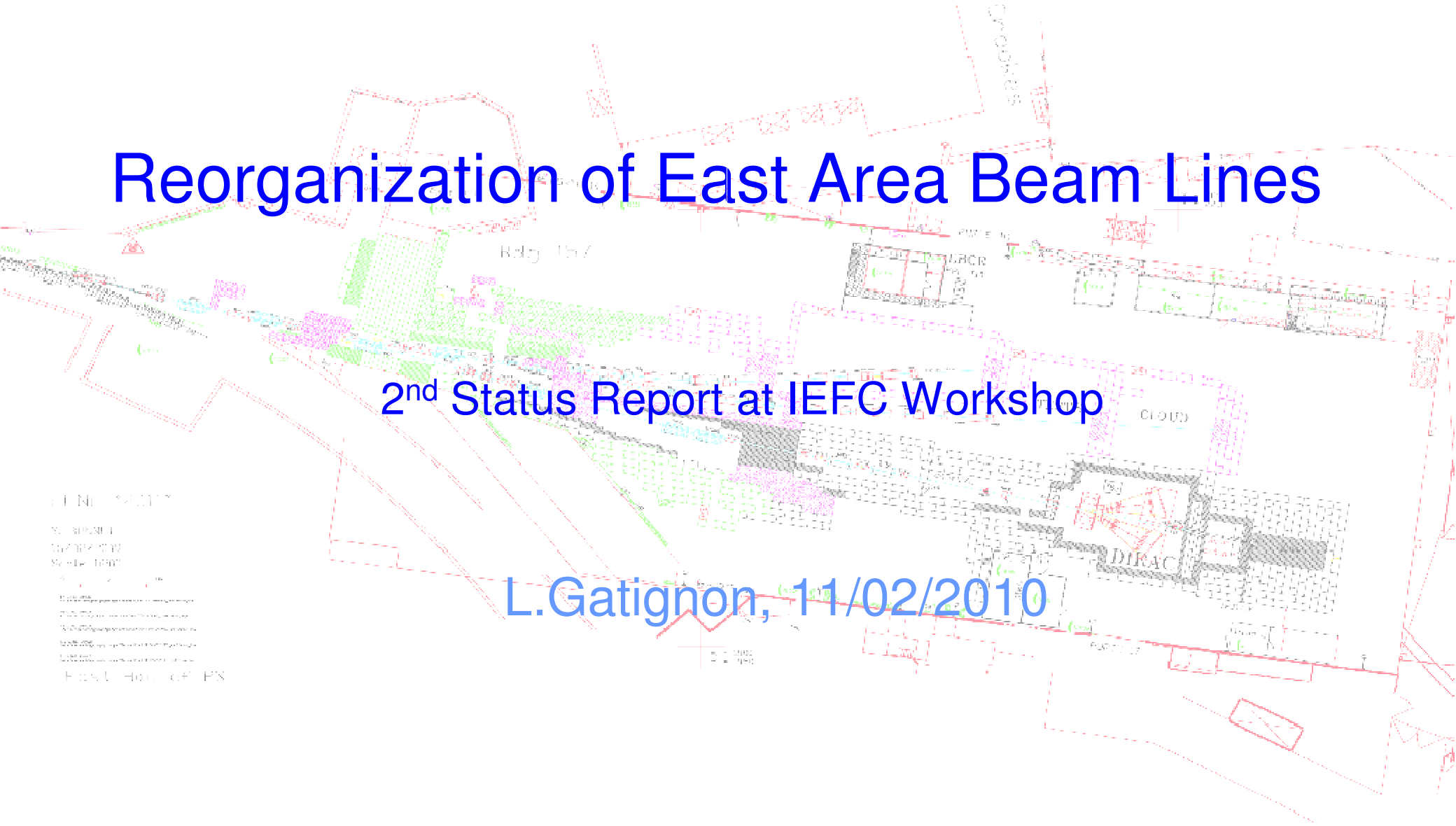
# Reorganization of East Area Beam Lines




2nd Status Report at IEFC Workshop

L.Gatignon, 11/02/2010

**OUTLINE:**

- Motivation
- Reminder of 2009 conceptual design
  - *Constraints from physics programme*
  - *Contain radiation*
  - *Magnets available*
- Open questions in 2009
- Update
  - *Shielding and other RP requirements*
  - *Controls*
  - *Costs and resource requirements*
- Time line
- Conclusions

# WHY A NEW LAYOUT FOR THE EAST AREA

**Triggered by ABOC/ATC days in 2007**

- Splitters lead to high beam losses in critical regions
  - high radiation levels
  - no beam loss monitors!
- Catastrophic situation of magnets
  - 63 magnets of **22 different types**, many critically weak and/or **no spares**
  - need **2 weeks to open & close concrete roof shield** + cooldown + repair
  - space very tight, access extremely difficult
  - high radiation levels
  - EA has only 8% of #magnets in NA, but needs same #FTE to maintain
- No remote control for most systems (motors in particular)

  No high level control system, no beam files

  Grossly insufficient beam instrumentation – *somewhat improved since then*

## Recommendation: global review of East Area

***Note:*** *Operational difficulties with F61N.BVT01 in 2008,*
*T10 only 6 GeV due to two Q800 (smoke traces!), three Q120's replaced in 2009, …*
*+ F61N.DVT01 broken, suspected problems in T7 line, … (2009/2010)*

# THE EAST AREA CONTINUES TO BE POPULAR:

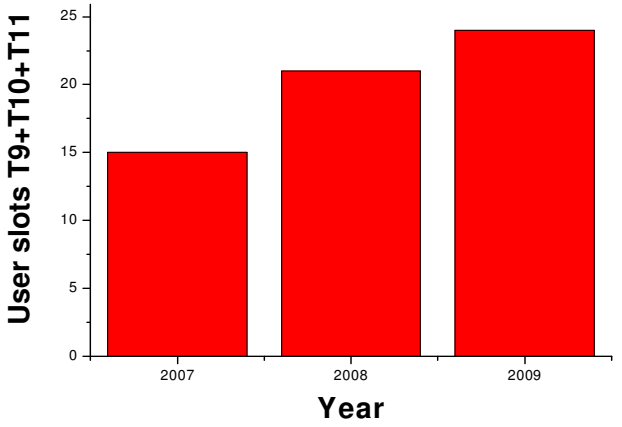
20-Jan-2009 **2009 PS Fixed Target Programme** Version 0.0

Colour code: dark blue (dark shading) = not yet allocated ; yellow (light shading) = not allocatable or Machine Development

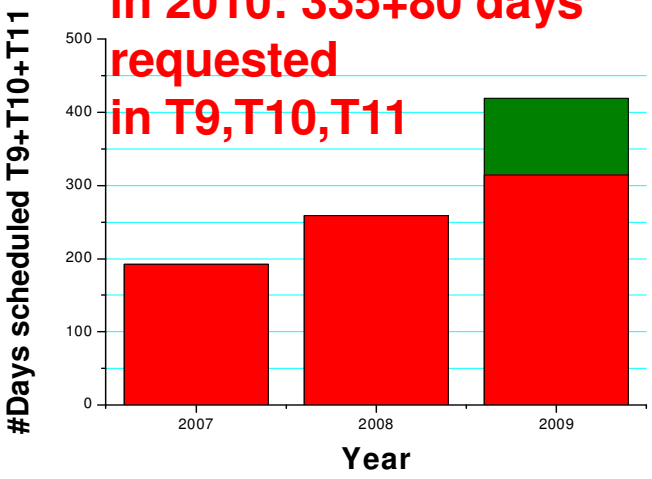
| | | P1 | P2 | P3 | P4 | P5 | P6 |
|---|---|---|---|---|---|---|---|
| | | 35<br>30 Apr<br>4 Jun | 35<br>4 Jun<br>9 Jul | 35<br>9 Jul<br>13 Aug | 35<br>13 Aug<br>17 Sep | 35<br>17 Sep<br>22 Oct | 32<br>22 Oct<br>23 Nov |
| T7 | Setup 7 | Irradiation 35 | 35 | 30 | 5 | Irradiation 35 | Irradiation 35 | Irradiation 32 |
| T8 | Setup 7 | DIRAC 35 | DIRAC 35 | DIRAC 35 | DIRAC 35 | DIRAC 35 | DIRAC 32 |
| T9 | Setup 7 | T2K-ECAL 35 | T2K ECAL 14 | CALICE RPC 17 | 4 2 | COMPASS CALO 14 | MICE EMR 14 | 5 | 35 | 10 | NA62 16 | VIPIX 9 | NA62 15 | PBES 17 |
| T10 | Setup 7 | ALICE PMD 10 | ALICE FARICH 10 | CALICE WMEGAS 15 | ALICE TOF 14 | ALICE VHMPID 13 | CMS ECM 8 | ALICE TOF 15 | RD51 CALICE 15 | 5 | 35 | 10 | CALICE WMEGAS 10 | 7 | ALICE TOF 8 | ALICE TOF 7 | ALICE HPTD 16 | ALICE VHMPID 9 |
| T11 | Setup 7 | CLOUD 35 | CLOUD 35 | CLOUD 35 | 35 | 35 | 32 |

To liberate PS cycles for DIRAC

*and still requests being added,*
*due to pressure on beam time!*




**This trend continues in 2010: 335+80 days requested in T9,T10,T11**



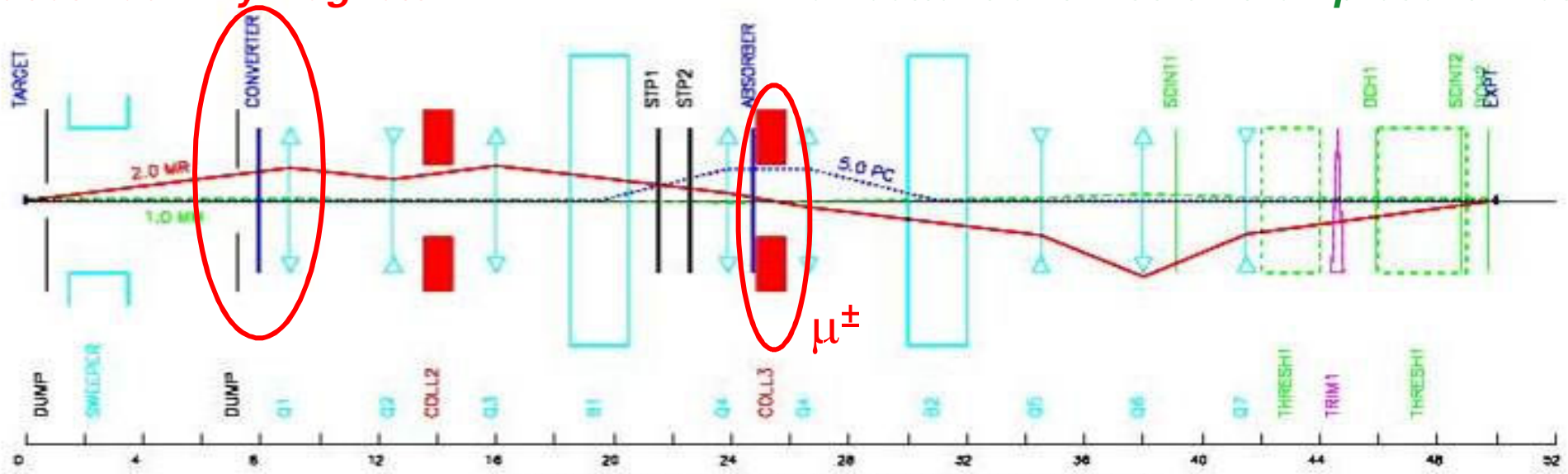
# BASIC PRINCIPLES FOR NEW EAST AREA

- Use fewer types of **reliable magnets** with spares
- Reduce roof shielded areas and **ease access to equipment**
- **Keep radiation restricted** to upstream areas as much as possible
- Keep T8 beam and DIRAC installed as it is until the end of DIRAC, or for IRRAD in case they take over the DIRAC location
- Replace SMH1 and F61S.BHZ1 by two MCB magnets in PPM mode, i.e. no more splitter *(F61S.BHZ01 replacement already done).*
- Could also serve IRRAD as now, through air, however not from ZT7.BHZ01 but from F61S.BHZ02
- **Design new beam(s)** to 1 (or 2) "North target" marguerite(s)
  - *two decoupled beams, but at the cost of cycle efficiency*
  - *two beams coupled by "wobbling station", coupled but higher cycle efficiency*
- Test beams can provide **pure** hadron and muon secondary beams up to 15 GeV/c and pure (> 95%) electron beams from $\gamma$ conversion (up to about 10 GeV/c)

