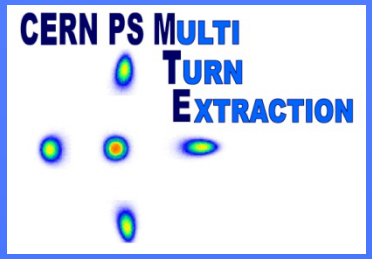


MTE commissioning in 2008

M. Giovannozzi

- A bit of history
- What is needed to implement MTE
- Installation status
- Schedule
- Commissioning

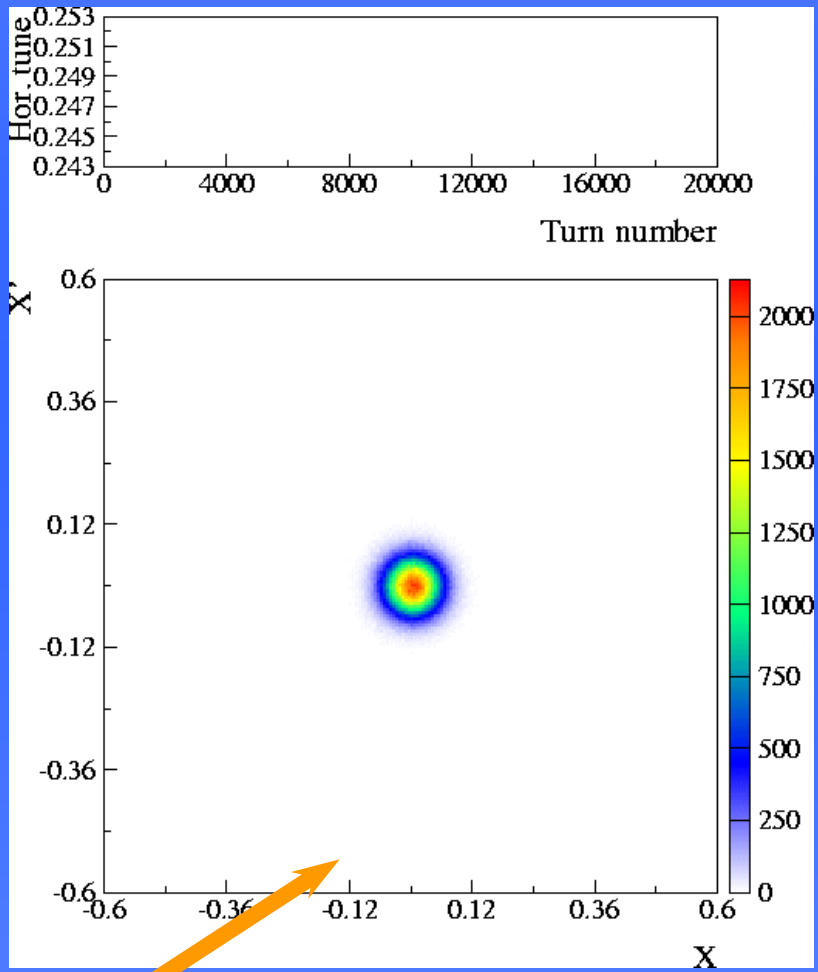
Acknowledgements: A. Franchi, S. Gilardoni and G. Arduini, E. Métral, Y. Papaphilippou.

