PAUL SCHERRER INSTITUT

PSI

Gian Luca Orlandi :: Electron Beam Instrumentation

Electron instrumentation

3rd SwissFEL Performance Workshop

January 27, 2021

Charge Monitors (DWCM/DICT/DFCP)

System Expert: G.L. Orlandi

- Progress in 2020:
  - DWCM: upgrade of IOC/Channels recording B1&B2 signal at 100Hz (Divall, Voulot, O.)
  - DICT: upgrade to independent trigger for B1&B2 (Llorente)
  - DICT: Save&Restore procedure of the settings, also applying to DBLM and DLLM (Llorente, Alarcon, O.)
  - Meas. campaign (DWCM,DICT,DBPM vs FC) for absolute charge calibration (Craievich,Marcellini, O.)

- Present status:
  - DICT (Aramis&Athos) in operation (100Hz, B1&B2)
  - DICT calibration: last measurement session on 17.01.2021. Data analysis on-going
  - Charge calibration campaign (DFCP,DICT,DWCM,DBPM): results to be presented in a SPM in February

- Issues:
  - Aramis DICTs show a relative systematic discrepancy, fortunately constant over a long time scale (~1 year)

- Plans/Upgrades:
  - DWCM (Summer 2021): Summer Student Position for characterization of the transfer function in the frequency and time domain and studies of possible improvements
  - DICT: according to the calibration results, decision has to be taken whether :
    - live with a systematic error and off-line correction;
    - investigate and fix the problem (new project and new resources, Porthos 3-bunch upgrade could be the right framework);
    - think of calibrating the existing DWCM and the spare one (to be possibly installed at the high energy section of the machine) for absolute charge measurements and BAG issues.

Loss Monitors (DBLM/DLLM/DDRM)

System Expert: G.L. Orlandi

- Progress in 2020:
  - DDRM:
    - Maintenance DDRM-SATUN22➔19
    - New installation: DDRM-SATUN18➔8
    - Set-up reshuffling for additional sensors (not in the HL-Liste) SATUN05-DDRM405-R (z=418.5m) and SATUN14-DDRM405-R (z=443.7m)
    - New controller set-up and control panel reshuffling (Divall); additional cabling (Villano)
  - DBLM:
    - SATUN14-DBLM405 & SATUN22-DBLM005 fiber replacement
    - Installation and beam commissioning of SATDI01-DBLM305
  - DLLM:
    - Installation (Baldinger, O.) and beam commissioning of SATUN09-DLLM035 (from z=430m to z=500m)

- Present status:
  - Sensor installation according to the planning
  - Loss monitor signals integrated in the MPS (DBLM and DLLM 100Hz,B1&B2)

- Issues:
  - DBLM Athos undulator set-up judged as very essential

- Plans/Upgrades:
  - SATDI01-DBLM095 (z=344m) and SATDI01-DBLM105(z=346m) to be installed with dechirper (April 2021)

Bunch Compression Monitors (DBCM)

