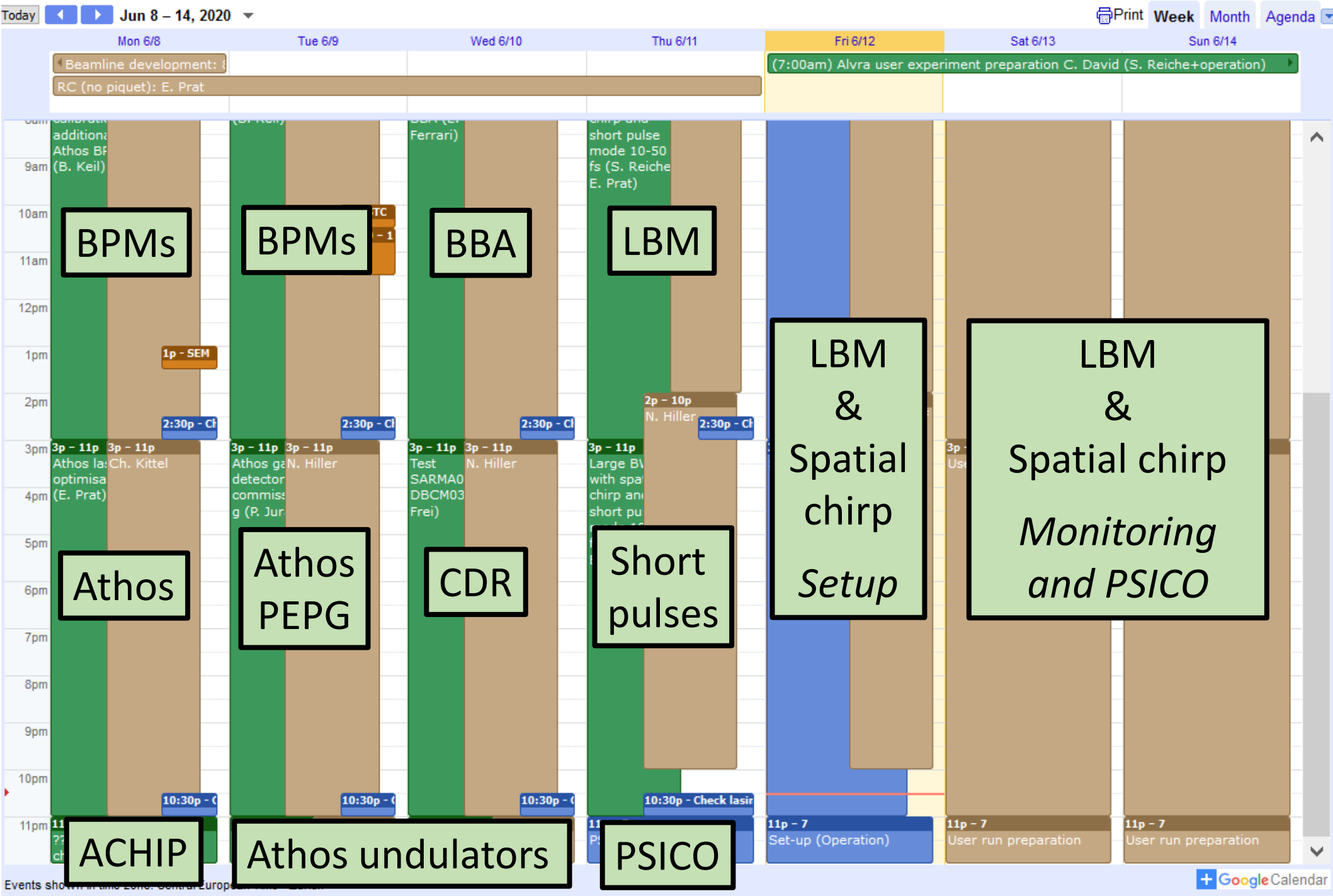
Machine report, week 24

E. Prat

SEM meeting, June 15

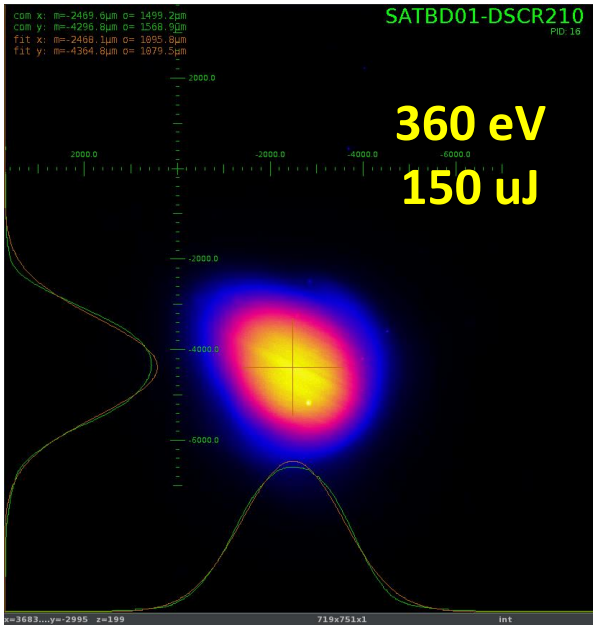
Overview


Today
Jun 8 – 14, 2020
Print
Week
Month
Agenda
Mon 6/8
Tue 6/9
Wed 6/10
Thu 6/11
Fri 6/12
Sat 6/13
Sun 6/14
Beamline development:
RC (no piquet): E. Prat
(7:00am) Alvra user experiment preparation C. David (S. Reiche+operation)
9am
10am
11am
12pm
1pm
2pm
3pm
4pm
5pm
6pm
7pm
8pm
9pm
10pm
11pm
BPMs
BPMs
BBA
LBM
LBM & Spatial chirp Setup
LBM & Spatial chirp Monitoring and PSICO
Athos
Athos PEPG
CDR
Short pulses
ACHIP
Athos undulators
PSICO
1p - SEM
2:30p - Cl
2p - 10p
N. Hiller
3p - 11p
Ch. Kittel
N. Hiller
10:30p - Check lasir
11p - 7
Set-up (Operation)
User run preparation
User run preparation
Google Calendar

Athos commissioning

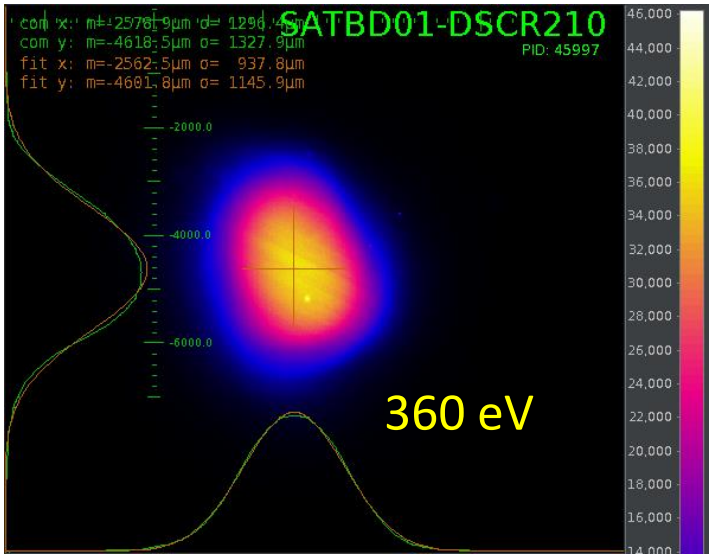
M. Calvi, E. Ferrari, C. Kittel, N. Hiller, P. Juranic, S. Reiche, E. Prat

