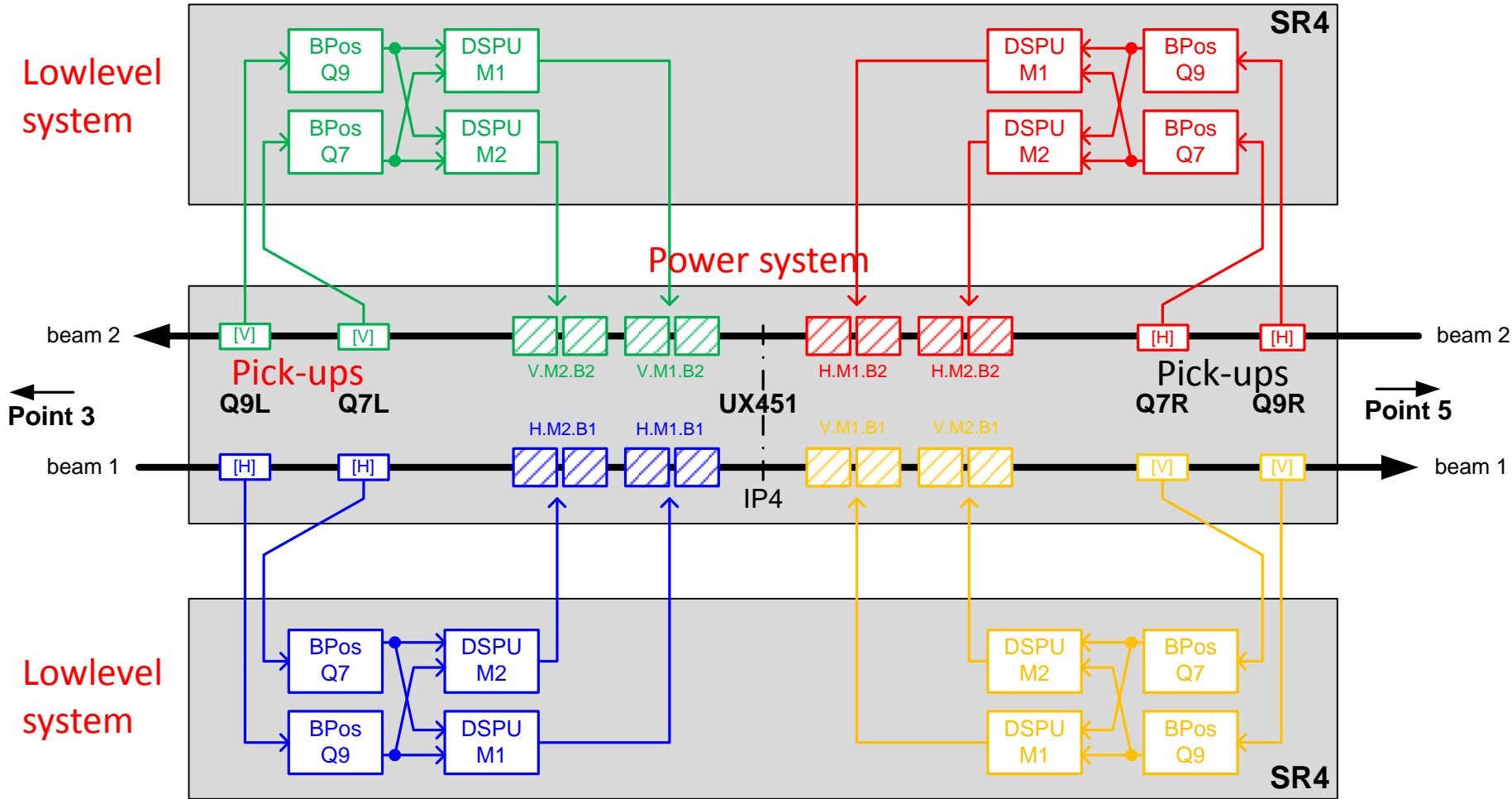


ADT Transverse Feedback & Gap Cleaning Readiness for MJ Beams June 2015

Wolfgang Hofle, CERN BE-RF for ADT Team

Overview of ADT System



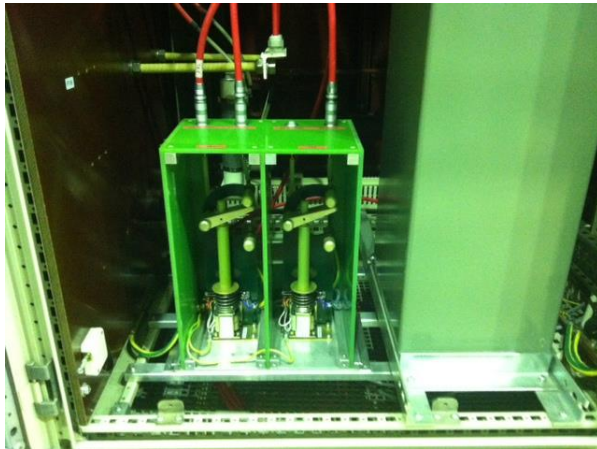
Bpos – Beam Position Module
 DSPU – Digital Signal Processing Unit

Status of changes with respect to Run 1

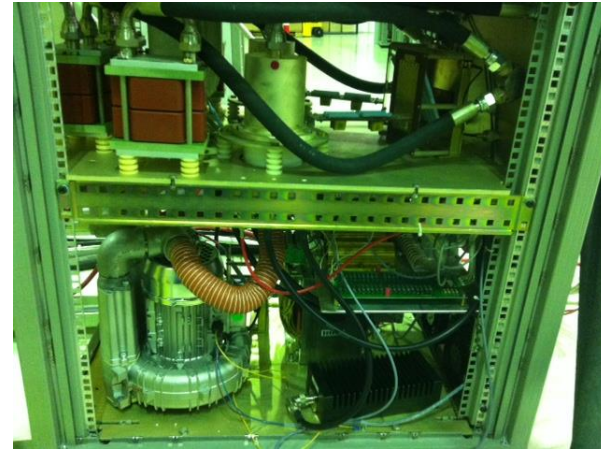
○ Power system (increased reliability and availability)

