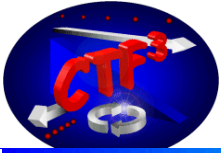


Beam Instrumentation seen from Operations



Frank Tecker - AB/OP
for the CTF3 Team

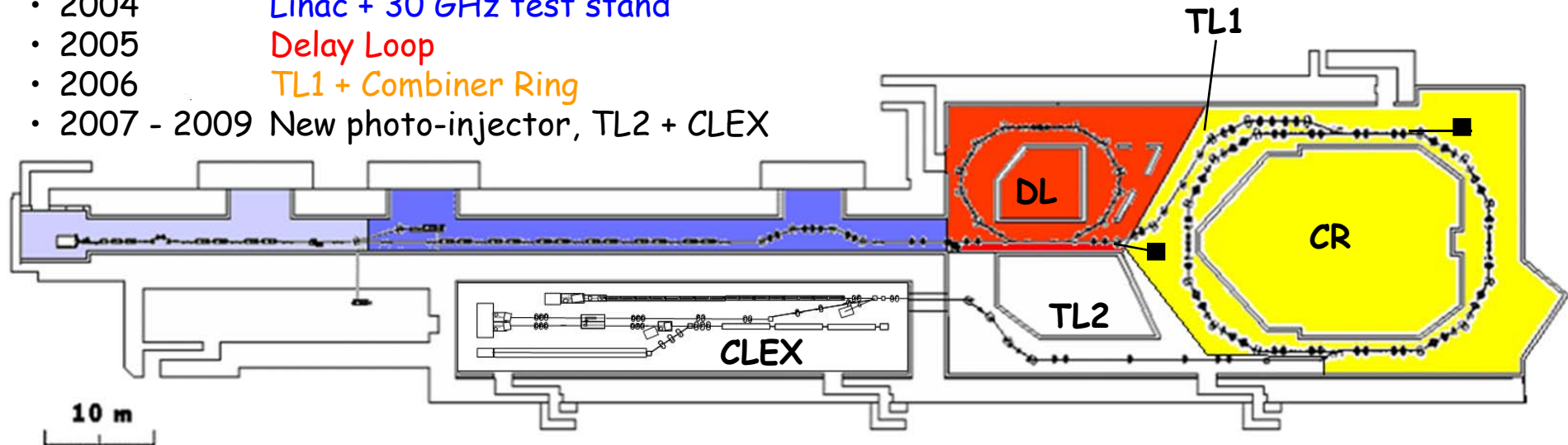
- Review of various instruments
 - BPMs, MTVs, Spectrometers, Longitudinal Measurements, Streak Camera
 - In view of hardware/software/improvements
- Conclusion



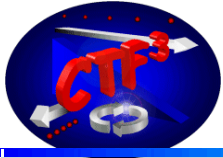
Preface



- 2003 Injector + part of linac
- 2004 Linac + 30 GHz test stand
- 2005 Delay Loop
- 2006 TL1 + Combiner Ring
- 2007 - 2009 New photo-injector, TL2 + CLEX



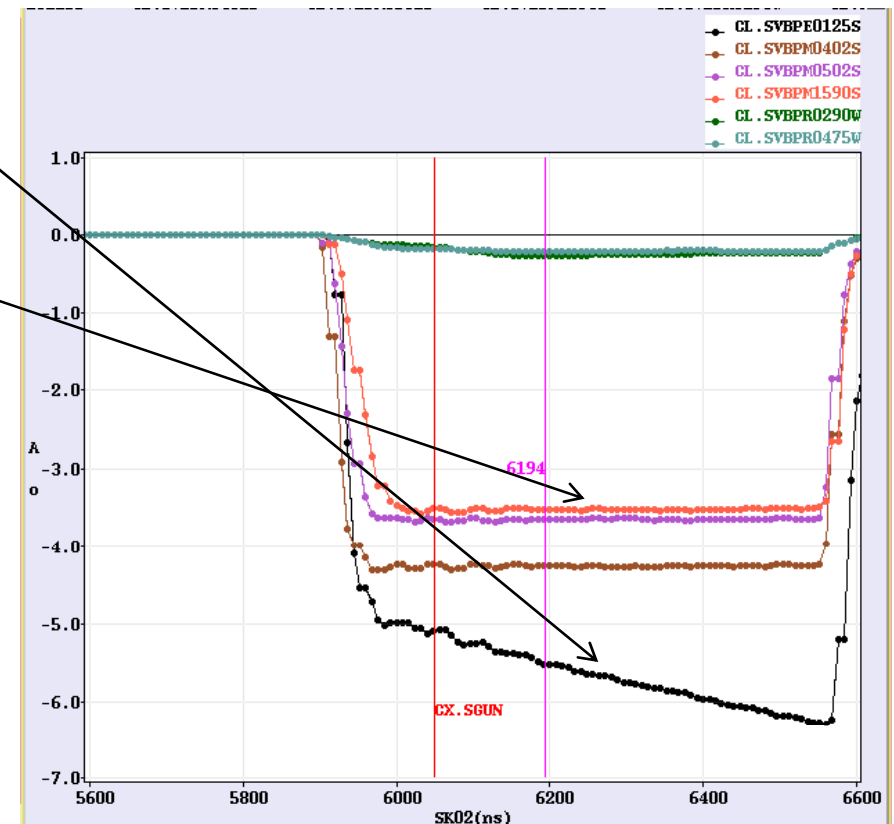
- CTF3 in **steady evolution** since 2003
 - Machine extending every year
 - Work concentrated on commissioning of new components
 - Increased complexity
- **Full recombination** (DL + CR) to be demonstrated
 - Operation becomes more demanding
 - We need good stability of the machine
 - We need **reliable instrumentation** to characterize the beam properties

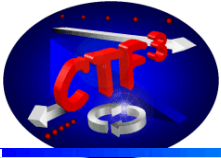


BPMs and WCMs



- We have different types of current / Beam Position Monitors (different chamber geometry) with different electronics
- **BPE**: electrostatic, in solenoids charge up during pulse, bias test not successful
- **BPM**: circular, **working very well** since the beginning
- **BPR**: RF BPM with waveguide output, used for injector setting-up
- **WCM** (Wall Current Monitor): basically unused, some didn't work foreseen beam loss system

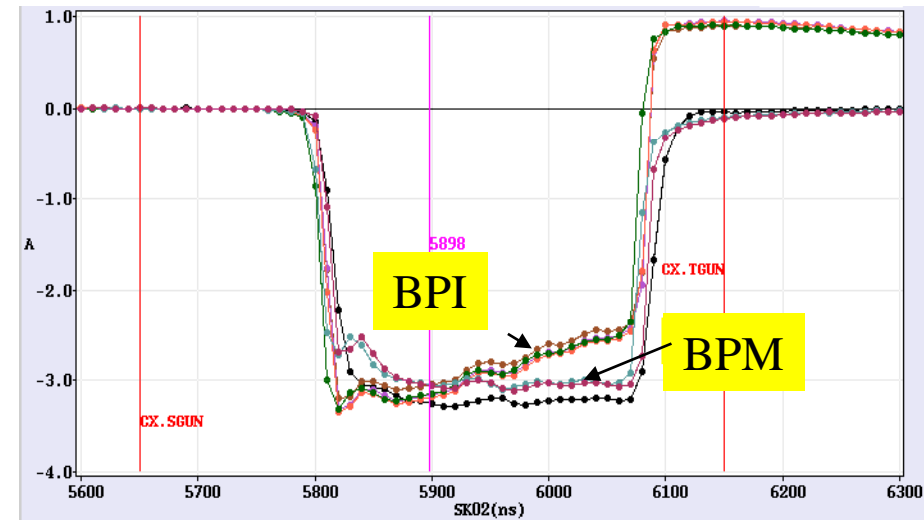
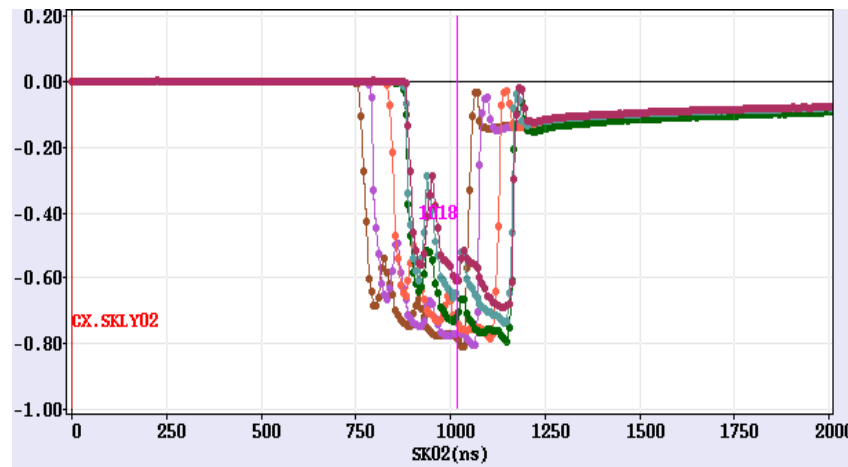




