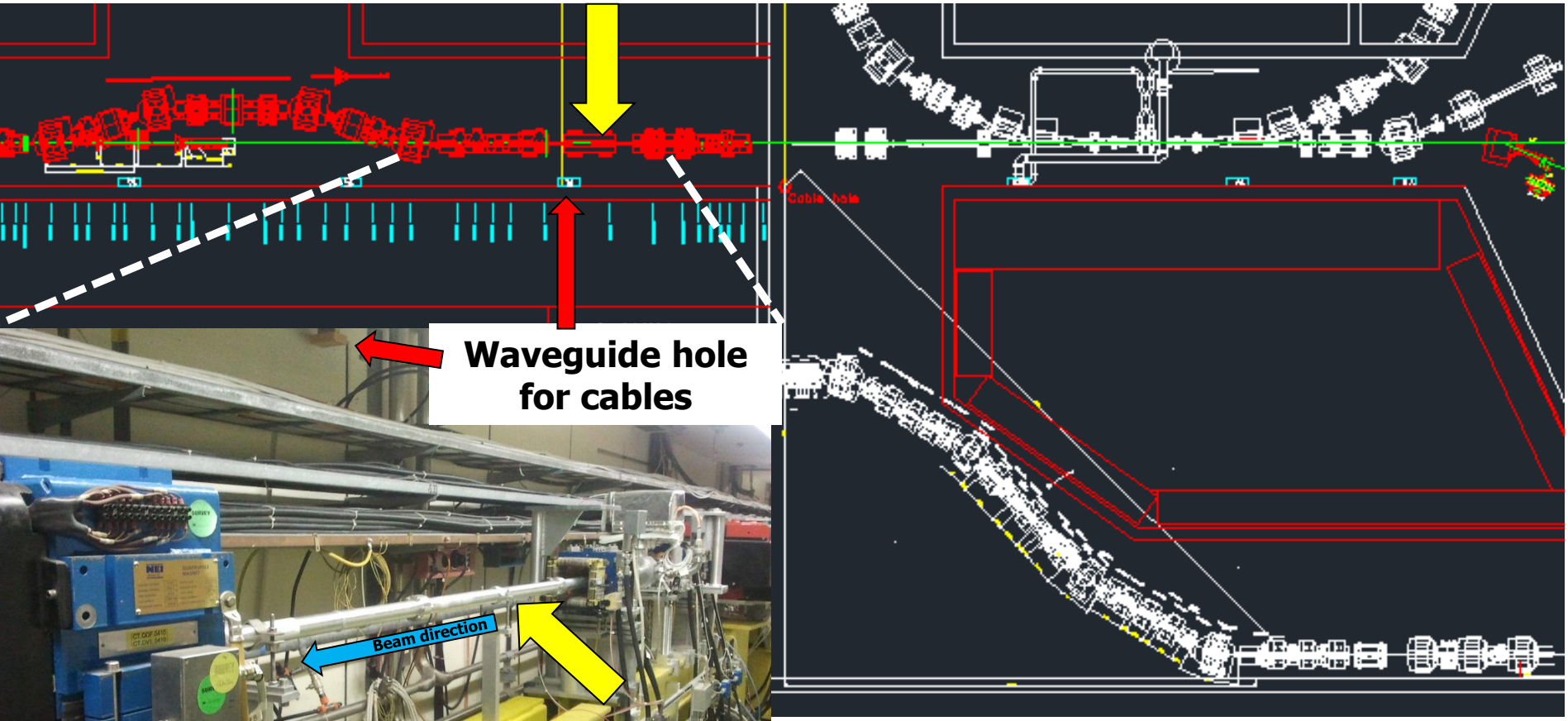
Phase Feed-Forward in CTF3
The preparations

Piotr Skowroński

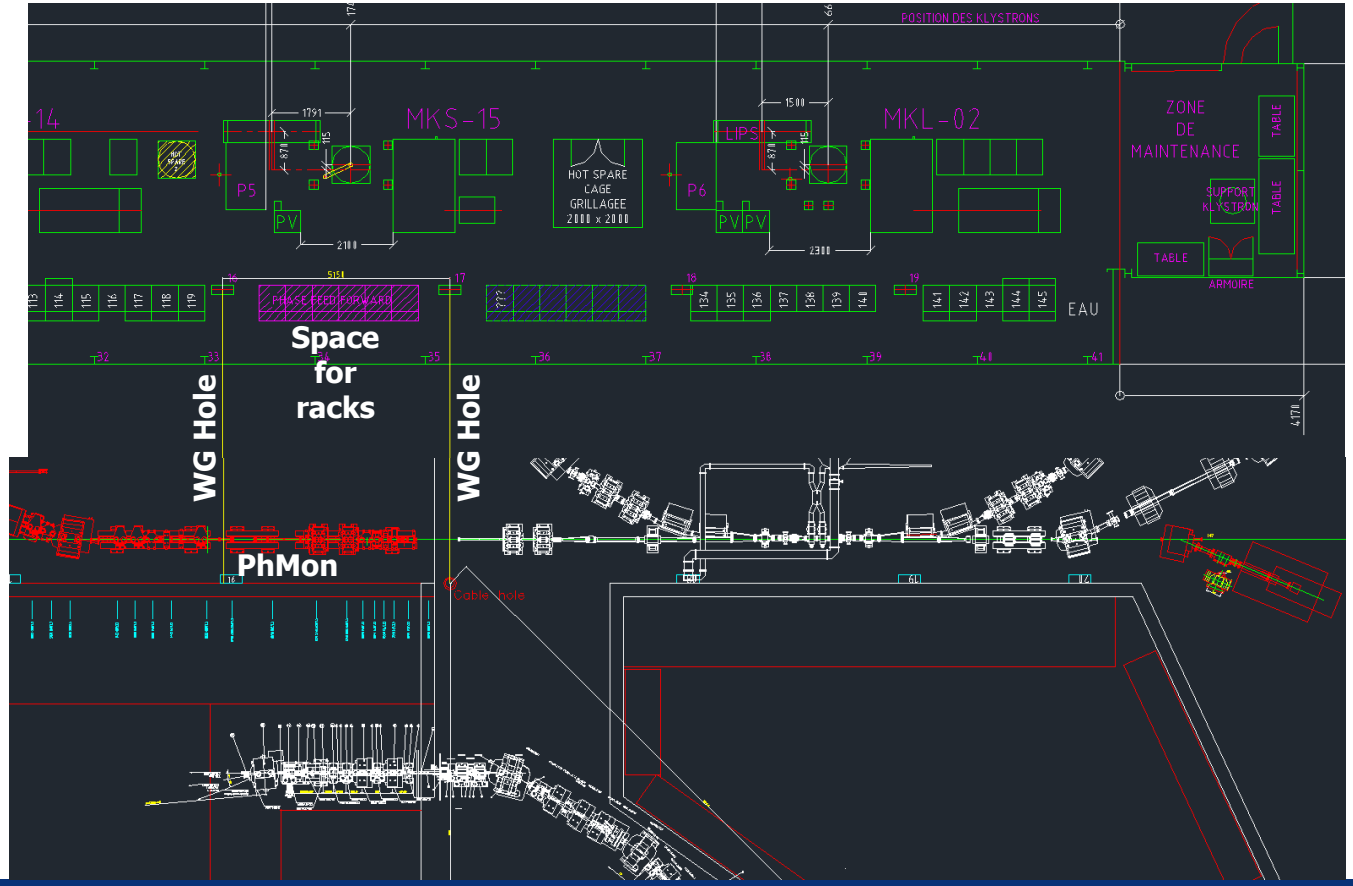
Installation of the first monitor

- The first monitor will be installed at girder 3 of the CT line, just before the wall at the end of the Linac hall



