BLRWG recommendations: where are we ?

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In collaboration with
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BLRWG recommendations. Where do we stand?

In red, open questions for 2008

- PS Bridge:
  - ☑ Controlled access (2004-6 SD)
  - ☑ Understanding of the losses (loss displacement 2007)
  - ☑ Additional shielding ⇒ no more necessary
  - ☑ Additional monitoring & measurements in the PS area ⇒ done (2006-7)

- Goward Road problem (partial gain in 2007, expect reduction with MTE, more studies SD and run 2008)

- SS31:
  - ☑ Minimization of the CT extraction losses (done ⇒ running at ~95% - 93% eff.)
  - ☐ MTE implementation (during run 2008)

- Air release points (PS and SPS):
  - ☐ Monitoring of air activation in the PS area (to be extended)
  - ☐ Machine studies to identify contributions of the activated air release in the TT10 stack (data collected in 2006, need a second iteration in 2008)

BLRWG recommendations (SPS). Where do we stand?

- TDC2/TCC2 area:
  - ☑ Installation of a RAMSES ventilation station to monitor airborne radioactivity released to the environment (done SD 2006/7)
  - ☑ Interlocking of the ventilation unit to the access system ⇒ solution in place – access regulated by DIMR
  - ■ Installation of air sniffing system to measure air activation during and after operation. Used to decide which safety measures are required for access to TDC2/TCC2 (pipe BA80⇒TCC2 installed, need to install monitoring station)

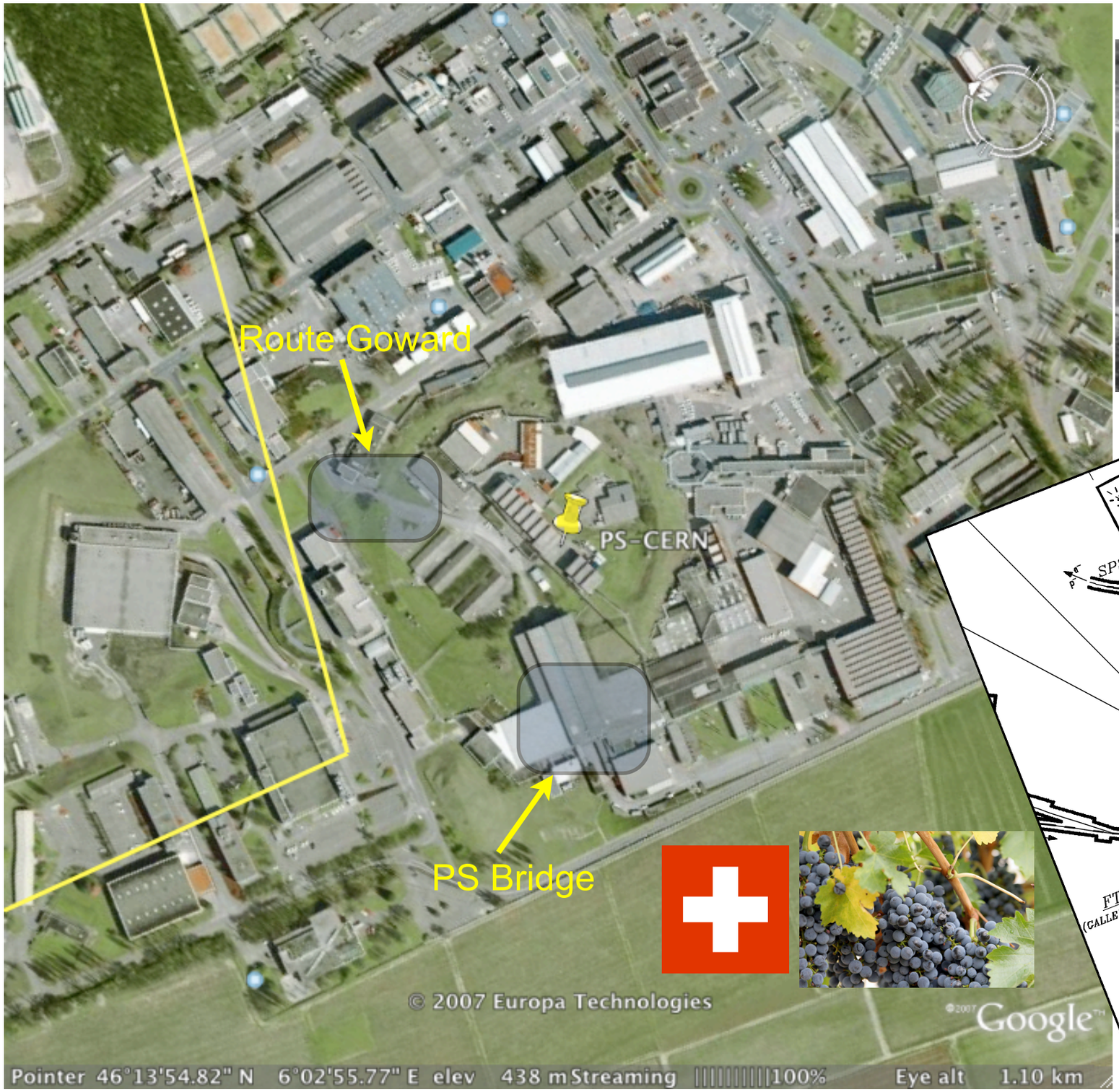
- ECA4:
  - ☑ Controlled access to the two highest gangways (SD 2004-2006)
  - ☑ Verification of the dose rates in ECA4 during CNGS operation to benchmark simulations (done confirmed simulations ⇒ ECA4 floor level and barracks = supervised radiation area (safety code 2006 F))
  - ☑ Interlocks to prevent sustained losses at the extraction elements in LSS4 (done during CNGS commissioning)
  - ☑ Cleaning of the abort ⇒ not deemed to be necessary on the basis of the operational experience

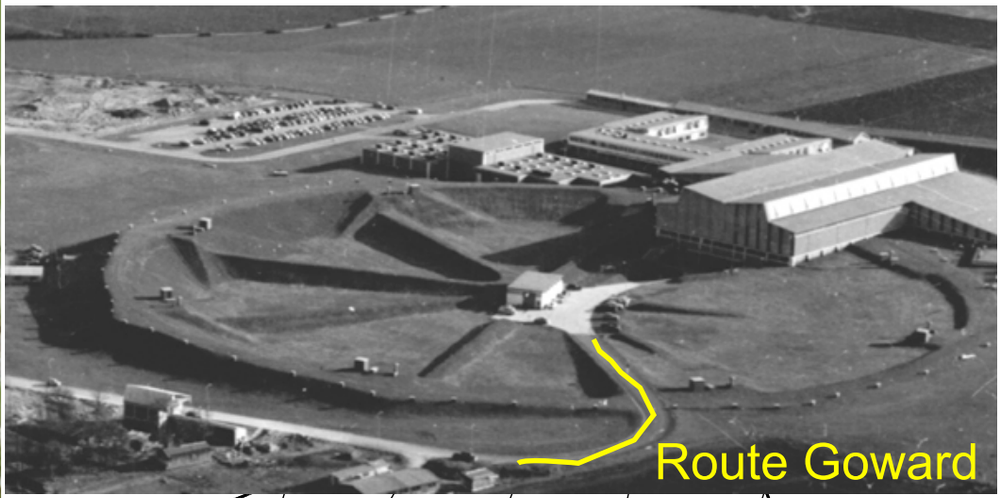
- Restore and extend the use of BLMs to measure SPS wide the residual dose rate during beam-off periods:
  - ☑ BLM calibration in terms of H*(10)
  - ■ Change of electronics gain, adaptation of integration timing, implementation of data logging system
  - ■ Online display of the BLM residual dose rate function

PS radiation issue of Route Goward

Tunnel built at ground level, not enough shielding in some locations ....

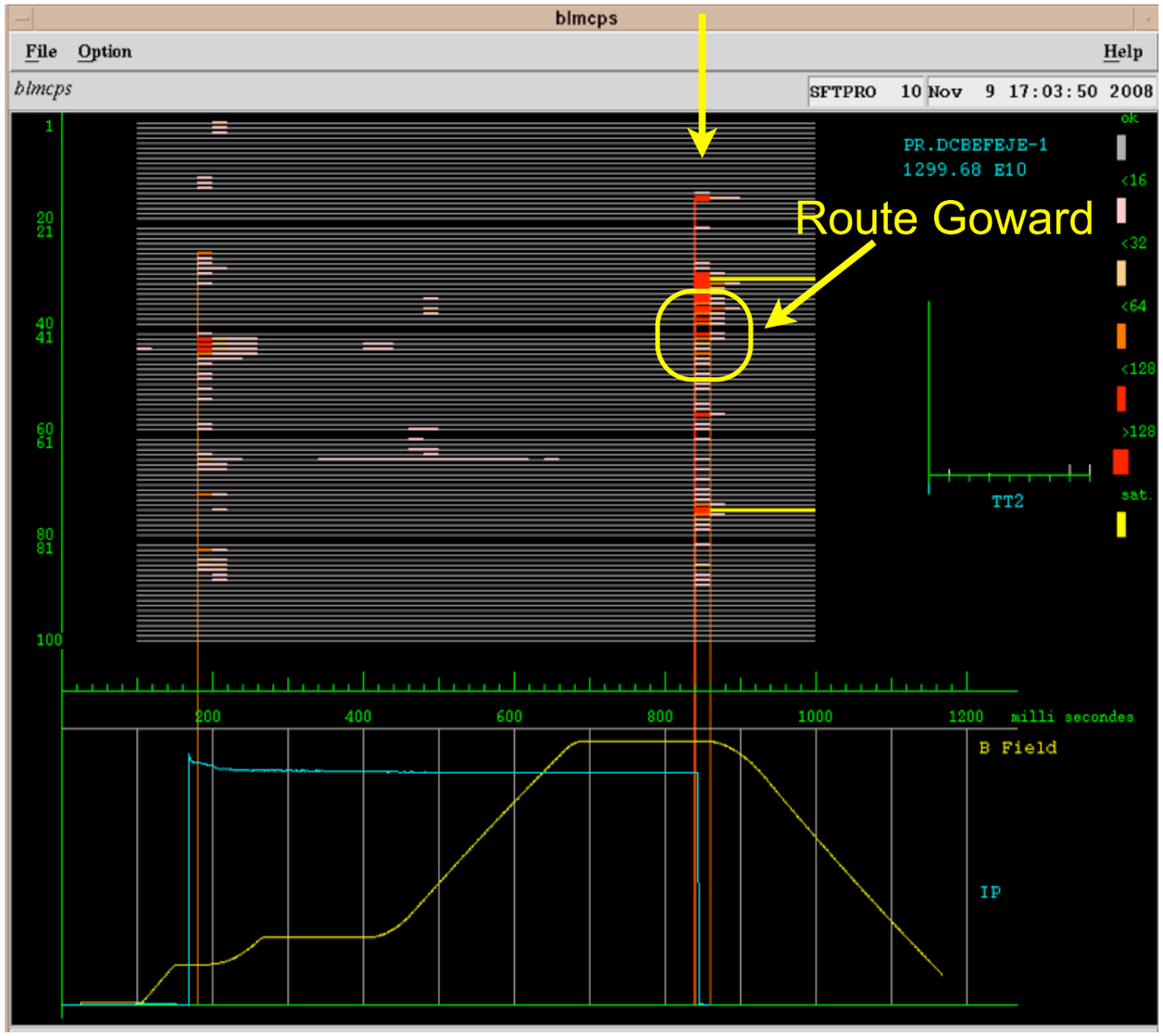
50% irradiation from CT extraction. ~ 0% with MTE
50% directly from beam injection



