FLASH Beam Dump Line

ILC TTF/FLASH 9mA Workshop, 16. January 2009

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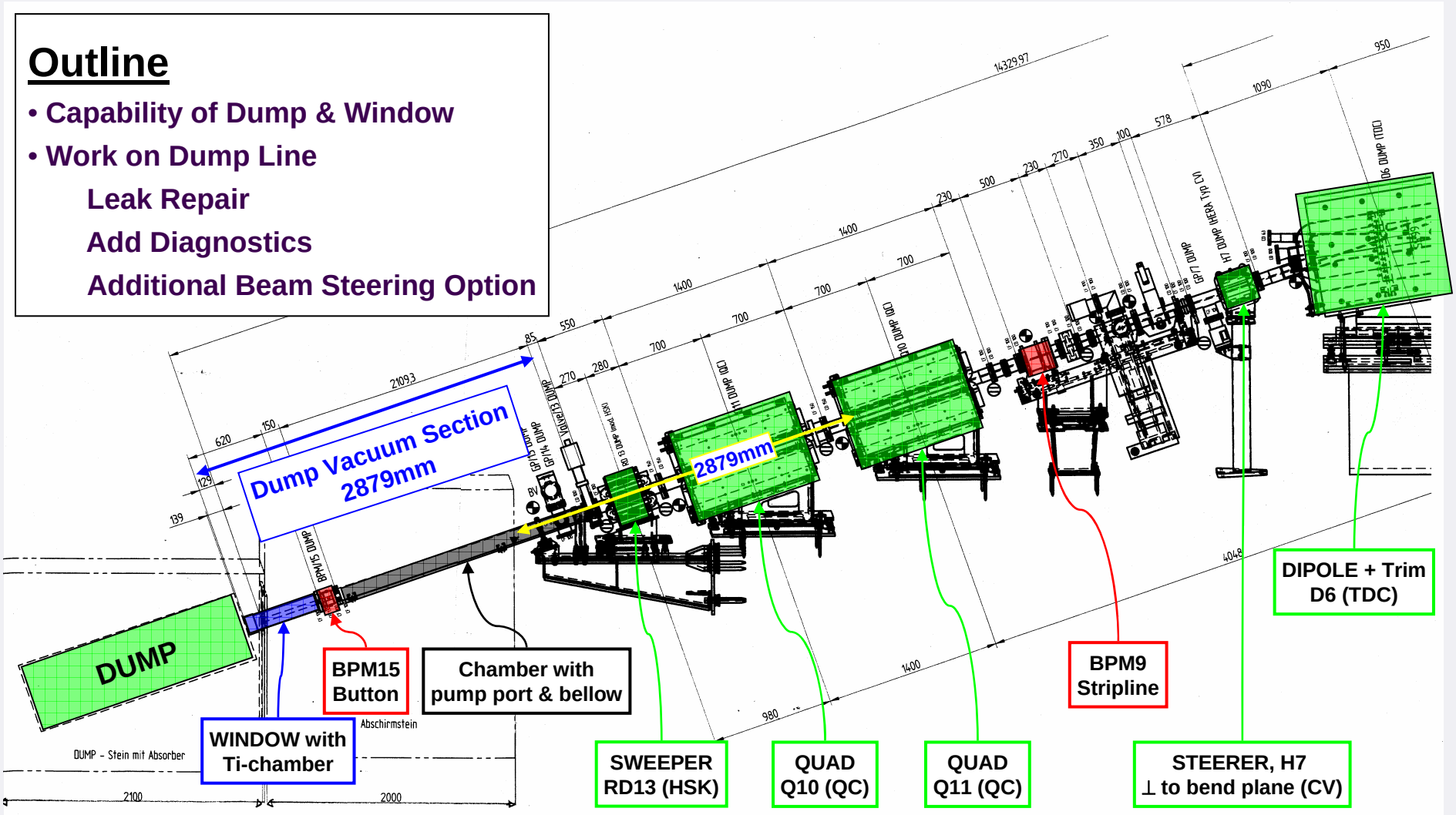
Outline

- Capability of Dump & Window
- Work on Dump Line
  - Leak Repair
  - Add Diagnostics
  - Additional Beam Steering Option



