TCS-PC meeting

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2016/Jan./15

Activity in this week

- Brainstorming meeting (Bas, Eric, Annalisa, Suresh, Laura, Kazuhiro)
  - One-beam scanning or two-beam scanning
  - Goal of each phase camera
- Reboot of the phase camera (PC1a)
  - Phase maps are obtained
- Confirmation of the beam information
  - Annalisa and Eric has confirmed a beam profile at EIB
  - Optics information of the input test beam at PC2 (SPRB)
  - Romain is checking an available test beam power (and SB) on PC2
- Meeting about PC simulation (with Jerome)
- Discussion with Suresh

Goal of each phase camera

PC1a (EIB): Reflection from ITM

- ☑Check of the phase camera components
- Cross check of the modulation depth (commissioning)
- Comparison with scanning Fabry-perot (commissioning)

PC1b (EIB, B2): Reflection from PRM (after getting PRC)

- Interferometer loss (input mode matching)
- Comparison with scanning Fabry-perot

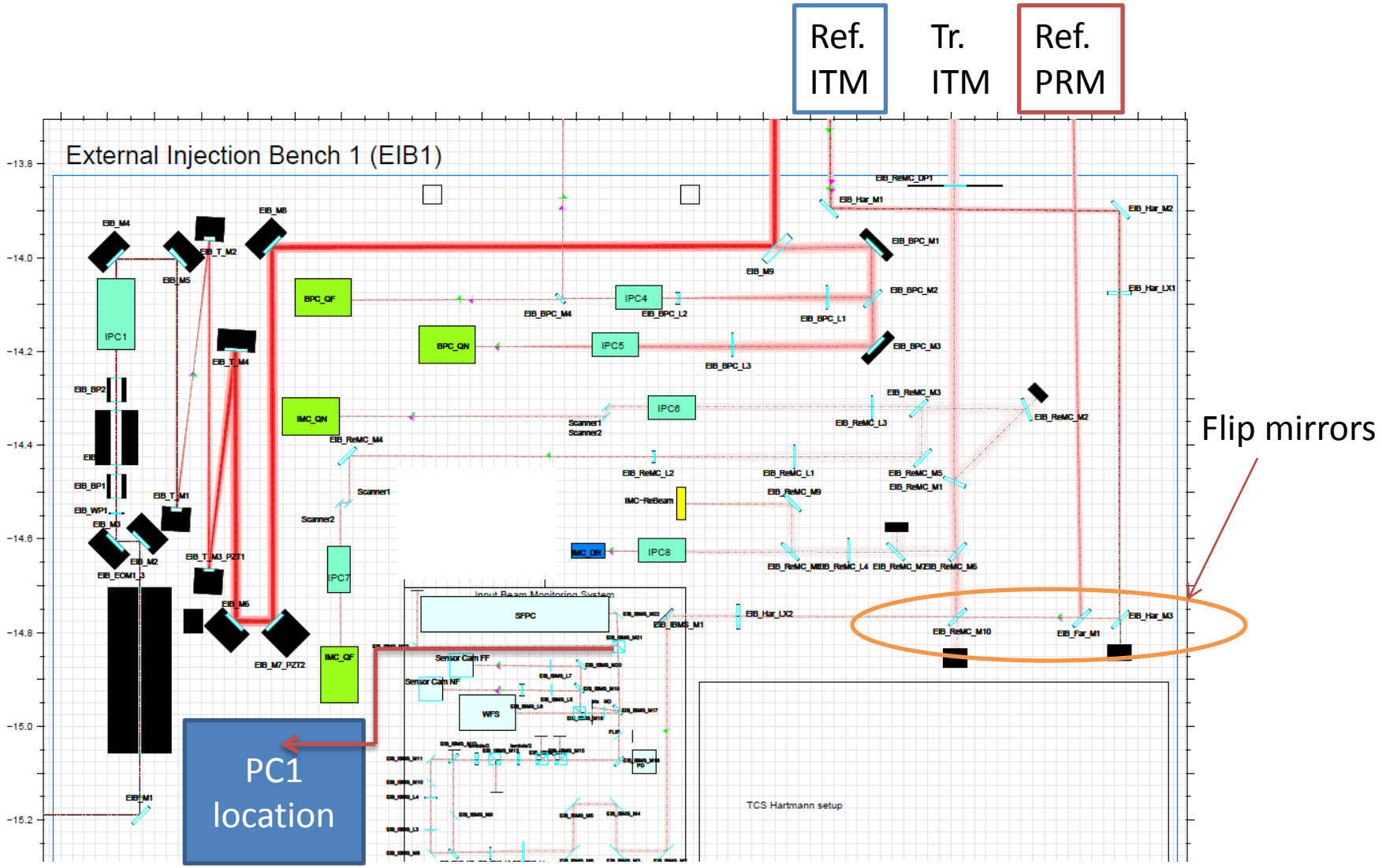
PC2 (EPRB, B4) (after getting PRC)