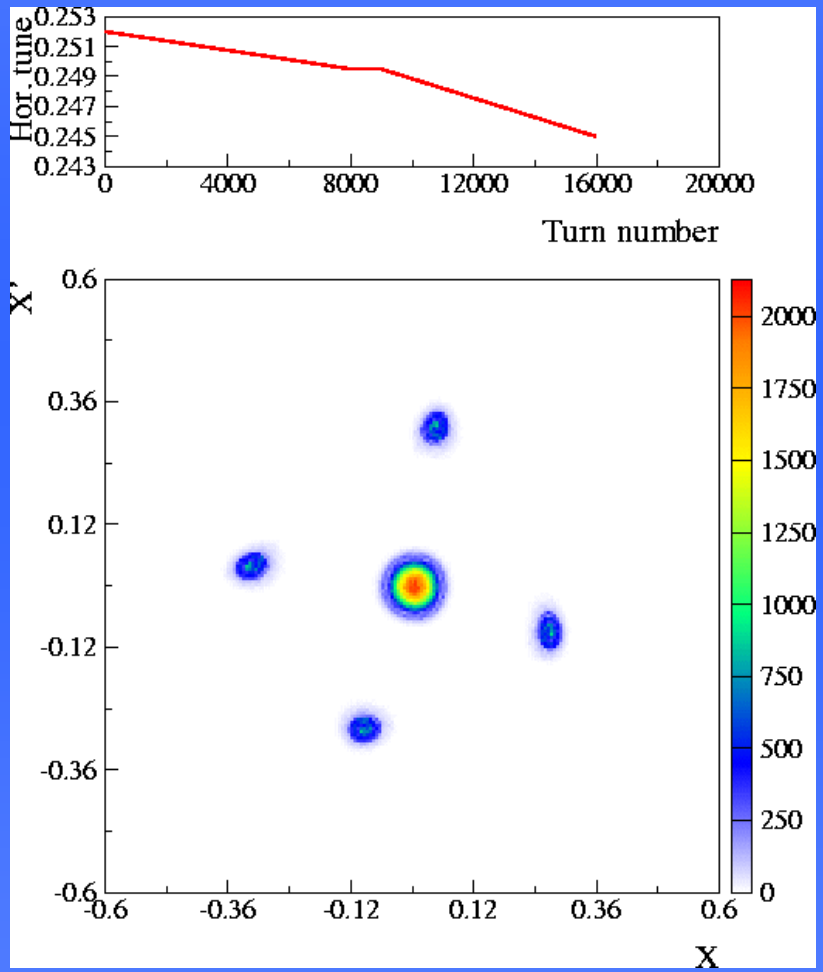
CERN PS MULTI TURN EXTRACTION

How does it work - I

Tune variation

Simulation results



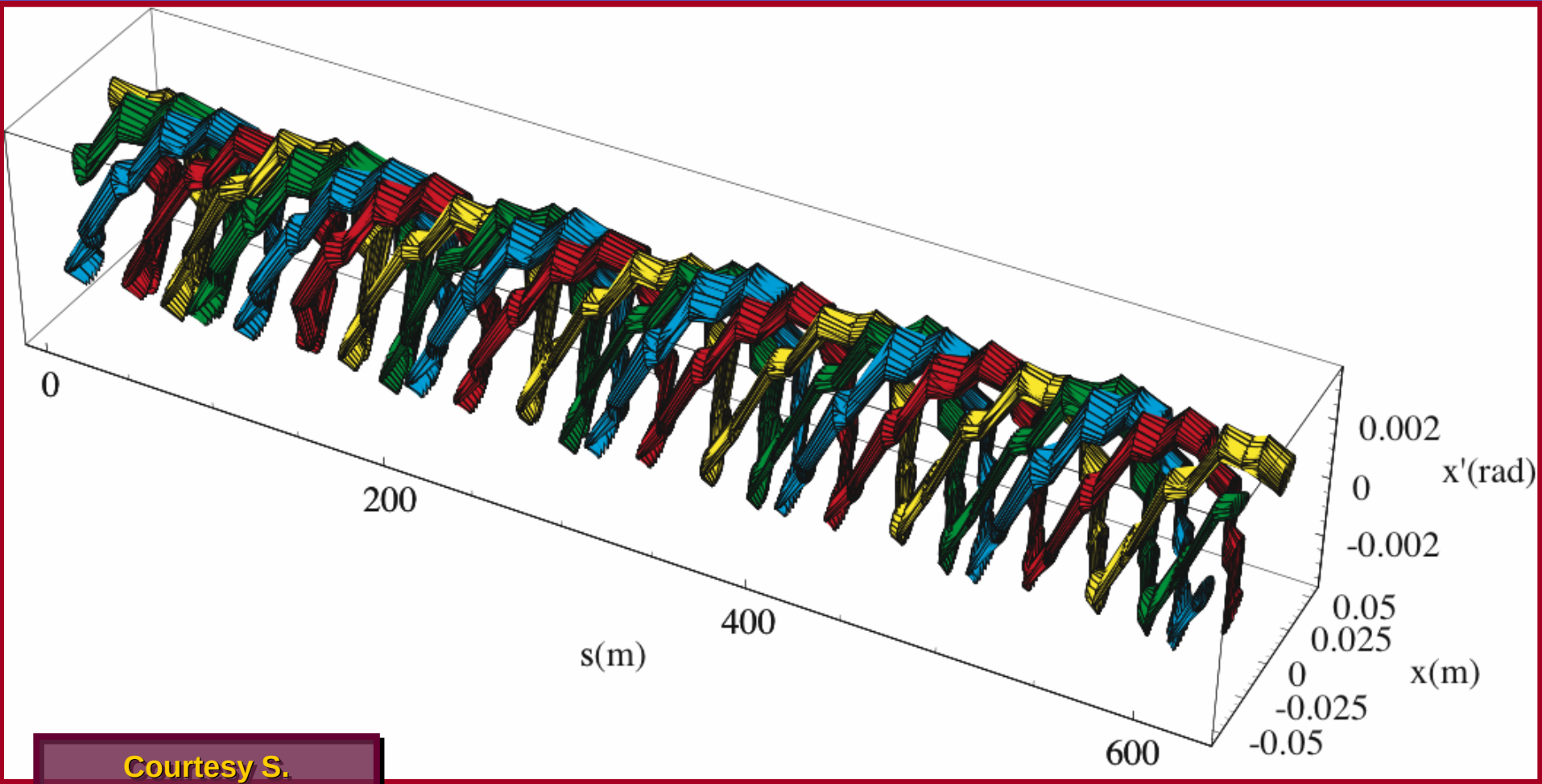


