MTE Commissioning 2008

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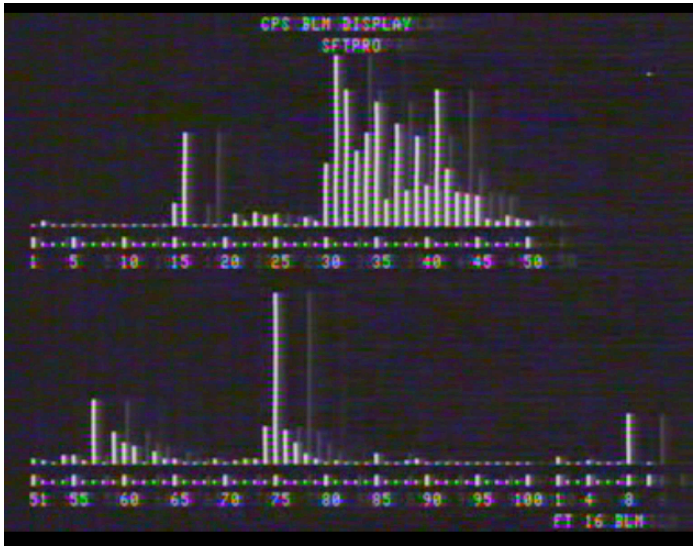
Thanks to: the members of the PS Multi-Turn Extraction Project (see last slide) and to all the others who contributed to the successful installation and commissioning

Brief introduction to PS-SPS transfer

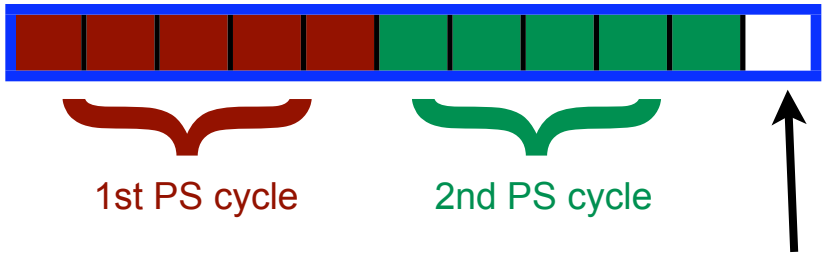
PS Beam loss monitors



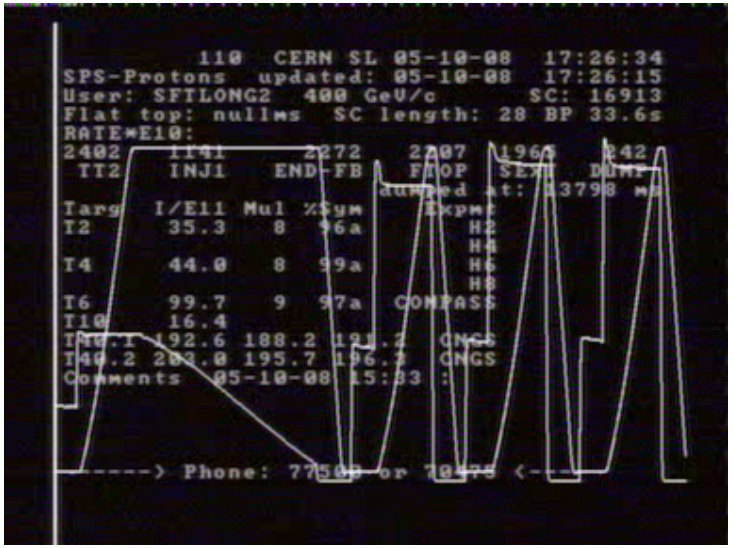
PS cycle

Beam for fixed target physics (CNGS)
at the SPS are extracted from the PS at 14 GeV/c
during five turns repeated on two cycles
with large losses in the PS

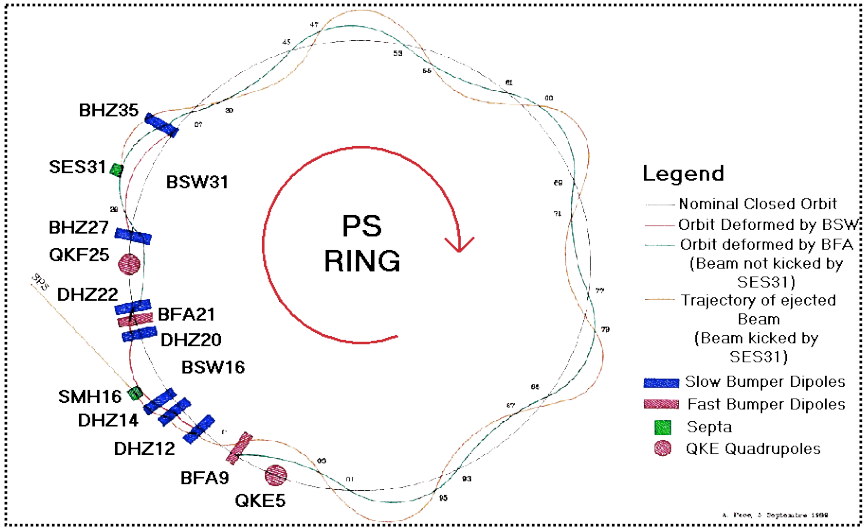
1 SPS circumference
=
11 PS circumferences



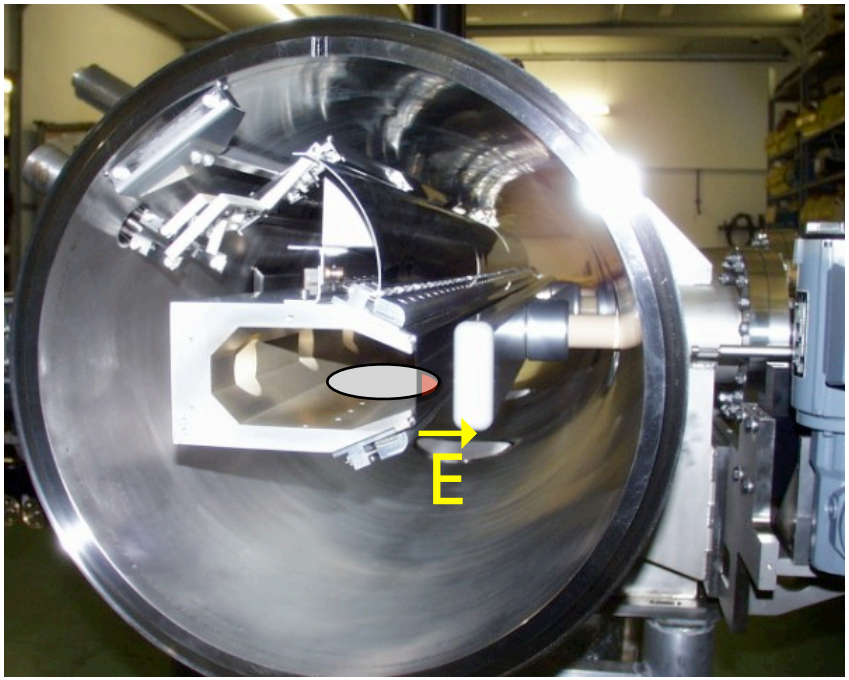
SPS cycle

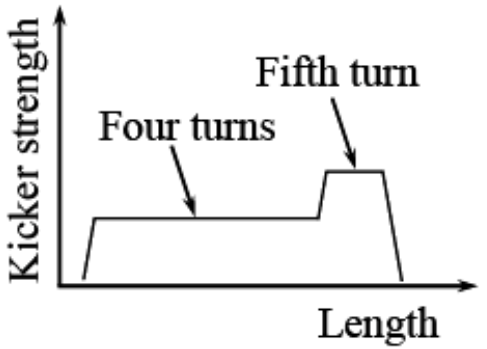


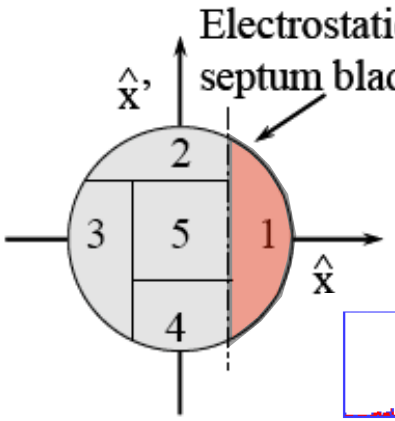
Continuous Extraction (CT, 70s): the principle

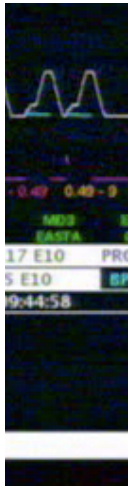


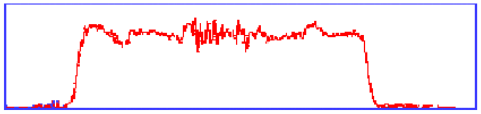
- Horizontal tune set to 6.25 phase advance per turn of 90°.
- A part of the proton beam is pushed by a slow and a fast bumps beyond the blade of an electrostatic septum.
- The sliced beam that receives the kick of the electrostatic septum is extracted during the current machine turn
- The rest is extracted with the same mechanism within the next 4 turns.
- The five beam slices feature the same intensity.





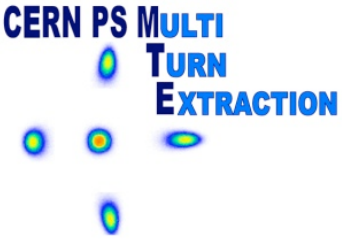






← Five PS turns →

New Multi-turn Extraction



The main ingredients of the novel extraction MTE extraction:

- **The beam splitting is not performed using a septum**, **thus avoiding losses**.
  The beam is separated in the transverse phase space using:

  a. Nonlinear magnetic elements (sextupoles ad octupoles) to **create stable islands in which the beam is trapped**.

  b. Slow (adiabatic) tune-variation to cross an appropriate resonance, **1/4 to have 5 islands**.

  c. When the 5 beams are separated enough, each islands is ejected in 5 different turns

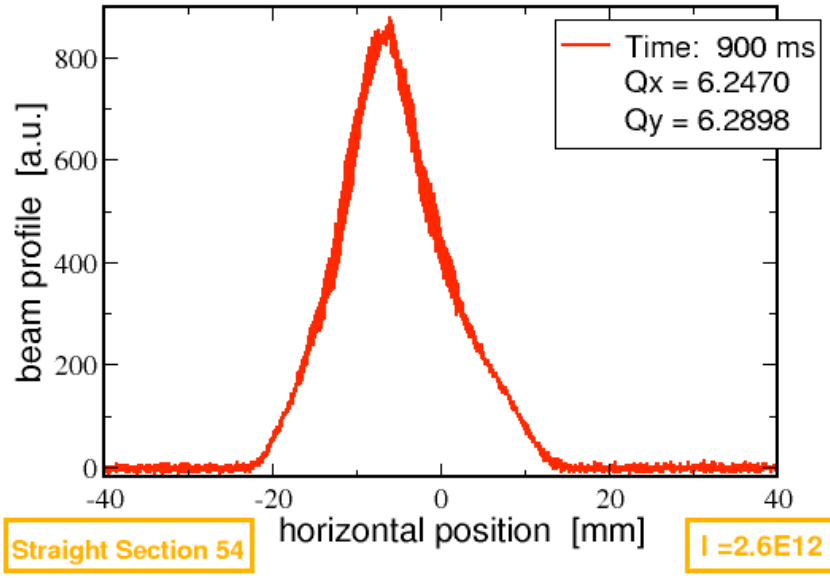
     a. Slow bump to approach extraction septum ⇒ New bump 16

     b. Fast bump to jump the septum blade ⇒ New kickers.

- This approach has the following beneficial effects:
  - Losses are reduced.
  - The phase space matching is improved with respect to the present situation.
  - The beamlets have the same emittance, optical parameters and nearly the same intensity.

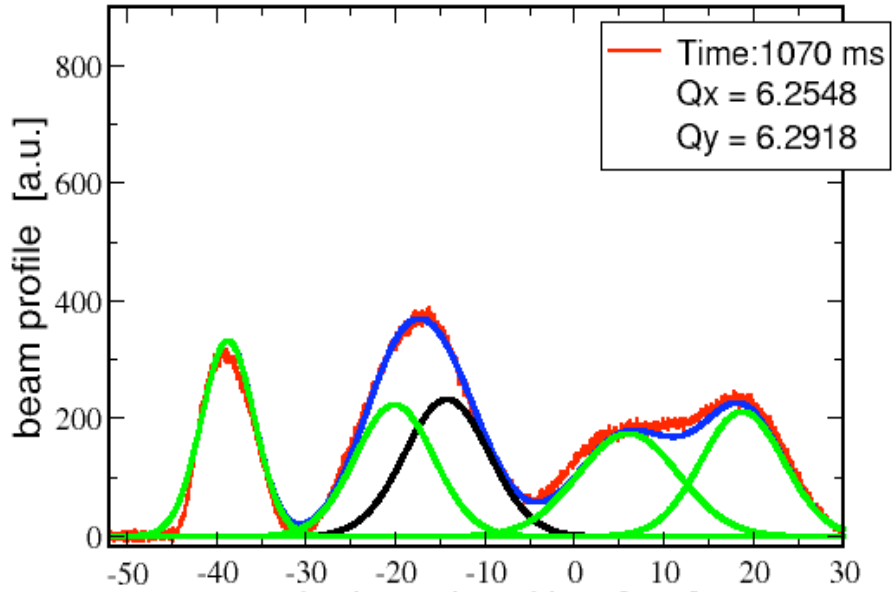
PS Multi-Turn Extraction experiment, 20-11-2006

Depleting the beam core via unstable resonance excitation



Straight Section 54

I =2.6E12 ppb



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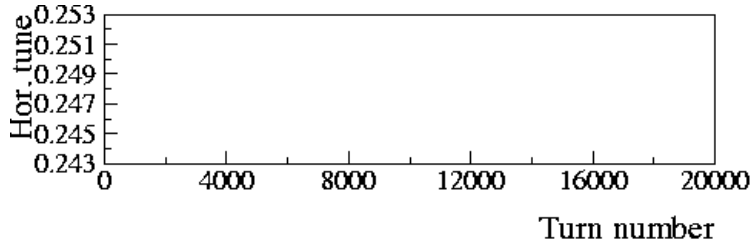
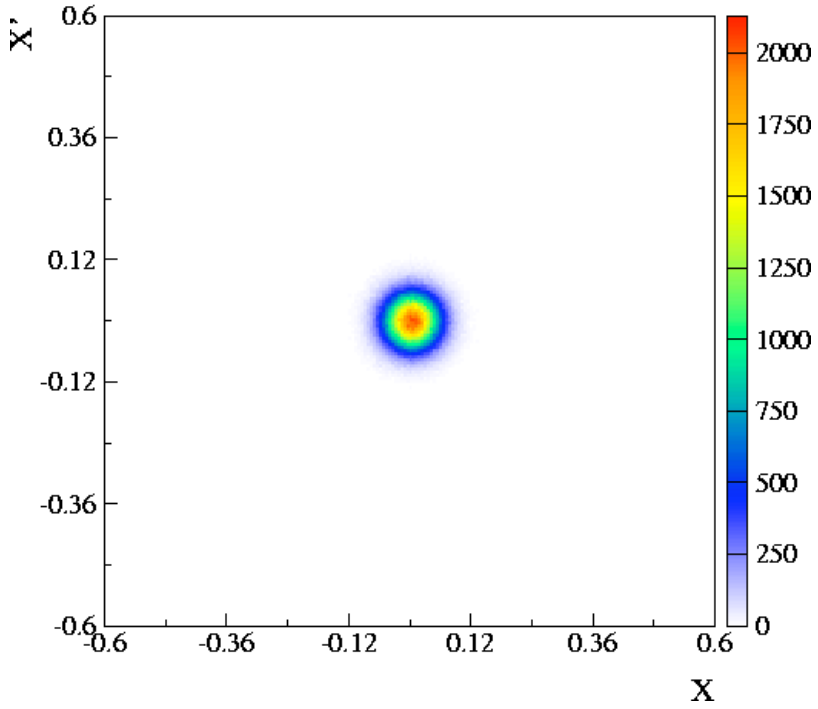
MTE: Multi-Turn extraction

a clean way

to generated beamlets





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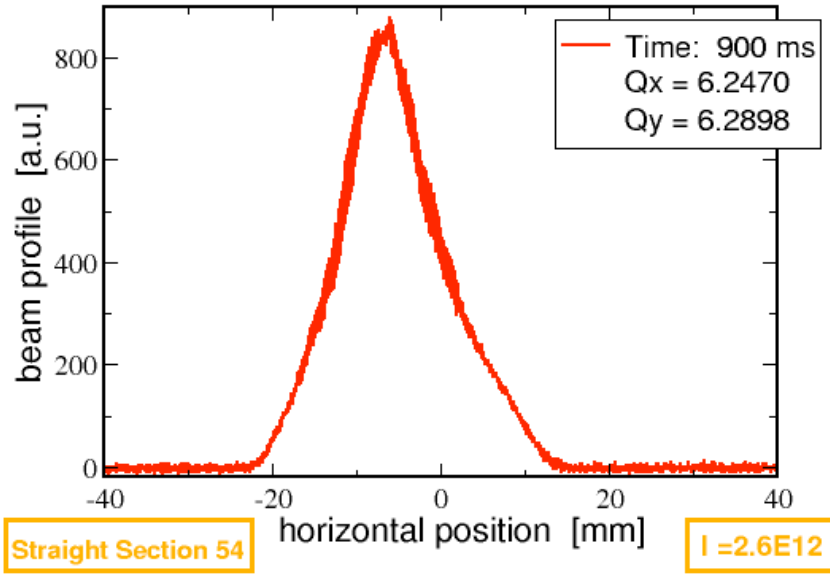

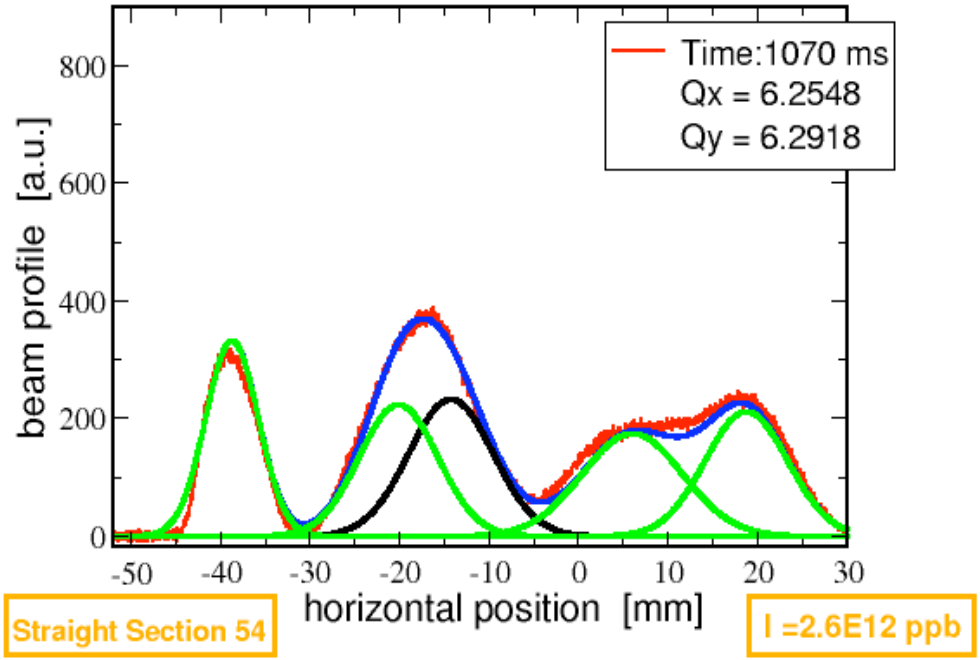

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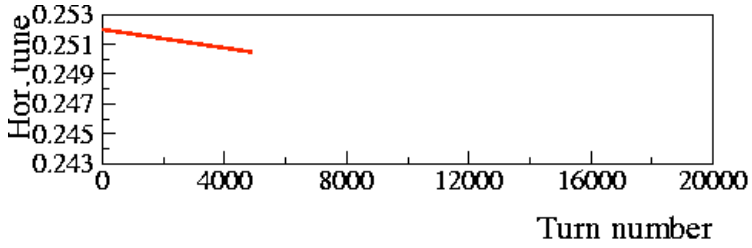

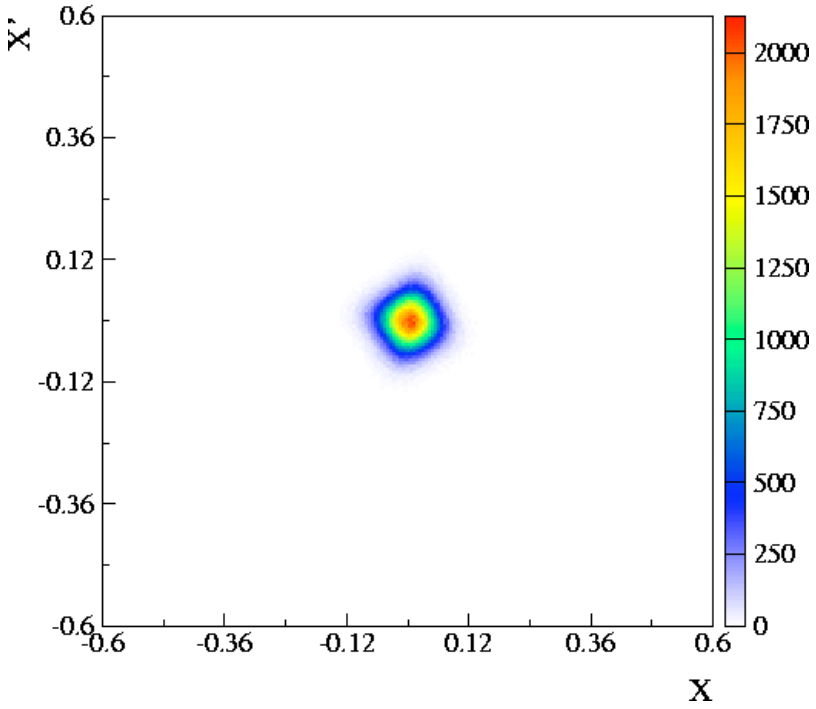

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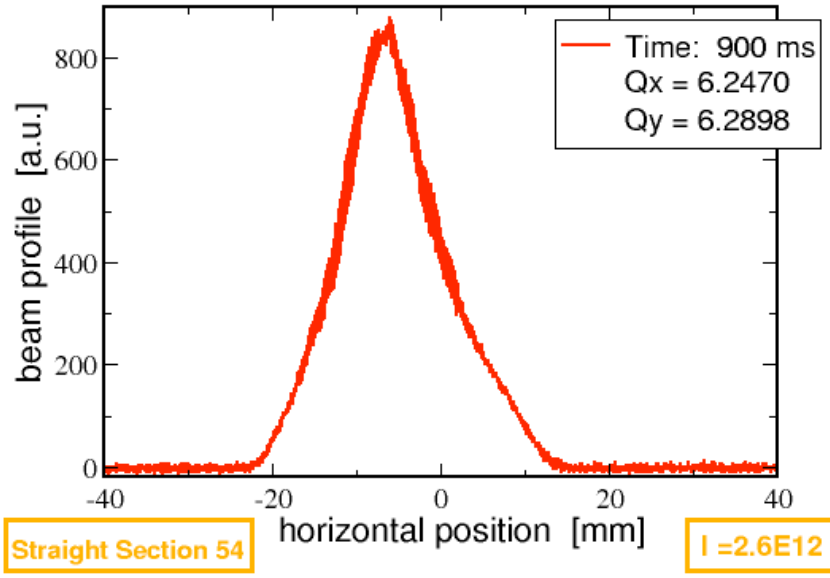

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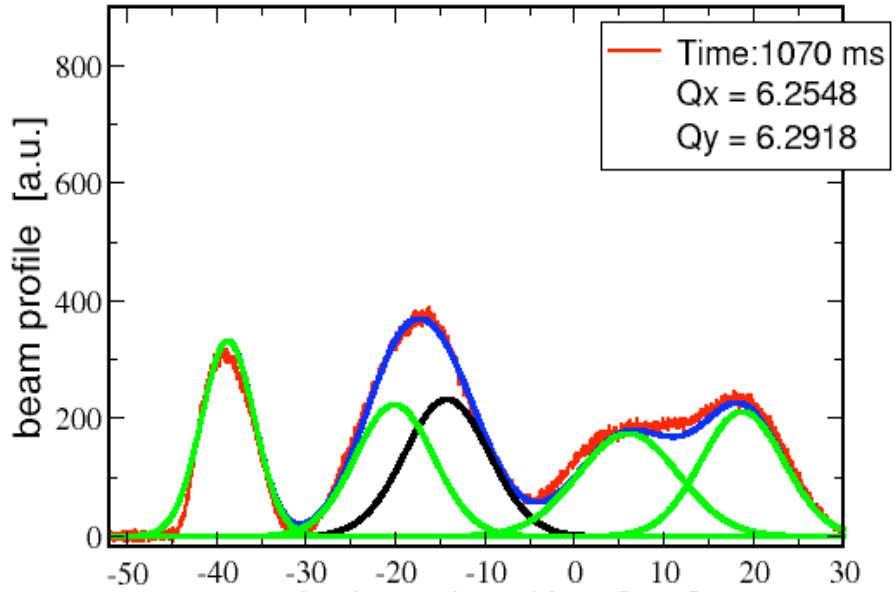