- TCS
- Recycling gain

PC3 (EDB, B1p) (after getting SRC)

- TCS
- Contrast defect of IFO

Difference between PC1a and PC1b

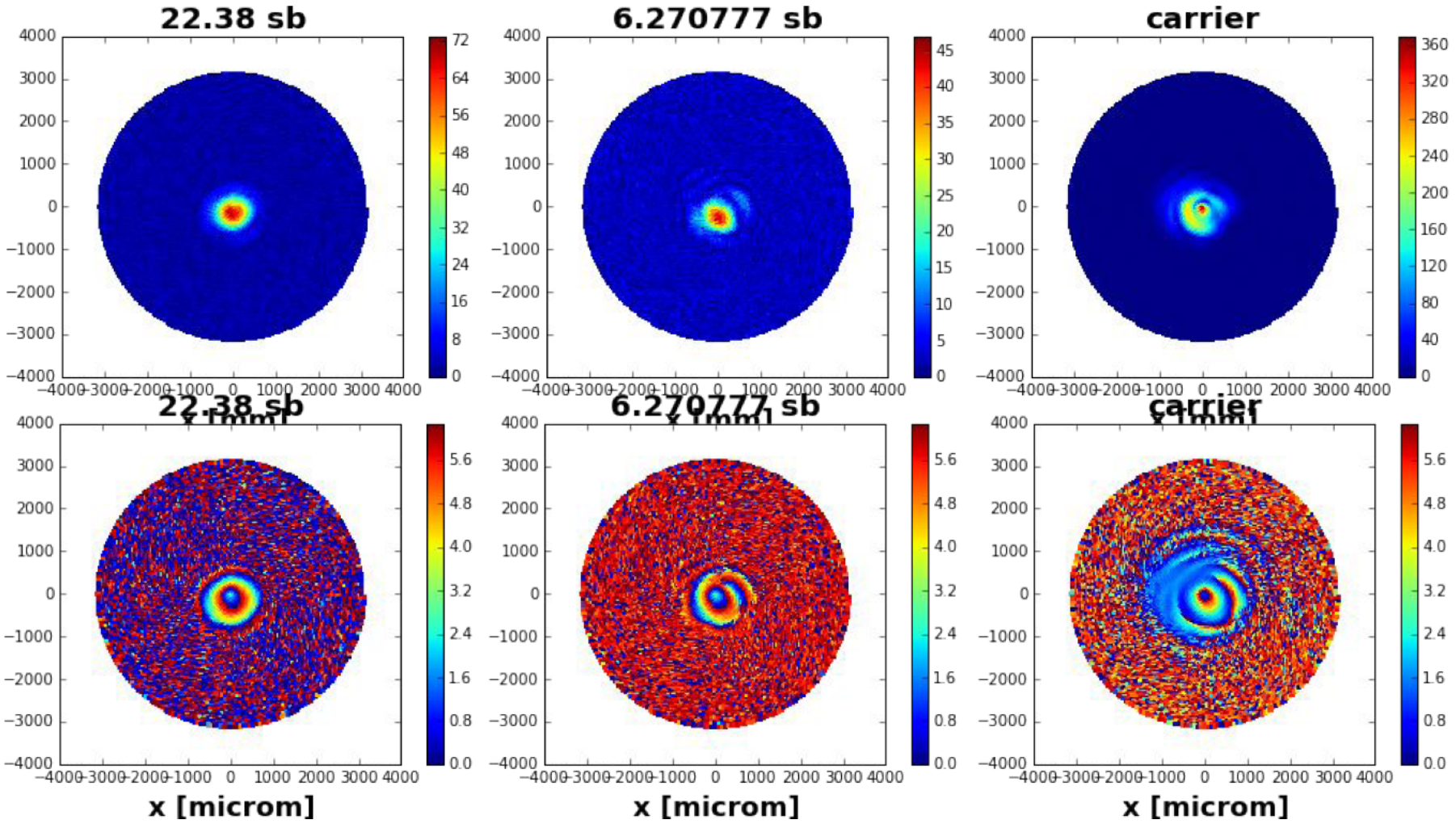


Detection location is not changed but we need to re-design optics layout (lenses, etc.) for PC1b