Phase space portrait

CERN PS MULTI TURN EXTRACTION

How does it work - II

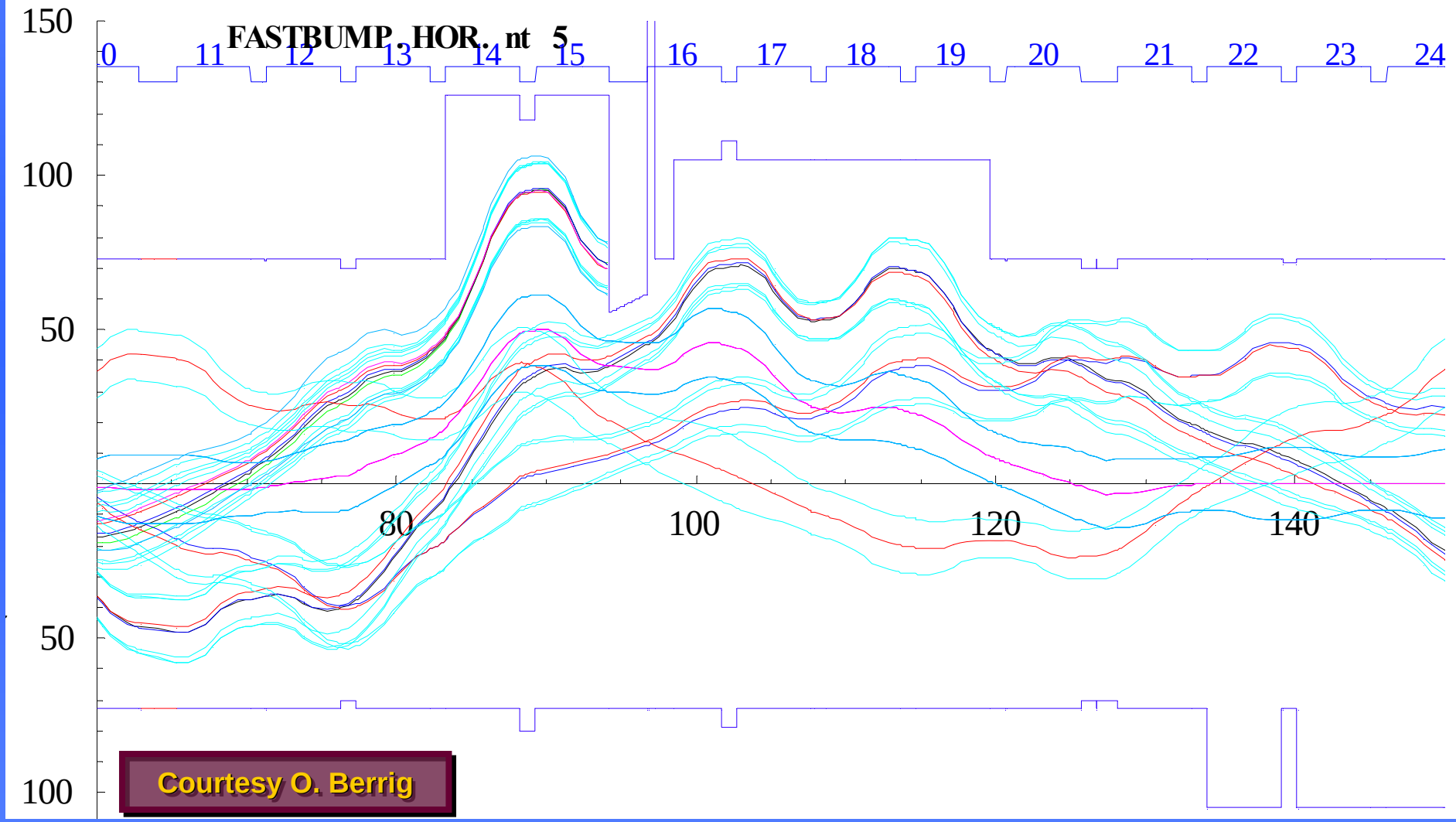
Final stage after 20000 turns (about 42 ms for CERN PS)