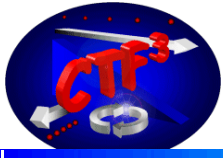
BPIs



- **BPI**: racetrack, similar to BPM, different electronics
- First version had a **signal droop** due to different low frequency cut-off
- CR BPMs overcompensated for droop during 1st run 2007



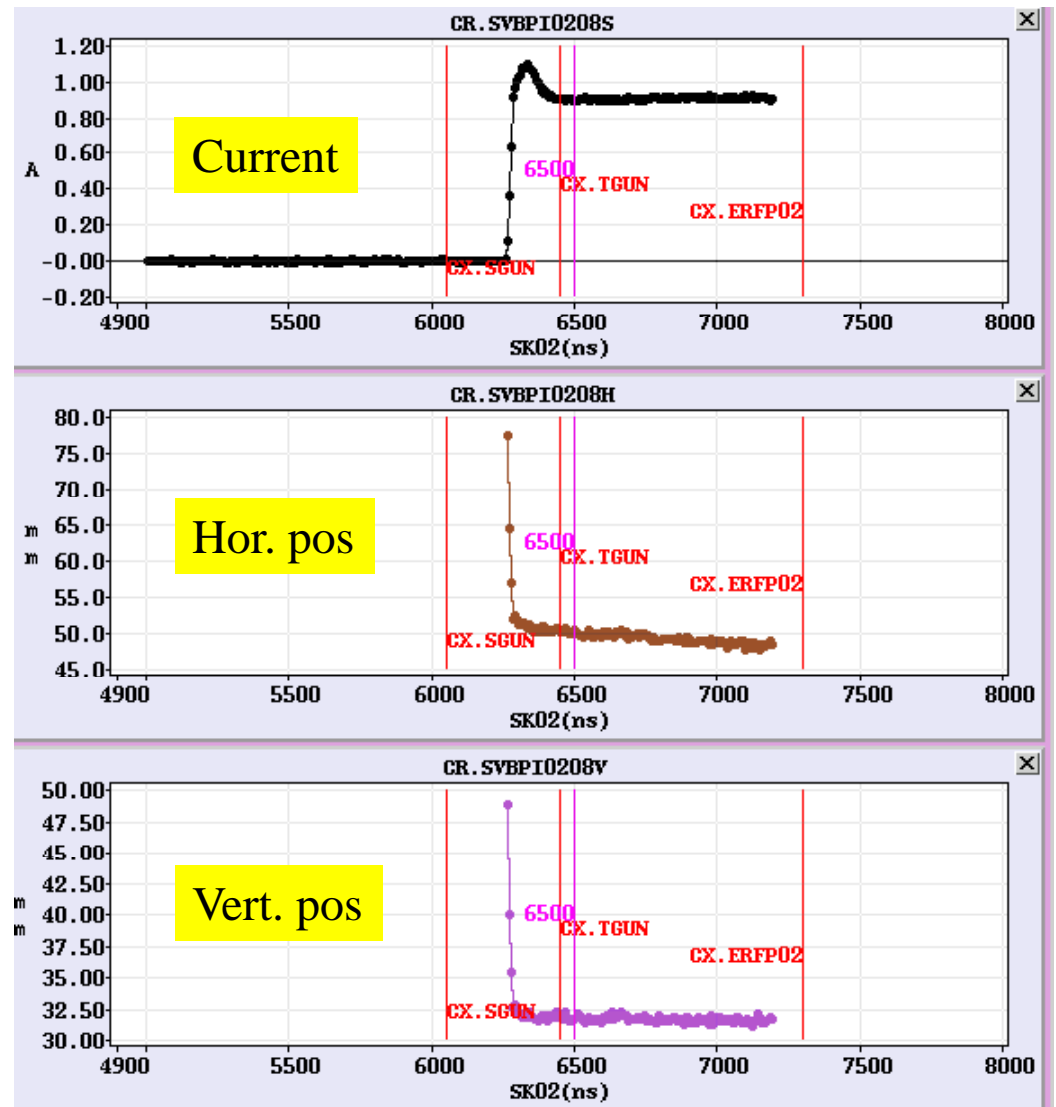
- Finally, also working very well (see next slide)

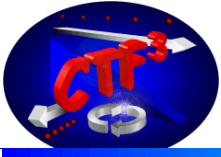


BPI signal droop corrected



- Adjustment of electronics solved droop for current signal
- Still small droop for position signals left

