



# MTE ROADMAP SEEN FROM OP

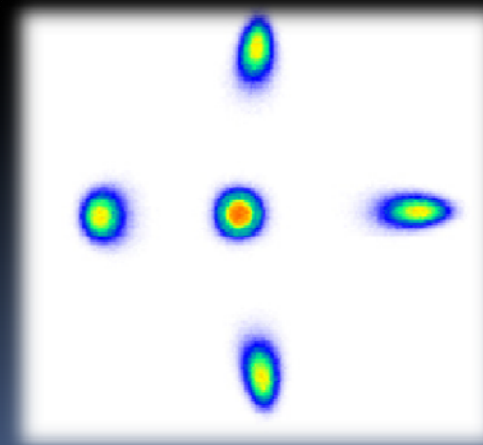
Rende Steerenberg,  
BE-OP

Thanks to : K. Cornelis, S. Gilardoni, M. Giovannozzi, M. Widorski,  
OP-PS team, .....

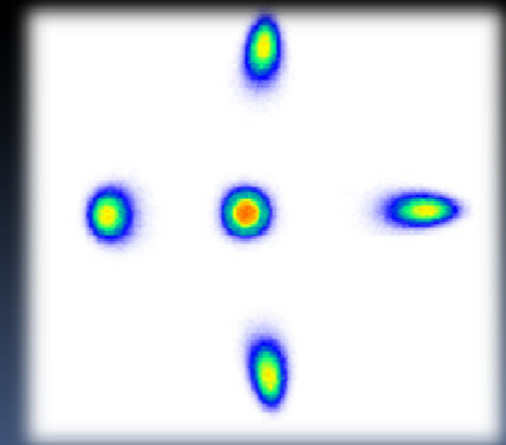
IEFC Work Shop 2011  
21 – 24 March 2011

# Contents

- Why MTE, What do we Gain From it ?
- Radiation Issues
- PS experience & Tools
- SPS experience
- Plans
- Concluding remarks



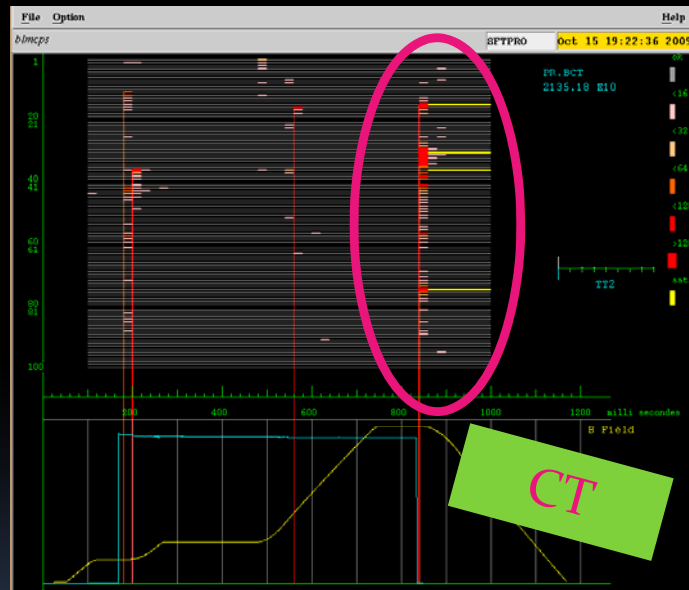
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# Short term MTE benefits for PS

- Provided present problems are mitigated..
- A lot to gain immediately in PS
  - Lower losses around the whole machine

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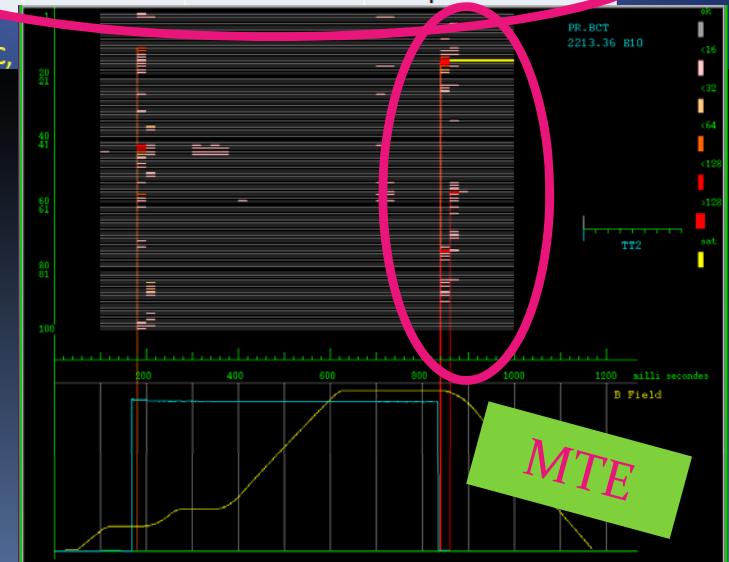