Capability of Dump & Window

	Layout Parameters for FLASH Dump & Window	9mA Experiment
I_t, current in train	≤ 9 mA (9MHz · 1nC)	≤ 9 mA (3MHz · 3nC)
Q_t, charge in train	≤ 6.4 μC (6400 · 1nC)	≤ 7.2 μC (2400 ·3nC)
T_t, length of train	≤ 800 μs	≤ 800 μs
ν_t, rep. rate of trains	≤ 10 Hz	≤ 5 Hz
I_{ave}, avg. beam current	≤ 64 μA	≤ 36 μA
E, beam energy	≤ 2 GeV	≤ 1 GeV
P_{ave}, avg. beam power	≤ 128 kW	≤ 36 kW
Beam Requirements		
given by Dump	σ ≥ 1 mm slow sweep r ≥ 2cm	σ ≥ 1.1 mm slow sweep not required
given by Window	σ ≥ 2 mm slow sweep r ≥ 2cm	σ ≥ 2.2 mm slow sweep r ≥ 1 cm

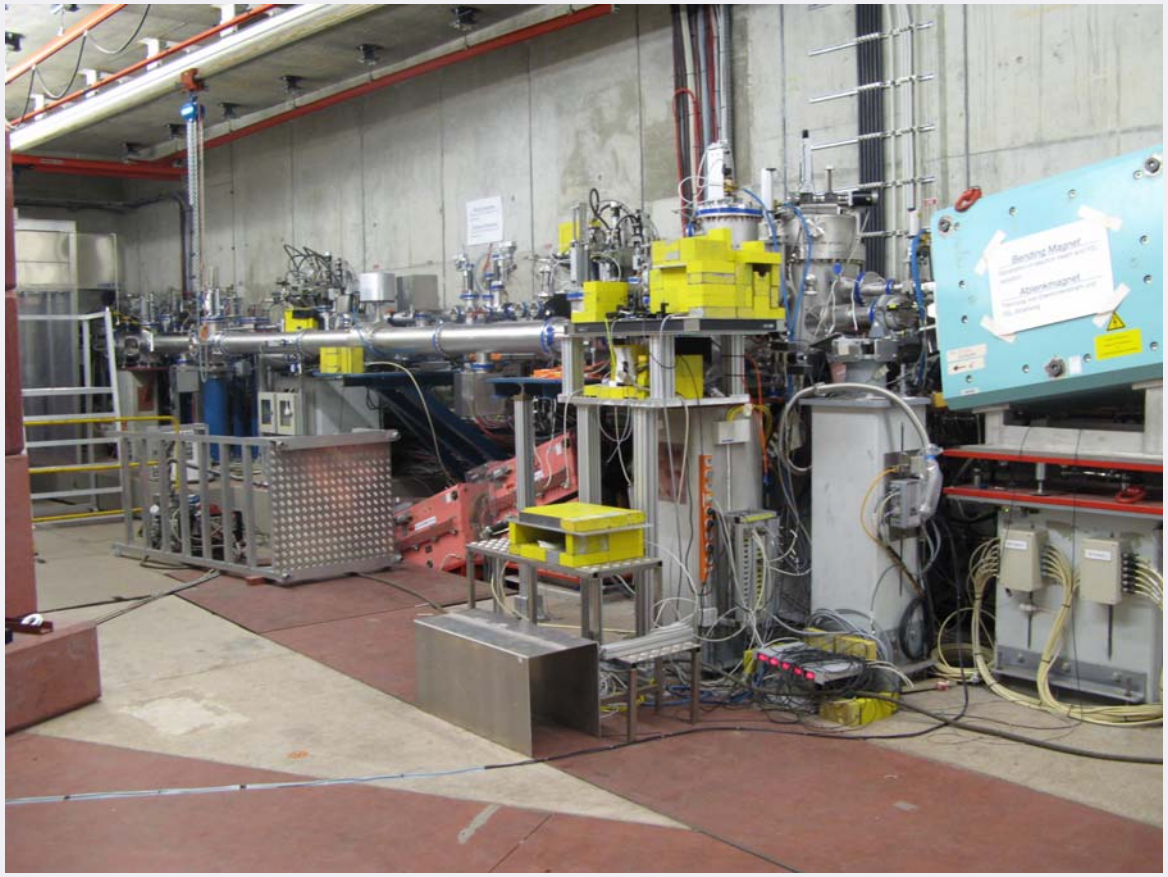
⇒ 9mA Experiment within Dump & Window layout parameters, i.e. should work w/o problems

- as far as the requirements of size and sweep are fulfilled
- and beam is guided cleanly to there (needs diagnostic and steering)

Work on Dump Line (I)

1.) Demount Beam Line upstream of Concrete Shield

- Incl. both QC (upper & lower half) for convenient de-/installation space of dump vacuum section
- Feasible with forklift and / or Egyptian style
- All photon beam lines above can stay untouched (minor interference with some supports)



Work on Dump Line (II)