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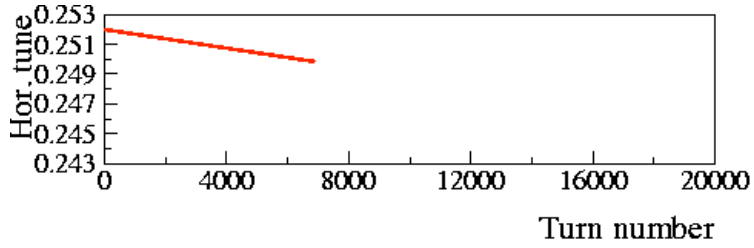

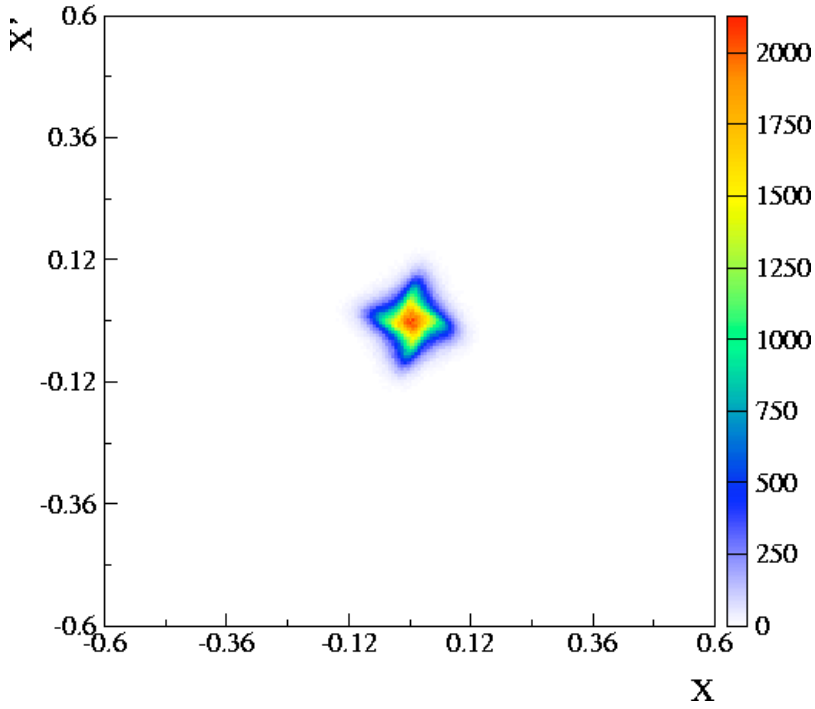

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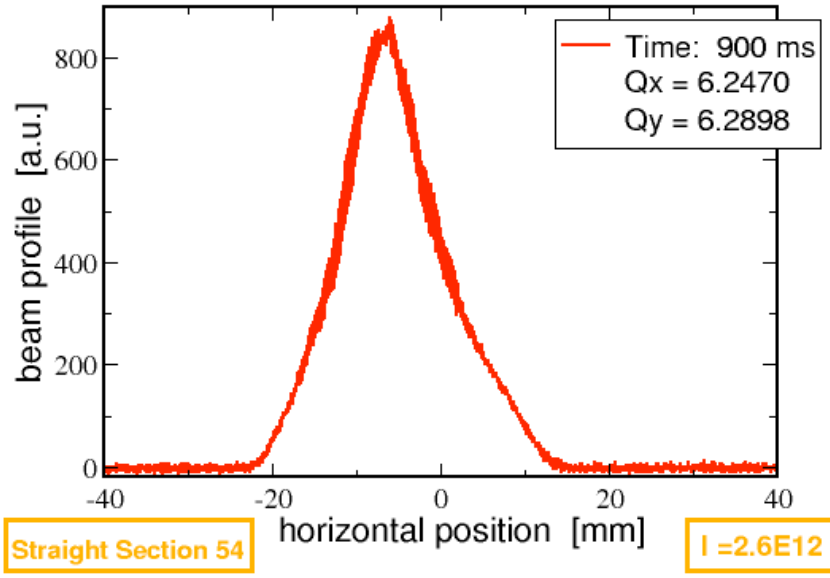

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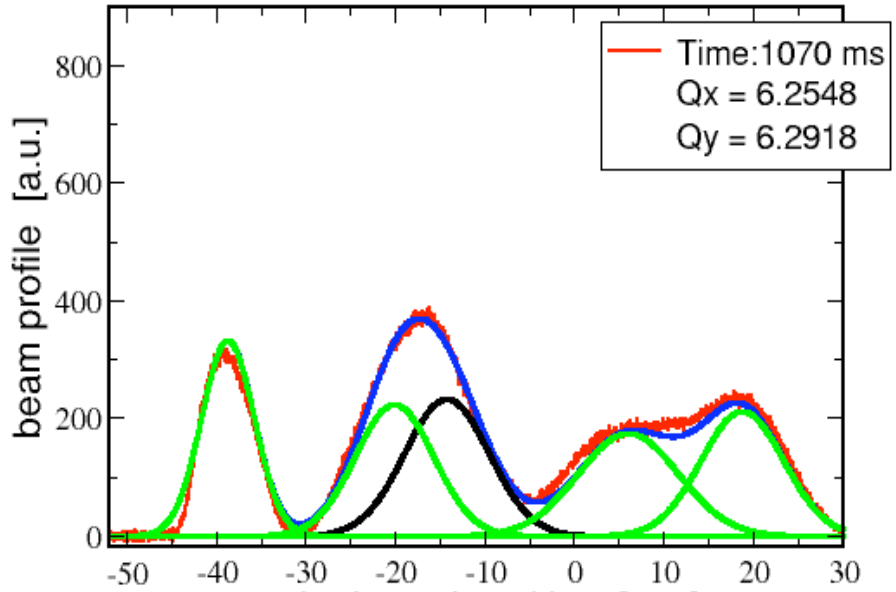

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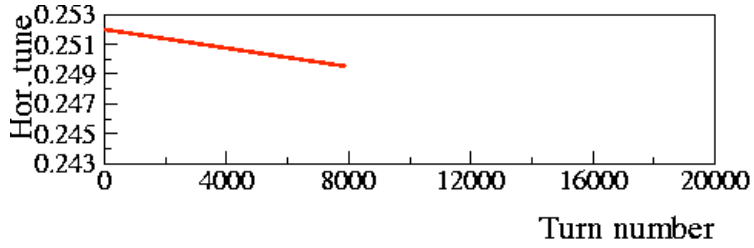

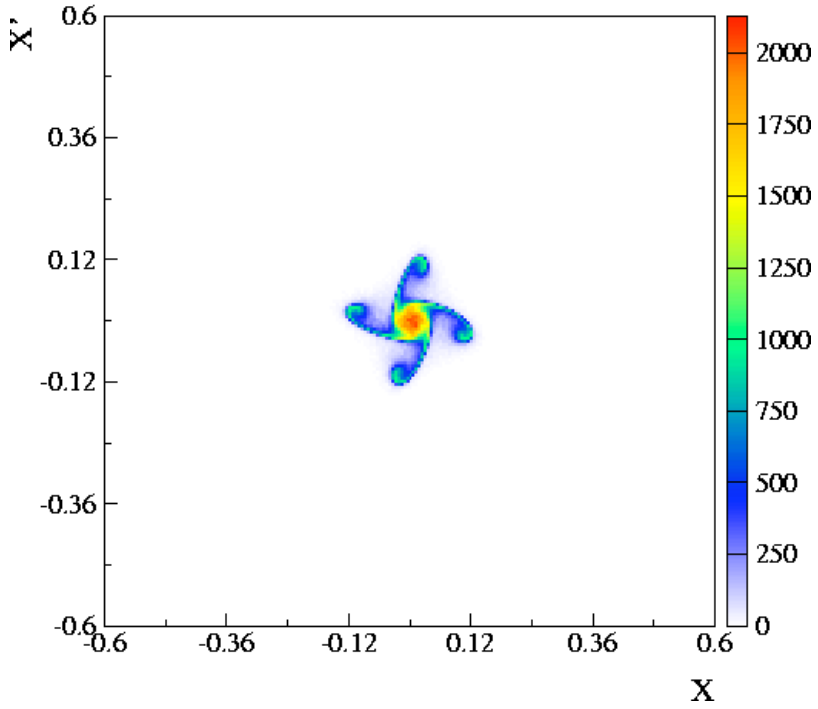

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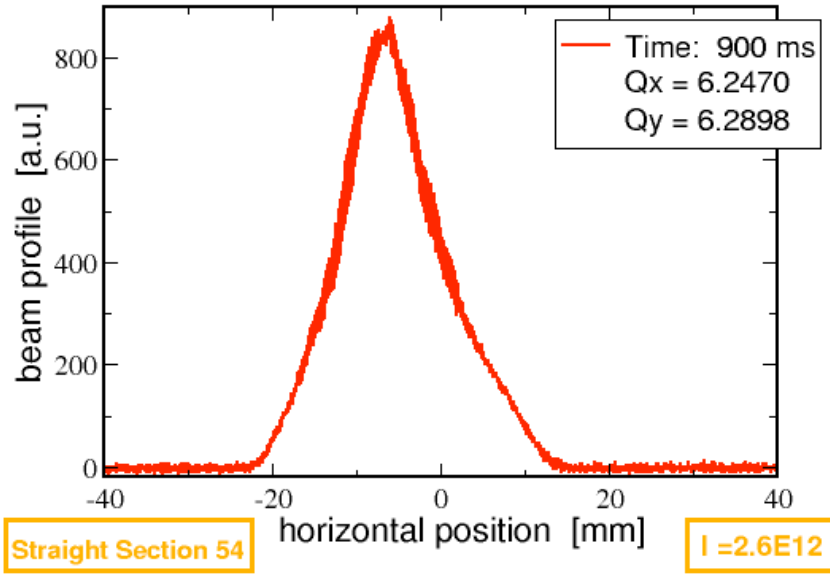

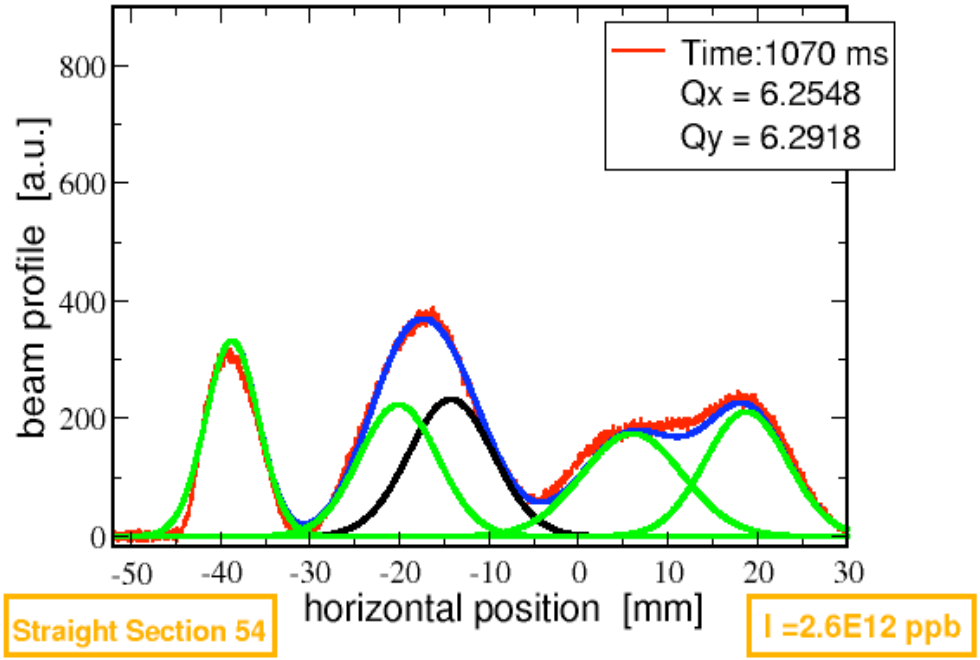

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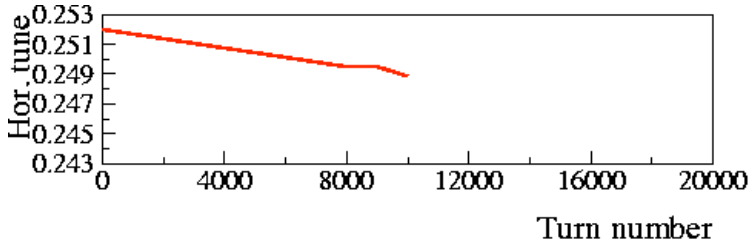

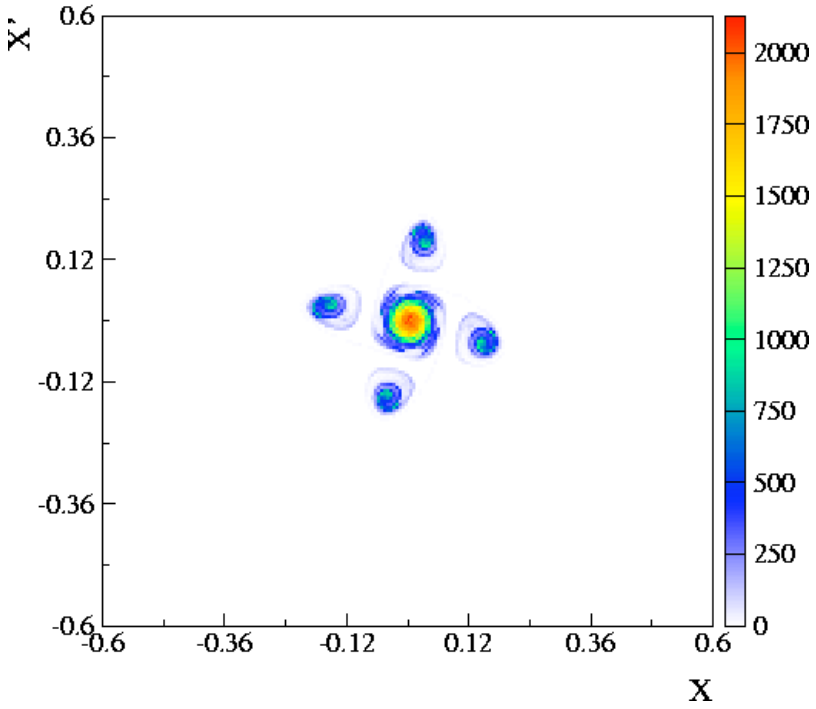

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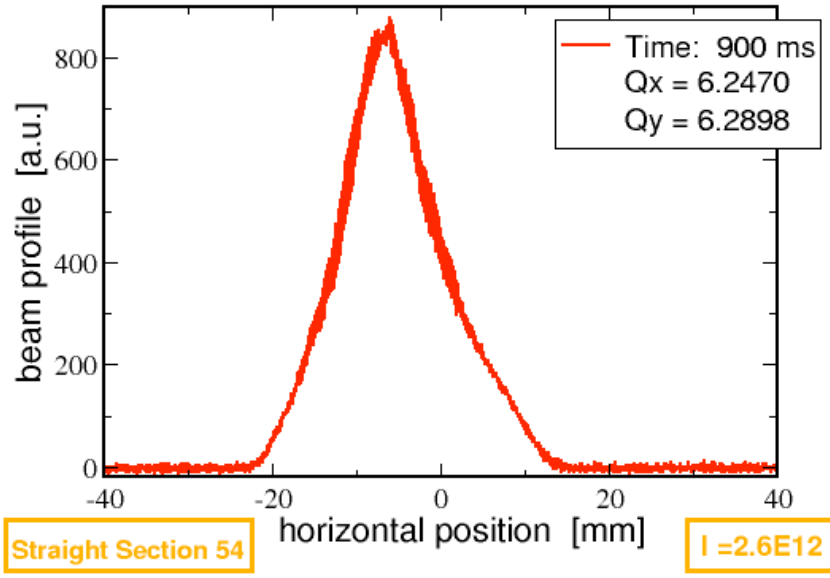

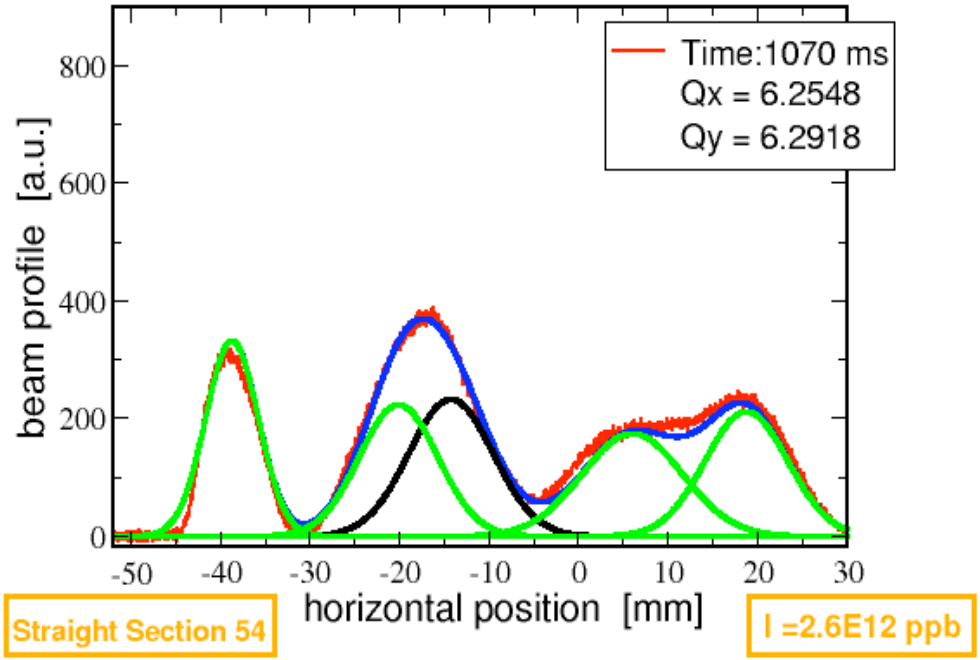

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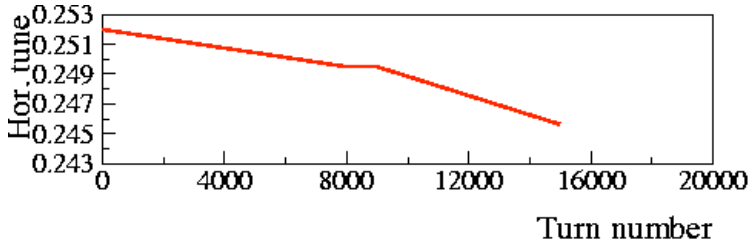
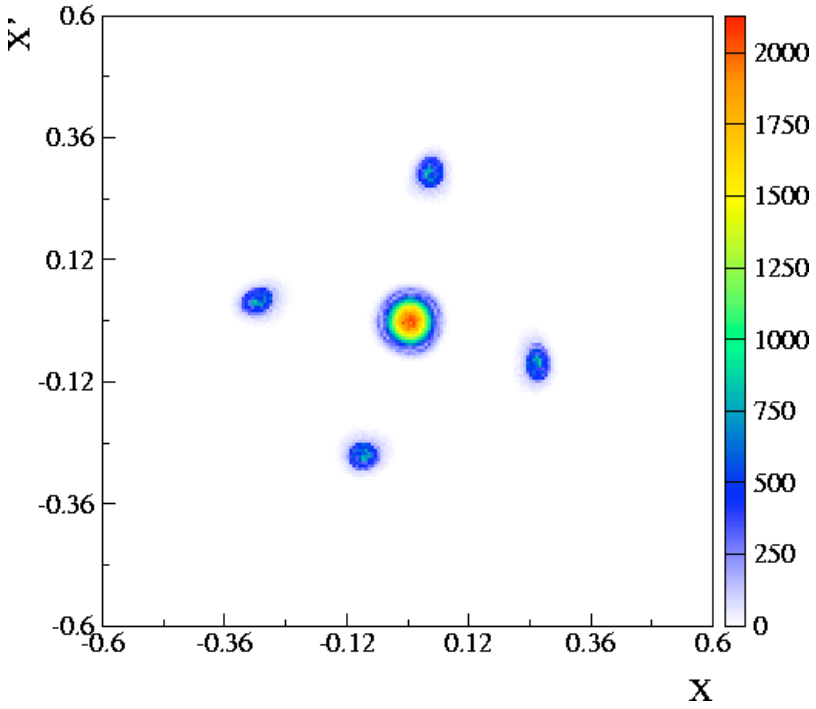
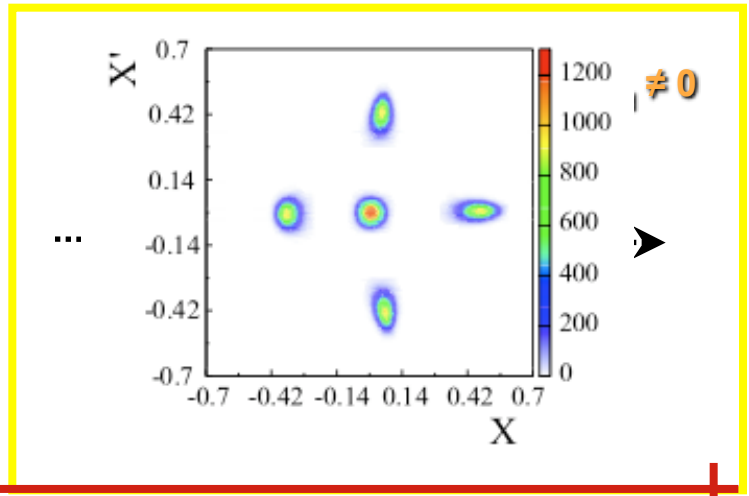




MTE Slow/Fast bumps

New slow bump composed by 6 independent power converter
⇒ close the slow bump on 7 ms

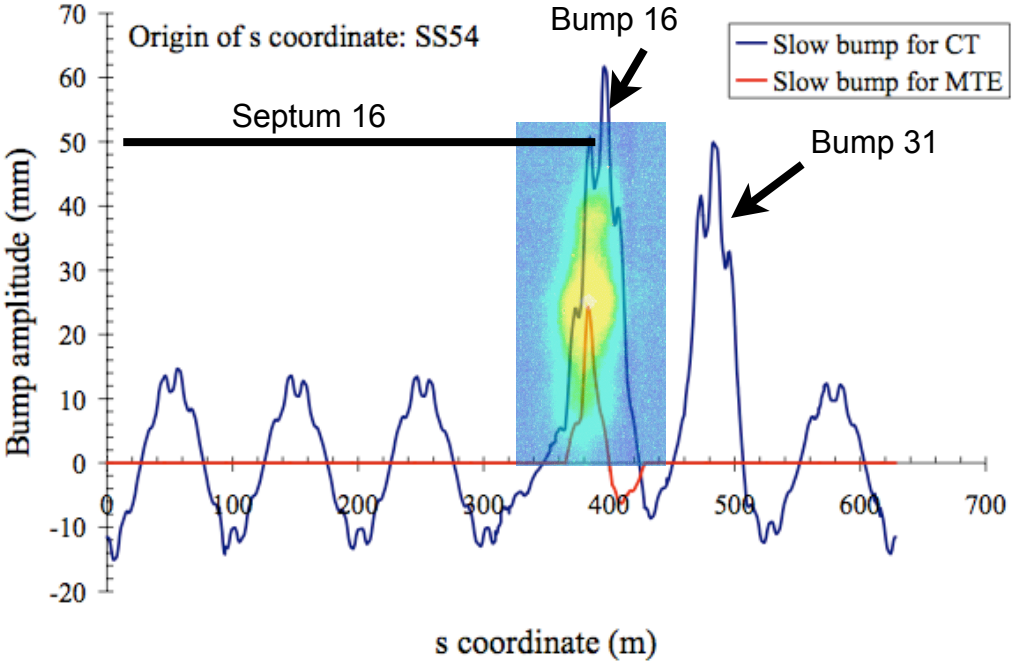
New fast bump composed by 5 independent kickers
⇒ close the fast bump on 5 turns

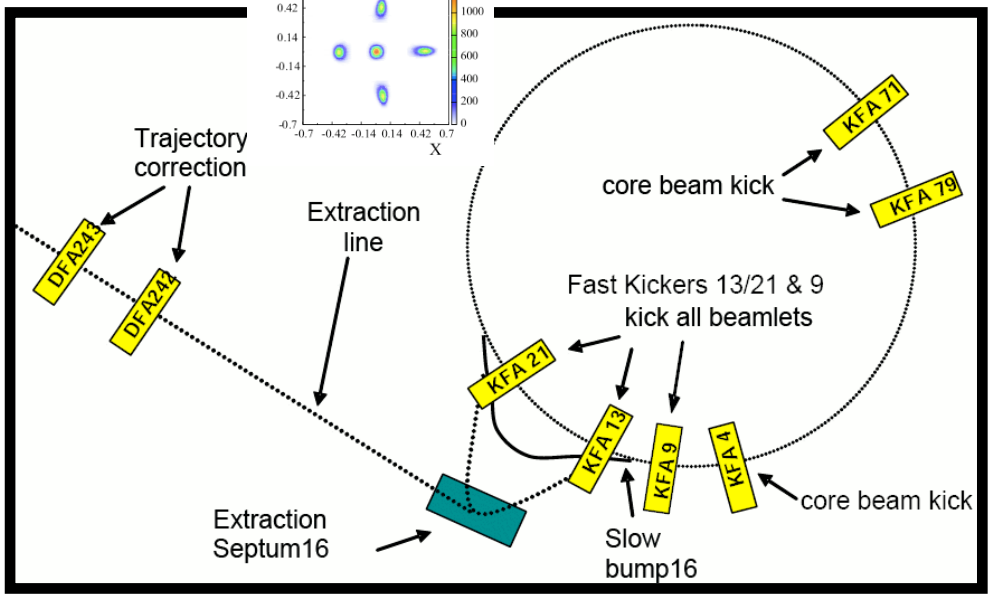


KFA9, KFA13, KFA21
⇒ 5 turn constant kick

KFA71/79, KFA4
⇒ core smaller amplitudes

⇒ extra kick + trajectory correction





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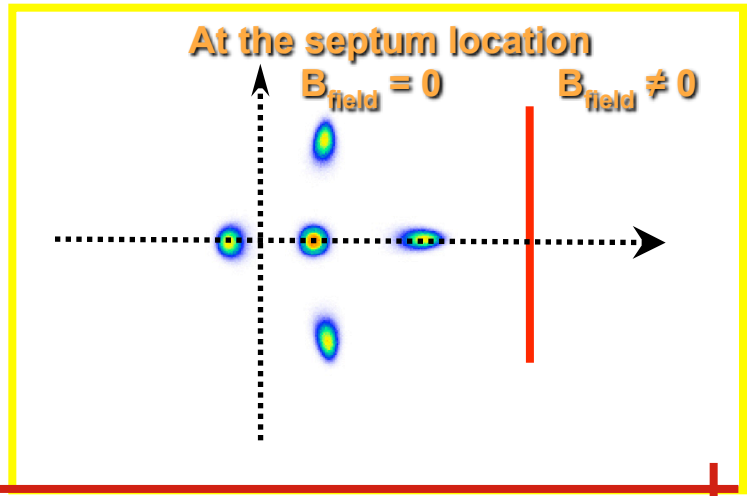