Calculated from intensity & loss  
S. Baird

|                              | Intensity                          | Relative Loss | Loss rate                                |
|------------------------------|------------------------------------|---------------|--|
| Injection                    | $8.2 \cdot 10^{12} \text{ s}^{-1}$ | 6 %           | $5 \cdot 10^{11} \text{ s}^{-1}$         |
| Extraction (high.int. beams) | $6.4 \cdot 10^{12} \text{ s}^{-1}$ |               |  |
| CT                           |                                    | 10 %          | $6.4 \cdot 10^{11} \text{ s}^{-1}$       |
| MTE                          |                                    | 1 – 2 %       | Up to $1.3 \cdot 10^{11} \text{ s}^{-1}$ |

Average/supercycle

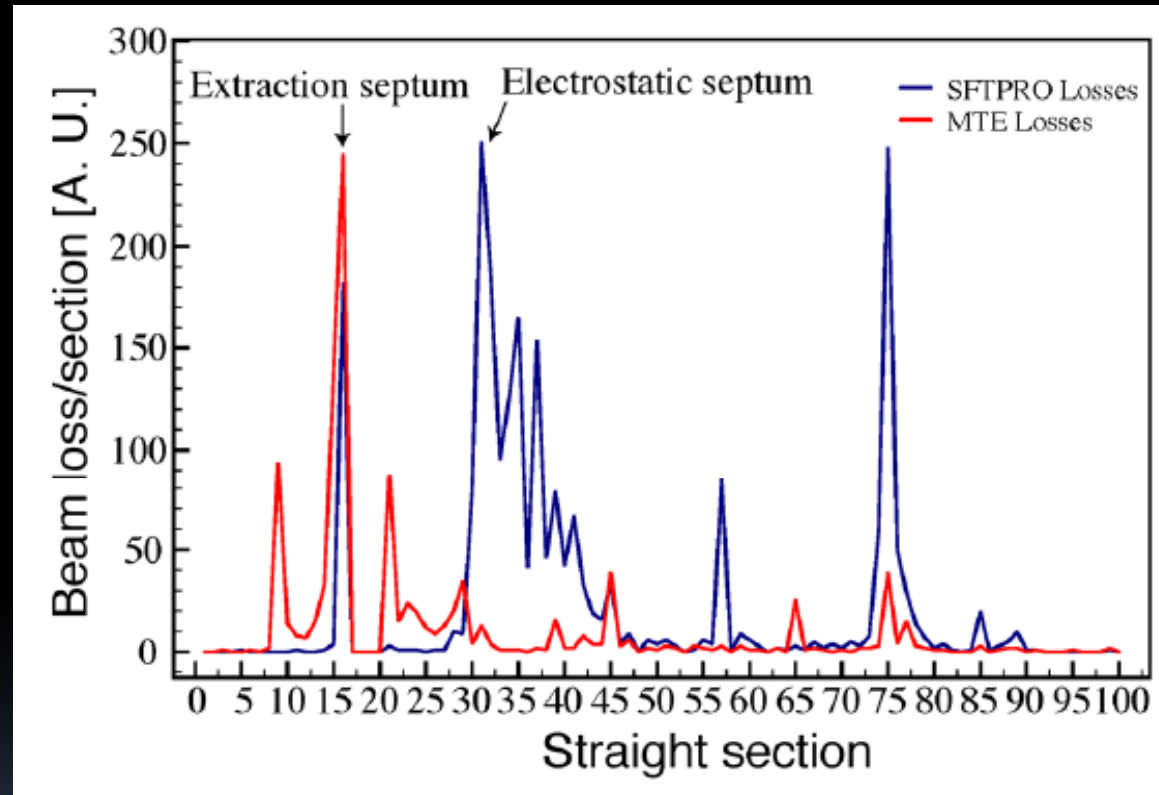
Not including nTOF, LHC,



- Lower radiation levels inside, means also lower levels outside the PS

# Short term MTE benefits for PS

- Much lower and better loss profile around PS

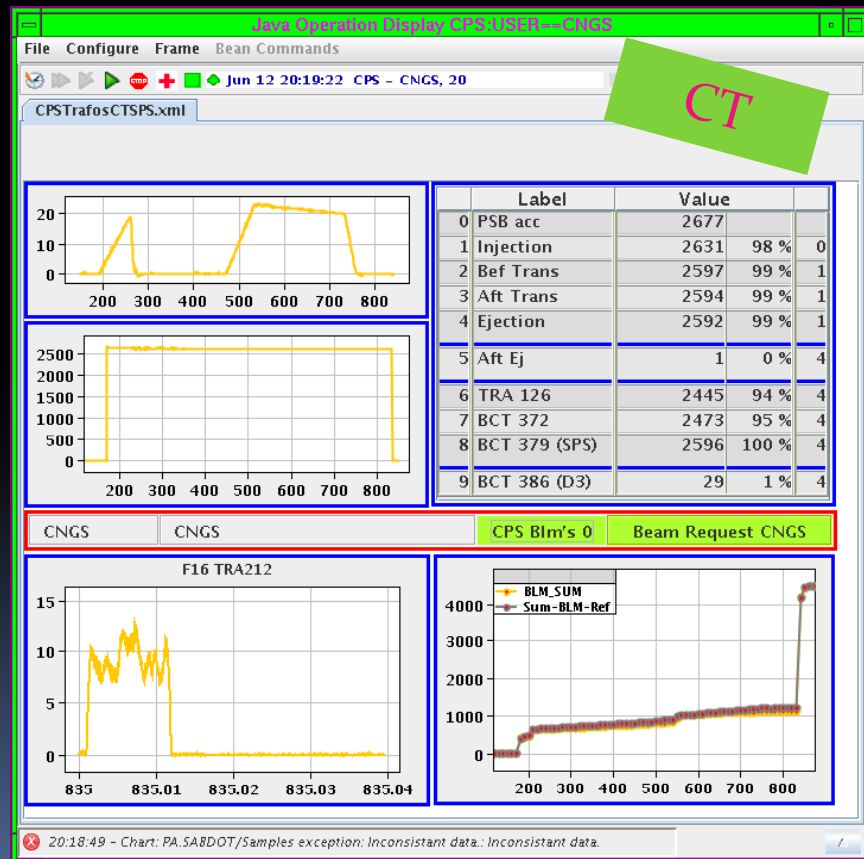


- Lower losses will result in lower radiation levels and better maintainability of the machine equipments

