PITZ Run Coordination (2019 / week 33)

Gun4.2 run

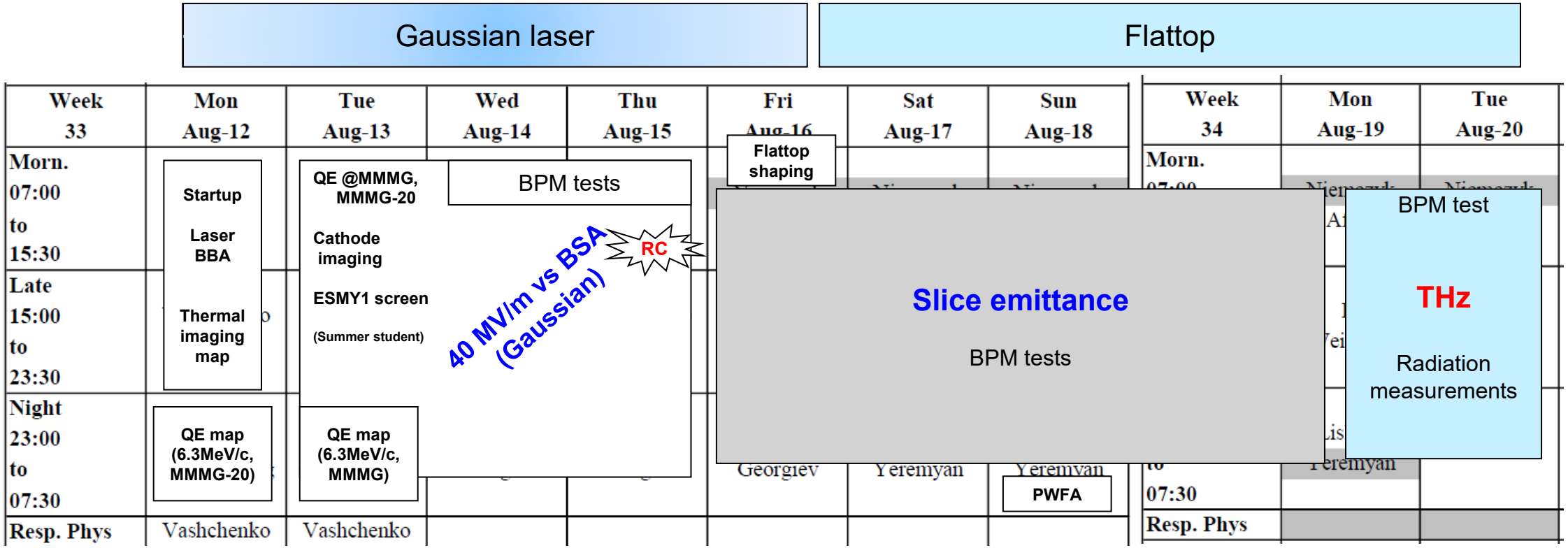
M. Krasilnikov
Zeuthen, 15.08.2019

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

DESY.

Shift planning for week 33

Status 12.08.2019



- QE map setting: 09.07.2019 07:01

Run Summary

Status 15.8.2019

- Preliminary (commissioning) test run on Thursday, 8.8.2019 to Friday, 9.8.2019 to check all the systems after timing upgrade in the shutdown (VME → µTCA):
  - RF1,2,5 → OK (minor tuning)
  - No general event number available – many servers were not running (e.g., DAQ, screen stations,…) → solved on Friday, 9.8.2019
  - Laser shows 18.5ns (54MHz) jumping → solved on Monday, 12.08 (cable termination issue)
- Regular run started on Monday, 12.8.2019 ➔ **Achievements:**
  - All systems (almost) have been checked with electron beam
  - Laser BBA done
  - Thermal emittance measurements – done partially (thermal emittance map – 20190815N)
  - QE(cathode#672.1)=25%, QE map → done
  - Cathode imaging with electron beam → done
  - Some screen studies → done?
  - RF2 (gun) LLRF tests by HH experts (remotely)
  - Commissioning of new **BPM** electronics with beam
    → B. Lorbeer: "…position reading is stable like in the system we have here at FLASH…" !
  - Repeat (refine) emittance optimization for 40MV/m and Gaussian laser pulses → ongoing!
- Further program:
  - Slice emittance measurements
  - High-charge studies for THz generation