Courtesy S. Gilardoni

CERN PS MULTI TURN EXTRACTION

How does it work - III



Courtesy O. Berrig

CERN PS MULTI TURN EXTRACTION

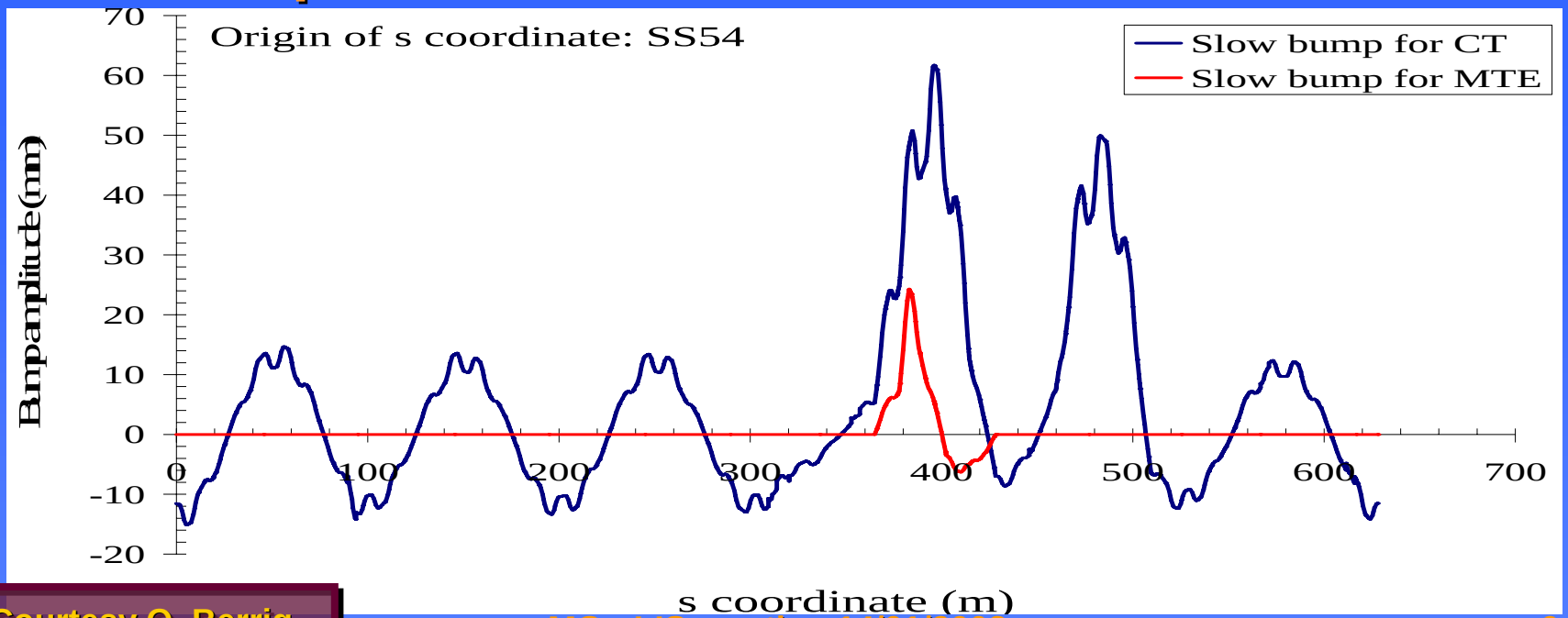
What is needed to implement MTE - I

- Beam splitting:
  - Magnets: Sextupoles and new octupoles.
  - Power converters: New devices to replace old Tekelec.
- Beam extraction:
  - Slow bump: New power converters (capacitor discharge).
  - Fast bump: New kickers.
  - Trajectory correction in the TT2 line
    - Displacement and upgrade of Emittance Reduction Dipoles (ERDs or DFAs).
- Aperture:
  - Replacement of vacuum chambers in straight sections (SS).
  - Replacement of vacuum chamber in magnet units (MU).