Racks

- Luckily the space above in the gallery is free and at least 3 racks can be installed without any extra effort
  - It should allow for possibly minimal cable lengths
- It is also not too close to the dump area in the CTS line

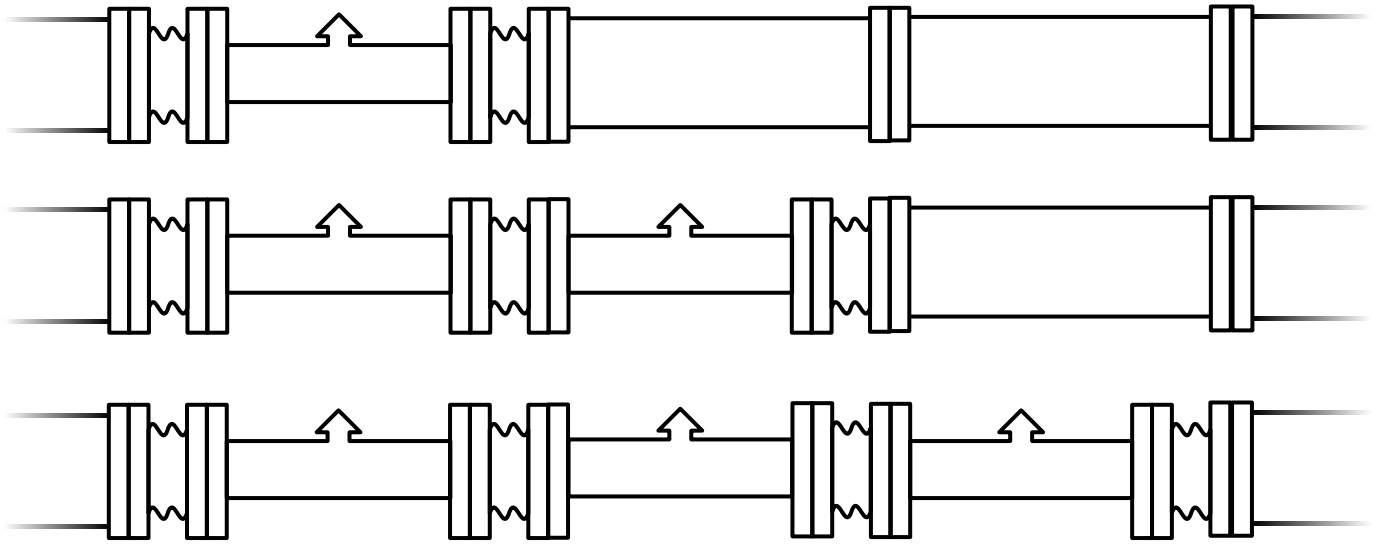


Klystron Gallery

Accelerator Hall

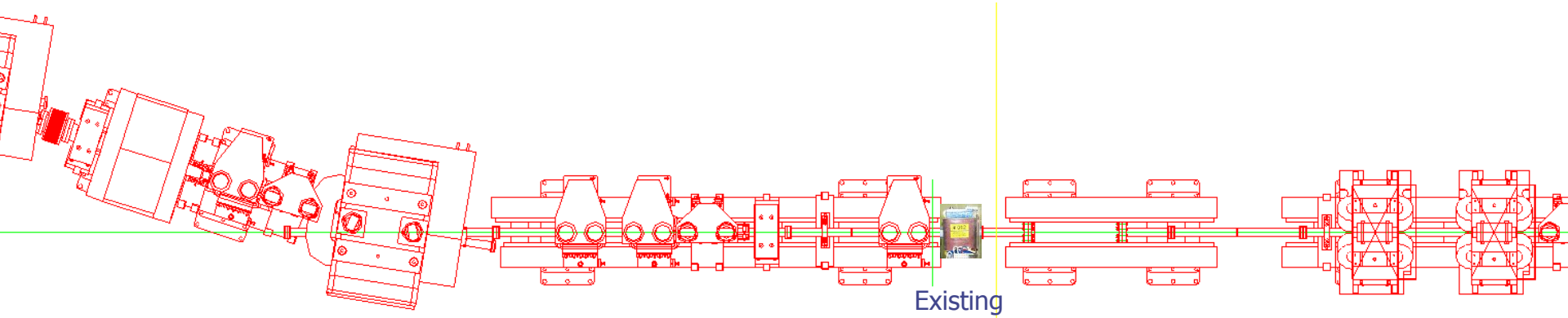
String of monitors

- Initially all 3 monitors will be installed in this location to form a string
  - It will allow to cross check them
  - Find their accuracy and resolution
- Mechanical engineers received the 3D drawings and started working on the redesign of the line
  - Since each monitor needs to be aligned a bellow on each side is necessary
  - **In this case a taper is not needed, since it gives anyway large discontinuity (?)**
  - 6 bellows and 2 replacement chambers are needed



Steering through monitors

- To assure sufficient steering capability through the phase monitors 2 additional correctors shall be installed upstream of the phase monitor
  - Phase monitors have 2cm aperture, while the rest of the machine is at least 4cm
  - Measurements of monitor response w.r.t. beam position
  - There is one corrector just before phase monitor, but at least one more is needed
  - Second one, after the last bend of the chicane would be certainly very useful, since there is only few correctors and BPMs inside the chicane
- But, we have only 2 spares for our standard corrector magnets
  - They were designated to be installed around the kickers for drift correction, static checks and tuning



Steering through the monitors

- Another, the prototype one, was found in the magnets lab and after a check-up will go before the phase monitor

- Our magnets engineer has found some other corrector magnets
  - No documentation, even don't know which machine they were installed in the past
  - They are not laminated, and hence Eddy currents die out only after 30s or more
  - They will be measured and quantified, and hopefully we can install such piece after the chicane
    - Very slow response is not an issue at this position
- Installation of the power converters and cables is already arranged

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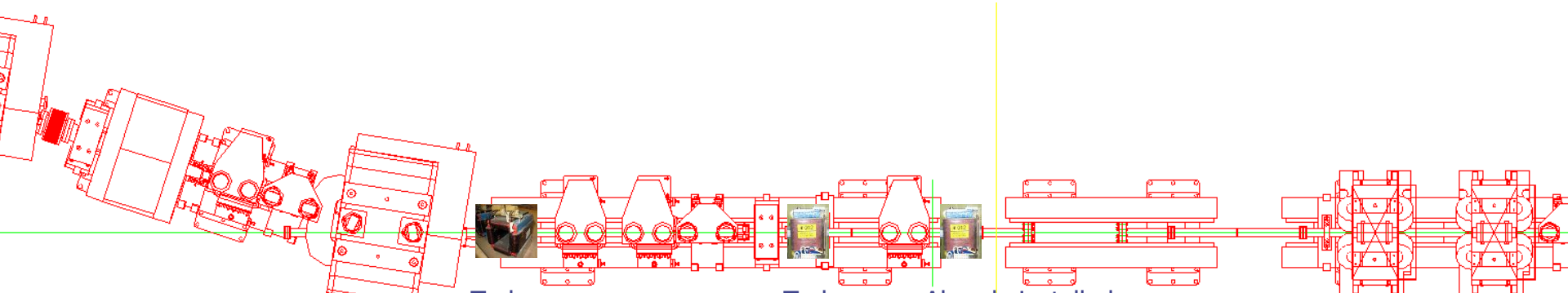
- Installation of 4 power converters and of cables was triggered