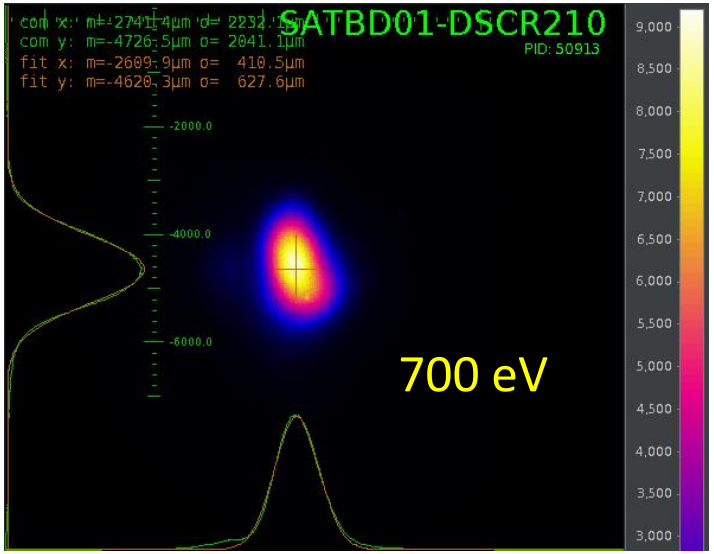
- 6/16 undulators, mostly at ~360 eV (K=3.5) and circular polarization
- June 9 (https://elog-gfa.psi.ch/SwissFEL+commissioning/14729)
  - 2 bunch setup, good e- beam quality
  - ~80 uJ at 360 eV
- June 10, focus on gas detector commissioning (https://elog-gfa.psi.ch/SwissFEL+commissioning/14738):
  - Improved lasing : ~110 uJ at 360 eV
  - Gain curve measured with gas detector (effective gain length ~0.8m)
  - Gas detector matches e- beam energy loss measurement
  - Lased at different photon energies (up to 700 eV)
  - Measured optical klystron curve (max at 1.45 um delay, corresponding to an energy spread of 600 keV)
  - Other gas detector studies (see next slides)
- June 11 (~1 hour in parallel to Aramis)
  - CHIC effect on lasing: from ~110 uJ to ~0.2 uJ
  - Improved lasing: ~150 uJ at 360 eV



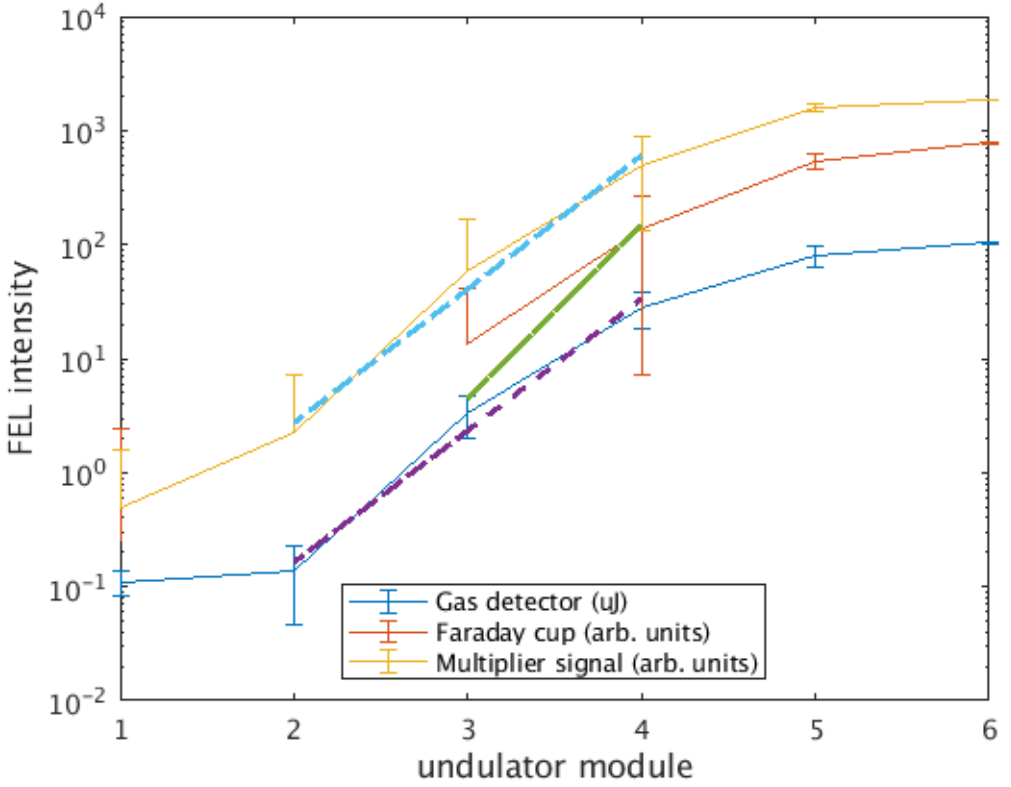
Athos commissioning

M. Calvi, E. Ferrari, C. Kittel, N. Hiller,
P. Juranic, S. Reiche, E. Prat





Gain curve at 360 eV for 110 uJ



Outlook: continue standard commissioning

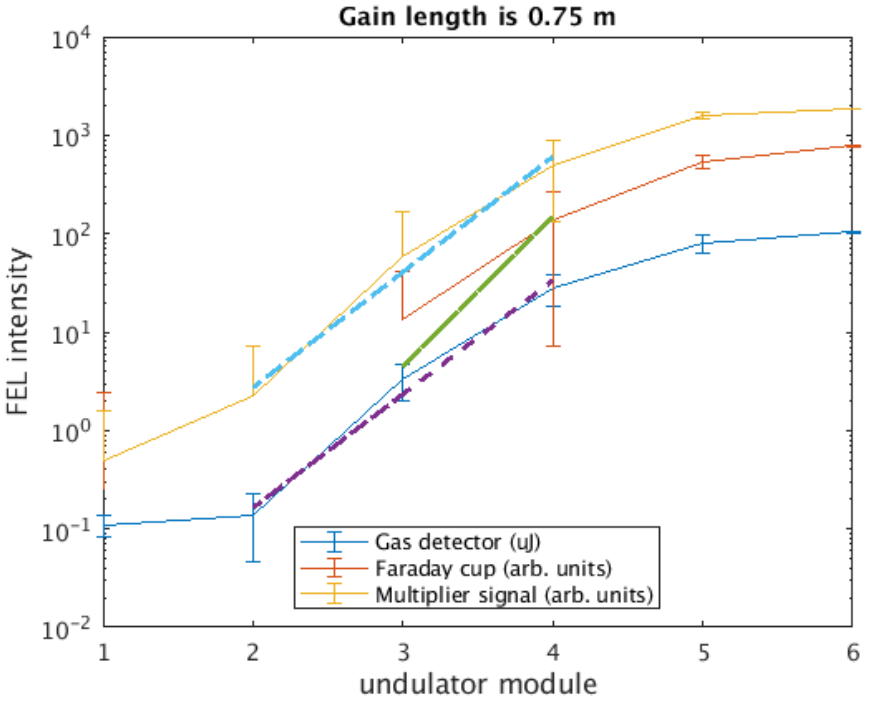
- Undulators
- Dechirper
- Mizar laser
- …