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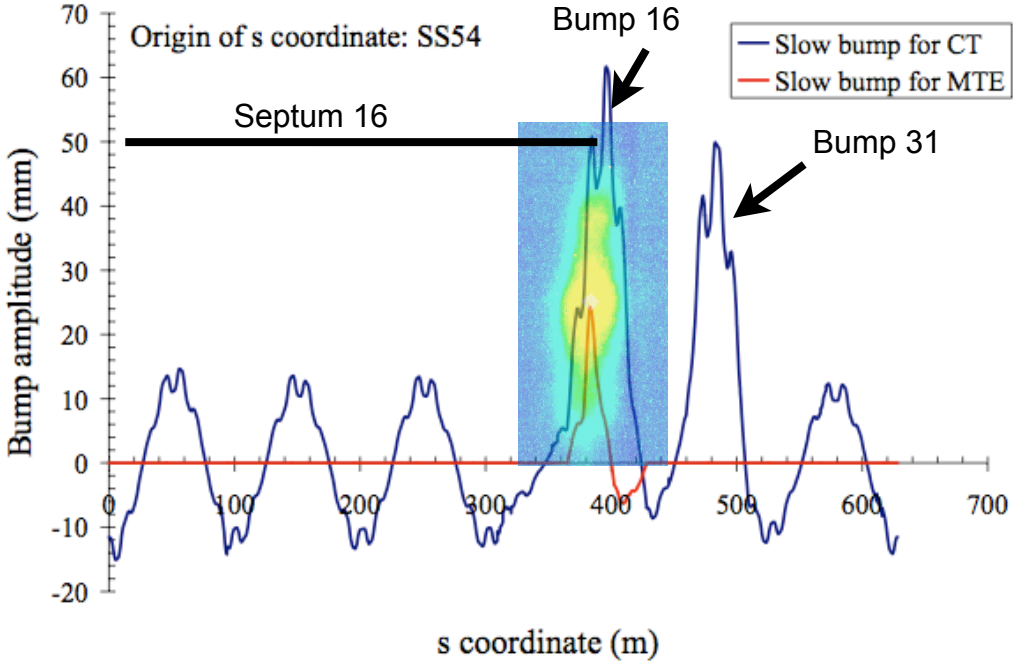

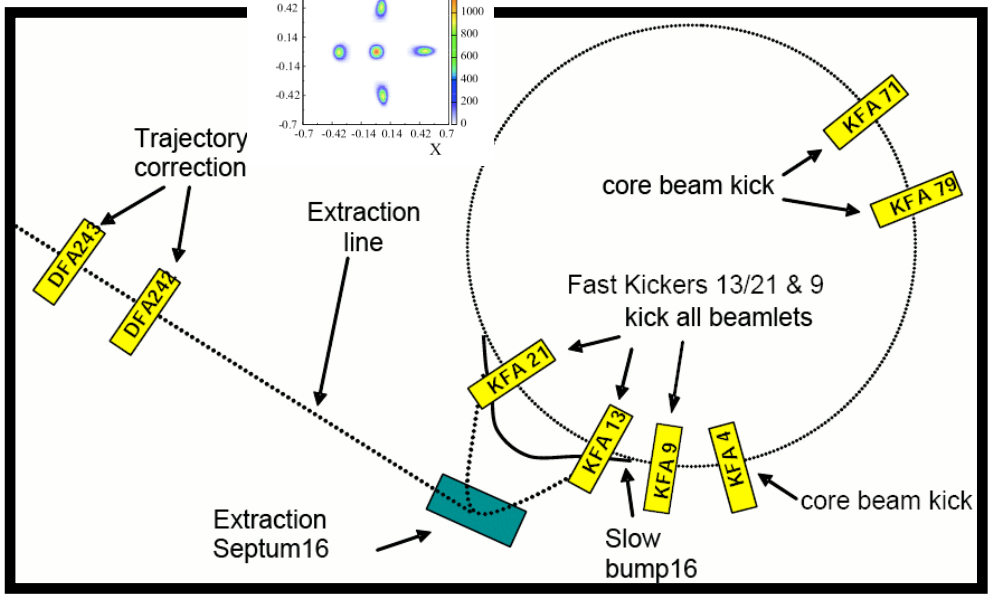

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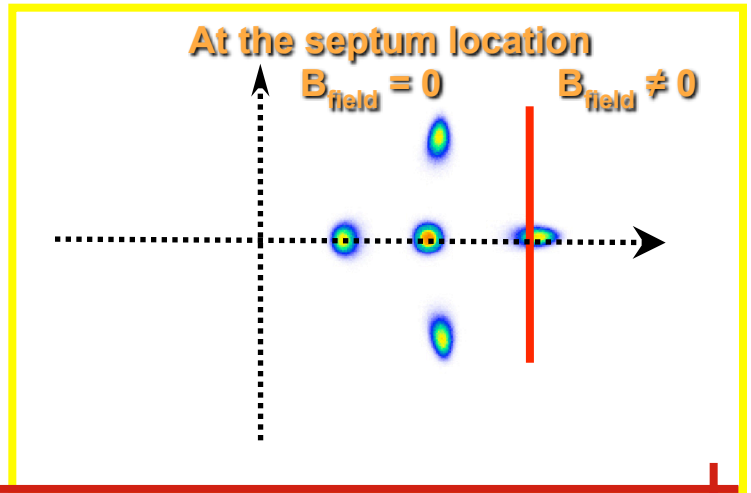

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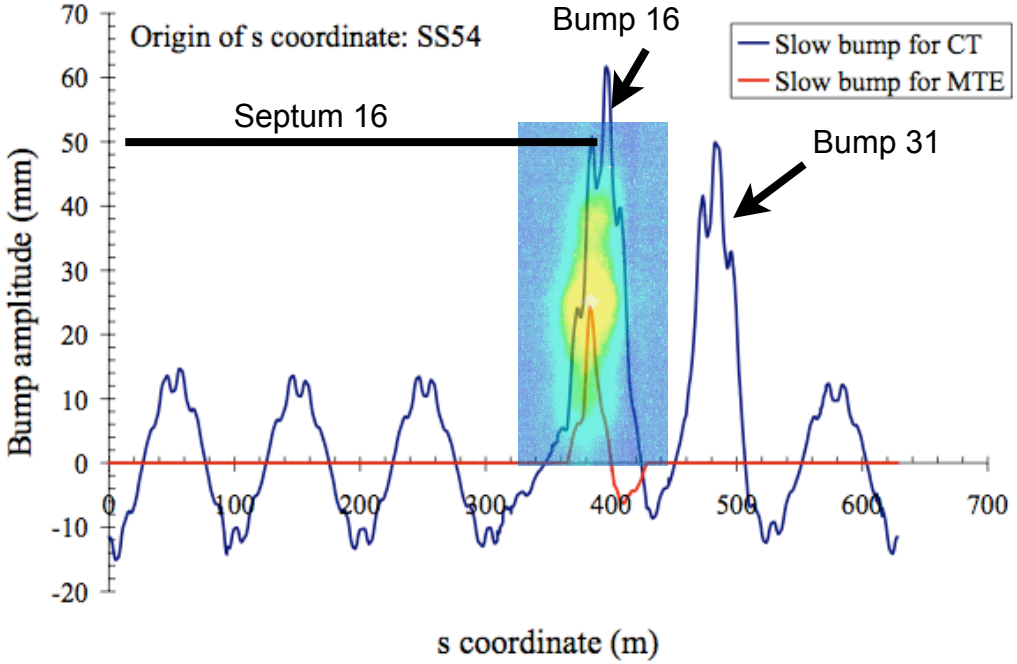

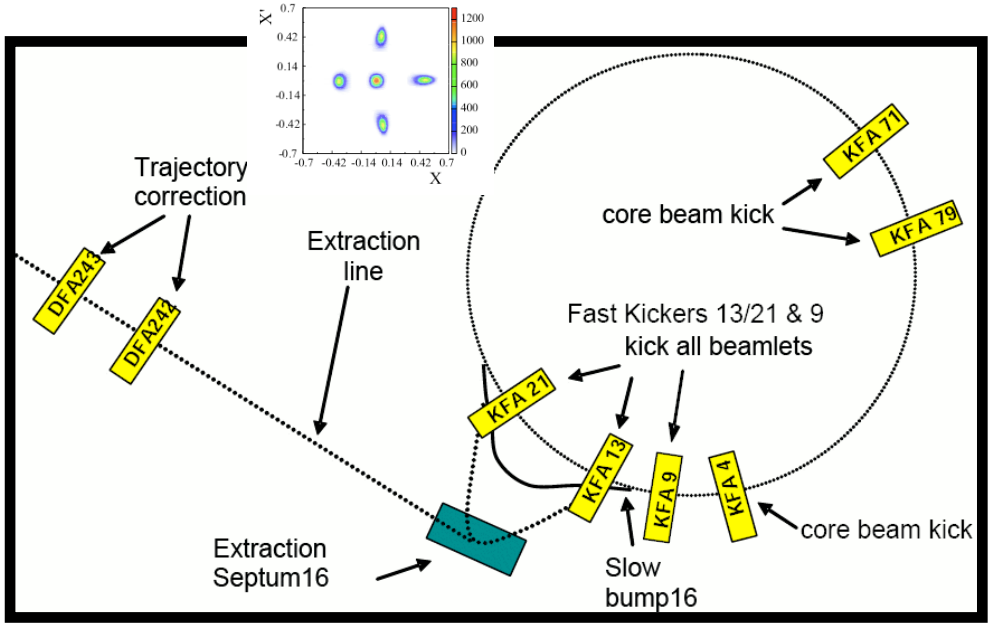

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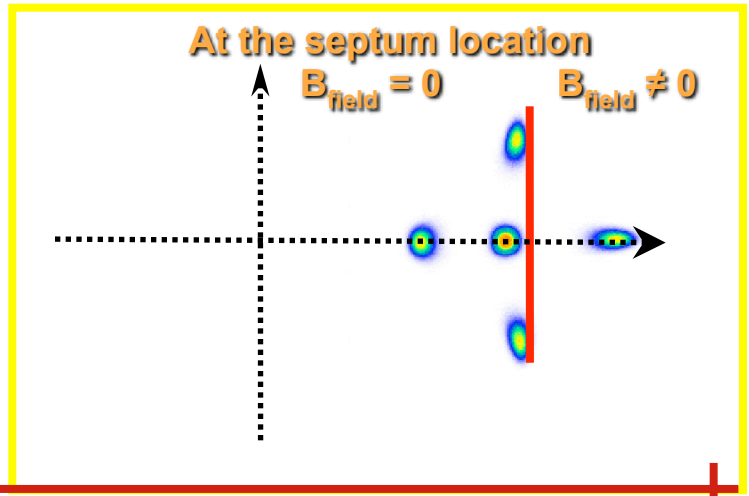

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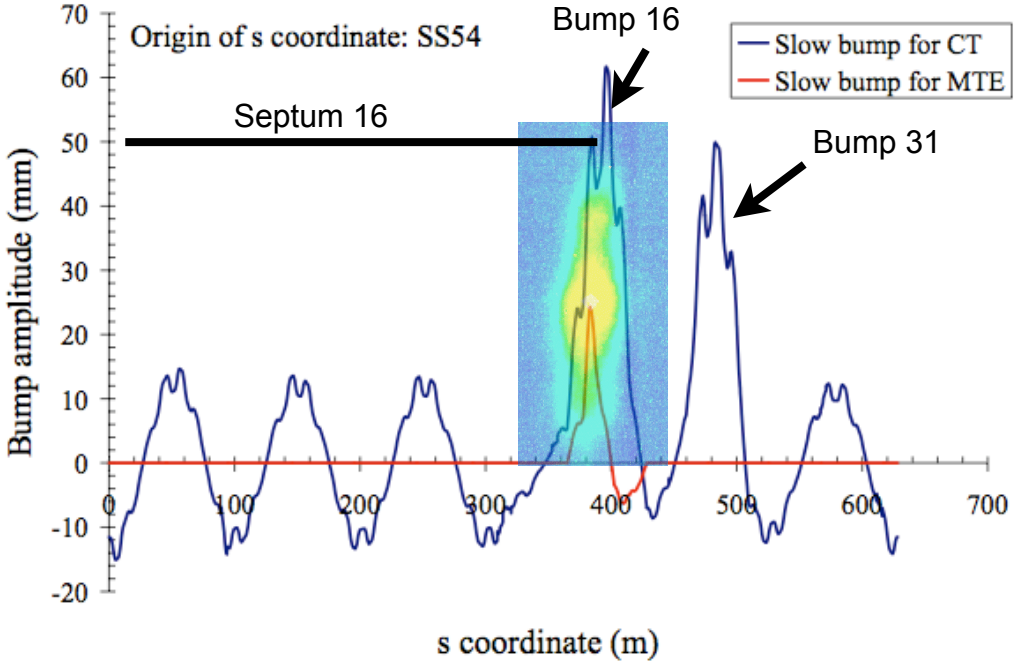

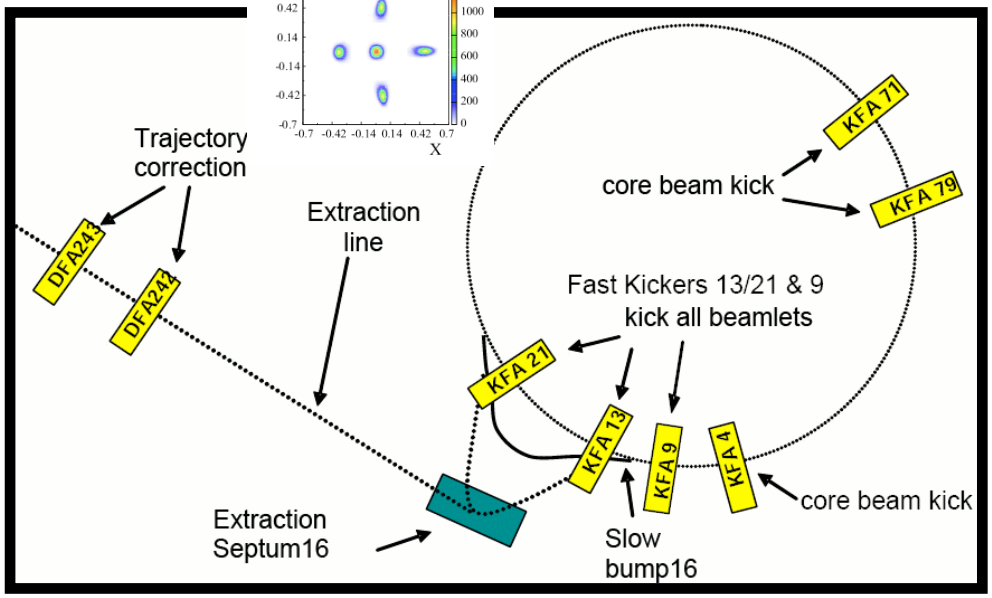

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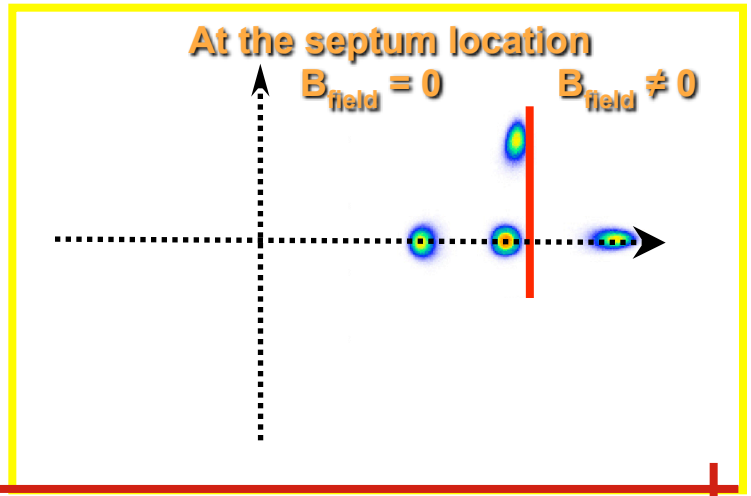

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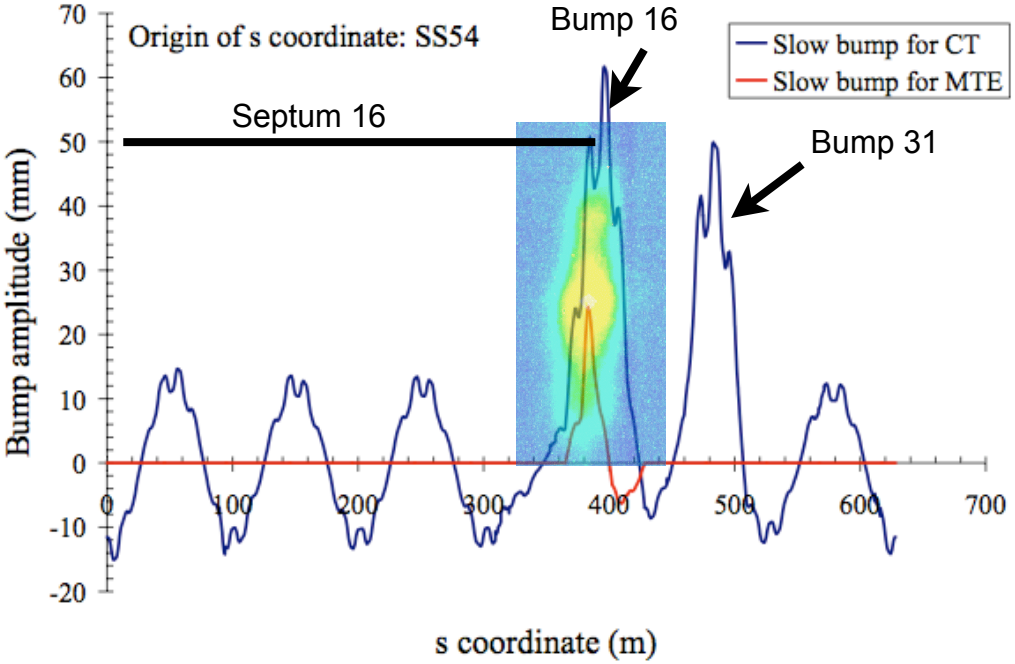

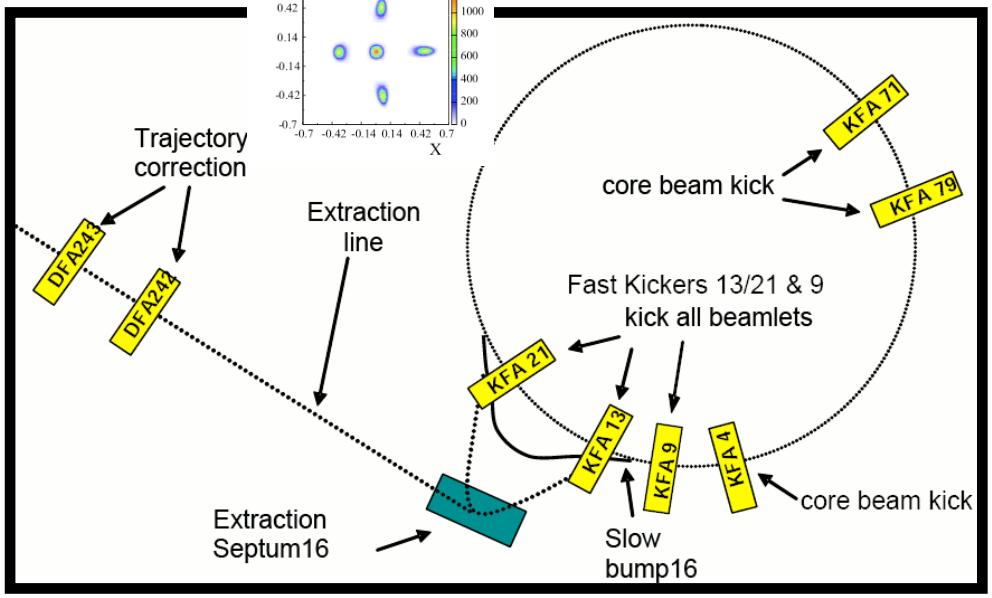

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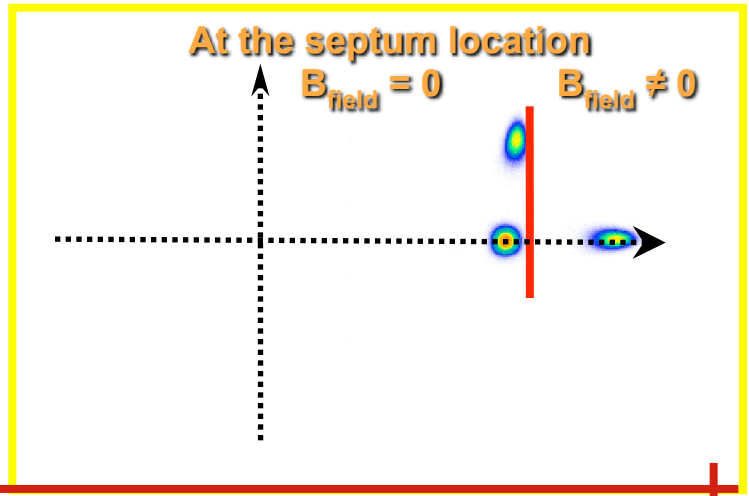

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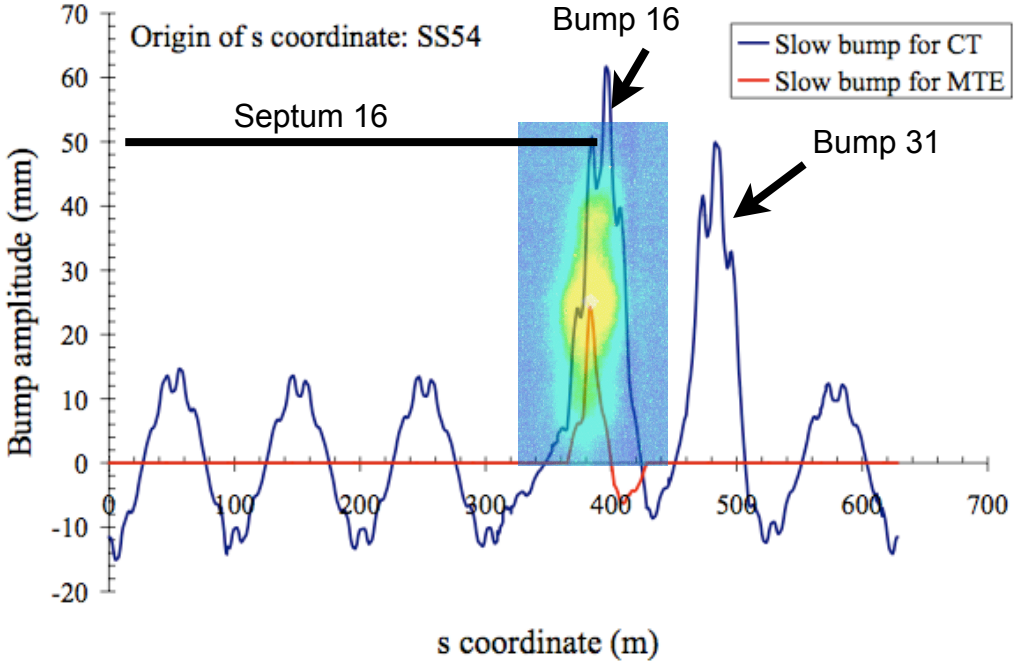
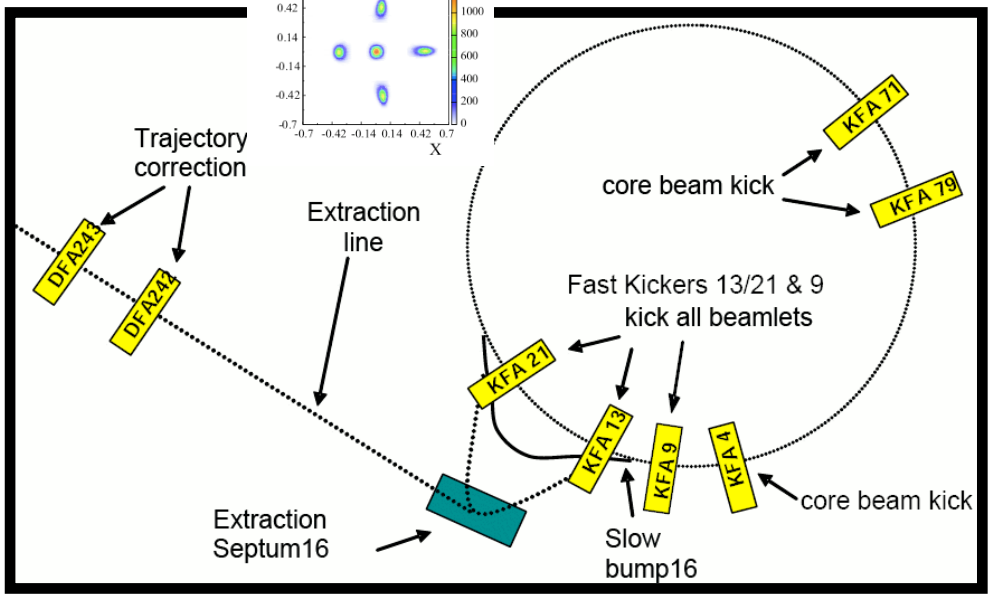
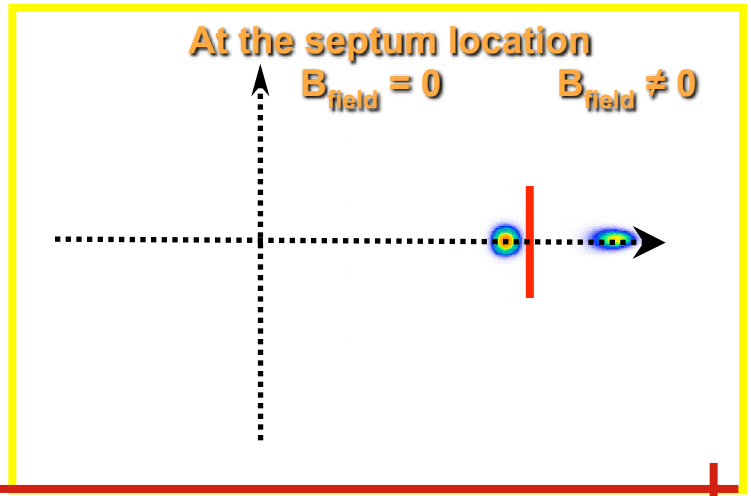