Reboot of the phase camera (PC1a)

- We turned every electronics for PC1a on, since there was a power shut down during Christmas holiday
- Re-alignment of optics
  - Alignment was optimized using spectrum analyzer
- Scanner debug (setup of AWG)
  - Trigger check
  - Version check of scanning pattern
- Connection with a new RTPC (by LAPP)

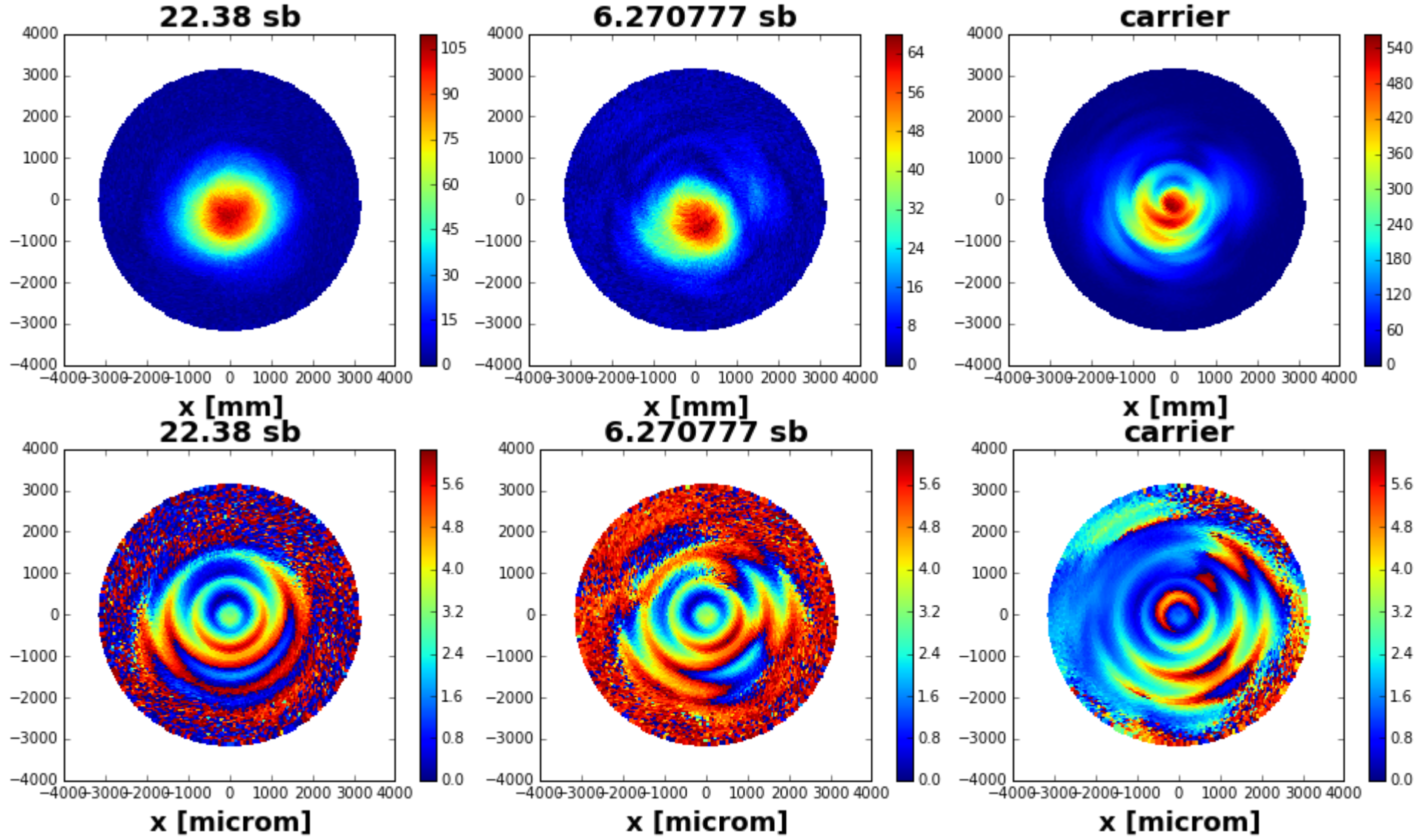
Obtained phase map



The reference beam size (radius) is 400 um => consistent with the above measurement