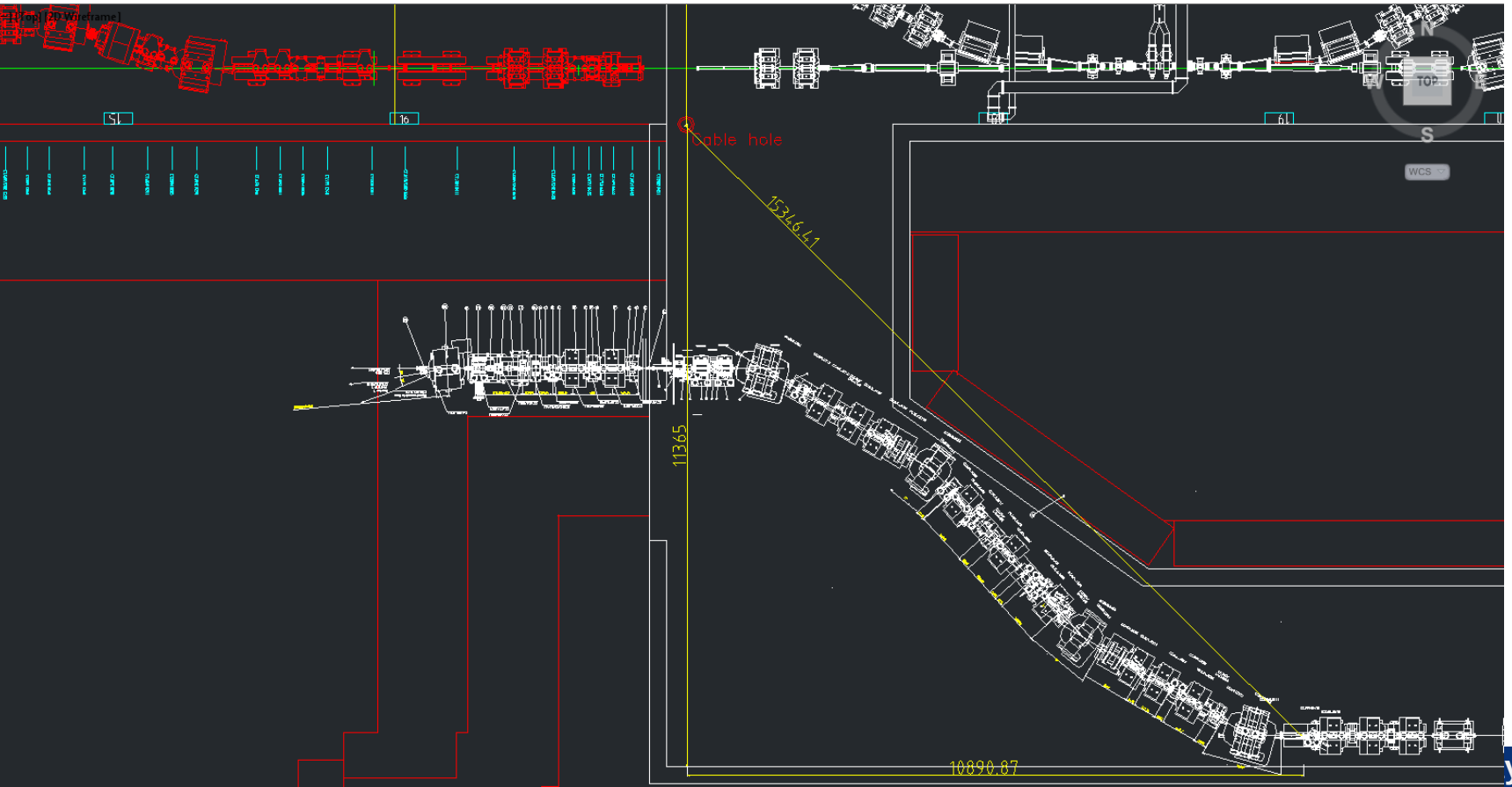


Slow correction

- We have found 2 spare correctors to install around the kickers
  - These are standard CTF laminated magnets
  - Response time around 300ms
  - Square aperture of 10cm
  - Can be opened for installation
  - Kickers are 8.8cm
  - Deflection kick is 0.091/E [rad/MeV]
    - At 150MeV and 10A maximum current gives 6mrad
    - Which is 6 times the range of kickers
- The slow correction will be done with a desktop application using standard controls communication
  - Its latency is around 3s
    - For slow correction should be ok
  - In case higher speed is needed, a special direct loop needs to be created
- The lab checks of the magnets were triggered
- The power group is previewed to prepare 4 power supplies

Total cable length

- Total cable length from the monitor is below circa 30m
  - 5m from the monitor up to the gallery
  - 5m between the holes in the gallery
  - 2m down to the CR hall
  - 15.5m from the hole to the more distant kicker (straight line)

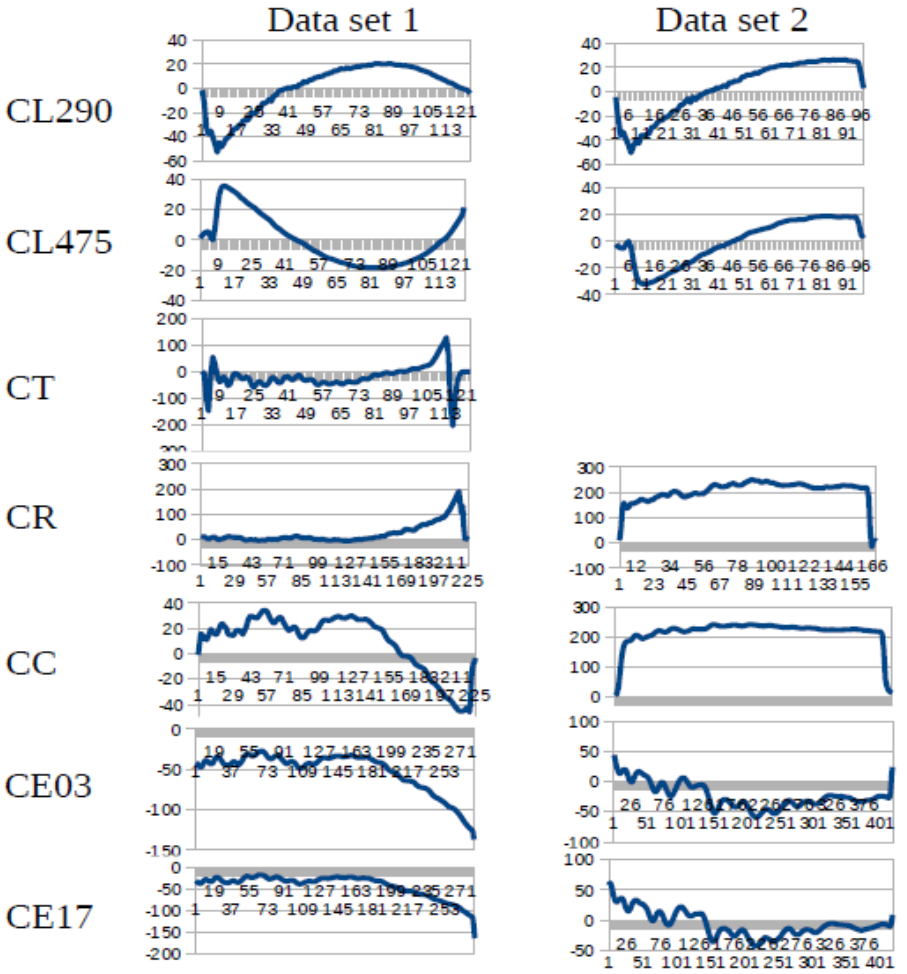


Phase jitter

- The phase jitter peak to peak amplitude is 20deg at 12GHz
  - It is driven by
    - Beam energy jitter **AND**
    - Large natural R56=0.46 of the Stretcher Chicane (aka Frascati Chicane)
  - **Is it above the system range?**
  - For the purpose of the experiment R56=0 will be implemented
  - This shall bring down the jitter at least factor 2
    - If R56 from the Linac to the phase correction place is null than we shall see no phase jitter due to beam energy, theoretically
    - But we will start seeing than other sources of the jitter