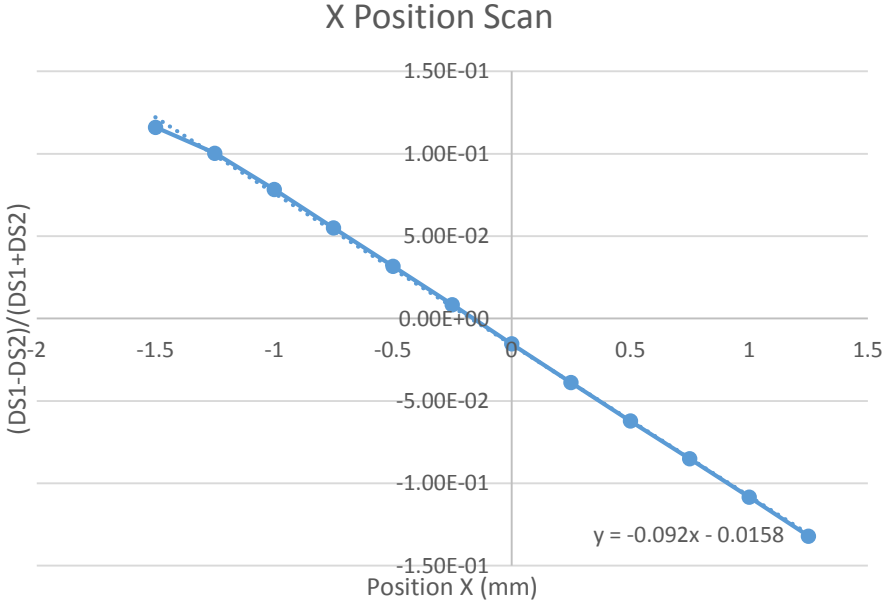
Athos gas detector

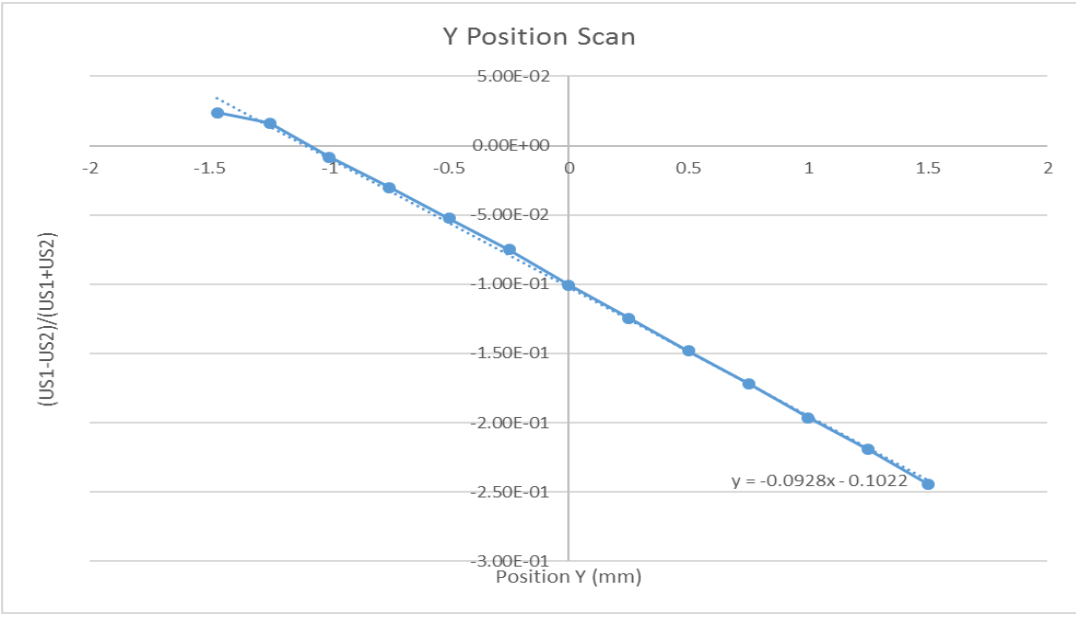
Slide from P. Juranic

Basic commissioning

- Checked linearity of fast and slow signals with each other.
- Checked the range of pulse energies where the PEPG can work—able to measure the full FEA gain curve!
- Position calibration for X and Y directions (given to controls to implement)



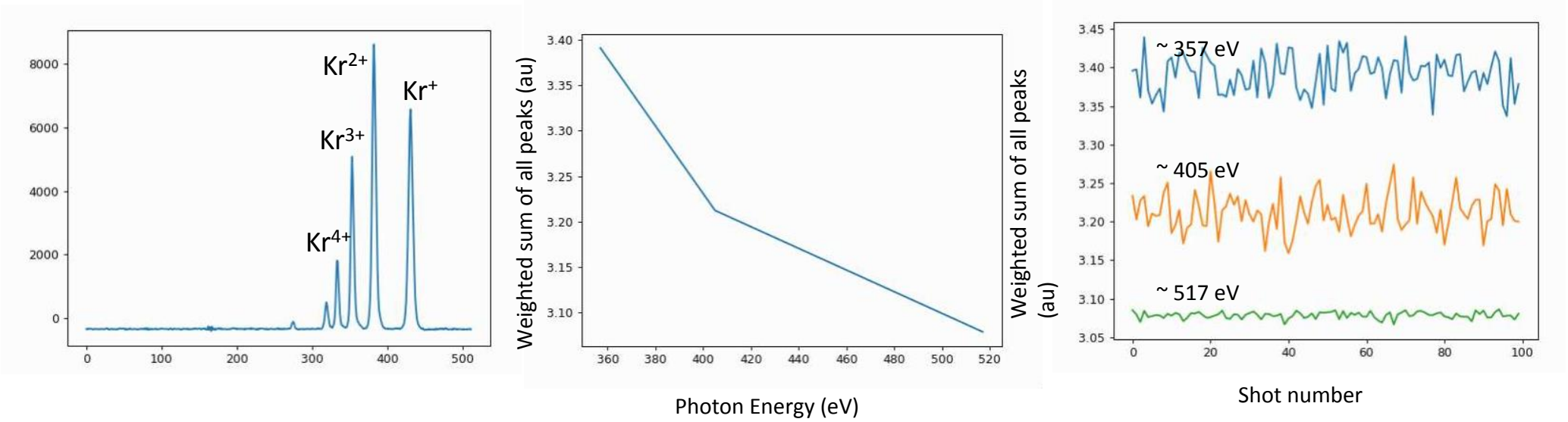




Athos gas detector

Slide from P. Juranic

More Advanced ideas



We could try using the signal from the multipliers (which act as a rough ion TOF) to roughly measure the photon energy. We cannot straight-up use the literature curve, since it does not include the detector response, which is significant.