- Maintenance of tetrode power amplifiers (16 + 4 spares)
- Maintenance of 32 driver amplifiers (200 W)
- Improvement of amplifier to kicker connection and new loads
- Vacuum interlocks (to minimize risk of false interlocks)
- Exchange of flow meters for water cooling interlocks
- Installation of HV switches in power converters to take one amplifier off if needed, and HV maintenance (done)

All operational and ready for MJ beams



HV switch



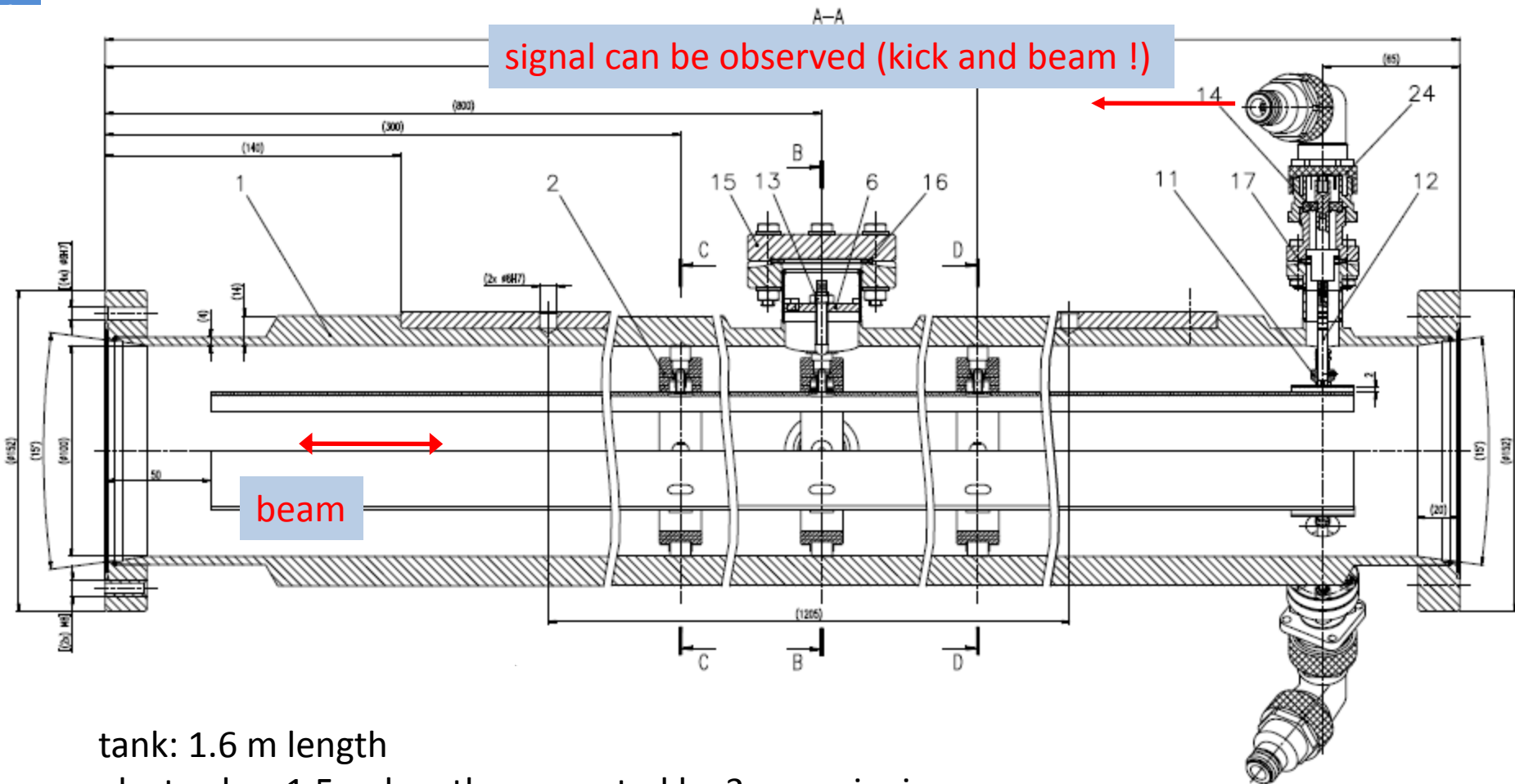
Tetrode amplifier

Team E. Montesinos

Migrate controls of power system to FESA3 (to be done)

ADT kicker (16 x)

HOM port 1
(H front)
(V top)