2.) Replace leaky Dump Vacuum Section

- Replace leaky section with new one, but
  - WITHOUT any flange connection or feedthroughs inside inaccessible concrete shielding
  - Check sliding properties of chamber feet on surface of concrete hole
- Long term need of new spare window w/o Ti-chamber (a la XFEL approach)
- Equip new dump vacuum section with a lot of diagnostics (→ K. Wittenburg talk)
  - New BPM15 position of limited benefit (~ in focus of Q10/11 at normal operation settings)
    - Open Decision: Need additional BPMs ?
      - on atmosphere (N_2 vented) side of window head (impact on length of Ti-pipe insertion)
      - behind Q10 and / or Q11, requires new chambers (round or special profile)
  - No good idea for profile measurement at window up to now for this setup
    - Open Decision: New D1Dump chamber with rear port to install optical window
      - allows investigation of infrared, OTR, or Luminescence at window, but long distance (~15m)

3.) Installation of upstream Beam Line

Open Decisions:

- Install modified QC for steering purposes ? (field has to be evaluated)
- Install new QC chamber(s) with Button BPM

Summary

- Demount upstream beam line possible w/o impact on photon beam lines above

- Replacement dump vacuum section should be ready in time
  Decision: BPM in window head ?

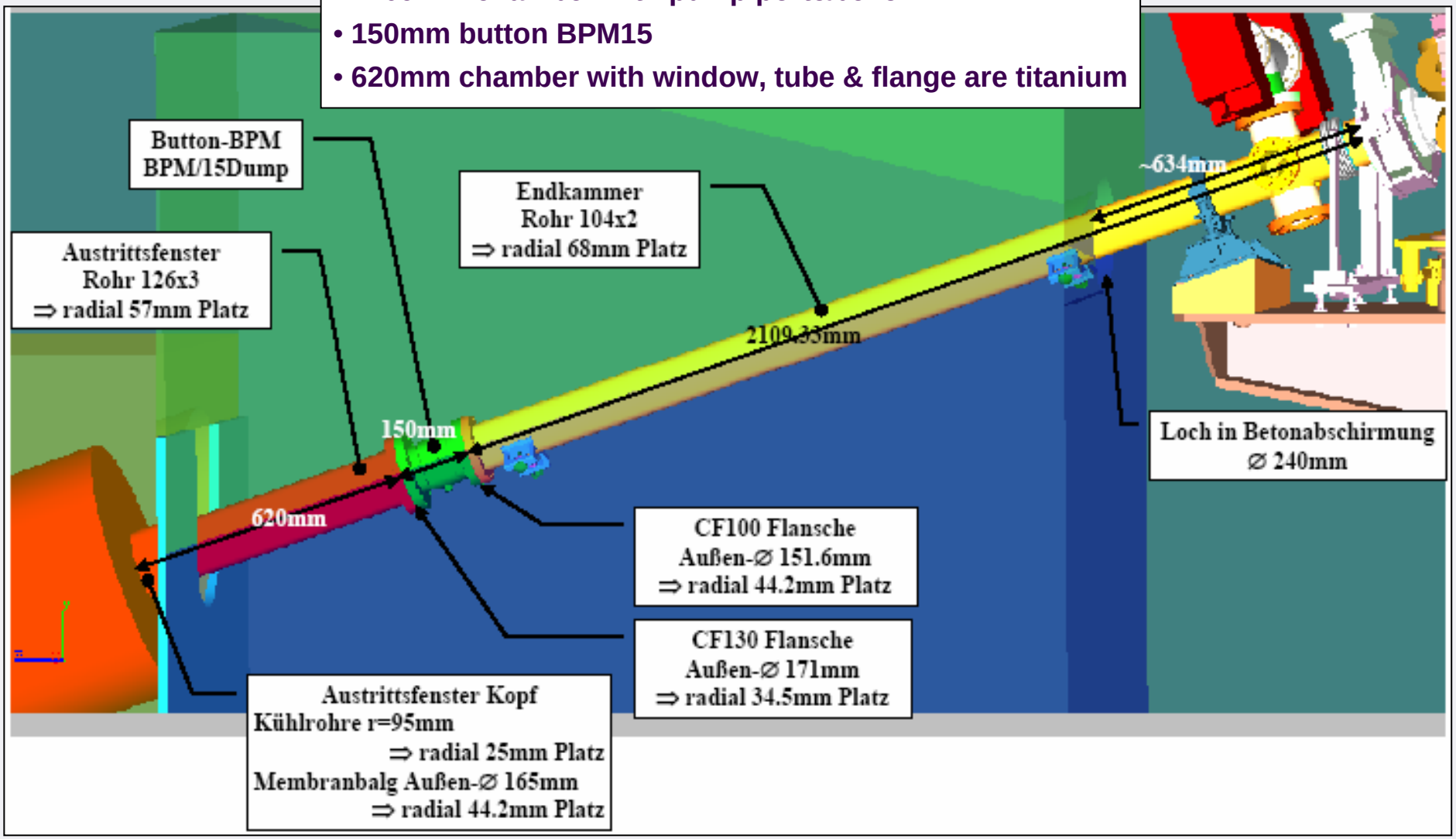
- Preparations (mechanically and electrically) for modified QC can be done in advance, except cabling needs open tunnel
  Decision: QC as steerer ?