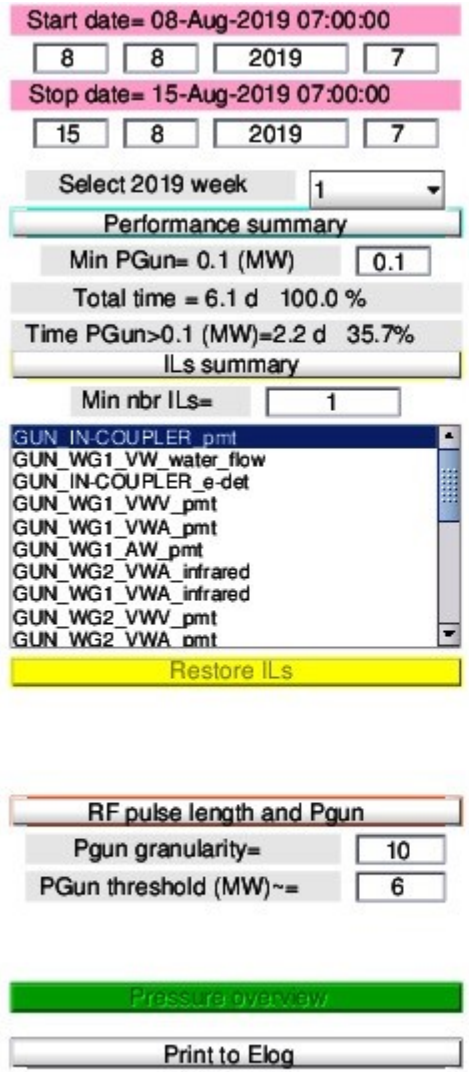
Run Summary: problems

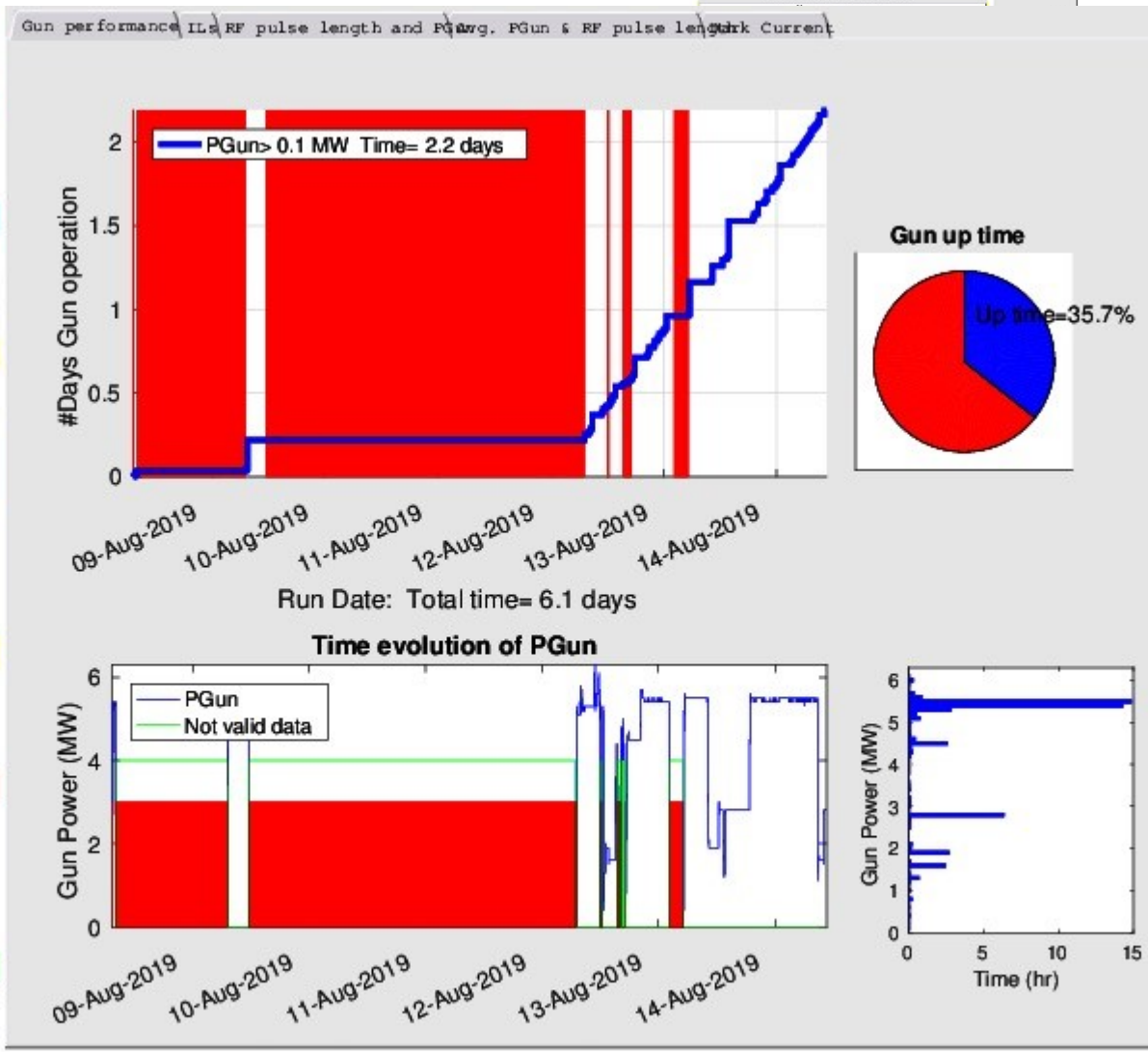
Status 15.8.2019

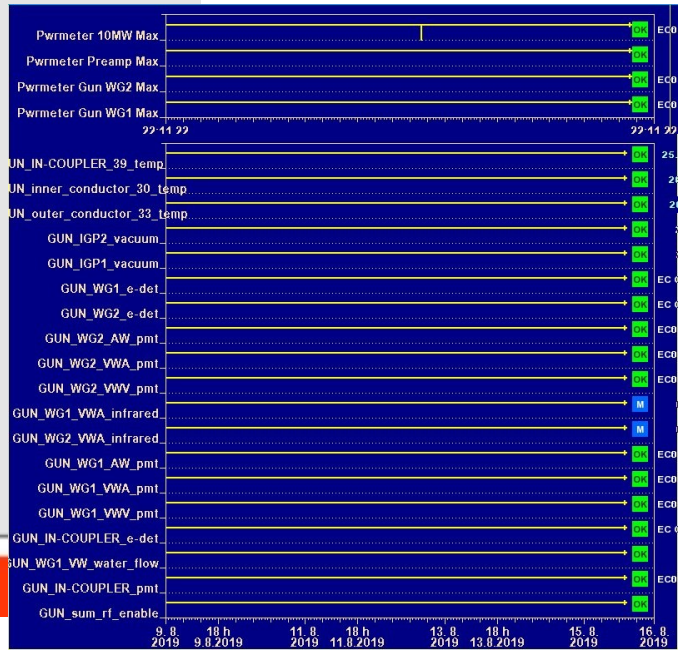
- Problems:
  - 18,5ns (54MHz) laser pulse jumps – solved by Mario (cable termination)
  - Laser distribution at VC2 is inhomogeneous – fixed by laser alignment at BSA
  - Water pipe was blocking LEDA viewport. Tunnel had to be opened to fix this problem. Nevertheless due to pipes distribution in the vicinity of LEDA it is not guaranteed that it will not be blocked again. To be fixed during the shutdown.
  - Big valve at Gun WCS doesn't work => long gun recovery times →fixed
  - Checked position on vacuum mirror (14.08M) - we were on the edge. Last vacuum mirror scan was done in April!
  - Experts lists are not available in the e-logbook
  - EMSY1 beta angle cannot be properly controlled → ??
  - **OSS does not work!**
  - …

Summary

Ils_gui: → no ILs, but they were?