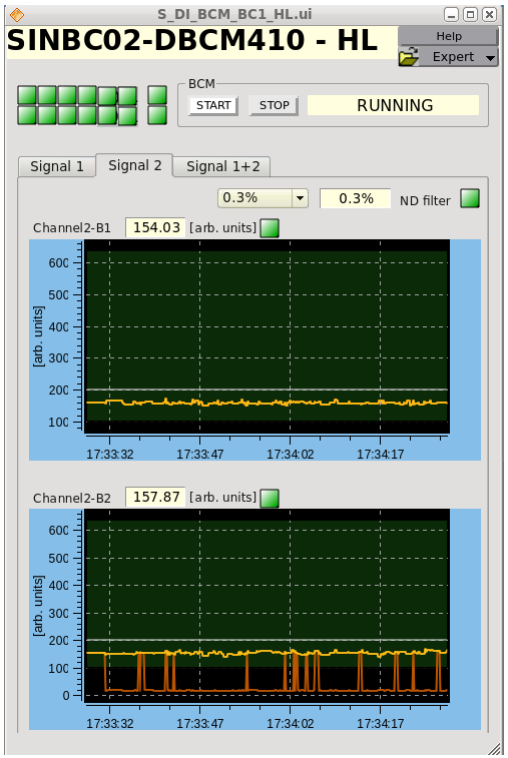
System Expert: G.L. Orlandi

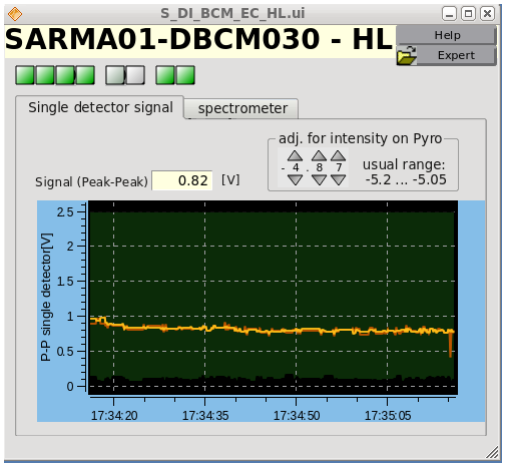
- Progress in 2020:
  - hand-over DBCM responsibility from F.Frei in July 2020
  - Reliable and well structure legacy from Franziska

- Present status:
  - SINBCO2-DBCM410:
    - integrated in the machine compression feedback (100Hz, B1&B2)
  - SARMA01-DBCM030:
    - ready to be integrated in the machine compression feedback (100Hz, B1)
  - S10BC02-DBCM410:
    - HW to be installed/commissioned first
    - IR-Hutch infrastructure complete
    - continued only if requested by project.

- Issues:

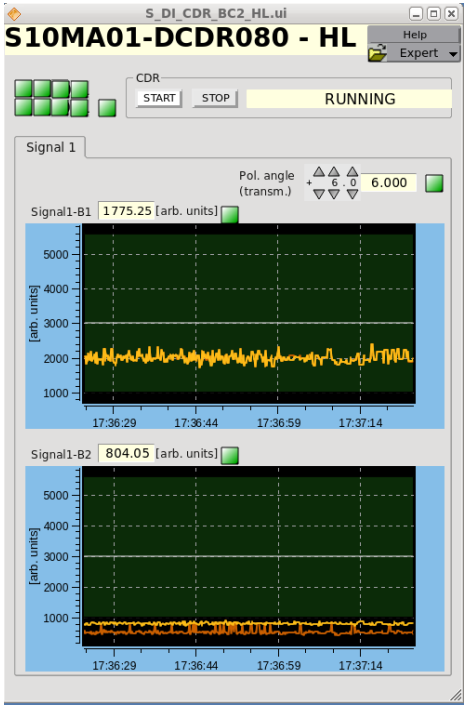
- Plans/Upgrades:
  - SARMA01-DBCM030 spectrometer maintenance





Coherent Diffraction Radiator (DCDR)

System Expert: G.L. Orlandi

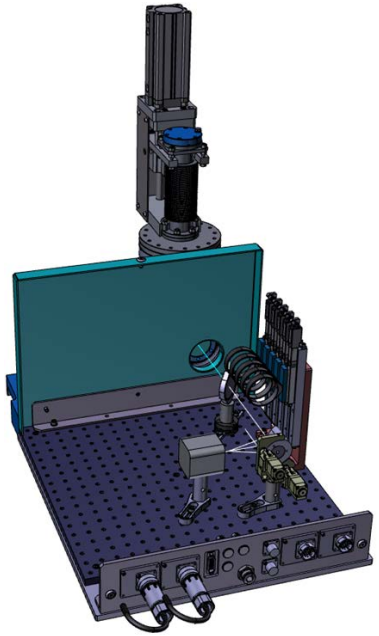


- Progress in 2020:
  - Hand-over DCDR responsibility from F.Frei in July 2020
  - Reliable and well structure legacy from Franziska

- Present status:
  - S10MA01-DCDR080 integrated in the machine compression feedback (100Hz, B1&B2)

- Issues:
  - S10MA01-DCDR080 polarizer set automatically to zero as a system protection action in case of machine interlock (manual setting of the polarizer at the original value needed at the restart)