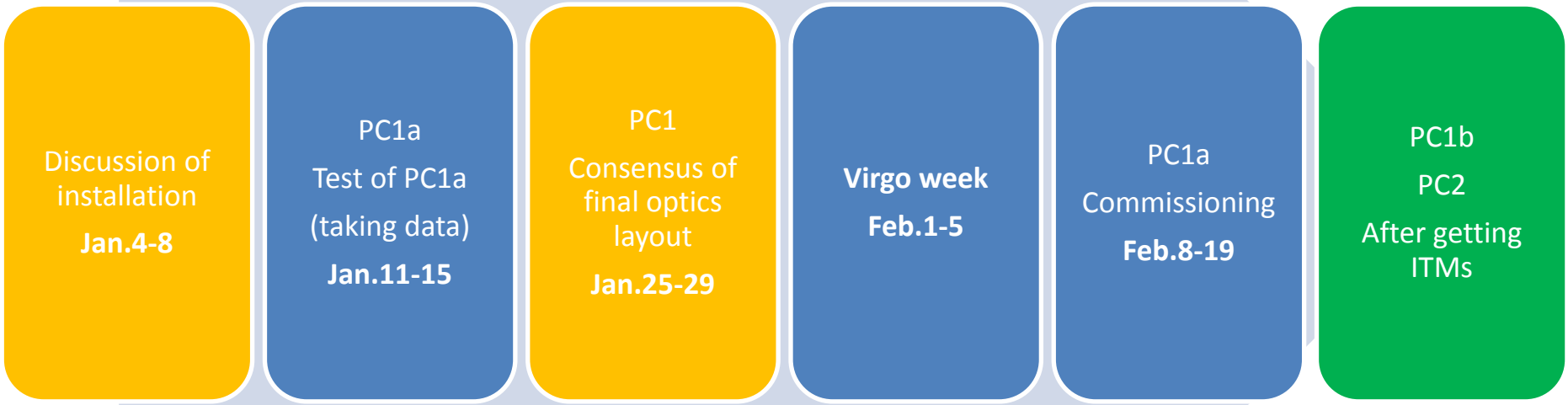
The sideband of 22.38 MHz is clean because it is expected to be reflected by IMC

Obtained phase map



Sometimes the beam becomes strange

Revised installation plan



PC1: Phase Camera 1, at EIB
PC1a: detect ref. of ITM,
PC1b: detect ref. of PRM
PC2: Phase Camera 2, at EPRB
PC3: Phase Camera 3, at EDB

To do list

Virgo site

Optical layout

- Test beam design (Laura, Annalisa)
  - PC1b
  - PC2 (under confirmation)
  - PC3
- One beam or two beam scanning discussion (Kazuhiro, Bas, Annalisa): almost done
- Procurement (Kazuhiro)
  - Vertical stage for PD position adjustment
  - Optical shutter
- Setup of optical components (1 week for each port): PC1b, PC2, PC3
  - Measure beam profile
  - Measure beam power
  - Check RF signal

Calculation

- SNR calculation (Kazuhiro): almost done
- Simulation: whole phase camera (Laura, Jerome, Annalisa): few months?