CERN PS MULTI TURN EXTRACTION

What is needed to implement MTE - II

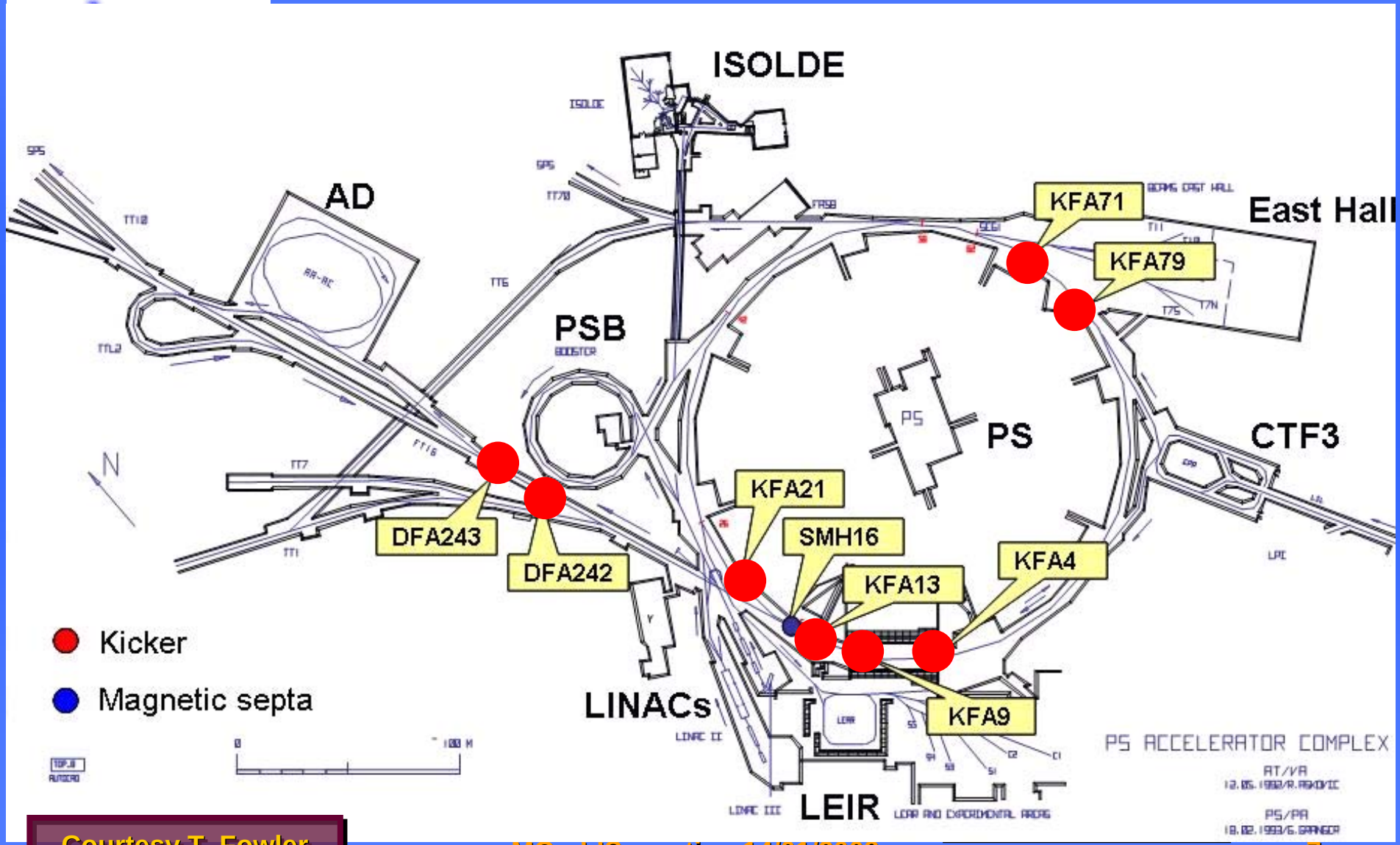
- Extraction proper: slow bump
  - Six dipoles, independently powered, are foreseen.
  - Large number of magnets -> optimal bump shape.
  - Present slow bump: four dipoles powered with a series/parallel circuit.