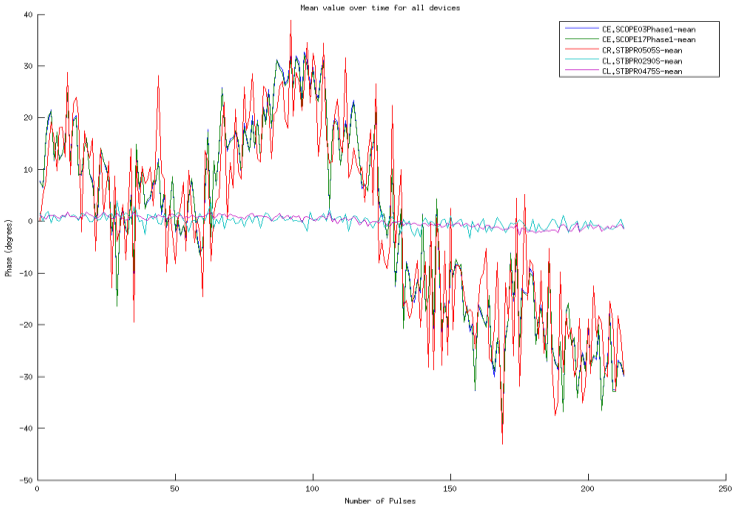
Phase sag

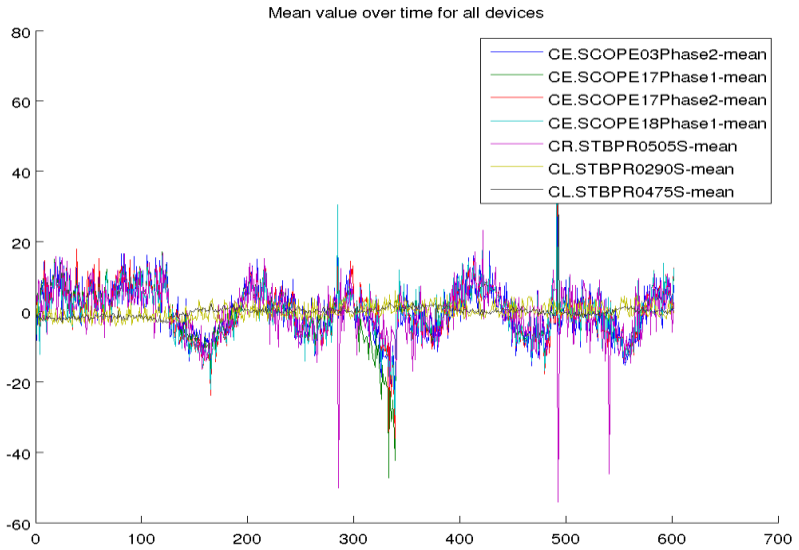
- Phase sag over pulse has a parabolic shape with 60deg amplitude
  - Due to pulse compression that generates phase sag in the acc. field
  - **The primary experiment will be done with short pulse**
    - Do we know
    - Of course the middle part will be used where the sag is minimal
    - Although it might be an issue when for combined beam stabilization
  - This can be reduced by shaping the beam energy along the pulse and keeping the Stretcher Chicane with non 0 R56
    - Of course, it contradicts the setup to minimize the jitter
    - A compromise solution would need to be found



Phase drift

- Up to 200 degrees phase drift was observed
  - It is again related to energy drift
- 2 additional feedbacks were put in place to stabilize the beam energy drift
  - Hopefully the phase drift won't be present anymore
- On top of this, magnetic correctors will be installed around the kickers and slow drift correction will be put in place





Phase jitter and sag minimization

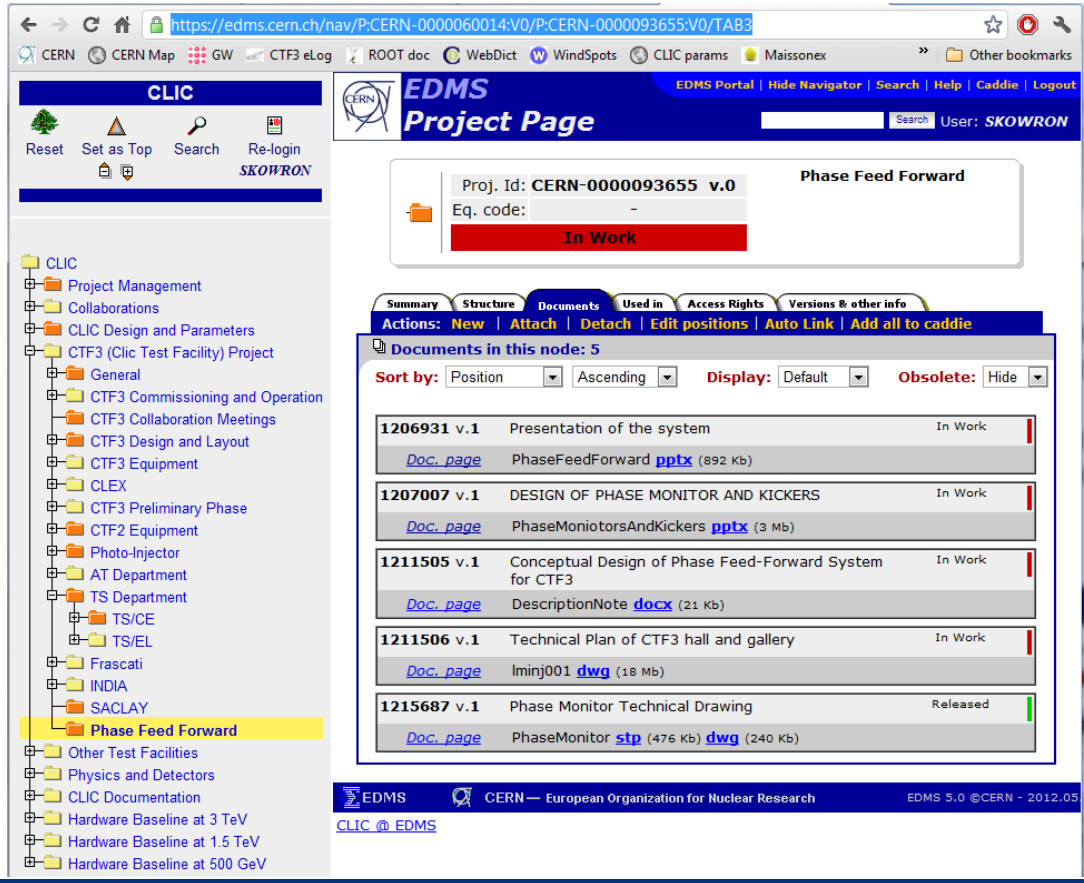
- On the very beginning of this run a couple of weeks were reserved to
  - Commission lower R56 optics in the Stretcher Chicane
  - Phase jitter reduction study
  - Phase sag reduction study
- Due to massive problems with different klystrons the beam was seen down the Linac maybe for 2 or 3 days