AOM

- Power loss problem (check by changing optical feedthrough) (Kazuhiro, Martin): 1 day
- Increase the power of amplifier (not urgent) in future

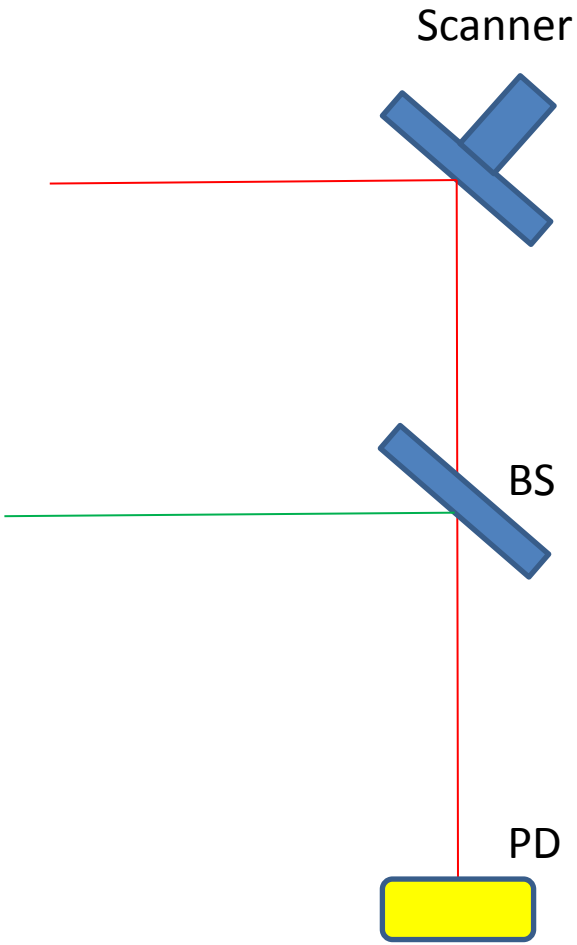
PD

- Linearity check (Martin, Kazuhiro): few days

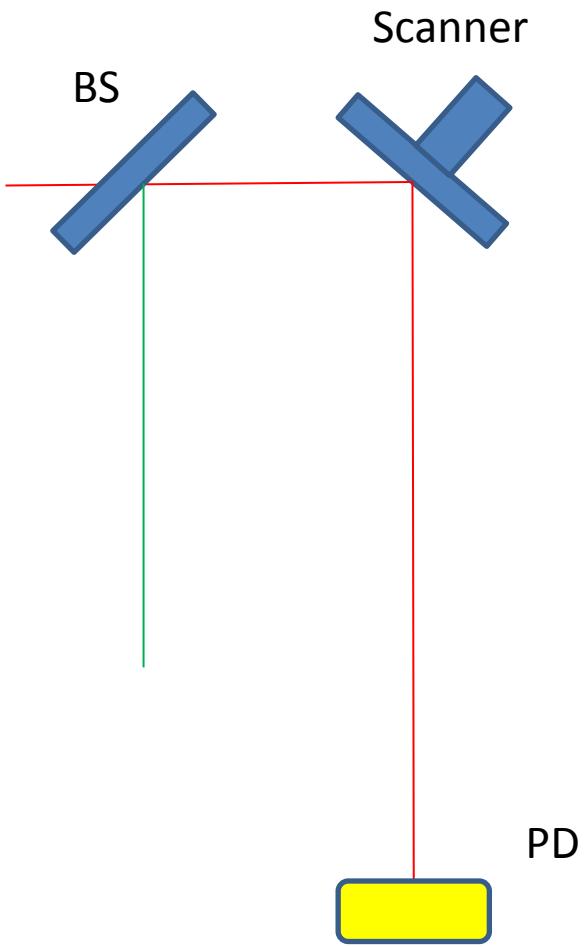
Readout system

- ~~Phase map stability check (strange behavior)~~ => The reason was setup of AWG for the scanner
- DAC channels (Martin, LAPP)
- Connection with Real DAQ (Martin, Mesfin, LAPP)
  - Control Software
  - Dictionary
  - TOLM ver.2
- Procurement of cables and electronics (Martin)

Which is better
One-beam or two-beam scanning?



Test beam is scanned



Both beams are scanned

Pros and cons (preliminary)

One-beam scanning

- Better SNR at beam edge
- Short gap fringe patterns by different angle incident

Solution

- **Long distance** between PD and scanner (small angle operation of the scanner)

