Something New from the Metrology Light Source (MLS)

associated workgroups:

HZB: **J. Feikes, M. Ries, P. Schmid, G. Wüstefeld**
PTB: **A. Hoehl, R. Klein, R. Müller, A. Serdyukov, G. Ulm**

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Birds view of BESSY II site

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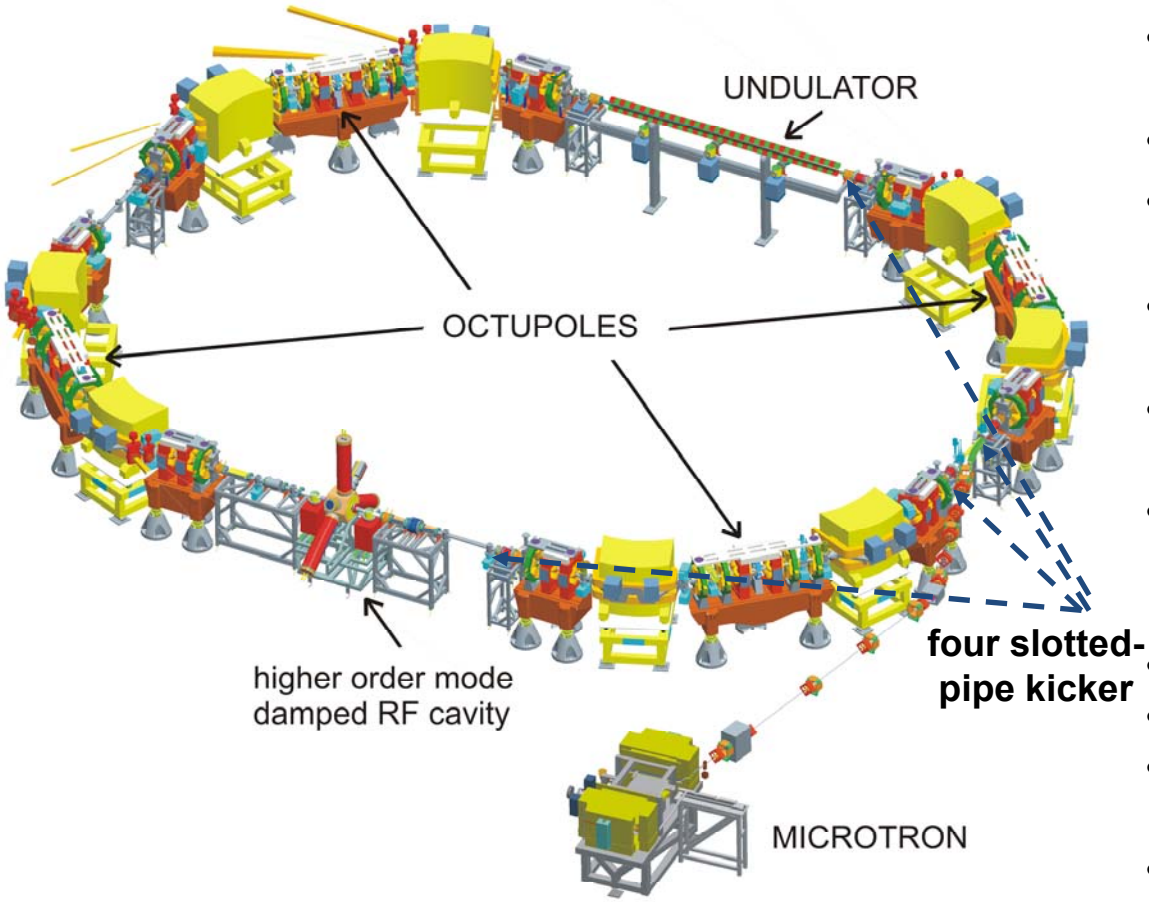
The MLS ring



- $2\pi R$ = 48 m
- R_{bend} = 1.528 m

- Injection E = 105 MeV
- operational E= 105 -629 MeV

- I_e = 1 pA (=1e-) - 200 mA

- t_{damp} = 5 s at injection

- $|\alpha|$ = 1x10-5 – 7x10-2
  (Talk of Markus Ries)

- f_{RF} = 500 MHz
- V_{RF} = 50 - 500 kV
- h =80= 500 MHz / 6.25 MHz

- Qx / Qy = 3.18 / 2.23

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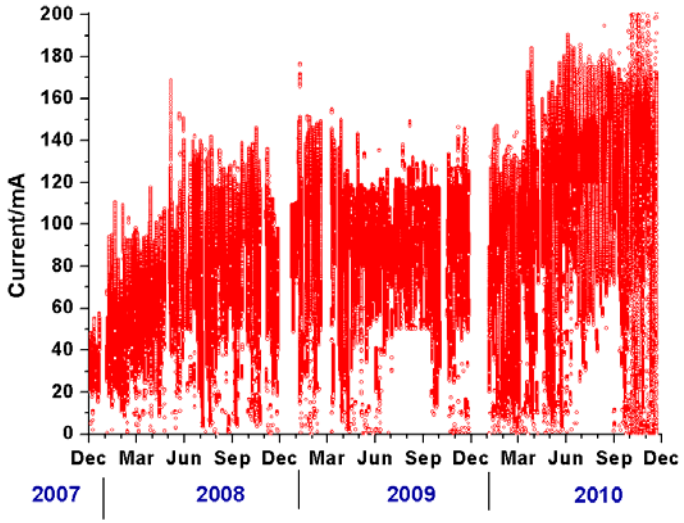
Since June 2010 User Operation with Currents up to 200 mA (Design value)