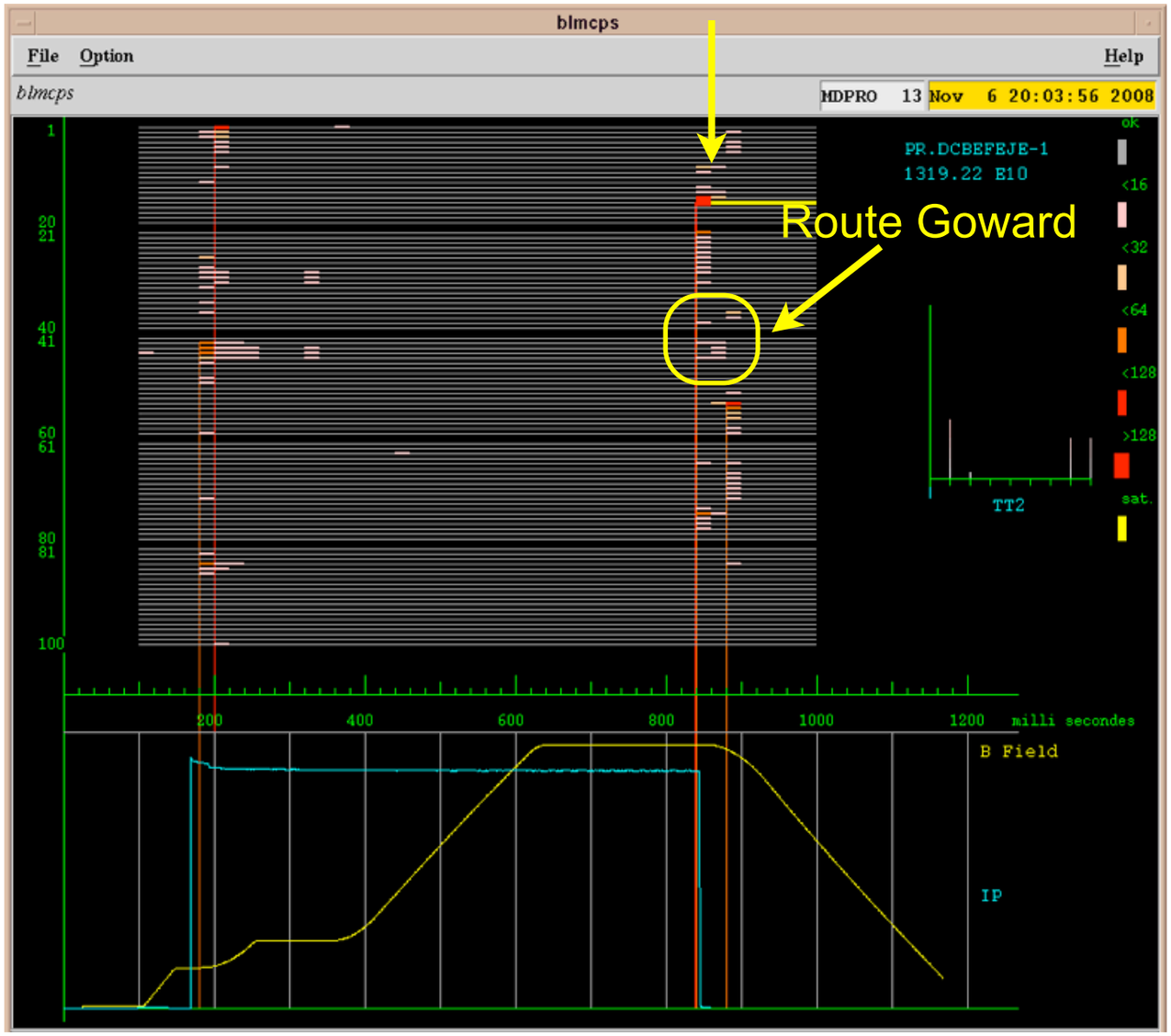


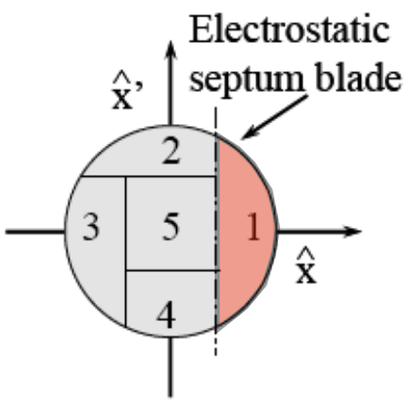
SFTPRO losses CT vs MTE extraction

CT extraction: 5% losses for 1.3e13

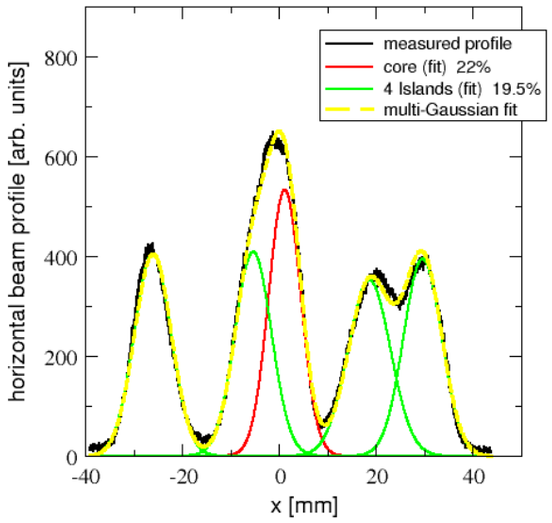


MTE extraction: 2-3% losses for 1.3e13

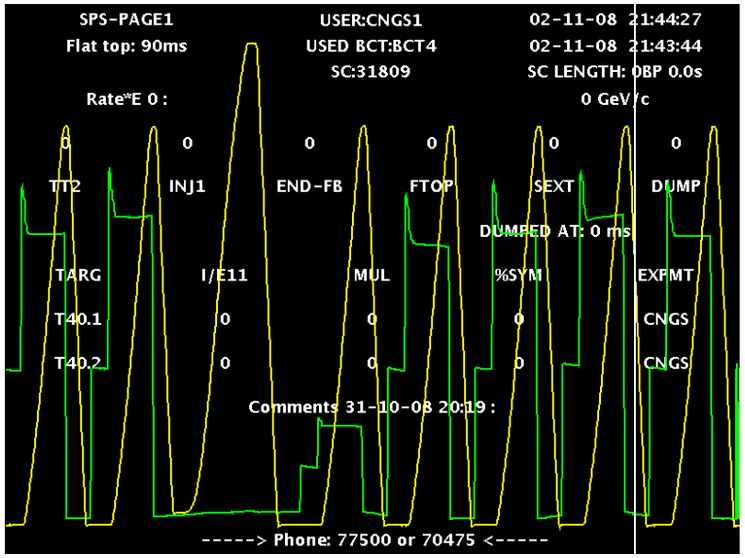


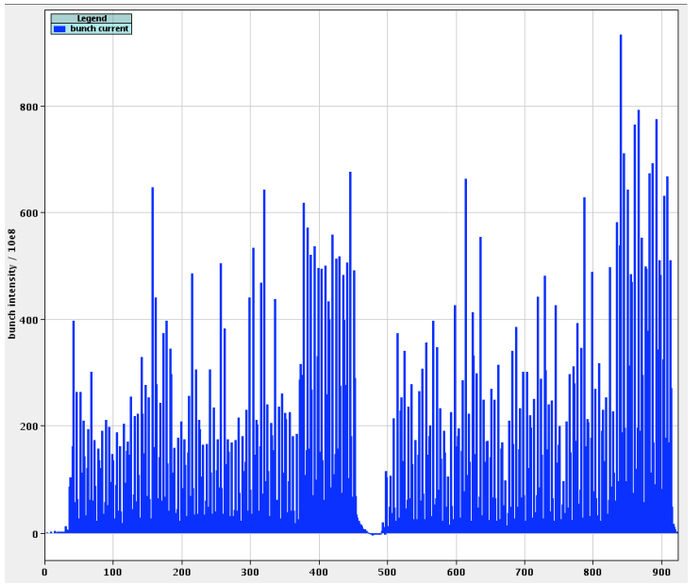


- CT extraction:
  - Loss mechanism: particle scattering on the septum in SS31
  - Losses distributed all around the ring
- MTE extraction
  - Loss mechanism: Beam not trapped in an island and extraction kicker rise time
  - Losses concentrated in extraction area (can be optimised)



MTE status (see yesterday MTE presentation)





1. MTE extracted beam has been provided to the SPS for the last night of CNGS run.

2. Intensity extracted so far 1.3-1.4e13 (typical SFTPRO) with extraction losses down to 2-3%. Stability of the losses however still not reached. Sometime fluctuation up to 10% still to be understood. Most probably due to negative chromaticity during capture.

3. De-bunched extraction has been prepared. Basically same extraction efficiency as for the h16 bunched case. Tests with the SPS have been finished by using the normal CT to define the most suitable longitudinal structure.

4. No major problems encountered for MTE specific equipments. Main delays produced by:
    1. same issues encountered by normal PS operation
    2. more time than foreseen to clarify the best longitudinal structure for the SPS.

5. The 2009 planning aims to provide an SFTPRO-MTE extracted by the middle of the run.

PS Injection losses study

From ATCABOC days ‘08

Proposals for SD 07-08 and run 2008

Different sources of losses in the injection region has been identified, and whenever possible, fixed.

This lead to a 40-70% loss reduction in the injection region. Still to understand the relation between losses and PAXS51.

Losses are produced from:

1. The beam entering in the machine before or during the first turn. Possible reasons and cure adopted:

   (a) Losses are in the BTP line due to beam trajectory and are seen by the ring BLMS and by the PAXS51

   ⇒ LHC BLMS will be installed in the BTP line
   ⇒ Study of the beam trajectory wrt to BTP aperture
   ⇒ Relative alignement of BT+BTP+PS will be checked during the current SD
   ⇒ Orbit/trajectory study, simulation and next year measurements

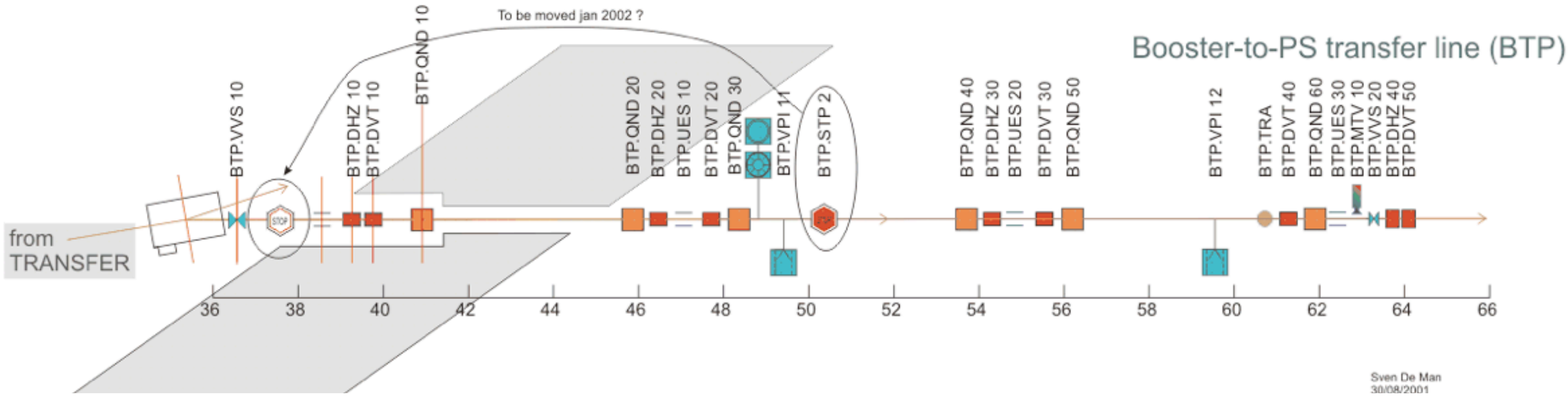
   (b) Losses are mainly at the septum due to the different aperture reductions either at the last part of BTP, or/and at the BSM42 or/and at the septum:

   ⇒ Modelling of the Septum region (BSM42, SMH42 and relative aperture restrictions) in a Monte-Carlo simulation.

- What has been done:
  - LHC blms installed in the ring and in BTP line
  - Matching PSB-BT-BTP-PS study
  - Trajectory study
  - Alignement measurements of BT-BTP-PS

- To be done:
  - MC simulation of injection losses

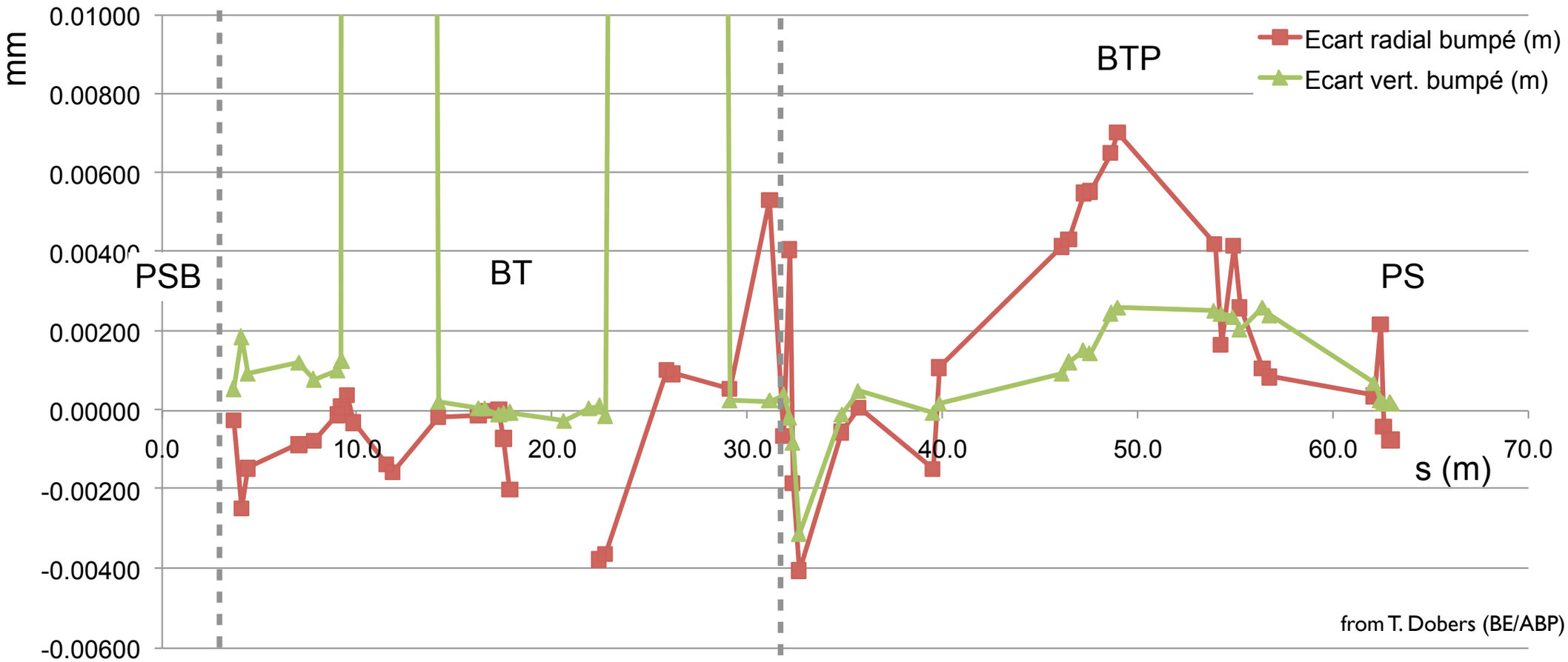
BT-BTP alignment measurements



First campaign of measurements done by removing vacuum chamber in BT and BTP

Extra technical difficulty if an alignment is decided and only short shut-down available