tank: 1.6 m length

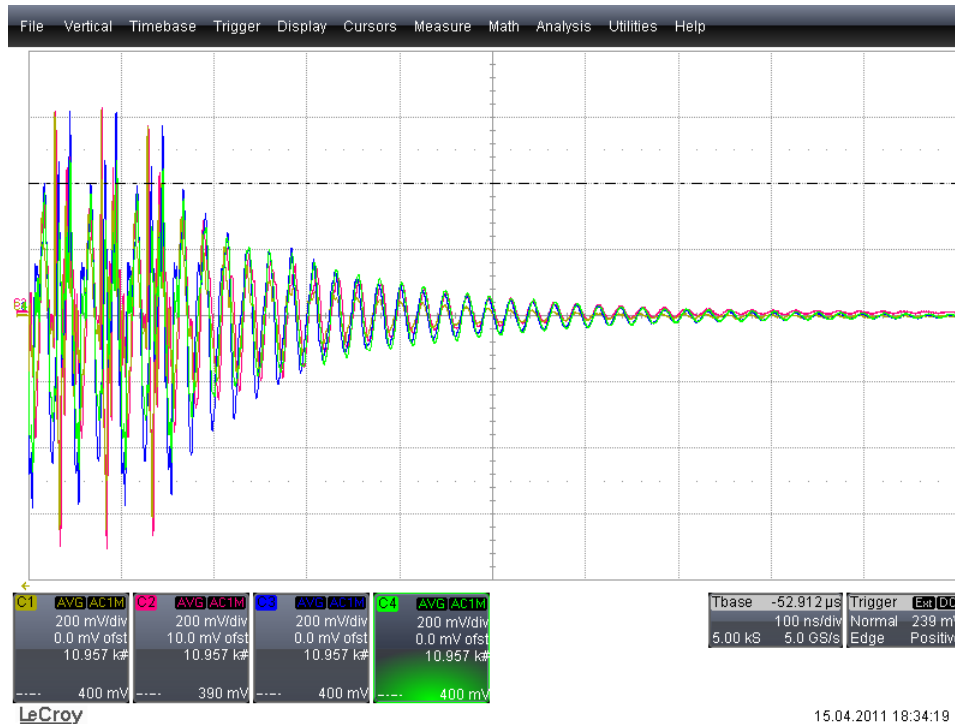
electrodes: 1.5 m length, supported by 3 ceramic rings

centering is achieved by accurately machines tank and ceramic rings

longitudinal expansion of electrodes possible by design

HOM port 2
(H back)
(V bottom)

Beam induced signal on kicker



Resonance: close to 40 MHz
Q = 600, tau = 210 ns
~ 200 V induced by nominal beam

Watch this for
Intensity increase
with 25 ns

100 ns / div [10 div]
end of batch of 36 bunches @50 ns
15.04.2011; ok for next intensity step

Status of changes with respect to Run 1

- **Lowlevel System (increased performance, flexibility)**
 - X-change of cables (8 pick-ups plus 8 new pick-ups) → done, but electronics for new pick-ups deferred to YETS 2015/2016
 - New cables for 8 drive signals from surface (SR4) to UX45 (better pulse for AGC) → done
 - New VME electronics for beam position detection → deferred to YETS 2015/2016 following experience in SPS with new mixers, production of hardware ongoing
 - **New VME mDSPU (signal processing) with independent gain control functions for cleaning and damping (4 independent DACs, analog outputs combined)** → done
 - Number of FGC functions increased → done
 - Diagnostics: Instability trigger network → deployed, working on “last mile” to ADT
 - Observation BOX → under development, first roll-out for long. plane
 - New developments are in FESA 3 (e.g. abort gap and injection gap cleaning)

Pickups available for ADT after LS1

effectively no change in 2015 with respect to Run 1

B1 horizontal	Q10L	Q9L	Q7L	Q7R	Q9R	Q10R
	$\beta = 28 \text{ m}$	$\beta = 127 \text{ m}$	$\beta = 112 \text{ m}$	$\beta = 78 \text{ m}$	$\beta = 16 \text{ m}$	$\beta = 158 \text{ m}$
		existing	existing	new		new

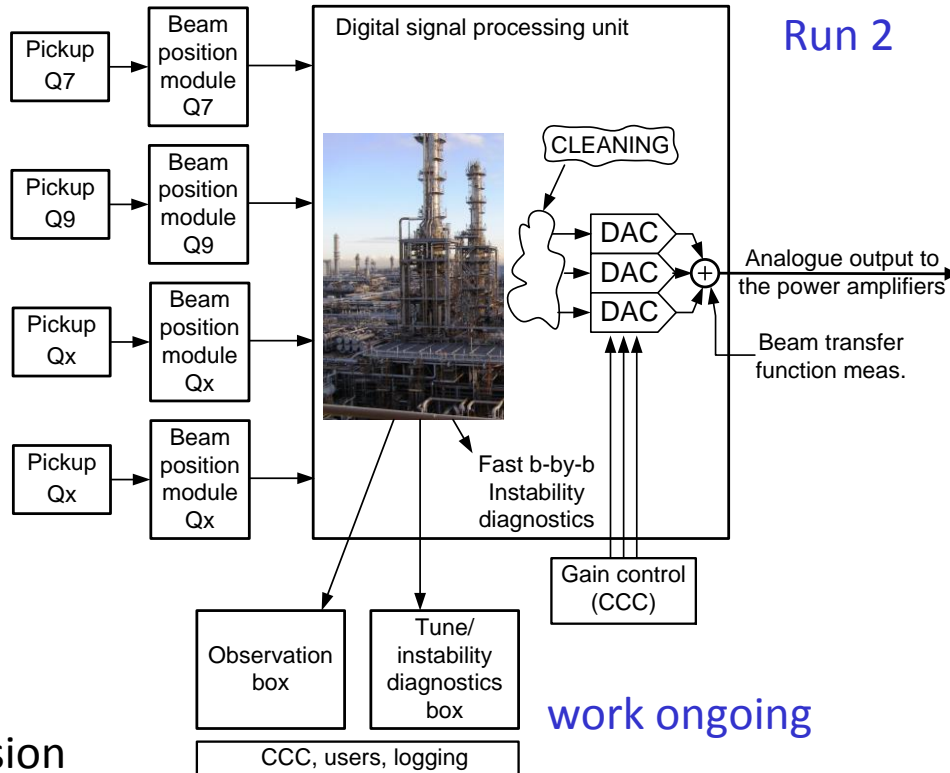
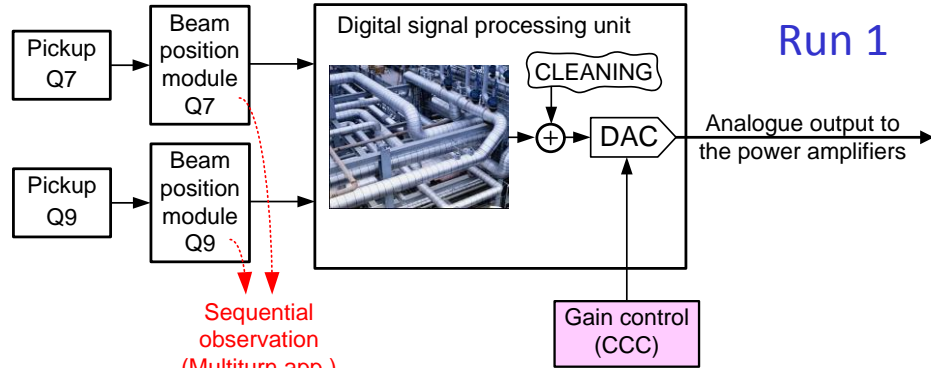
B1 vertical	Q10L	Q9L	Q7L	Q7R	Q9R	Q10R
	$\beta = 172 \text{ m}$	$\beta = 25 \text{ m}$	$\beta = 52 \text{ m}$	$\beta = 127 \text{ m}$	$\beta = 138 \text{ m}$	$\beta = 38 \text{ m}$
	new		new	existing	existing	