# Short term MTE benefits for SPS

- Presently no immediate gain for SPS
  - Only advantage is a flatter spill with less spikes

MTE ROADMAP SEEN FROM OP





# Long term MTE benefits

Provided Spoiler or dummy septum is in place

- Once MTE is working correctly:
  - Less losses in PS removes bottleneck for intensity increase
  - Work can start to increase intensity by further optimizing injection and acceleration
  - Prepare for higher intensity and brighter beams with LINAC<sub>4</sub>
- If MTE is not made operational then the full capabilities of LINAC<sub>4</sub> and possible PSB/PS upgrade cannot be exploited



# Possible Future Needs

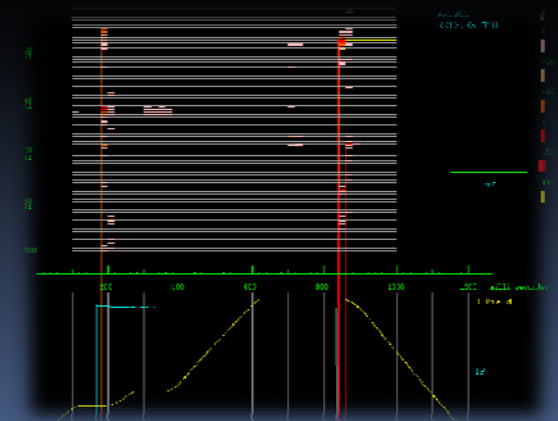
See also talk Ilias Eftymiopoulos in the afternoon

- LAGUNA-LBNO (preliminary)
  - Design study proposal with staged approach
  - 1<sup>st</sup> step is increase of power on CNGS target from ~500 kW to ~750 kW
  - This can only be achieved by increasing the intensity per extraction
- This is just one example showing the need to remove the extraction losses bottleneck in the PS