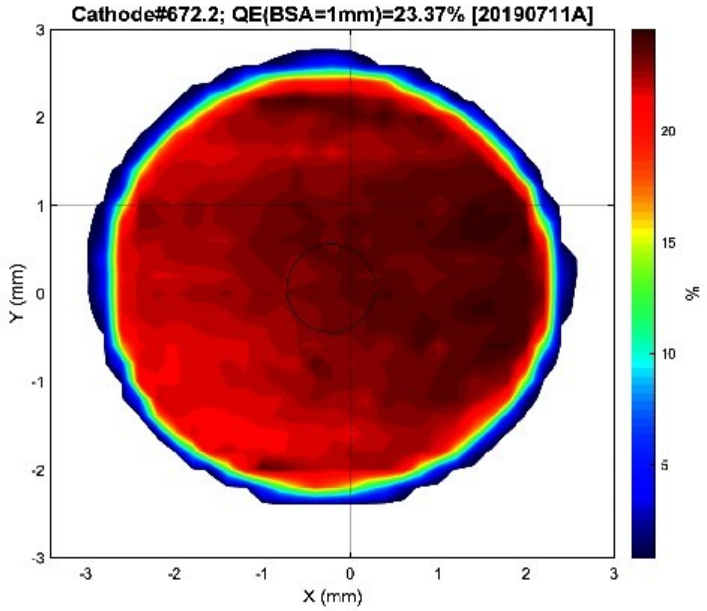


Done. Gun performance calculated for selected time interval.

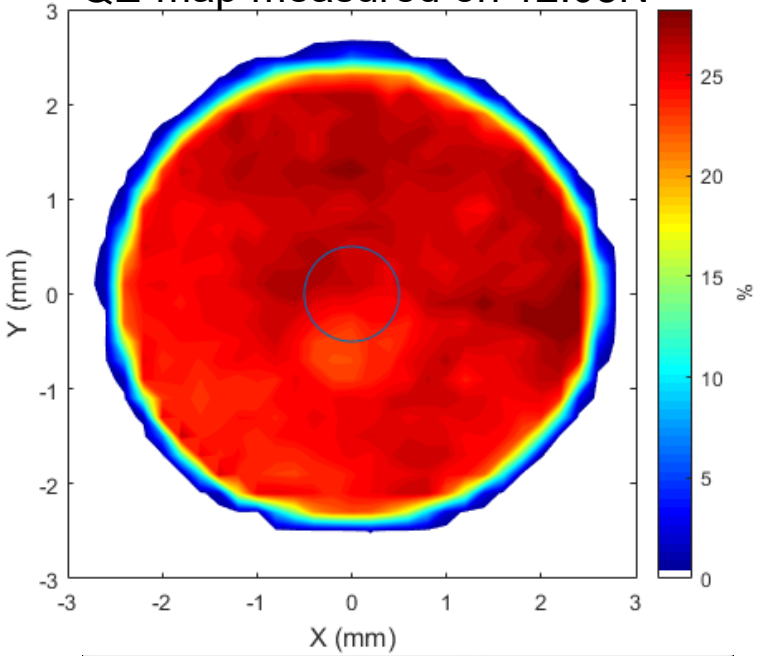
QE and QE map

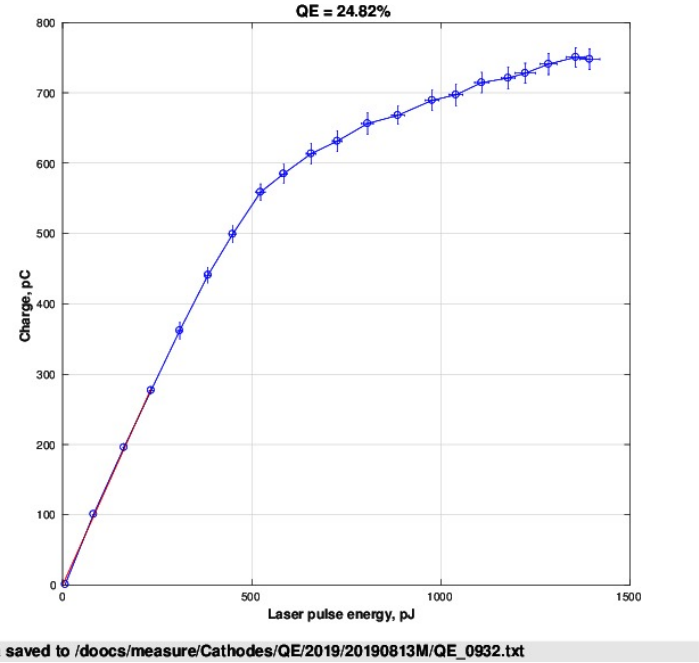
Checked position on vacuum mirror (14.08M) - we were on the edge!