- New QC-chambers could be prepared in advance to allow for additonal BPM(s)
  circular profile simpler (time & cost) than existing profile
  Decision: Additional BPMs required?
  if yes: can we afford little less aperture by using a simple circular profile

Dump Vacuum Section Repair (I)

2879mm long Dump Vacuum Section consists of:

- **2109mm chamber with pump port&bellow**
- **150mm button BPM15**
- **620mm chamber with window, tube & flange are titanium**

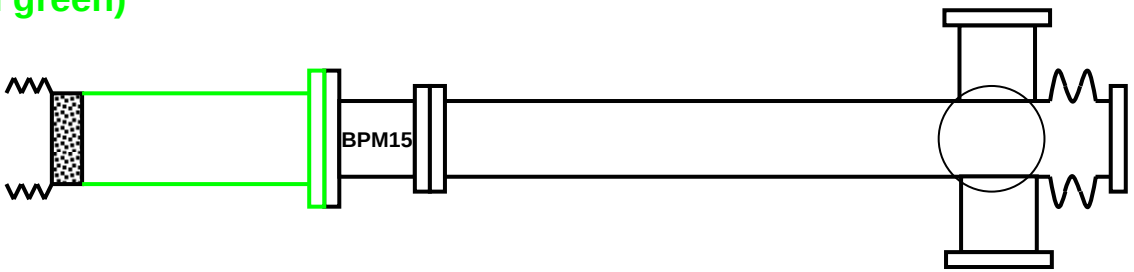


Dump Vacuum Section Repair (II)

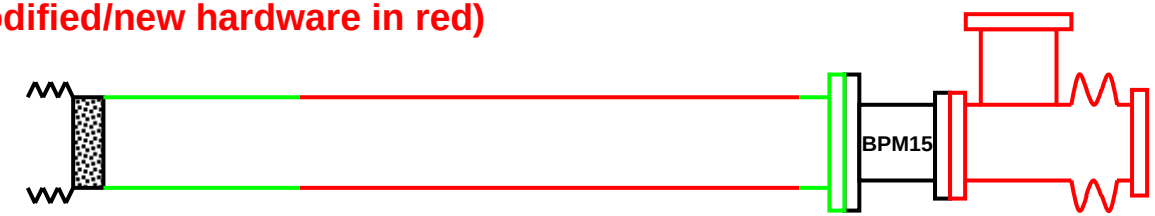
Plan

- Complete dump line section (window, BPM15, tube with pump port & bellow) exists as spare.
  1. Use spare window, cut off Ti-flange, insert long Ti-tube (rolled from plate material, Laser welded)
  2. Re-use BPM15 and put upstream to window (outside of concrete)
  3. Put new pump port & bellow unit upstream of BPM15

Existing spare assembly
(Ti in green)



Modified dump vacuum section
(modified/new hardware in red)



Dump Vacuum Section Repair (III)

Status / Outlook

- Offer for Ti-tube including laser welding it between existing window tube and Ti-flange exists, company Hoedtke, delivery time 10 weeks
- Order will be placed mid. jan.09 ⇒ beg. april 09 new window chamber at DESY
- Manufacturing of pump port & bellow unit in shadow of above timeline

After that:

- Leak check, clean (pump and purge)
- Flange together with BPM15 and pump port & bellow unit
- Install Cu-cooling pipes and N_2-pipe along the section
- Install diagnostics and / or empty supports for it
  - diamond halo sensors (& BPM?) in window head
  - loss monitors along the vacuum pipe (flexwell cables, glass fibres, water cerenkov)
- Adjust height of the feet, which rest inside the concrete according to a prior measurement at the deinstalled section
- …