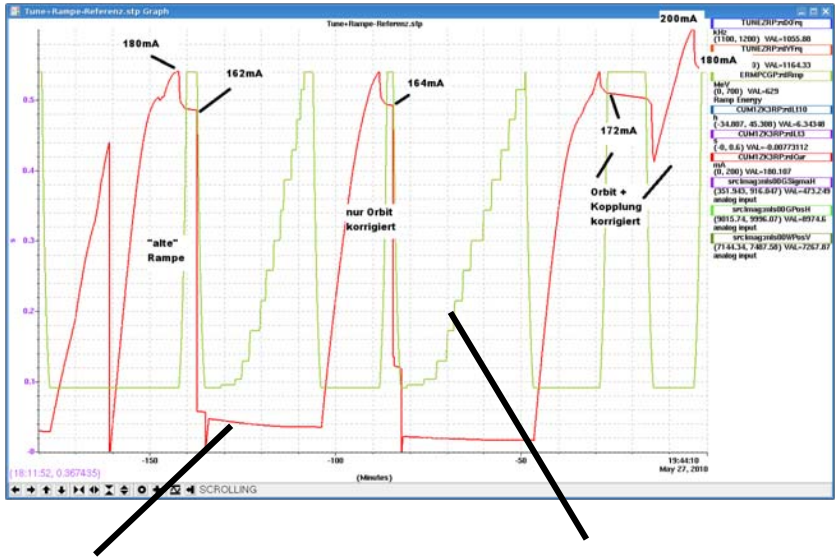
- electr. isolation of Septum from transfer line allows improved new accumulation scheme at a 2 Hz rate (x10)
- adjustment of transv.+ long. tunes, chromaticity, coupling on ramp