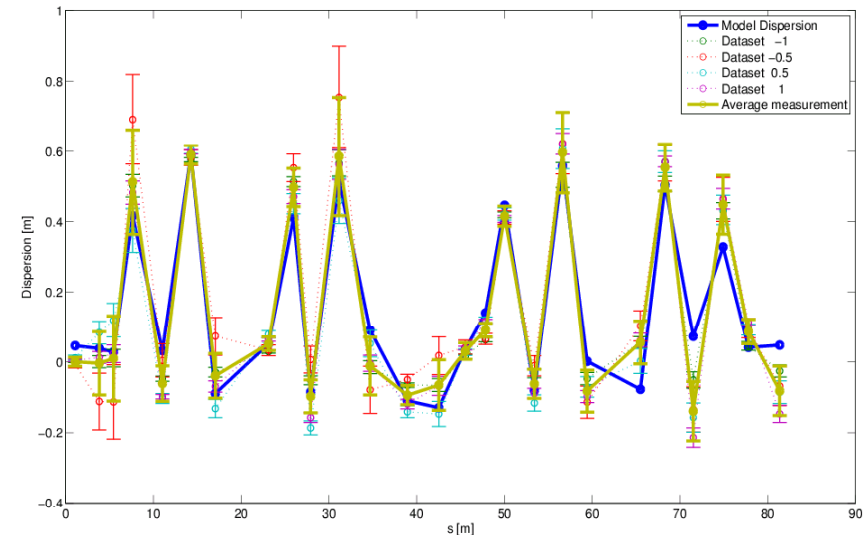


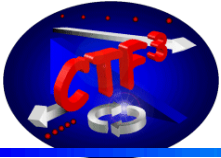


BPM calibration

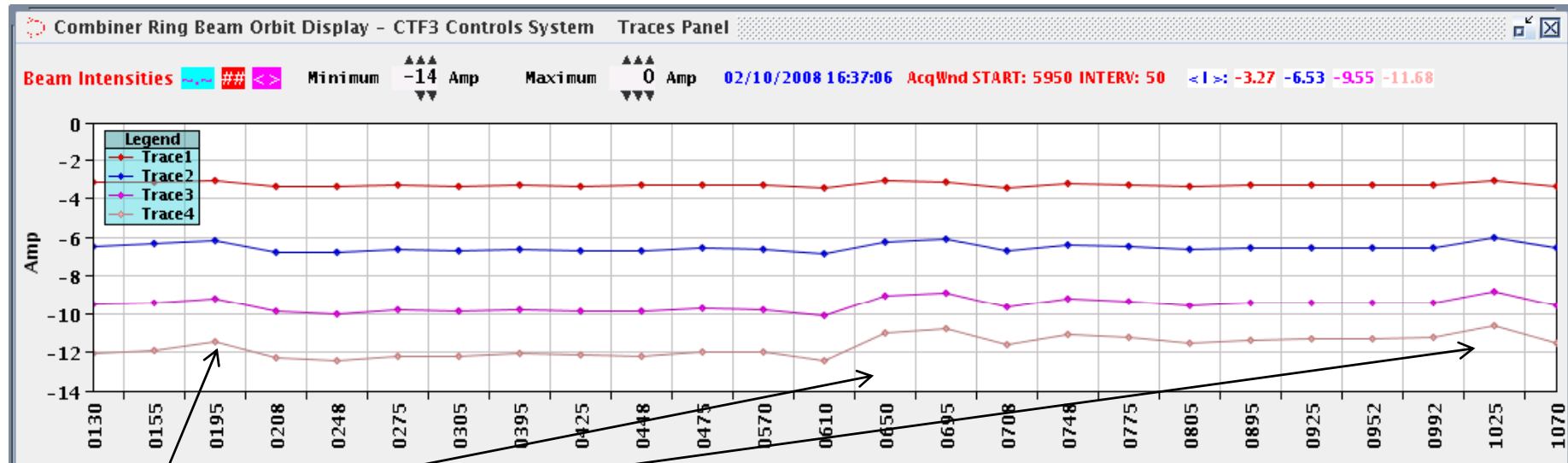


- In the past, we had some problems/confusion with the different type of BPIs concerning calibration
 - Different calibration windings
 - Different gain
 - Different signal treatment
- **BPMs and BPIs used for many important optics studies**
 - Dispersion
 - Corrector kick measurements
- Doubts about position calibration
 - BPMs in CR showed smaller position variation than BPI
 - All **BPMs** gave a **factor 2 too small position** reading
=> understood (calibration signal split into two) and corrected
- **Position calibrations seem understood now**



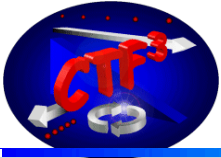


BPM calibration (intensity)



- **BPMs in CR show a slightly smaller current** compared to BPIs
- same in TL2
- => should do careful recalibration this run

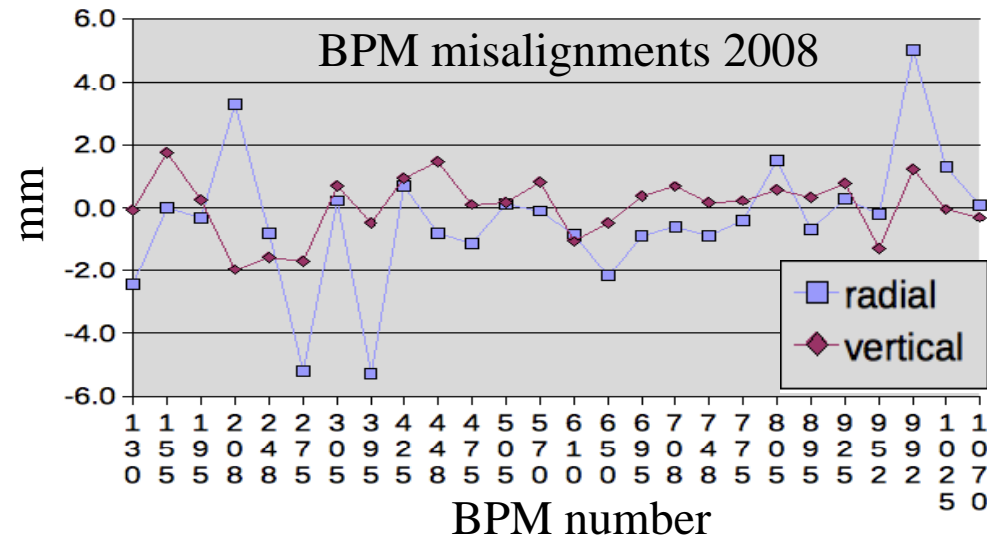
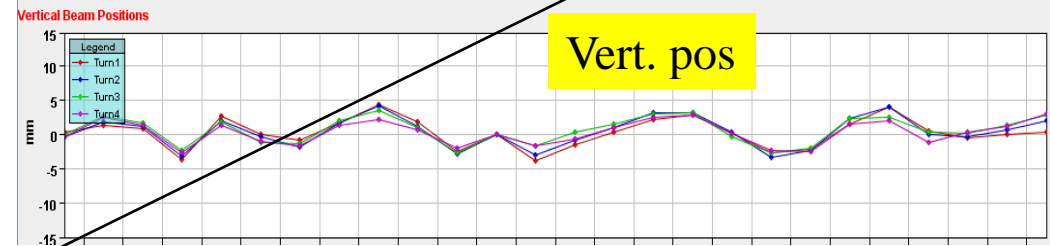
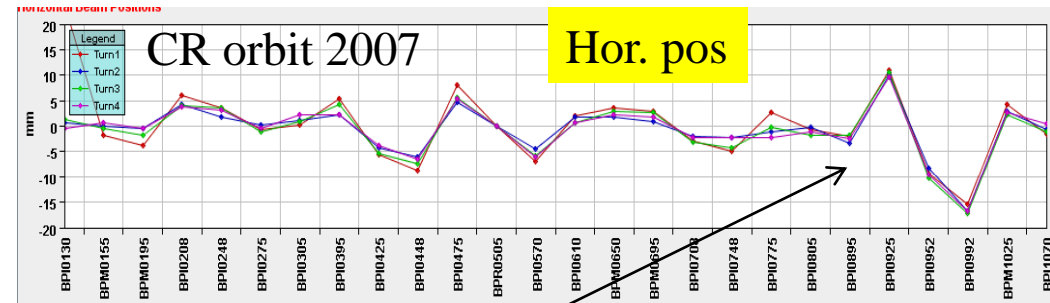
- We can't change calibration when we change gain/attenuation for linac to CR

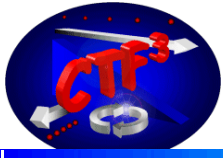


BPM alignment



- DL and CR vacuum chamber has sparse bellows
- Difficult to align
- Initially BPM offsets up to 15mm measured
- Taken into account in software but still questionable
- were realigned during 07/08 shut-down
- Offsets up to +/- 5mm