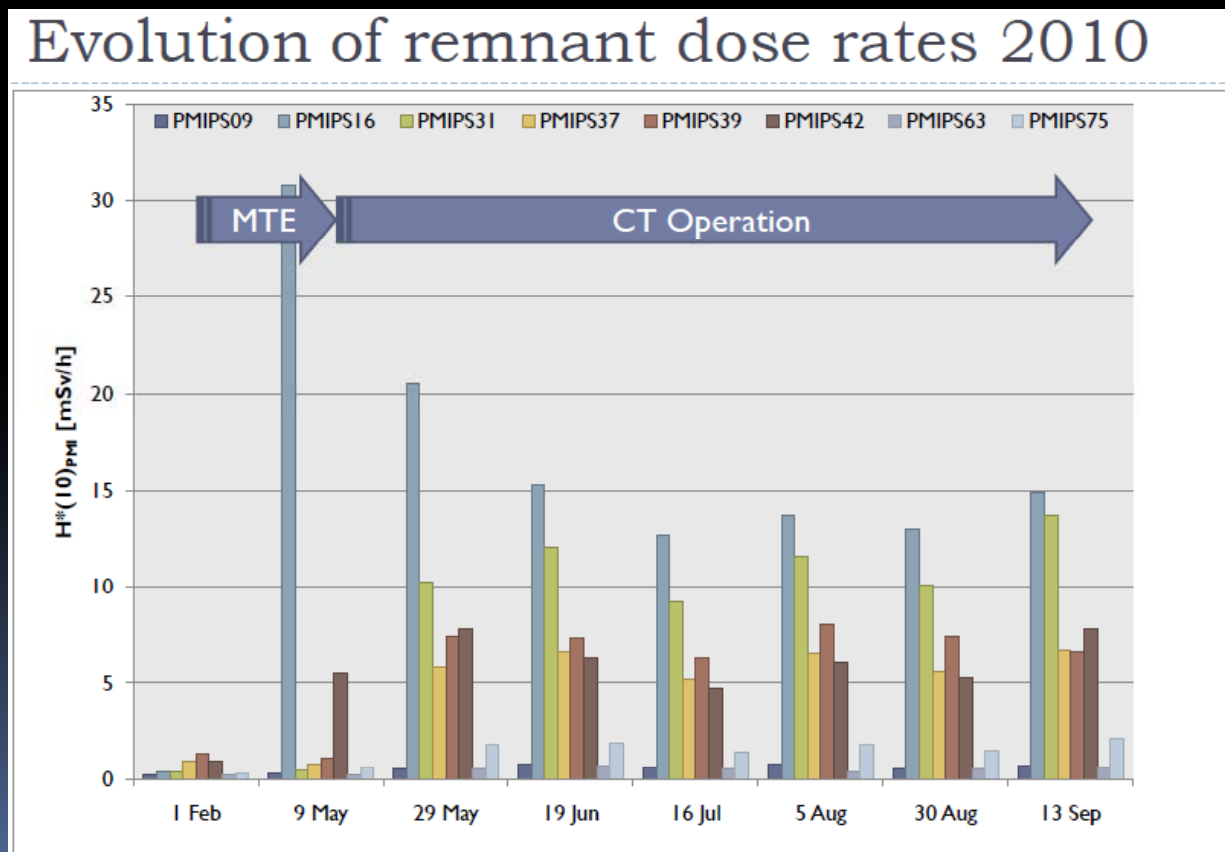


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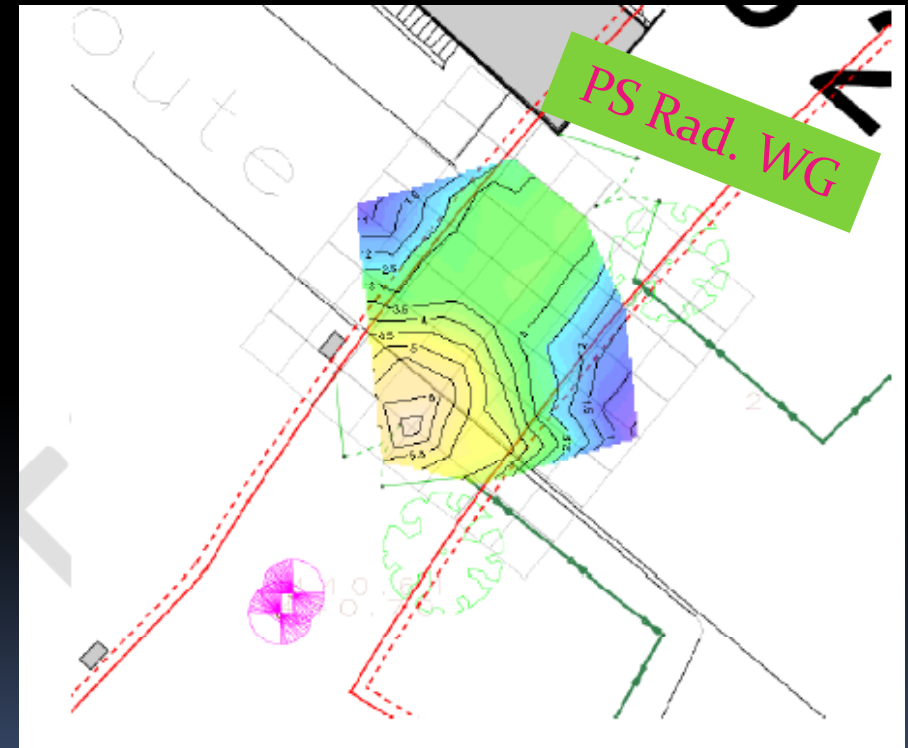
# PS Radiations Issues

- With MTE the PS is much cleaner
- However, very high activation of SMH16
  - Proposed mitigation: Spoiler / dummy septum



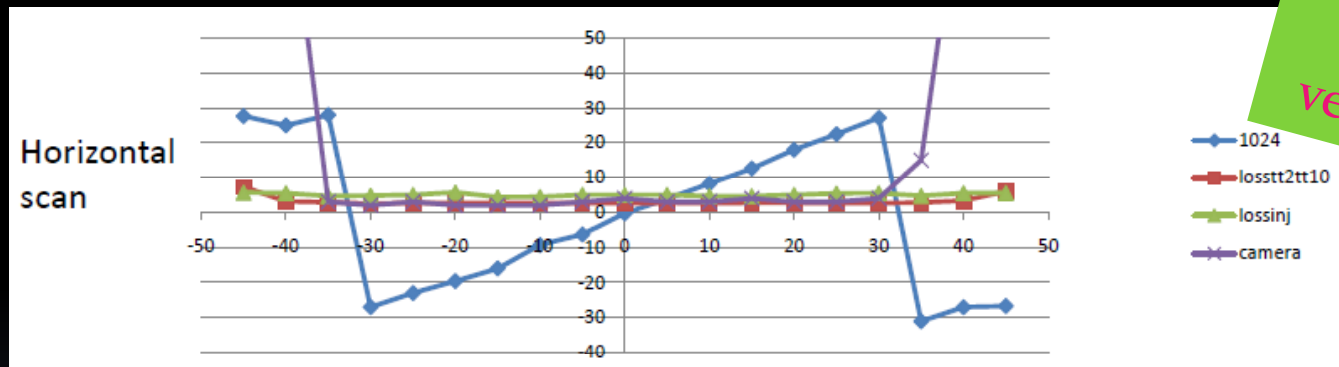
# Route Goward

- The Dose rate on the Route Goward will decrease when replacing CT by MTE



# SPS Radiations Issues

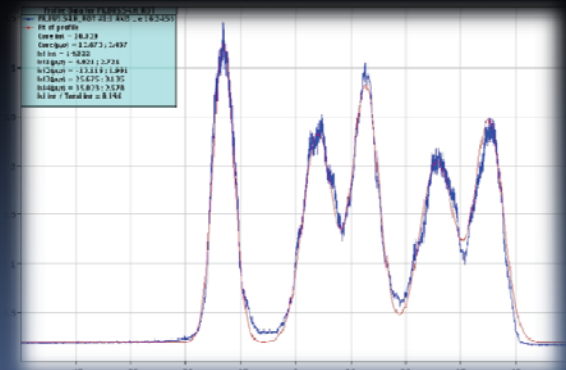
- The Hot spot in TT10
  - Was a result of bad steering in TT2/TT10 of the different islands and core
  - Issue understood and fix put in place (YASP)



Similar in vertical plane

- Losses in SPS were higher than for CT, but could not be optimized due to the periodic fluctuations

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# MTE workshop September 2010