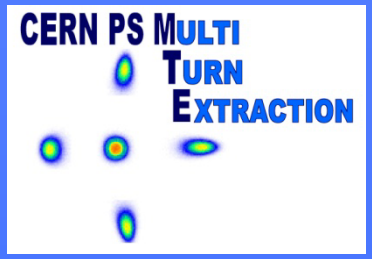
Courtesy O. Berrig

CERN PS MULTI TURN EXTRACTION

What is needed to implement MTE - III



Courtesy T. Fowler



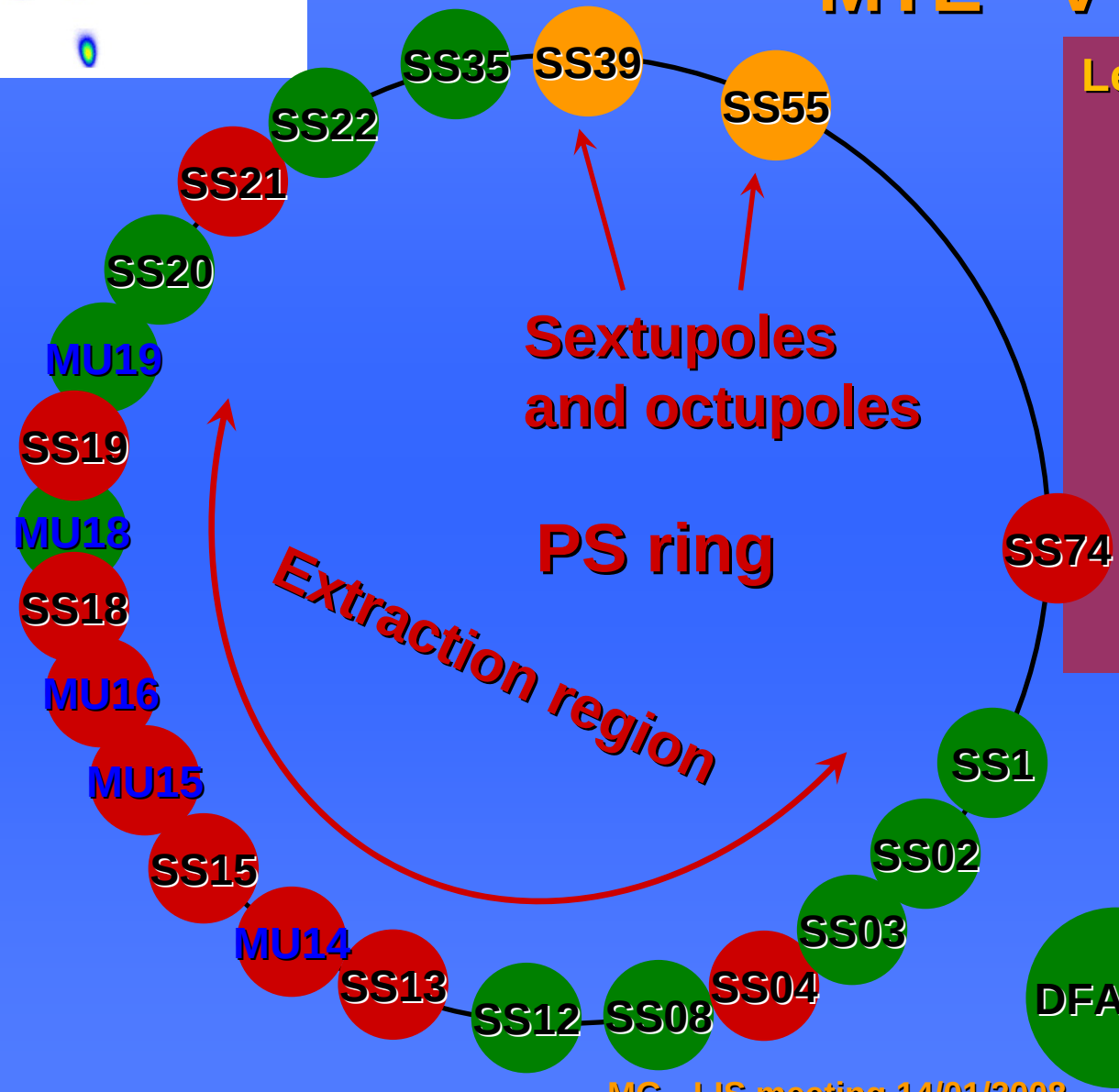
What is needed to implement MTE - IV

The Kicker systems will be implemented in two phases:

- **Phase 1** will use the KFA13/21 and KFA4 sub-systems to validate the new extraction method in the PS machine, whilst maintaining the existing Continuous Transfer (CT) system operational. Will be operational for 1st July 2008.
- All new phase 1 surface equipment will be located in building 367.
- The systems have been designed to maximize, where possible, the re-use of existing, spare equipment
- Once the new scheme is validated, the existing CT will be dismantled and the **second phase** sub-systems, **DFA242/254**, needed for trajectory correction (**TT2**) and KFA9 for perfect bump closure (**PS ring**), will be modified/installed, for start-up 2009