-> only 15% ramp losses at currents around 200 mA

beam currents in user operation

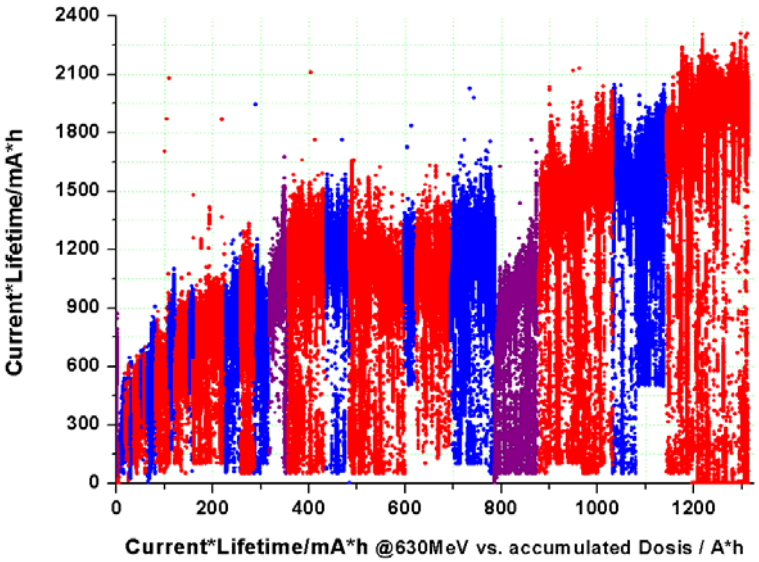


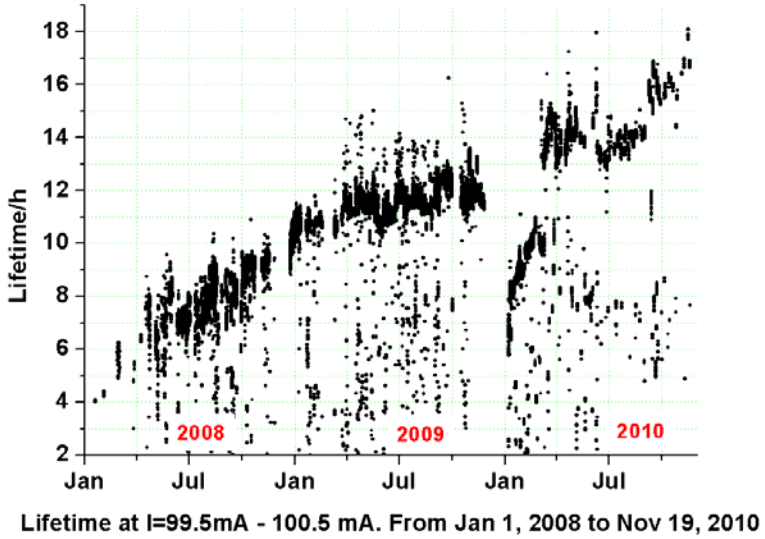
optimizing ramp tables



Vacuum and lifetime

- continous beam scrubbing -> better vacuum -> improved machine handling





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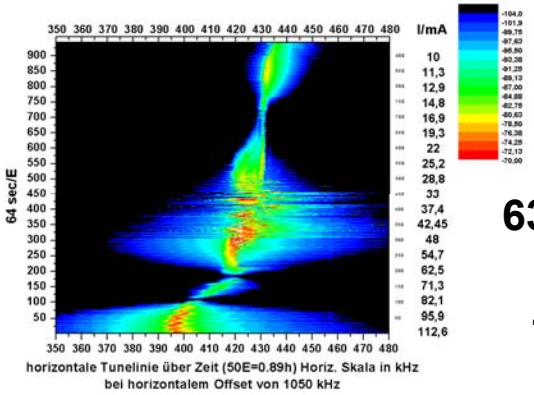
MLS – basic operation conditions established !

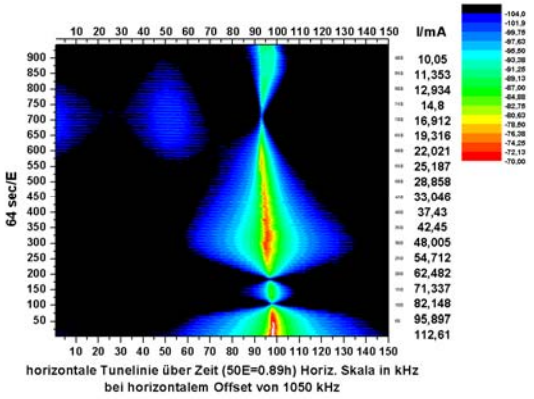
after 3 years Commissioning at a complex machine

f_x vs. I_{Beam}



Example:
630 MeV beam spectra vs beam current -> a lot of dynamics

f_z vs. I_{Beam}



- **low injection energy (105 MeV) – damping time some seconds**
- **many ion related problems**
- **strong impact of hysteresis on handling**
- **succesful development to dedicated THz source (Markus Ries Talk)**

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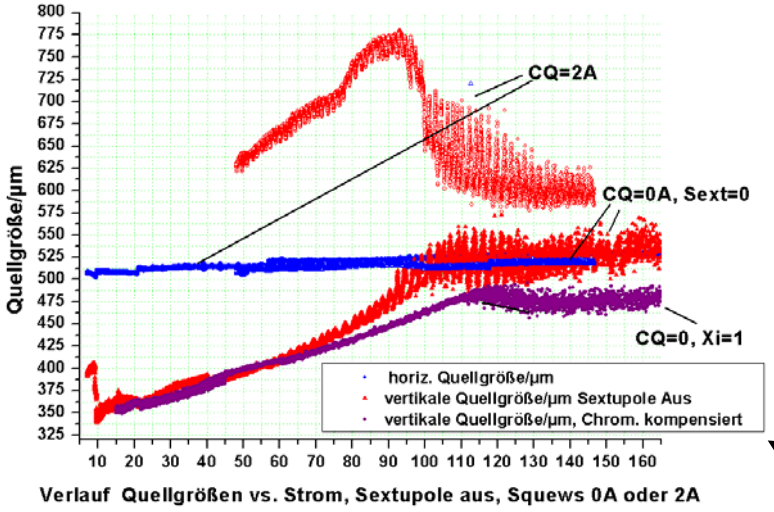
up to now moderate user requirements on beam conditions

(at currents > 80 mA beam is highly unstable in all spatial directions)

2011: new reflectometry BL with challenging demands

beam size requirement horiz. < 250 µm, vert. < 200 µm (1 sigma)
stability -> max 10% of beam size at time scale 1s – 1h



Verlauf Quellgrößen vs. Strom, Sextupole aus, Squews 0A oder 2A

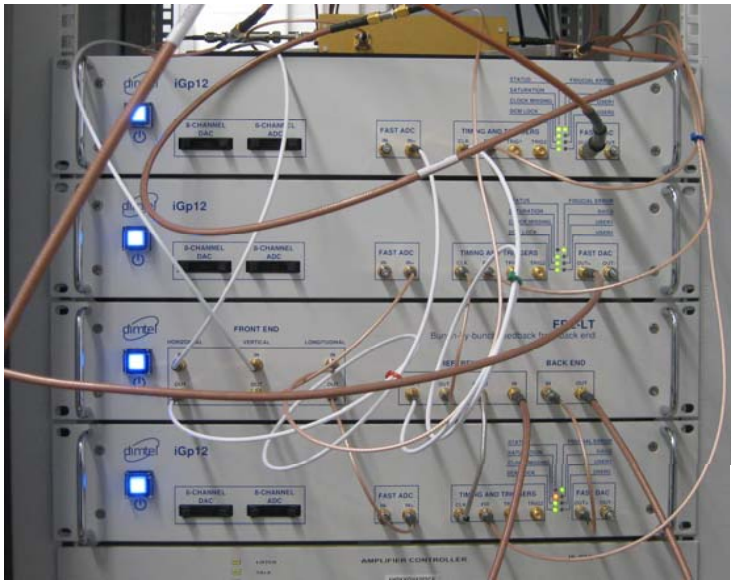
systematic investigations of user files

-coupling
-tunes
-chromaticity
-….