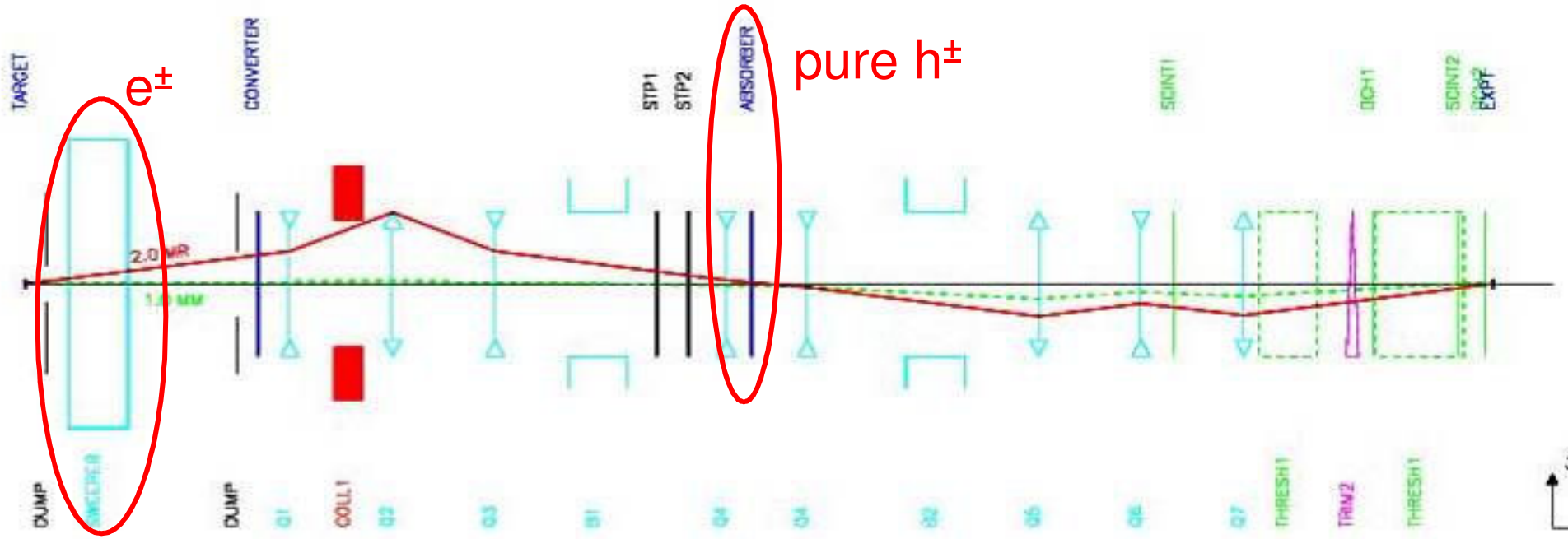
***Inspired by and similar in spirit to West Area rebuild in the end of the 1990's!***

**Uses "dummy magnets"**

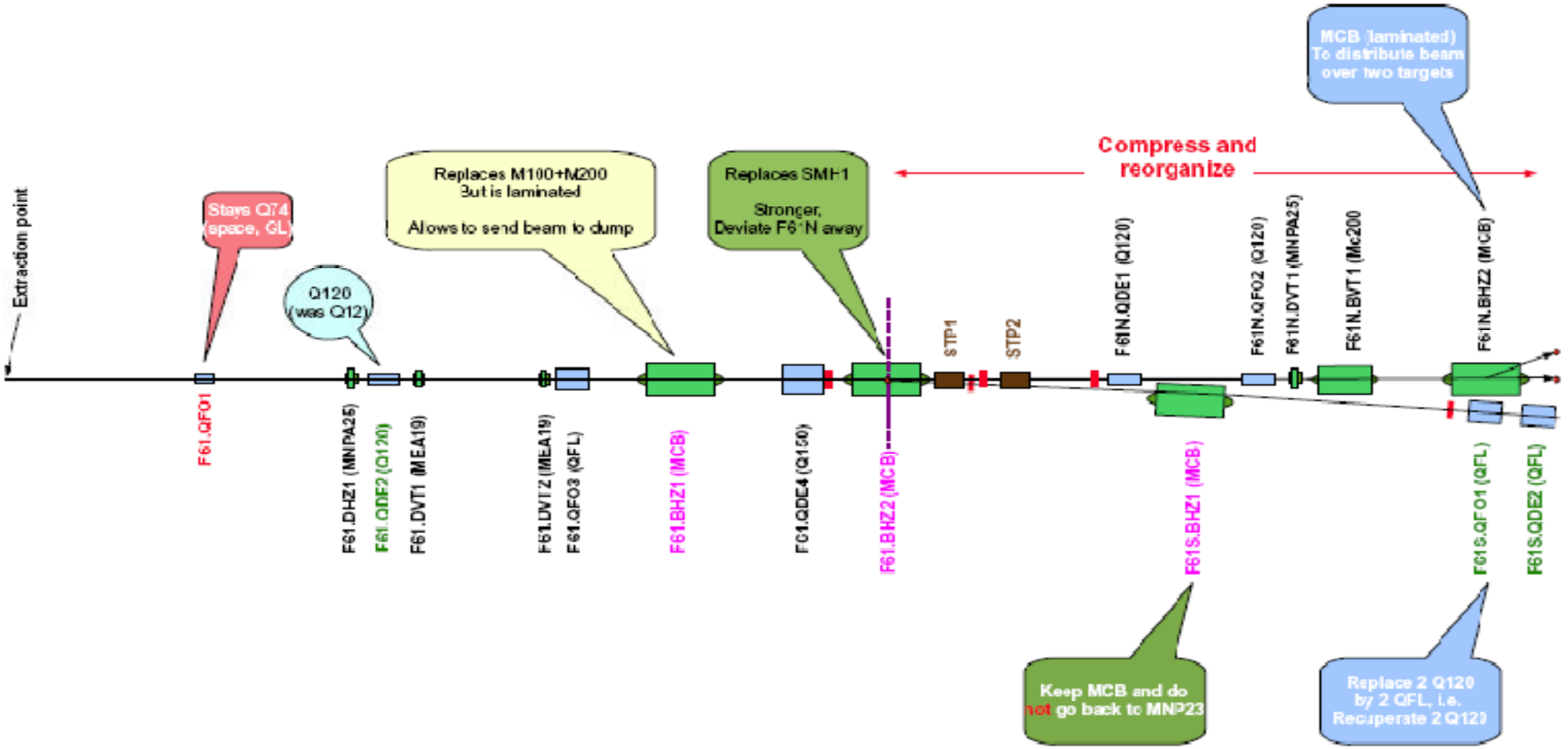
**~5x better transmission than present lines!**