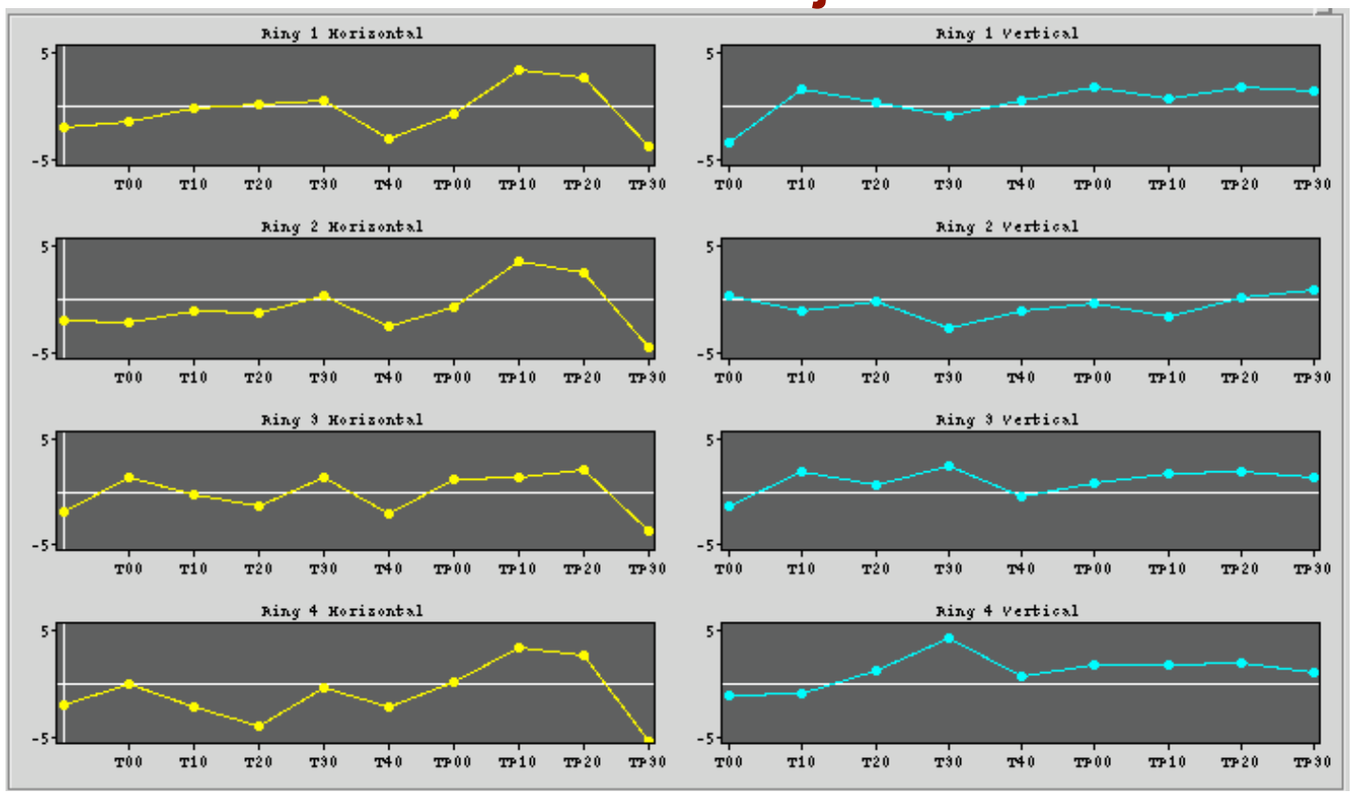
Alignment results



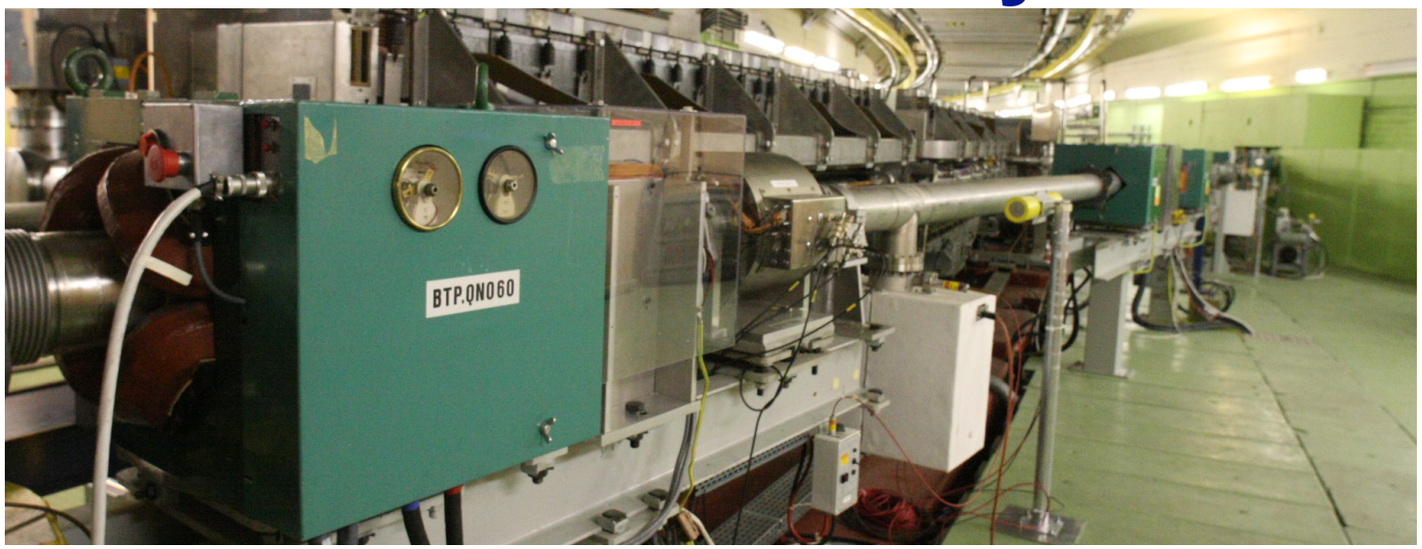
Alignment is pretty poor: this could explain unusual trajectories programmed in BT-BTP to optimise PS injection efficiency

Line require re-alignement, to be done together with BTY and BTM probably

BT-BTP trajectories



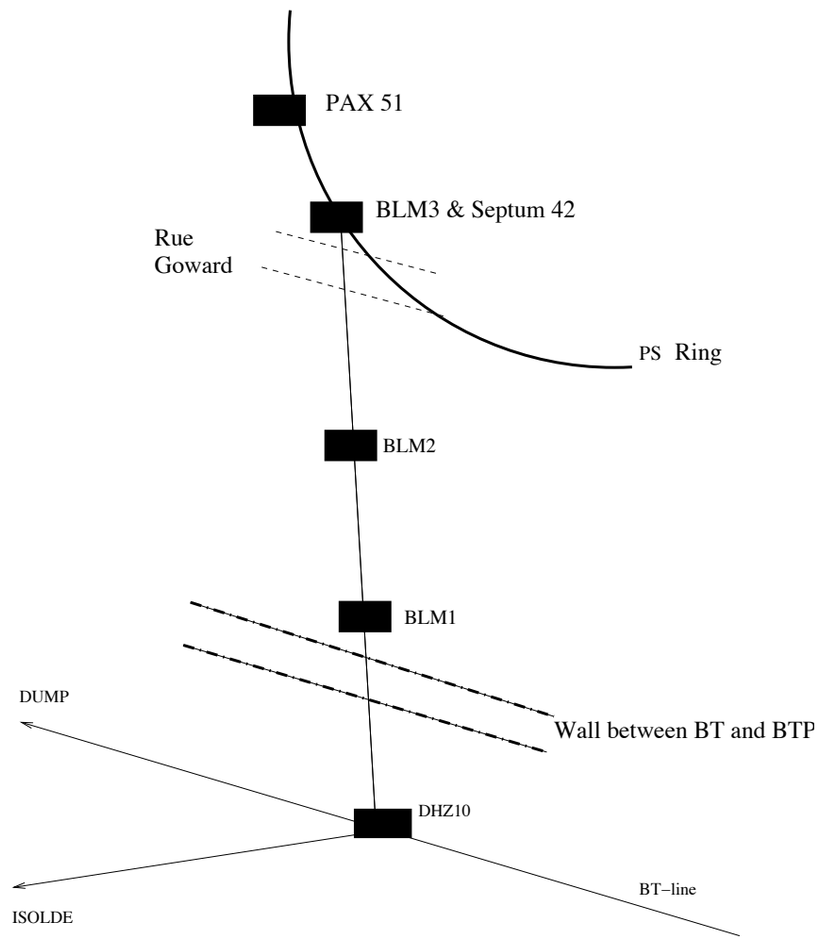
BTP losses study vs radiation on r. Goward



- LHC blms type: ionisation chambers mounted on movable supports.
- Signal available in OASIS via BLM spare channels
- Thanks to V. Prieto (BE/BI)

- Losses at septum increase radiation levels at PAX51 (route Goward)

Loss experiments on the radiation level at Rue Goward



- three LHC type BLMs installed in the BTP line.
- We force losses in the BTP line (BLM 1 and 2): no increase of the radiation given by the radiation monitor at Rue Goward.
- We force losses on the septum (BLM3): increase of the radiation at Rue Goward.
- We turn off the septum and put a screen instead: increase of the radiation level but not as much as with the septum turned on.

Dispersion measurements

Dispersion measurements in the BT-BTP line

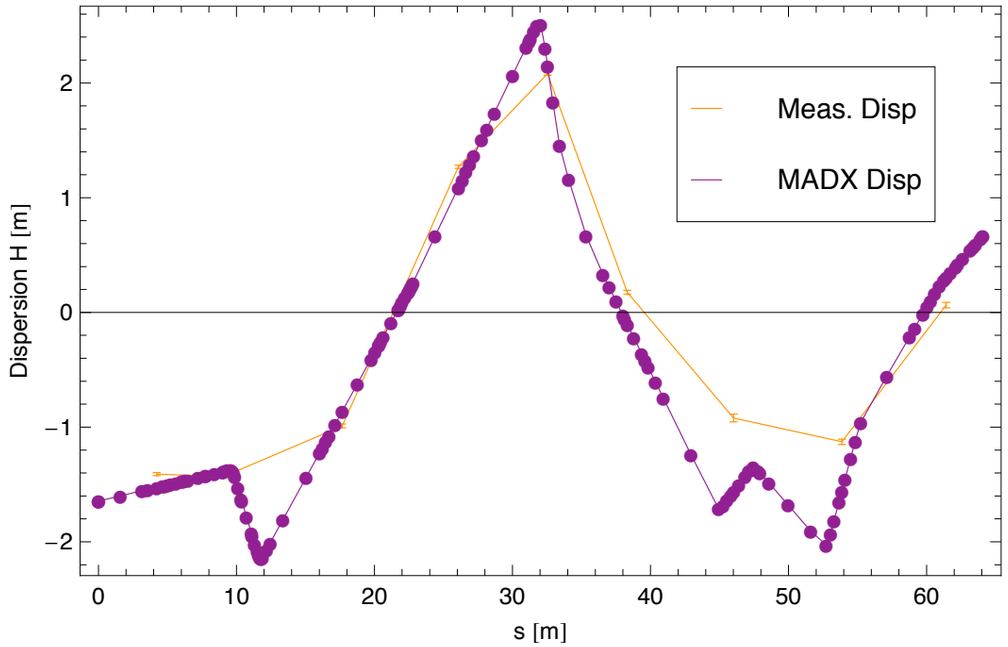


Figure: Horizontal dispersion.