Cathode#672.1 (10nm) fresh
QE-map measured on 11.07A

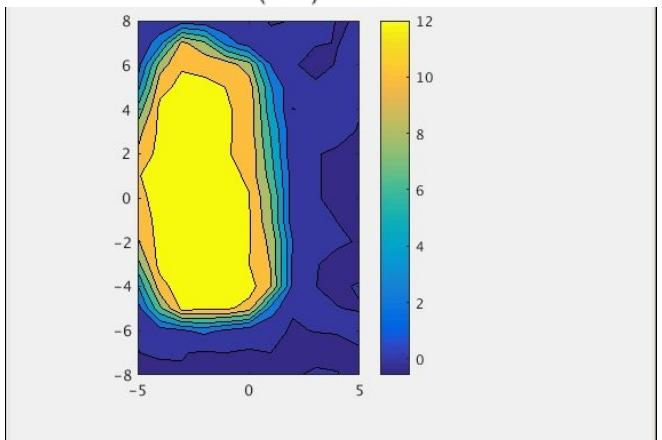


Cathode#672.1 (10nm) fresh
QE-map measured on 12.08N





Data saved to /doocs/measure/Cathodes/QE/2019/20190813M/QE_0932.txt



Emittance 40MV/m, Gaussian lase pulses (FEL2019 paper)

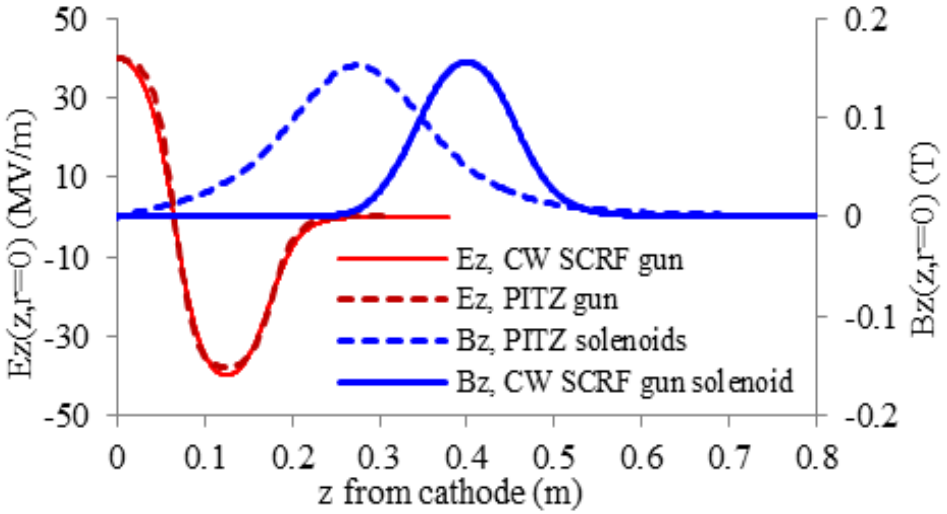
"PITZ experimental optimization for the aimed cathode gradient of a superconducting CW RF gun"

Motivation:

- CW SCRF gun ("TESLA-like" 1.5-cell cavity with Ecath=40MV/m) + solenoid after gun + ACC1 (8xTESLA cavities 14.5MeV/cavity), Gaussian laser pulses σ_t=4ps, Q=100pC
  → optimization {σ_{xy}^{laser}, peak solenoid field, gun phase}
- PITZ setup with Ecath=40MV/m, CDS (acceleration ~ 1st cavity of ACC1), Gaussian laser pulses σ_t=2.6ps, Q=100pC
- Simulations for the **PITZ** experimental setup (radiall homogeneous laser and C+H)