MTE Slow/Fast bumps

New slow bump composed by 6 independent power converter
⇒ close the slow bump on 7 ms

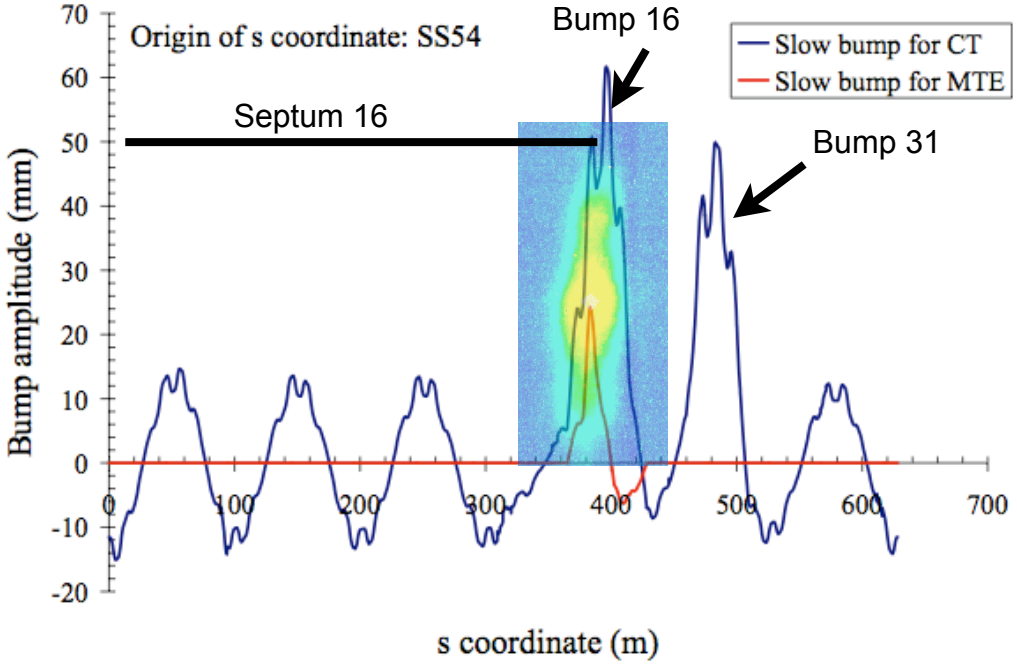
New fast bump composed by 5 independent kickers
⇒ close the fast bump on 5 turns

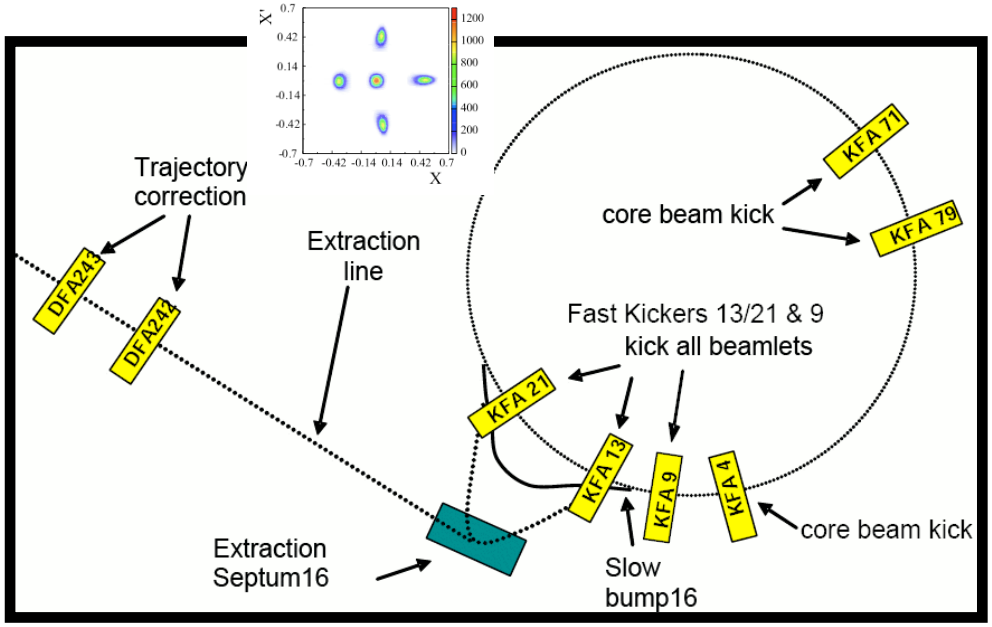


KFA9, KFA13, KFA21
⇒ 5 turn constant kick

KFA71/79, KFA4
⇒ core smaller amplitudes

⇒ extra kick + trajectory correction





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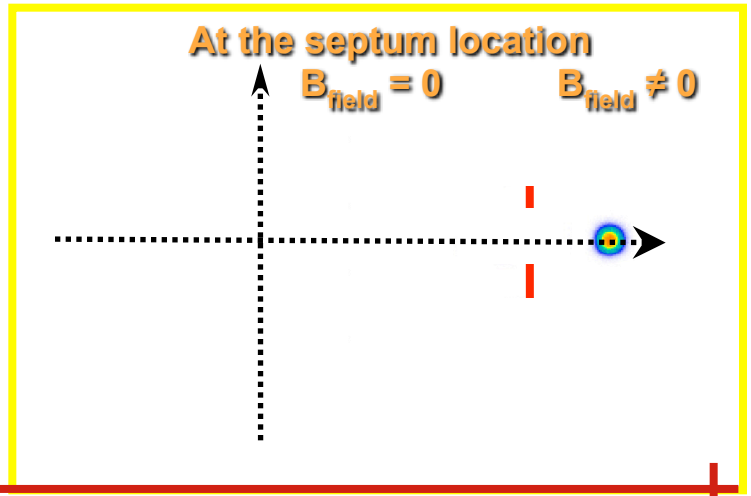

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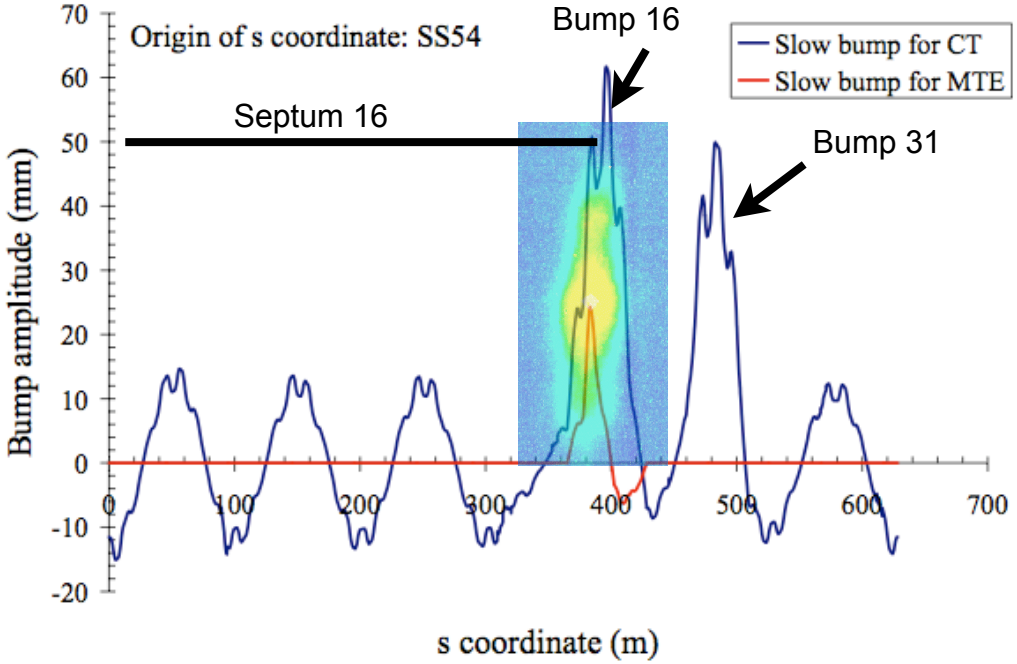

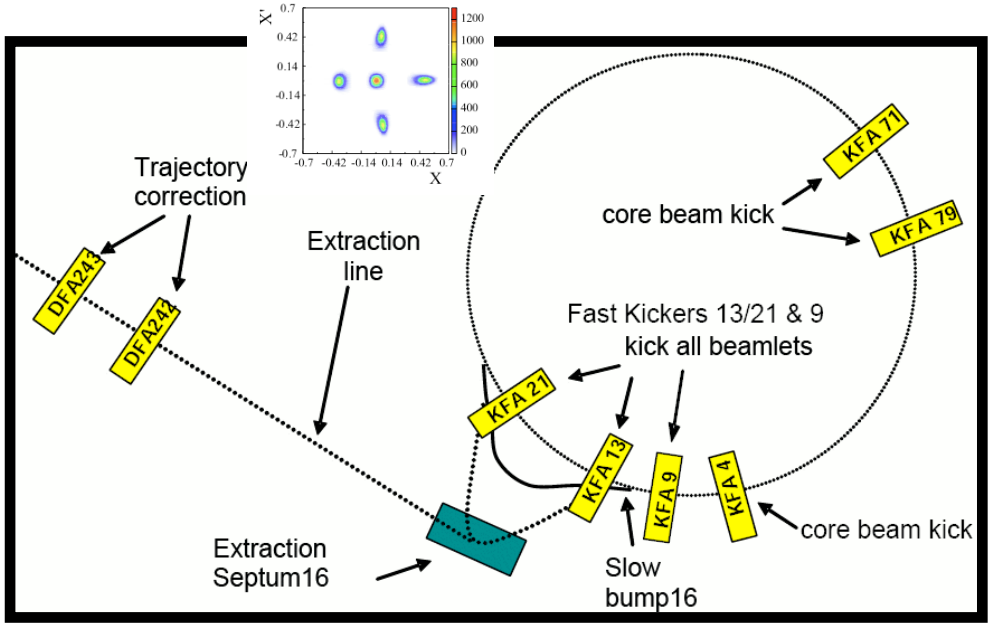

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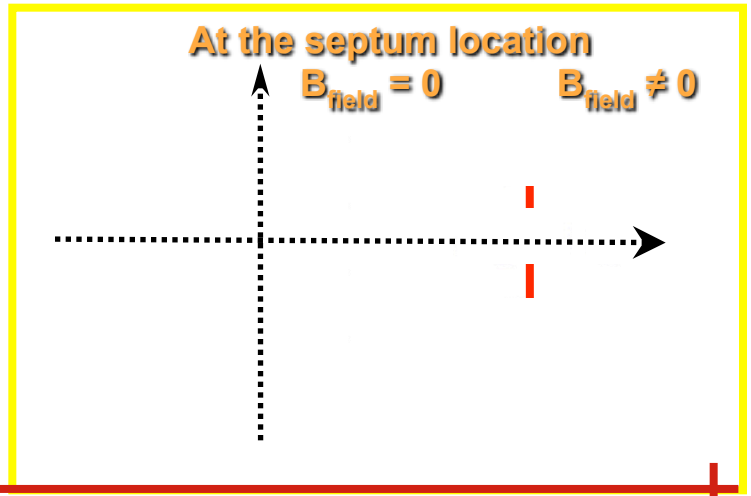

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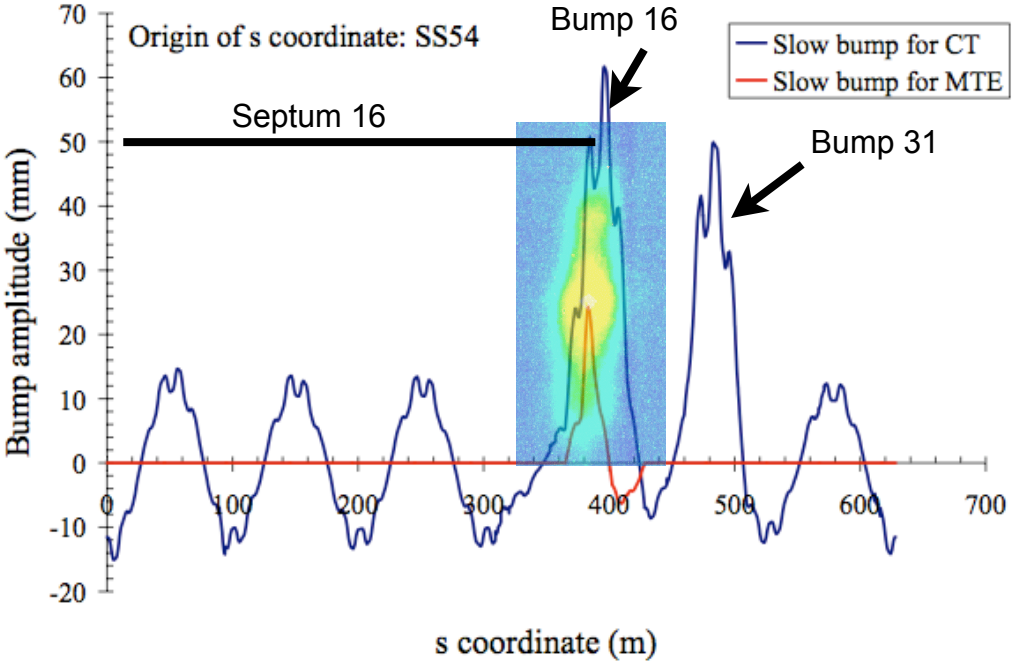
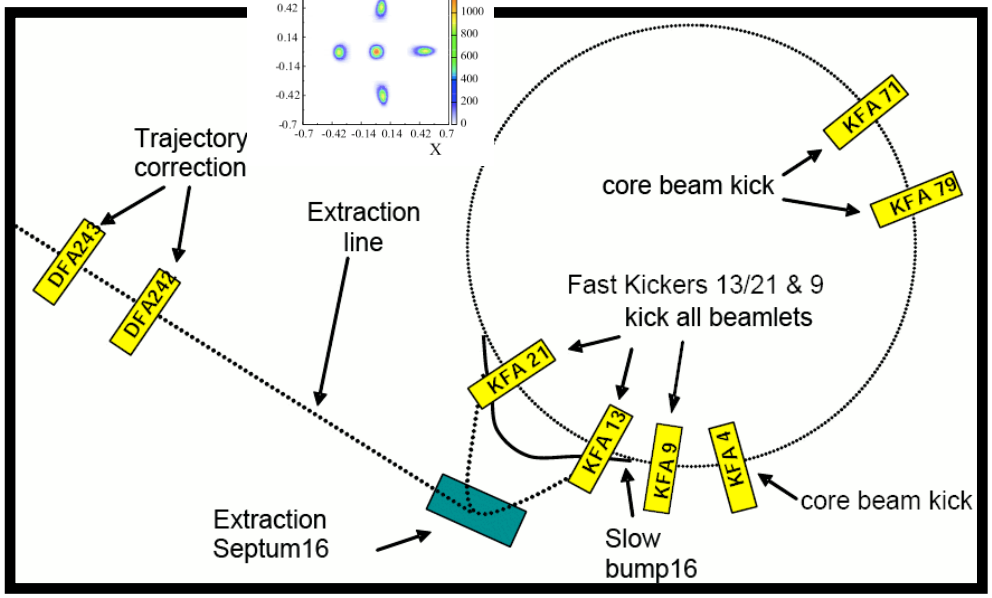




Commissioning phases in 2008

Initial goal: provide the CNGS/SFTPRO beams with MTE by the middle of the run

Phase 1

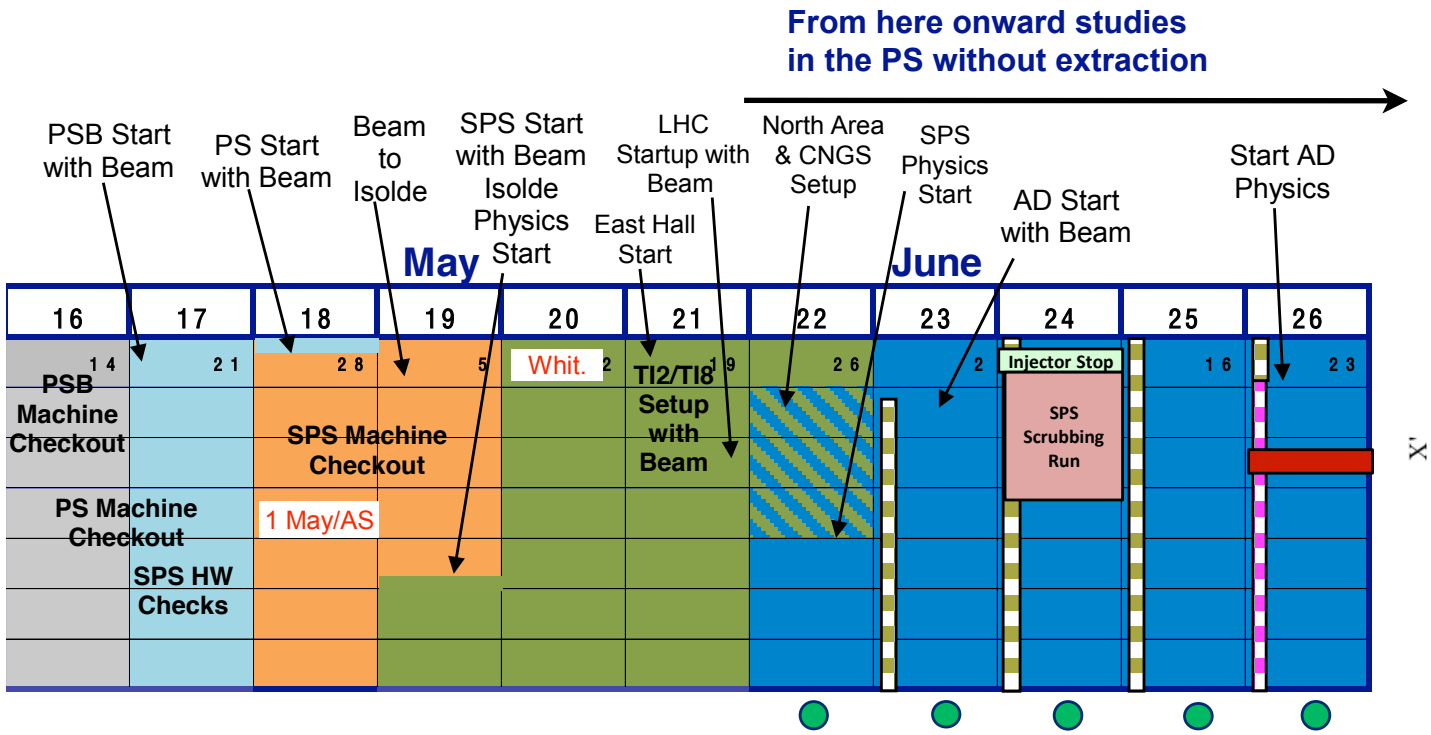
1. Beams preparation ⇒ 2 USERS ⇒ PSB(h1-h2), PS(2 bp for studies, 1 bp for extraction)
2. Measurement of nonlinear chromaticity to establish working point for capture
   ⇒ Working Point (Qx,Qy,Xix,Xiy but also Xix')
3. Re-establish capture ⇒ islands formation and capture optimisation ⇒ 2 bp ⇒ prepare 1 bp
4. Tests of CT extraction with bunched beam: best longitudinal structure to reduce losses in PS keeping the same losses in the SPS as for the classical CT
5. Preparation of the extraction elements
   ⇒ Kickers with no beam on ZERO Cycle
   ⇒ Optimisation/Calibration of the new bump 16

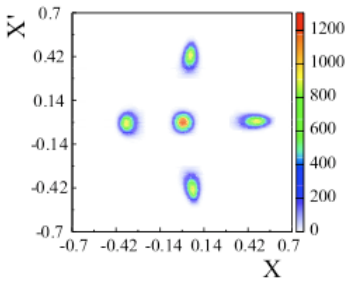
Phase 2

6. Preparation of nominal extraction with moderate intensity for CNGS-SFTPRO operation ⇒ 1 bp
7. Optics study and matching PS-TT2-TT10-SPS
8. CNGS-SFTPRO with MTE extraction
9. make a party ...

MTE commissioning - Schedule 1st part

Phase 1: Capture with normal fast extraction on single turn

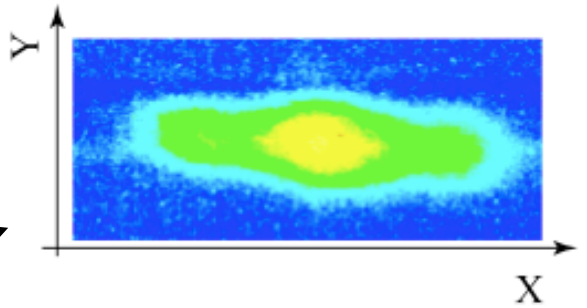




Weeks with MTE commissioning without extraction

MTE Setup and Development with Beam to LHC

Image in physical space on OTR in TT2 of the 5 islands fast extracted on single turn



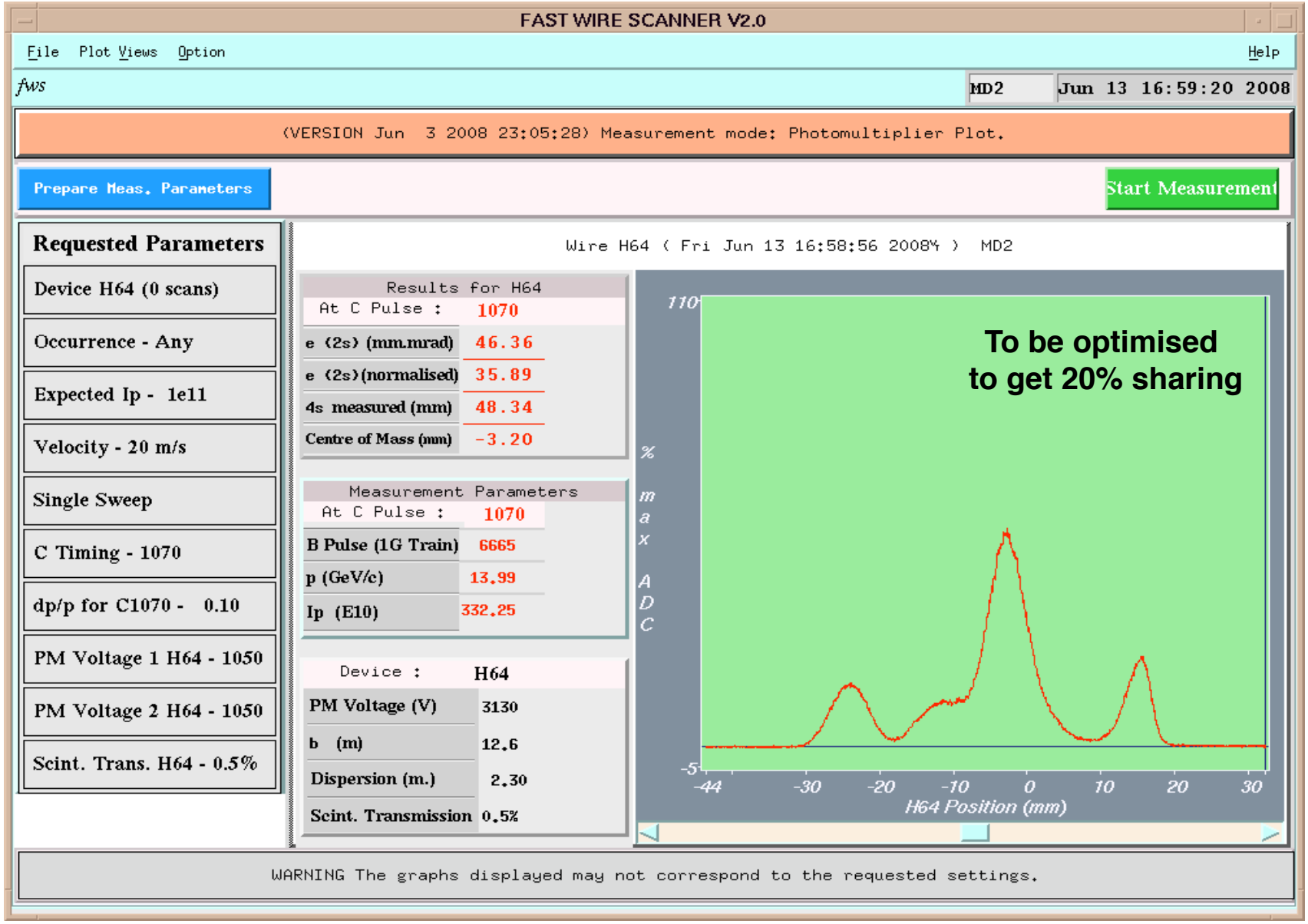
Different Beams for different purposes...