⇒ After all that new Dump Vacuum Section ready to be installed

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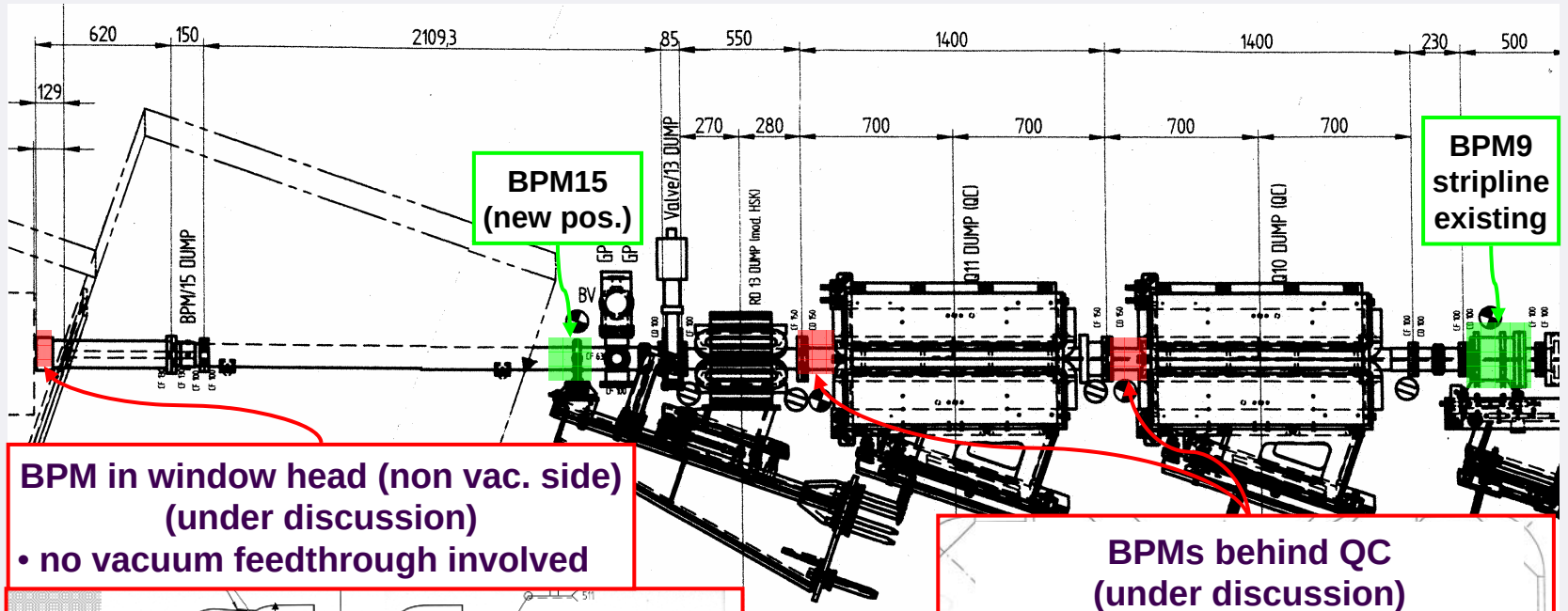
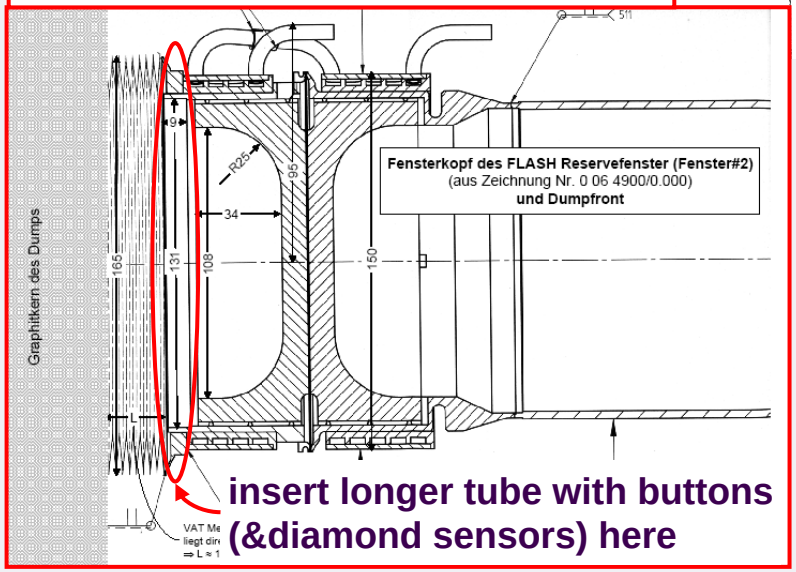
BPM Situation

Buttons for additional BPMs exist (weld type from HERA)