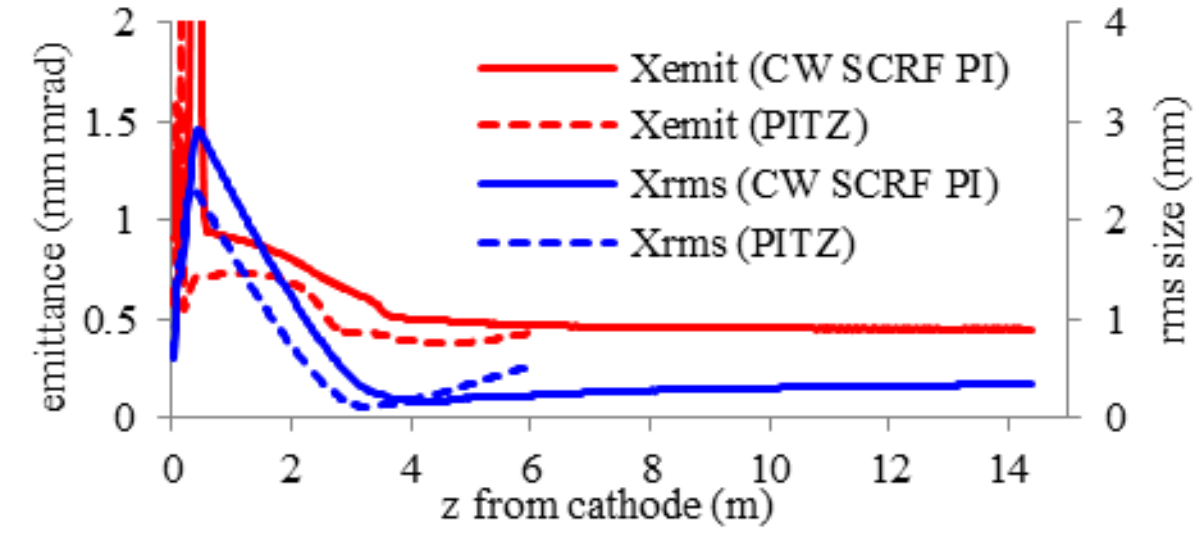
⇨ M. Dohlus for **CW SCRF PI** setup and initial results, then MK, XKL for optimization