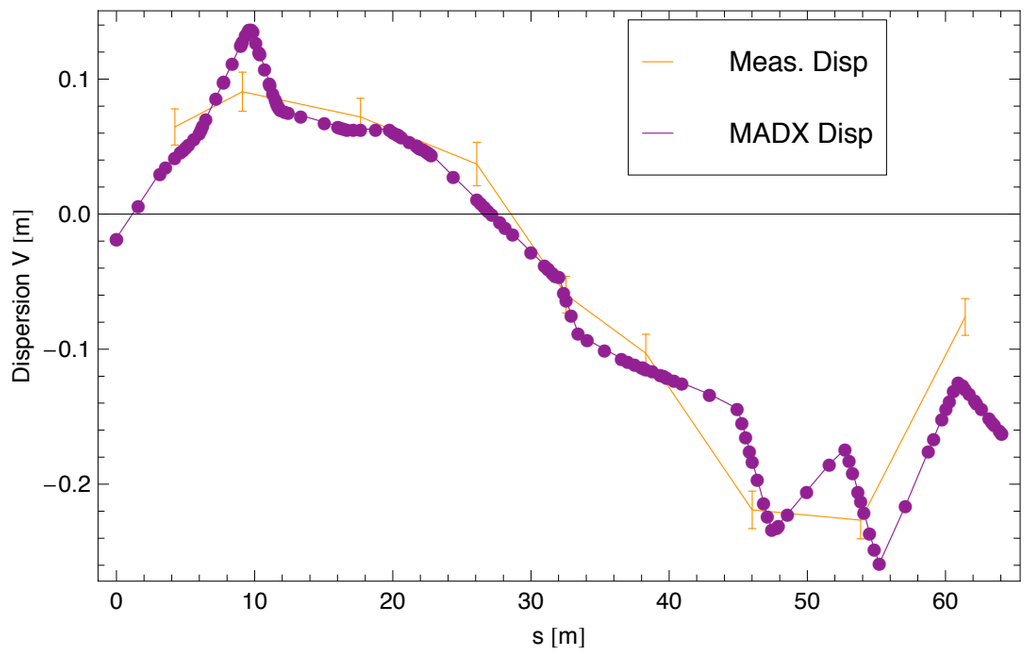


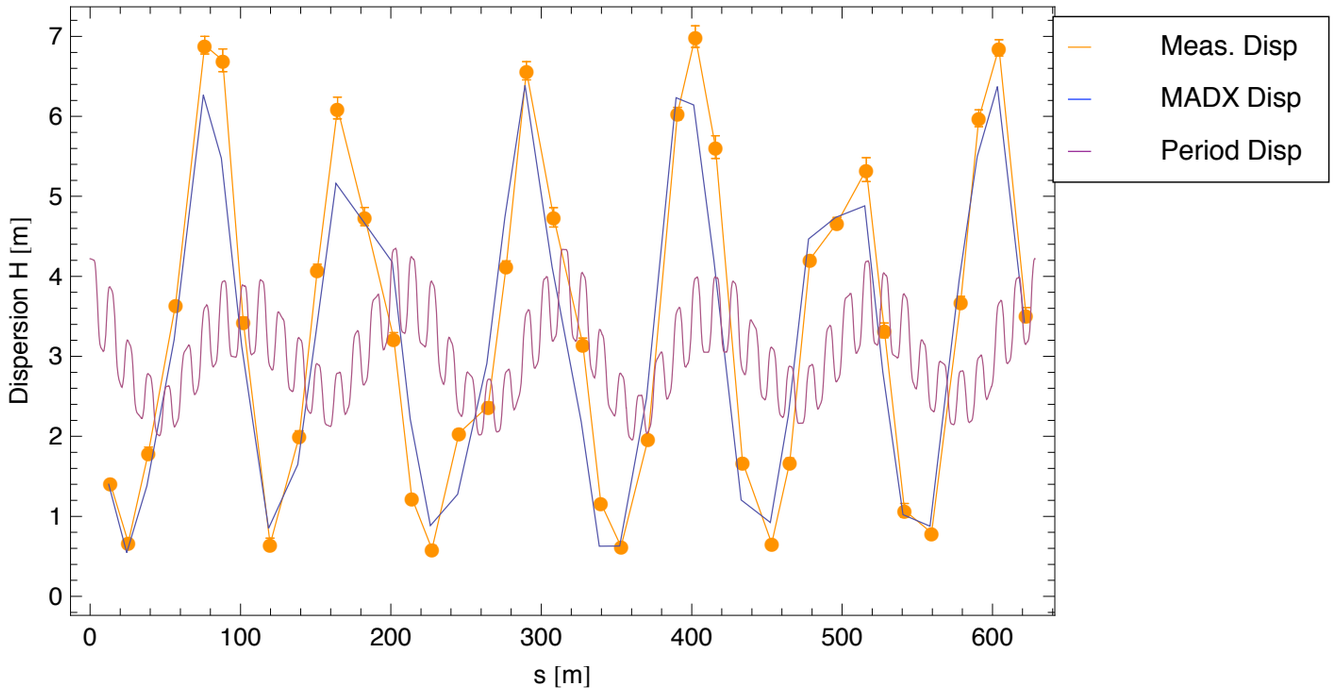
Figure: Vertical dispersion.

HOR. and VERT. fairly well reproduced.

Conclusion for injection studies

- BTP-PS dispersion mismatch in the horizontal plane with respect to the periodic dispersion.
  - *New injection optics will be tested*

- Beam envelope in the BTP due to the stray field at the limit of the aperture at the PS septum: no measurements possible because of a lack of equipment (possibly screens) between the last BTP magnet and the injection septum



Aperture of the septum, both for incoming as for circulating beam, seems to be at the limit for the high intensity beams

Surface area on top of TT20

Area on top of TT20 needs to be classified as radiation area

- **Fence around surface area located on top of TT20 beam line encloses :**
  - Water pit DP 523
  - First and second series of splitters
  - Building 898 (ventilation building with direct connection to beam line)

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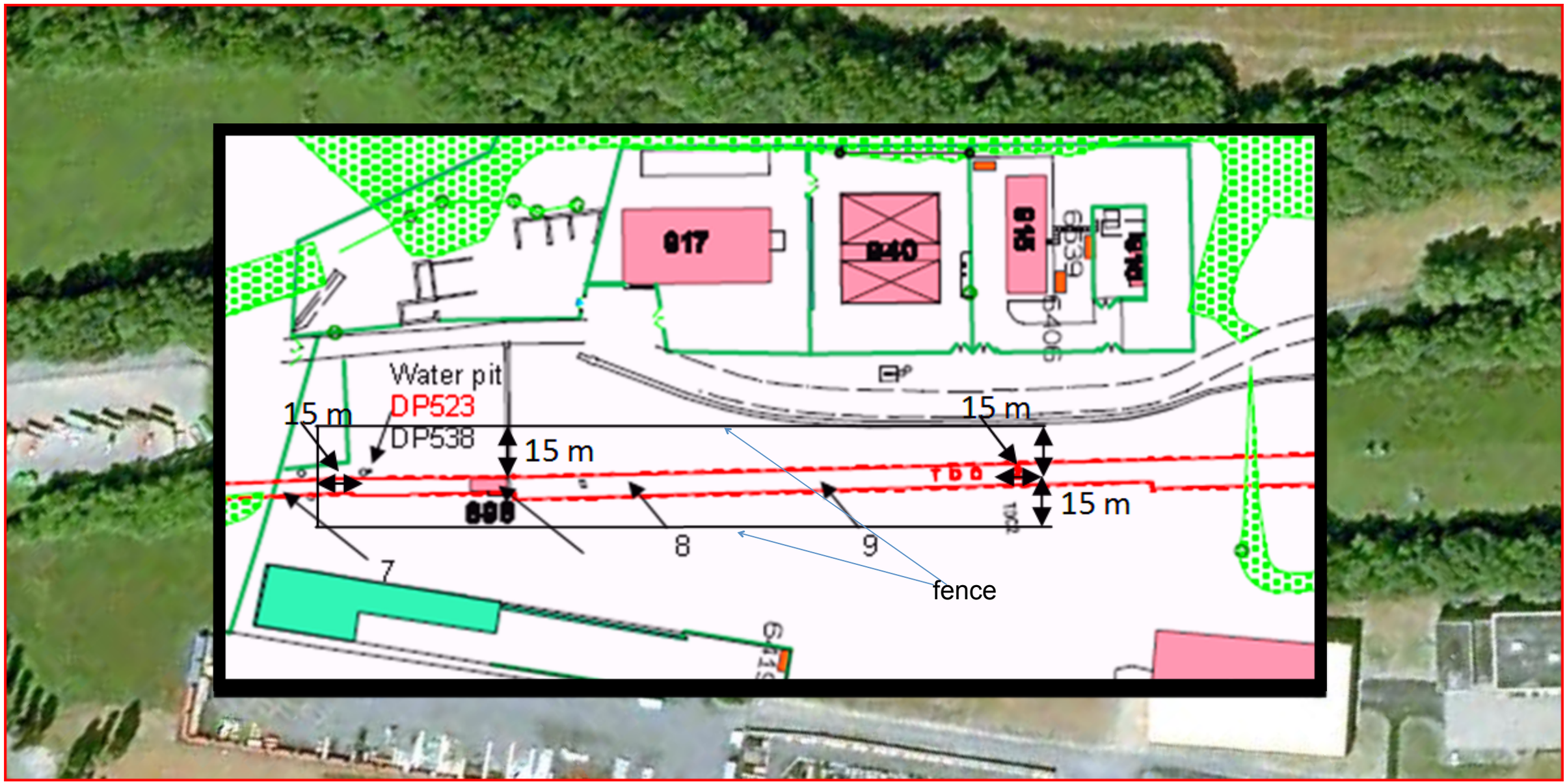

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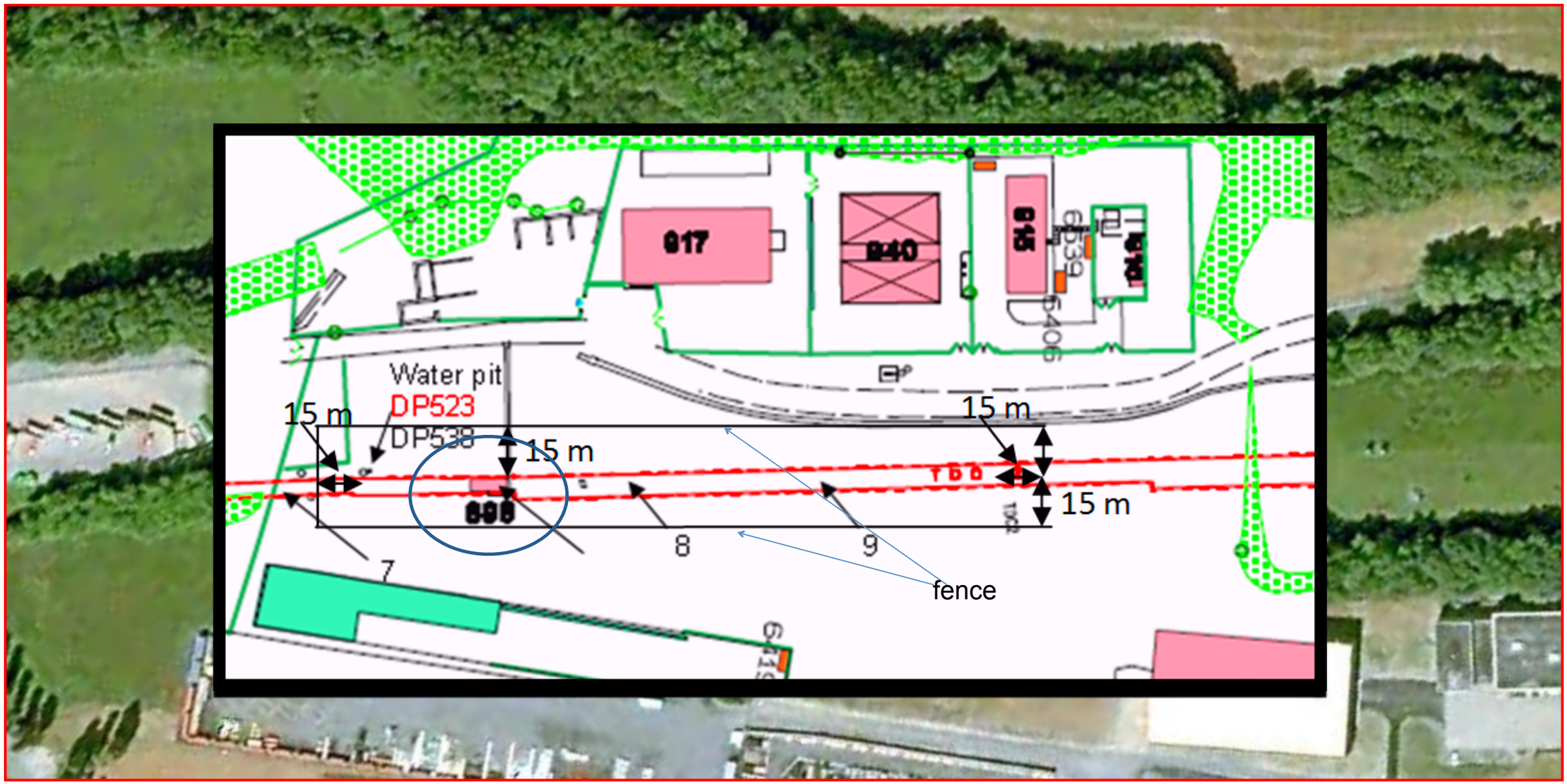
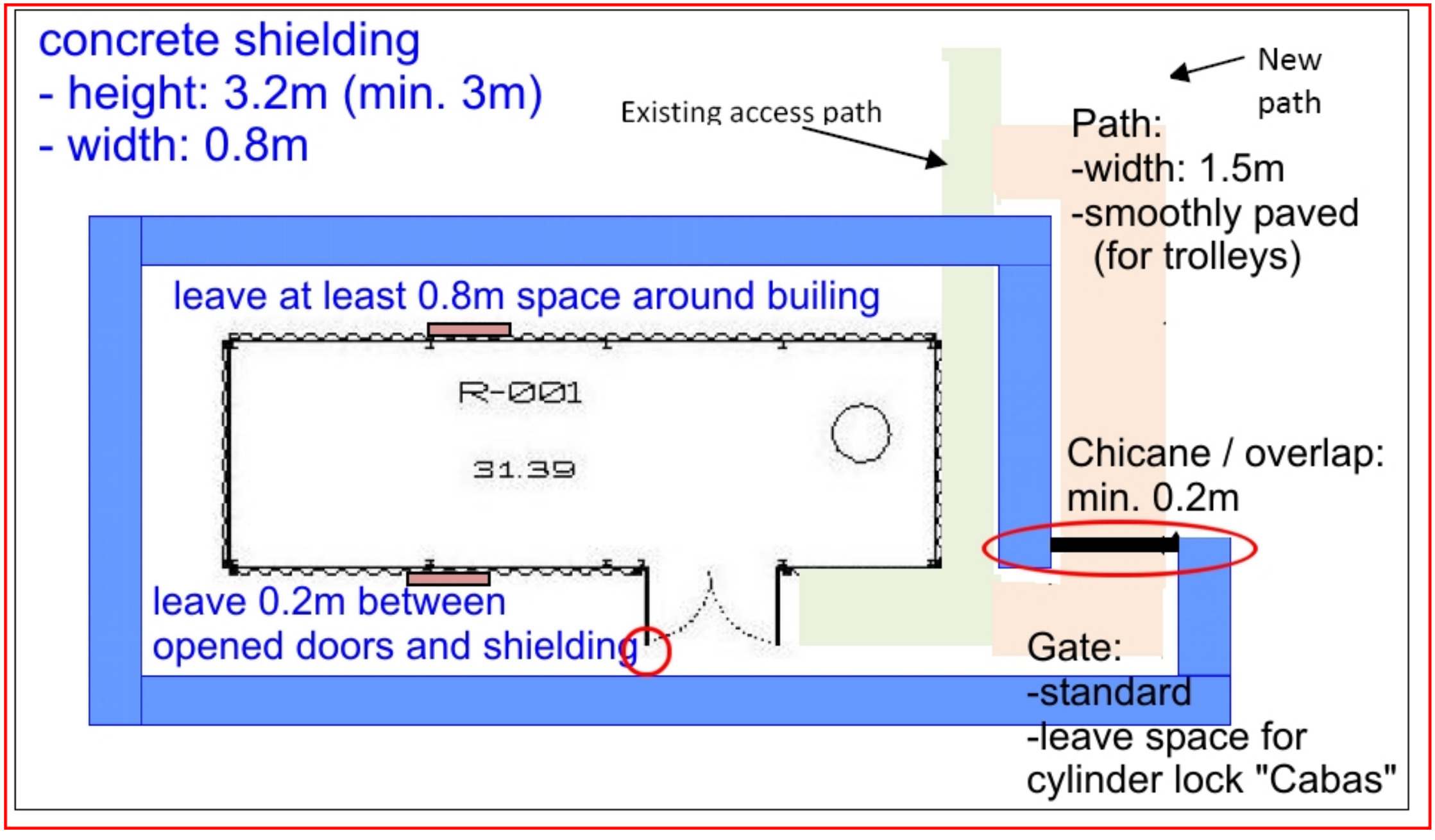