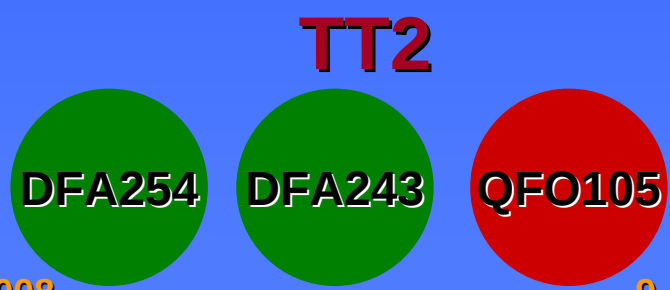
CERN PS MULTI TURN EXTRACTION

What is needed to implement MTE - V



Legend:

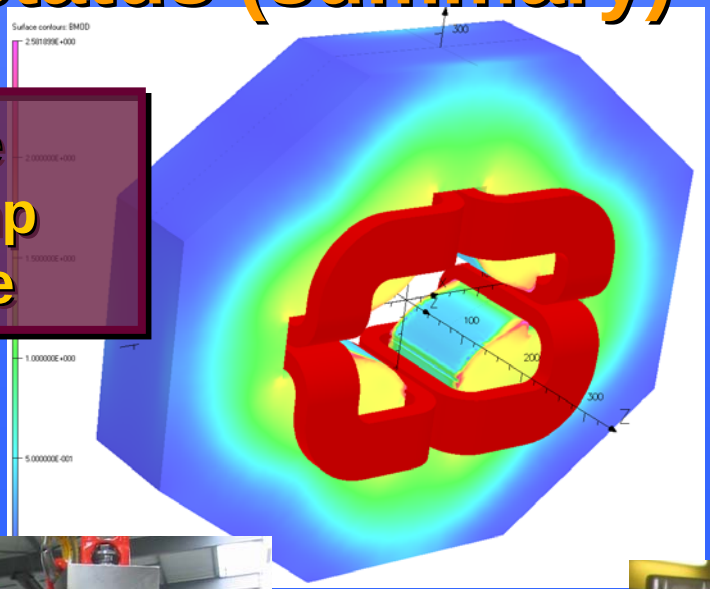
- Red circle -> “heavy” intervention: mechanical design, vacuum intervention.
- Orange circle -> “light” intervention: auxiliary magnet exchange.
- Green: work done during the 2006/7 shut down.



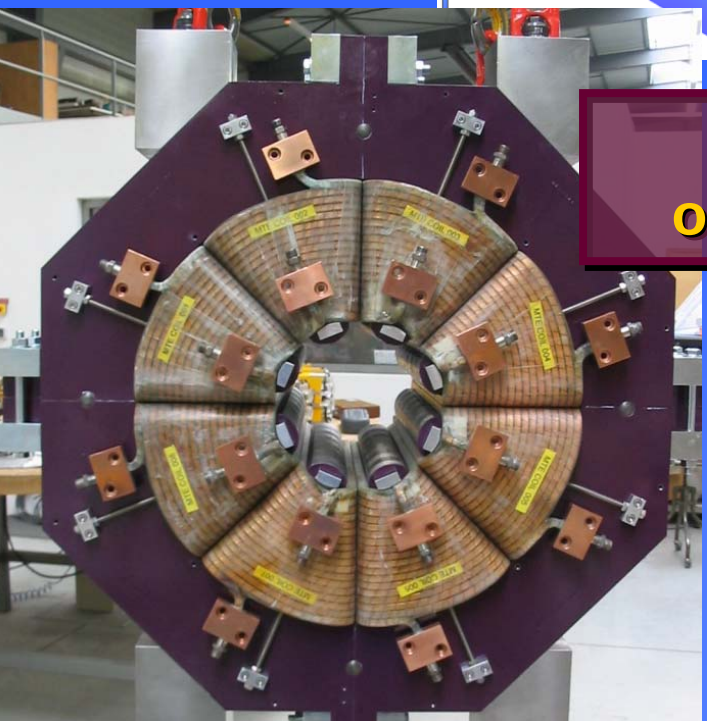
CERN PS MULTI TURN EXTRACTION

MTE project: installation status (summary)

New spare gamma-jump quadrupole



New extraction vacuum chamber



New octupole

New kicker in the PS

CERN PS MULTI TURN EXTRACTION

MTE beam commissioning: first period - I

- **First period (May-June 2008. Kickers not ready for beam, yet):**
  - Setting up of the operation cycle with low-intensity, single-bunch beam (pencil-like if not too difficult to be produced by the PSB).
  - Setting up of the new slow bump 16. It implies also response measurements to have full control of the trimming capabilities of the various magnets.
  - Non-linear chromaticity measurements (PS model validation/determination).
  - Resume splitting (3×10^{12} p/b).
  - Switch to multi-bunch operation (3×10^{12} p/b, corresponding to a total intensity of 2.4×10^{13} p in the PS).