Summary

- The preparation for the installation is progressing although we accumulated already some delay
- Still hope to have the monitor installed before June
  - We need to align with the other modifications in the machine and its program

EDMS documentation

- During Glenn's visit at CERN it became apparent that extensive documentation should be prepared ASAP so it is clear to all of us what we shall do and where we stand at the moment
- I have created a place for us in CERN's Electronic Document Management System (EDMS.cern.ch) and I put what we have till now
- Please!
  - Send me all the documentation you have
  - Edit and comment the material that is in, specially the Conceptual Design document



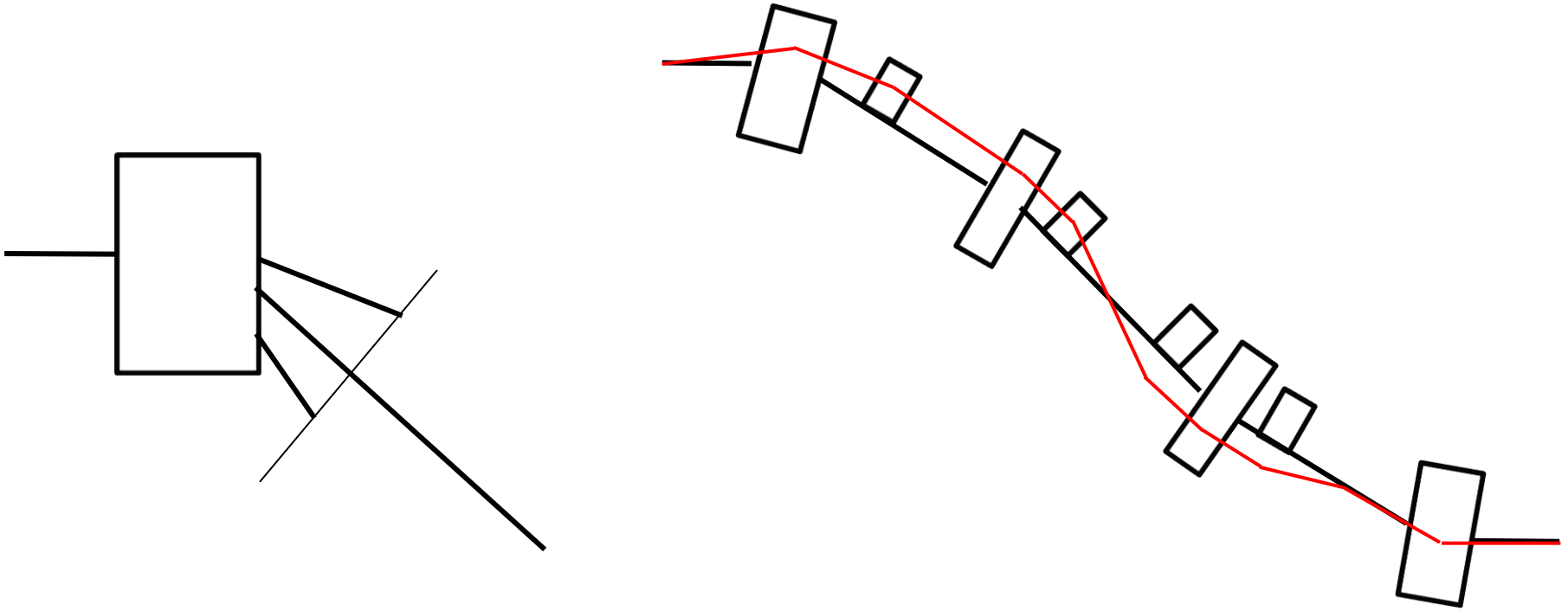
QUESTIONS

- Bellows RF shielded or not?
- Do we need tapers around the monitor if there are bellows?
- For the string of monitors, interleave the monitors with bellows?
  - If we connect monitors directly we risk the that they are not perfectly in line
- ?
- ?
- ?

BACKUP

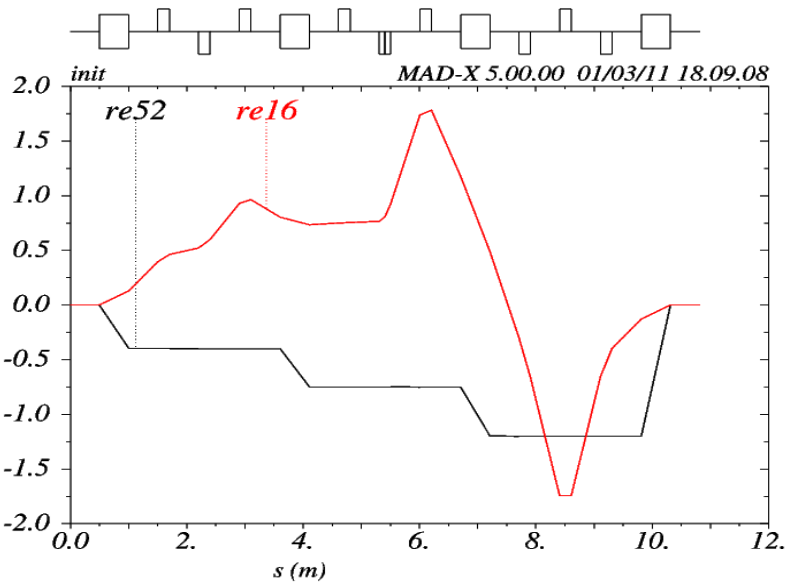
2 kickers setup
Basic considerations

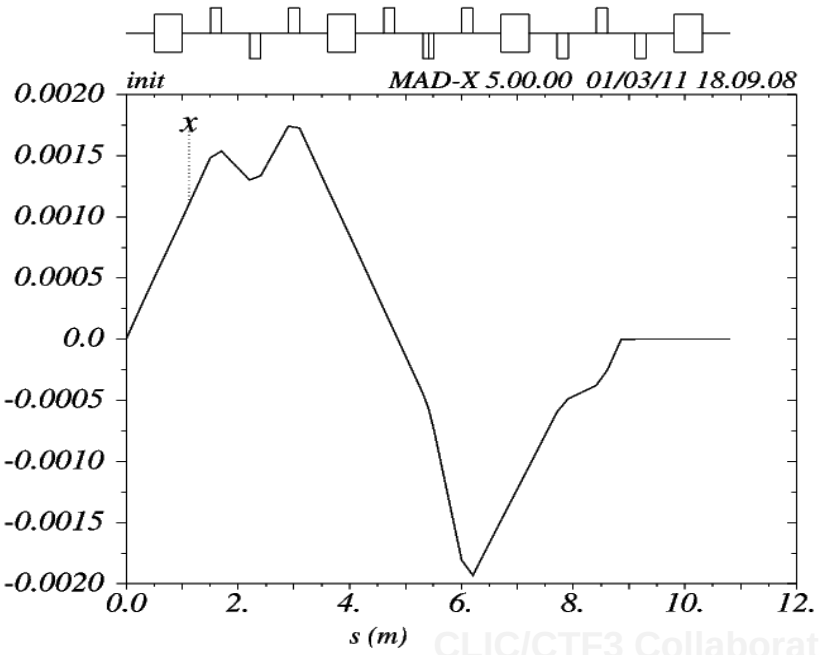
- The figure of merit is R_{52}, which relates kick (the 2nd variable) with the trajectory length (the 5th variable)
  - R_{52} is changed only by bends
    - It is connected to rotation of reference frame
  - R_{52} disappears whenever dispersions disappear
    - If we want to keep the beam dispersion free after the chicane the second kicker should be placed inside the chicane