Ventilation building 898 on top of the TT20 line

First proposal for shielding of building 898



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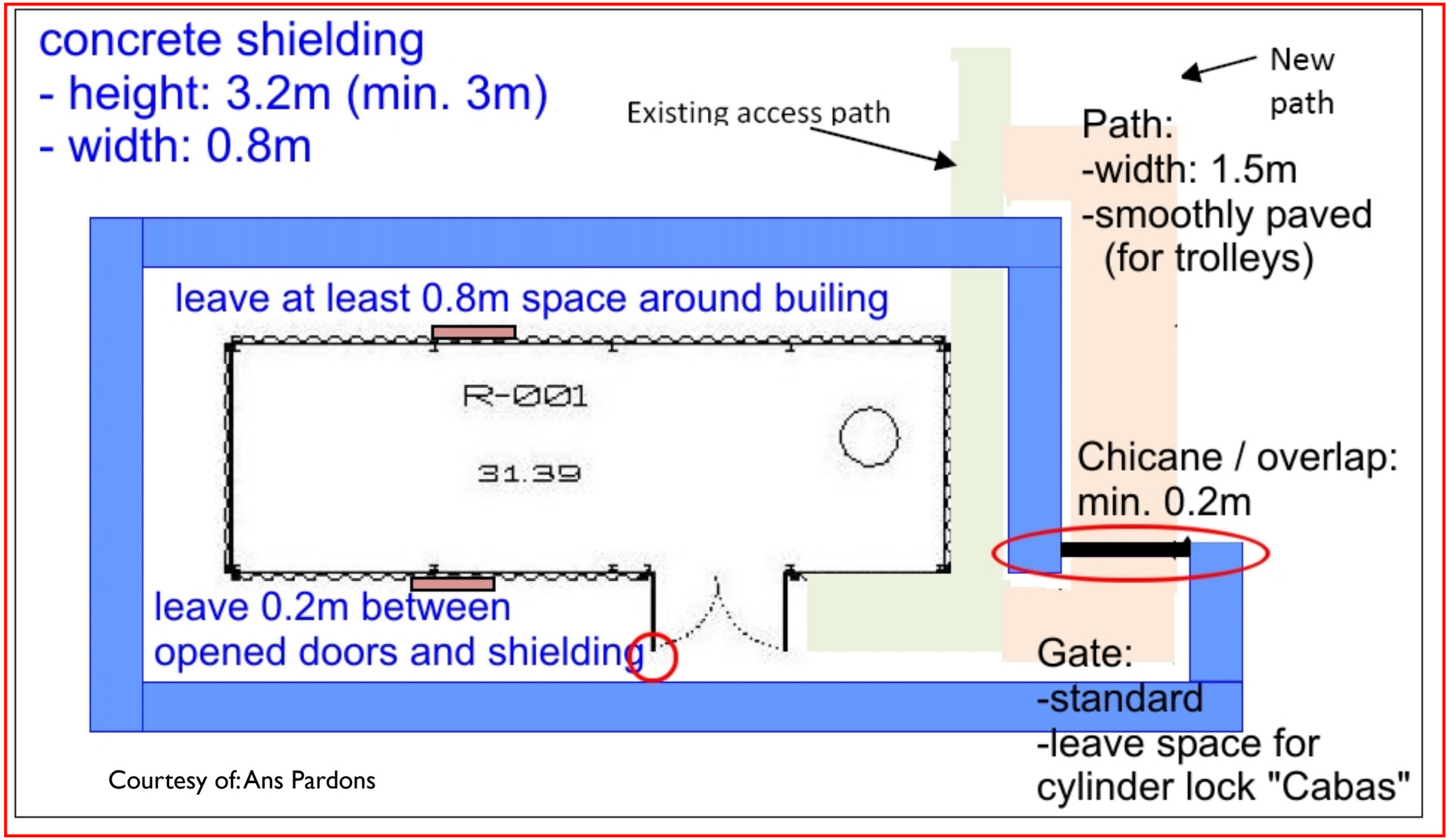
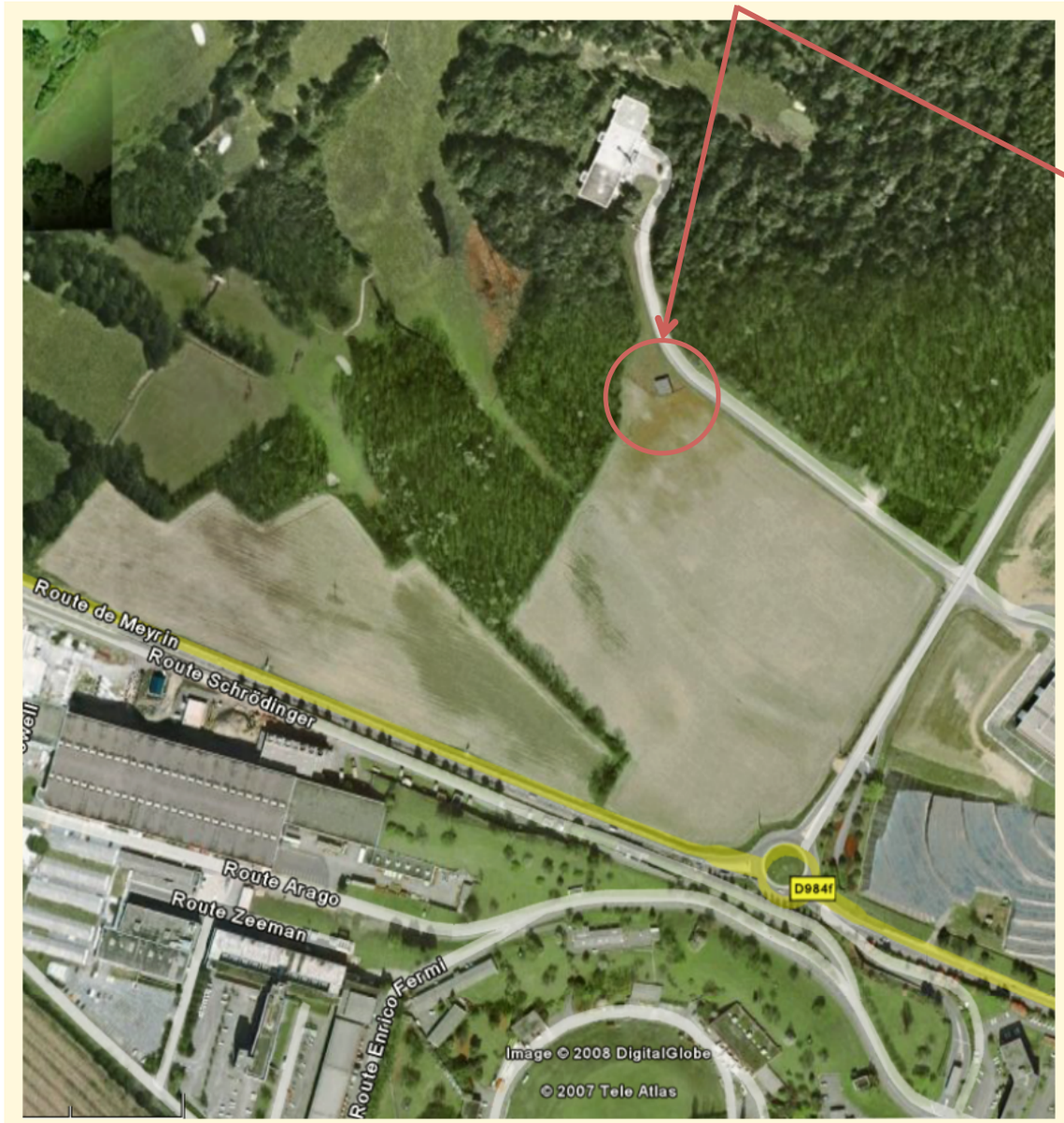
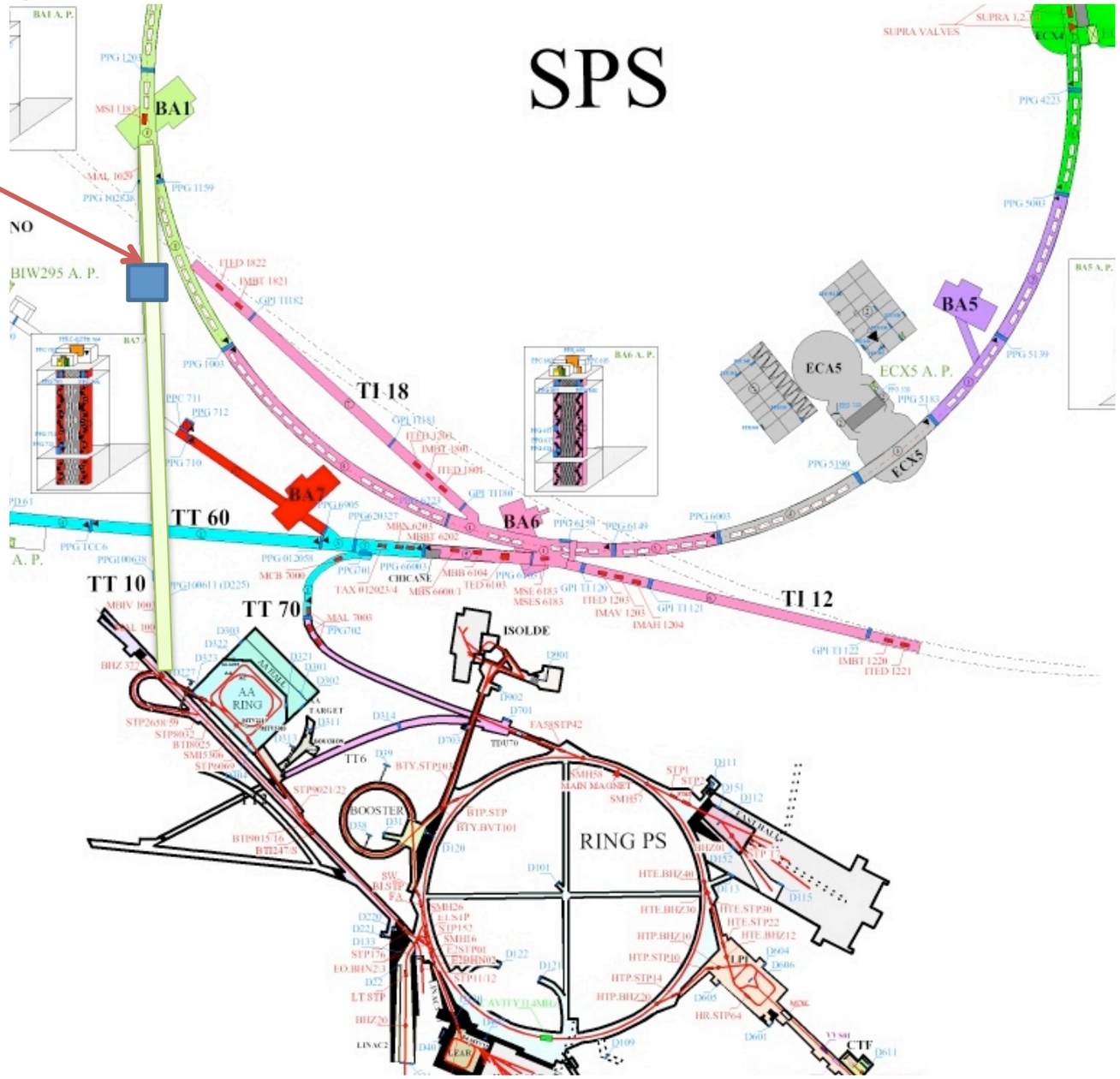