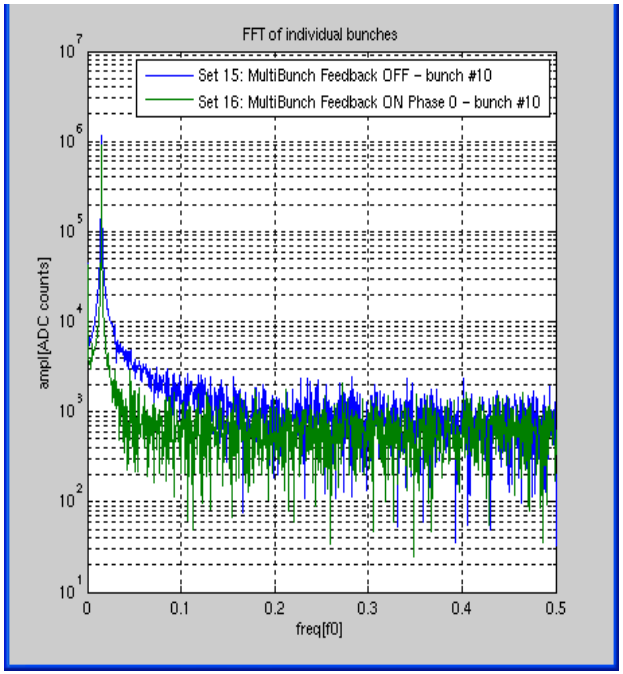
Example:
vert. beam size vs beam current vs coupling

strong **Multi Bunch Instabilities** at **I >80 mA** ->
Reflectometry BL needs stable beam at highest currents
Multi Bunch Feedback in all spatial directions desired

-> **Test of available systems at MLS**



Dimtel (=Dmitry Teytelman)



Libera

long. spectrum with FB on/off
(P. Tavarez, Nigel Smale, Karlsruhe)

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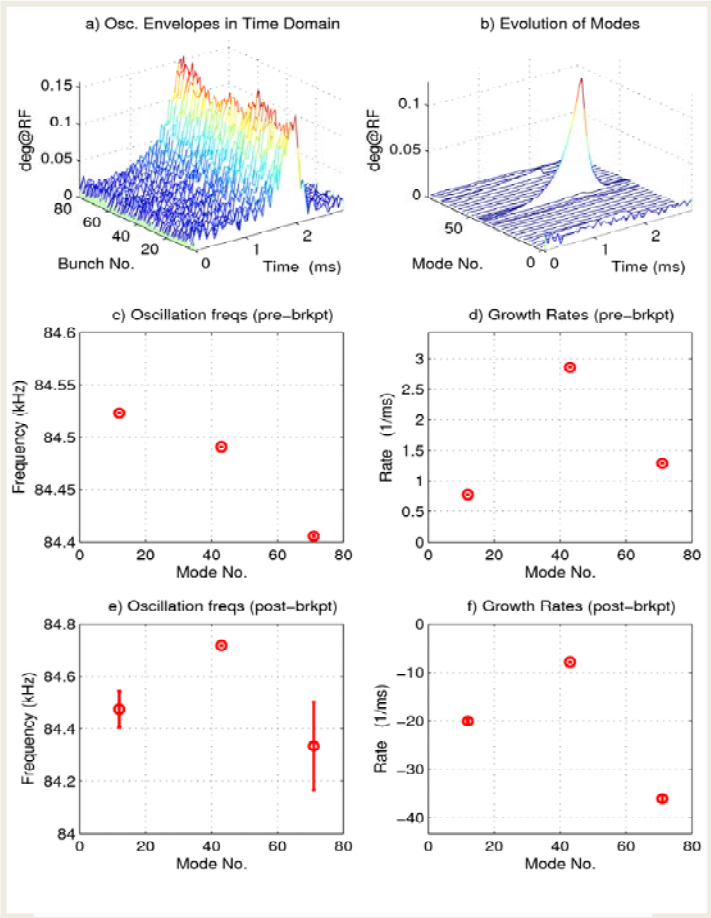
Feedback für MLS ordered at Dimtel and succesfully commissioned at MLS Nov 15 – Nov 19 (2010) by Dmitry



- Open-loop growth at 86 mA shows modes 43, 71, and 12
- Very fast feedback damping
- Resistive - minimal tune shift
- Average damped transversal oscillation amplitude is about 5 µm.
- Average oscillation amplitude is 14.4 milli-degrees (80 fs)
- neither accumulation nor energy ramp is achieved so far with active FB