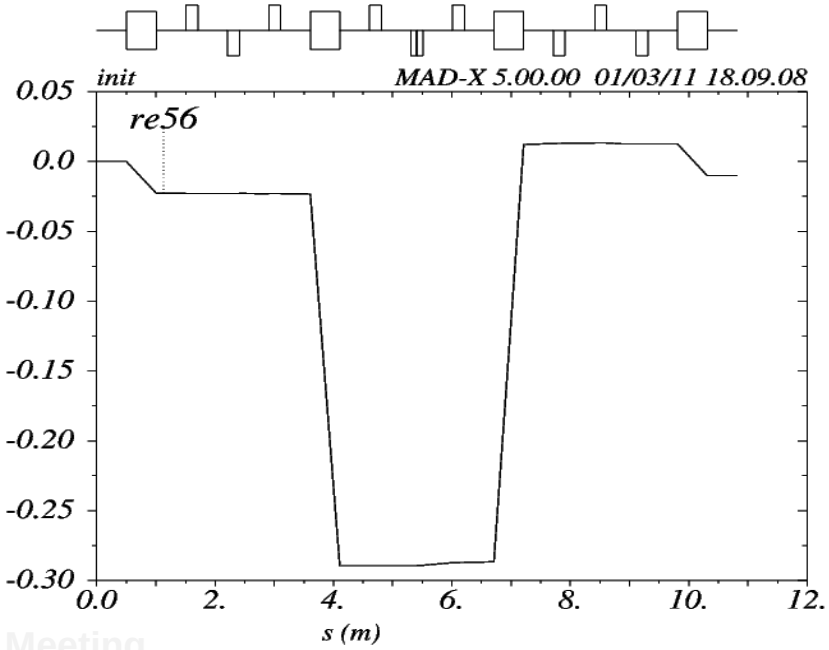


2 kickers setup

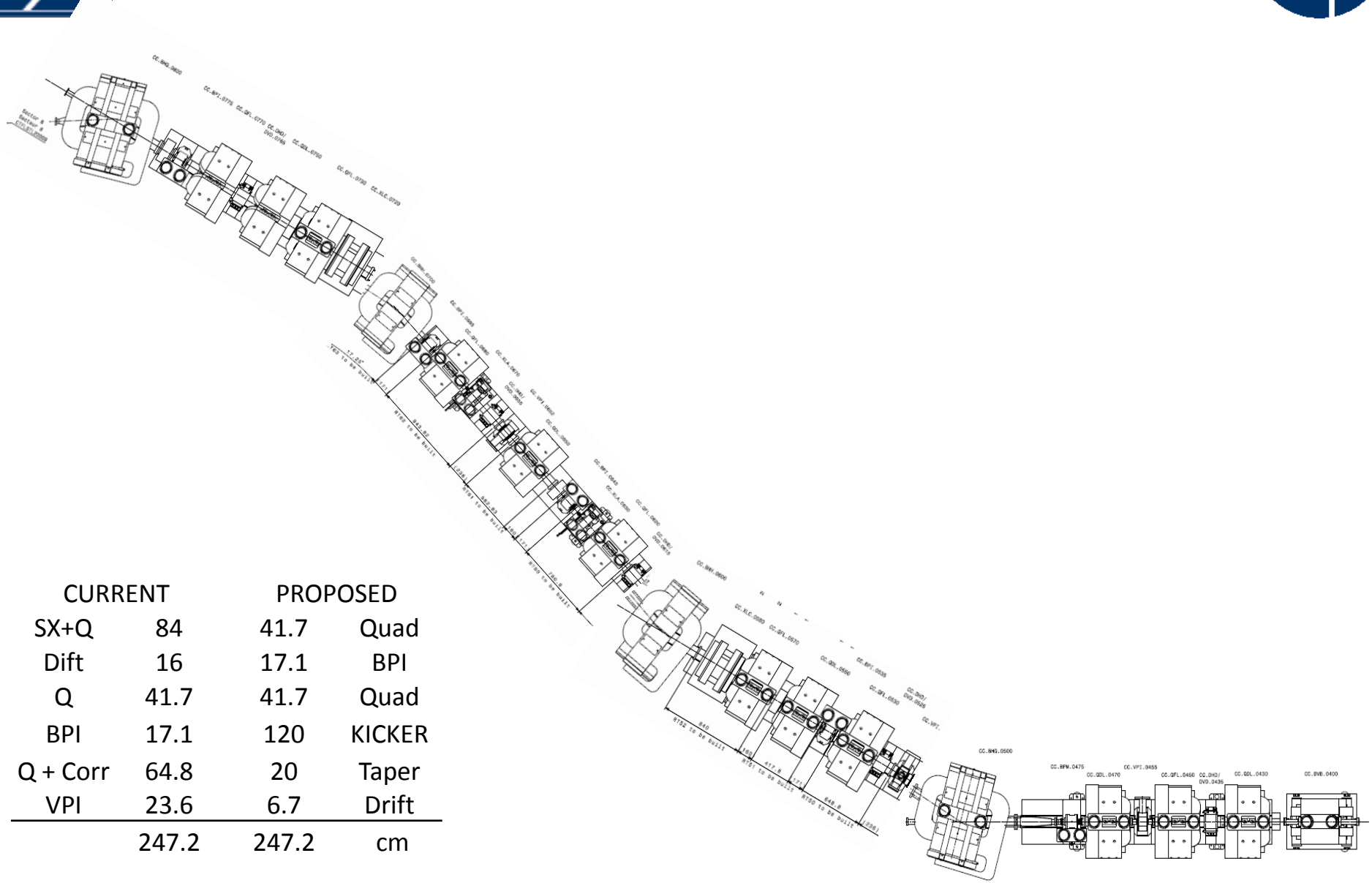
- R52 = -1.2 at the 2nd kicker
- Dispersions = 0
- R56 = 0
- Max kick (1 mrad) giveas orbit change smaller than 2mm