B2 horizontal	Q10L	Q9L	Q7L	Q7R	Q9R	Q10R
	$\beta = 164 \text{ m}$	$\beta = 17 \text{ m}$	$\beta = 60 \text{ m}$	$\beta = 173 \text{ m}$	$\beta = 106 \text{ m}$	$\beta = 30 \text{ m}$
	new		new	existing	existing	

B2 vertical	Q10L	Q9L	Q7L	Q7R	Q9R	Q10R
	$\beta = 36 \text{ m}$	$\beta = 140 \text{ m}$	$\beta = 169 \text{ m}$	$\beta = 23 \text{ m}$	$\beta = 34 \text{ m}$	$\beta = 181 \text{ m}$
		existing	existing	new		new

New pick-ups to be made operational in YETS 2015/2016

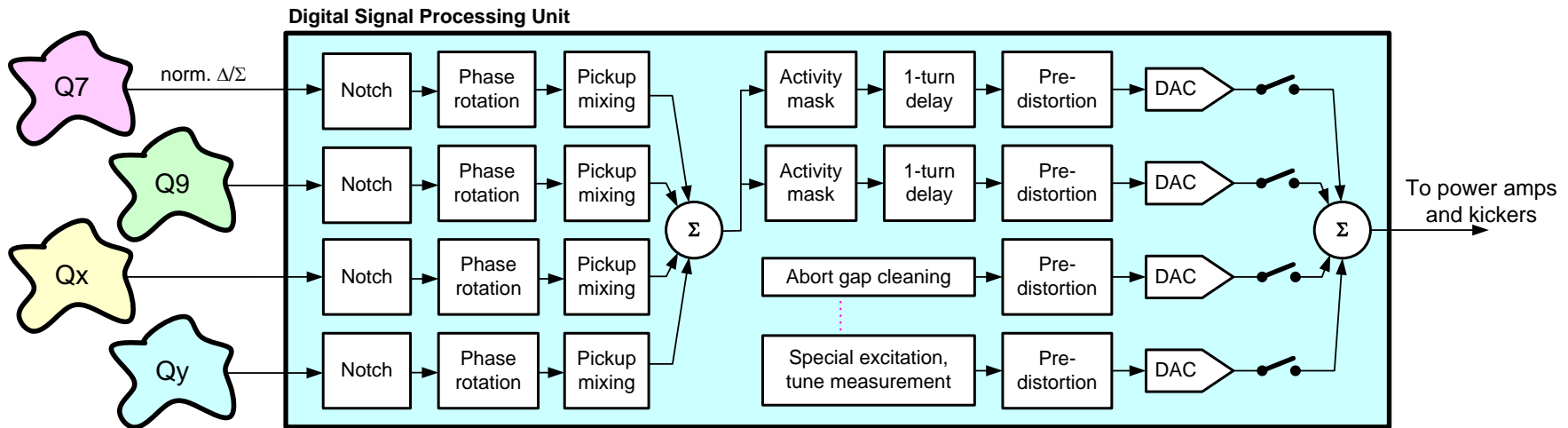
Reasons for change: "DSPU"



- need to combine **four pick-ups**
- Separate control for all features with high resolution calls for **independent output DACs**
- digital links to future **diagnostics HW**
- adequate number of **spares** missing

vision
@end of Run1

New VME mDSPU for ADT signal processing



Status:

- Installed and operational
- New LSA functions for control operational
- New firmware, FESA classes, including for cleaning and blow-up