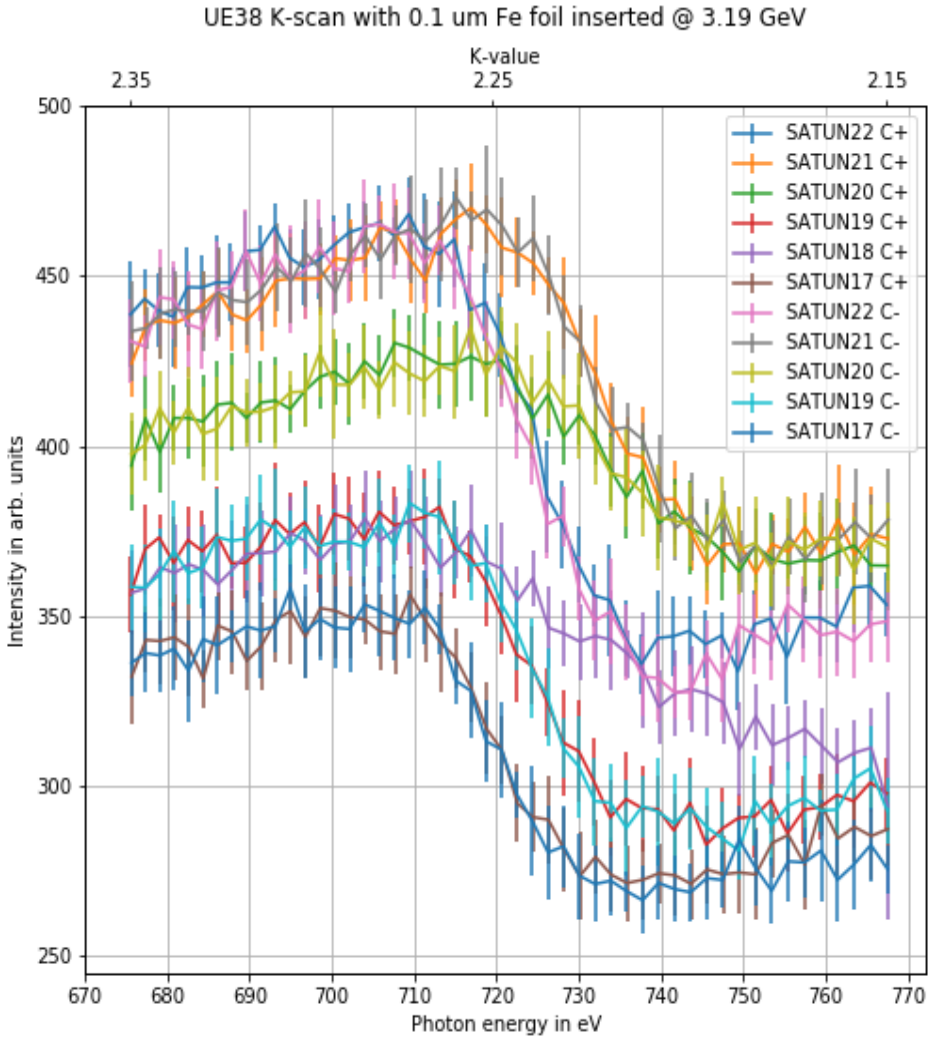
This measurement be used as a stop-gap until a 'real' spectrometer is installed. It would at least show when the energy drifts. Shows only central photon energy, not the bandwidth or anything more advanced. We would need to wait until Athos fully functional for full curve and more points.

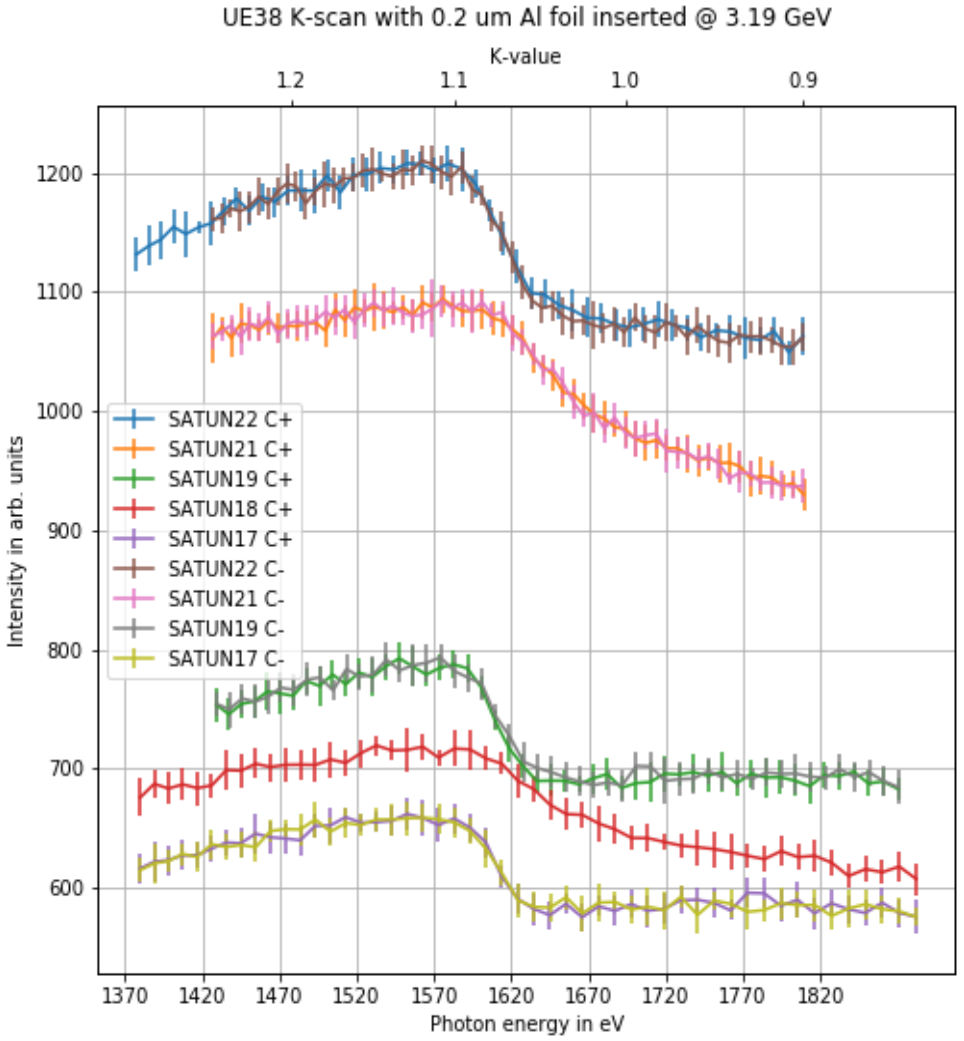
UE38 K-scan vs metallic filter

Slide from C. Kittel

C.Kittel, M.Calvi, C.Arrell

Absorption edges of Iron and Aluminum foils measured in circular polarization (+/-) with the diode in the Athos front-end