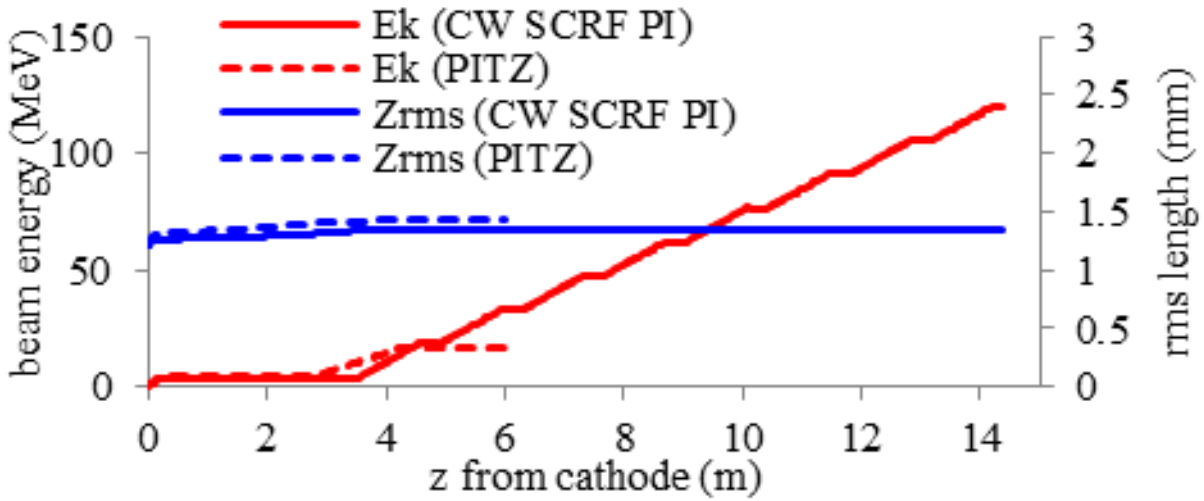
⇨ X.-K. Li

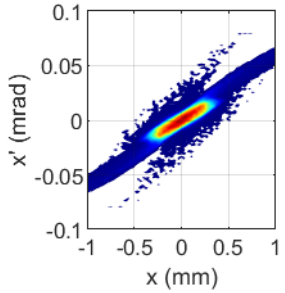
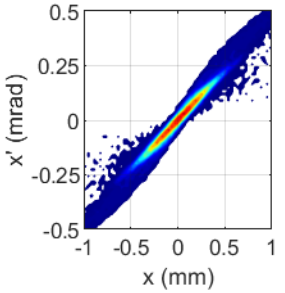
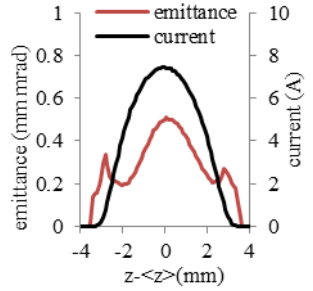
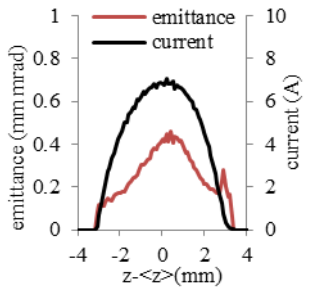


Emittance 40MV/m, Gaussian lase pulses (FEL2019 paper)

ASTRA simulations

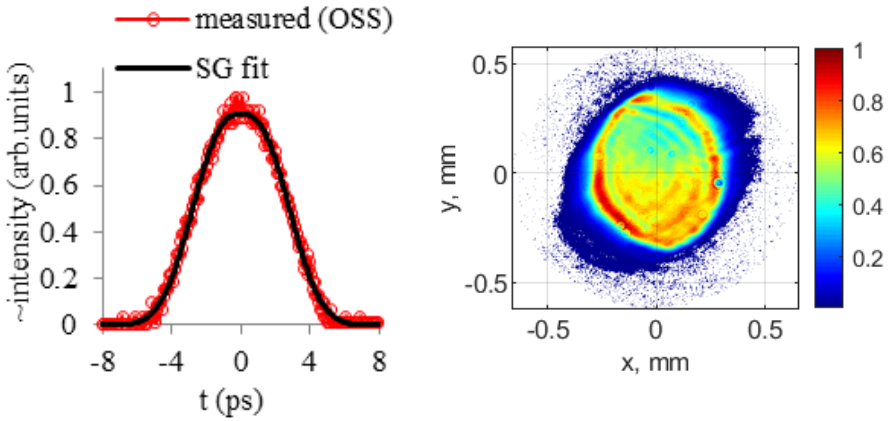


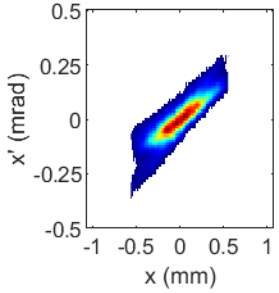
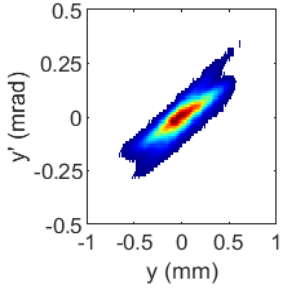
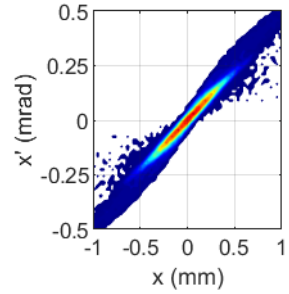


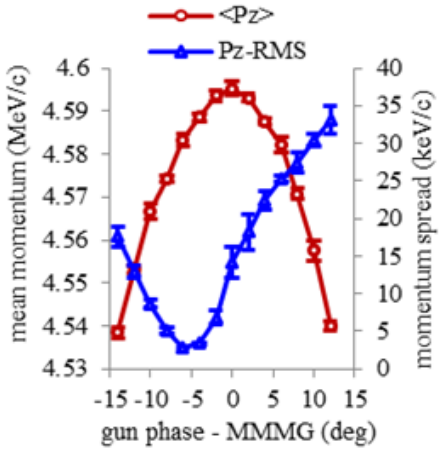
	CW SCRF PI	PITZ
X-X'		
slice		

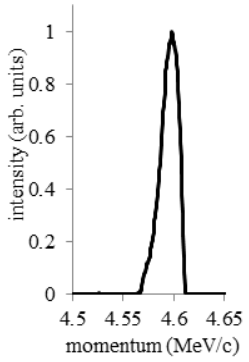
Emittance 40MV/m, Gaussian lase pulses (FEL2019 paper)