Courtesy of: Ans Pardons

Weakness of the shielding of the PGC1 shaft of the PS – SPS transfer tunnel (TT10)

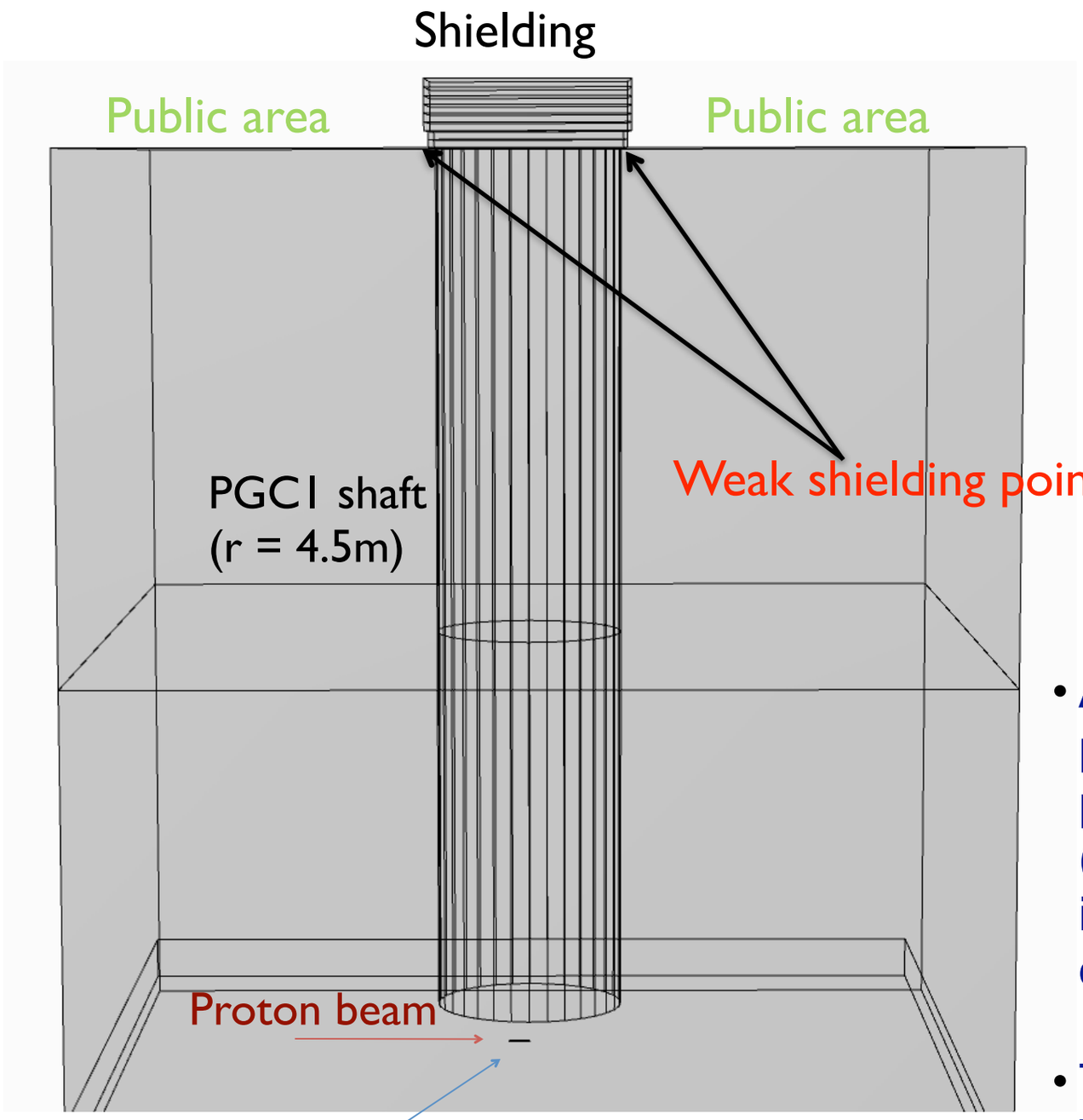
Shielding of PGC1 pit (r =4.5 m)





Future operations: 6E19 protons/year will be sent through TT10.

TT10 PGC1 shaft shielding



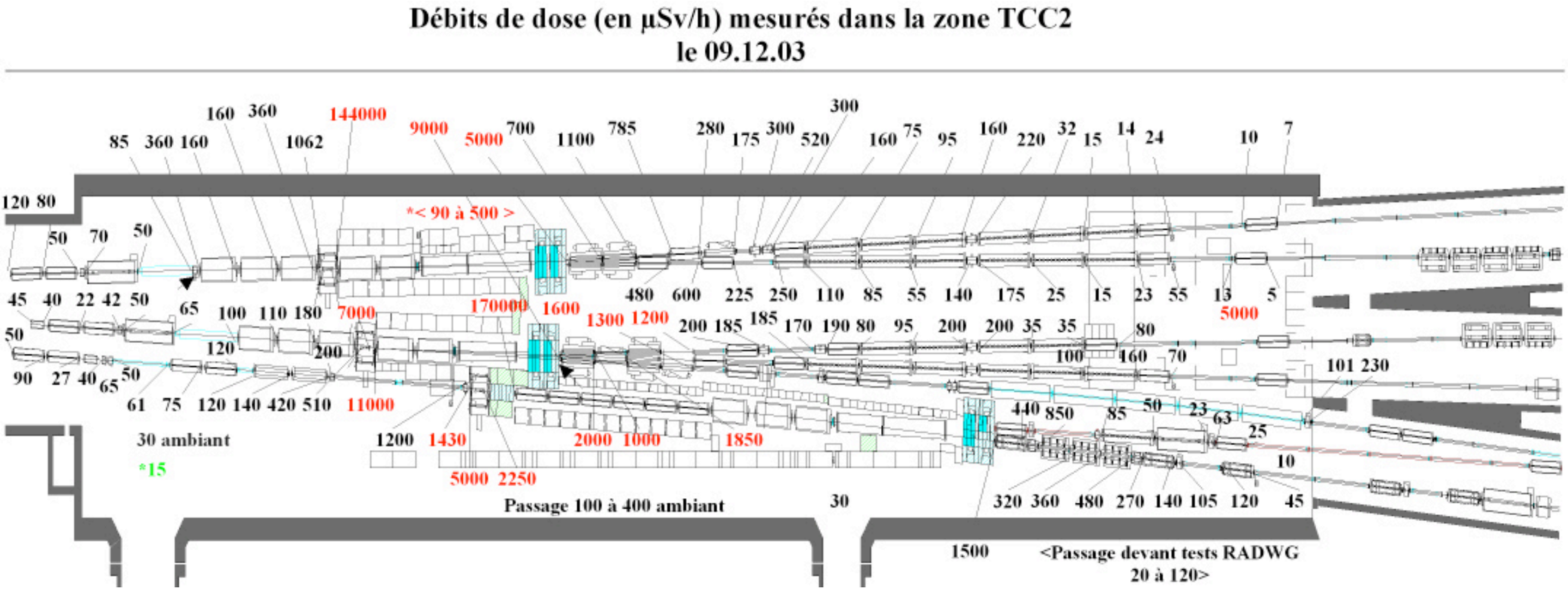
Optimum target representing beam loss location (conservative loss assumption)

- A shielding reinforcement of 1 m at the weak points was done in 2008 during an already planned refurbishment work of the PGC1 pit (Civil Engineering: R. Morton). The annual dose in public areas has to remain below 100 uSv during high intensity operation.

- The dose rate will depend on the losses in the TT10 line. TLD measurements in the vicinity of the new shielding were done in 2008 to estimate if the first shielding reinforcement is sufficient. Irradiated TLDs were sent to Krakow for analysis.

TCC2 area

TCC2 is one of the most radioactive areas at CERN



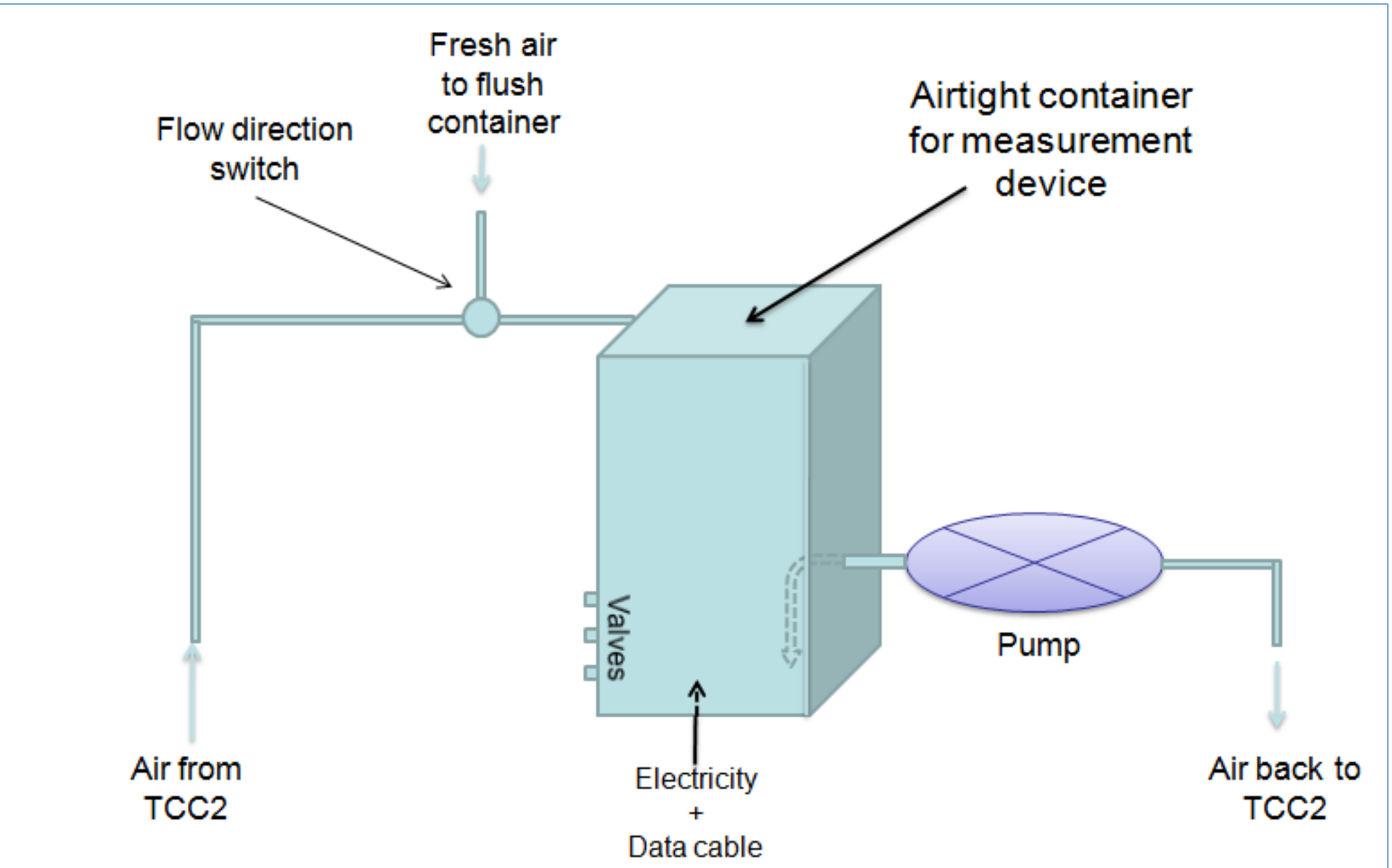
- The need of a remotely controlled radiation survey and observation platform to be used in TCC2 was defined by RP.
⇒ This device would allow for a reduction of collective dose and down-time of physics operation.

- In order to study the feasibility of the project discussions with Keith Kershaw (EN/HE) and his group were started.