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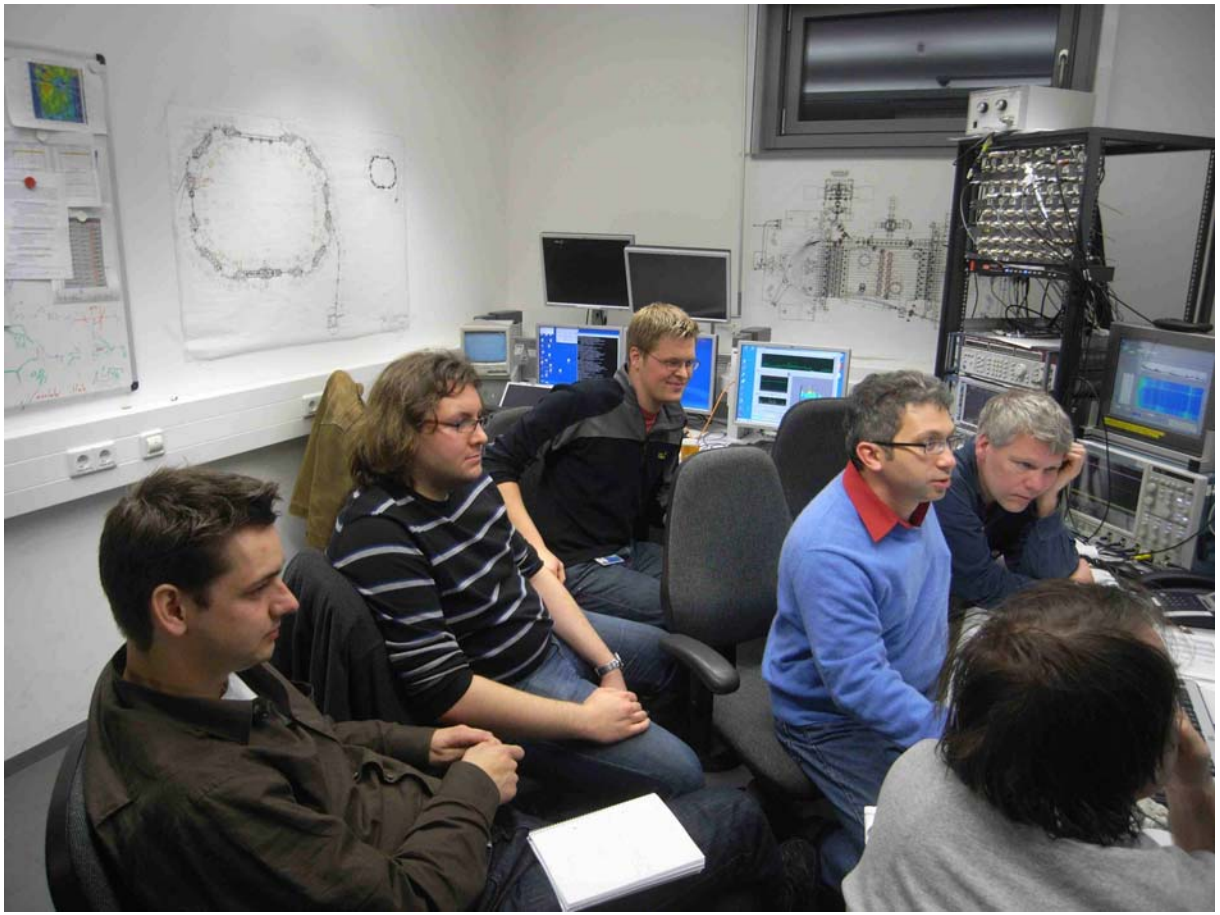
FB Tutorial in the MLS Controll Room