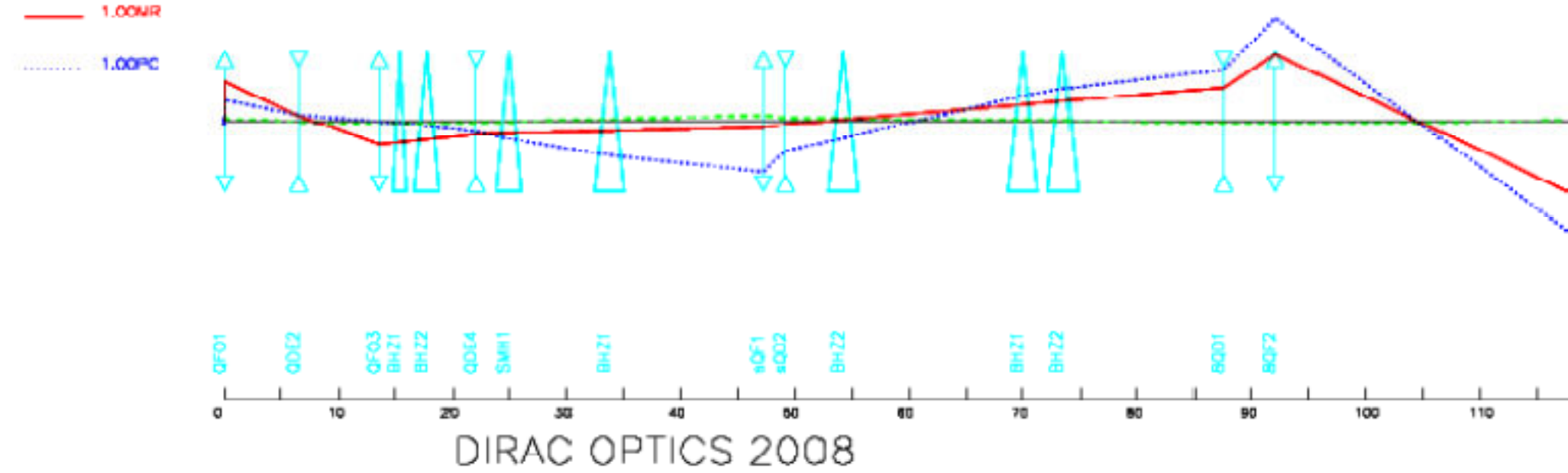


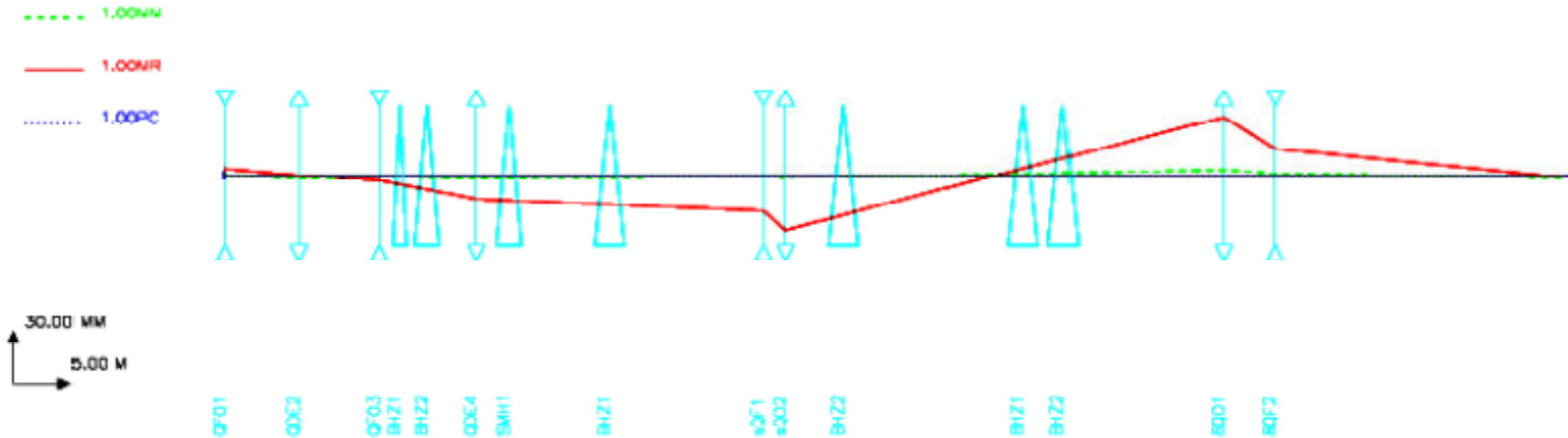

GENERIC EAST AREA TESTBEAM OPTICS

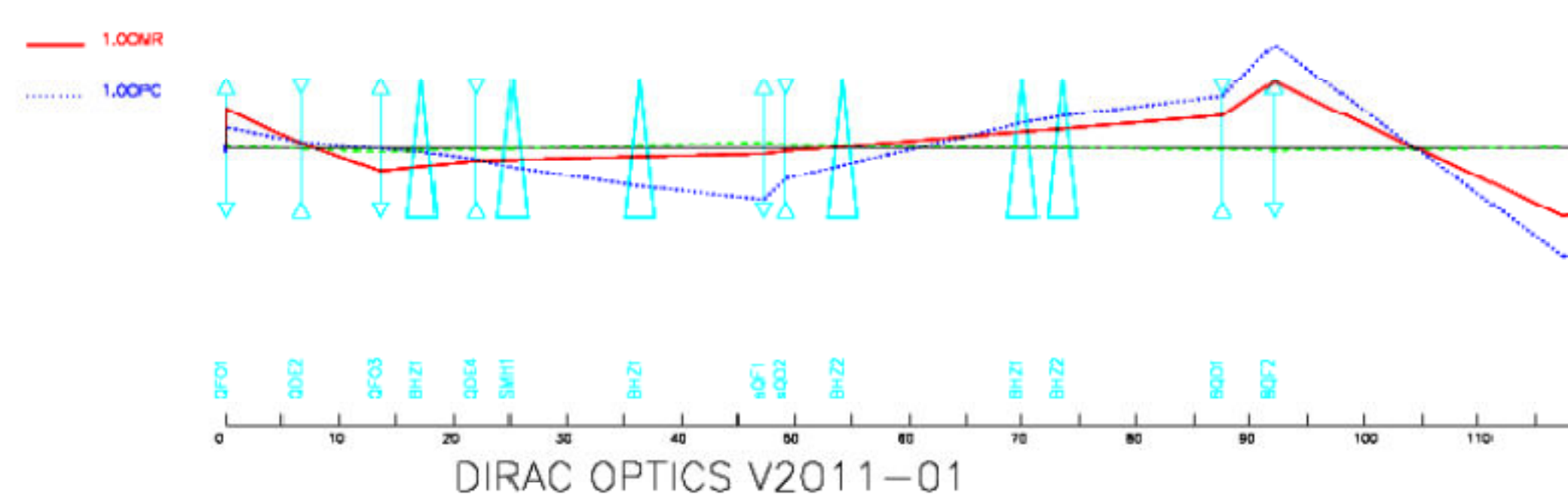


# SCHEMATIC LAYOUT OF NEW EAST AREA PRIMARY BEAM FRONTENDS

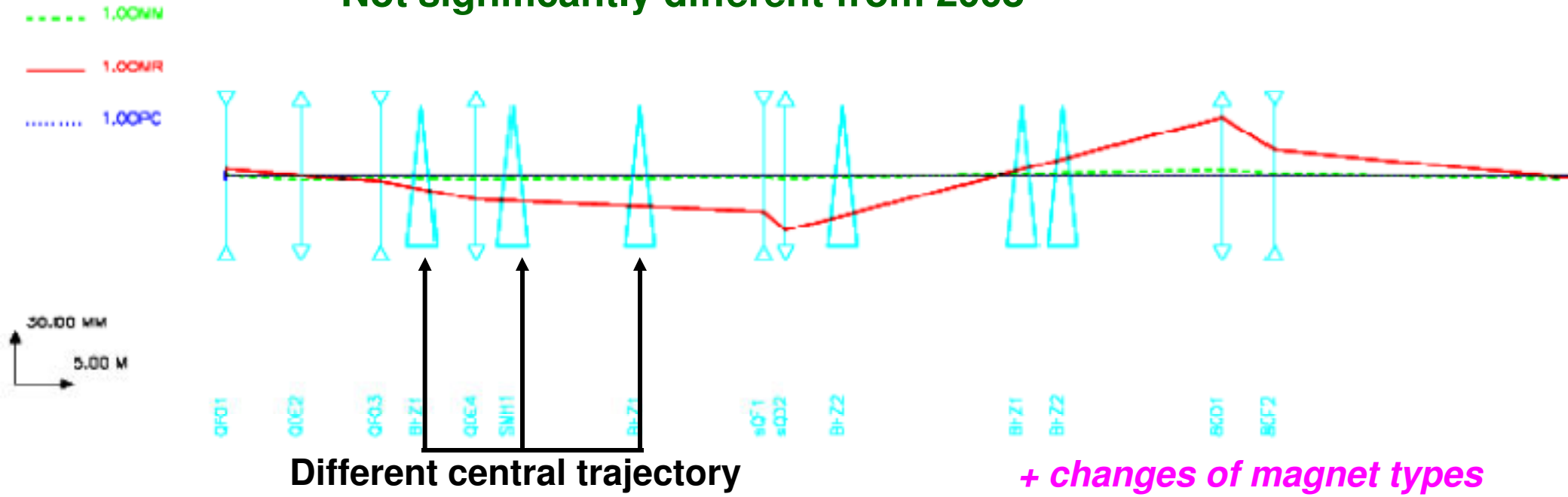



1.00MR
1.00PC
QF01
QDE2
QF03
BHZ1
BHZ2
QDE4
SMH1
BHZ1
sQF1
sQD2
BHZ2
BHZ1
BHZ2
BQD1
BQF2
0
10
20
30
40
50
60
70
80
90
100
110
DIRAC OPTICS 2008