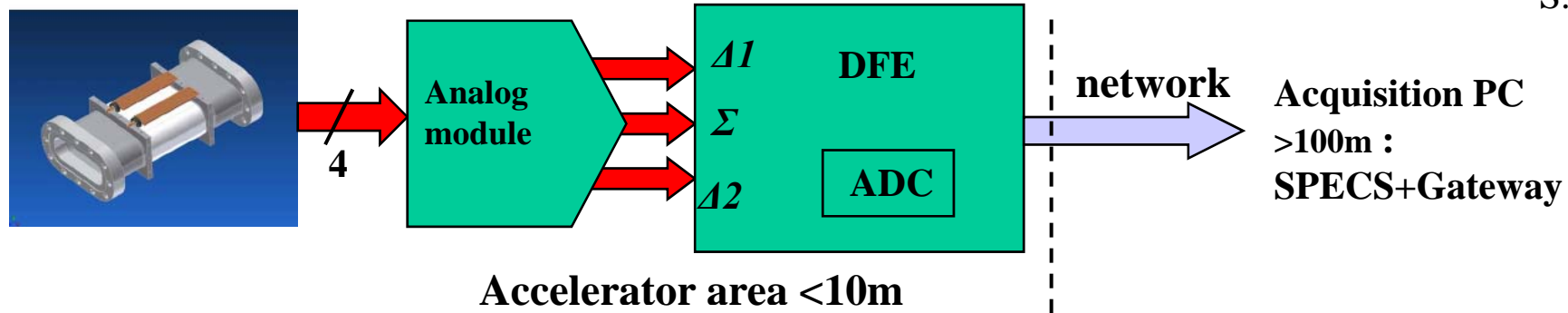




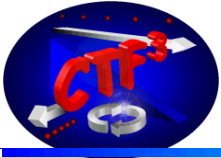
TL2 line/CLEX BPMs



S.Vilalte



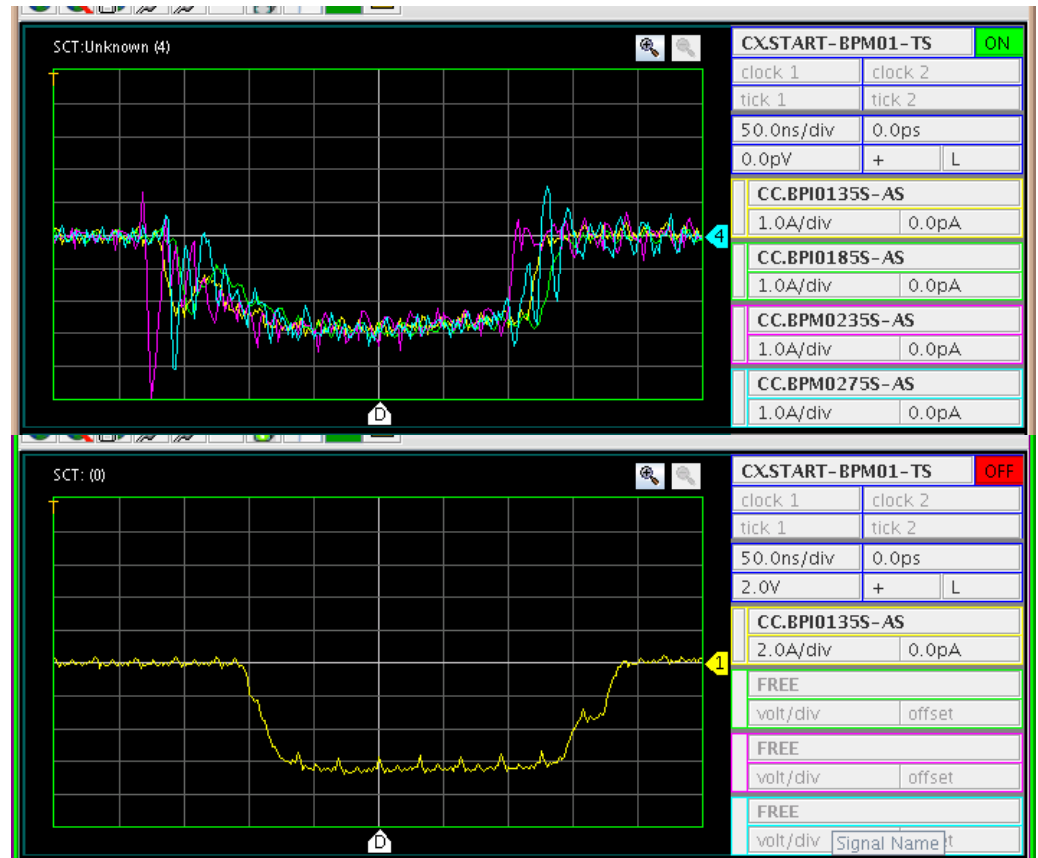
- **New BPM electronics**, read-out and software developed by LAPP for reduction of cost
- **Radiation hard** analog + digital front end board electronics close to the beam
- 3 channel, 500 MS/s
- Acquisition PC with data treatment for Control system
- Details in the following presentation by LAPP
- No analog signals, signals in OASIS Viewer

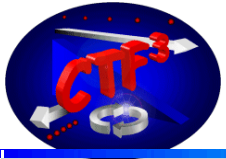


TL2 BPM hardware issues



- Due to the internal clock, there is a **30ns time jitter**
 - Suppressed in software by edge detection
 - Problem when no clear signal
- The signal shows **spikes** from the analog memory
 - Subtraction in software
 - Issues: constant in time + amplitude?
- with **beam loss**: signal shows large **ringing** => position measurement uncertain
- All **BPMs** in TL2 had **horizontal and vertical signals swapped**

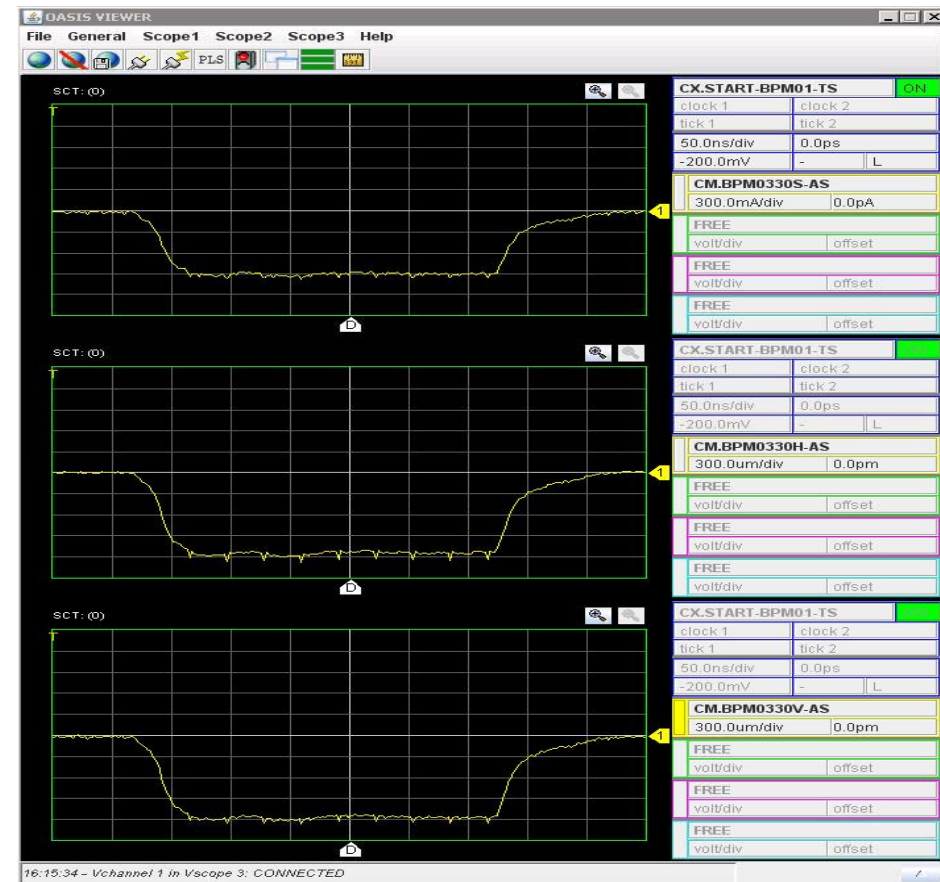


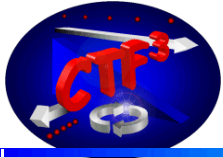


New BPM system and OASIS



- Many **problems** with **OASIS** (standard CO application, like scope)
 - Could not connect the signals
 - Could connect read-only
 - Random mix up of signals
Transverse instead of sum, etc.
 - Signals not updated
- Situation **improved** over run
 - Bug fixes
 - Priority of control room increased
- Front end task problems