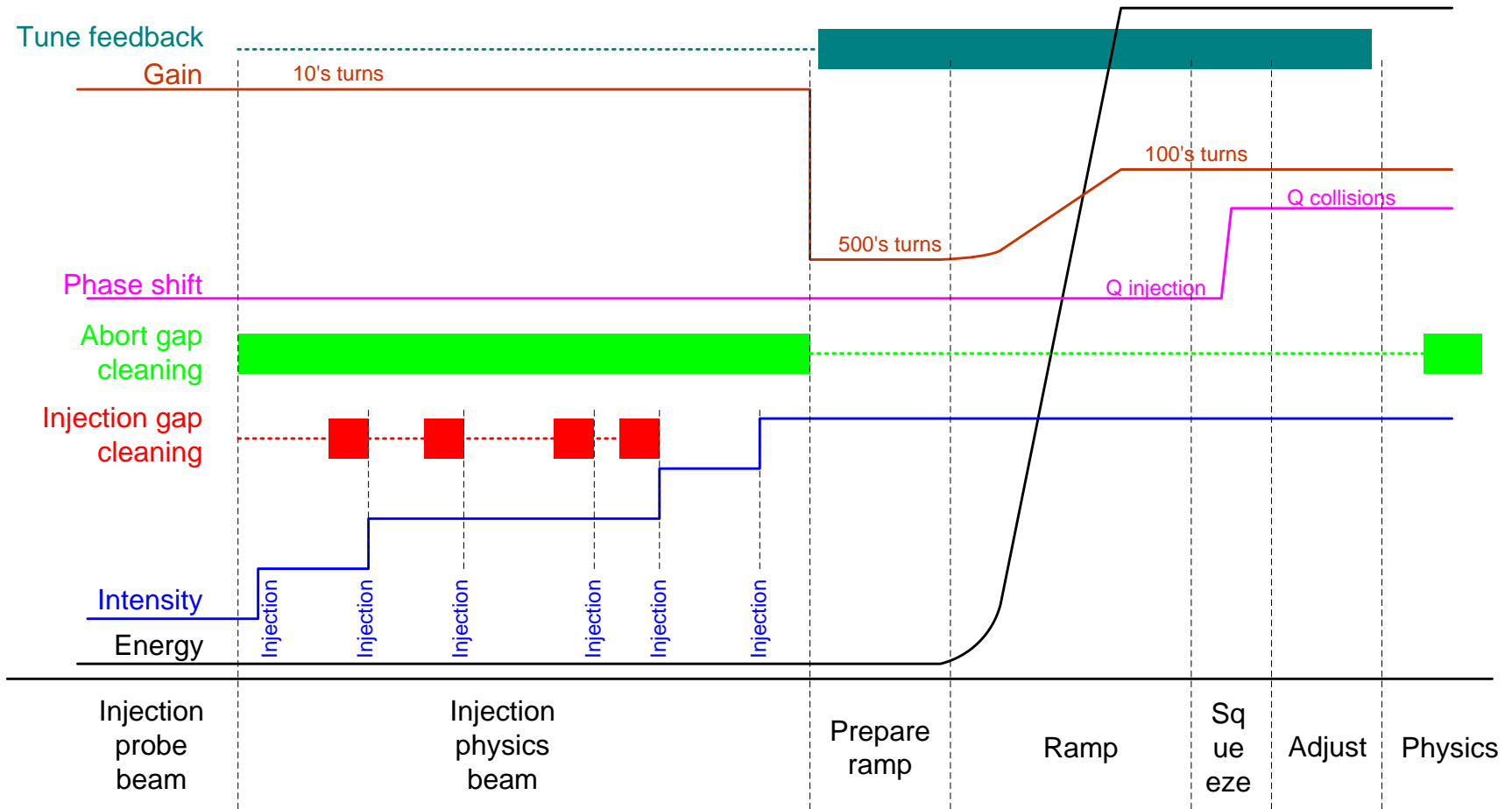
SPS as testbed:

- Board is also in use in SPS since 2014 run

G. Kotzian, T. Levens, D. Valuch

ADT during the cycle

Run 1 damping times:



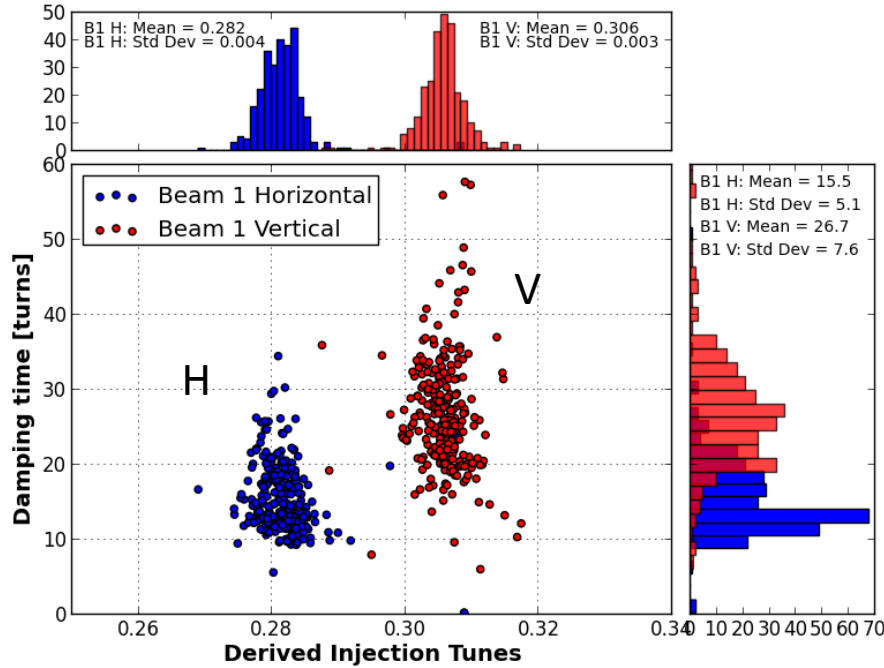
Run 2: We can increase FB gain at flat-top (witness bunches with low gain)

Commissioning status: Done

- Set-up for probe, nominal and 50 ns trains
- Transverse blow-up (loss maps etc.)
- Functions in ramp: values programmed
- Cohabitation with BBQ with low gain on witness bunches
- Link for chirp sent from BI
- Abort Gap cleaning: Basic set-up for 450 GeV
- Injection Oscillation display
- Logging (under verification, some issues)
- Damping gain measurement and optimization, calibrations
 - < 50 turns at 450 GeV, single bunch
 - < 100 turns at 6.5 TeV, single bunch ?