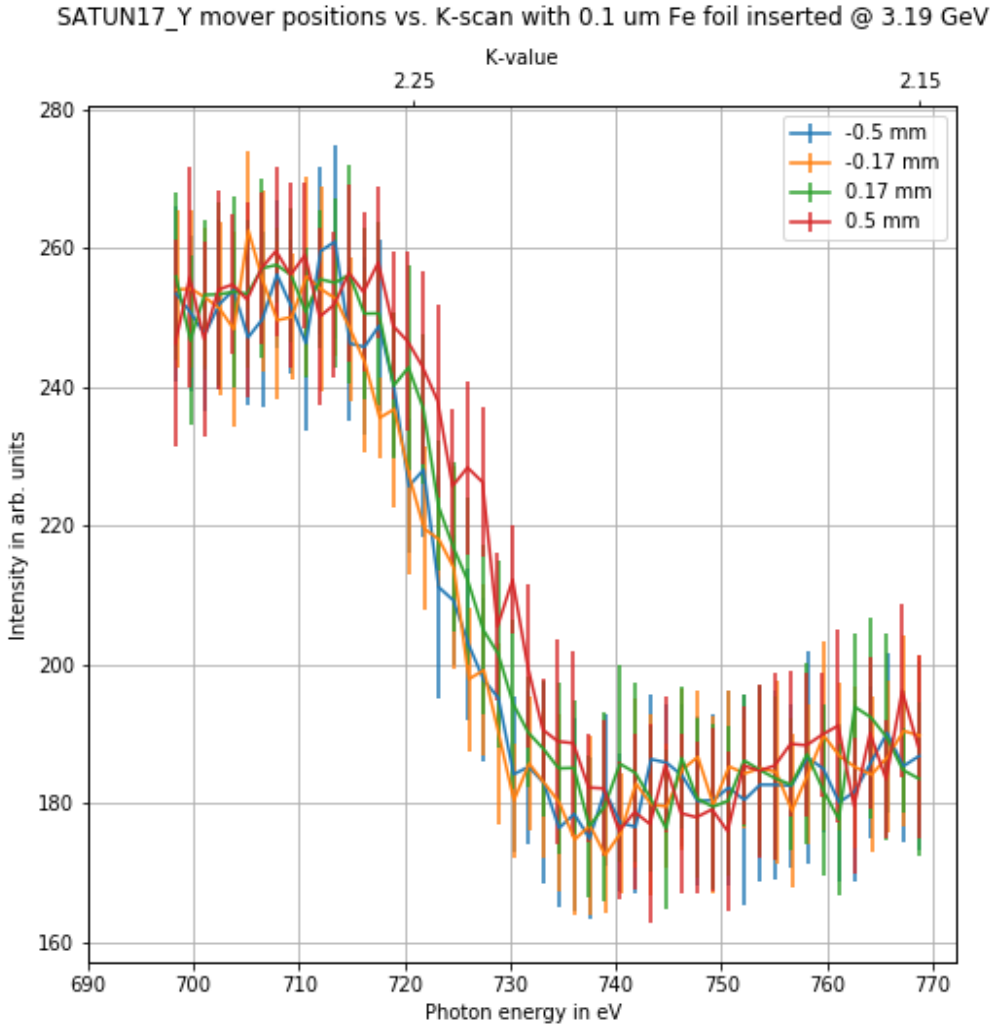


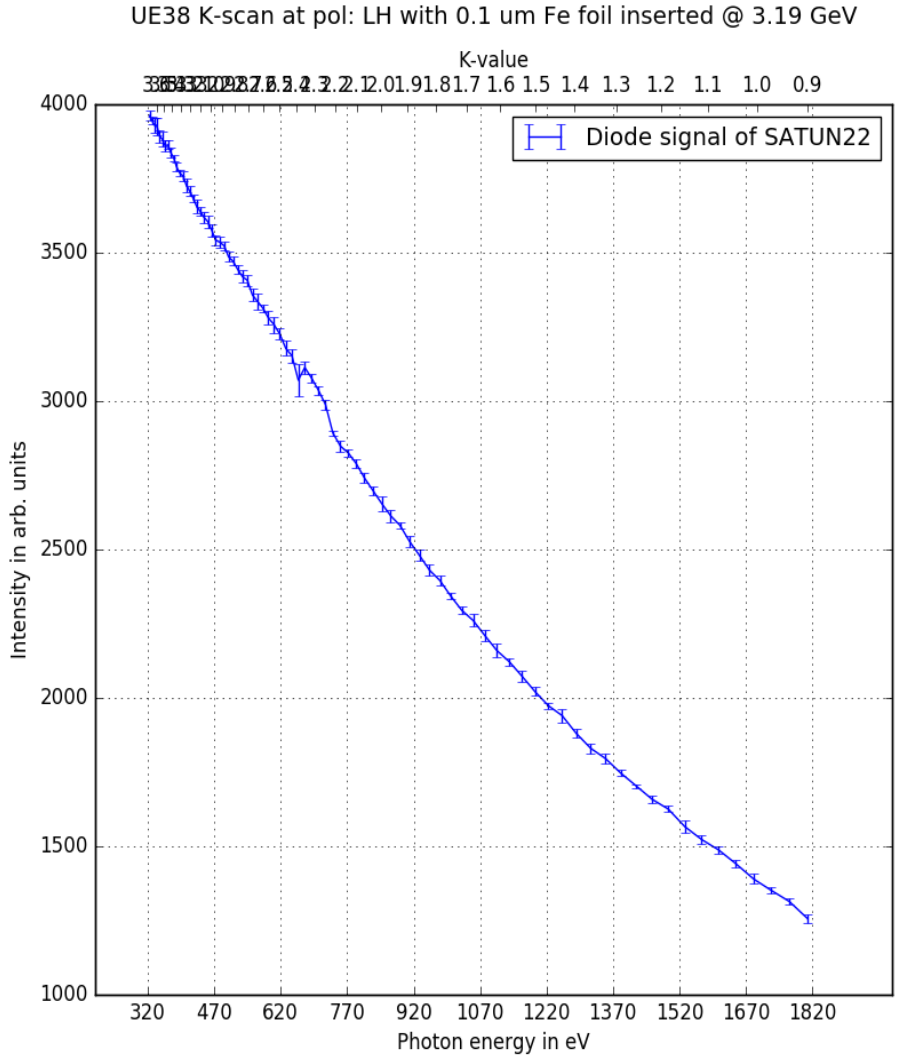
UE38 K-scan vs metallic filter

Slide from C. Kittel

C.Kittel, M.Calvi, C.Arrell

Repeated for different X and Y mover positions
and for linear horizontal polarization