1.00MN
1.00MR
1.00PC
30.00 MM
5.00 M
QF01
QDE2
QF03
BHZ1
BHZ2
QDE4
SMH1
BHZ1
sQF1
sQD2
BHZ2
BHZ1
BHZ2
BQD1
BQF2

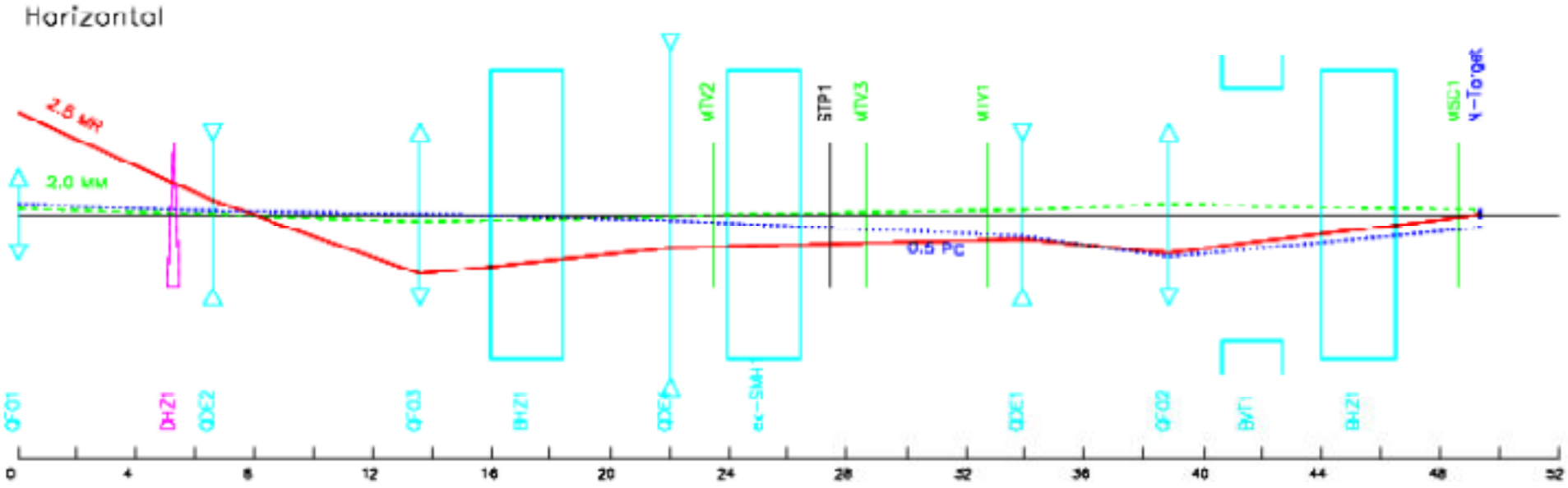



**Not significantly different from 2008**

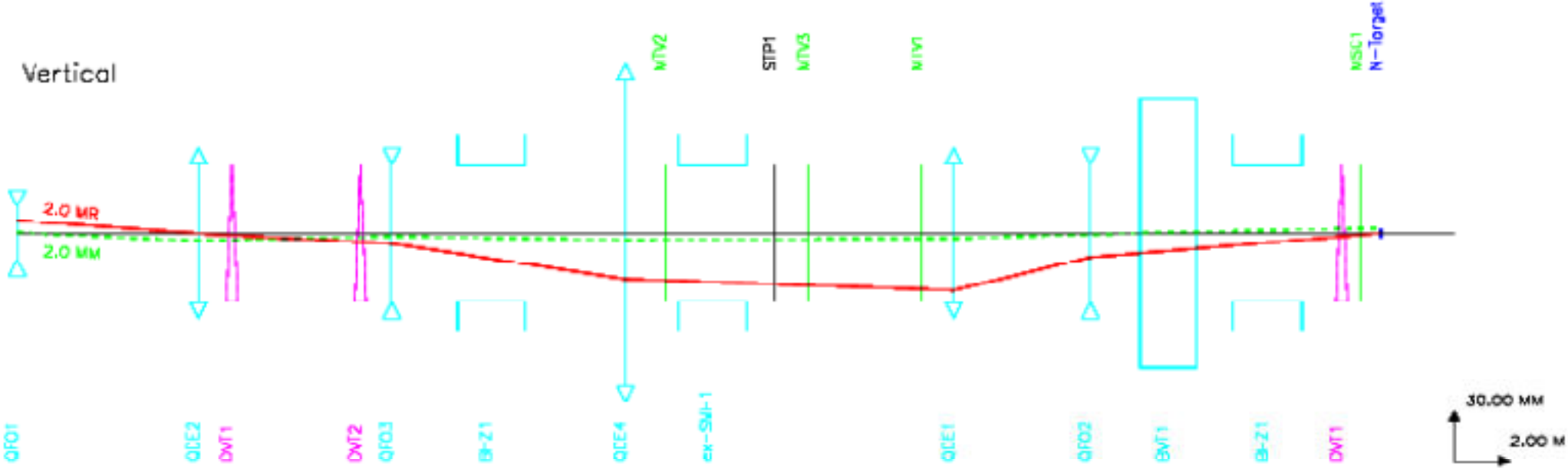



**Different central trajectory**

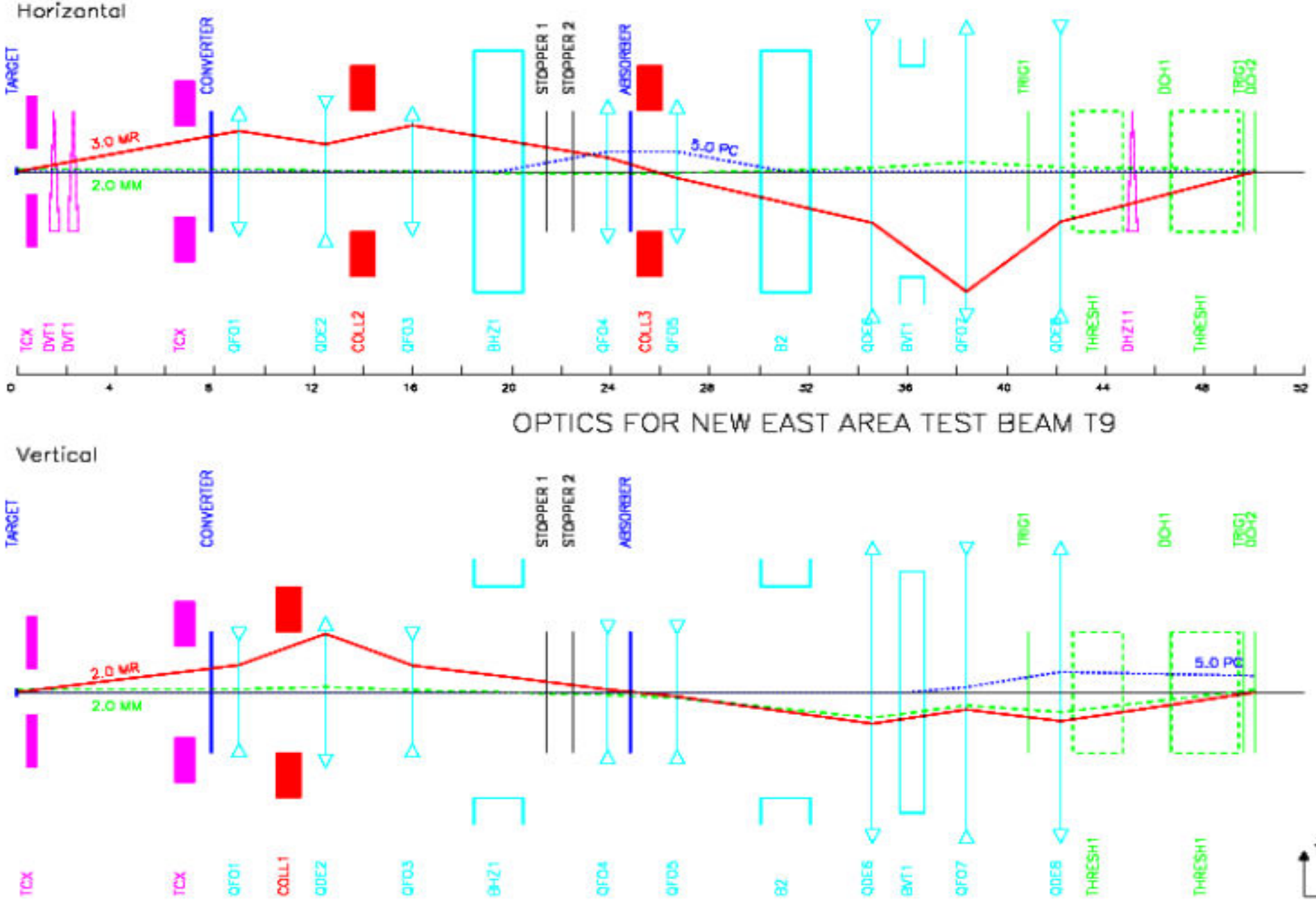
***+ changes of magnet types***




NORTH BRANCH OPTICS V.2011-01

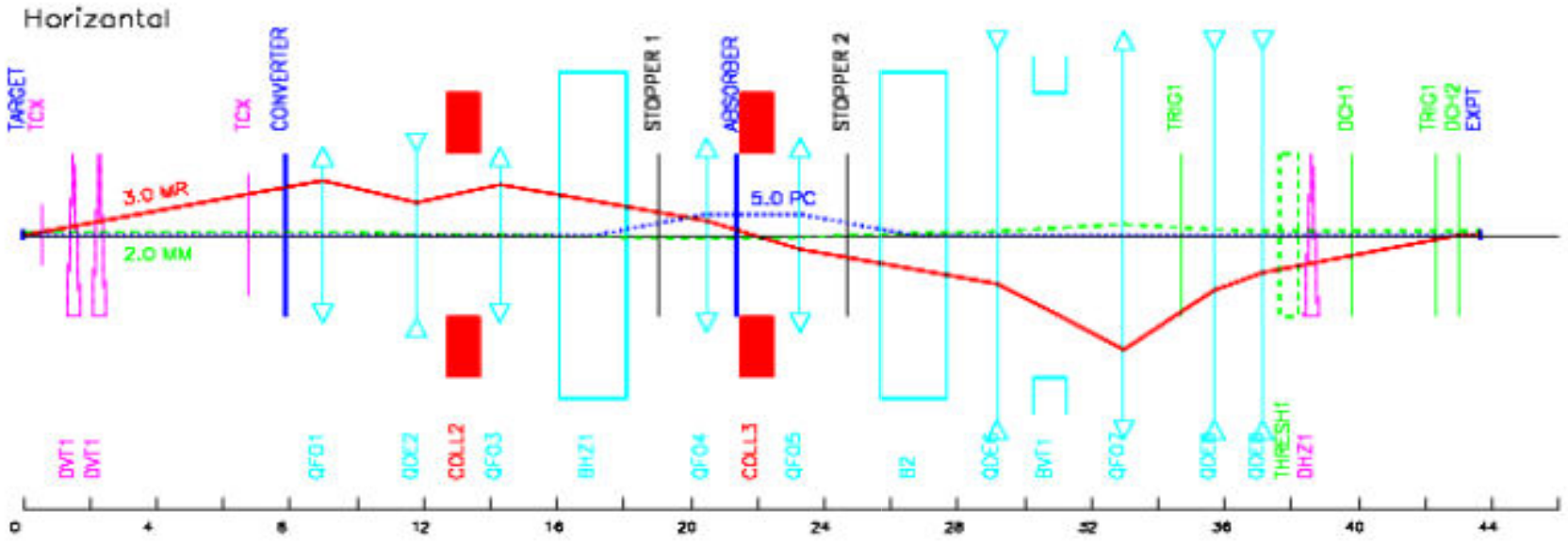


# SECONDARY BEAM → OPTICS FOR "T9++ BEAM" – UP TO 15 GeV/c

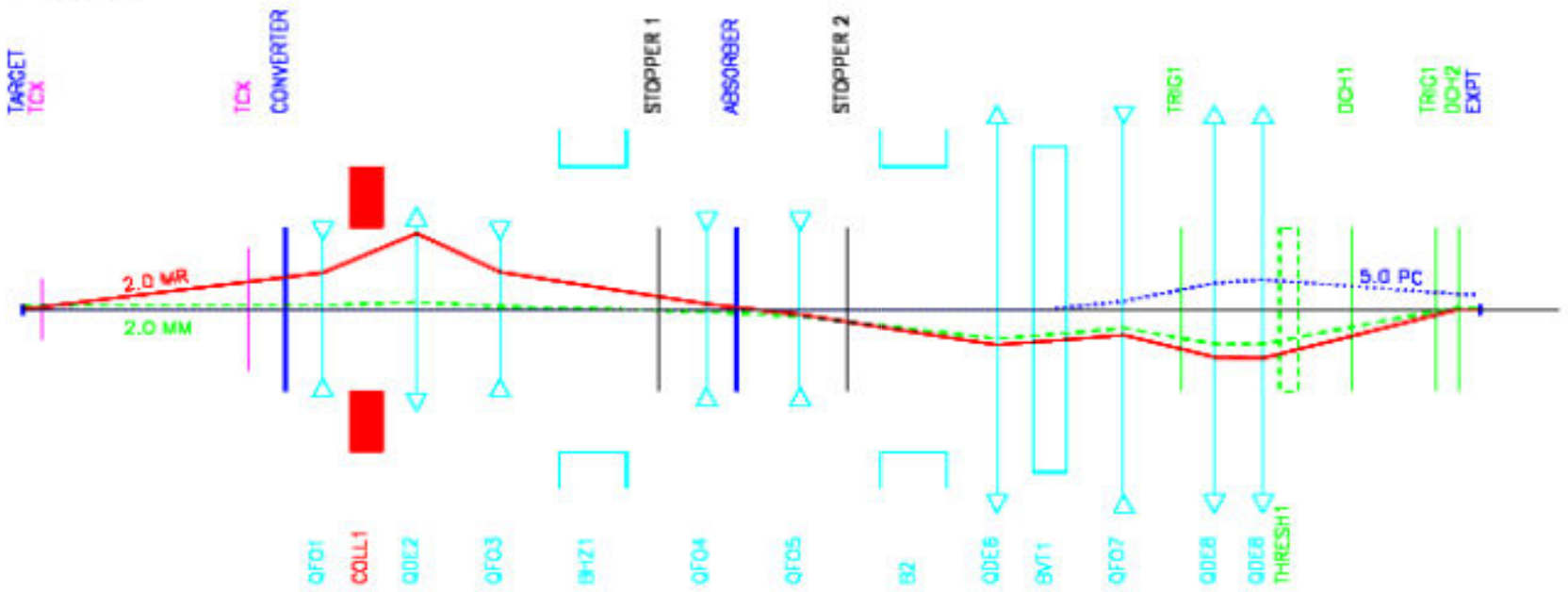



*Even better transmission than generic optics!*

# SECONDARY BEAM OPTICS FOR "T10$^{++}$ BEAM" – UP TO 12 GeV/c




OPTICS FOR NEW EAST AREA TEST BEAM T10

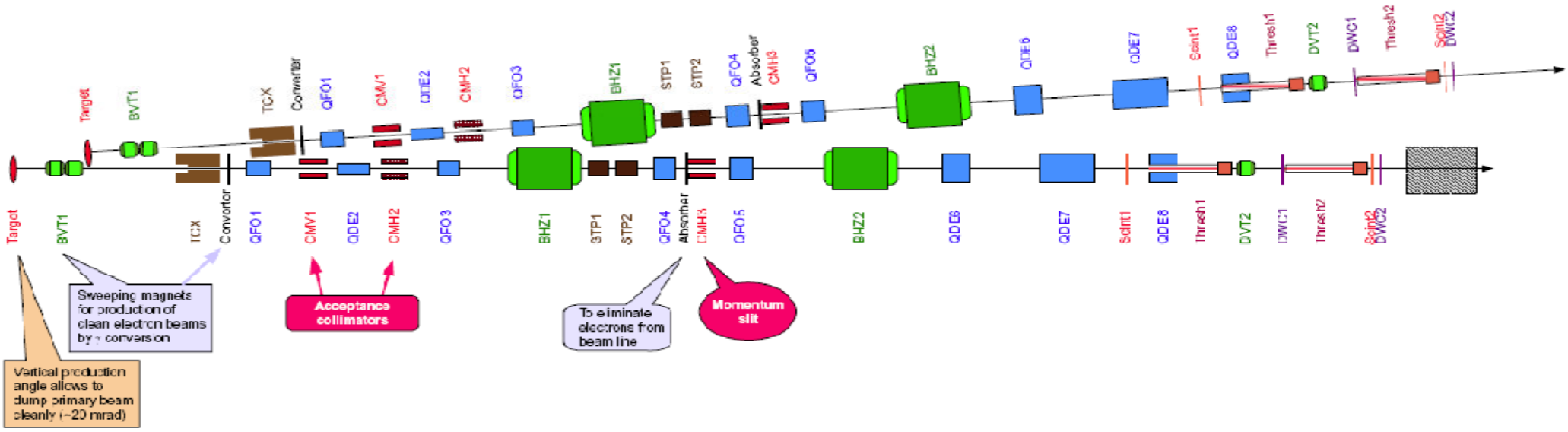


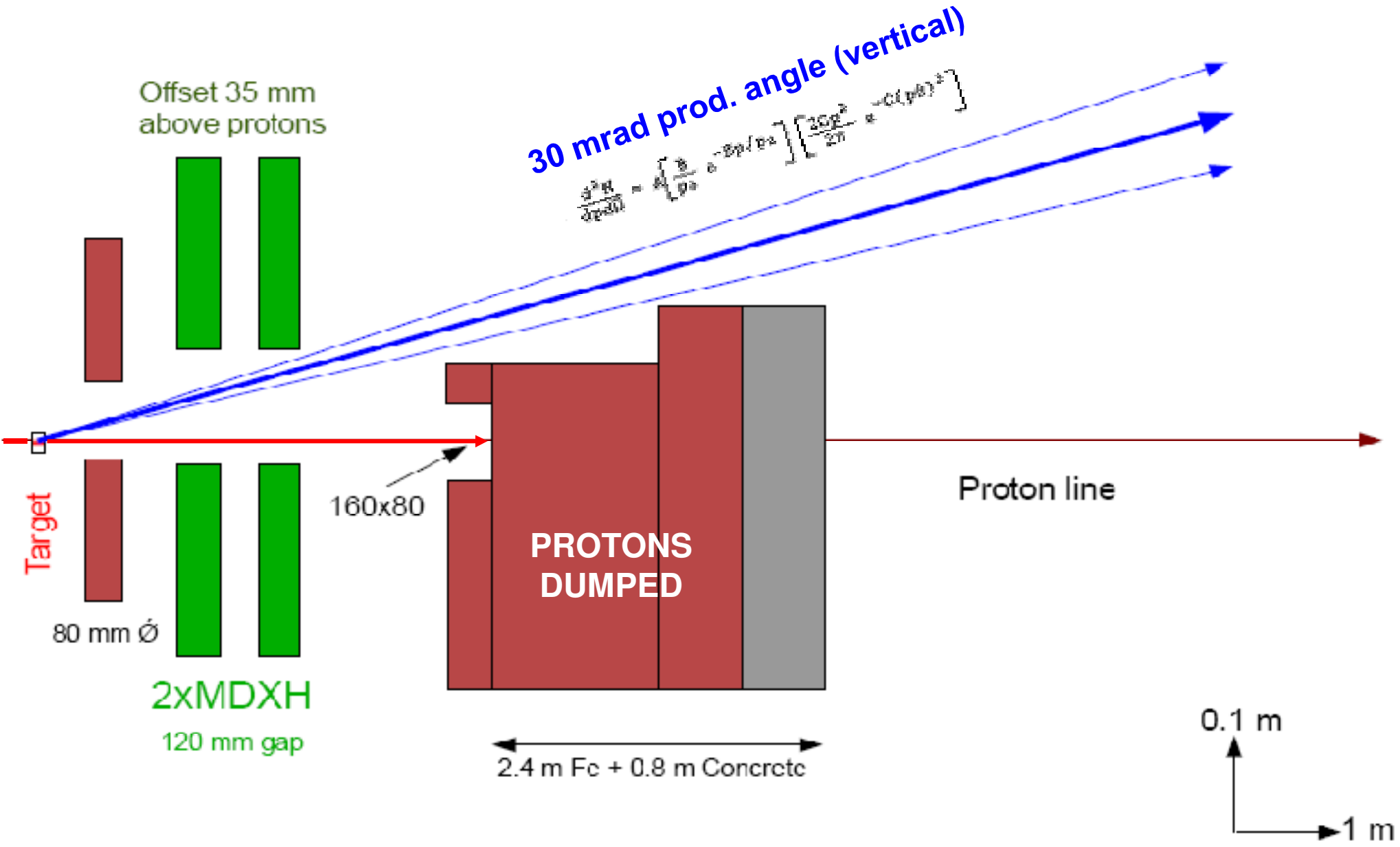

30.00 MM

2.00 M

# SCHEMATIC LAYOUT OF THE TWO SECONDARY BEAMS

## (inspired by “West Area 2000” approach)




Offset 35 mm
above protons
30 mrad prod. angle (vertical)
Target
80 mm Ø
2xMDXH
120 mm gap
160x80
PROTONS
DUMPED
2.4 m Fe + 0.8 m Concrete
Proton line
0.1 m
1 m

# Magnets for new East Area

| Type | # Avail | Locations where used | | | | | | | | | Used | #Spares |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MCB | 10 | BP.BHZ1 | BP.SMH1 | BS.BHZ1 | BS.BHZ2 | BD.BHZ1 | BD.BHZ2 | BP.BHZ1 | BN.BHZ2 | +Spares at SPS | 8 | 2 |
| M100SP | 4 | B1.BVT1 | B2.BVT1 | | | | | | | | 2 | 2 |
| M105 | 3 | BS.DHZ1 | BN.DHZ1 | | | | | | | | 2 | 1 |
| M200SP | 10 | B1.BHZ1 | B1.BHZ2 | B2.BHZ1 | B2.BHZ2 | | | | | | 4 | 6 |
| MC200 | 7 | BN.BVT1 | | | | | | | | | 1 | 6 |
| MEA19 | 8 | BP.DVT1 | BP.DVT2 | | | | | | | | 2 | 6 |
| MNPA25 | 6 | BP.DHZ1 | BN.DVT1 | | | | | | | | 2 | 4 |
| MNPA30 | 7 | BS.DVT1 | BD.DVT1 | | | | | | | | 2 | 5 |
| Q100 | 17 | B1.QDE6 | B1.QDE8 | B2.QDE6 | B2.QDE8 | B2.QDE8b | | | | | 5 | 12 |
| | | | | | | | | | Spares at SPS | | | |
| Q120 | 7 | BP.QDE02 | BN.QDE1 | BN.QFO2 | B1.QDE2 | B2.QDE2 | | | | | 5 | 2 |
| Q200 | 5 | BD.QDE1 | BD.QFO2 | B1.QFO7 | B2.QFO7 | Spares at SPS | | | | | 4 | 1 |
| Q600 | 9 | BP.QDE4 | | | | | | | | | 1 | 8 |
| QFL | 5 | BP.QFO03 | BS.QFO1 | BS.QDE2 | | | | | | | 3 | 2 |
| QFS | 10 | B1.QFO4 | B1.QFO5 | B2.QFO4 | B2.QFO5 | | | | | | 4 | 6 |
| QDS | 12 | B1.QFO1 | B1.QFO3 | B2.QFO1 | B2.QFO3 | | | | | | 4 | 8 |
| Q74 | 2 (?) | BP.QFO01 | | | | | | | | | 1 | 1 |
| MDX | 10 | B1.DVT1a | B1.DVT1b | B2.DVT1a | B2.DVT1b | B1.DHZ1 | B2.DHZ2 | | | | 6 | 4 |
| MEJ15 | 3 | | | | | | | | | | 0 | 3 |