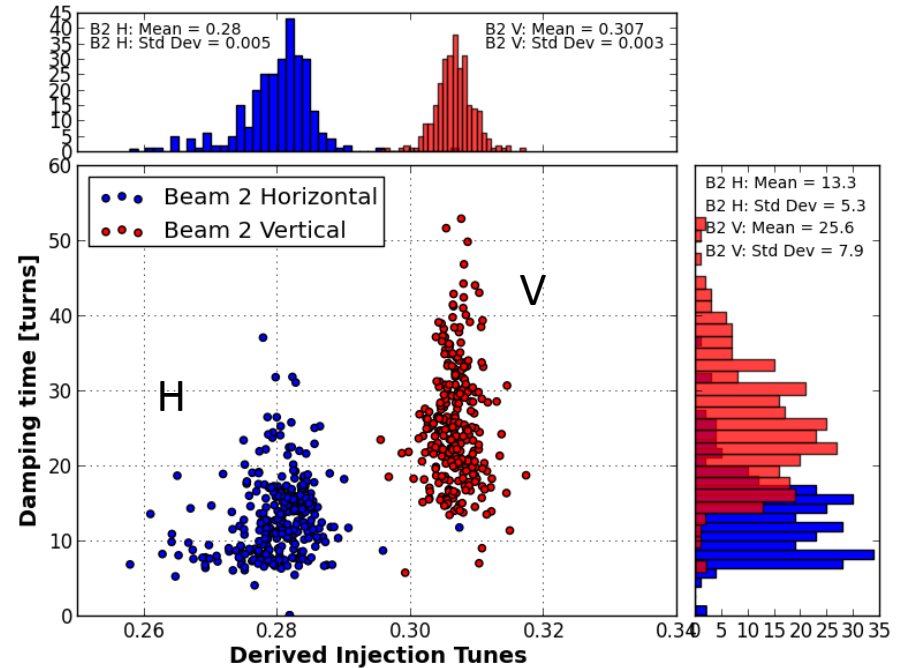
Run 1 performance with 50 ns trains (1st bunch of injected train)

Need to recover this



Beam 1
H: 16 turns
V: 27 turns

Beam 2
H: 13 turns
V: 26 turns



(first bunch of train)

A. Macpherson
CERN BE-OP & BE-RF

Commissioning status: To do

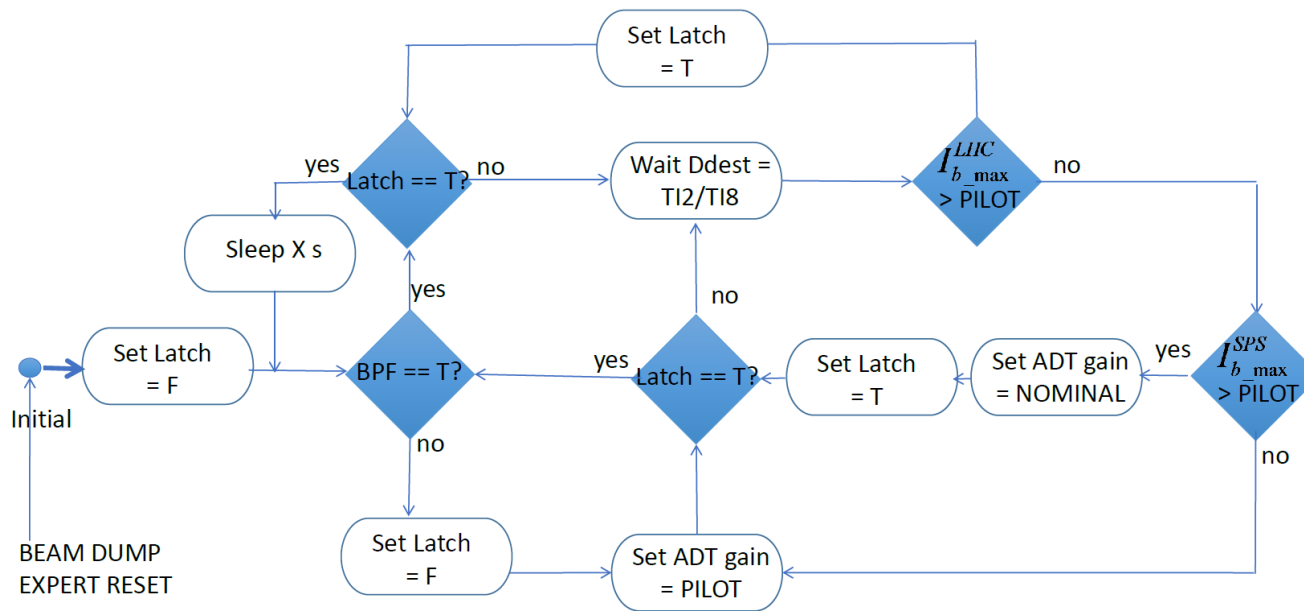
(musts for MJ in red)

- Injection gap cleaning (needed to inject long bunch trains)
- Abort gap cleaning at 6.5 TeV
 - Commission procedures linking abort gap cleaning to abort gap monitor (automatic switch-on was planned)
 - Pulse shape is bipolar, optimization of edges to limit effect outside gap
- 50 ns trains: frequency response and hold algorithm to push gain
- Bunch trains 25 ns → full set-up of fine delay
 - > 20 MHz BW commissioning, frequency response optimization
 - 25 ns trains can be injected with the 50 ns basic settings (bandwidth will be limited to 10 MHz)
- verify post mortem
 - concurrent use of post mortem buffer for observation during scrubbing run