## Operational Status

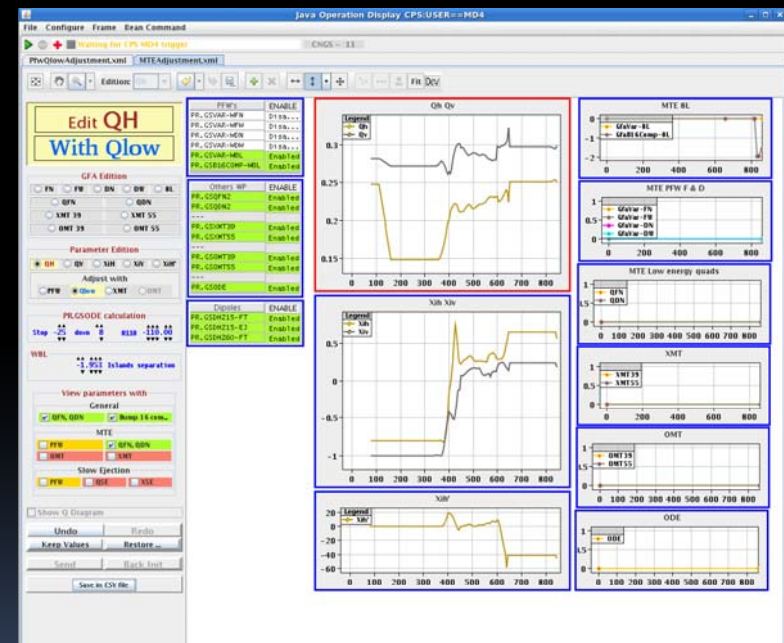
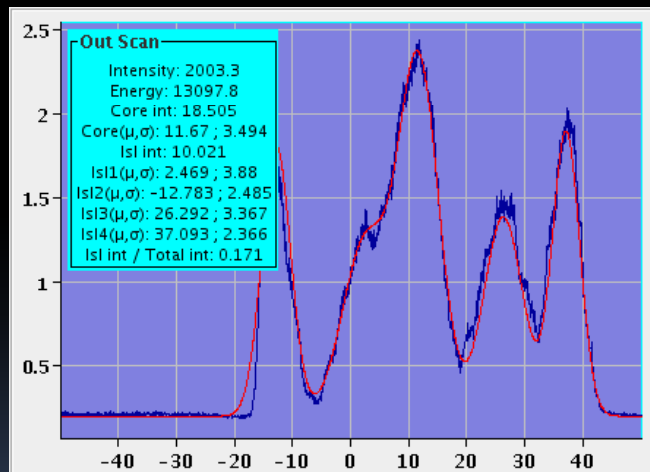
- We started the 2010 run with MTE, but prepared also beams with CT extraction as backup
- The beam with MTE was used by the SPS
  - Initially with low intensity for SPS setting up
  - Later also for physics with an intensity of  $\sim 2.2 \times 10^{13}$  per PS extraction
- The periodic fluctuations caused regular radiation alarms and the Op team had little means to act on the beam to avoid them
- However,
  - The Op teams gained valuable experience with the MTE and are motivated to get it working
  - This period was very useful to create the operational web based beam documentation
  - The extracted MTE spill structure is much flatter than the CT, which often contains gaps and spikes
- Radiation issues on SMH16 caused a switch to the CT extraction

Since then many systematic measurements were made by PS-OP team

# MTE Tools

- The development of MTE tools is also very beneficial for normal operation

*“Machine studies keep the minds sharp and the instruments working”*



- However, difficulties measuring the extraction losses of the order of 1-2% with present BCT's



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2009 target  
primer teletext 111

User: CNGS2

04 May 2010 10:50  
Last update: 1 secs ago

|  | TT2  | TT10 | %LOSS | INJ  | %LOSS |
|--|------|------|-------|------|-------|
|  | 2248 | 2167 | 3.6   | 2035 | 6.1   |
|  | 2160 | 2082 | 3.6   | 1997 | 4.1   |

|           | I/E10 | %LOSS | %TRNS | TIME/ms |
|-----------|-------|-------|-------|---------|
| INJECT    | 3985  | 5.1   | 95    | 1210    |
| END_FB    | 3950  | 2.0   | 98    | 1260    |
| 20 GeV/c  | 3834  | 2.9   | 95    | 1470    |
| 27 GeV/c  | 3782  | 1.4   | 94    | 1530    |
| 50 GeV/c  | 3752  | 0.8   | 93    | 1740    |
| 400 GeV/c | 3743  | 0.3   | 93    | 4200    |