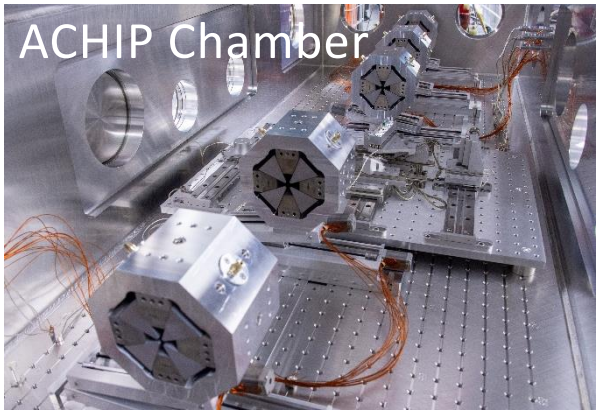


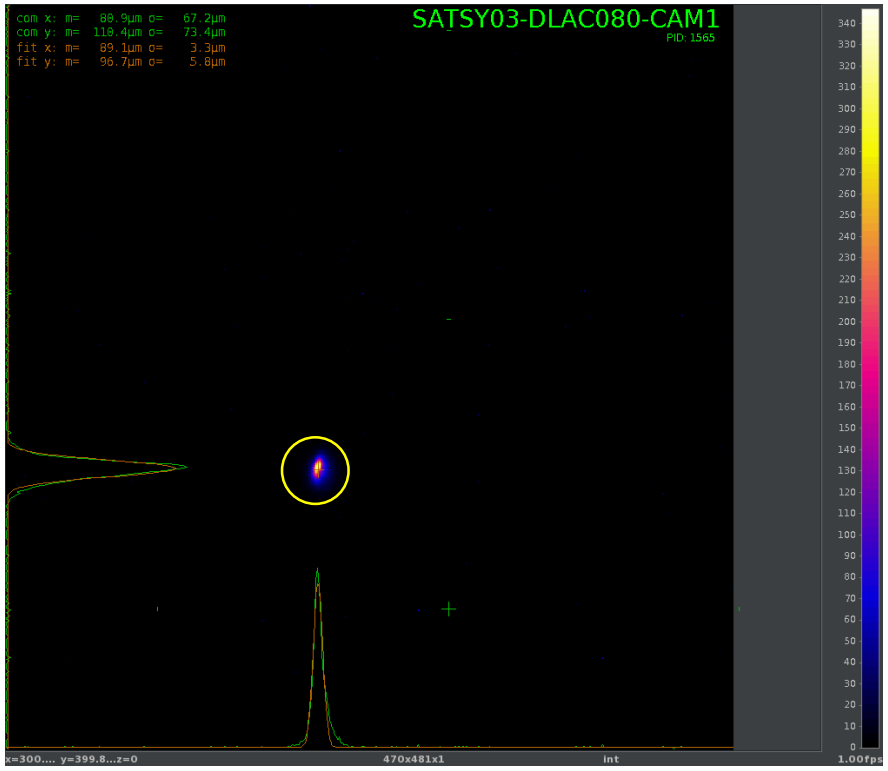
ACHIP focus studies

Slide from B. Hermann

B. Hermann, R. Ischebeck, P. Juranic, E. Prat

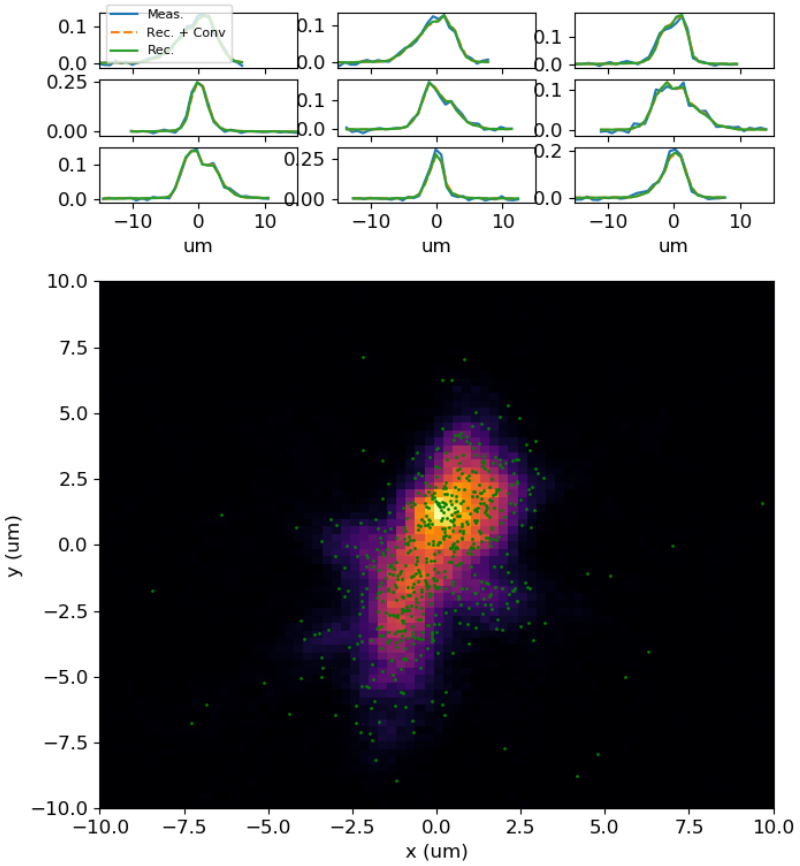
- Athos, 1 pC
- Focusing with permanent magnet triplet
- Commissioning of new YAG screen microscope





YAG + Microscope $\sigma_{x,y} = 3.3, 5.8$ um

New record!

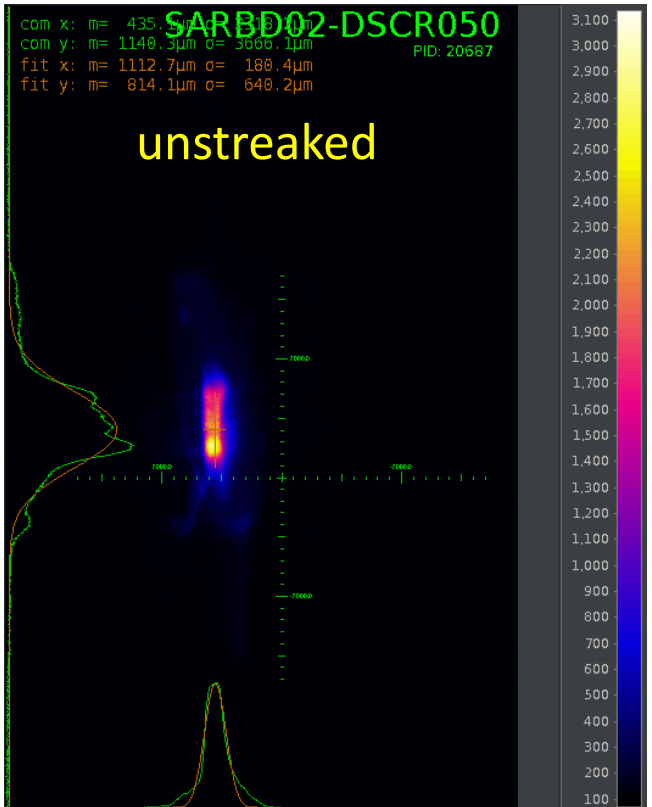


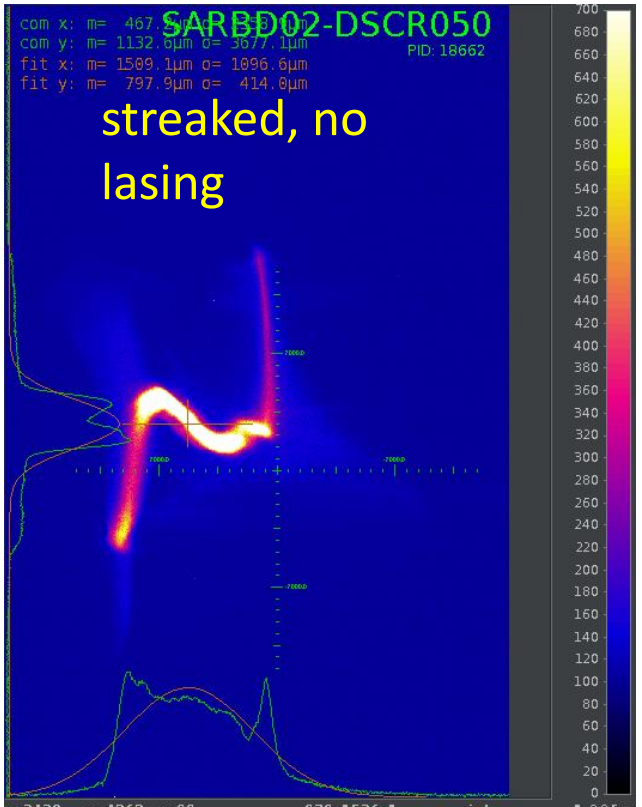
Wire Scan $\sigma_{x,y} = 1.6\ , 2.4$ um