Commissioning status: To do (including “exotics”)

- **Settings switching** between probe and nominal
 - joint development between OP and RF (Daniel, Reyes)
- **Flat frequency response** in squeeze and collide Beam Process
- **Scrubbing doublet** beam set-up and commissioning
 - first test with trains during first scrubbing run
- Deployment of “observation box” to collect ADT data for studies and potentially tune feedback
- Connect, configure and commission triggering via the instability trigger network
 - First application of instability trigger network in BI: connection of headtail monitor and BBQ

State Machine for Intensity Switching



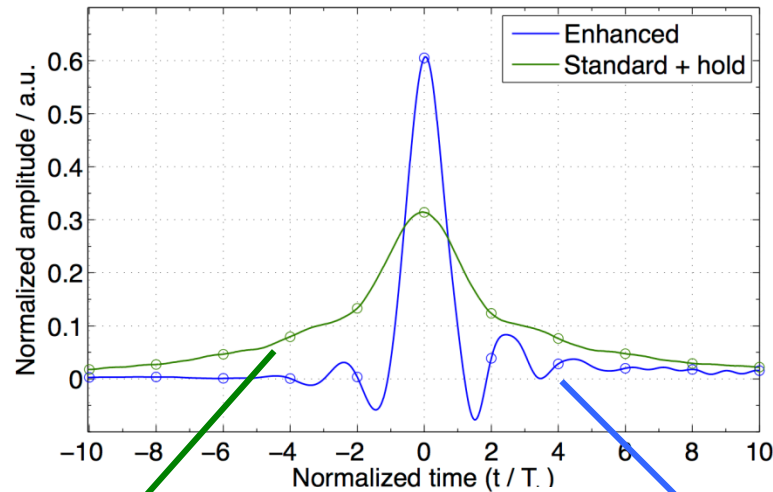
- will be extremely useful to have probes visible
- can be extended to automatic switching between settings for bunch spacing
- needs thorough check before roll-out

R. Alemany, D. Valuch

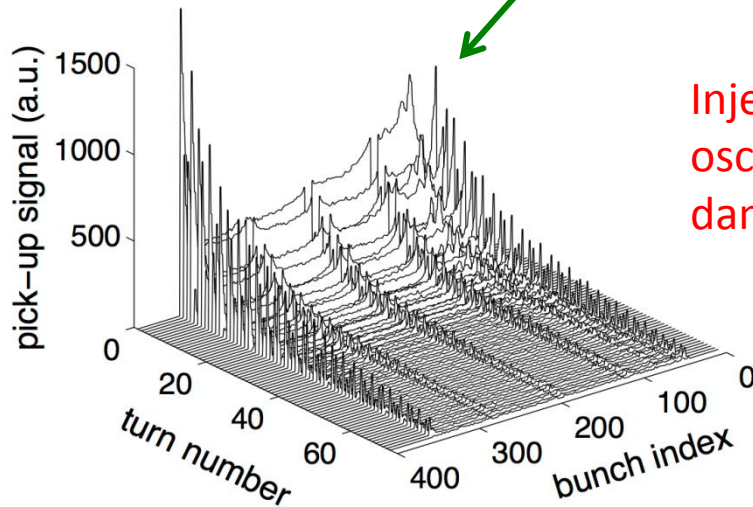
Towards 25 ns operation in 2015

For 2015:
response of ADT →
continue optimization
for 25 ns running

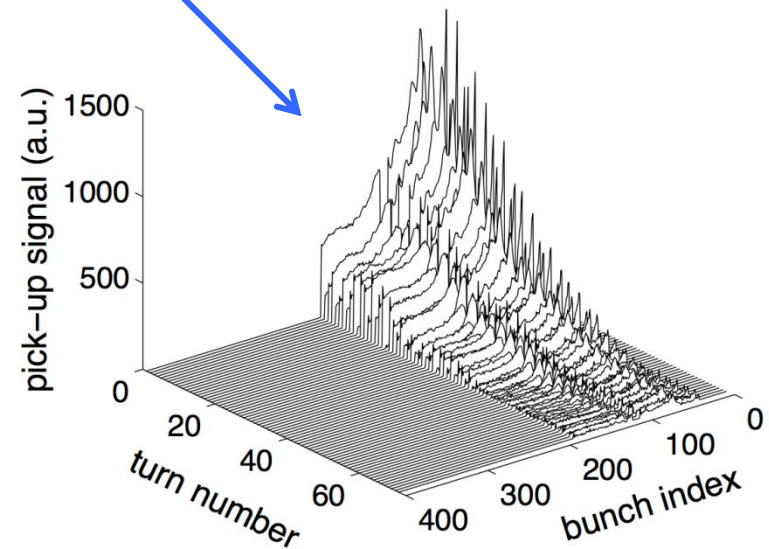
50 ns bunch spacing
standard + hold
144 bunches (4x36)



25 ns bunch spacing
enhanced bandwidth
144 bunches (2x72)