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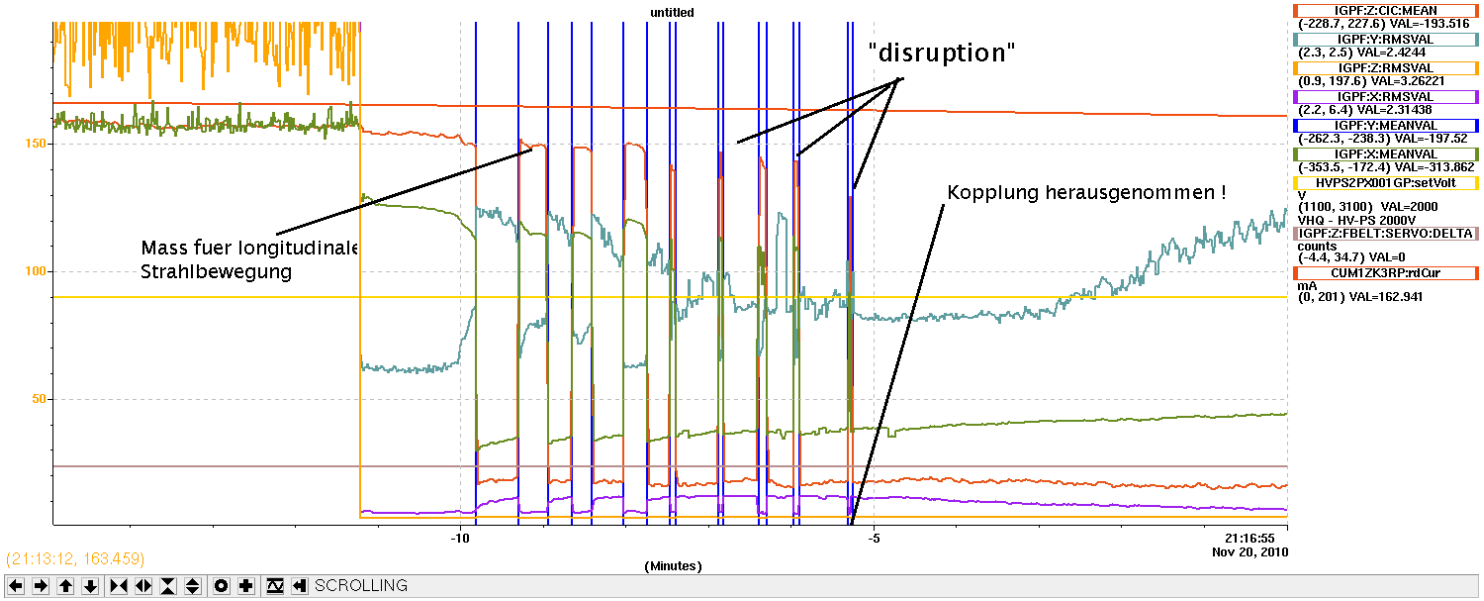
Future investigation of intensity dependent instabilities using powerful DIMTEL Analysis Tools

A first FB related example for complex behaviour:

longitudinal phase jumps every 10 seconds due to Ion-FB interaction



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Operational issues

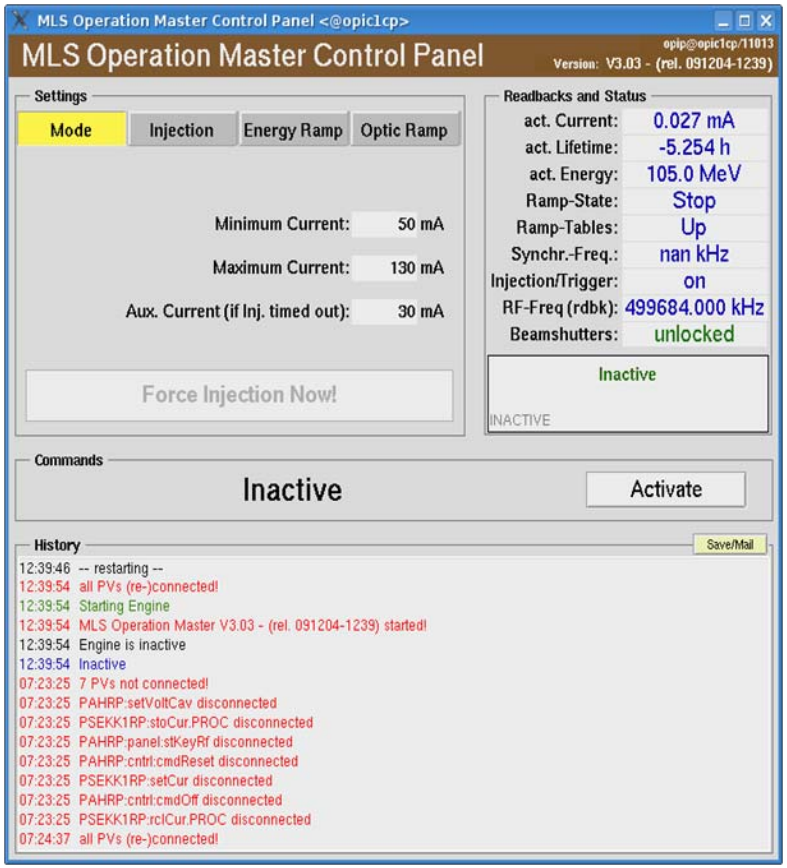
- User operation from Mo-Fr 7 h–20 h. Performed by BESSYII staff

- typical for MLS operation are widely varying user conditions

  - beam current : 1e (1pA) – 200 mA
  - beam energy : 105 MeV – 629 MeV
  - momentum compaction factor: 0.033 -> 0.00001

Often changes of user settings decided at a short term

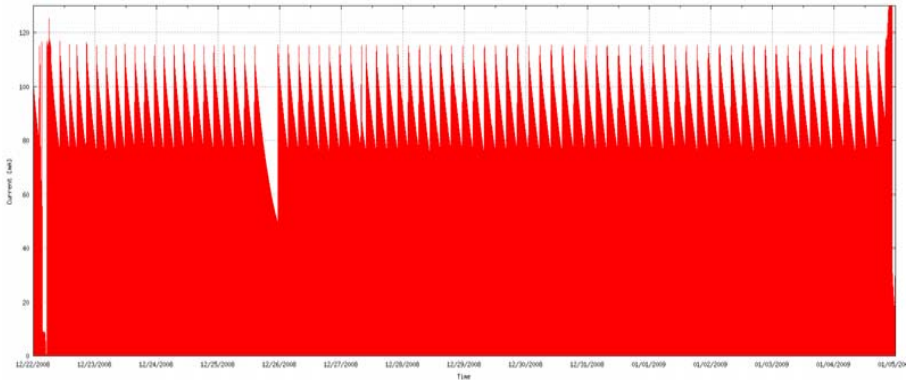
As changes of user states are complex and blunder is easy operation is done by a
automaticly working state machine = „Operation Master“



defining the desired operating parameters

-> Activate!