Two-beam scanning

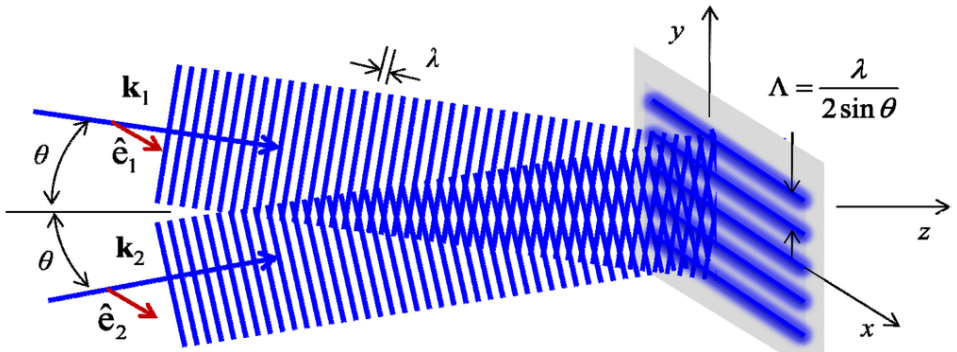
- Cancelling phase shift due to the scanner
- Less SNR at beam edge
- Calibration is necessary for amplitude measurement

Solution

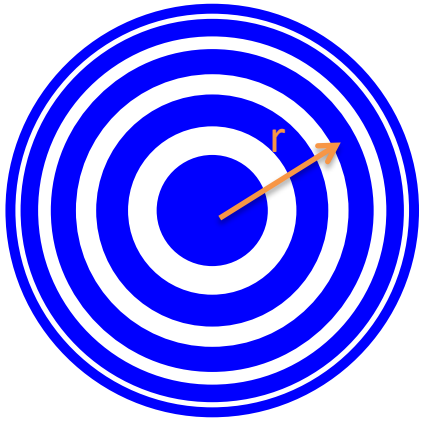
- **Sufficient power** for the incident beams (above 5 mW for each beam)

One beam scanning

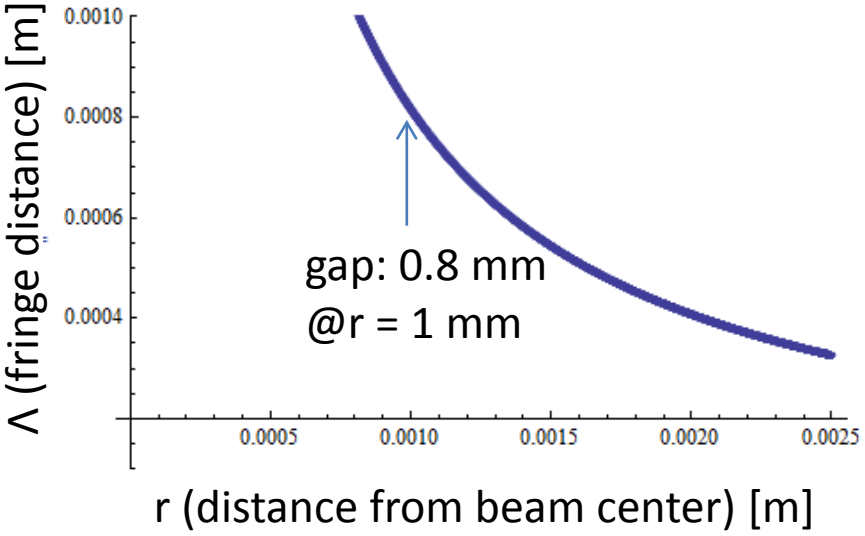
- Merit: Better SNR
- Demerit: Contrast defect by different incident angle



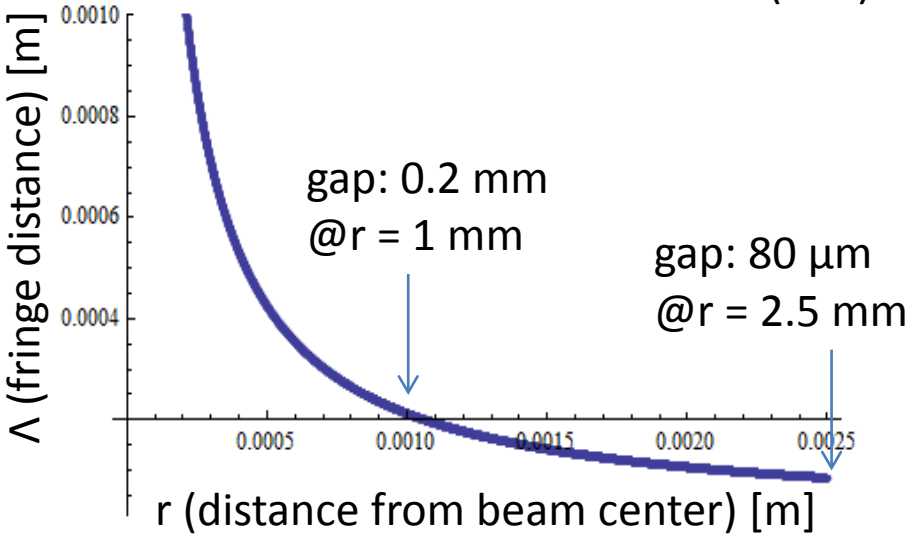
[*Micromachines* ***2011, 2, 221-257; doi:10.3390/mi2020221***]