- The continuation of the project requires manpower and money which still needs to be found

Air sniffing system in BA80

System will allow to measure remotely airborne radioactivity of TCC2



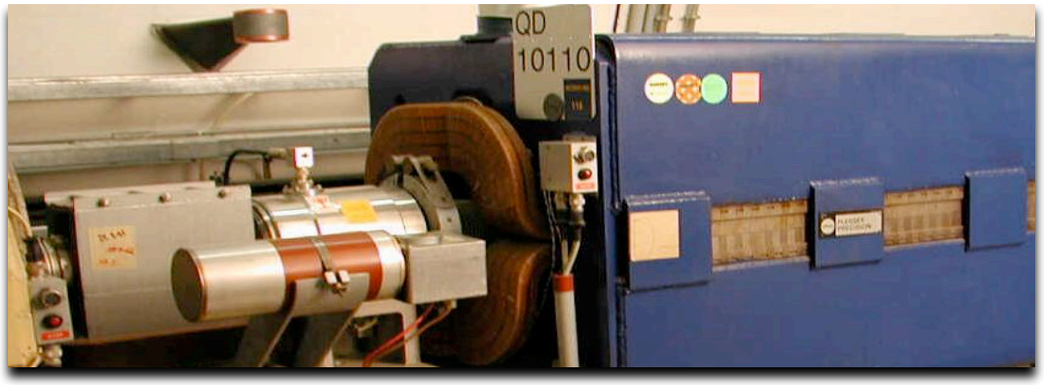
- **Piping work installed**
- **Steel container and required equipment manufactured or ordered**

Due to other priorities the installation and testing of the equipment had to be postponed to 2009

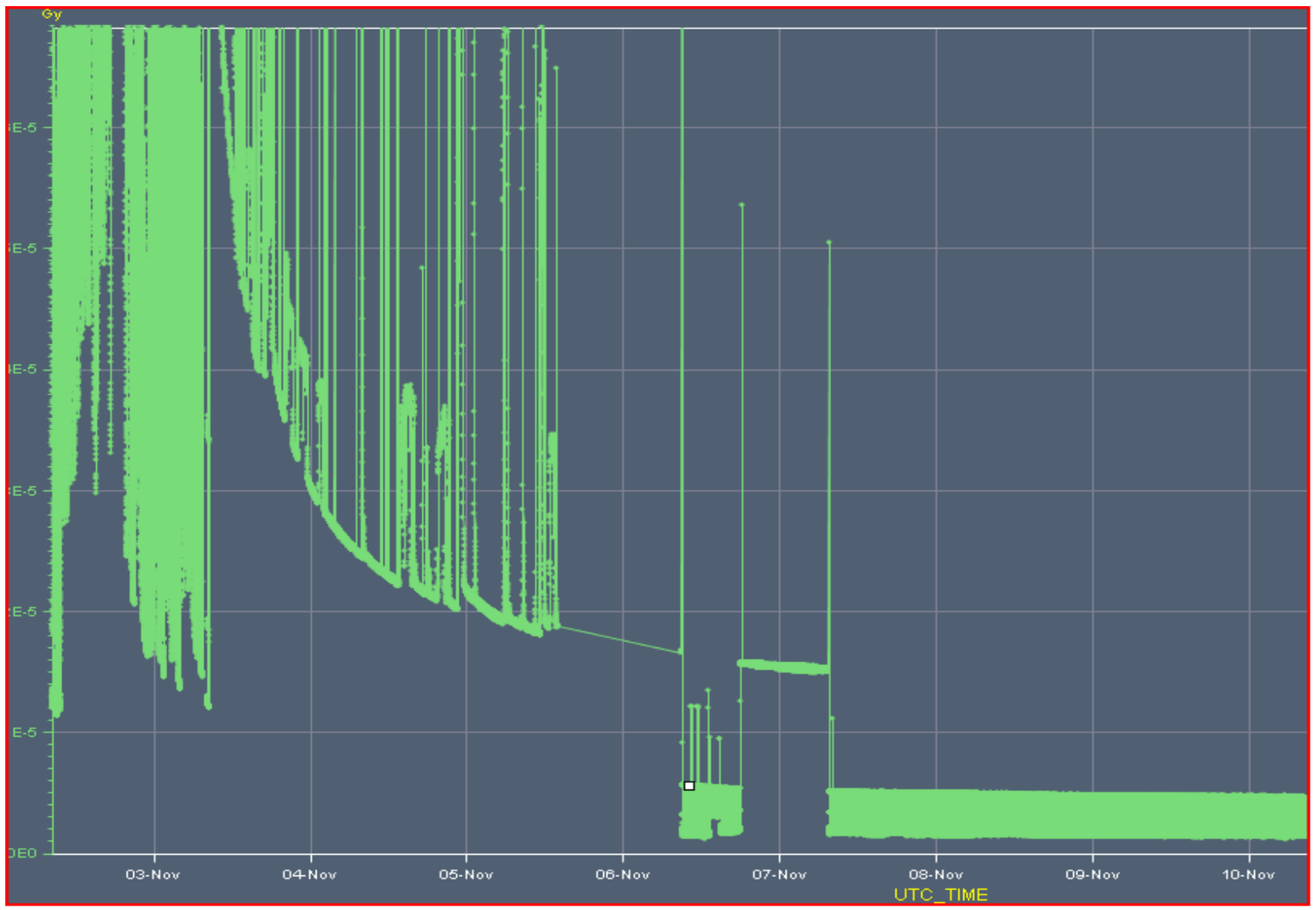
SPS-BLM readout device for residual dose rate measurements

It is planned to use BLMs in the SPS for measuring residual dose rates during beam stops and shut down periods

- Change of electronics gain, adaptation of integration timing, implementation in data logging system
- Data accessible via Timber
- System needs to be tested by RP and EN
  - Test with well known sources
  - Check of usability for RP purpose
- Online display of the BLM residual dose rate functions: to be done



First very preliminary read out example



Machine alignements: PSB

PSB alignment studies
Orbit correction 2008

Alignment: T. Dobers and his team

Orbit correction: M. Chanel, G. Rumolo, R. Tomas, B. Mikulec

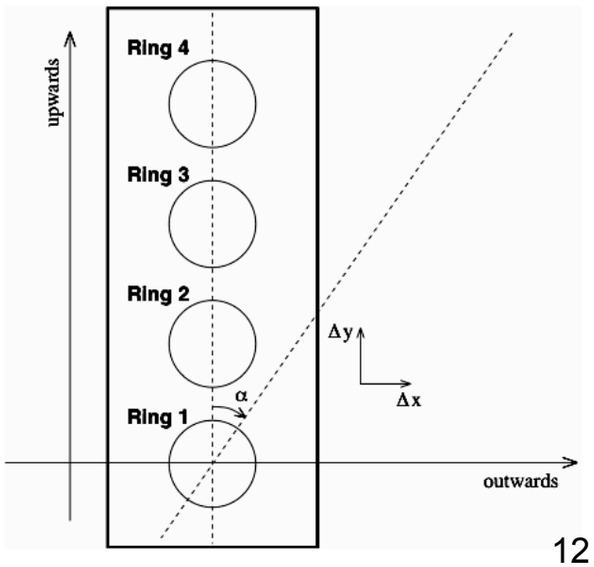
Thanks to all the others involved!

Introduction

- Last complete measurement of the Booster: 1996
- This date coincides with the last orbit correction of the Booster!
  - PSB orbit too large over the years
  - only a few orbit correctors available and not really in operational state (waiting for multipole consolidation during 2009/2010 shutdown)

- **As for PS-SPS, orbit correction via magnet displacement to reduce orbit peak-to-peak and optimise aperture for high intensity beams**

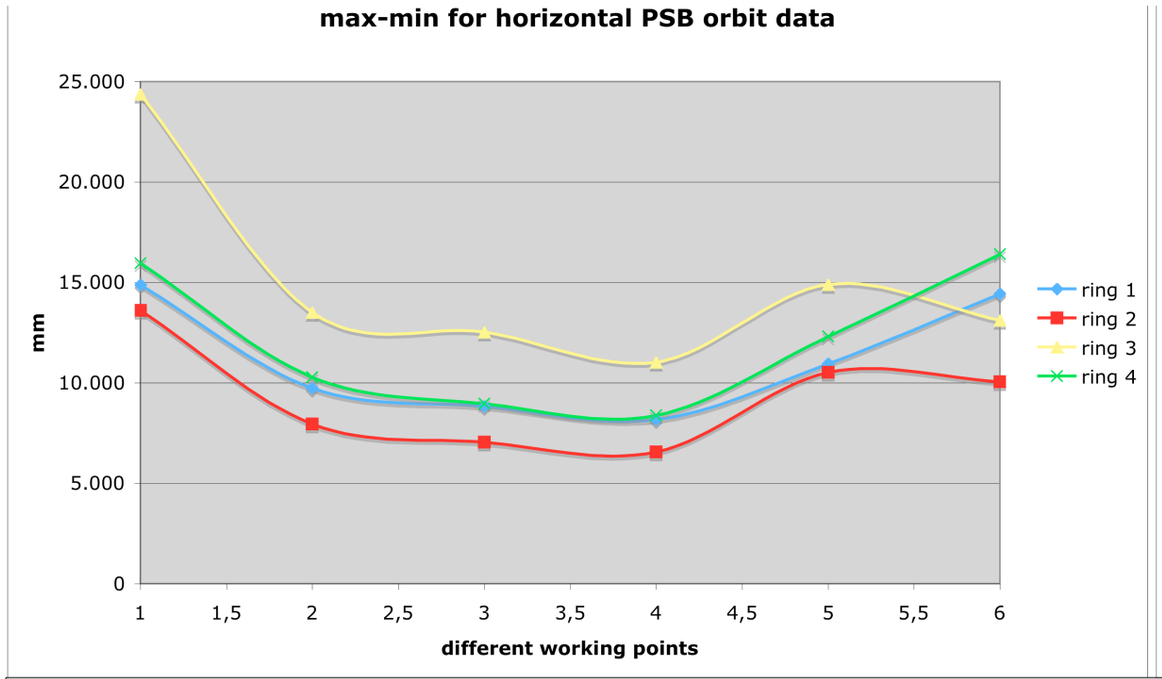
- **More complicated than other machines since four PSB rings are mechanically coupled**

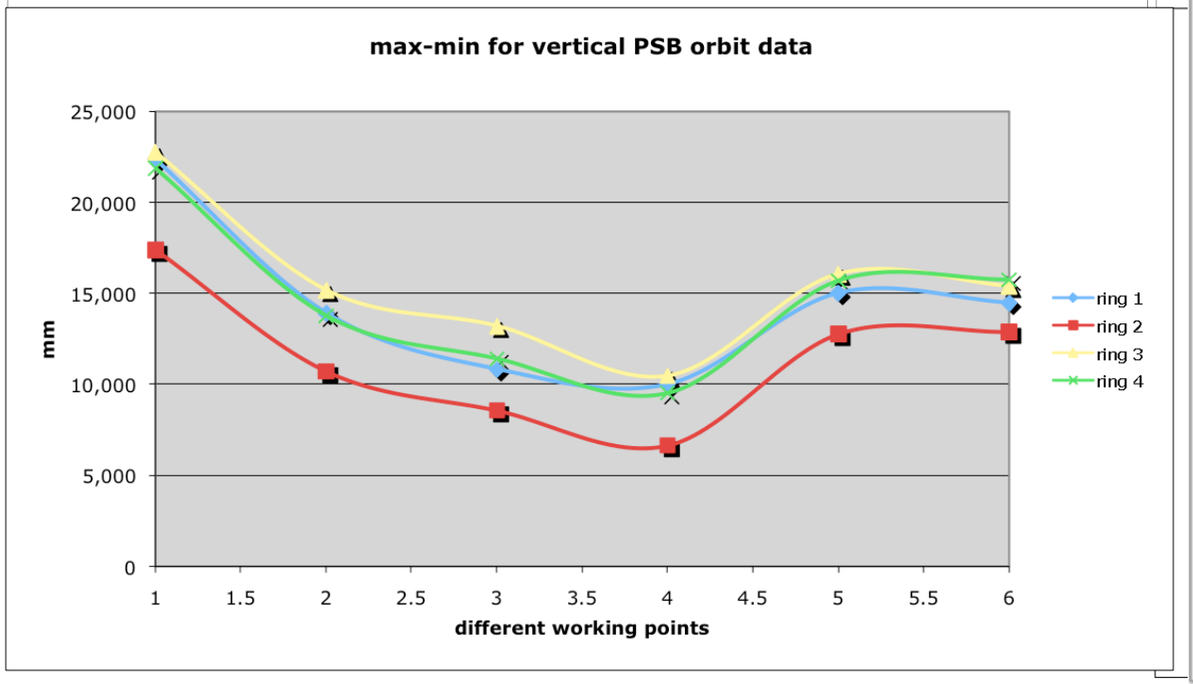


Peak-to-peak orbit improvement

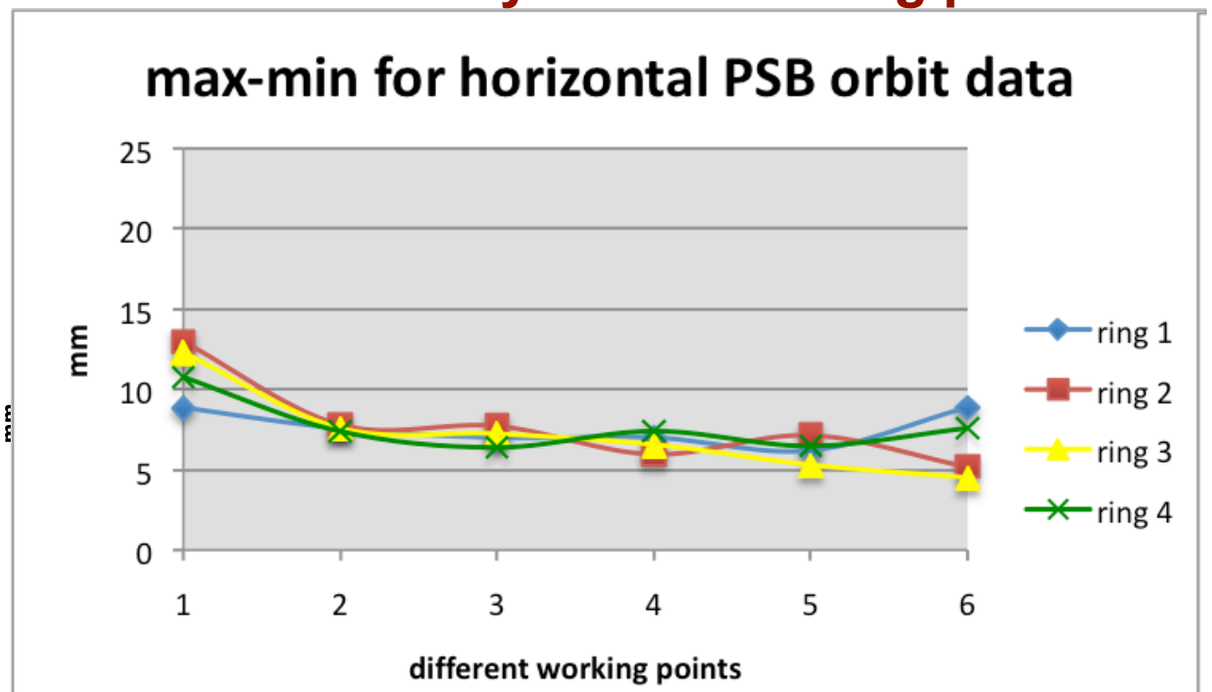
Presentation at APC 23 May 2008 B. Mikulec