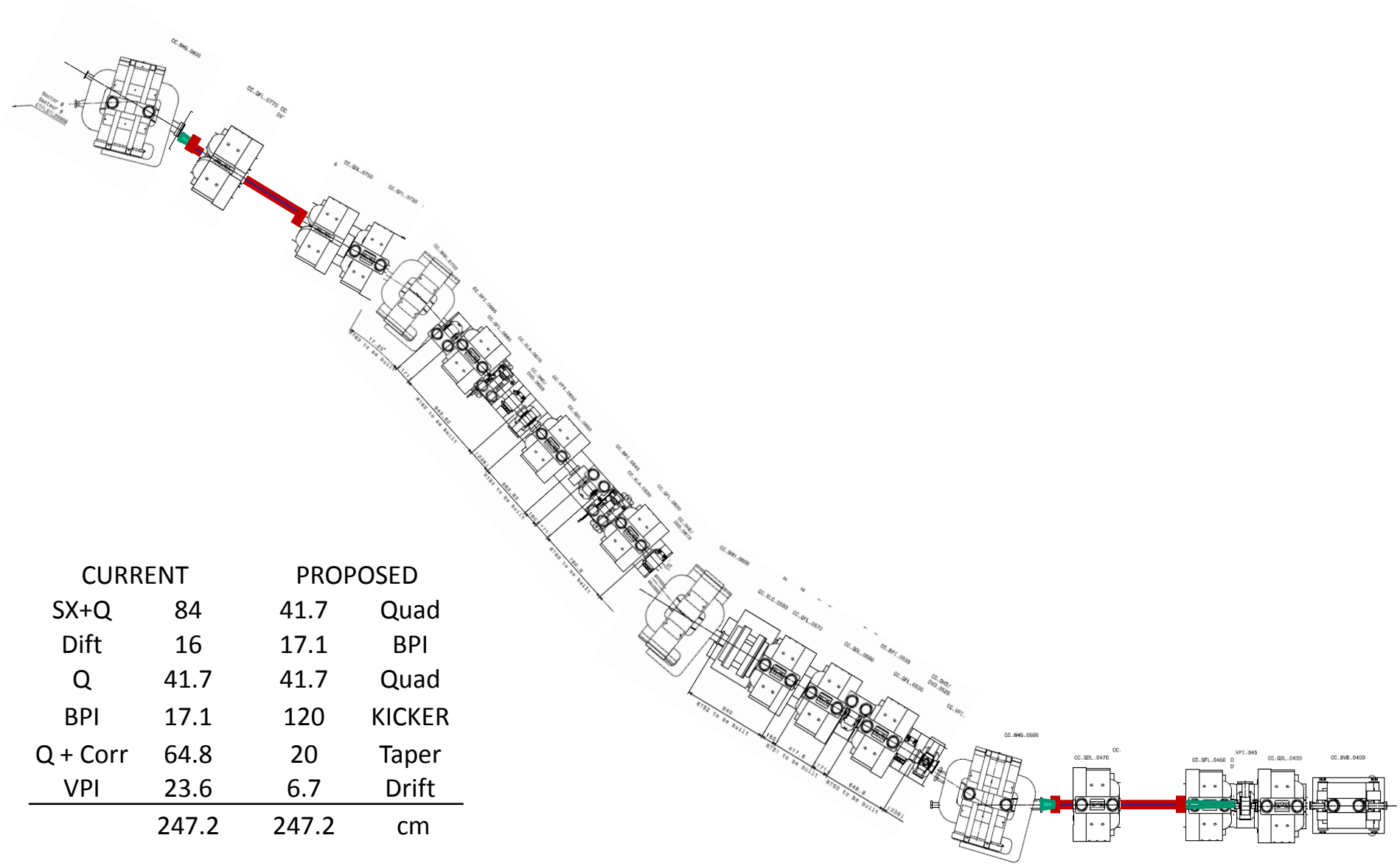


The current layout



CURRENT		PROPOSED	
SX+Q	84	41.7	Quad
Dift	16	17.1	BPI
Q	41.7	41.7	Quad
BPI	17.1	120	KICKER
Q + Corr	64.8	20	Taper
VPI	23.6	6.7	Drift
	247.2	247.2	cm

The proposed layout



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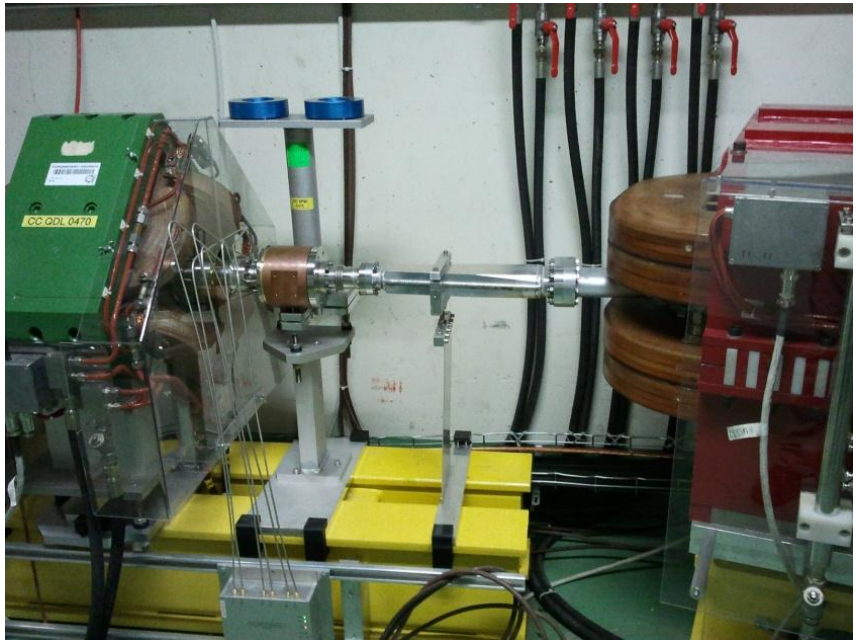
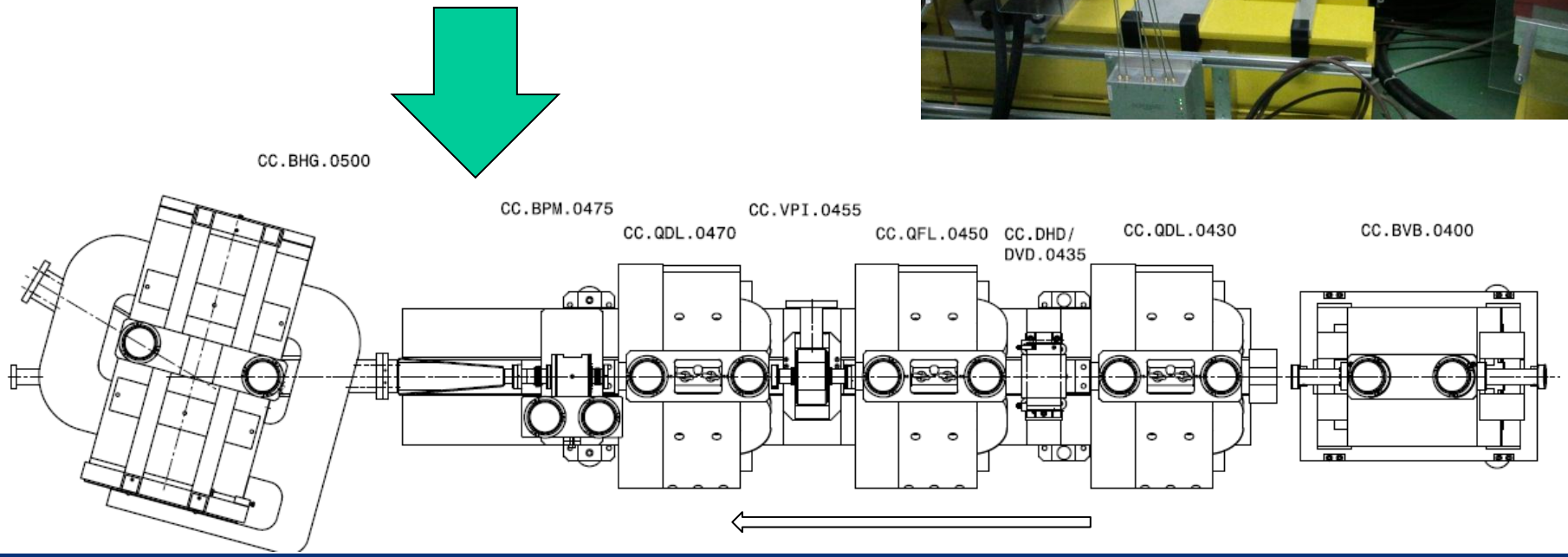
VPI	23.6	6.7	Drift
	247.2	247.2	cm