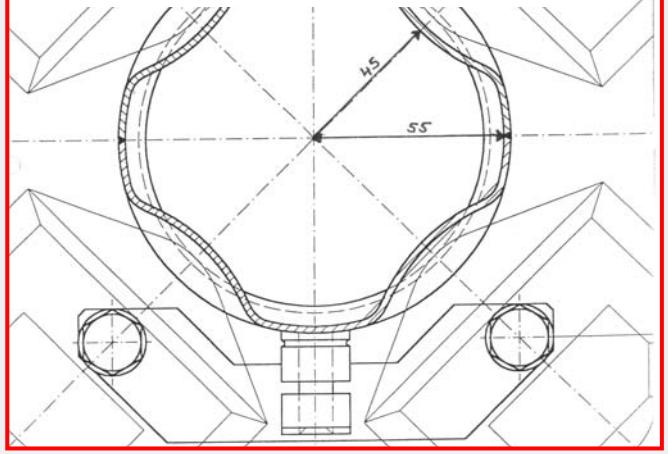


BPM in window head (non vac. side)
(under discussion)
- **no vacuum feedthrough involved**



insert longer tube with buttons (&diamond sensors) here

BPMs behind QC
(under discussion)
- **requires new quad chambers**
- **simpler with circular profile**



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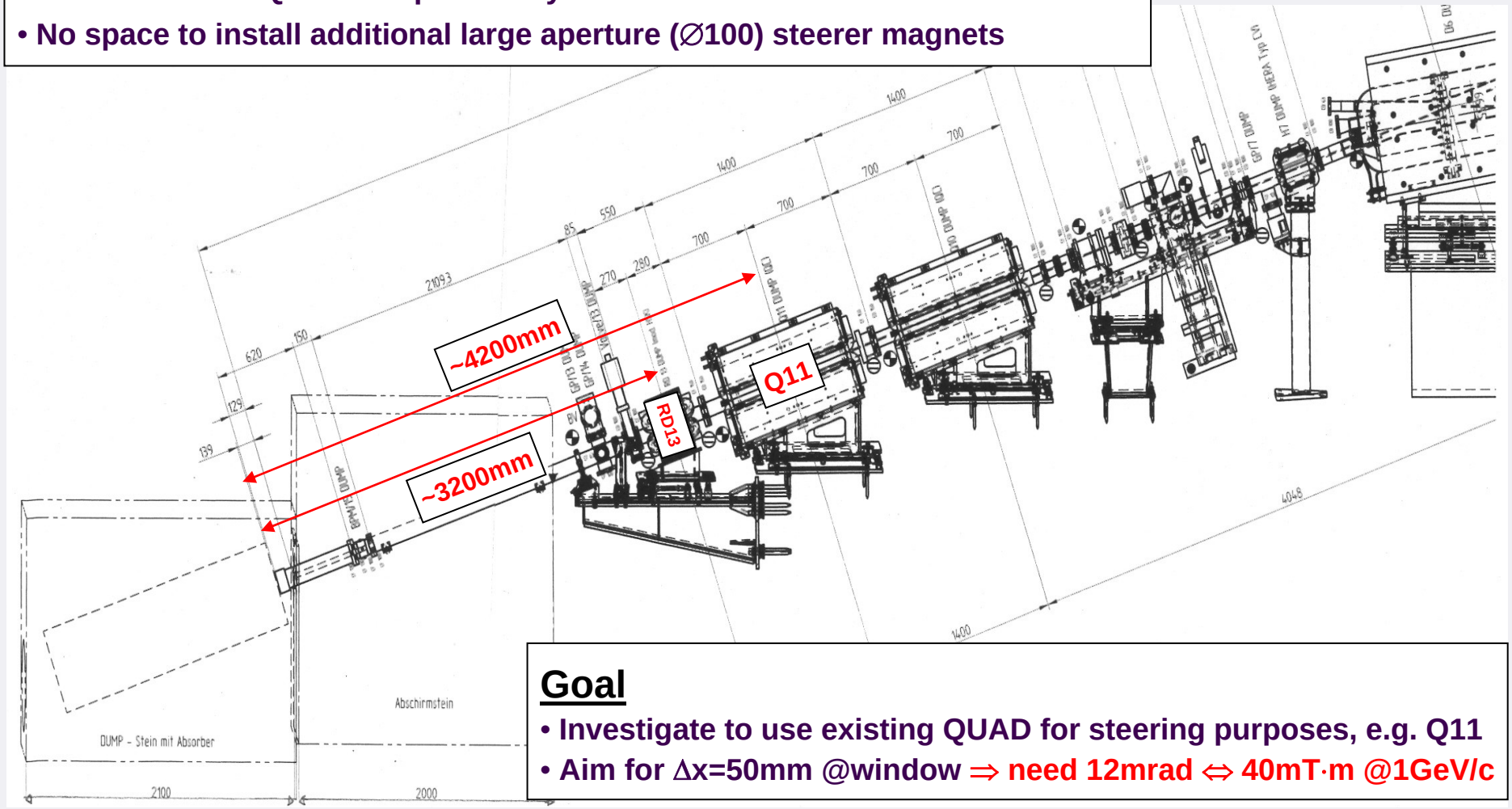
Additional Beam Steering Option (I)