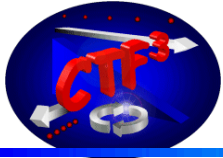




BPM front end issues



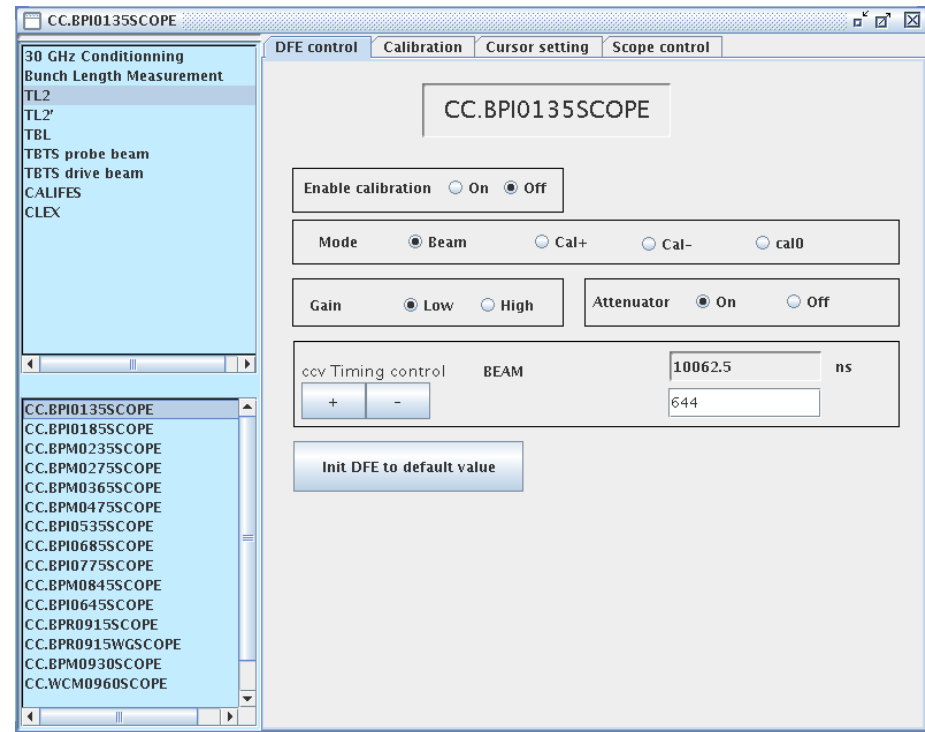
- Front end FESA task runs on two computers
- Crashed frequently and needed to be restarted
- Delay, gain and attenuation settings lost each time calculation needed to be enabled again
- Problem still present at the end of the run
=> will be improved during shutdown
- Further wishlist:
 - Vertical scale offset adjustment
 - 'spike' subtraction
 - manual, ...
- Some front-end boards stopped working => fixed
- CC.BPM0930 not working



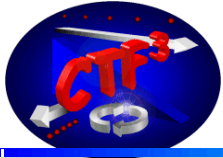
LAPP BPM System



- ‘Specialist’ software for
 - calibration
 - gain + attenuation settings
 - acquisition mode selection
 - timing offset
 - enabling measurement
 - ...
- this application became very frequently used in operation



- New BPM system needed **large effort to commission**
- made TL2 commissioning challenging, but improved significantly



Orbit software



- Developed by Indian Colleagues within the CTF3 Collaboration

- many thanks!