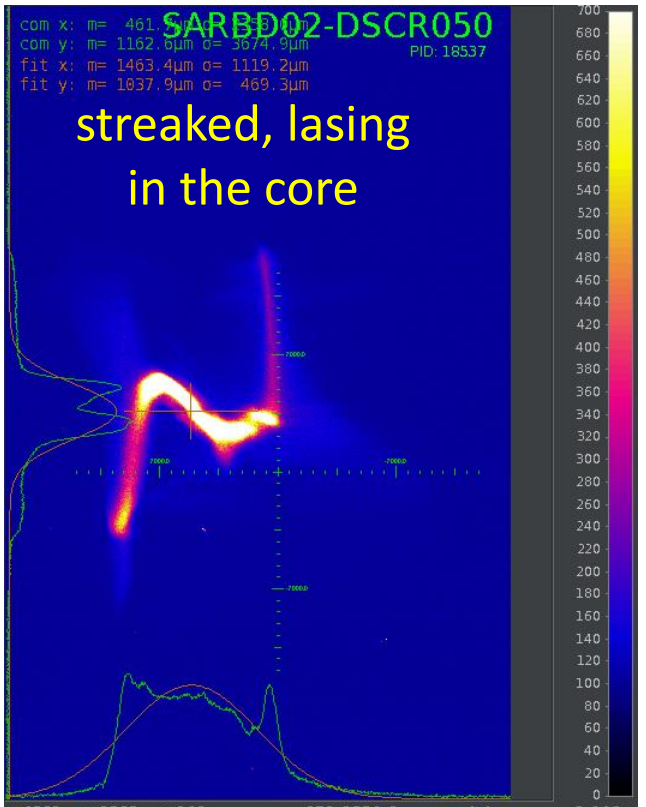
Short pulses with tilted beam

P. Dijkstal, E. Prat, S. Reiche

- Generated short pulses with beam tilt at energy collimator and BC2. Pulse reduced by factor 5 and more wrt standard case.
- This method allows to *continuously* vary the pulse duration with a single knob.
- Moved the lasing part of the beam by changing the trajectory
- The tilt can also be used to diagnose the FEL (without passive streaker)
- Many data saved for different cases. To be analyzed.



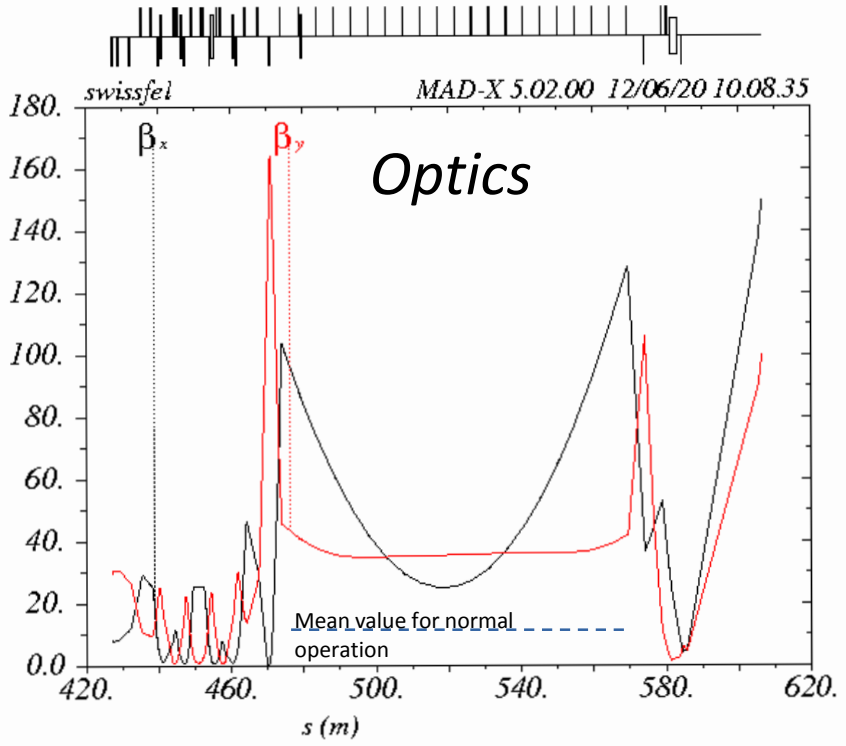


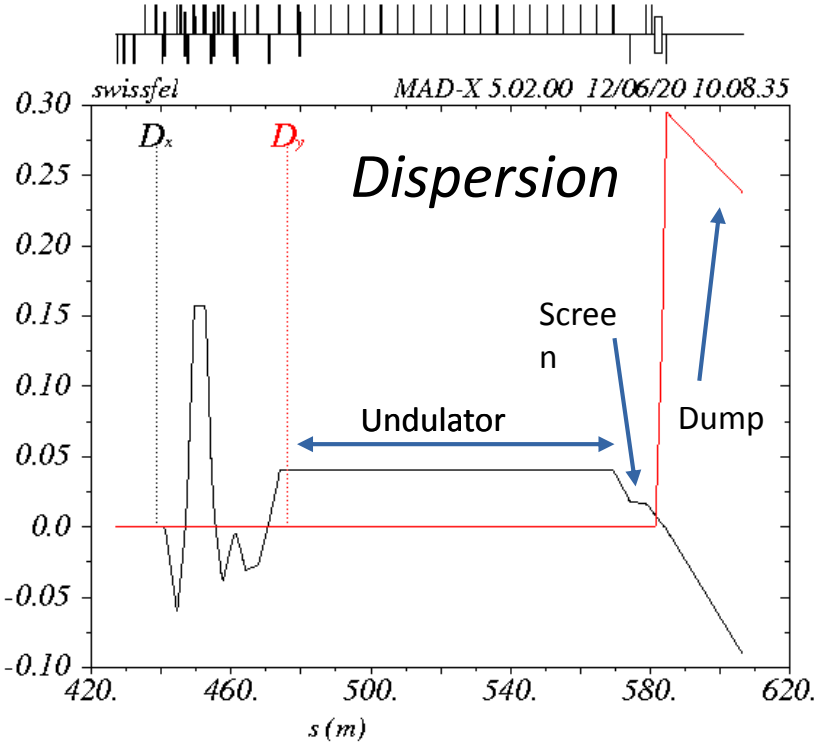


Spatially chirped FEL pulses (Procedure)

Slide from S. Reiche

- **Overcompression in BC2**
- *Needs isochronous set-up of the energy collimator*
- **Focusing-free optics in the undulator**
- *Free drift through the undulator. Only natural focusing of the undulator in the vertical plane*
- **Leak out dispersion into the undulator**
- *Chirp is converted into spatial tilt. Dispersion needs to be constant through the undulator*
- (Control chirp with dechirper)





Spatially chirped FEL pulses (Setup)

