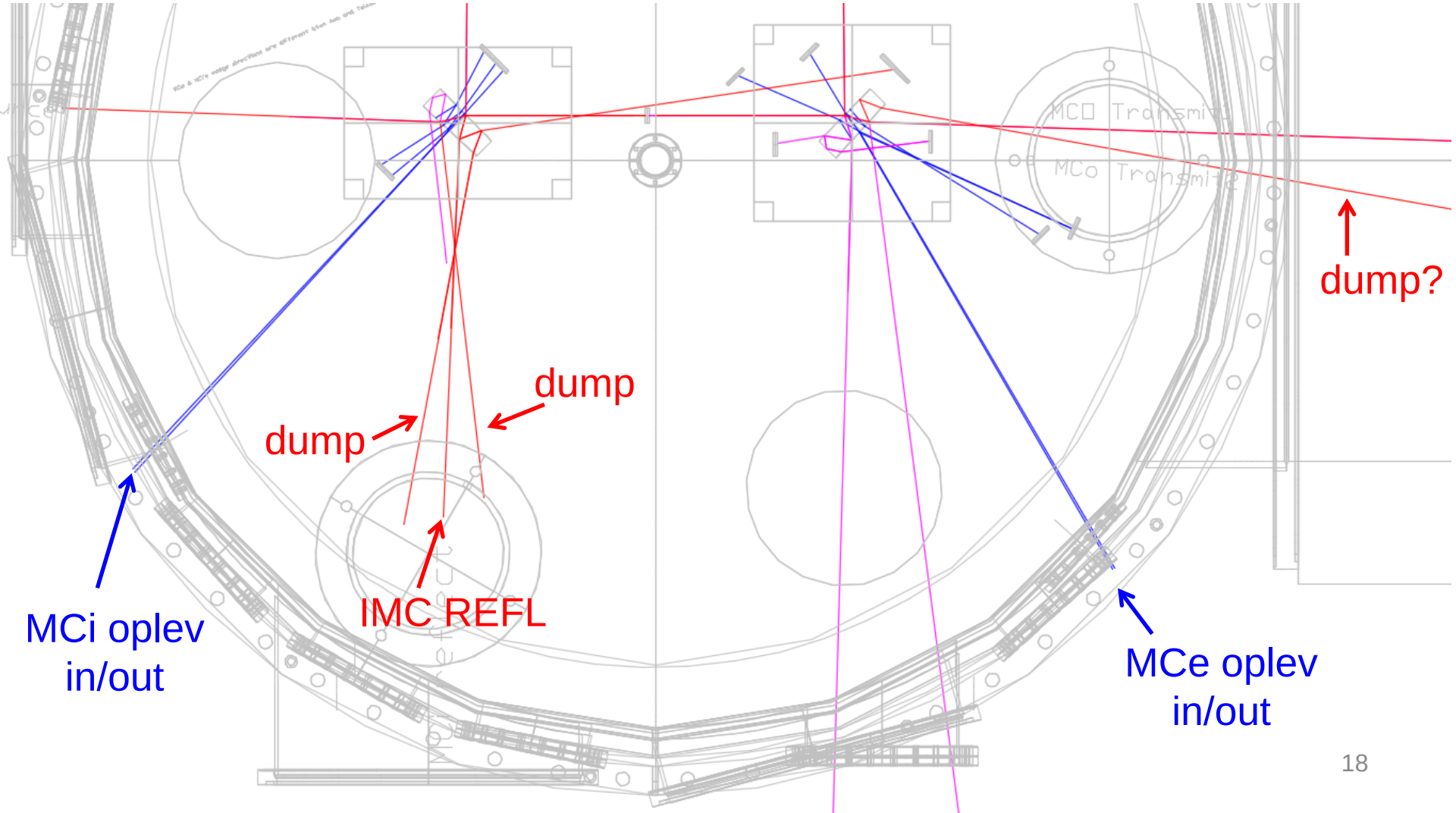
Beams around MCe

JGW-D1402507



Beams around MCi and MCo

JGW-D1402507



Some Important Info (for iKAGRA)

- Suspended optics from laser to PRM chamber are just IMC mirrors
  - we don’t suspend IFI nor IMMTs
  - oplevs only for IMC mirrors (no oplevs for IMMTs)
- IMMTs are flat and have picomotors

Questions

- Are we going to use IMMTs as actuators for ASC of FPMI?
- Are there PDs/QPDs which should be in vacuum?
  - only MIF REFL?
- What are we going to do with MCo AR reflected beam?
  - I don't think it is essential for ISC point of view
- How many standalone digital system will be needed by Nov 2014?
- What's the situation about FRC servo circuit?
  - Miyakawa-san said he delivered to IOO on Sep 2013
- Are we really going to use FRC? Is it a default plan?
- How many picomotors for a MC mirror?
- What do we need for digital system to picomotor driver interfaces? Do we need some interface circuits?
- What's the camera situation? How do we put them in the digital system?
- Where and how many do we have optical tables and pylons? What are the sizes of them? Do we need periscopes for them?