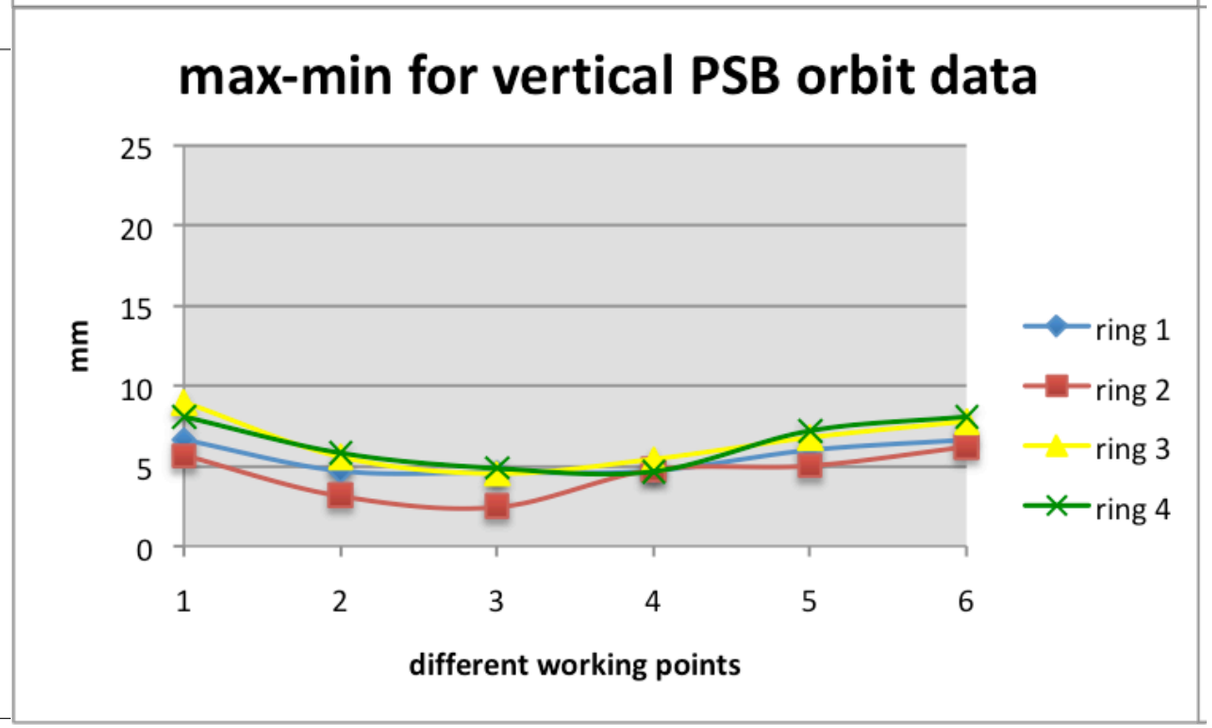
P-to-P Nov. ‘07 vs working point





P-to-P May ‘08 vs working point

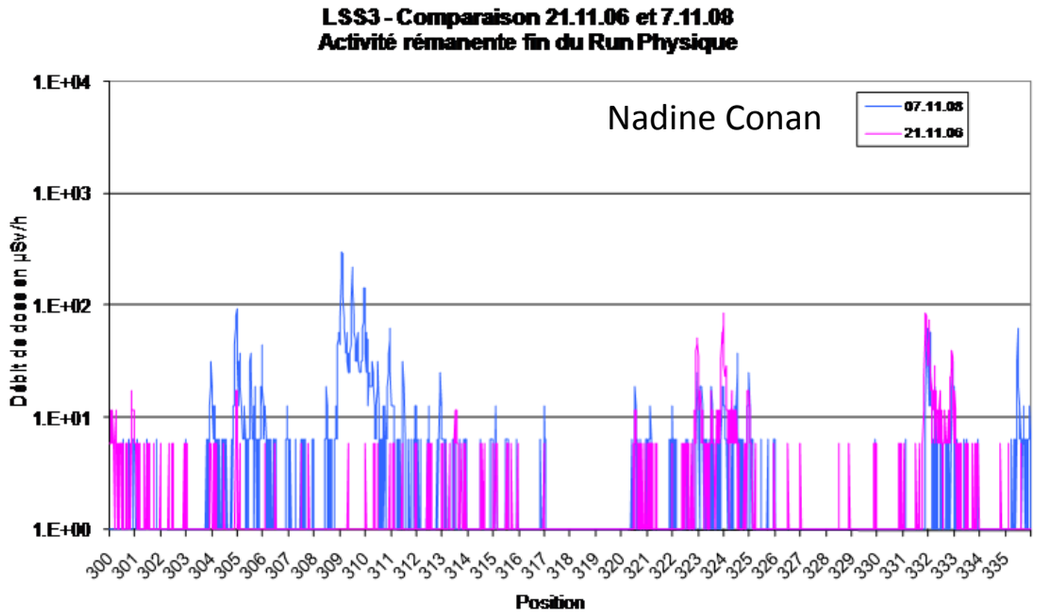


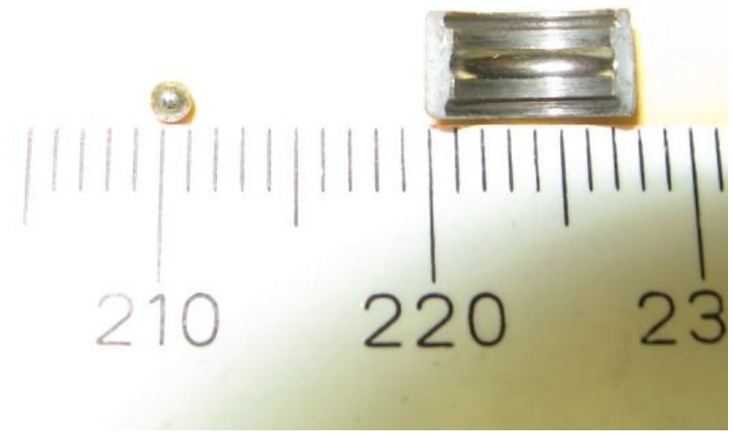


- The vertical orbits improved by a factor 2-3 corresponding to expectations
- Improvement in particular at low energies; orbit now similar between all working points and energies
- Ring 3 has become like the other rings in terms of its orbit
- The PSB startup was very smooth; many special tunings per ring are not anymore required

Search for hot spots

- Après analyse des mesures de radiations sur le ring.
- Détection de pertes anormales entre 303 et 311.
- Prise de mesures plus précises dans ce secteur.
- Localisation de différents points chauds.
- Détermination du ou plan se trouve ces différents points.
- Mise en place d'un plan d'action pour essayer de comprendre et d'éliminer ces pertes.
  - Contrôler l'alignement géométrique des éléments.
  - Contrôler l'ouverture en visuel (objet présent dans la chambre obstruant l'ouverture).
  - Contrôler si des aimants dipolaires ou quadrupolaires ont été changé ou déplacé durant le shut down précédant.





• Results of the radiation survey are compared with loss maps and eventual aperture restrictions, known or unknown (see for example APC talk of S. Cettour Cave)

• In general, no big surprises this year in PSB-PS: no really hot spot but radiation in general increased due to high intensity run.

• For the SPS, one of the hot spots has been related to a ball bearing found in the aperture ...

Injector Optics and aperture CSV/web repository

cern-optic-accelerators Site

http://cern-accelerators-optics.web.cern.ch/cern-accelerators-optics/

optics cern

Welcome to cern-accelerators-optics

LHC optics

SPS optics

PS optics

PS Booster

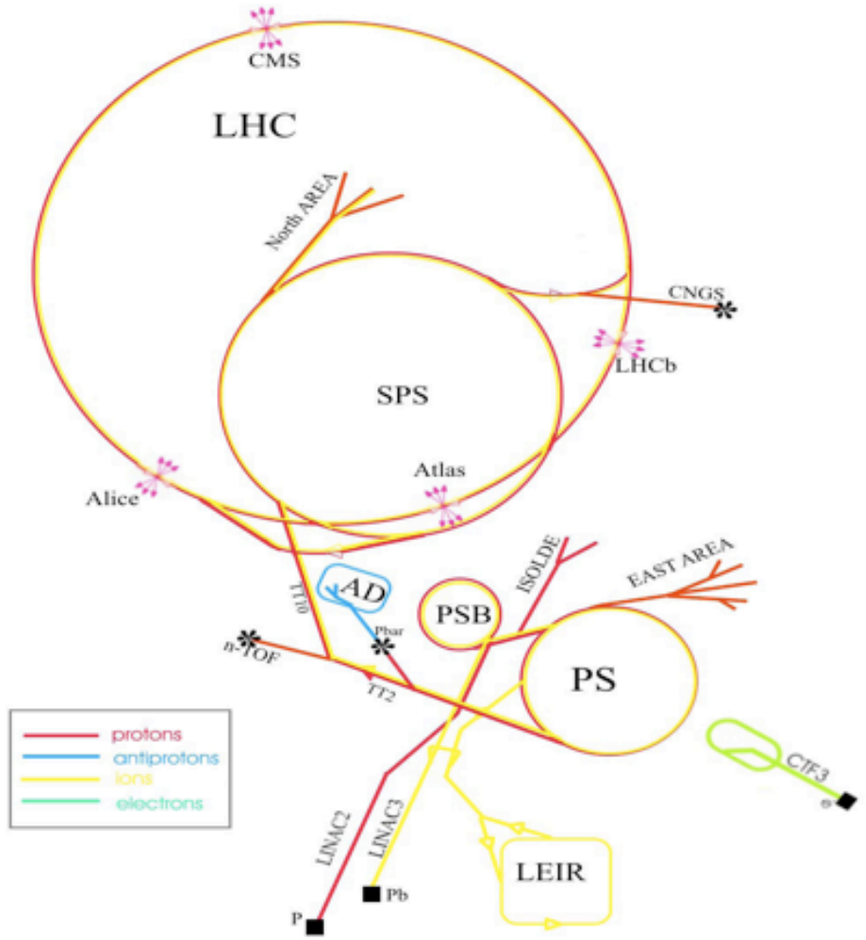
LEIR optics

AD optics

1. BI (From LINAC2 to BOOSTER)
2. BT/BTP (From BOOSTER to PS)
3. BT/BTM (BOOSTER measurement line)
4. BTY (BOOSTER to ISOLDE)
5. LEIR lines (From LINAC3 to LEIR)
6. TT2 (From PS to SPS, AD or nTOF)
7. TT10 (From PS to SPS; via TT2)
8. FTA (From TT2 to AD)
9. FTN (From TT2 to nTOF)
10. FT61 (From PS to EAST hall)
11. TT20 (From SPS to North Area - targets: T2/T4/T6 and lines H2/H4/H6/H8)
12. TT40 (From SPS to LHC or Gran Sasso)
13. TT41 (From SPS to Gran Sasso; via TT40)
14. TI2 (From SPS to LHC)
15. TI8 (From SPS to LHC; via TT40)

TT60/TT70/TT1/TT6 drawing

cern-accelerator-optics@cern.ch co/ Olav Berrig



- Optics and aperture models for rings and transfer lines available from web page: responsible O. Berrig (BE/ABP)

- Information start to be stored in the layout database as for the LHC (BE/CO, BE/OP, BE/ABP)

Conclusions

- Recommendations status:
  - MTE commissioning will end in 2009: less radiation @ route Goward, no radiation in SS31, losses concentrated at extraction septum
  - radiation @ route Goward: injection studies ongoing
  - No additional air activation studies for TT10 in 2008 due to other priorities. Postponed to 2009
  - Surface area on top of TT20 has been fenced
  - TT10 PGC1 shaft shielding has been renovated
  - Air sniffing system in BA80 installation started but, due to other priorities, work will be finished in 2009
  - SPS-BLM readout device for residual dose rate measurements testing started
- Operation always attentive to reduce as much as possible beam losses
- Other steps taken to reduce/understand losses: machine alignment, renovation of beam loss monitor system, cross-check between radiation survey and BLMs data...