Slide from S. Reiche

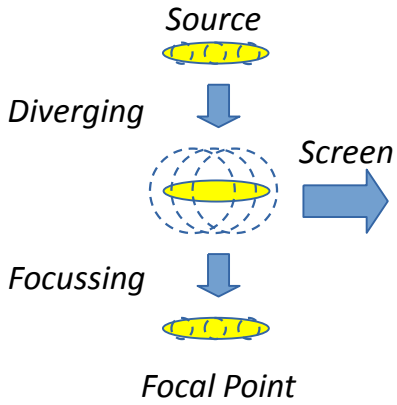
M. Boll, C. Kittel, N. Hiller, P. Dijkstal, E. Prat, S. Reiche

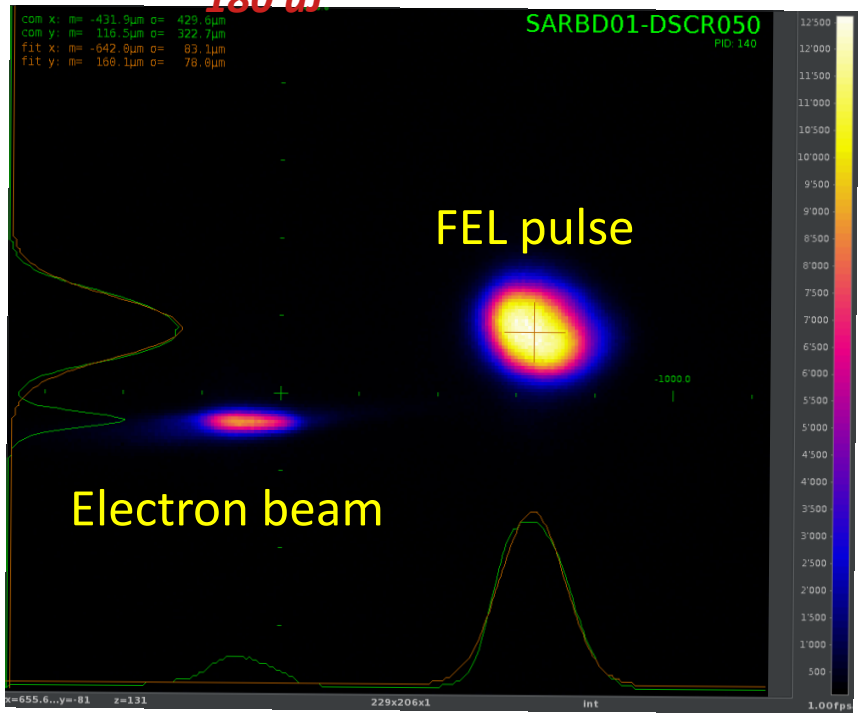
- Full set-up of the machine (new optics + new response matrices for feedback)
- No specific difficulties during the set-up (though CDR monitor for BC2 has low signal (no horns in current profile) and does not provide a stable signal.
  - No compression feedback till today (been checked today again)
  - PSICO uses Linac 1 phase directly (and acts as a slow feedback)
- Losses were manageable and mode can run with same repetition rate as standard normal mode.

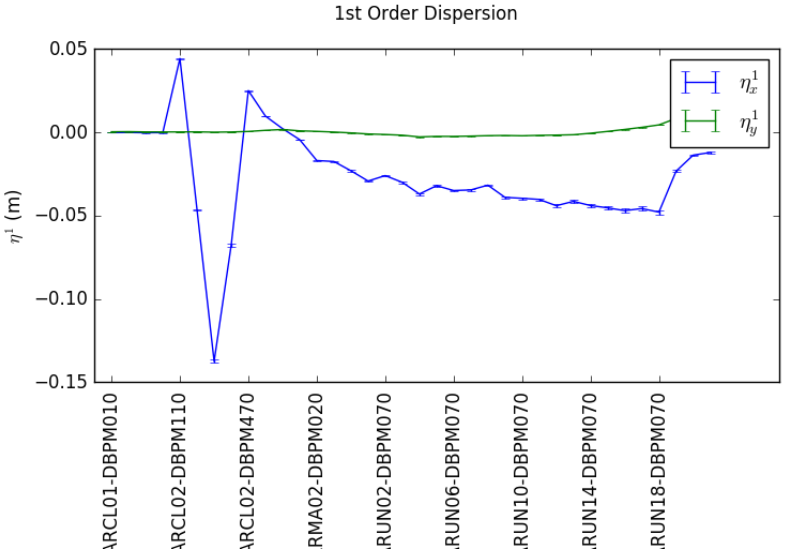
- ***Output much higher than expected. Optimized signal gave about 180 uJ***

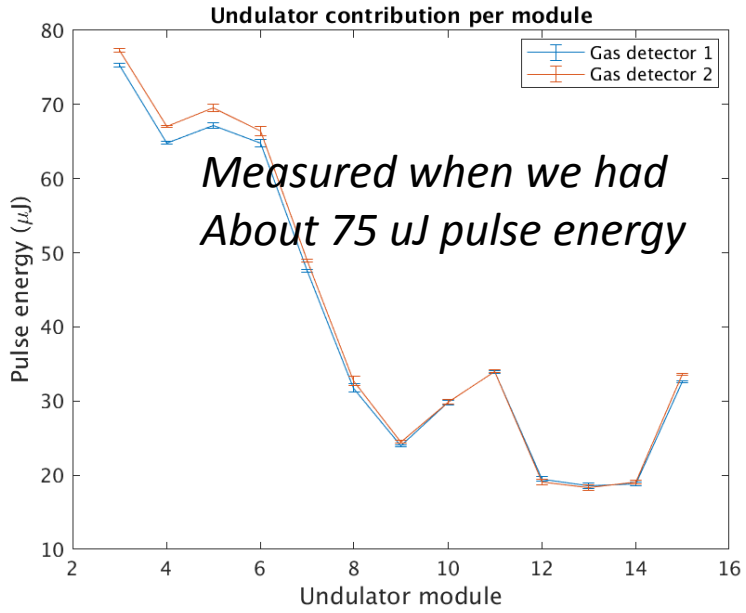
Why is the FEL beam not that flat?

Image is not in the focal point nor the source point!









Other studies

- BPM (Monday and Tuesday morning, B. Keil et al)
  - Test new BPM electronics in Athos with beam

- BBA (Wednesday morning, E. Ferrari)
  - dispersion corrected down to few hundred micrometer
  - work in progress

- Compression monitor (Wednesday late, F. Frei and W. Koprek).
  - Updated tools for feedbacks:
    - Changed firmware for BCM-BC1, CDR-BC1, CDR-BC2
    - Installed new version of high-level application and panels
  - Successful tests performed for different situations

Main issues

- Somebody or something changed magnet settings on Tuesday, causing losses and effectively ~2 hours of down time during the Athos BPM shift.
- SINSB01 problems. ~2 hours of downtime on Tuesday night. Replacement of power supply on Wednesday afternoon.
- SATUN22 got stack several times and needed a local reset
- Gas detector signal fluctuations due to vacuum valve regulation (Thursday)

Conclusions

- All week according to the calendar
- No major issues, some minor problems
- Good progress:
  - ✓ Component development: BPMs, compression monitors, screens, Athos gas detector
  - ✓ Athos undulator foil measurements
  - ✓ Athos lasing: 150 uJ at 360 eV with 6 modules
  - ✓ Established new operation mode for users: FEL pulses with energy and transverse chirps