Injection
oscillation
damping

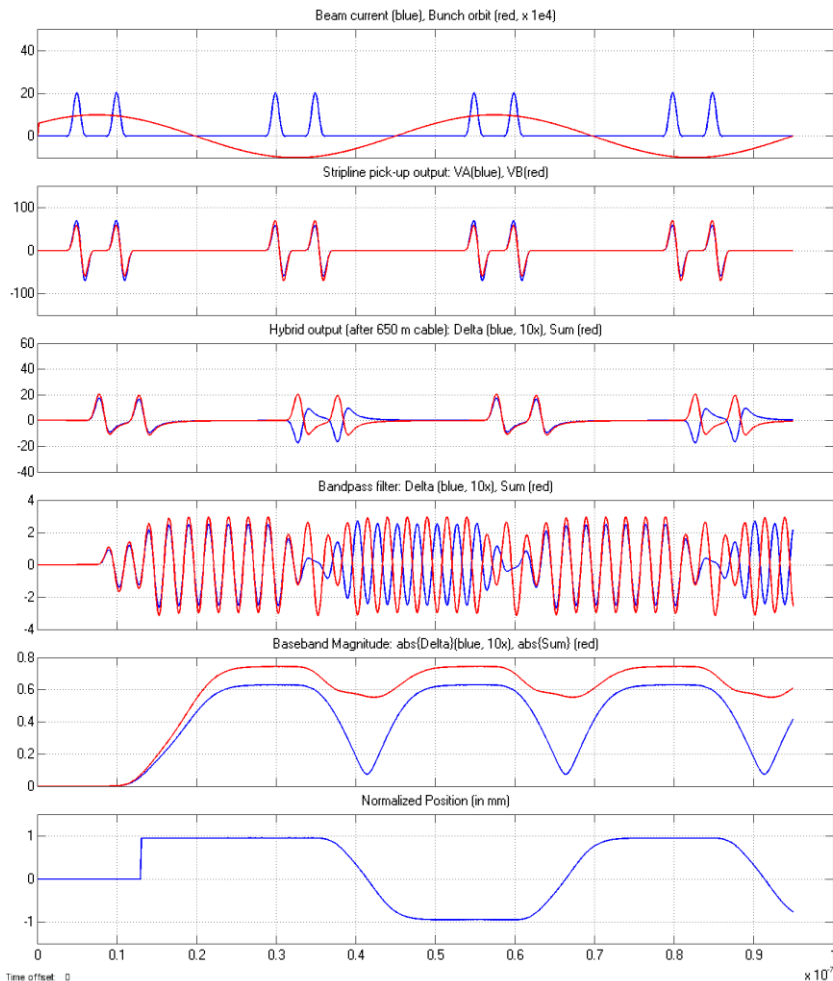


LHC ADT 2012 performance

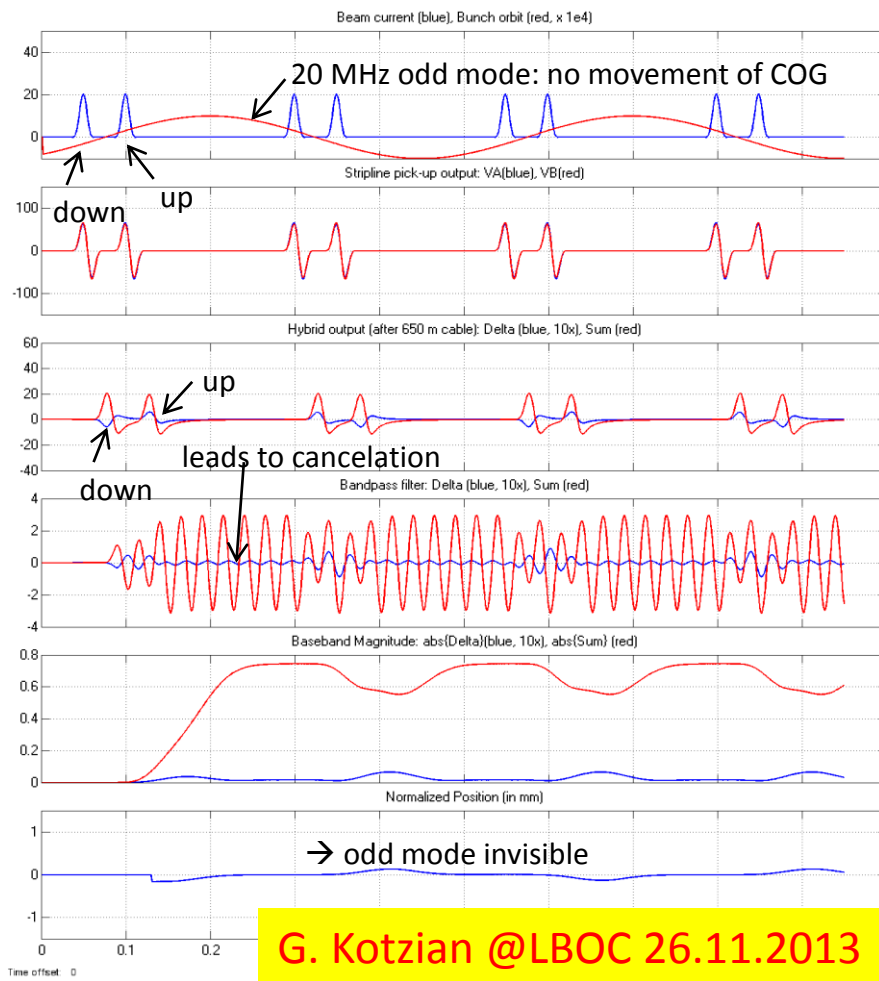
IPAC'13, WEPME43

LHC ADT BPOS: Readiness for scrubbing beam

centre of gravity oscillation (even parity)



within bunchlet oscillation (odd parity)



G. Kotzian @LBOC 26.11.2013

→ current and future LHC ADT HW ready for 5 ns bunchlets
 requires separate set-up (fine delays for clocks)

Conclusions

- ADT hardware and software - for power and lowlevel - are ready for MJ beams
- Commissioning is well advanced
- Abort gap and injection gap cleaning a must for MJ beams, need commissioning time, commissioning of abort gap cleaning started with 450 GeV, to do 6.5 TeV
- Bunch trains at 25 ns and 50 ns as well as doublet beams need set-up time
- Recovering Run 1 performance and reacting to requirements from tune feedback and to fight instabilities is an iterative optimization process