Beam type	Intensity per bunch	Emittance* H/V	Harmonic	Total intensity (up to)	Number PSB rings	Aim	PS bp
Pencil	50 10^{10}	~2/~1	1	50 10^{10}	1	Xix' meas.	2
Moderate intensity	300 10^{10}	~9/~6	1	300 10^{10}	1-4	Capture study	1-2
Operational	300 10^{10}	~9/~6	2	2400 10^{10}	4	CNGS SFTPRO	1
High intensity	600 10^{10}	~9/~6	1	600 10^{10}	1	Capture studies	2

***Emittance: 1 σ normalised of the beam BEFORE capture i.e. from PSB**

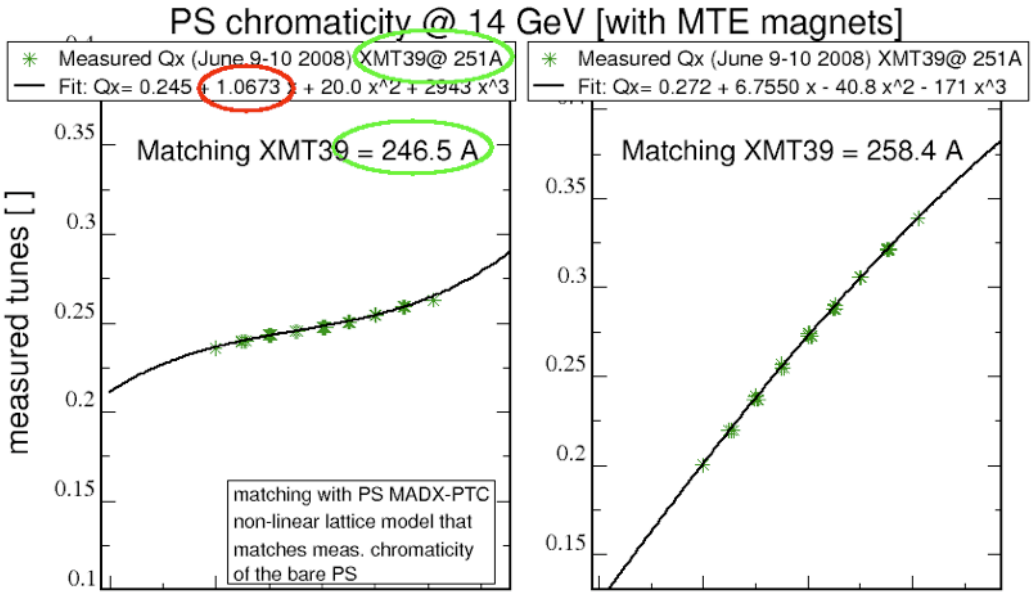
	Booster	PS	Aim
During commissioning	MD1	MD1 (1 bp)	Extraction setting up
	TOF	MD2 (2 bp)	Capture preparation & optimisation
	SFTPRO/CNGS	SFTPRO/CNGS	Normal CT extraction
Operation	SFTPRO/CNGS	SFTPRO/CNGS	MTE extraction
	MD1	MD1 (1 bp)	Settings ready for SFTPRO/CNGS *CT extraction switch in case of problems with MTE*
	TOF	MD2 (2 bp)	Further studies

First capture resumed June 13th



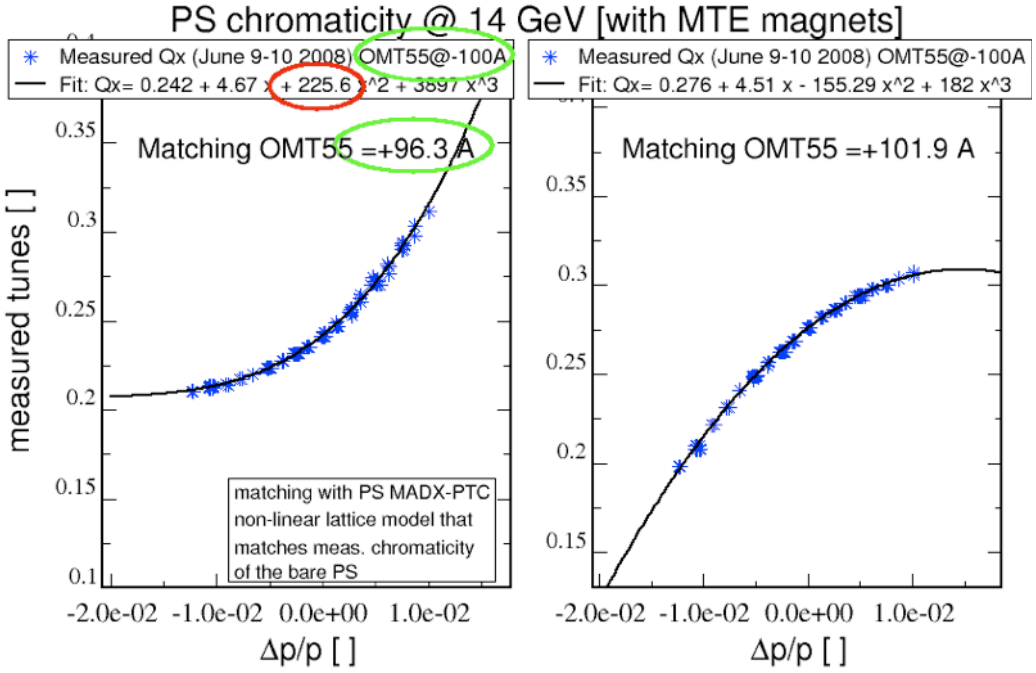
Large H emittance beam prepared by PSB used in first part of the commissioning

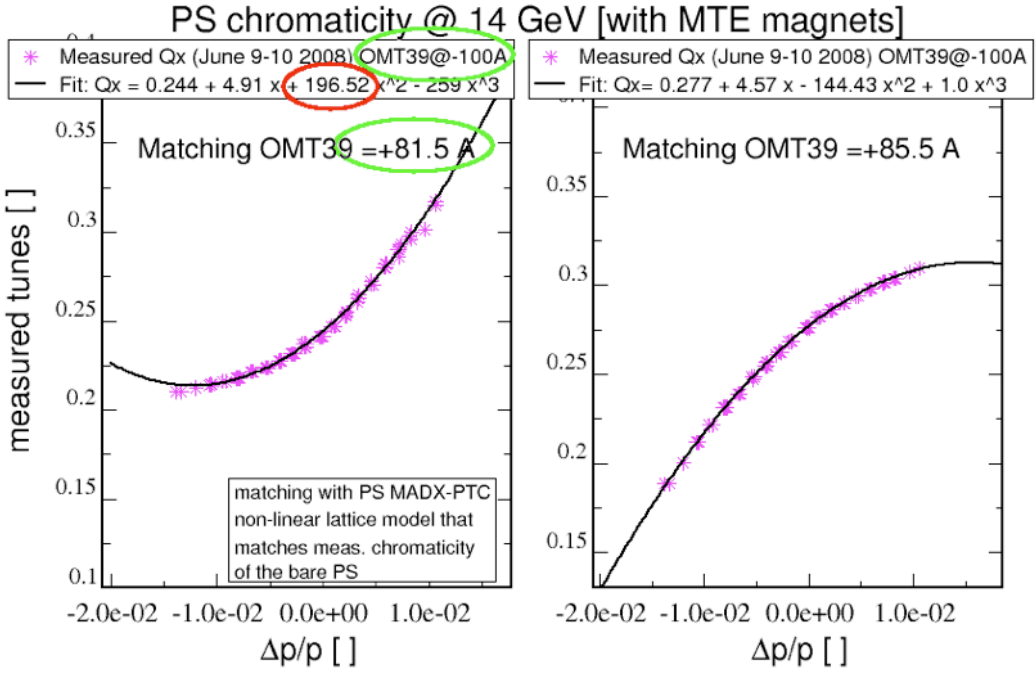
Calibration of new nonlinear elements



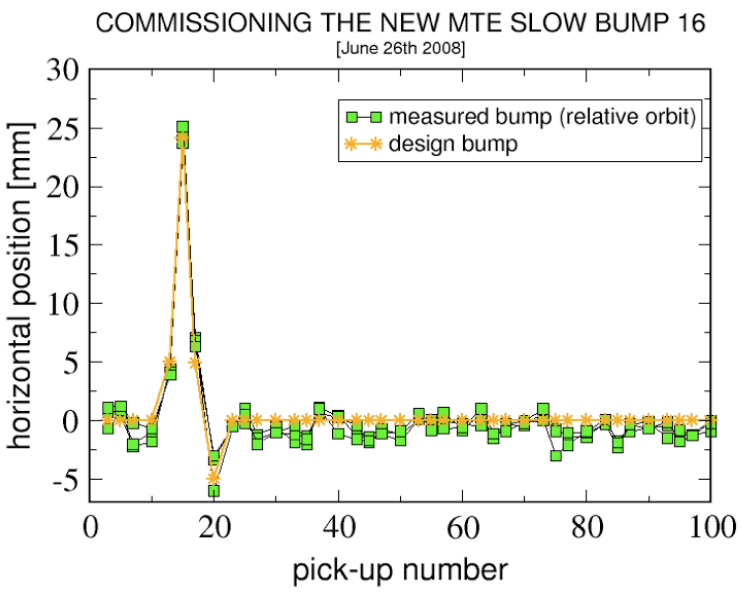
Calibration of non-linear elements showed:

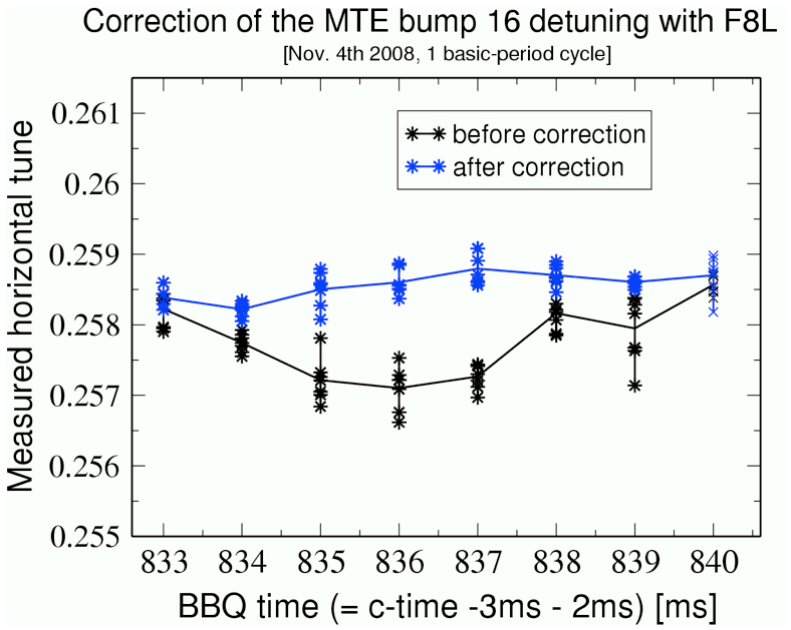
- sextupole calibration and polarity correct
- octupole polarity inversed wrt convention (no pb, pows are bipolar)
- doubts calibration of octupole in ss39 (under investigation feed down from orbit or power converter - magnet OK)

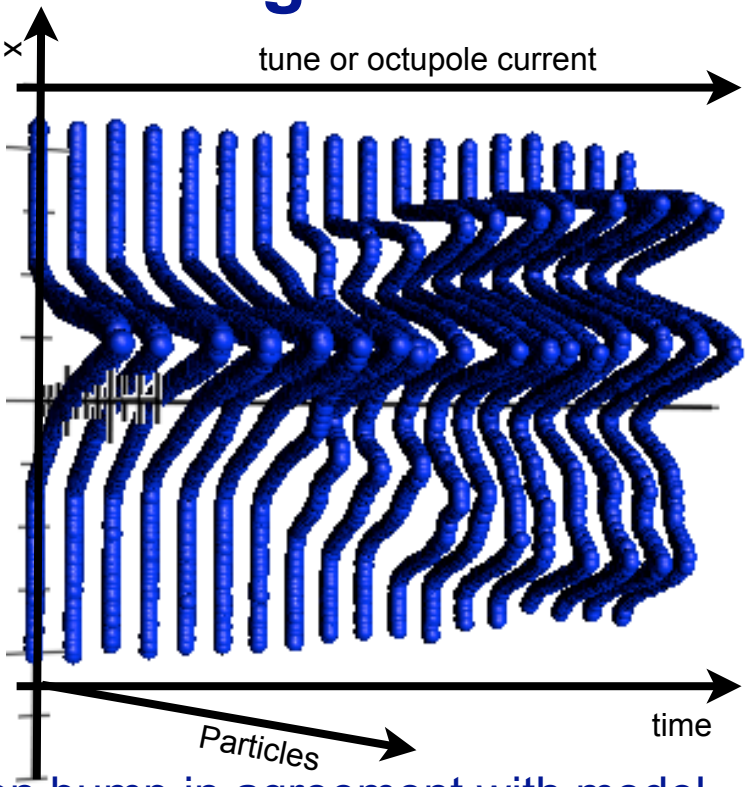




Bump 16 commissioning & tune change correction





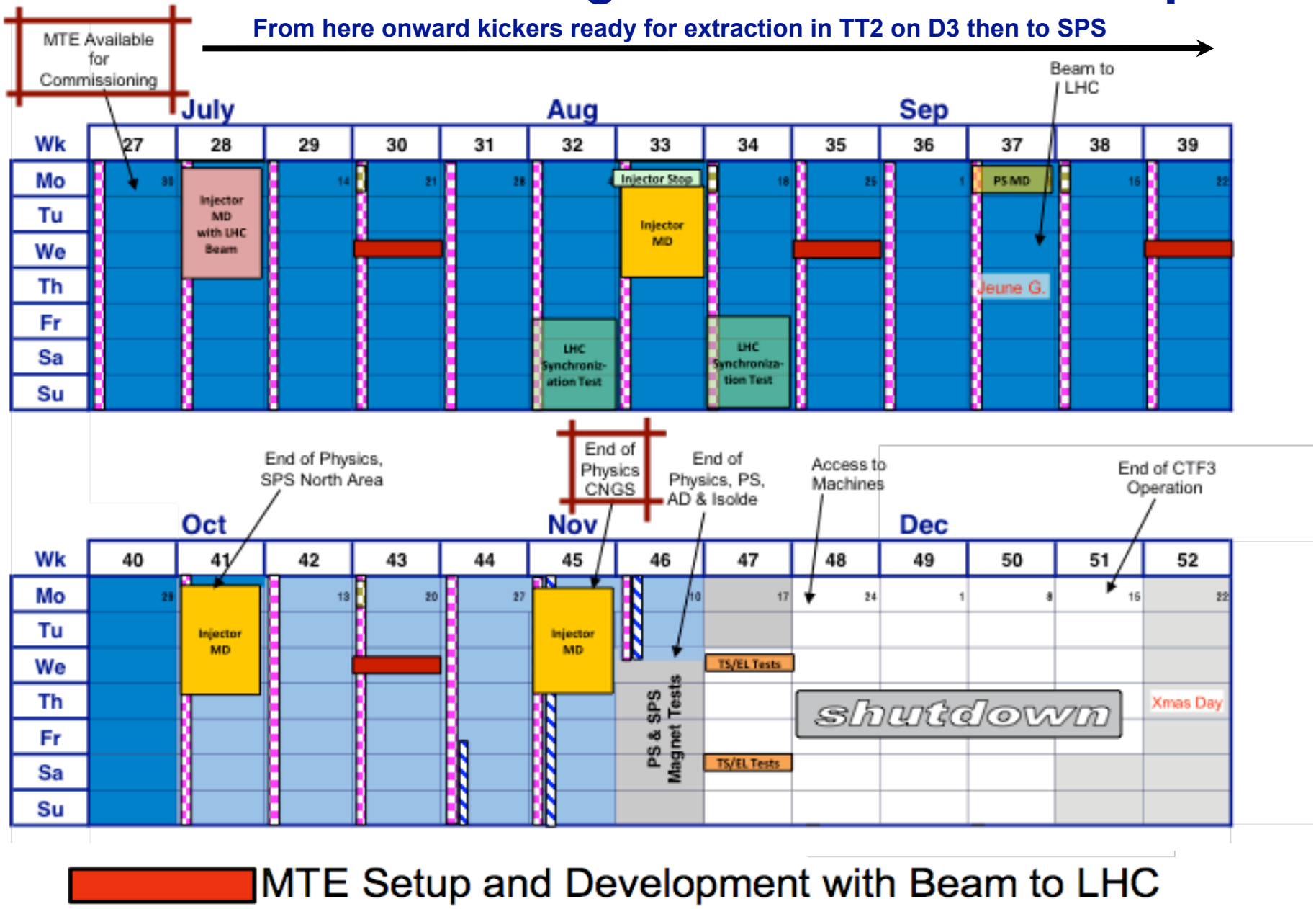


Extraction bump in agreement with model.

Extraction bump introduces a tune variation that changes the islands separation during ~ 7 ms. Tune compensation done using low energy quadrupoles plus F8L.

Fundamental for the compensation: correct triggering of the orbit measurements and BBQ. Chirp might be problematic

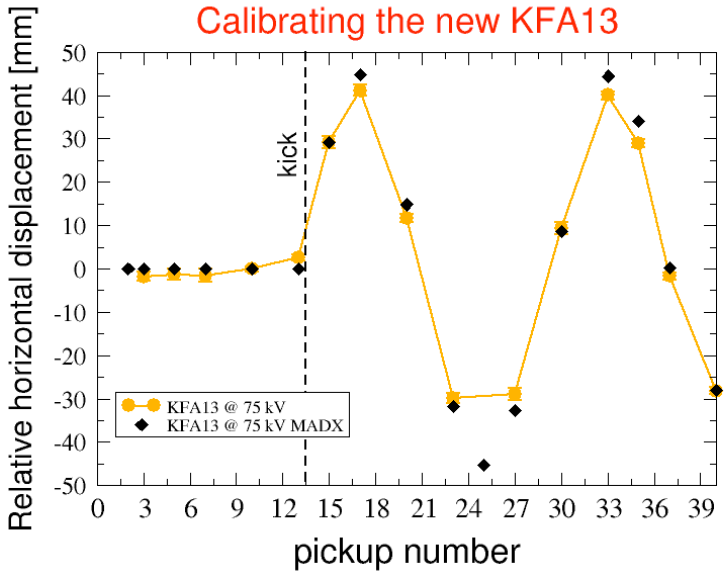
MTE commissioning - Schedule 2008 2nd part



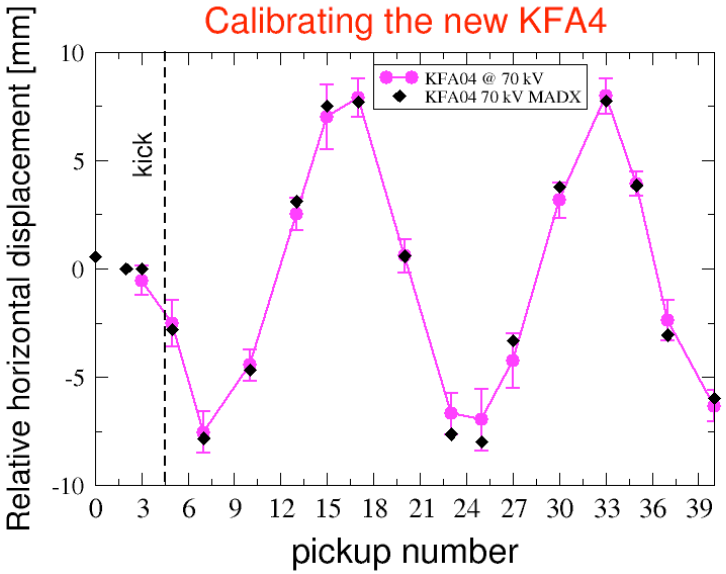
MTE Setup and Development with Beam to LHC

Kicker calibration

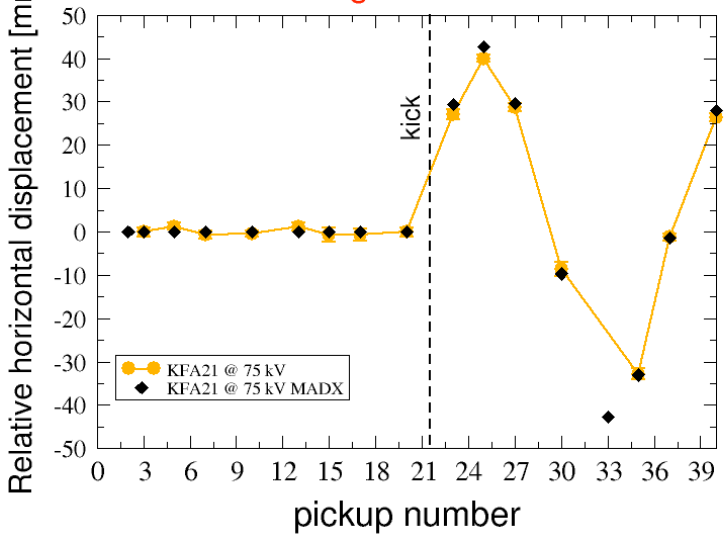
Calibrating the new KFA13



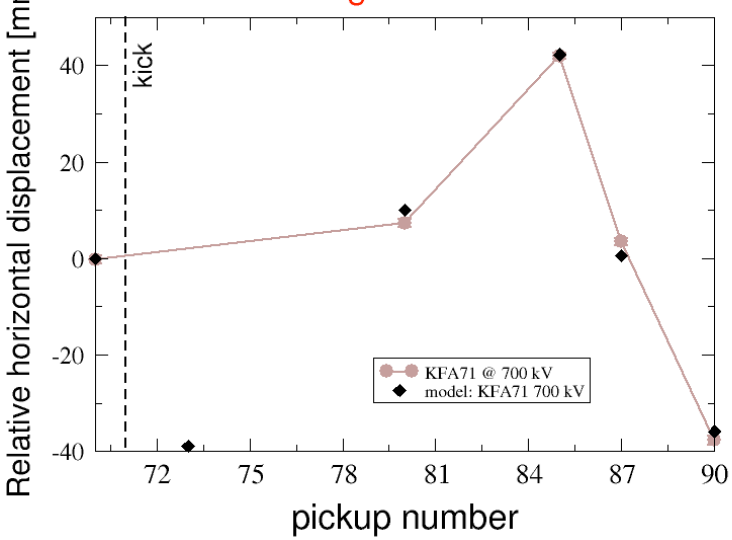
Calibrating the new KFA4



Calibrating the new KFA21

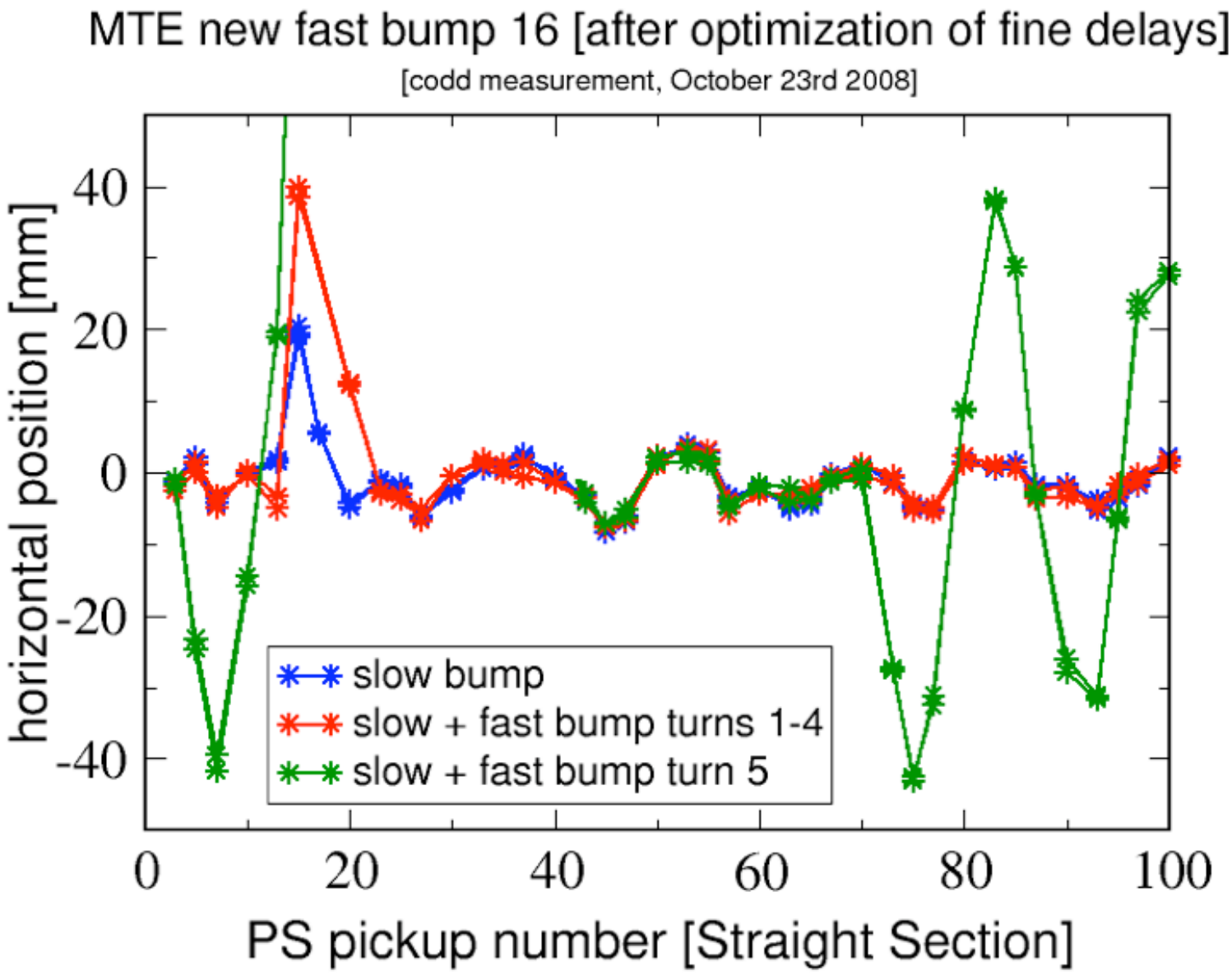


Calibrating the KFA71

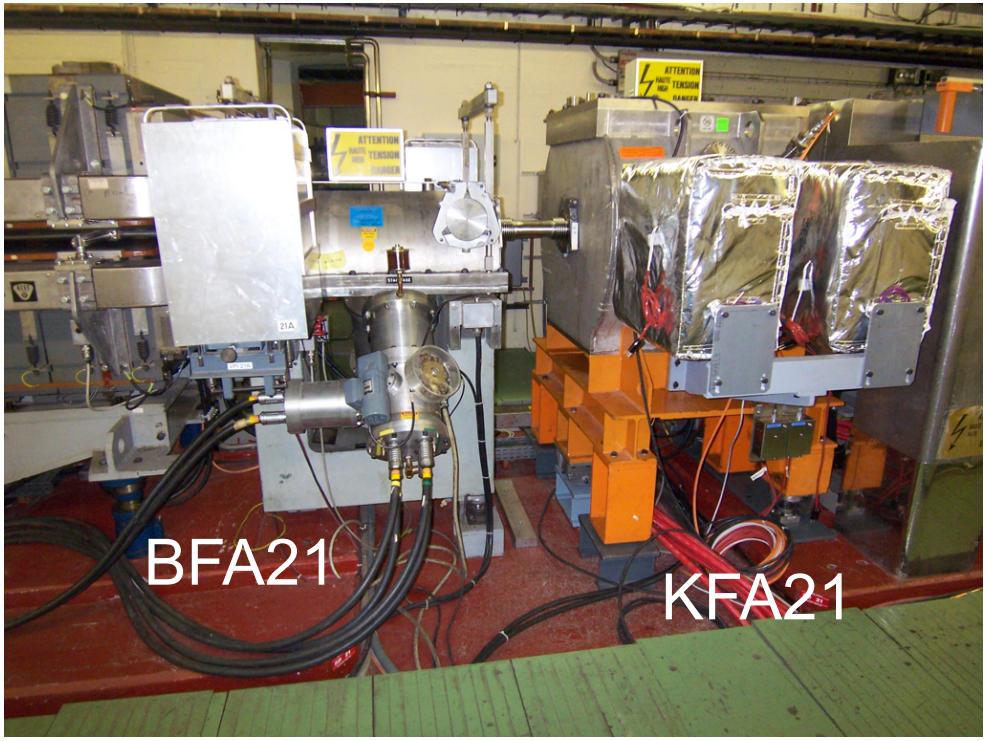


Good agreement between expectation from the model and trajectory measured

Closure of Slow and fast bumps



Kicker commissioning issue



Two “weak” points during new fast bump commissioning:

1. KFA21 HV connectors proved to be weak, had to be changed few times

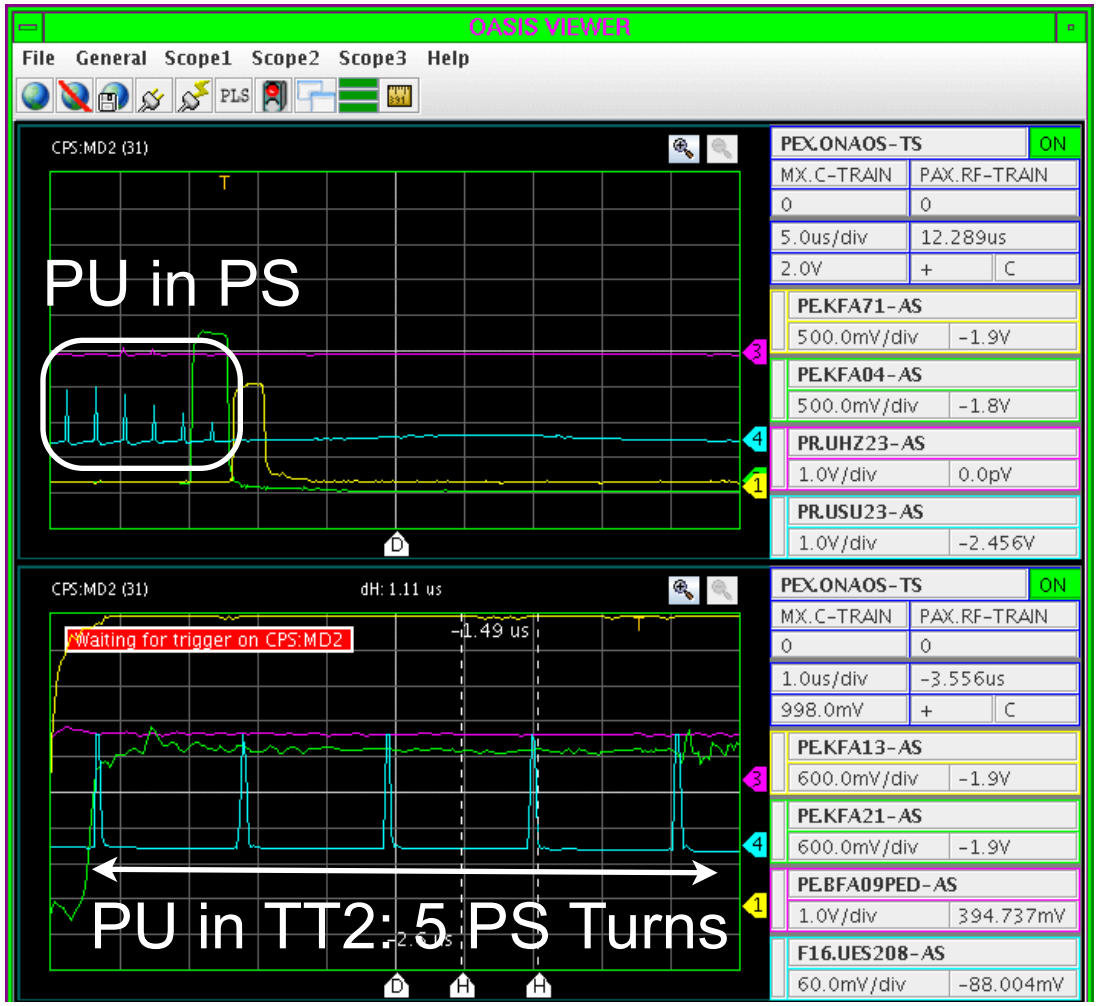
⇒ **New design for 2009**

2. BFA9 (common to classic CT) not fully PPM: change of MTE extraction efficiency due to different supercycle composition (how many CNGS ...)

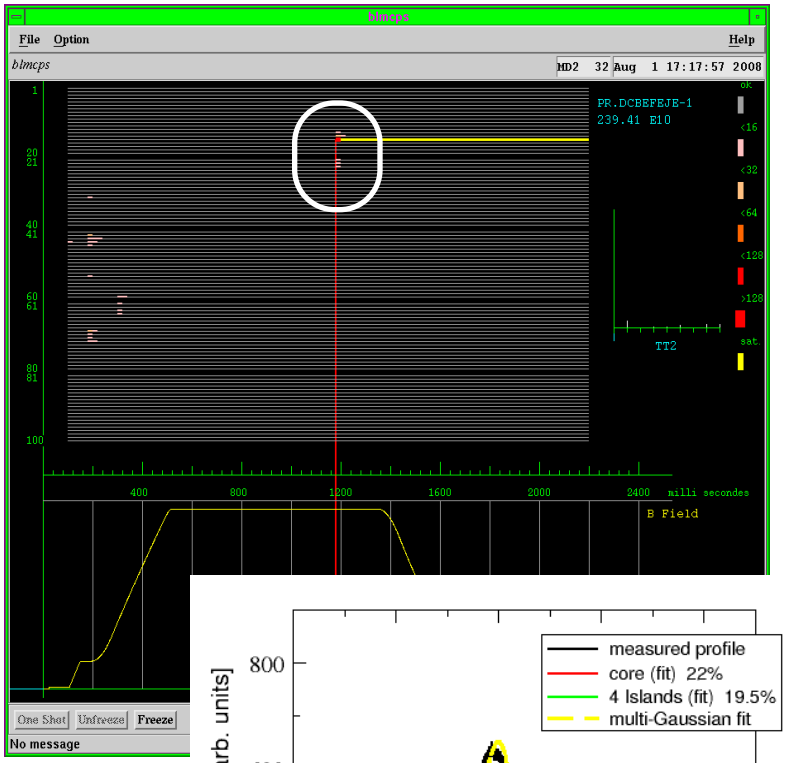
⇒ **Improved power converter for 2009**

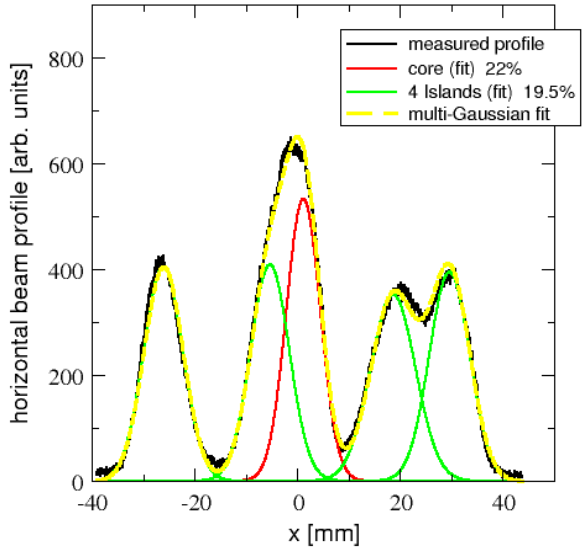
First beam extracted in August

Fast MTE signals



Beam loss monitors: losses only SMH16





18%-19% loss less capture per islands

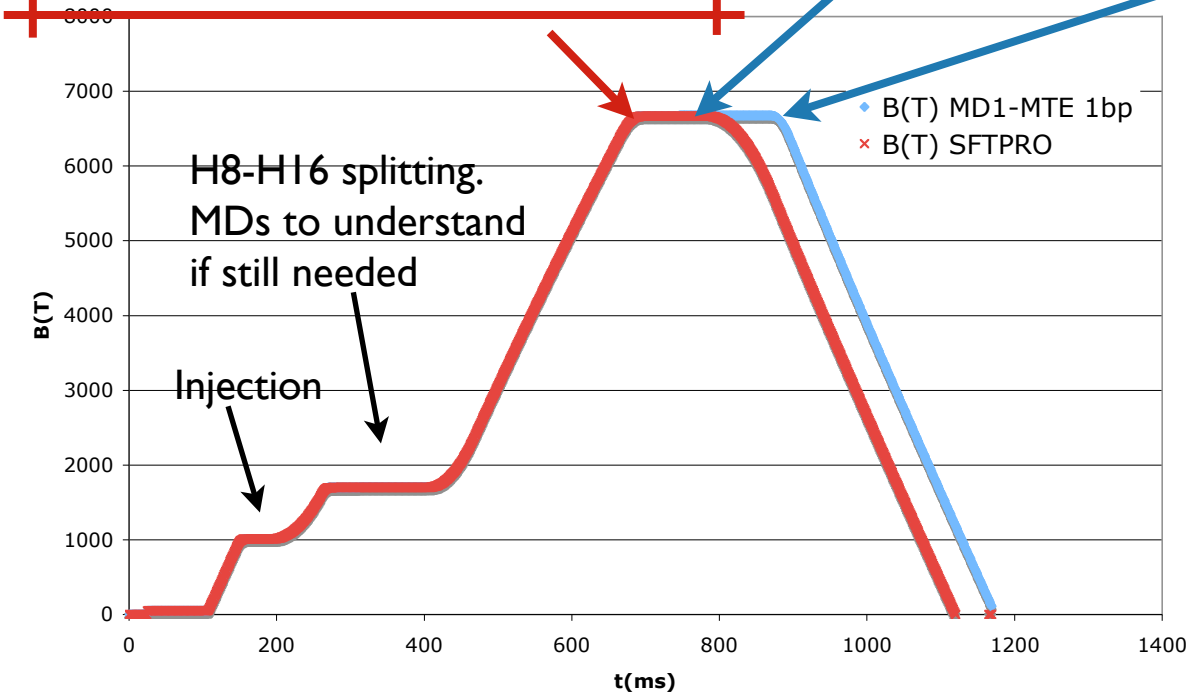
Extraction on 5 turns in TT2 done

Cycle MTE 1bp vs SFTPRO-CNGS CT extracted

SPS placing
De-bunching plus 200 MHz structure
CT extraction ct = 770 ms

Synchronisation (to be done **FIRST**)
Capture which takes about 100 ms

200 MHz structure
MTE extraction at 845 ms



MTE 1bp operational cycle longer than classical CNGS because:

1. capture takes about ~100 ms

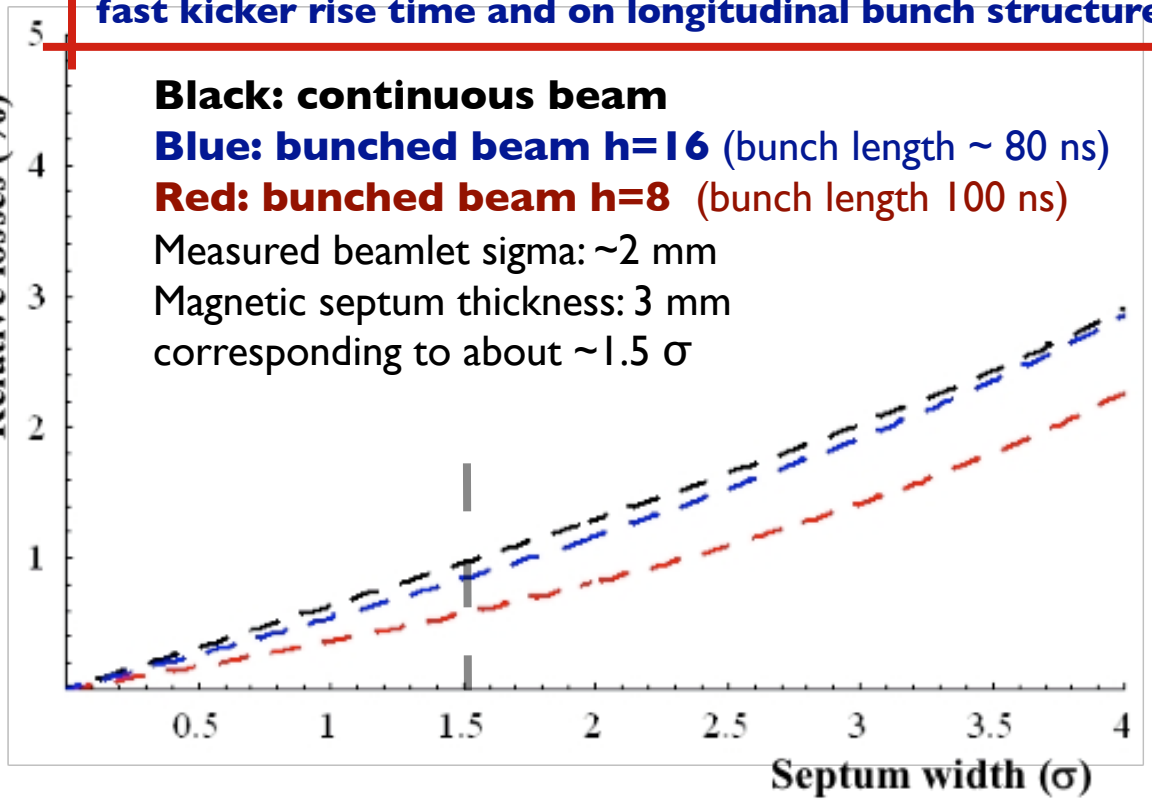
2. if bunched extraction,100 ms needed for synchronisation. Bunched extraction best to minimise losses due to kicker rise time (longer than bunch spacing).

Increasing the cycle length had a direct impact on the operational CT-extracted cycle. To be able to inject in the SPS a CT or an MTE extracted beam minimising the impact on the SPS:

1. all the PS FT operational cycles had to be reprogrammed to have the same MTE extraction timing
2. change the MTG offset between the PS and SPS

Losses vs longitudinal structure

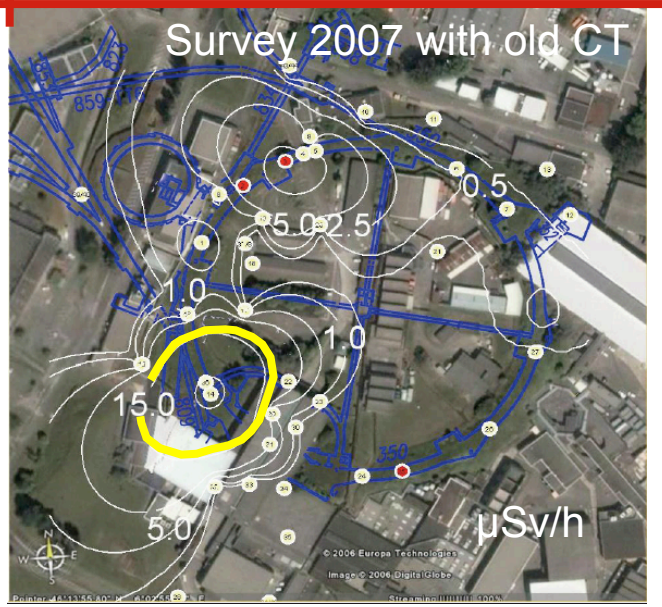
Losses on the septum 16 depends on septum thickness, fast kicker rise time and on longitudinal bunch structure



Black: continuous beam
Blue: bunched beam h=16 (bunch length ~ 80 ns)
Red: bunched beam h=8 (bunch length 100 ns)
Measured beamlet sigma: ~2 mm
Magnetic septum thickness: 3 mm
corresponding to about ~1.5 σ

Loss diff. between h16 and debunched is only marginal.

MD needed to understand if SPS can accept bunched beam, either h8 or h16. 200 MHz structure always there to allow trajectory measurement in TT2-TT10 - 1st turn in the SPS



Simulated

	Beam losses (%)		
	Continuous	Bunched (h=16)	Bunched (h=8)
Nominal configuration	1	0.9	0.6
Total (capture+extraction)	3–4	2.9–3.9	2.6–3.6
Improved kickers (faster rise time)	0.6	0.5	< 0.1
Total (capture+extraction)	2.6–3.6	2.5–3.5	2.1–3.1
Reduced thickness of magnetic septum	0.6	0.5	0.3
Total (capture+extraction)	2.6–3.6	2.5–3.5	2.3–3.3

Longitudinal structure study results

- Study done by injecting in the SPS a CT extracted beam:
  - bunched and synchronised in h8 with different RF voltages
  - bunched and synchronised in h16 with different RF voltages
  - debunched from h8 with same debunching time as for h16
  - debunched from h16, as in normal operation for the CNGS/SFTPRO
- **Results after many iterations** which caused also a change, few times, of the operational CNGS and SFTPRO users and a change of the MTG offset between the PS and SPS
  - Not possible to have a bunch splitting h8-h16 at 14 GeV/c in the PS
  - Not possible to synchronise with less than 40 kV with existing hardware
  - The SPS has minimum losses with two structures: a) debunched from h16; b) bunched h16 with 4 kV in the PS, which is practically a debunched beam and cannot be synchronised
- **Not possible to minimise losses in the PS by using an h8 beam**.
  Further study to reduce the cycle length by debunching from h8.

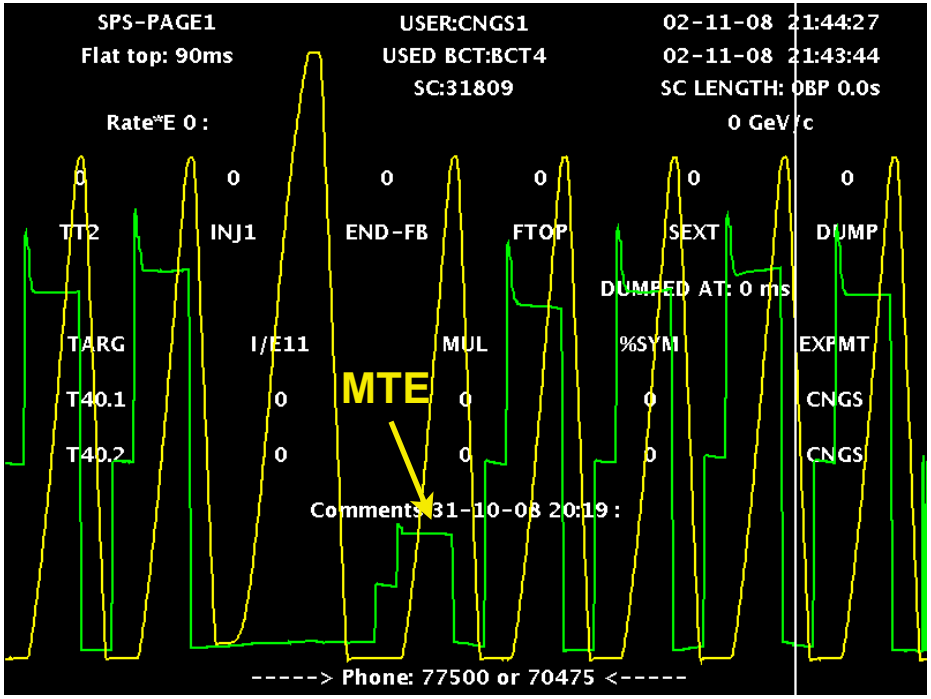
Thanks to G. Metral, T. Bohl, H. Damerau, S. Hancock, K. Cornelis, J. Wenninger, and OP crews

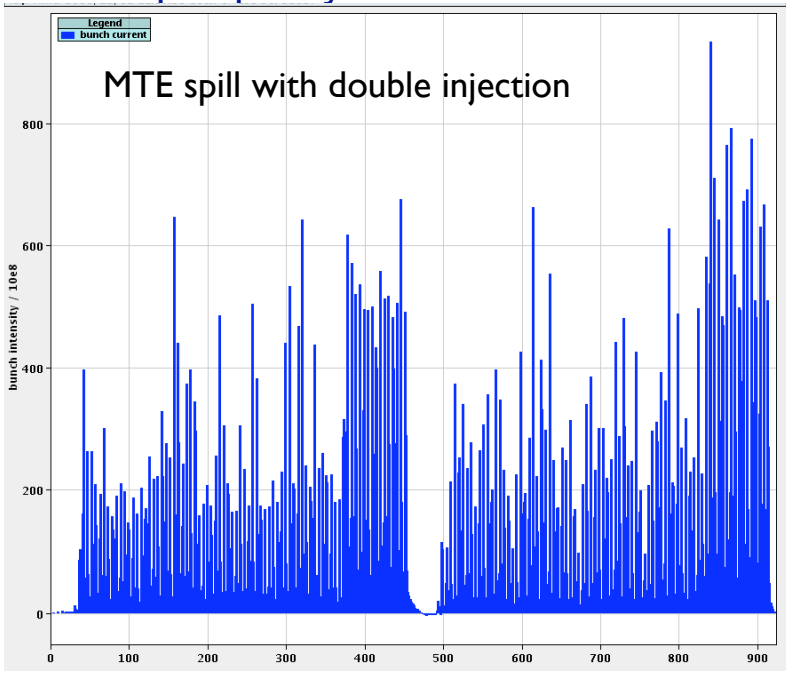
MTE beam injected in SPS - up to CNGS target

A) **MTE bunched beam has been injected in the SPS, accelerated and extracted to the CNGS**.
B) Double injection done with about **600-700e10 per injection**.

C) **No time to match the injection optics, LHC type optics used instead** without the emittance exchange section in TT10. H plane larger than on normal SFTPRO but V smaller.
Losses up to 15% observed at injection most probably from large optics mis-match, in particular Dy.
D) **Longitudinal structure not optimum for the SPS** ⇒ Bunched h16 synchronised (60 kV) with 200 MHz structure. Losses during acceleration. **De-bunched beam prepared after the SPS stop.**

E) **Extraction left in operation for the last night of the CNGS run without any mayor issue**. However, large losses (≈ 10%) in the PS at extraction ⇒ changed beam radial position from synchro. on real SPS frequency. No time to retune extraction during tests ⇒ impact on spill quality.