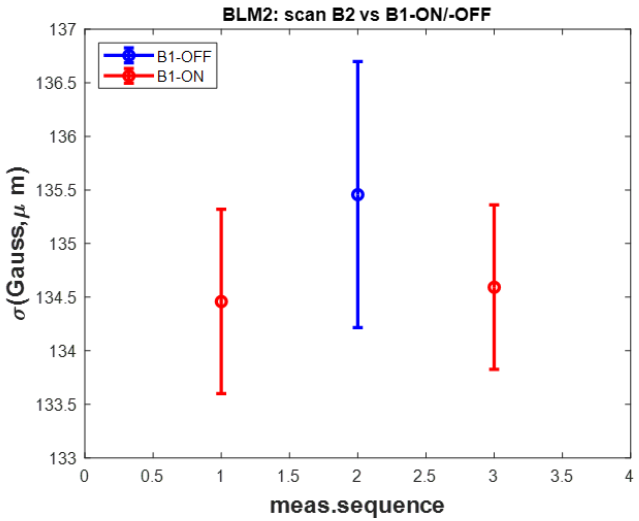
- Plans/Upgrades:
  - New DCDR Athos SATSY03-DCDR050 (z=318.5m):
    - All components already on place or ordered (with the exception of the Beckhoff Motion+DAQ server)
    - In-vacuum components and optics+detector box planned to be installed in April 2021 shut-down
    - Beam commissioning planned in Summer 2021
  - New DCDR Aramis SARCL01-DCDR105 (z=449.9m):
    - Most of the components already on place or ordered;
    - Time schedule of the device installation not defined yet (reasonably after SATSY03-DCDR050 commissioning)



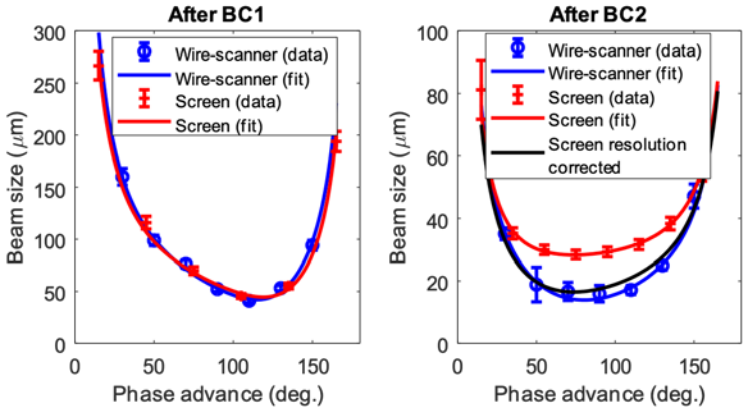
Wire Scanners (DWSC)

System Expert: G.L. Orlandi

- Progress in 2020:
  - Update of the WSC-HL-application (A.Gobbo, O.) to 2-bunch operations
  - Athos DWSCs commissioned with beam
  - Phase Space Tomography with Wire Scanner (see next slide)
  - Signature of License Agreement Contract between PSI and UHV-Design for the Intellectual Property Transfer and Commercialization of the SwissFEL WSC (M. Frei-Hardt, P. Heimgartner, O.)



- Present status:
  - WSC emittance measurements performed with pyscan code (adapted from screen meas., E. Prat, P. Dijkstal, A. Babic) and WSC-HL-application (A.Gobbo, O.)
  - Emittance measurements successfully performed after BC1 & BC2 with S10DI01-DWSC010 (z=110m) and SARCL01-DWSC160 (z=452m)
  - Athos switch-yard matching: emittance measurements with SARMA02-DWSC060 (z= 492m) successfully performed