Very good experinence with automated operation !



Dez08-Jan09:2 weeks of unmaned operation

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Some developments at MLS

• **mode free Cavity** (E. Weihreter, F. Marhauser et. al.)
Prototyp reached **38 kW** (planed **80 kW)**. Design was modified in house and a modified Cavity ordered -> higher voltage desired

• **500 MHz IOT succesfully commissioned** (H.G. Hoberg, A. Heugel, et.)

• **hardware capabable to do fast orbit correction** (T. Schneegans, G.Schindhelm) is in use since beginning of operation and working reliable

• design, construction and reliable operation of four **slotted pipe kickers**

• **use of octupoles not** only to adjust 2d order long. chromaticity (M. Ries talk) but also to stabilize the beam at higher currents

• adapting **MatLab ToolKit** to needs of MLS control and measurement (D. Engel, P. Schmid)

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Next steps in MLS evolution

• Dec 2010 installation of a **NEG coated Undulator chamber**

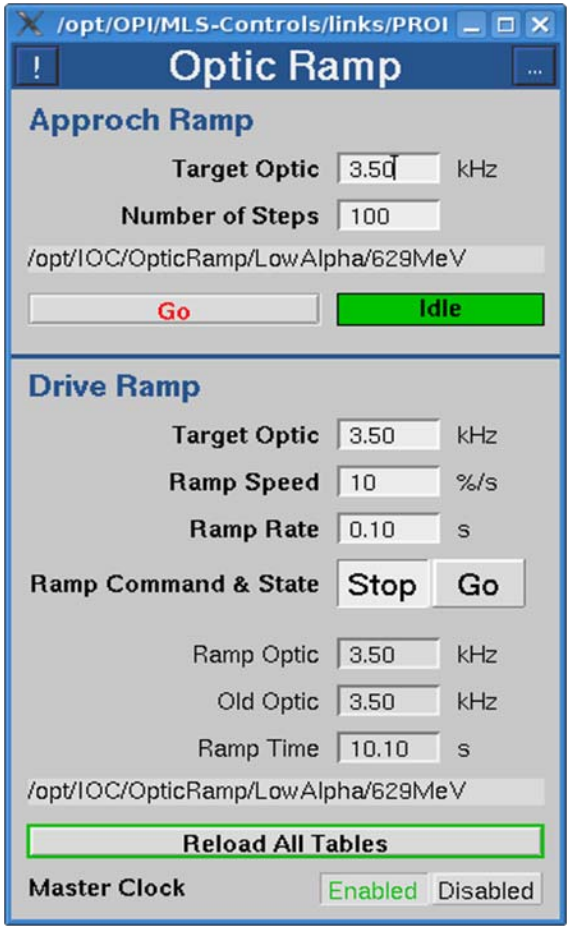
• establishing **high current, high quality beam** for needs of new sensitive reflectometry Beam Line users (how to operate MB Feedback ?)

• in Dec 2010 **PS upgrade**. Each Quadrupole will be powered individually
Motivation:
- indiv. control of **dispersion in Cavity and injection** (10Hz injection ?)
- **symmetrisation** of optics with undulator powered
- flexible adjustment of **optical functions in source point**

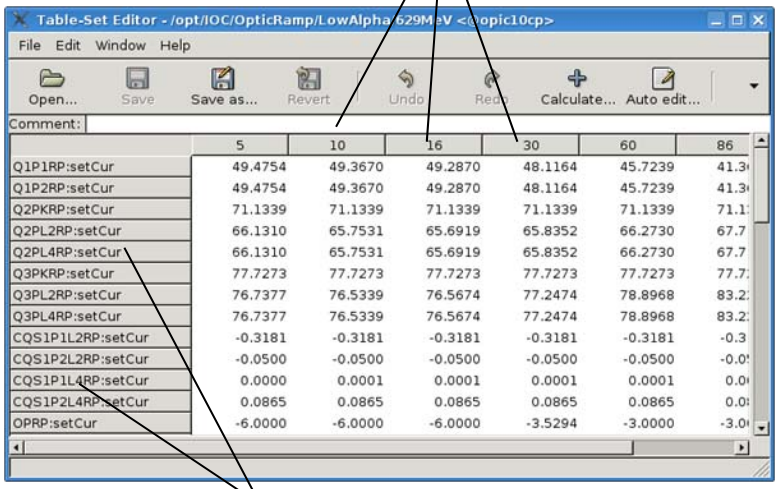
• **further investigation of the observed bunch lengths** (streak camera)