BP = Primary line
BD = DIRAC beam line

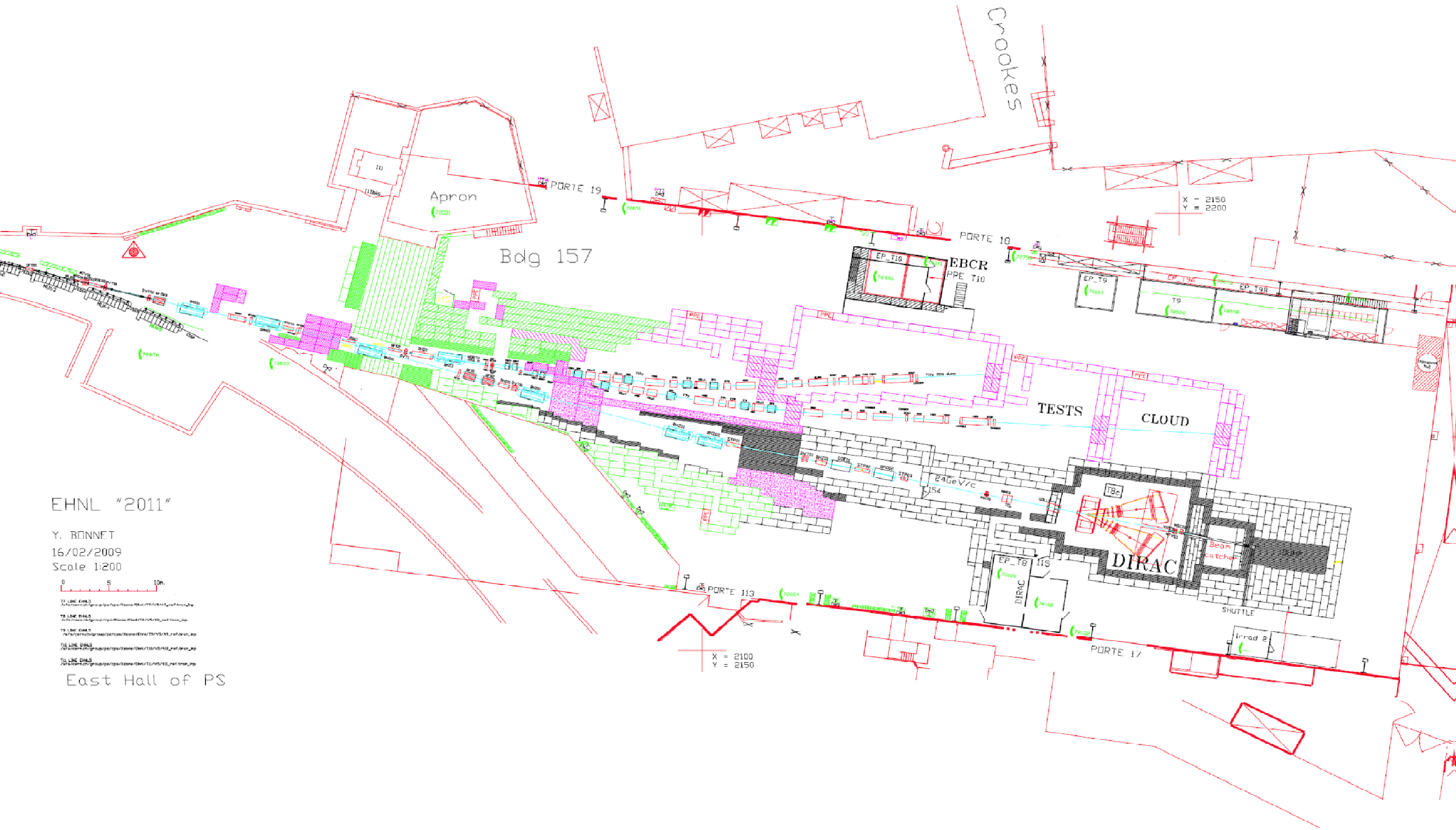
BN=North branch
BS=South branch

B1 = Secondary beam #1
B2 = Secondary beam #2

Green shading = spares
Red shading = unavailable

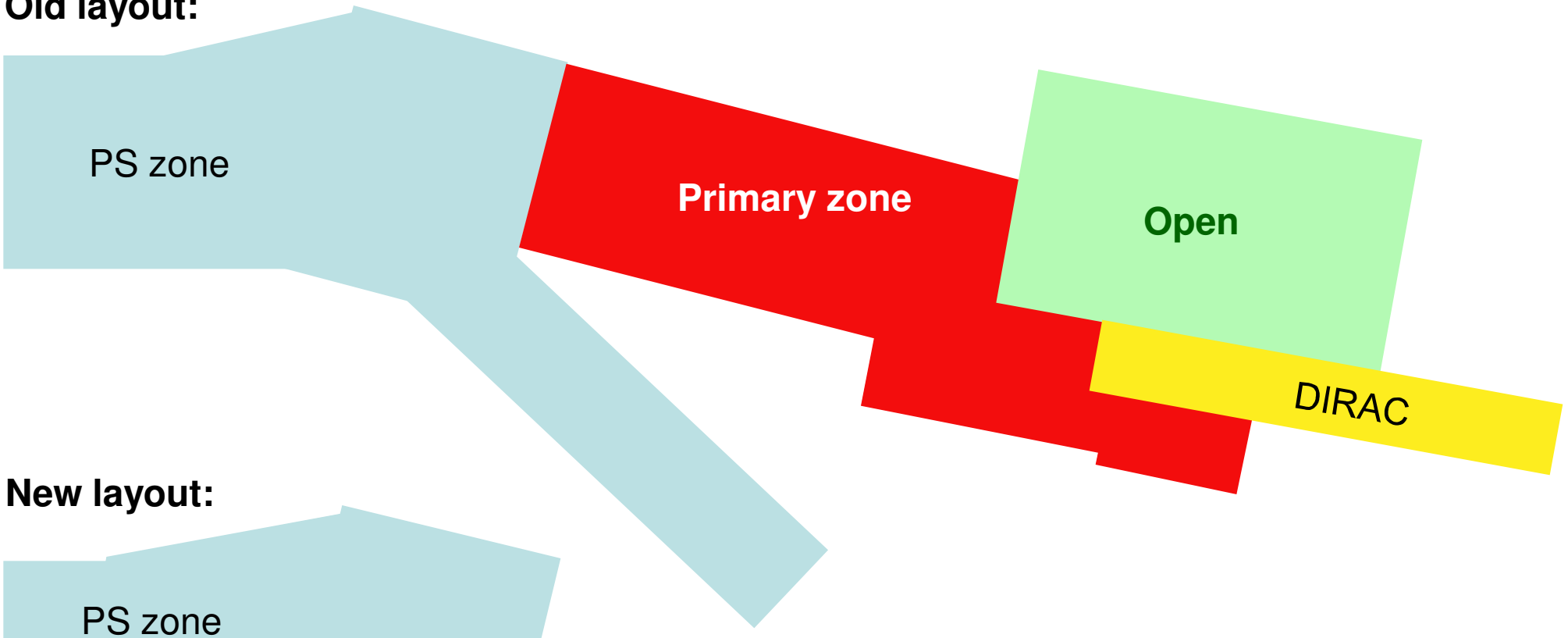
# And this is how it looks ‘on the floor’:

**2009 version**

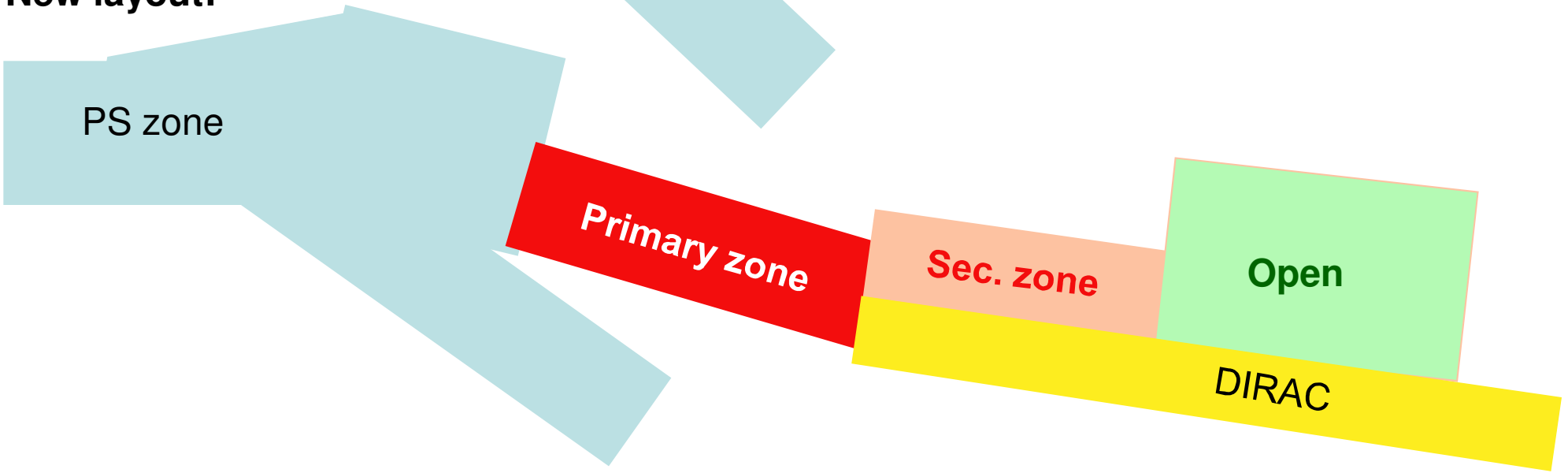


*The shapes are made as overlays on the old, respectively new layout drawing, on the same scales*