Problem

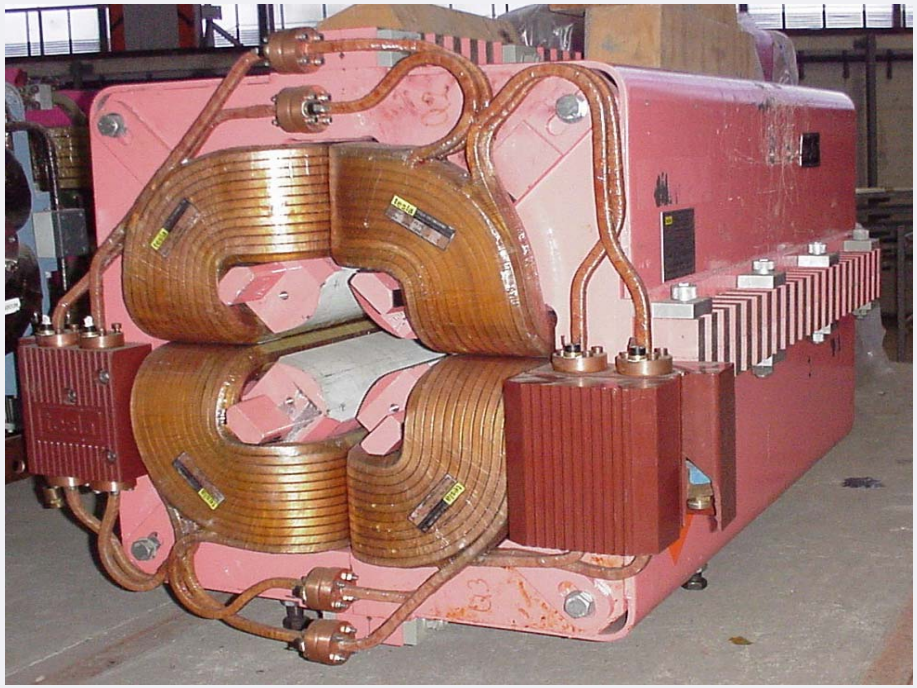
- Rather strong quads Q10/11 (typ. 1/f~1m) create strong kick for off axis beam
- Downstream of Q10/11 no possibility to correct for it
- No space to install additional large aperture (∅100) steerer magnets



Goal

- Investigate to use existing QUAD for steering purposes, e.g. Q11
- Aim for Δx=50mm @window ⇒ need 12mrad ⇔ 40mT·m @1GeV/c

Additional Beam Steering Option (II)



Q11 parameters (HERA quad type QC)

- Gradient = $4.21 \cdot 10^{-2}$ T/m·I[A],
- L_{eisen} = 1000mm
- I_{max} = 380A
- Pole tip radius = 50mm