Thanks to T. Bohl, J. Wenninger, D. Manglunki and OP SPS crew

A “LARGE” for MTE-extracted beam in SPS

MTE LARGER

115 CERN SL
MD2 updated: 02-11-08 18:09:07

TT2	TT 10	%LOSS	INJ	%LOSS
null	767	null	701	8.6
null	769	null	624	18.9
	I/E10	%LOSS	%TRNS	TIME/ms
INJECT	701	8.6	91	20
END FB	1292	0.0	100	1260
20GeV/c	1184	8.4	100	1470
27GeV/c	1126	4.9	100	1530
50GeV/c	1114	1.1	100	1740
400GeV/c	1113	0.1	100	4200

LOSS @ FB: 3.3%

CT LARGER

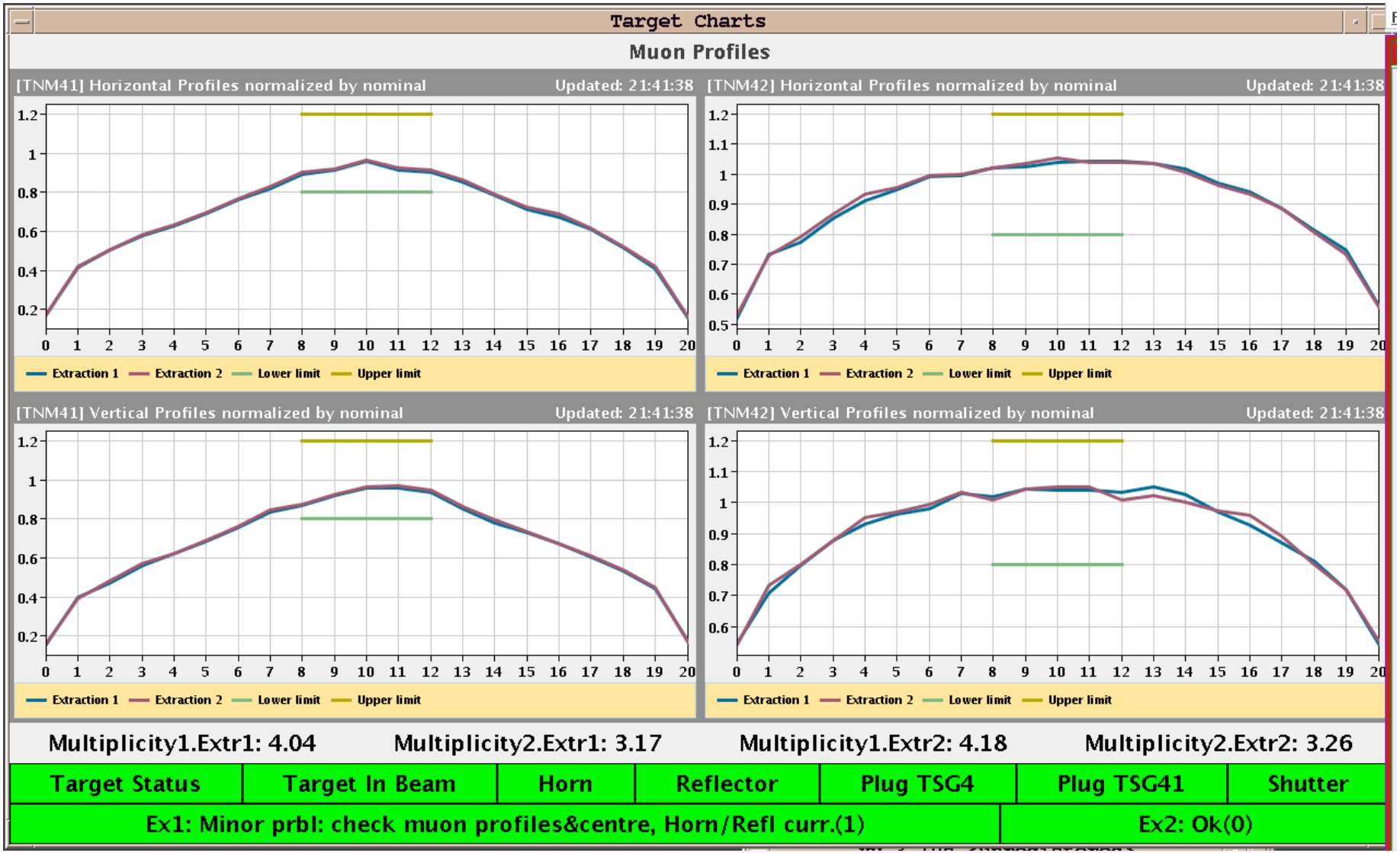
116 CERN SL
CNGS3 updated: 16-10-08 18:00:05

TT2	TT 10	%LOSS	INJ	%LOSS
1355	1352	0.2	1305	3.5
1361	1366	0.0	1313	3.9
	I/E10	%LOSS	%TRNS	TIME/ms
INJECT	2618	3.7	96	1210
END FB	2594	0.9	99	1260
20GeV/c	2547	1.8	97	1470
27GeV/c	2526	0.8	96	1530
50GeV/c	2524	0.1	96	1740
400GeV/c	2523	0.0	96	4200

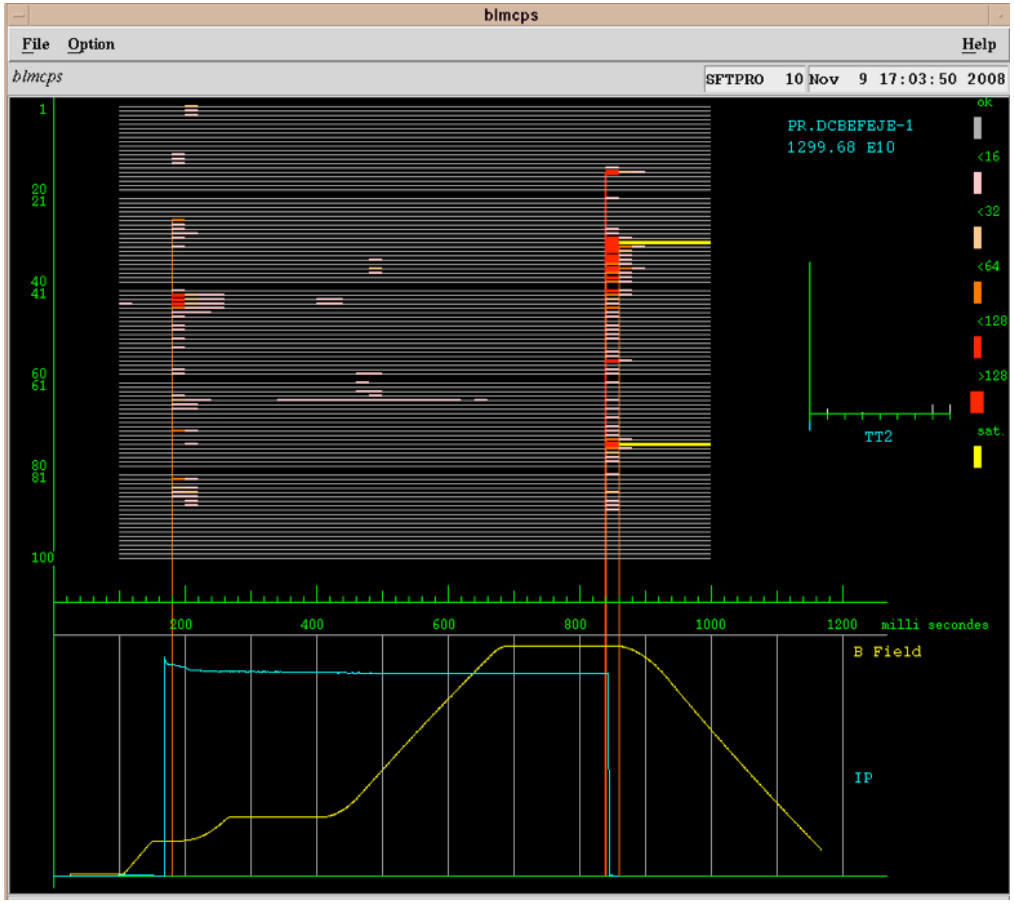
LOSS @ FB: 1.7% LOSS T.L. N.A.

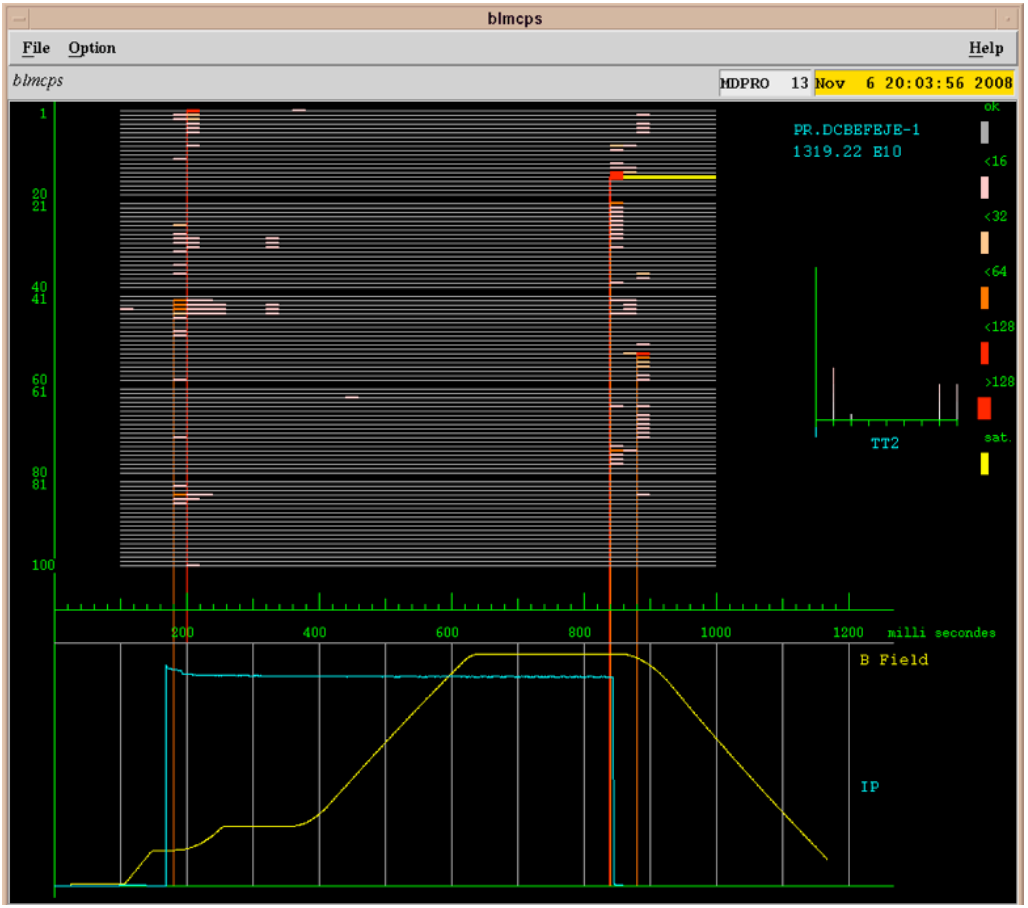
courtesy of T. Bohl

First MTE's neutrinos ...



SFTPRO-CT vs SFTPRO-MTE





MTE commissioning continued after the end of the SPS run

De-bunched SFTPRO-like MTE beam has been extracted with losses about 1/2 of the normal CT for the same accelerated intensity (1.3 10^{13})

MTE ≈ 97-98 % extr. eff. vs CT ≈ 95 % in agreement with expectation.
Losses concentrated on SMH16 as expected due to kicker rise time and large core emittance

Islands emittances

Islands and core emittance deduced from profile measurements and PS optics model:

emittance H core (1sigma,normal) ~ 43 mm mrad

emittance H islands(1sigma,normal)~ (6.8+-3) mm mrad

Core emittance too large with respect to islands emittance confirmed by measurements in TT2: ~ 38 mm mrad and in SPS at extraction: ~ 22 mm mrad (full beam, reduced by losses)

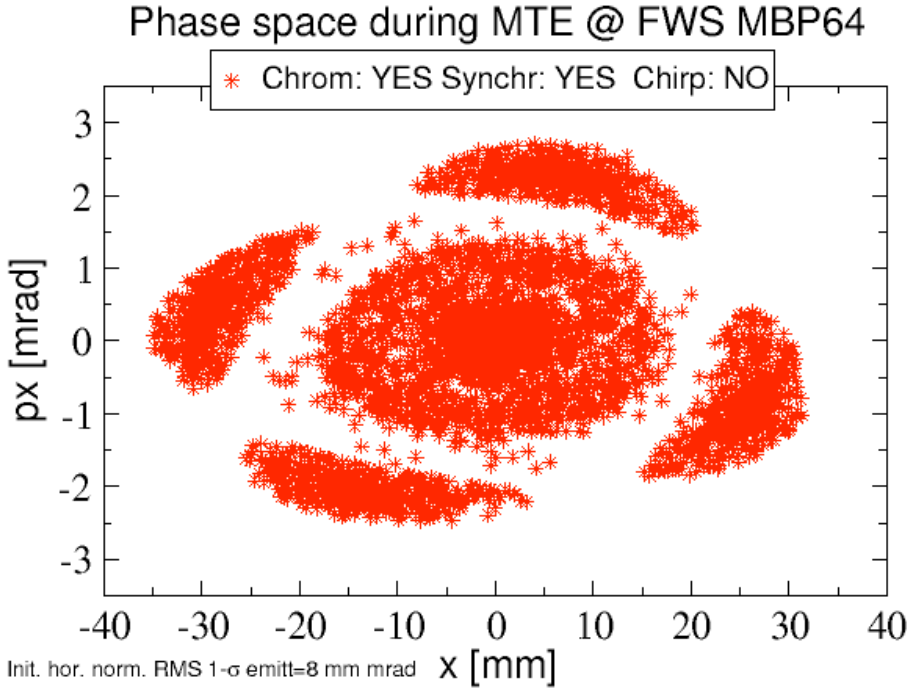
As shown by simulations, negative chromaticity before capture generates large core beam. New non-linear working point to be chosen to keep large intensity sharing and core sufficiently small (as in 2007 run).

In vertical plane, no emittance change before/after capture observed: emittance V (1sigma,normal) ~ 4.25 mm mrad

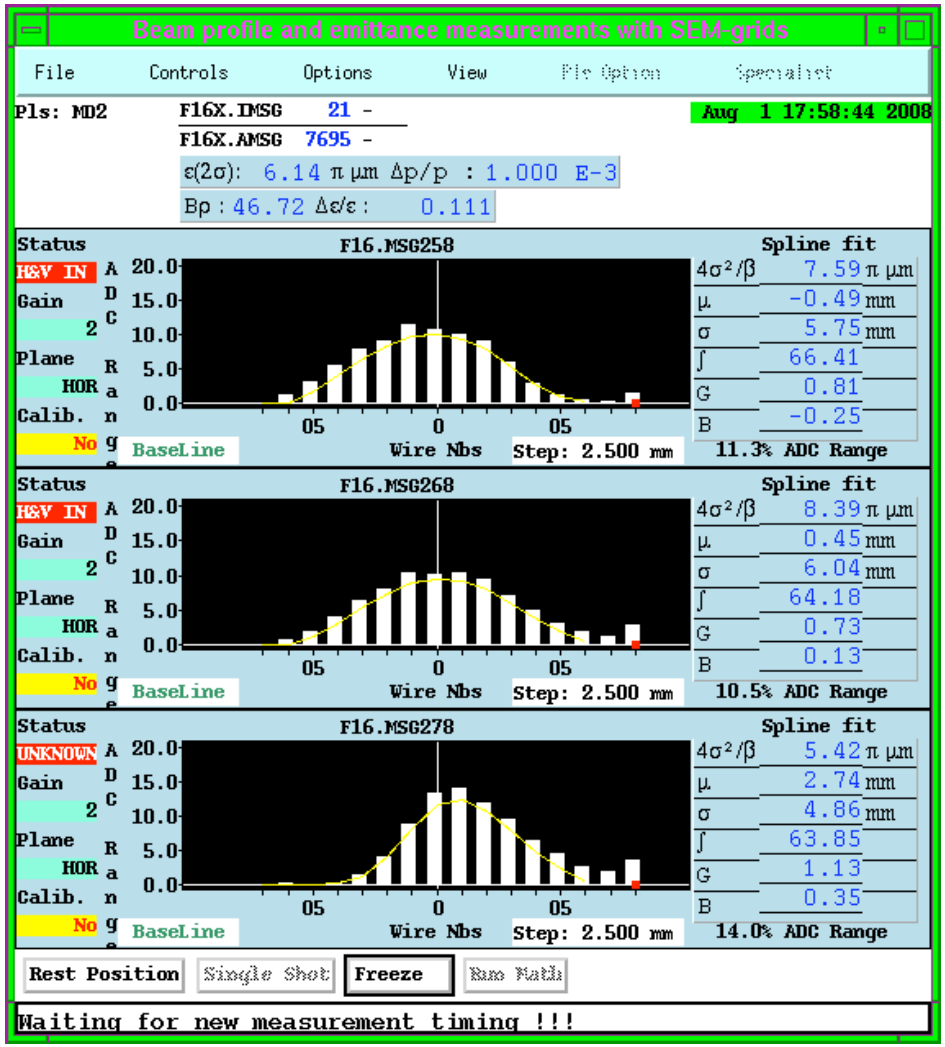
Once injected into SPS, without TT10 phase exchange, losses @ injection due probably to large core horizontal emittance+large optics mismatch.

Not possible to measure the H emittance @ injection during test.

Vertical emittance increasing during SPS acceleration, from ~ 4 mm mrad to 7 mm mrad.
Instability observed in the V plane to be understood.



TT2-TT10-SPS matching



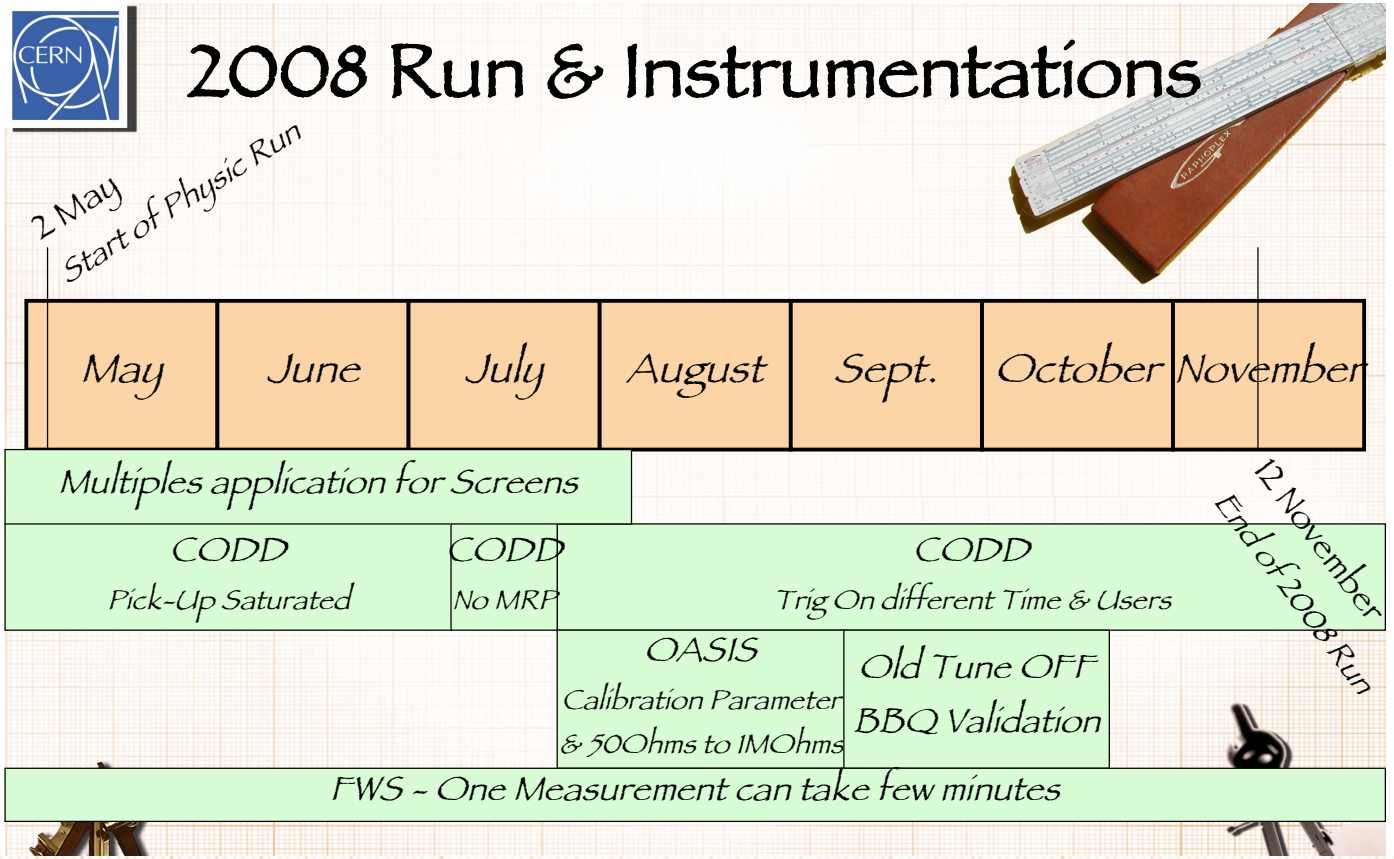
Matching study started:

Large profiles observed in TT2 due to different island trajectories at extraction.
To disentangle the single island, gated acquisition will be installed.

Optics with and without phase exchange in TT10 will be computed

Measurements will be repeated since core emittance should be reduced with better nonlinear working point

Instrumentation issue



Unfortunately we had only rarely all the instrumentation needed available at the same time, as for normal operation.

Commissioning program “adapted” according to the instrument operational at the particular moment and MTE resources used to help in debugging/validating the different systems.

2009 start-up

- Open questions from last year:
  - large core emittance ⇒ chromaticity too small, even negative in same cases ⇒ different ξ choice
  - Matching with SPS ⇒ best matching optics w/wo the TT10 phase exchange ⇒ start without phase exchange
  - Instabilities and losses in the SPS ⇒ debunched beam from PS required
  - Capture optimisation using chirp excitation ⇒ no need of large emittance beam from PSB
  - Longitudinal gymnastics ⇒ debunching from h8/h16 before capture
  - Definitive choice of magnetic cycle/extraction timing
- Proposal for this year:
  - **Start to provide SFTPRO-CNGS beams with the classical CT**.
  - **Prepare in parallel an MTE extracted beam with the same intensity as SFTPRO**.
  - Once the SPS starts, an MD cycle should be included in the Super-Cycle, even without acceleration, to optimise the PS-SPS matching.
  - **Provide as soon as possible SFTPRO with MTE extraction.**
  - CNGS will start with a normal CT.
  - Initially, one CNGS cycle could be served by MTE. The intensity will be the highest compatible with the status of the MTE setting up.

Conclusions

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.