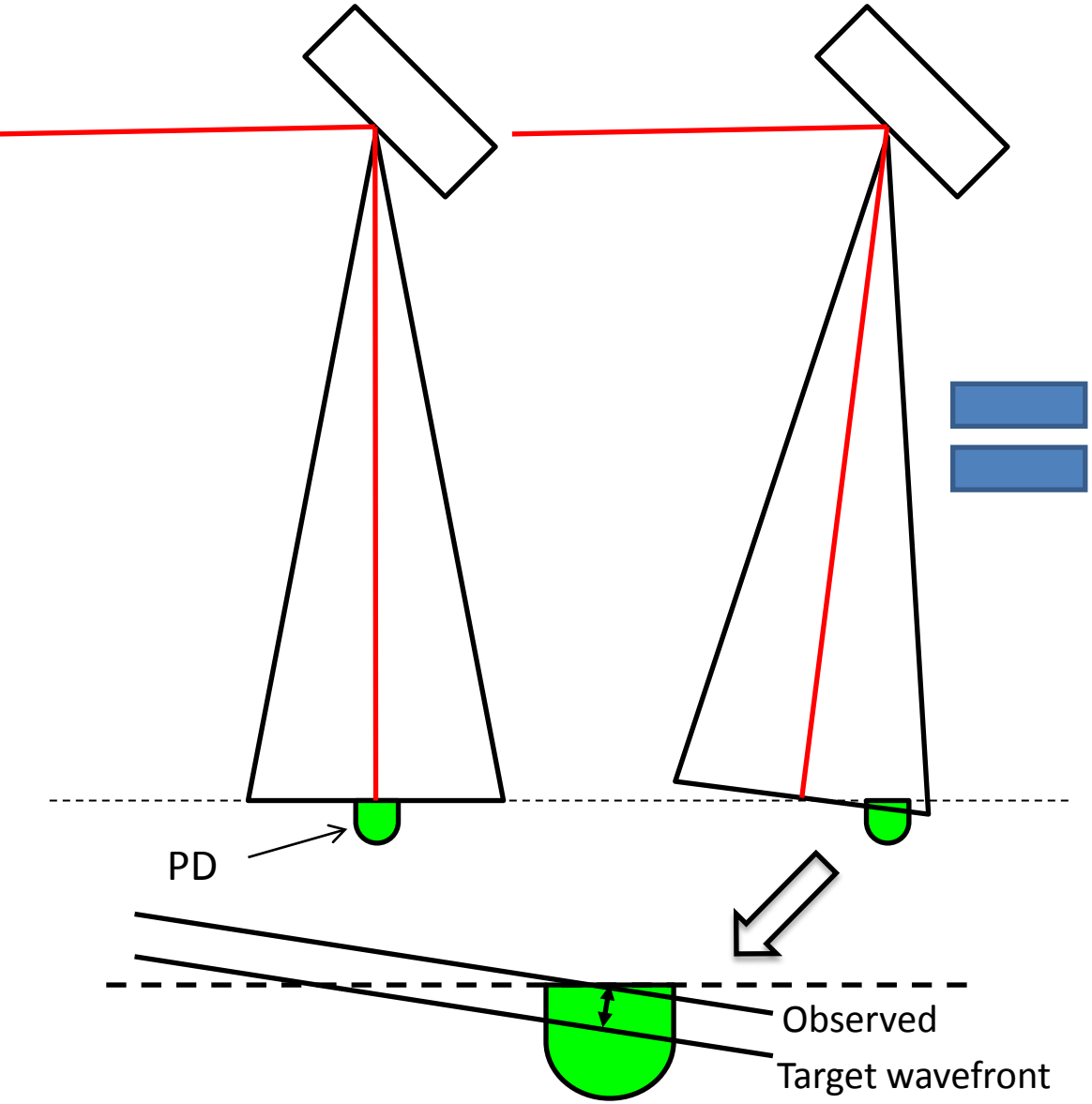
PD-Scanner distance: 77 cm

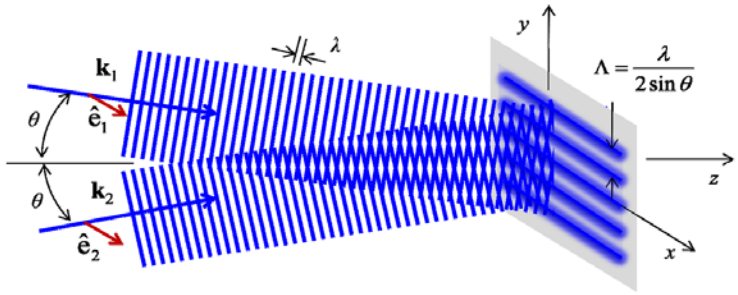


PD-Scanner distance: 20 cm (PC1)



Incident angle effect





Time dependent:

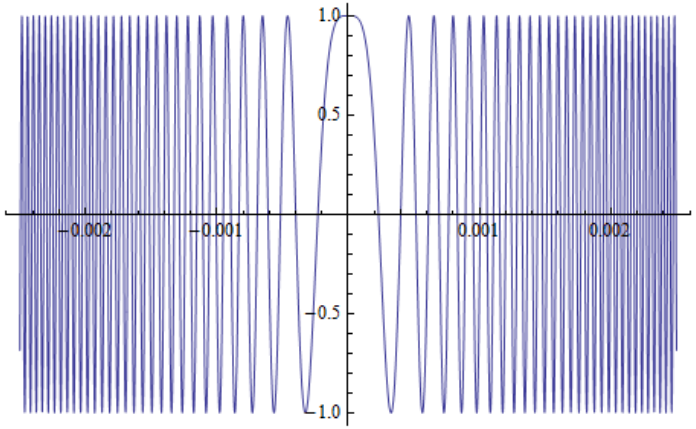
In the heterodyne detection, this pattern moves by heterodyne frequency (80 MHz)

It is the same as the additional phase shift at PD by the tilt incident

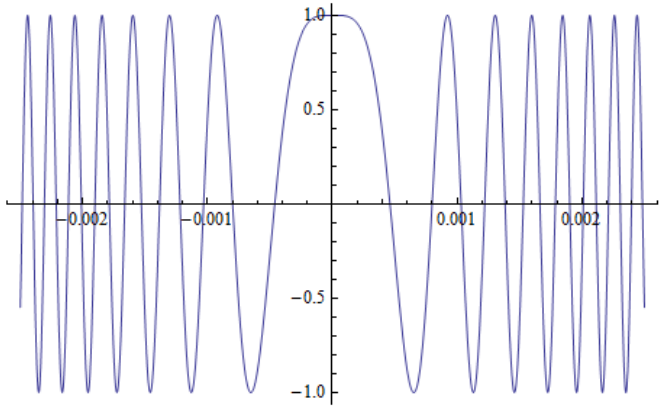
Fringe gap

- Important point is not the existence of fringe but fringe gap

$$\text{Plot}\left[\text{Cos}\left[2*\pi*\frac{2*\text{Sin}\left[\frac{\text{Abs}[t]}{2*ls}\right]}{\lambda}*t\right],\ \{t,\ -0.0025,\ 0.0025\},\ \text{PlotRange}\rightarrow\text{All}\right]$$



PD-Scanner distance: 20 cm (PC1)



PD-Scanner distance: 80 cm

Detection area (55 um) should be smaller than this fringe gap
~ Roughly, a PD-Scanner distance of 50cm is necessary
=> For the PC1 setup, two beam scanning is better.

Available test beam power

- PC1a: 1mW?
- PC1b: ???
- PC2: between 24 mW and 35 mW (according to Romain) => 12 mW – 17mW at PD
  - Modulation depth (under confirmation)
- PC3: under investigation