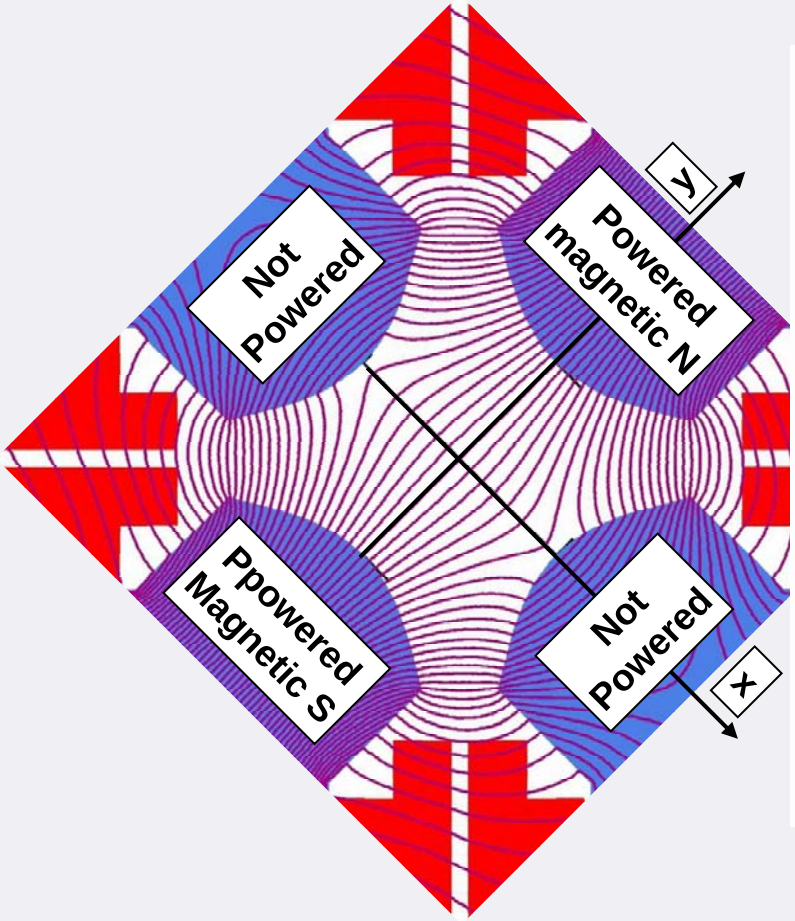
Effort to modify QC

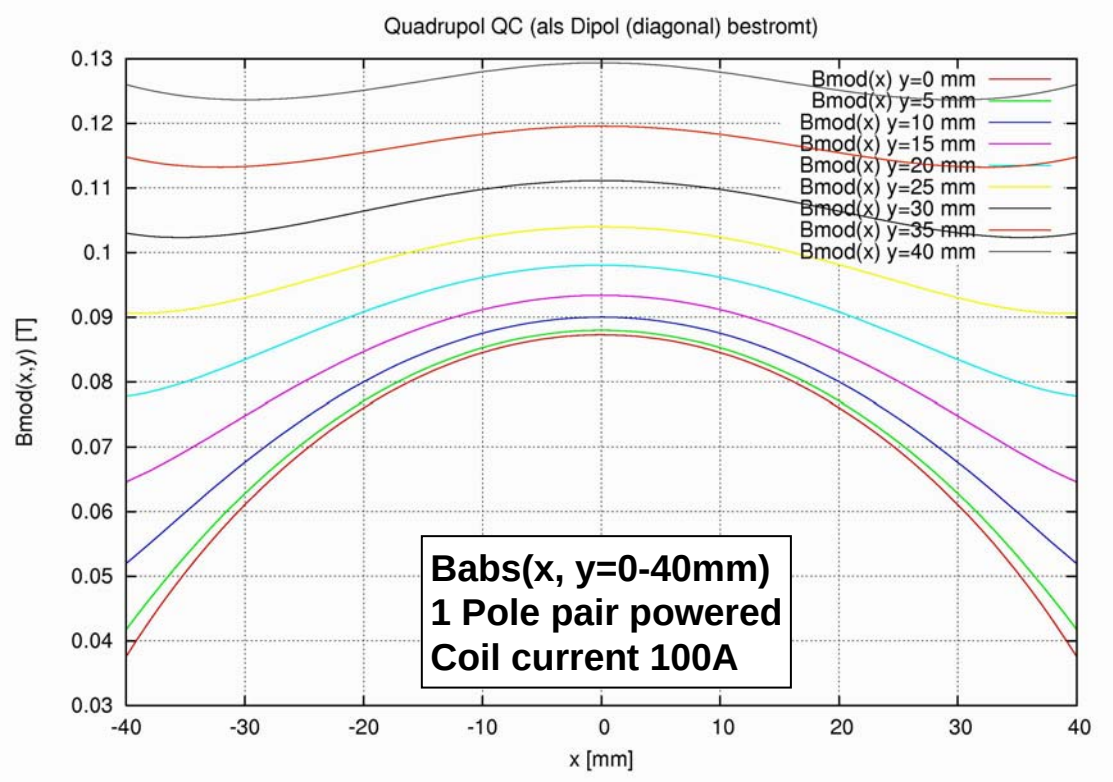
- Modify the electric circuitry at the magnet, to allow individual powering of each pole is possible (K. Liebeck –MEA-), could be prepared in advance with another QC
- 3 additional power supplies + PSC and cabling through the tunnel. power supplies, PSC and space available (A. Hauberg –MKK-), cabling needs ~3days in tunnel
- Software which translates the 4 circuits into 3 knobs (Quad, CX & CY) for operators
- Equip the modified magnet with alignment nests and make transfer measurement
- Prepare everything that the magnet fits on the given support in the tunnel

Additional Beam Steering Option (III)

QC opera simulation (M. Marx), 1 pole pair powered as “dipole”

- $B_y(x=0, y=0) = 0.88\text{mT/A}$, $L_{eisen} = 1\text{m} \Rightarrow$ 12mrad requires $I = 45\text{A}\cdot p[\text{GeV/c}]$ no problem in strength enough overhead, since quad current (typ. $\leq$ 200A), and $I_{max} = 380\text{A}$
- Field quality acceptable? has to be evaluated





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