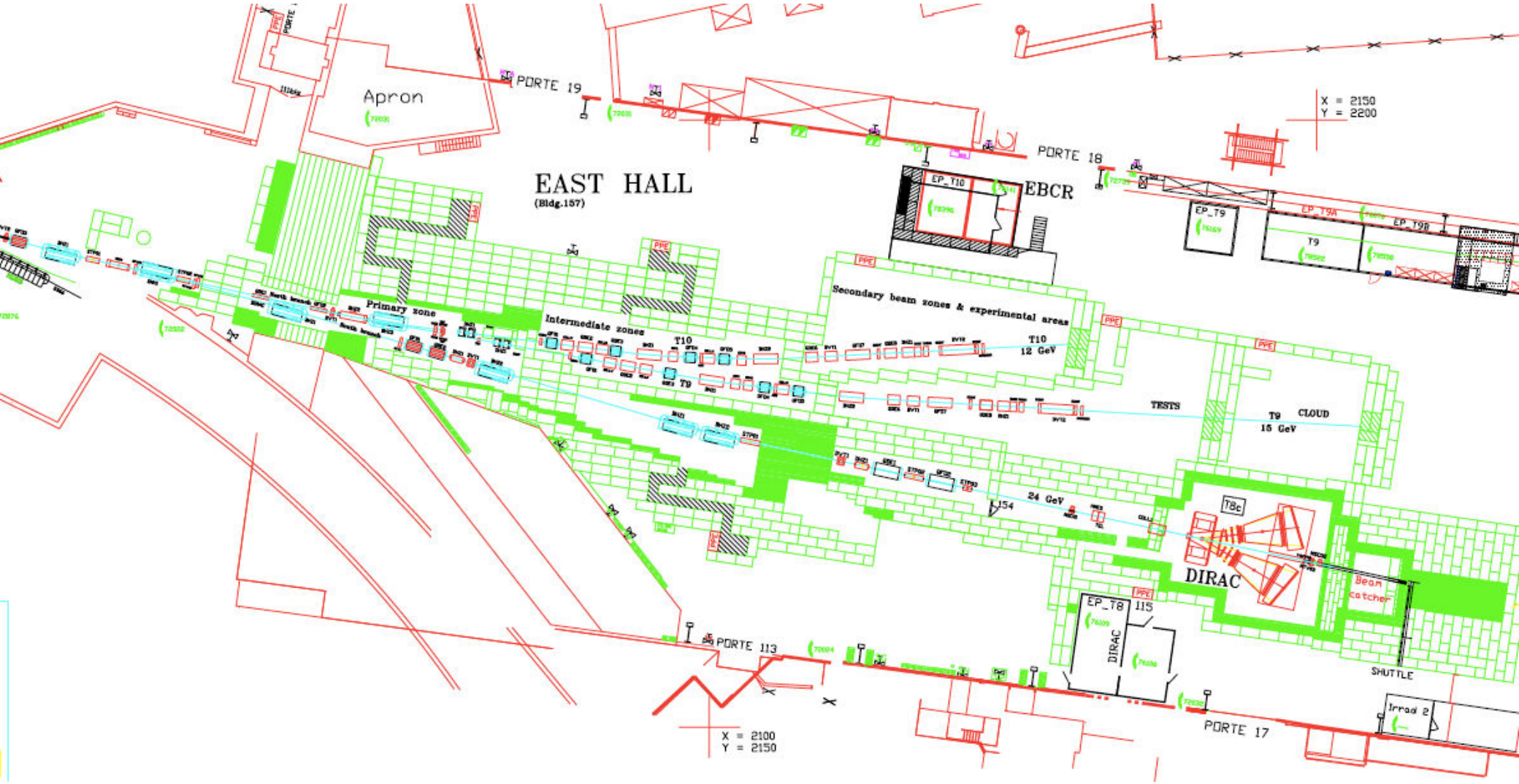
**Old layout:**



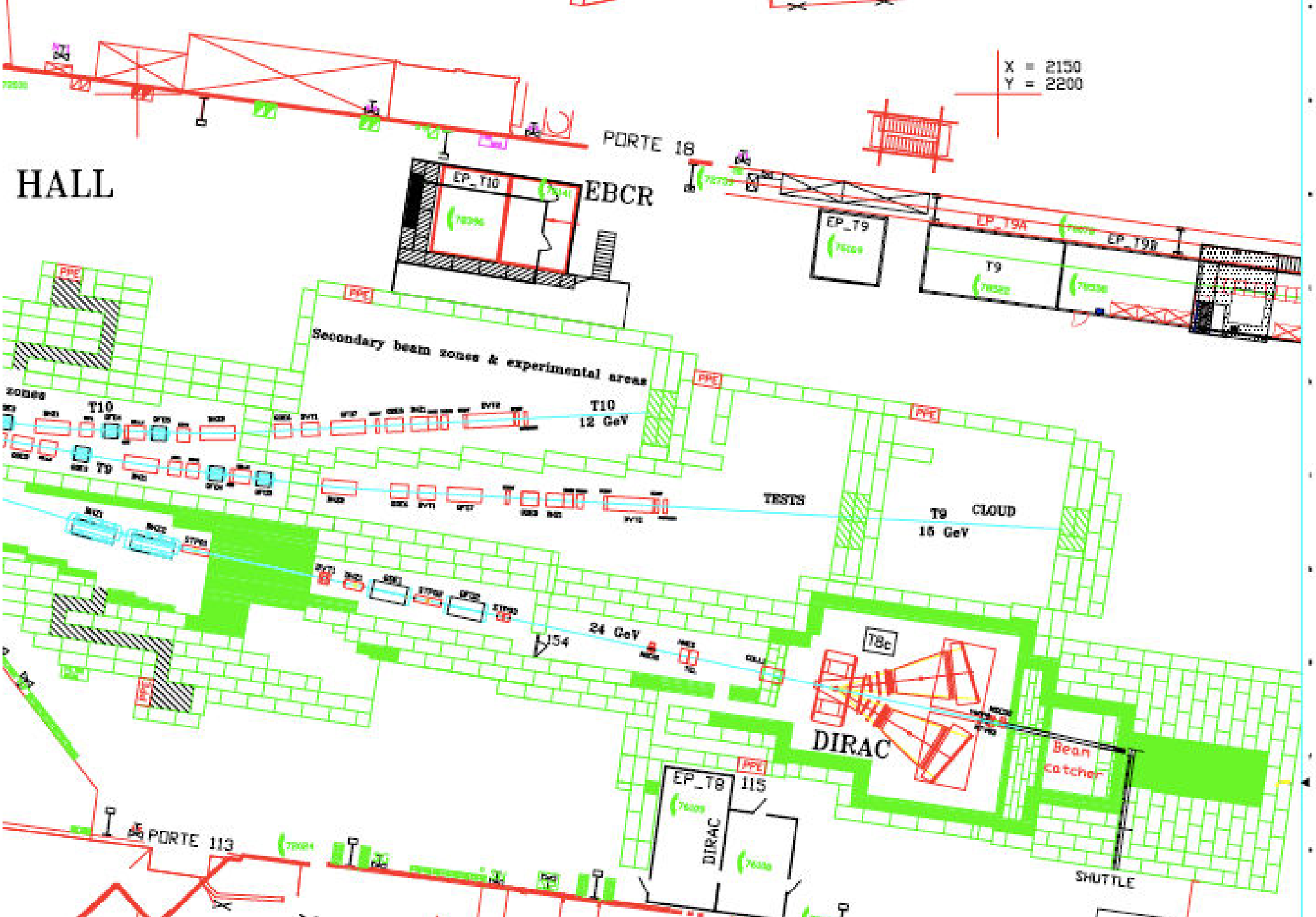

**New layout:**



# Proposed layout, 2010 version:




PORTE 17
PORTE 19
Apron
EAST HALL
(Bldg.157)
Primary zone
Intermediate zone
T10
79


X = 2150
Y = 2200
HALL
PORTE 18
EBCR
EP_T10
EP_T9
EP_T9A
EP_T9B
T9
Secondary beam zones & experimental areas
zones
T10
T10
12 GeV
T9
TESTS
T9 CLOUD
15 GeV
24 GeV
154
T8c
DIRAC
Beam catcher
SHUTTLE
EP_T8
115
DIRAC
PORTE 113

# What does this mean (2009 slide) ?

- Compatibility with requirements from DIRAC/IRRAD and CLOUD
- More flexible and better test beams, but (effectively <) 1 less

  *Higher top momenta, small production angles, choice of particle type*
- Only use agreed 'healthy' magnets with sufficient spares

  *All magnets and rectifiers exist – reduced cost*
- Primary beam is dumped almost immediately after target

  *High (also induced) radiation levels restricted to minimal areas*
- Very restricted number of magnets is under heavy roof shielding
  The ones in a limited zone following the primary area have only a thin roof shield.
  Many have no roof shielding.

  *RP simulations are required to see whether the latter shield can be avoided*
- Restricted material cost but lots of reshuffling of lines and shielding

# Questions left open last year

- Radioprotection studies to confirm reduction of shielding
- Costs, resources
  - Transport and handling
  - Magnets and rectifiers + infrastructure
  - Instrumentation, controls
  - Vacuum
  - Radioprotection
  - …..
- Timeline

# Transport and handling resources

| Activity | Time (months) |
|---|---|
| Roof dismantling | 1.5 |
| Magnets removal | 0.5 |
| Wall removal (T7, T10, T11) | 0.5 |
| Install new walls | 1 |
| Install concrete platforms under magnets | 1 |
| Install new magnets | 1 |
| Install new roof | 1 |
| **Total** | **6.5 months** |

Estimate assumes a team of 3 persons

**Hence required ~ 20 man months**

# Cost for rectifiers and magnets:

| Item | Cost (kCHF) |
|---|---|
| **5 Rectifiers (4 +1 spare)** | **185** |
| **Rectifier Re-cabling, controls, installation, FGC3** | **45** |
| Magnet refurbishment material+labour | 97 |
| Cabling of magnets | 130 |
| Hydraulic connections (reusing tubes) | 20 |
| **Total** | **477** |

***The PO group recommends this even if we do not change the layout***

***On the longer term a more complete consolidation / renovation of the old rectifiers in the East Area will become necessary. A full consolidation might cost ~ 2.8 MCHF. Again, independently of whether the layout is changed or not.***

# POWER SUPPLY REQUIREMENTS PRIMARY BEAMS

*Preliminary*

*Courtesy J.L.Blanc*

| Magnet | $I_{max}$[A]/ $V_{max}$ [V] | TB | Rectifier |
|---|---|---|---|
| **PRIMARY LINE** | | | |
| BP.QFO1 | 650 | 24 | R2g.06 |
| BP.DHZ1 | 600/60 | 27 | R2g.07 |
| BP.QDE2 | 400/80 | 14 | R1.14 |
| BP.DVT1 | 250/70 | 20 | T1b.04pp |
| BP.DVT2 | 250/70 | 8 | R1.15 |
| BP.QFO3 | 400/40 | 28 | R1.16 |
| BP.BHZ1 | 600/120 | 5 | R2g.08 |
| BP.QDE4 | 350/140 | 7 | R2g.09 |
| **SOUTH BRANCH** | | | |
| BS."SMH1" | 500/100 | 16 | R2b.02 |
| BS.BHZ1 | 300/50 | 10 | R1.18 |
| BS.QFO1 | 400/40 | 12 | R1.17 |
| BS.QDE2 | 400/40 | 21 | R2b.04 |
| BS.DHZ1 | 180* | 301 | T1b.01pp |
| BS.DVT1 | 600/80 | 2 | R2b.05 |
| BS.BHZ2 | 800/150 | 9 | R3.02 |

| Magnet | $I_{max}$[A]/ $V_{max}$ [V] | TB | Rectifier |
|---|---|---|---|
| **DIRAC LINE** | | | |
| BD.BHZ1 | 400/80 | 92 | R2g.01 |
| BD.BHZ2 | 400/80 | 93 | R2g.02 |
| BD.DVT1 | 200/40 | 302 | T1b.05pp |
| BD.DHZ1 | 480*/30 | 303 | T1b.03pp |
| BD.QDE1 | 500/100 | 103 | R2g.03 |
| BD.QFO2 | 500/100 | 105 | R2g.04 |
| SPECTRO | 2500 | | R6.01 |
| **NORTH BRANCH** | | | |
| BN.QDE1 | 250/50 | 30 | R10.01 |
| BN.QFO2 | 300/60 | 17 | R3.03 |
| BN.DVT1 | 400*/60 | 15 | R3.04 |
| BN.BHZ2 | 800/100 | 1 | R3.05 |
| BN.BHZ3 | 880/200 | 25 | R2b.06 |

*) Same limit as before

En rouge: nouveaux convertisseurs
À fabriquer

# POWER SUPPLY REQUIREMENTS SECONDARY BEAMS

*Preliminary*

*Courtesy J.L.Blanc*

| Magnet | $I_{max}$[A]/ $V_{max}$ [V] | TB | Rectifier |
|---|---|---|---|
| "T9 BEAM" | | | |
| T9.DHZ1 | 240/150 | 33 | R2.01 |
| T9.QFO1 | 350/25 | 34 | R2.02 |
| T9.QDE2 | 350/80 | 36 | R2.03 |
| T9.QDE3 | 350/25 | 49 | R2.04 |
| T9.BHZ1 | 600/150 | 38 | R2G.10 |
| T9.QFO4* | 350/30 | 53 | R2.05 |
| T9.QFO5* | 350/30 | | |
| T9.BHZ2 | 600/150 | | R2G.05 |
| T9.QDE6 | 700/150 | 44 | R2B.01 |
| T9.BVT1 | 450/120 | 31 | R2.06 |
| T9.QFO7 | 600/120 | | R2B.07 |
| T9.QDE8 | 700/150 | 50 | R2B.03 |
| T9.DHZ1 | 240/80 | 43 | R2.07 |
| T9.DVT2 | 240/80 | 41 | R2.08 |

| Magnet | $I_{max}$[A]/ $V_{max}$ [V] | TB | Rectifier |
|---|---|---|---|
| "T10 BEAM" | | | |
| T10.DHZ1 | 240/150 | 89 | R2.09 |
| T10.QFO1 | 400/30 | 66 | R2.11 |
| T10.QDE2 | 450/80 | 48 | R2.12 |
| T10.QDE3 | 400/30 | 52 | R2.13 |
| T10.BHZ1 | 750/200 | 51 | R3.07 |
| T10.QFO4* | 500/50 | 54 | R2.14 |
| T10.QFO5* | 500/50 | | |
| T10.BHZ2 | 750/200 | 59 | R3.08 |
| T10.QDE6 | 600/150 | 32 | R3.01 |
| T10.BVT1 | 600/150 | 55 | R3.06 |
| T10.QFO7 | 600/150 | | R2B.08 |
| T10.QDE8 | 400/160 | 56 | R2.15 |
| T10.DHZ1 | 240/80 | 60 | R2.16 |
| T10.DVT2 | 240/80 | | R2.10 |

En orange: redresseurs déplacés du ERB3 à EGB

55 alimentations (53 avec aimants en série)

*) *Could be connected in series*

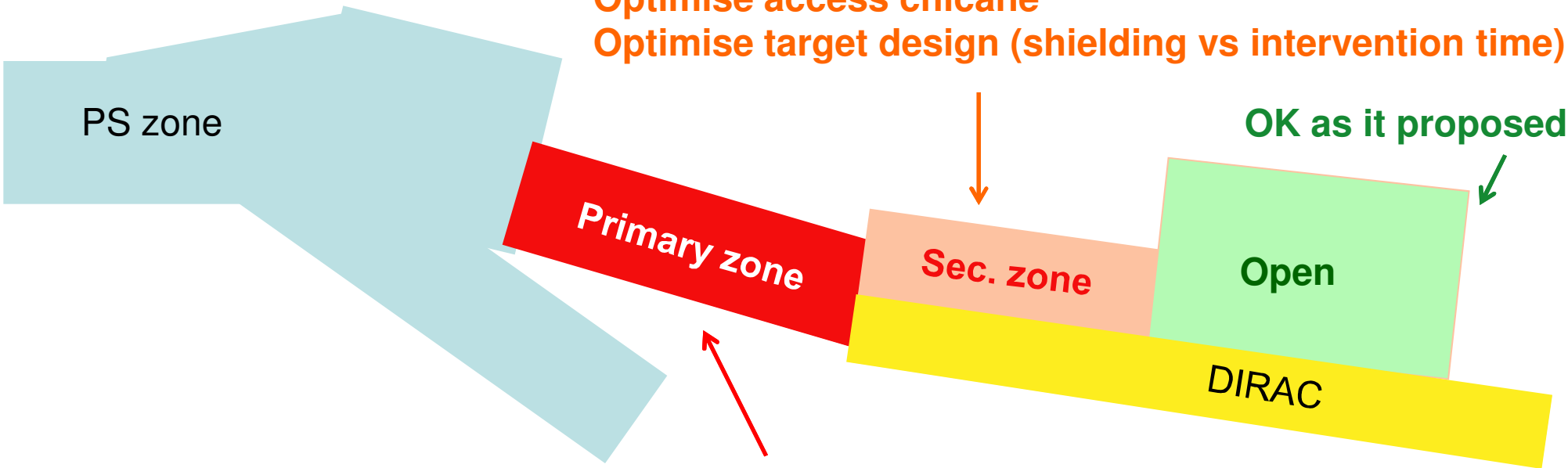
# SHIELDING AND RP ISSUES

Carefully studied by Thomas Otto / RP

**Thickness of shielding 2.4 m (as shown before)**
**Height of walls > 4 m to reduce sky-shine**

**No roof shielding required**

**Optimise access chicane**
**Optimise target design (shielding vs intervention time)**




**OK as it proposed**

**Side shielding thickness 6 to 6.4 m (as now)**
**2.4 m roof shielding, i.e. 0.8 m Fe + 1.6 m Concrete**
**Need ventilation (cf nTOF target area)**
**Optimise entrance chicane**