- exists for

 - Linac to TL1

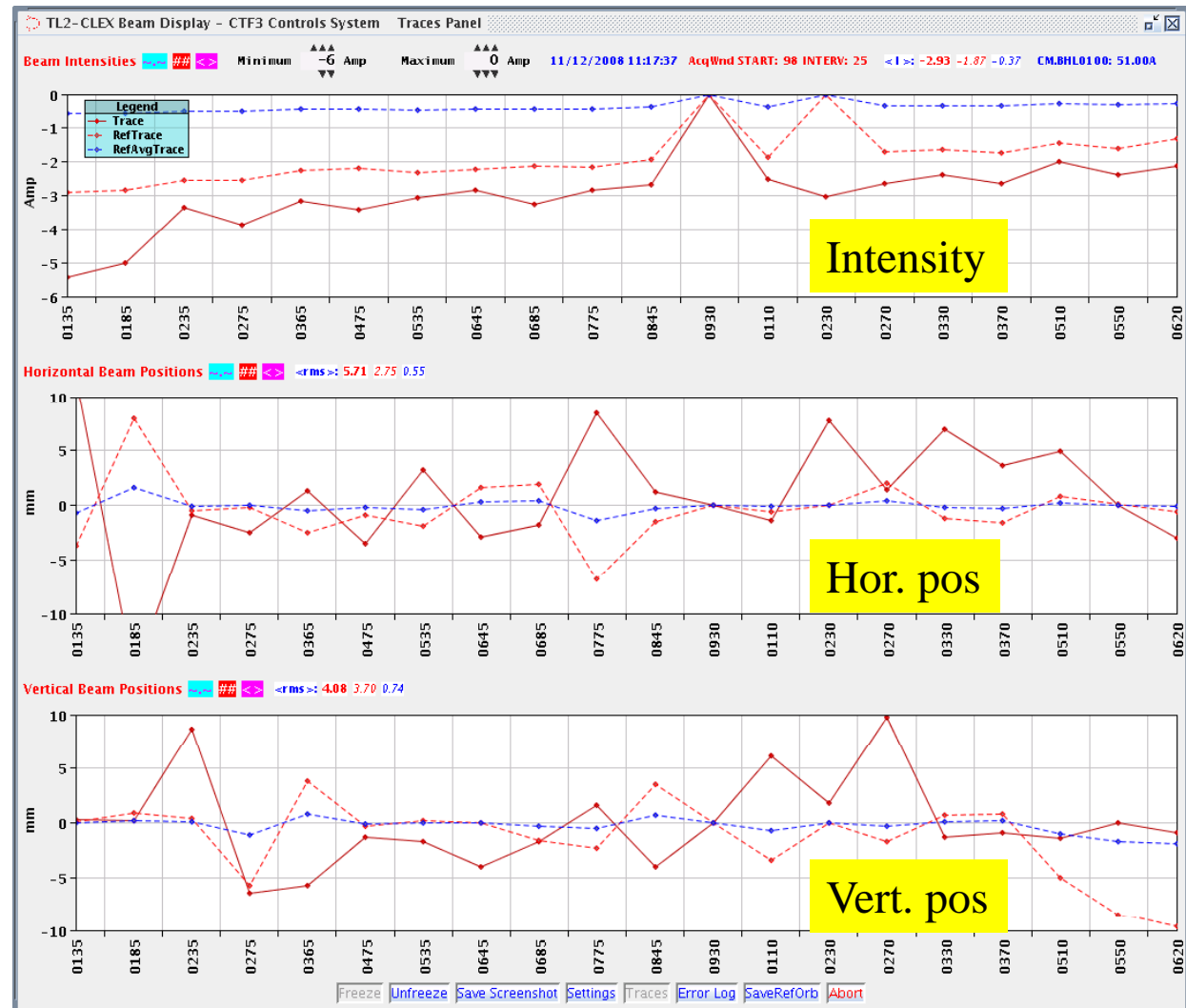
 - DL

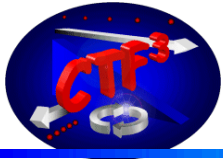
 - CR

 - TL2/CLEX

- working well

- we have **limited maintenance**



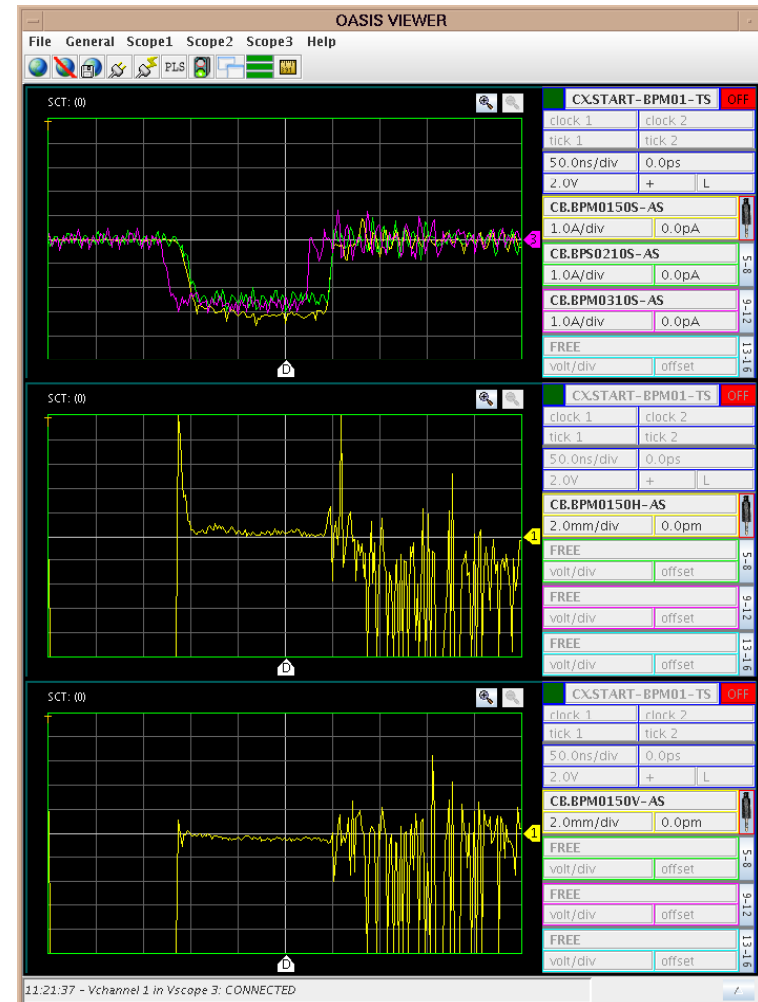


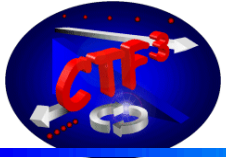
Other Beam Position Monitors



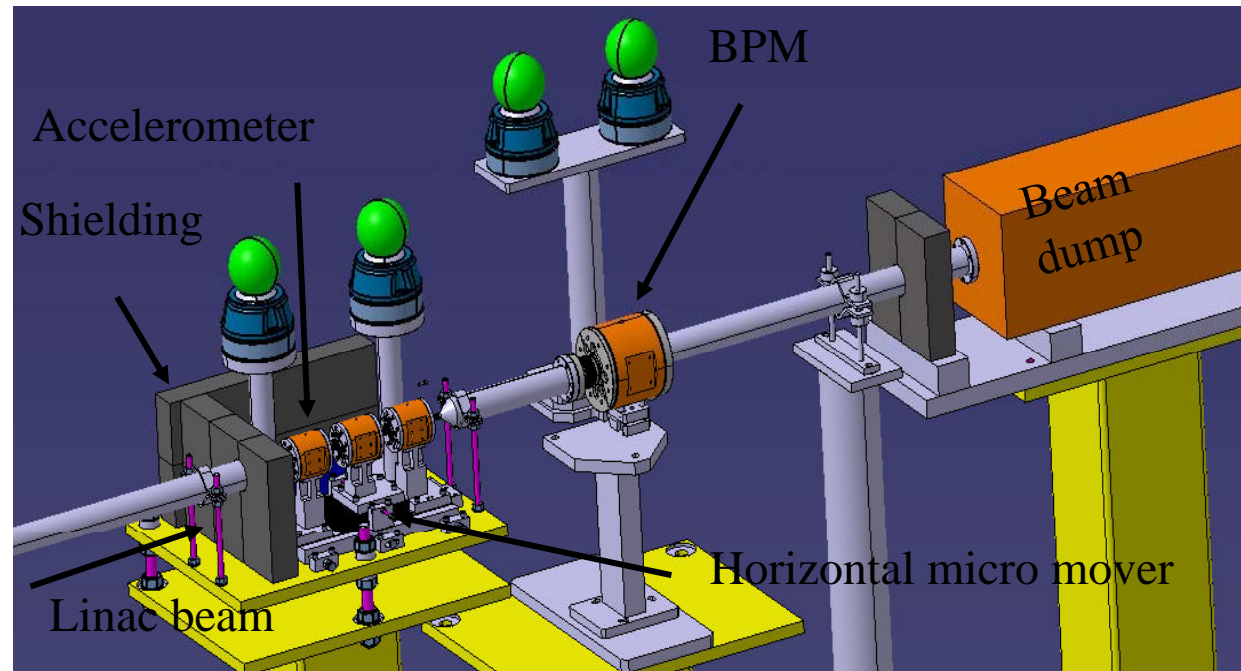
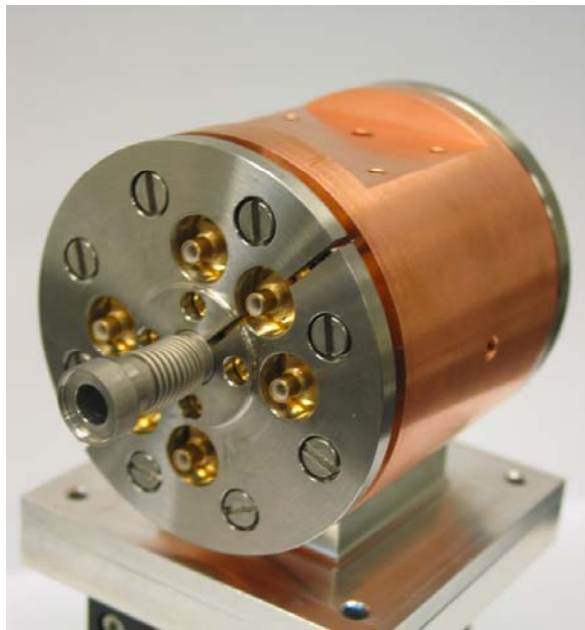
- BPS
- Prototype installed in TBL
- Integrated in LAPP system
- First beam test done
- See following talk

- CALIFES Cavity BPMs
- Multiplexed read out system
- See later talk
- To be integrated in operation