MTE beam commissioning: first period - II

- **Some comments:**
  - Setting up of the operation cycle, i.e. 1.2 s user, partially done in 2007.
  - Few sessions for the hardware tests of the kickers. Pulsing the kickers should be done either on the “zero” user or after extraction of another selected user. Short accesses to the PS ring might be required.

MTE beam commissioning: first period - III

- **Beams required from PSB (in chronological order):**

*Normalized, 1σ

Beam type	Intensity/b	Emittances* (H/V)	Harmonic
Pencil	50×10^{10}	~2/~1	1
Moderate intensity	300×10^{10}	~9/~6	1
Operational	300×10^{10}	~9/~6	2
High intensity	600×10^{10}	~9/~6	1

- **Some comments:**
  - Crucial details: management of archives, users etc. source of problems in 2007…to be improved in 2008.
  - Production of PSB beams: we must be extremely efficient this year…excellent support from Michel in 2007…we count on you also for 2008 (it could be an option for training for Giovanni)!

MTE beam commissioning: second period - I

- **Second period (Starting from July 2008. Kickers available for extraction):**
  - Test of the fast bump with a low-intensity, single-bunch beam (no splitting). This might require some dedicated time at the beginning to avoid perturbing the fixed target physics at the SPS.
  - Five-turn extraction tests with a single bunch (3×10^{12} p/b) and steering to D3.
  - Multi-bunch extraction (3×10^{12} p/b, corresponding to a total intensity of 2.4×10^{13} p in the PS) and steering to D3.
  - Commissioning of full transfer to SPS.
  - Optics measurements and re-matching.

MTE beam commissioning: second period - I

- **Some comments:**
  - Commissioning of full transfer to SPS and optics measurements might take place before multi-bunch extraction.
  - To perform optics measurements after full transfer commissioning (with “undefined optics”) would profit from SPS instrumentation (first turn) for increased accuracy.
  - Beam structure to SPS is supposed to be bunched (**h=8 or 16**) with superimposed 200 MHz modulation. Tests of transfer between PS and SPS of bunched beams should be envisaged.

CERN PS MULTI TURN EXTRACTION

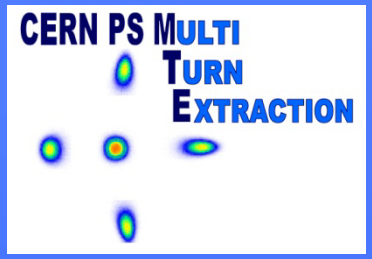
MTE beam commissioning: tools - I

- **List of required tools or improvements:**
  - Additional features to the FWS application: multi-gaussian fit and display of fit parameters. Multiple measurements with display of fit parameters evolution.
  - Tune application (assuming tune measurement works…): to ease tune control by means of low-energy quadrupoles during resonance.
  - Non-linear chromaticity measurement application (assuming tune measurement works…): already existing.
  - Trimming of new extraction bump 16: five bumpers + DHZ15 will be used to generate the new bump. ABS-like application is needed.
  - Trajectory correction in TT2: already existing.

CERN PS MULTI TURN EXTRACTION

MTE commissioning: general organization - I

Activity	ABP/OP contribution	Other contribution	Comments
MTE HW/control commissioning	OP (SL/Tech.)	Equipment specialists	OP is supposed to co-ordinate
MTE application SW	OP help needed		Specs. already provided
MTE cycle and beam setting-up	OP (SL/Tech.)		Specs. available
MTE beam commissioning	SG, AF, MG, OP		
Non-linear chromaticity measurement and PS model at 14 GeV/c	AF, SG		Crucial for MTE
TT2-TT10 matching	EB, AF		
CNGS beam on h=8/h=16 and extraction synchronization to bunch gap	EM	PS/SPS RF experts	Loss minimization on septum 16



Conclusions

- Once more, 2008 will be a very busy year!
- We will see in practice the results of the studies started in 2001.
- Your help is crucial for the successful completion of this enterprise!