0.28750      LOSS @ FB: 2.3%

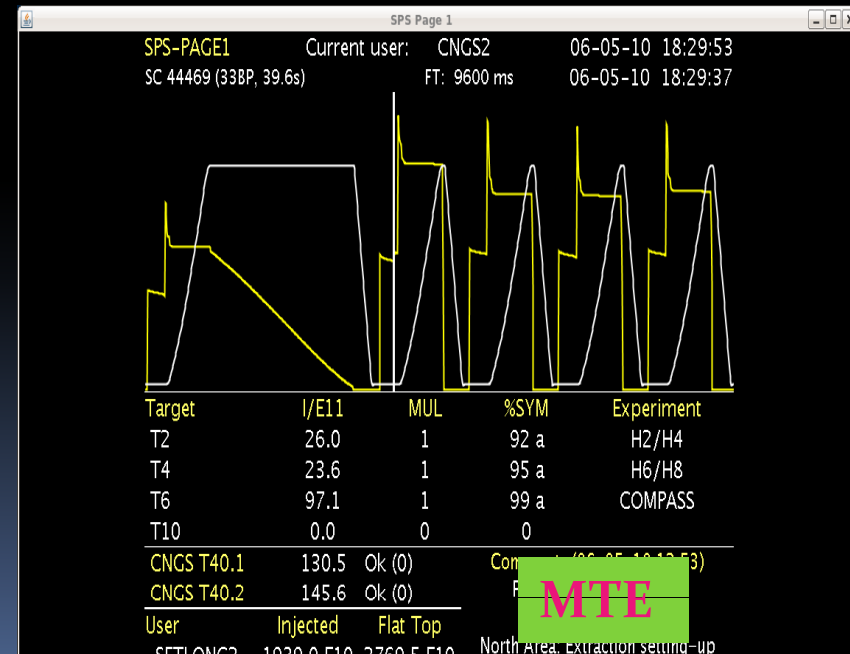
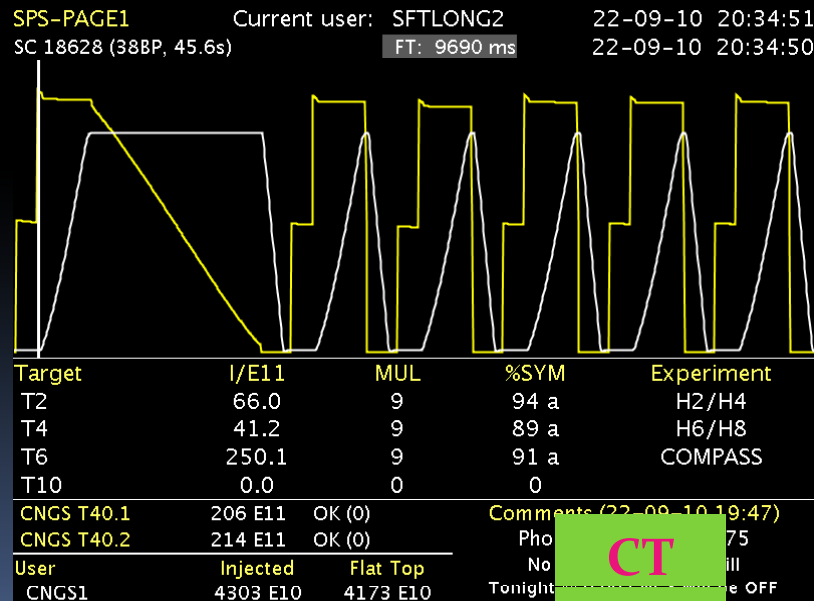