The End

example for sub-routine : change to Low Alpha Optics



synchrotron frequency

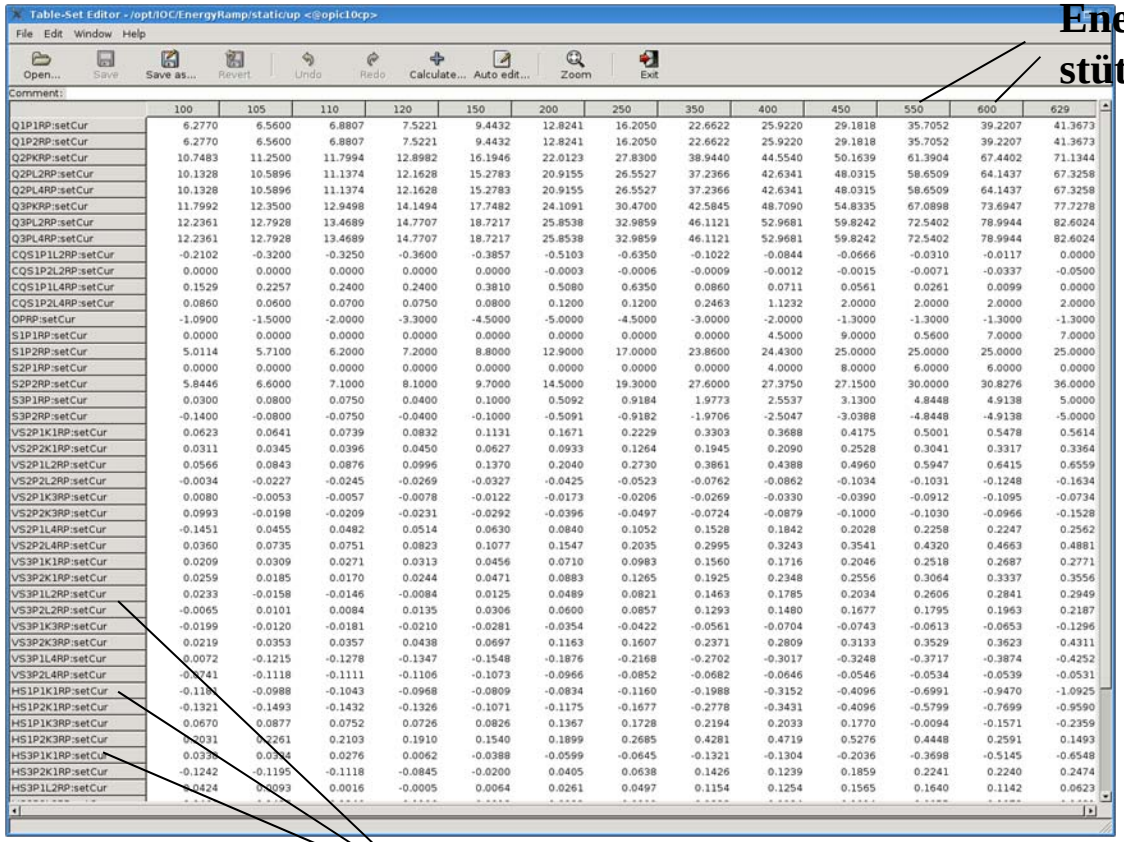


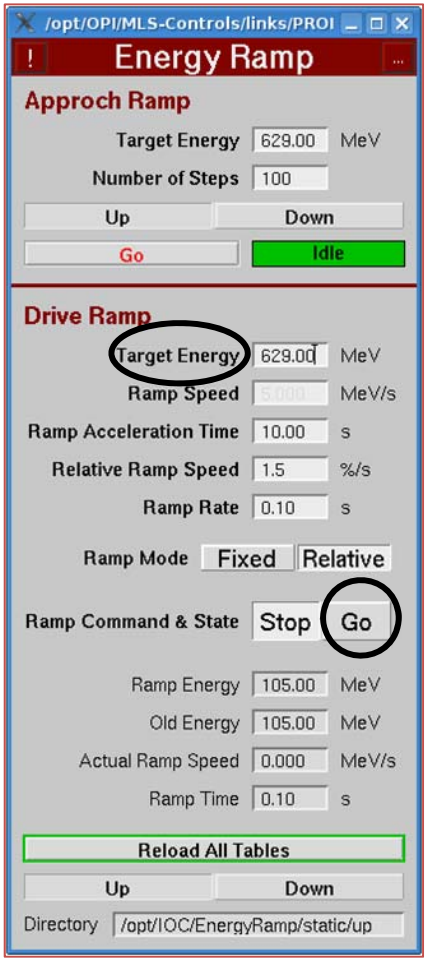
Devices

MLS control room

Wie wird gerampt. „ Energy Ramp“

synchrones Fahren aller Geräte mit „ **Energy Ramp**“





Ramp-Tabelle