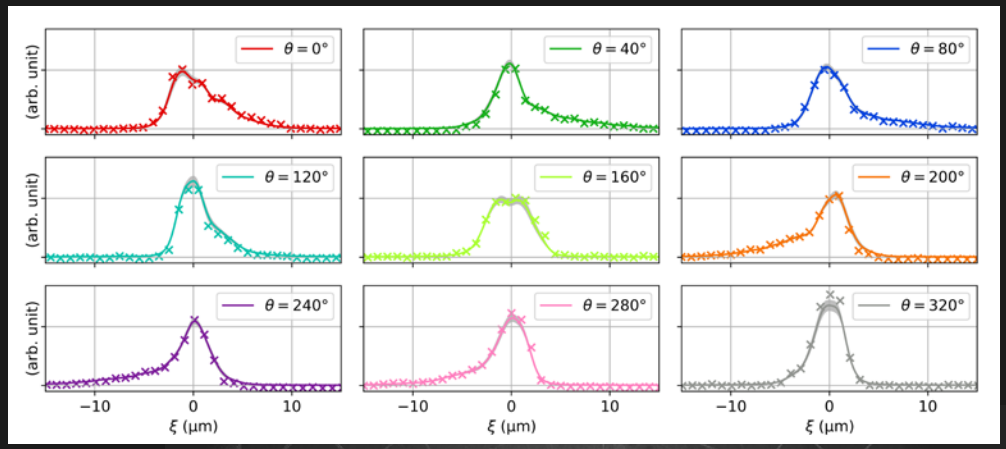


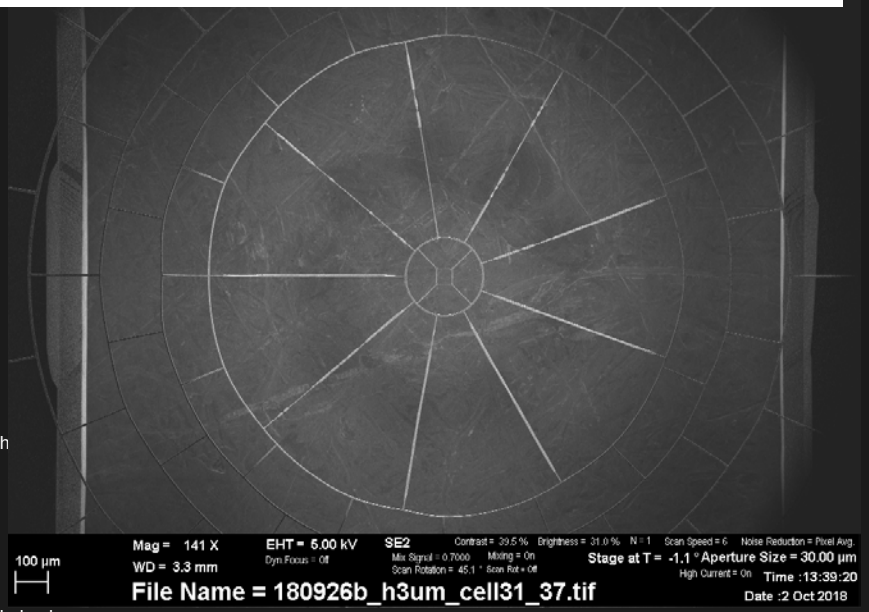
- Issues:
  - Emittance measurements with SARCL01-DWSC160: quadrupole scanning interval limited by beam-losses directly driven by optics mismatch blinding the beam losses produced by the wire

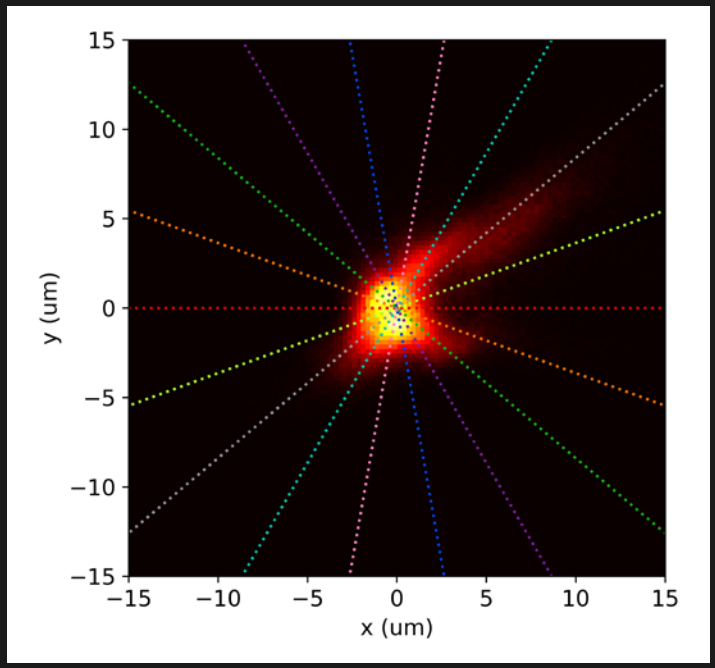
- Plans/Upgrades:
  - WSC emittance measurements with FODO scheme (in collaboration with BD): WSC set-up ready