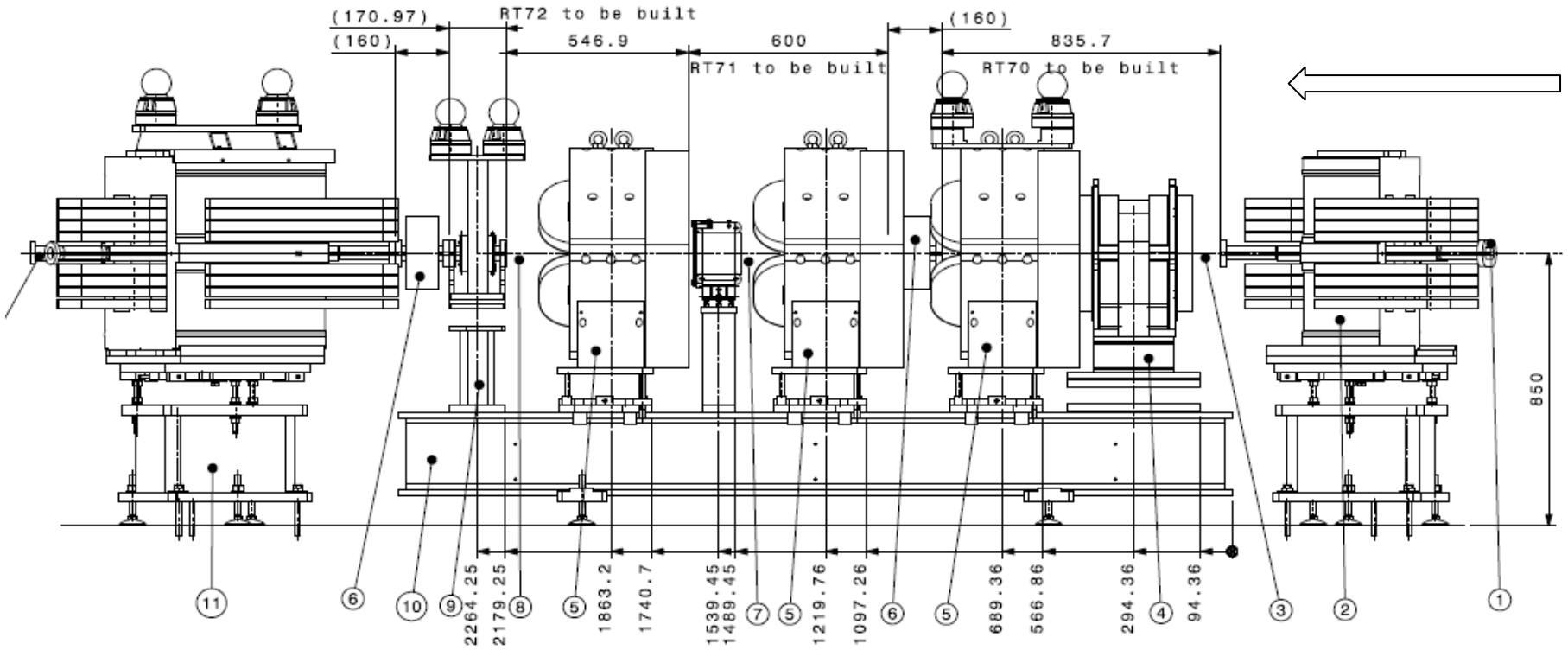
Space for kicker 1

- It is not an issue
  - In the best case only the vacuum chamber inside the bend needs to be reworked
  - Eventually BPM0475 would need to be moved to another location





Space for kicker 2



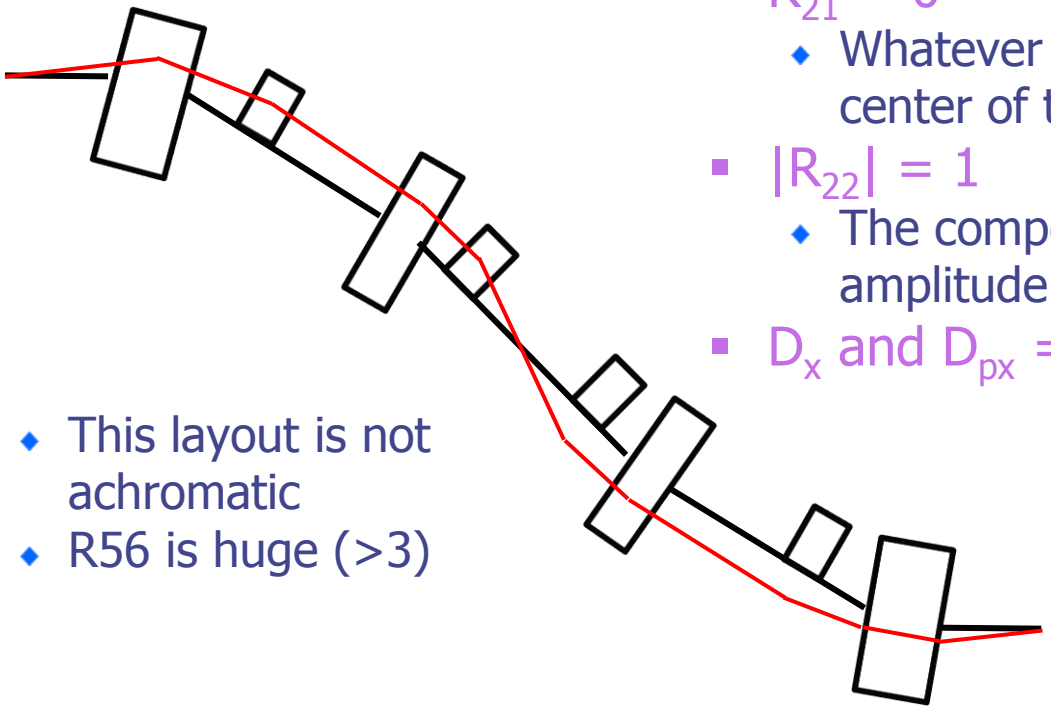
Backups slides

System based on 2 kickers?

- I investigate possibility of the system based on 2 kickers

Requirements:

- Phase correction range 10deg at 12GHz
- Implies TOF correction range of 0.7ms
- R_{52} of at least 0.7 or bigger (~1.0)
  - Assuming kicker with 1 mrad range
- $R_{21} = 0$
  - Whatever the kick, the same position at the center of the 2nd kicker
- $|R_{22}| = 1$
  - The compensating kick of the same amplitude as the first one
- D_x and $D_{px} = 0$



- This layout is not achromatic
- R56 is huge (>3)

Kicker Parameters

- Fabio Marcellini has prepared blueprint of a device with the following parameters
  - 1 mrad kick with 4 kV
  - Length of the electrodes 412 mm
  - Aperture 40 mm
  - Circular pipe with inner diameter of 74 mm