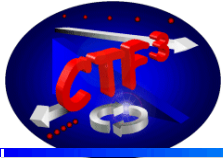




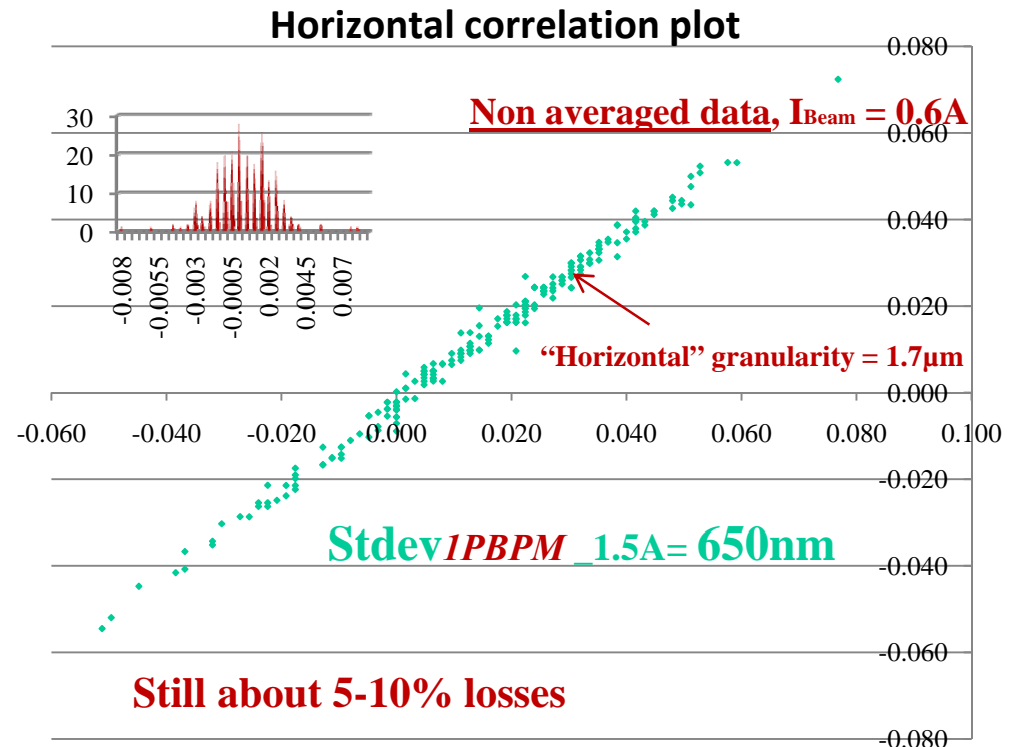
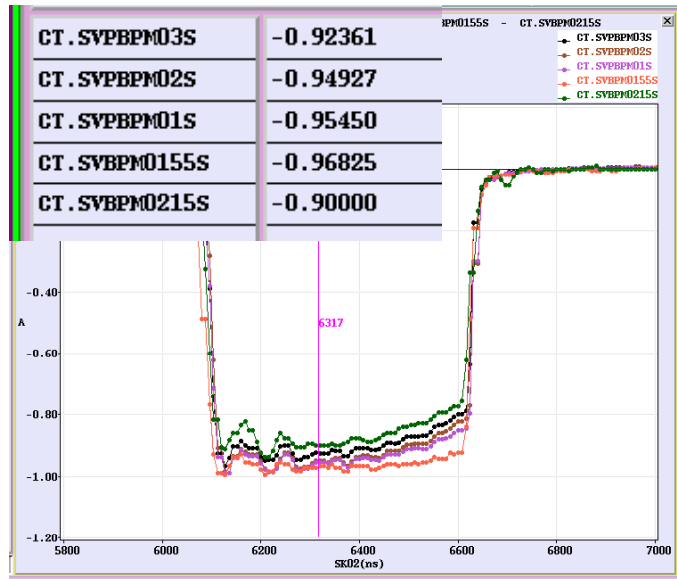
EuroTeV precision BPM tests



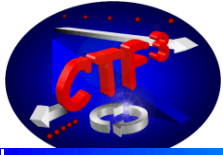
- Described in EUROTeV-Report-2007-008
- bench measured **resolution** for CLIC (1.5A) of **160nm / 220nm** close to the calculated one of 130nm
- 3 installed in the straight line of the INFN chicane at the linac end
- Resolution with beam from correlation of 3 measurements



PBPM Beam tests - Sept 2008



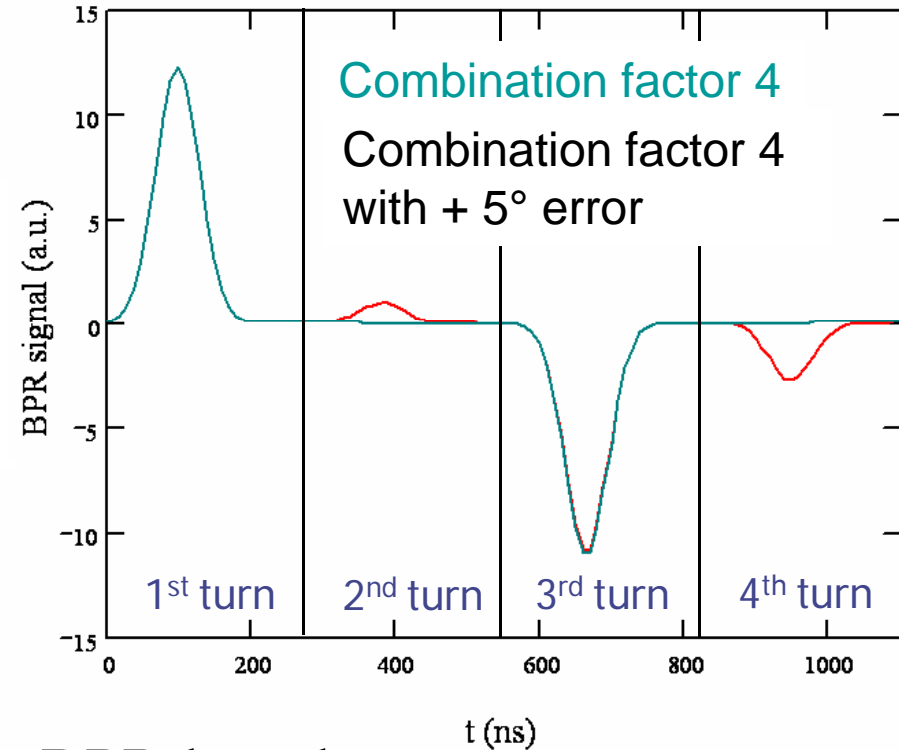
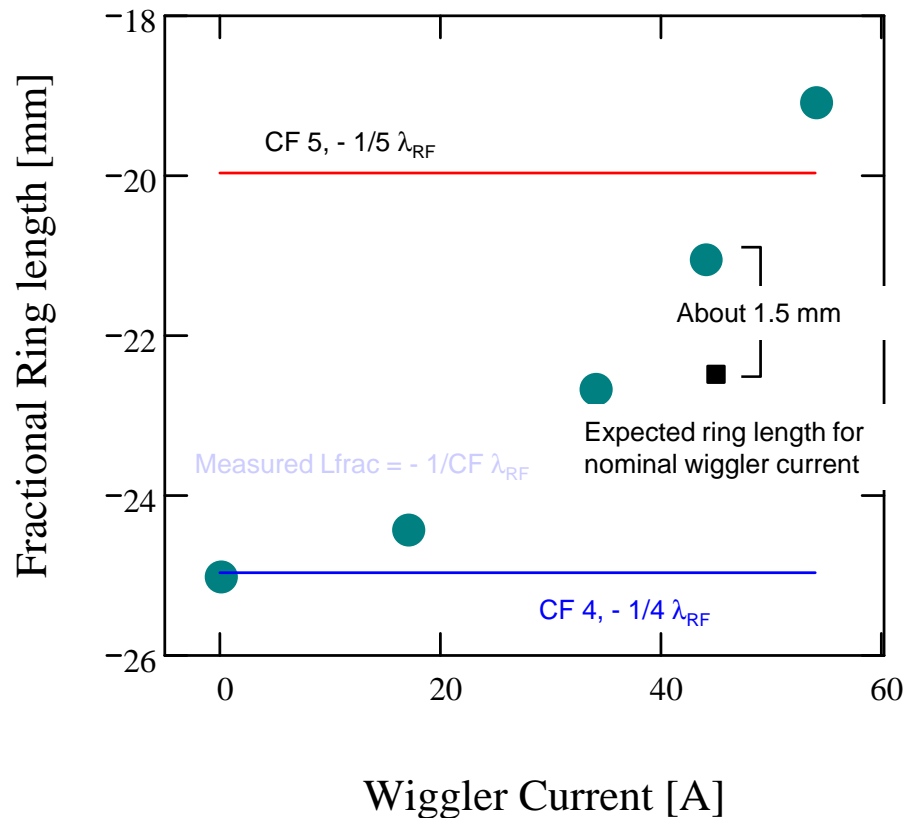
- Resolution ~650nm measured
- Results in vertical plane worse
- Promising results, further improvements by
 - Increasing the FE gain by ~10
 - reduction of beam losses
- More details at CLIC08 workshop in Lars Soby's talk
<http://indico.cern.ch/conferenceDisplay.py?confId=30383>