PHASE SPACE TOMOGRAPHY WITH WIRE SCANNER—BENEDIKT

- Spider web wire scanner manufactured by LMN
- Tomographic reconstruction of the beam shape





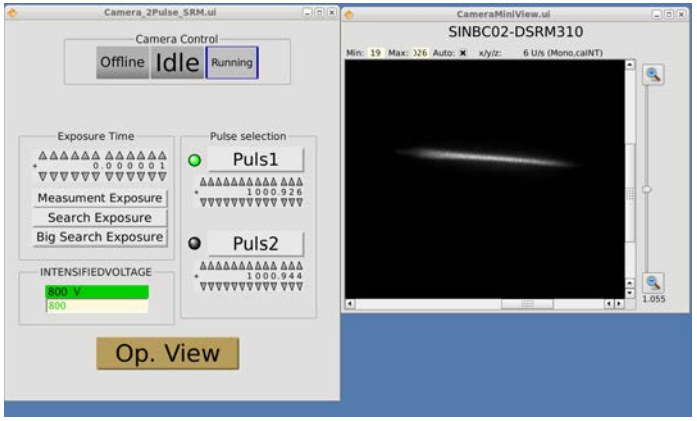


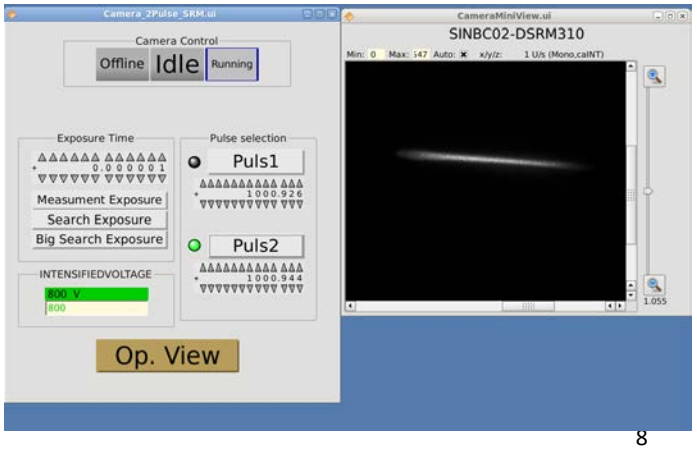
Synchrotron Radiation Monitor (DSRM)

System Expert: G.L. Orlandi

- Progress in 2020:
  - Installation of 2-bunch camera (gated MCP) in SINBC02-DSRM310 (M.Baldinger, T.Stapf, O.)
  - 2-bunch camera timing and software configuration (H. Brands)

- Present status:
  - SINBC02-DSRM310: basic commissioning B1&B2 done (timing)
  - S10BC02-DSRM310 in operation (sCMOS camera, 100Hz, reduced ROI)



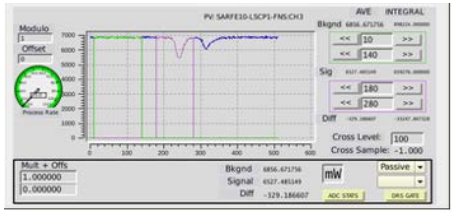


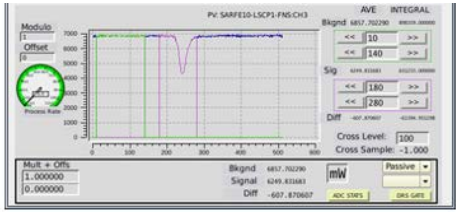
- Issues:

- Plans/Upgrades:
  - Adapt HL-Screen application to 2-bunch operations
  - Pixel calibration (um) and ROI to be set
  - IOC channel to be configured to lock the camera timing to the beam timing

Pulse Energy Monitors (Gas Detectors)

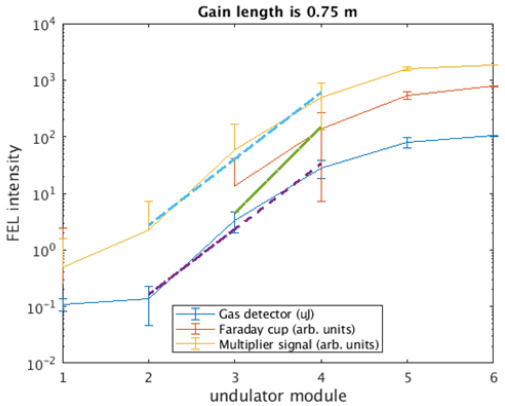
System Expert: P. Juranić





- Progress in 2020:
  - Aramis UV light issue solved with addition of UV filter in the last DSCR.
  - Athos gas detector commissioned and running successfully, used for all sorts of stuff.

- Present status:
  - Both Athos and Aramis branches in operation.



- Issues:
  - Athos DAQ is not synched correctly. Controls is looking to see where the problem is.
  - Archiver saving of data is unreliable, with the data being lost or format changed. Controls is looking into it.

- Plans/Upgrades:
  - Fast signal absolute energy calibration. Algorithm done, waiting for PV's to be created.
  - Automated gas exchange.
  - Athos gas detector as a rough spectrometer (central energy measurement).

DSCR (Screens)

System Expert: P. Juranić

- Progress in 2020:
  - Likely primary source of poor resolution discovered (filters with poor optical qualities).
  - Alternate filters found, but required a re-design of DSCR to fit different focal lengths.
  - Redesign is finished, parts are ordered. Initial plan is to upgrade SARCL01-DSCR170 und SATBD01-DSCR120 (main ones for emmittance measurements).

- Present status:
  - DSCR's in operation and working OK.

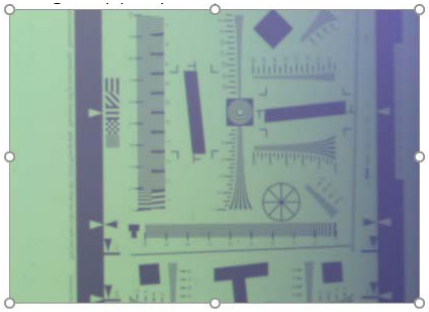


Abbildung 1: ND 2.0 Film Filter (9,156)

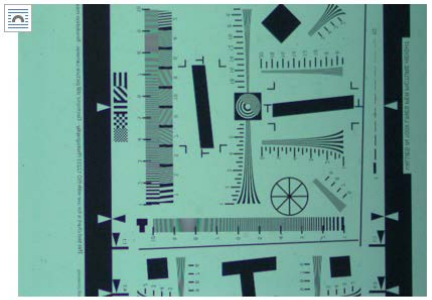


Abbildung 2: without Filter (14,783)

- Plans/upgrades:
  - Looking at secondary issues to improve resolution, like non-linearity of scintillators. Investigating thinner scintillators and computational models that correct for it.
  - May want to turn all DSCRs into the better-resolution version.

HERO screens

System Expert: P. Juranić

- Progress in 2020:
  - Defined measurement parameters and concept developed to measure e-beam/laser beam time and spatial overlaps.
  - Tests for diode responses to electron-generated OTR light and further tests on possible fine-time measurement tools are ongoing at the ACHIP chamber.
  - Test with laser heater performed to gain experience, look at issues, and try out some new ideas.

- Issues:
  - Parameters may need to change due to the evolving developments with the HERO project, which will require a design change.
  - A bit more HERO-dedicated communication would be welcome to be able to respond to changes more quickly before device drawing and construction starts.

- Plans:
  - Change design to fit new parameters, order parts.

Mit einzigartigen Beschleunigeranlagen an die Spitze der Forschung:
We make science work!