# Cost of Ventilation

Th.Otto requests a ventilation system for the small primary zone, similar to the one implemented for the nTOF target area.
This would also evacuate Ozone from the area, which now stays and affects the equipment in that zone (corrosion of magnets etcetera).
Evacuation of the extracted air via the roof of B157

For the cost we quote the cost of the nTOF installation as an example

| Item | Cost |
|---|---|
| Cost of nTOF cooling station | 35 keuro |
| Ventilation monitoring station | 50 keuro |
| **Total** | **130 kCHF** |

It would probably reasonable to to foresee a ventilation for the primary area even if the layout would not be changed

# Cost of Vacuum

| Item | Cost (kCHF) | FTE |
|---|---|---|
| Chambers (~50 x 2.5 kCHF) | 125 | |
| Windows | 10 | |
| Controls | 50 | |
| Manpower (2x1 month FSU + staff) | 20 | 0.2 |
| **Total** | **205** | **0.2** |

***To be confirmed***

# Other Costs

| Item | Cost | FTE |
|---|---|---|
| Modifications access doors | 40 kCHF | |
| Survey work 2.1 months x 2 persons | | 0.4 |
| Radioprotection 1 technician during dismounting, 0.5 technician during remounting | | 0.5+0.25 |
| Radioprotection infrastructure | 20 kCHF | 0.1 |
| Beam instrumentation *) | 10 kCHF | 0.1 |
| Upgrade threshold counters to NA standard *) | 20 kCHF | 0.2 |
| Displacement T9/T10 gas zone | 50 kCHF | |
| Coordination, superintendance, project management | | 0.5 |

*) Based on 2004 estimate in the framework of Renovation Programme Committee

# Side remark (2009 slide):

In 2005 a proposal was made to **upgrade the controls** of the East Area.
For the moment in the East Area there is:

- no remote control / readout of collimators
- control of magnet currents only by working sets and knobs
- no easy and convenient beam files
- no remote reading of access system and vacuum state
- no user applications for reading of beam instrumentation

*However, one delay wire chamber + a scintillator were added per beam since then*

It seems that this could be an occasion to **migrate the East Area controls to Cesar** (i.e. the recently upgraded North Area controls).

At the time the resource estimate (excluding DWC + scints) were about 80 kCHF for VME crates + Cerenkov upgrades plus a number of man months on the software side. Now part of this upgrade has been done already (timing, VME).

# Cost of controls upgrade

| Item | COST | |
|---|---|---|
| Motorisation upgrade (PLC + FESA gateway) for 6 COLLS + 2 absorbers + 2 converters | < 80 kCHF | EN-STI |
| CESAR extension to East Area, depending on experience of the person (without general CESAR consolidation also for NA) | 0.5-1 FTE | BE-CO |
| Full consolidation also for NA CESAR *) (NETBEANS replacement, integration with LSA, ..) | 0.5 - 1 FTE | BE-CO |
| PC's in user barracks | < 10 kCHF | |
| **Total** | **90 kCHF + 0.5-2 FTE** | |

*) Independent of East Area project but considered useful by BE-CO to combine the two

# Summary of costs:

| Item | Specific cost Material | Specific cost FTE | Useful anyway Material | Useful anyway FTE |
|---|---|---|---|---|
| Transport and handling | | 0.85 | | |
| Rectifiers | 45 | | 185 | |
| Magnets, cabling, cooling | 250 | | | |
| Ventilation | | | 130 | |
| Vacuum (incl. FSU | 205 | 0.2 | | |
| Access | 40 | | | |
| Survey | | 0.4 | | |
| Radioprotection | 20 | 0.85 | | |
| Controls | | | 90 | 0.5-2 |
| Other costs (BI, gas, …) | 80 | 0.3 | | |
| Project management | | 0.5 | | |
| **Total cost** | **640** | **3.1** | **410** | **0.5-2** |

**Grand total: ~ 1050 kCHF + ≤ 5 FTE**

## Consolidation of East Area recommended independent of this project

- Ventilation of primary area would reduce Ozone impact on magnets anyway
- Replacement of old rectifiers (R2A and R2) to be considered anyway
  and of most rectifiers in the not too distant future
- Upgrade of controls would be a good thing even in case of no layout change
- In the long term migration from ARCON to RAMSES-2 will become necessary
  Approximate cost 300 kCHF, foreseen in consolidation project.
  The migration to Ramses-2 should be kept in mind during the installation work
  of this project.
- The air conditioners are mostly in a pitiful state and need replacement

# Proposed time line (2009)

- CLOUD changes from Mk2 to Mk3 module in 2011 (tbc)
  This requires a larger beam and a larger zone (T11 → T9B zone)
  It seems reasonable to synchronize the EA modifications with this change
- DIRAC / IRRAD future not well understood at this moment
  but new design is essentially decoupled from this question

**2012+?**

**Run in 2010 "certain"**
**Will request run in 2011 (long-lived atoms)**

Rebuild of parts inside PS and of primary zone in **shutdown 2010/11**, provided CLOUD has completed its Mk2 program

Continue construction of test beams during the 2011 run
Could probably continue operation of DIRAC during 2011 with some additional local shielding at exit of the primary zone

**2011/12?**

Total duration of project: **first estimates 8-12 months**

Taking into account

- The timescales of CLOUD and DIRAC as they are known today,
- The recent announcements concerning a long LHC run, i.e. (to my understanding) no long shutdown in 2010/11,
- That the management is launching studies how to prolong the lifetime of the of the present injector complex (including the PS) by at least another 15-25 years

it seems that **starting the work end 2011/early 2012** could be a convenient option. It could then be completed in time for the 2013 start-up

**The duration of the work has been estimated to be less than one year** (9 months)**,**
**The part affecting PS operation within 4 months**

# CONCLUSIONS

- The design of a new East Area layout presented at the previous IEFC workshop has been validated (with very minor modifications) in terms of its radioprotection merits
- It uses reliable equipment and improves greatly their accessibility and maintainability
- The cost is around 1 MCHF + 4-5 FTE, even including some changes which should even be considered if the layout is not changed.
- The change can be done within one year, with at most 4 months stop for the PS, and the year 2012 seems a possible period in terms of the East Area physics prospects and the latest planning for LHC operation and shutdowns.
- A non-exhaustive list has been shown of some items that need further consolidation if the East Area has to be operated for another 15-25 years or more.

**Thanks to all who have helped in preparing this work.**
**Particular mention to:**

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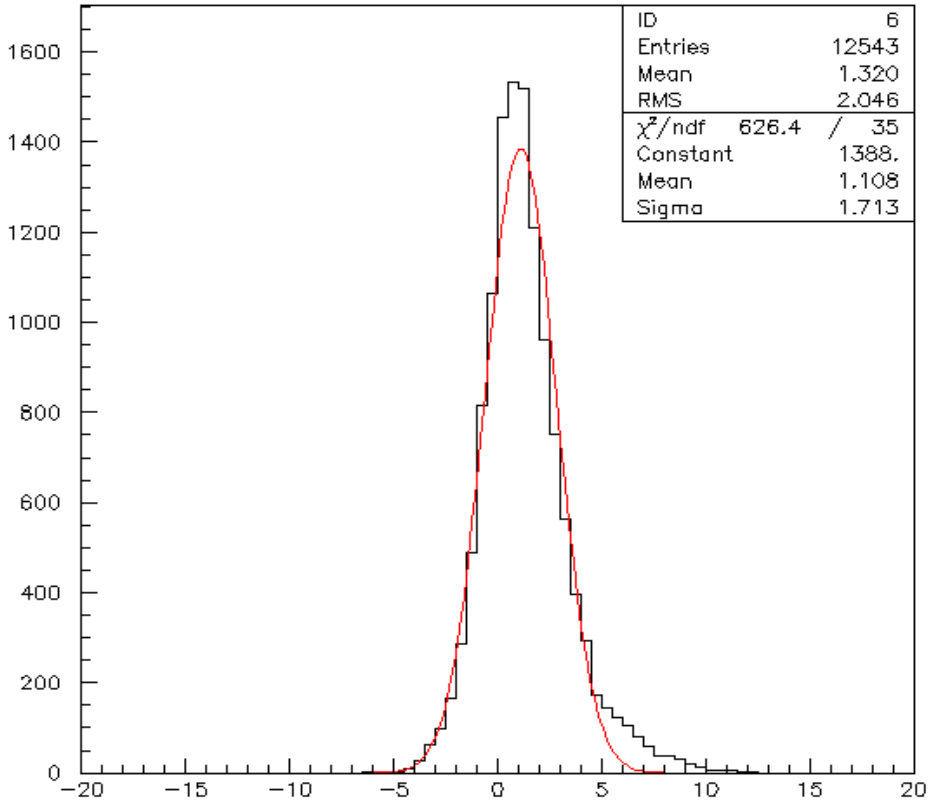
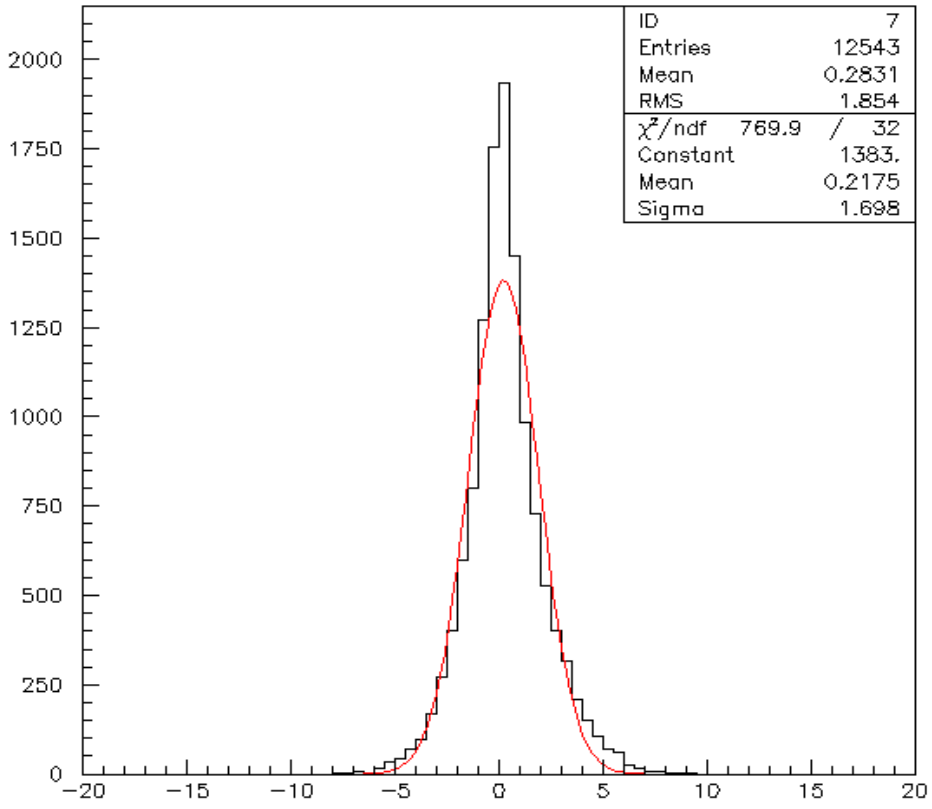
Yannick Body, Jan Hansen, Michael Lazzaroni, Gilles Le Godec,
Patrick Lelong, Alessandro Masi, Robert Mollay, Thomas Otto,
Jens Spanggaard, Davide Tommasini, Giovanna Vandoni, Markus Widorski,
…