# SPS experience CT versus MTE

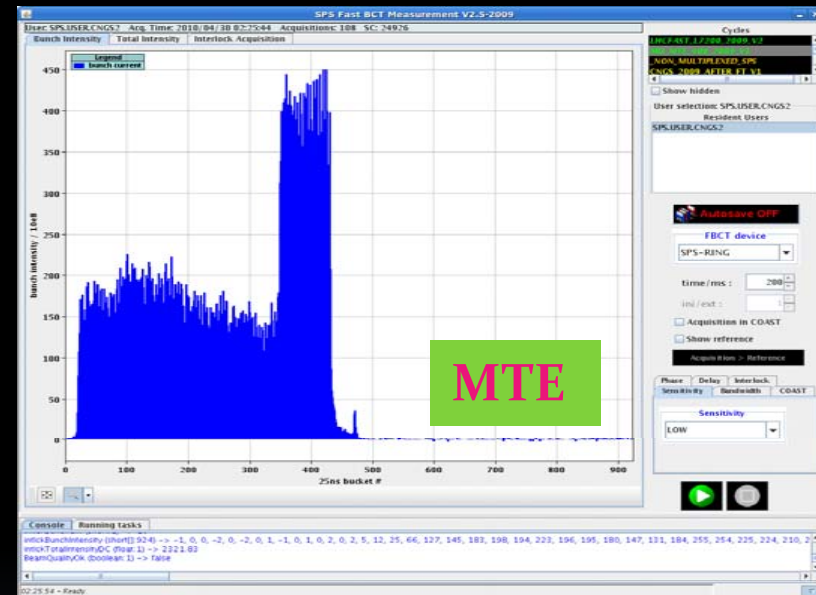
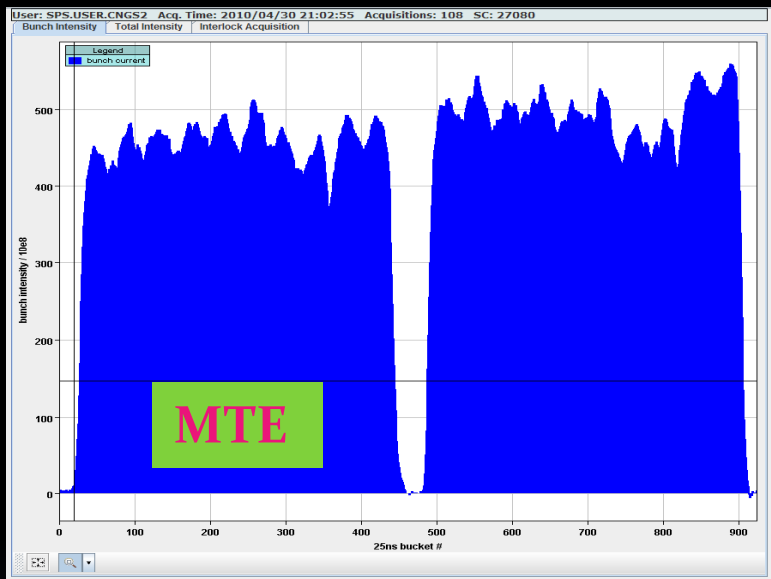
- For SPS optimization was difficult due to the periodic fluctuation

*“We are trying to shoot a moving target”*



# SPS experience CT versus MTE

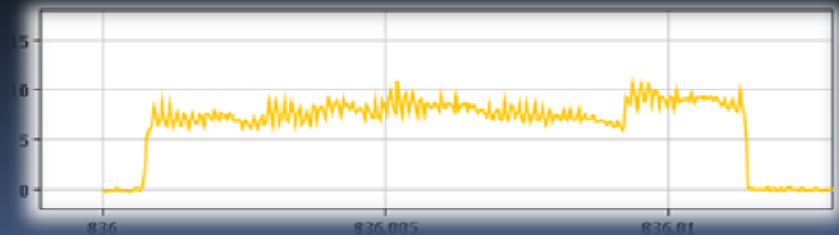
- The periodic fluctuations led to:



- SPS also noticed that the beam in the vertical plane was often big
  - $\epsilon_v < 6.6 \mu\text{m}$  at  $1\sigma$  normalised



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See also talk  
Massimo  
Giovannozzi

# Present PS MTE Activities

- Presently hybrid MTE is being setup for testing
  - Use of SEH<sub>31</sub>
- For the future a spoiler or dummy septum in front of SMH16 is foreseen.
- OP has a clear preference for the spoiler option, as the hybrid MTE complicates adjustments



# Planning OP viewpoint

- Planning:
  - Continue measurements to investigate periodic fluctuations in PS
  - Tests with and later use of hybrid MTE (for use until end 2012)
  - Commission MTE with spoiler start up 2014
- Main focus should be on the periodic fluctuations

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# Concluding Remarks

- MTE has an immediate benefit for the PS, but only a longer term indirect benefit for the SPS
- Presently PS extraction losses form the bottleneck for increase of intensity to SPS
  - MTE will reduce extraction losses in PS and will allow development to increase the PS extracted intensity
- Strong preference for spoiler/dummy septum and keep MTE operation as simple as possible
- Good support from PS and SPS OP needed, but also the equipment groups