Acknowledgements: The members of the PS Multi-Turn Extraction Project

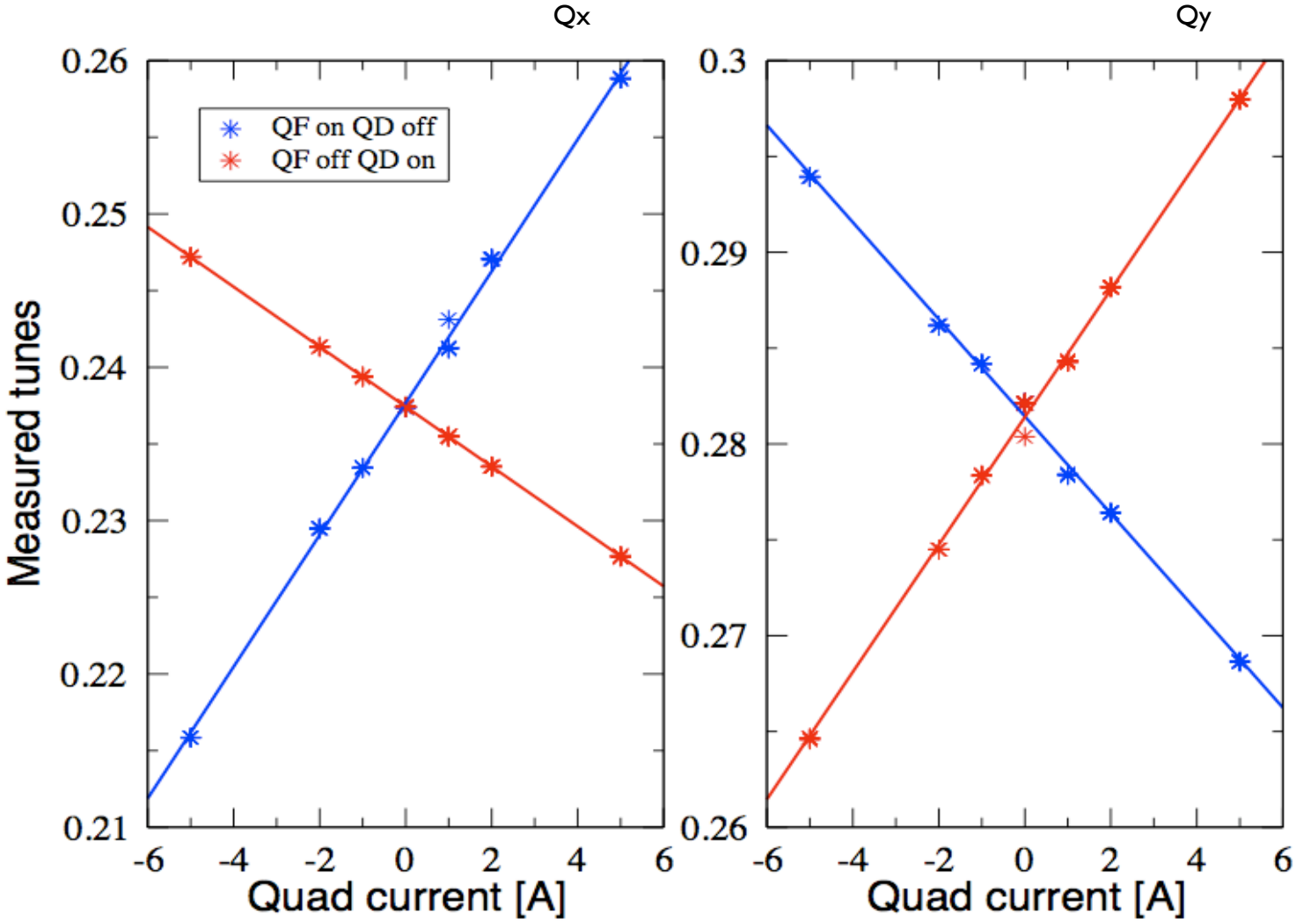
Fanny Arnold Malandain, Thomas Bohl, Stephane Cettour Cave, Karel Cornelis, Heiko Damerau, Fabio Follin, Pierre Freyermuth, Herve Genoud, Rossano Giachino, Steven Hancock, Yannick Le Borgne, Django Manglunki, Gabriel Métral, Louis Pereira, James Ridewood, Yannick Riva, Bernard Vandorpe, Jorg Wenninger, Elena Benedetto, Olav Ejner Berrig, Andrea Franchi, Simone Gilardoni, Massimo Giovannozzi, Cathelijne Bal, Bernd Dehning, Jan Koopman, Franck Di Maio, Claude Dehavay, Fritz Caspers, Tom Kroyer, Elias Métral, Mike Barnes, Tony Fowler, Volker Mertens, Klaus-Dieter Metzmacher, Remy Noulibos, Luc Sermeus, Dominique Bodart, Willi Kalbreier, Mikko Karppinen, Thomas Zickler, Pierre Bourquin, Gilles Villiger, Michel Caccioppoli, Gilles Favre, Rende Steerenberg, Jean-Marc Cravero, Carlos De Almeida Martins, Jean-Pierre Royer, Andre Beuret, Jean-Paul Burnet, Raymond Brown, Carlo Rossi, Jose Monteiro, Rosario Principe, Jan Borburgh, Michael Hourican, Tobias Dobers, Monique Dupont, Christian Lacroix, Daniel Allard, Jan Hansen, Edgar Mahner, Eric Page, Giovanna Vandoni, Carlos Pinto-Pereira.

and thanks to all the others who contributed to the successful installation and commissioning

for discussion

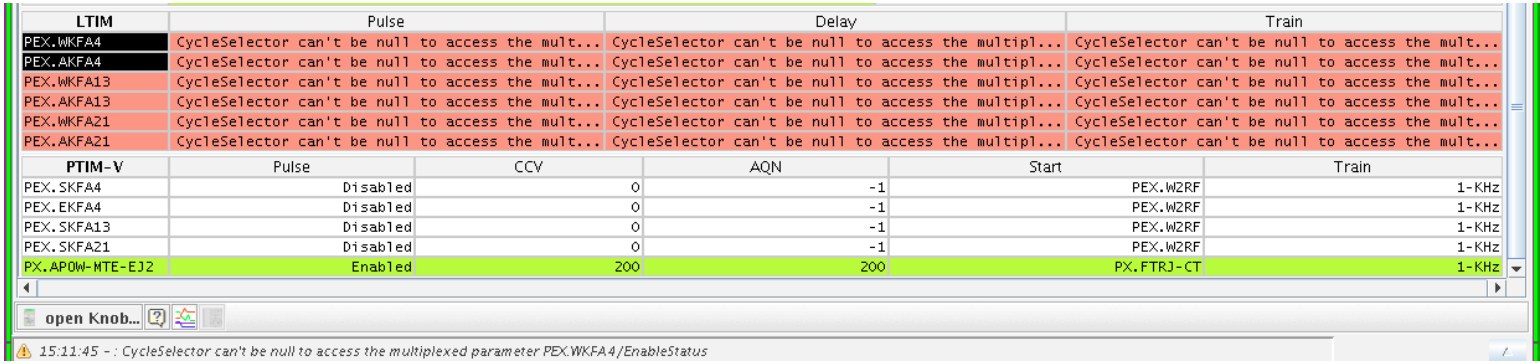
Low energy quadrupole matrix re-measured

$$\begin{pmatrix} \Delta Qx \\ \Delta Qy \end{pmatrix} = \begin{pmatrix} 0.0042984 & -0.0019526 \\ -0.002532 & 0.0033237 \end{pmatrix} \begin{pmatrix} \Delta Iqf \\ \Delta Iqd \end{pmatrix}$$



Typical PS control problem

JAVA CM cannot acquire, at first ,the KFA4 timing status

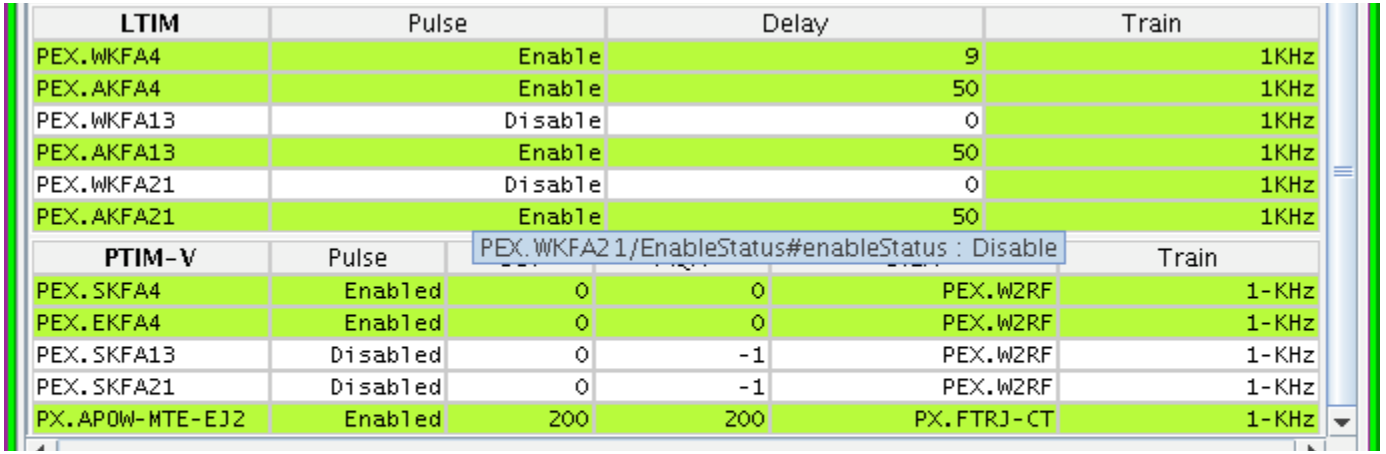


LTIM	Pulse	Delay	Train
PEX.WKFA4	CycleSelector can't be null to access the mult...	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...
PEX.AKFA4	CycleSelector can't be null to access the mult...	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...
PEX.WKFA13	CycleSelector can't be null to access the mult...	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...
PEX.AKFA13	CycleSelector can't be null to access the mult...	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...
PEX.WKFA21	CycleSelector can't be null to access the mult...	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...
PEX.AKFA21	CycleSelector can't be null to access the mult...	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...

PTIM-V	Pulse	CCV	AQN	Start	Train
PEX.SKFA4	Disabled	0	-1	PEX.W2RF	1-KHz
PEX.EKFA4	Disabled	0	-1	PEX.W2RF	1-KHz
PEX.SKFA13	Disabled	0	-1	PEX.W2RF	1-KHz
PEX.SKFA21	Disabled	0	-1	PEX.W2RF	1-KHz
PX.APOW-MTE-EJ2	Enabled	200	200	PX.FTRJ-CT	1-KHz

open Knob...

15:11:45 - : CycleSelector can't be null to access the multiplexed parameter PEX.WKFA4/EnableStatus



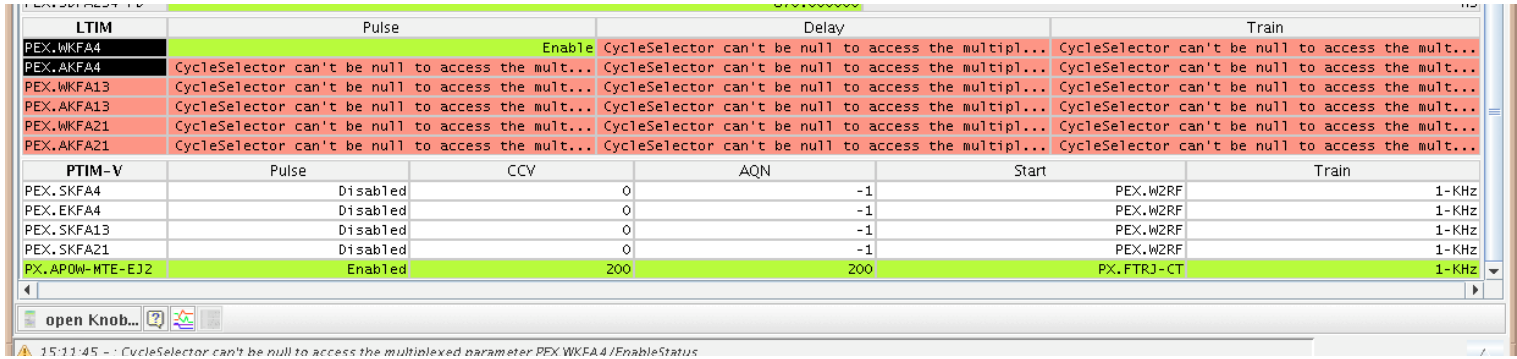
LTIM	Pulse	Delay	Train
PEX.WKFA4	Enable	9	1KHz
PEX.AKFA4	Enable	50	1KHz
PEX.WKFA13	Disable	0	1KHz
PEX.AKFA13	Enable	50	1KHz
PEX.WKFA21	Disable	0	1KHz
PEX.AKFA21	Enable	50	1KHz

PEX.WKFA21/EnableStatus#enableStatus : Disable

PTIM-V	Pulse				Train
PEX.SKFA4	Enabled	0	0	PEX.W2RF	1-KHz
PEX.EKFA4	Enabled	0	0	PEX.W2RF	1-KHz
PEX.SKFA13	Disabled	0	-1	PEX.W2RF	1-KHz
PEX.SKFA21	Disabled	0	-1	PEX.W2RF	1-KHz
PX.APOW-MTE-EJ2	Enabled	200	200	PX.FTRJ-CT	1-KHz

X-Motif tells that everything is fine. (Checked with the expert afterwards)

JAVA CM acquires only a status change



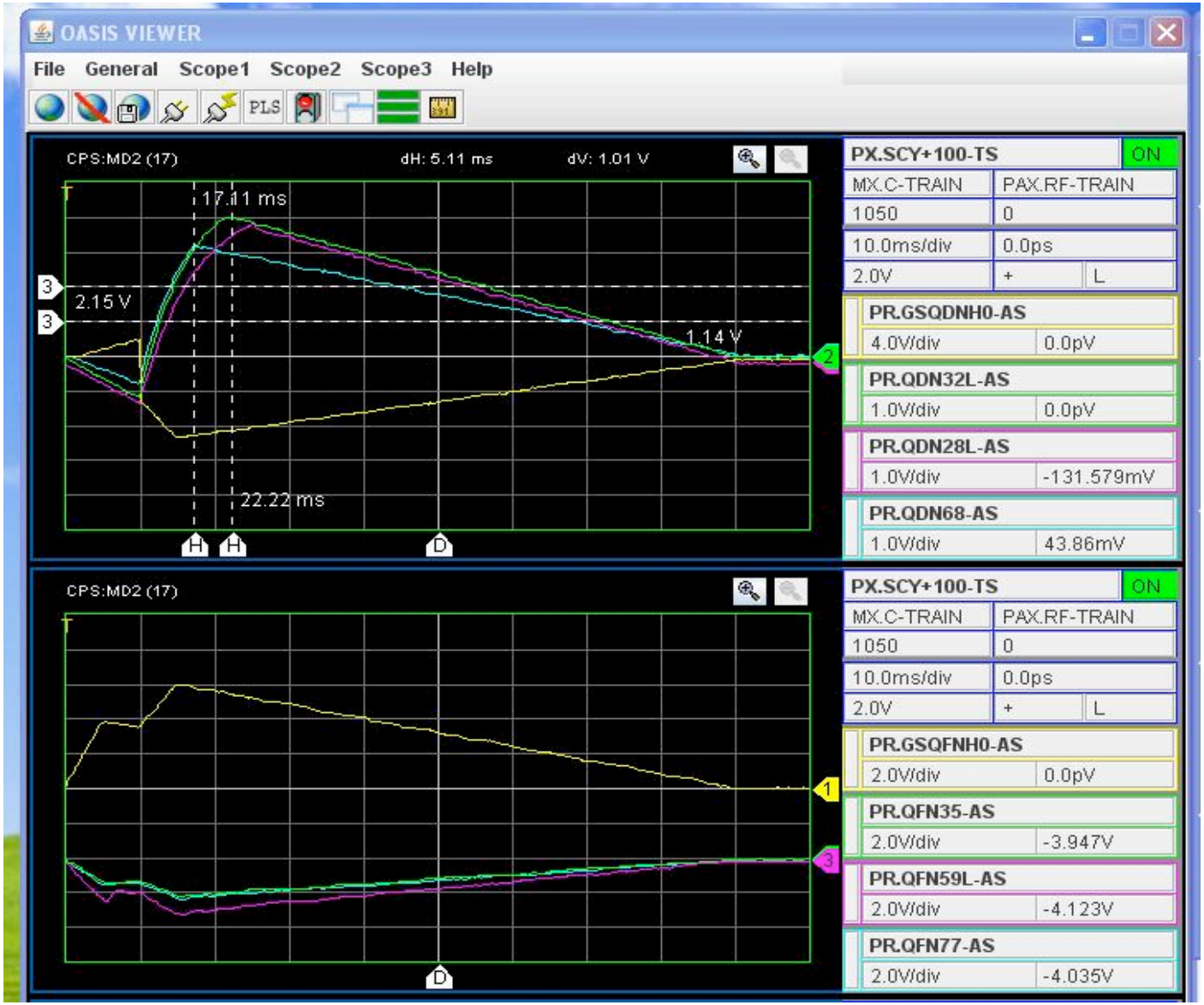
LTIM	Pulse	Delay	Train
PEX.WKFA4	Enable	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...
PEX.AKFA4	CycleSelector can't be null to access the mult...	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...
PEX.WKFA13	CycleSelector can't be null to access the mult...	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...
PEX.AKFA13	CycleSelector can't be null to access the mult...	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...
PEX.WKFA21	CycleSelector can't be null to access the mult...	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...
PEX.AKFA21	CycleSelector can't be null to access the mult...	CycleSelector can't be null to access the multipl...	CycleSelector can't be null to access the mult...

PTIM-V	Pulse	CCV	AQN	Start	Train
PEX.SKFA4	Disabled	0	-1	PEX.W2RF	1-KHz
PEX.EKFA4	Disabled	0	-1	PEX.W2RF	1-KHz
PEX.SKFA13	Disabled	0	-1	PEX.W2RF	1-KHz
PEX.SKFA21	Disabled	0	-1	PEX.W2RF	1-KHz
PX.APOW-MTE-EJ2	Enabled	200	200	PX.FTRJ-CT	1-KHz

open Knob...

15:11:45 - : CycleSelector can't be null to access the multiplexed parameter PEX.WKFA4/EnableStatus

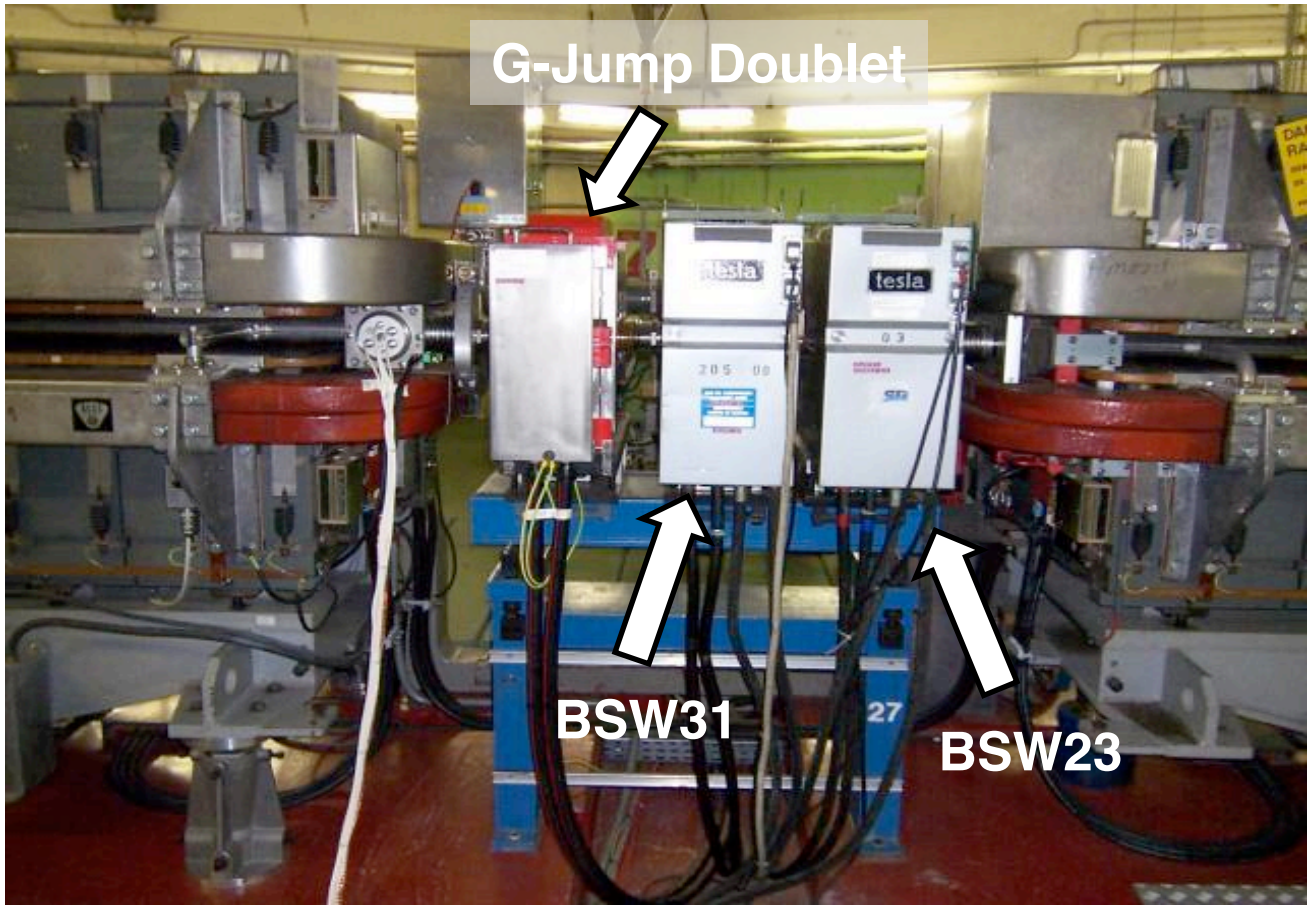
Limitation on dI/dt of low energy quads



For a dI/dt larger than 2 A/ms the large quadrupoles cannot follow the GFA. Investigation ongoing to understand if at least the spread of max current vs time can be reduced.

Bump 18 sacrificed….

Leaking connection



During the technical stop 9th of June, the dipole of the BSW23 – slow extraction found with a water leak.

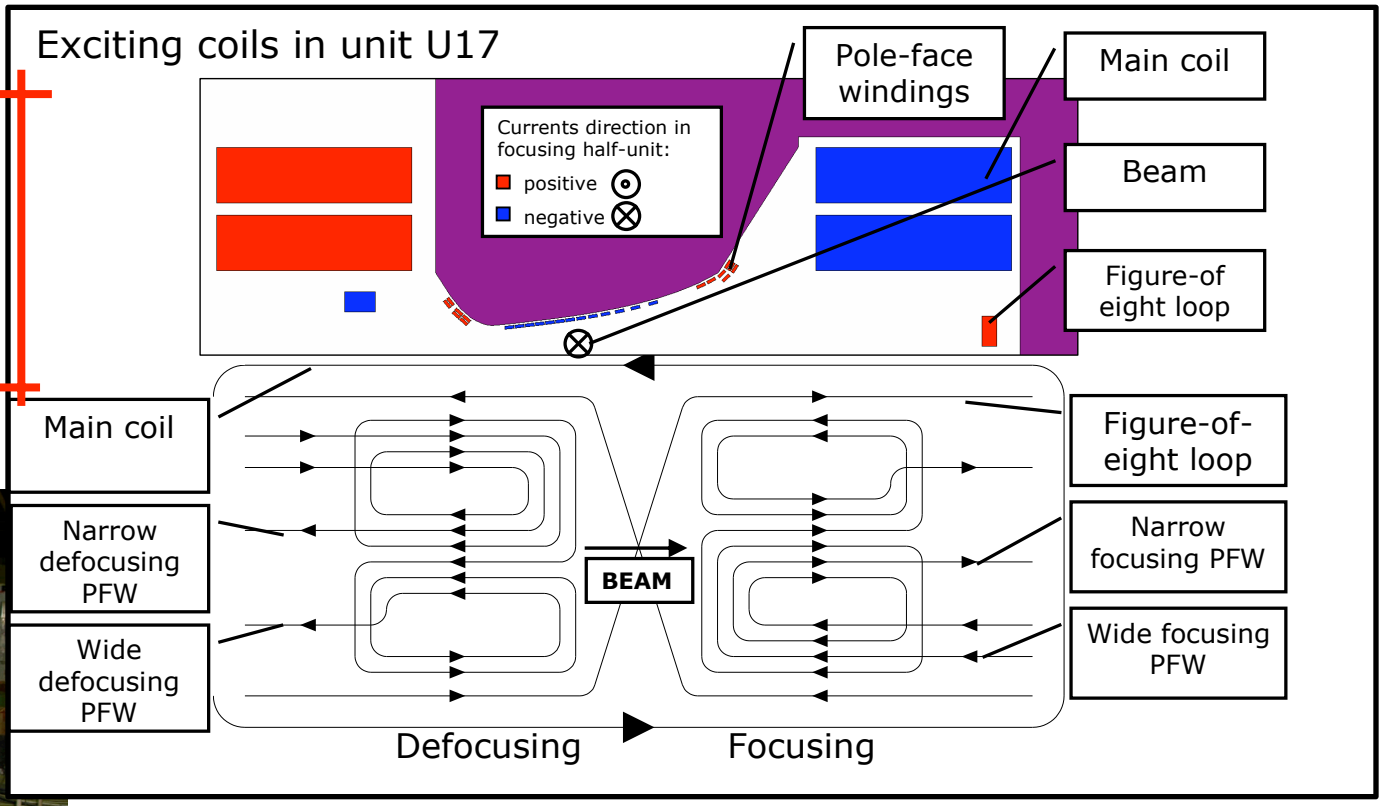
Since the **spare exists but is not available for installation**, the PSS suggested in agreement with the MTE Beam Commissioning Coordinator (myself&myself) to remove the MTE dipole in SS18 and avoid a 10 days stop of the EAST HALL physics.

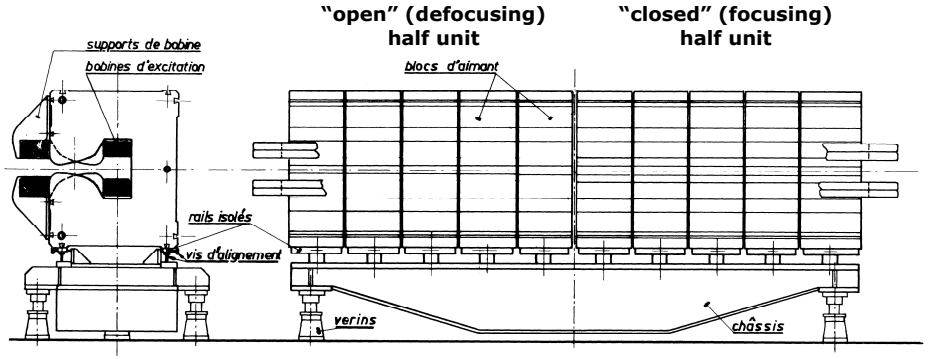
The MTE refurbished magnet will be reinstalled on Wednesday 25th June –
but **no spare available for a total of 10 magnets** - Fast & MTE extraction, slow extraction, CT extraction

Brief digression on PFW ...

In 5-CM there are :
- 4 machine physical parameters
- to control *5 free currents*

The 5th machine parameter could be:
a) non linear-chromaticity (MTE)
b) minimisation of the RMS F8L current





	ΔI FN	ΔI FW	ΔI DN	ΔI DW	ΔI 8L
ΔQh	$f^{FN}_{\Delta Qh}(E)$	$f^{FW}_{\Delta Qh}(E)$	$f^{DN}_{\Delta Qh}(E)$	$f^{DW}_{\Delta Qh}(E)$	$f^{8L}_{\Delta Qh}(E)$
ΔQv	$f^{FN}_{\Delta Qv}(E)$	$f^{FW}_{\Delta Qv}(E)$	$f^{DN}_{\Delta Qv}(E)$	$f^{DW}_{\Delta Qv}(E)$	$f^{8L}_{\Delta Qv}(E)$
ΔXih	$f^{FN}_{\Delta Xih}(E)$	$f^{FW}_{\Delta Xih}(E)$	$f^{DN}_{\Delta Xih}(E)$	$f^{DW}_{\Delta Xih}(E)$	$f^{8L}_{\Delta Xih}(E)$
ΔXiv	$f^{FN}_{\Delta Xiv}(E)$	$f^{FW}_{\Delta Xiv}(E)$	$f^{DN}_{\Delta Xiv}(E)$	$f^{DW}_{\Delta Xiv}(E)$	$f^{8L}_{\Delta Xiv}(E)$