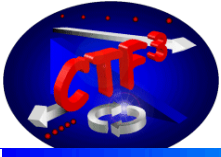
Measurement of the CR ring length



- BPR: RF Phase Monitor
- Mix of the beam induced signal and internal frequency (3 GHz)
- FFT of the signal



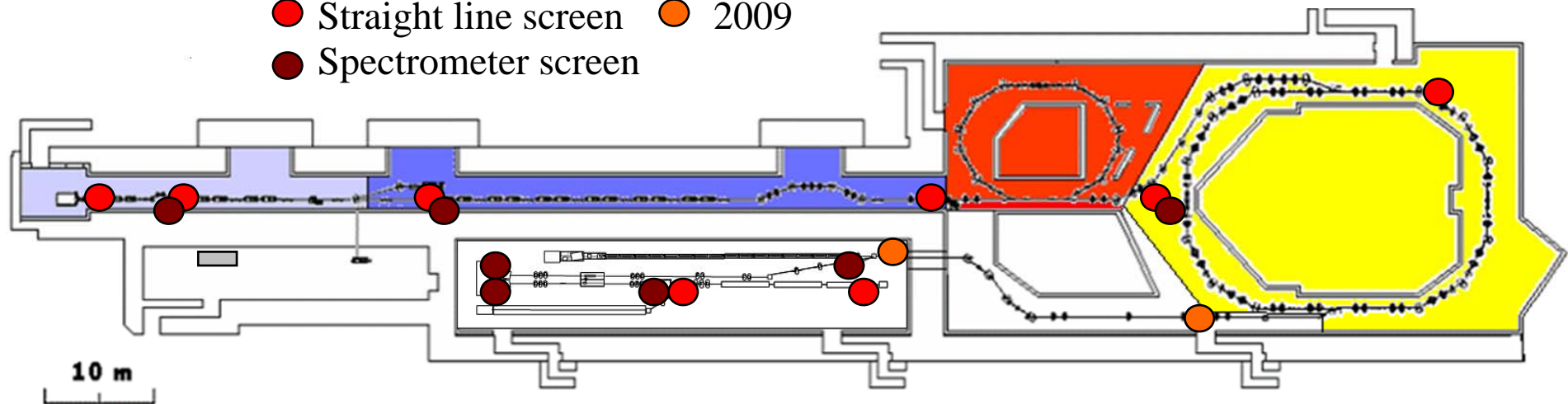
- BPR has shown:
 - Wiggler behaves as expected
 - ~1.5 mm difference only



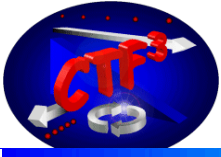
MTVs



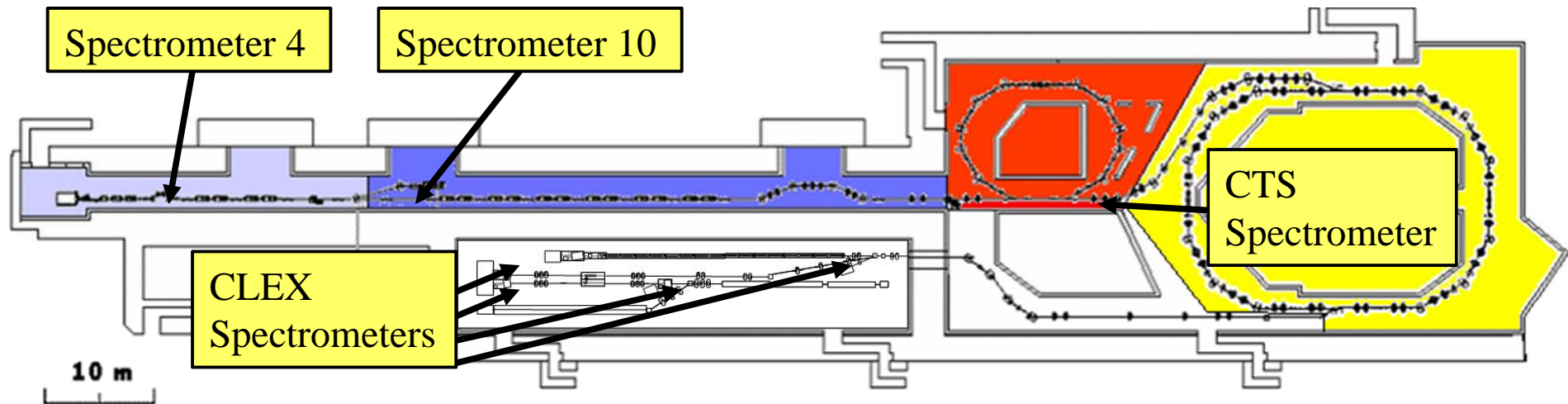
- Straight line screen ● 2009
- Spectrometer screen



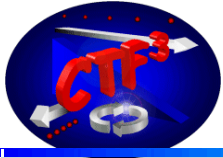
- MTV widely used for quadrupole scans
- Work very well in general, some software issues initially
- crate overloaded when more than 1 camera ON per crate
BI software section is aware of problem => hope this can be fixed
- 2 screens in TL2 were missing in 2008
- => no Twiss measurement after CRM line
- => TL2 commissioning very tedious and lengthy
- We need them working this run!



Spectrometers



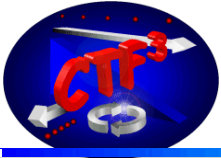
- We mainly need **beam energy measurement** in daily operation
- Spectro 10 commissioned and studied, works well (should put sensitivity into control system)
- For **energy after linac**, we use **bends** in INFN chicane, TL1, CR
- Time resolved measurements => Anne's talk after me
- CLEX spectrometers use OTR screen + BPM



Longitudinal Diagnostics



- **BPR waveguide outputs** => we use for injector setting up
- **Phase Monitor** with frequency filters and diodes for combination performance
- **RF-pickup** for bunch length measurement
- Measurements with **RF deflector** of the DL and MTV screen
- **Coherent Diffraction Radiation** experiment at the CRM line
- Synchrotron light outputs in INFN chicane, DL and CR for **streak camera** bunch length + spacing measurements
 - New streak camera lab built and equipped outside CR
 - In CLEX only space reserved, no installation done
 - Only one Streak Camera existing that has to be moved between CR and DL and eventually CLEX?!
- Mostly specialist measurements
- See the following talk by Anne



Conclusion



- CTF3 has become a complex machine with a variety of instrumentation
- **BPMs** are **essential** for daily operation and optics studies
 - TL2 BPM system had some teething problems
 - Many of them got solved, others will during shutdown but it would be very useful to have experts here for startup
- **MTVs** widely used for quad scans
 - Missing TL2 screens made commissioning difficult
 - Essential for TL2 studies this run
- Various instrumentation used for more expert studies
- **Thanks to everyone for their help and effort!!!**