# Spare slides

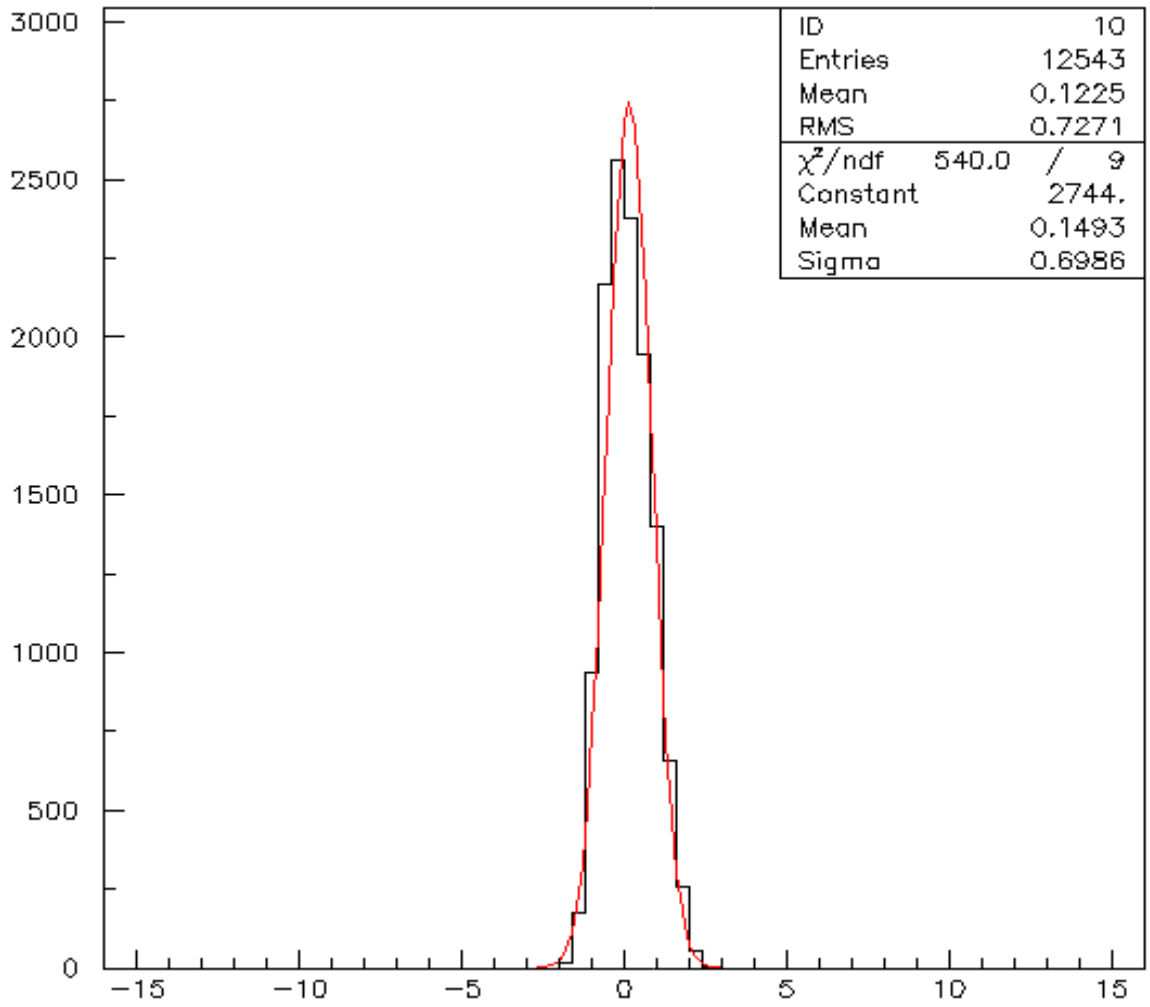
# TURTLE SIMULATION (for $C1_{ACCV}$=$C2_{ACCH}$ = ±40 mm, $C3_{\Delta P}$ = ±1 mm)




X in mm




Y in mm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Entries 12543
Mean 0.1225
RMS 0.7271
χ²/ndf 540.0 / 9
Constant 2744.
Mean 0.1493
Sigma 0.6986
3000
2500
2000
1500
1000
500
0
−15
−10
−5
0
5
10
15

**Δp/p in %**

# COMPLETE RECTIFIER CONSOLIDATION – Part I

| Logical Name | Designation Imax(A)/Umax(V) calcul selon caractéristiques Aimants | Last upgrade | Next upgrade | Consolidation Cost (CHF) 2009 ESTIMATION |
|---|---|---|---|---|
| **PRIMARY LINE** | | | | |
| BP.QFO1 | 650 | 20 ans | Consolidation type SPS (1000A/220V) | 30000 |
| BP.DHZ1 | 600/60 | 20 ans | Consolidation type SPS (1000A/220V) | 30000 |
| BP.QDE2 | 400/80 | 20 ans (Thyristors) | Changement car bobinages d'origine | 35506 |
| BP.DVT1 | 250/70 | 30 ans | Changement | 35855 |
| BP.DVT2 | 250/70 | 20 ans (Thyristors) | Changement car bobinages d'origine | 35506 |
| BP.QFO3 | 400/40 | 20 ans (Thyristors) | Changement car bobinages d'origine | 35506 |
| BP.BHZ1 | 600/120 | 20 ans | Consolidation type SPS (1000A/220V) | 30000 |
| BP.QDE4 | 350/140 | 20 ans | Consolidation type SPS (1000A/220V) | 30000 |
| **SOUTH BRANCH** | | | | |
| BS."SMH1" | 500/100 | 20 ans | Consolidation type SPS (1000A/220V) | 30000 |
| BS.BHZ1 | 300/50 | 20 ans (Thyristors) | Changement car bobinages d'origine | 35506 |
| BS.QFO1 | 400/40 | 20 ans (Thyristors) | Changement car bobinages d'origine | 35506 |
| BS.QDE2 | 400/40 | 30 ans | Changement | 22943 |
| BS.DHZ1 | 180* | 30 ans | Changement | 35855 |
| BS.DVT1 | 600/80 | 30 ans | Changement | 22943 |
| BS.BHZ2 | 800/150 | 30 ans | Changement | 81648 |
| **DIRAC LINE** | | | | |
| BD.BHZ1 | 400/80 | 20 ans | Consolidation type SPS (1000A/220V) | 30000 |
| BD.BHZ2 | 400/80 | 20 ans | Consolidation type SPS (1000A/220V) | 30000 |
| BD.DVT1 | 200/40 | 30 ans | Changement | 35855 |
| BD.DHZ1 | 480*/30 | 30 ans | Changement | 35855 |
| BD.QDE1 | 500/100 | 20 ans | Consolidation type SPS (1000A/220V) | 30000 |
| BD.QFO2 | 500/100 | 20 ans | Consolidation type SPS (1000A/220V) | 30000 |
| SPECTRO | 2500 | 15 ans | Consolidation type SPS | 60000 |
| **NORTH BRANCH** | | | | |
| BN.QDE1 | 250/50 | 30 ans | Changement | 19639 |
| BN.QFO2 | 300/60 | 20 ans | Consolidation type SPS (800A/300V) | 30000 |
| BN.DVT1 | 400*/60 | 20 ans | Consolidation type SPS (800A/300V) | 30000 |
| BN.BHZ2 | 800/100 | 20 ans | Consolidation type SPS (800A/300V) | 30000 |
| BN.BHZ3 | 880/200 | 30 ans | Changement | 103928 |
| **"T9 BEAM"** | | | | |
| T9.DHZ1 | 240/150 | 30 ans | Changement | 38241 |
| T9.QFO1 | 350/25 | 30 ans | Changement | 15686 |
| T9.QDE2 | 350/80 | 30 ans | Changement | 32641 |
| T9.QDE3 | 350/25 | 30 ans | Changement | 15686 |
| T9.BHZ1 | 600/150 | 20 ans | Consolidation type SPS (1000A/220V) | 30000 |
| T9.QFO4* | 350/30 | 30 ans | Changement | 38241 |

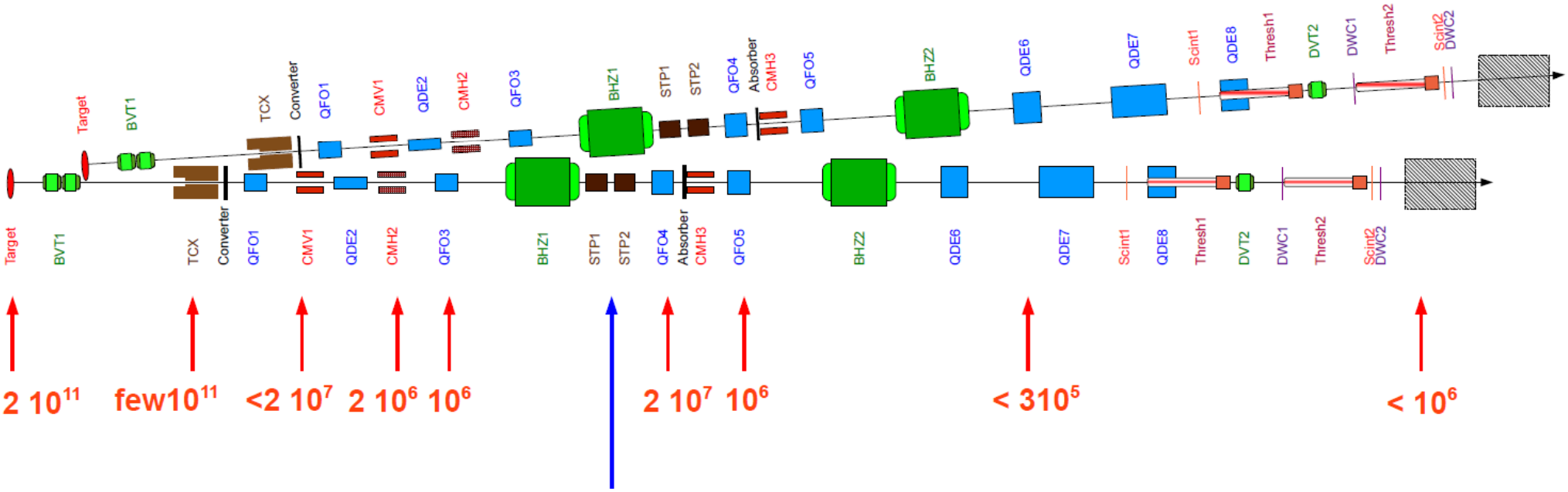
# COMPLETE RECTIFIER CONSOLIDATION – Part II

| | | | | |
|---|---|---|---|---|
| T9.QFO5* | | | | |
| T9.BHZ2 | 600/150 | 30 ans | Changement | 68113 |
| T9.QDE6 | 700/150 | 30 ans | Changement | 75060 |
| T9.BVT1 | 450/120 | 30 ans | Changement | 49371 |
| T9.QFO7 | 600/120 | 30 ans | Changement | 59181 |
| T9.QDE8 | 700/150 | 30 ans | Changement | 75060 |
| T9.DHZ2 | 240/80 | 30 ans | Changement | 25736 |
| T9.DVT1 | 240/80 | 30 ans | Changement | 25736 |
| "T10 BEAM" | | | | |
| T10.DHZ1 | 240/150 | 30 ans | Changement | 38241 |
| T10.QFO1 | 400/30 | 30 ans | Changement | 19140 |
| T10.QDE2 | 450/80 | 30 ans | Changement | 38241 |
| T10.QDE3 | 400/30 | 30 ans | Changement | 19140 |
| T10.BHZ1 | 750/200 | 15 ans | Consolidation type SPS (800A/300V) | 30000 |
| T10.QFO4* | 500/50 | 30 ans | Changement | 30392 |
| T10.QFO5* | 500/50 | | | |
| T10.BHZ2 | 750/200 | 15 ans | Consolidation type SPS (800A/300V) | 30000 |
| T10.QDE6 | 600/150 | 15 ans | Consolidation type SPS (800A/300V) | 30000 |
| T10.BVT1 | 600/150 | 15 ans | Consolidation type SPS (800A/300V) | 30000 |
| T10.QFO7 | 600/150 | 15 ans | Consolidation type SPS (800A/300V) | 30000 |
| T10.QDE8 | 400/160 | 30 ans | Changement | 54948 |
| T10.DHZ2 | 240/80 | 30 ans | Changement | 25736 |
| T10.DVT1 | 240/80 | 30 ans | Changement | 25736 |
| | | | Total (CHF) | 1942379 |
| | | | Proposition Consolidation (CHF) | *2000000* |
| | | | ==> les prix de consolidation sont basés sur une optimisation des caractéristiques des convertisseurs par rapport au besoin utilisateur ce qui n'est pas le cas actuellement (surdimensionnement). Le budget pourrait être revu à la hausse si une flexibilité est demandée | |
| | | | En suspend: Patch Panel + Simatic ==> Intérêt de conserver le système? | |
| | | | Consolidation infrastructure (Câbles AC/DC/Contrôle) *Estimation (CHF)* | 800000 |
| | | | TOTAL (CHF) | *2800000* |

**i.e. cost up to about 2.8 MCHF**

# BEAM LOSSES IN SECONDARY BEAMS

*This beam gives losses similar to the other beam*



# Survey manpower

Assume a team of 2 persons

| Item | Time (months) |
|---|---|
| Creation of new references in zone | 0.2 |
| Trace beam lines and equipments on floor | 0.2 |
| Define positions of the walls | 0.2 |
| Alignment of beam lines | 1.5 |
| **Total** | **2.1** |

**Total FTE: 4.2 man months**

## From note by Luc Durieu:

**Best resumed in the following table :**

| Device | Evolution | Number | Priority | Cabling | Software | Remark |
|---|---|---|---|---|---|---|
| MWPC | discard | 5 | High | | none | obsolete |
| DWC | new | 5 | High | ~ 5..10 k | heavy | replace MWPC |
| Magnets | no mod | 36 | - | - | exist/collect | |
| Beam stoppers | no mod | 5 | | | collect state | not AB |
| Collimators | none | 9 (x2) | High | exist | to middleware | need PLC |
| Vacuum | none | | | | collect state | AT/VAC |
| Cerenkov | automate | 5 | Low | ~ 5 k | same as EHN | VME interface |
| Beam counter | new | 5 | high | see DWC | | |
| Workstation | new | ~8 | medium | local | standard | physicist access |

*From note by Luc Durieu:*

**Estimated effort to invest for renovation.**

| Devices | Hardware cost | Manpower/hard | Manpower/soft |
|---|---|---|---|
| MWPC/DWC/beam counters | ~ 20 k | ~ 1 man*month | ~ 2 man*month |
| Collimators | ~ 20 k | << 1 man*month | > 2 man*month |
| Cerenkovs | ~ 10 k | ~ 2 man*month | |
| Magnets | none | none | < 1 man*month |


MWPC01
ZT11
T11a
T10a
T9a
T8a
T7a
ZT7
MCV
Radiation Survey Measurements
East Experimental Area - Target Zone
Ambient dose equivalent rate
measured at 40 cm distance in µSv/h
Beam stop: 07.12.2009
Remark: None
Date: 21.01.2010