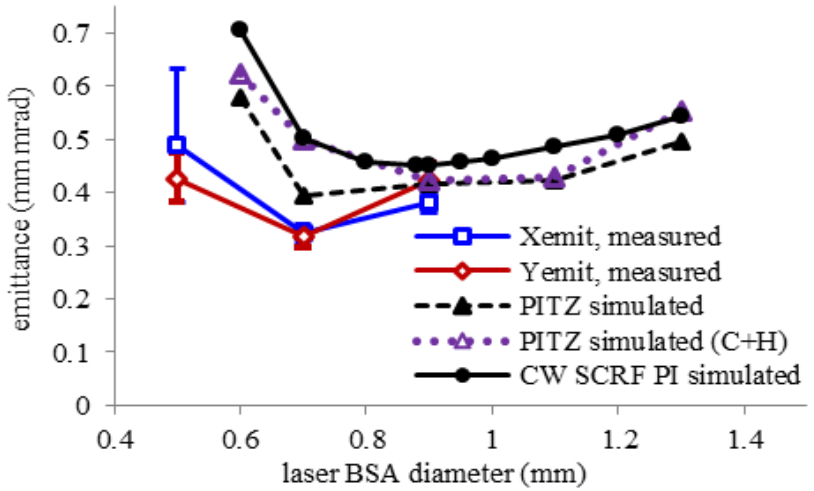
Experimental optimization (gain=12dB)

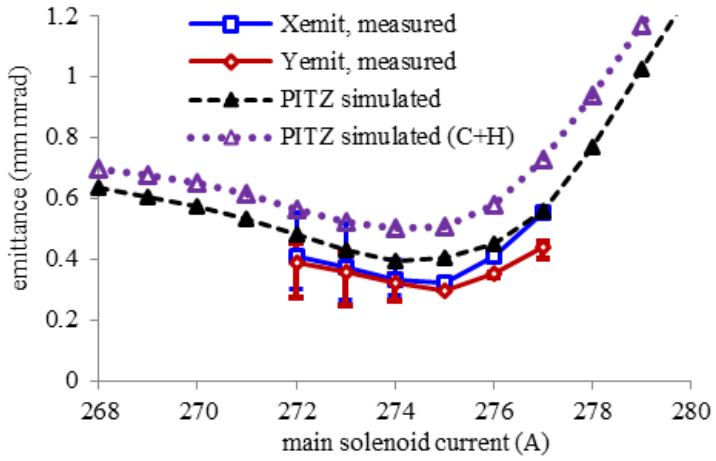


X-X', measured	Y-Y', measured	X-X', ASTRA
		









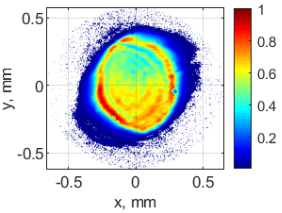
CONCLUSION

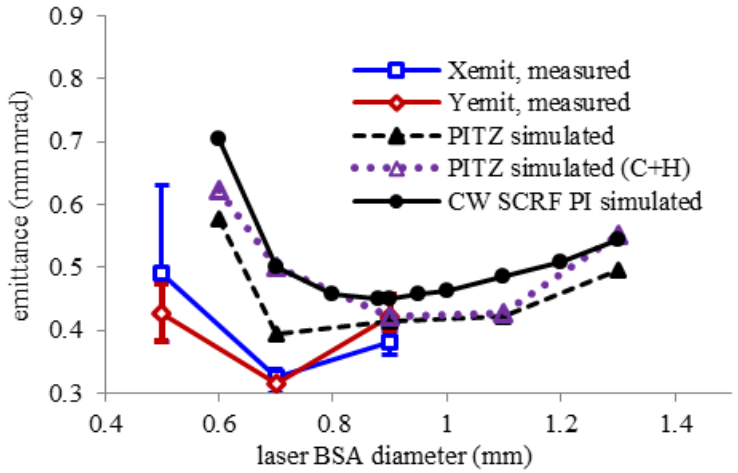
Beam dynamics simulations for a CW SCRF photo injector of the European XFEL have been performed assuming a peak RF electric field of 40 MV/m at the photocathode and 100 pC bunch charge generated by Gaussian photocathode laser pulses yielding optimum emittance values of ~0.5 mm mrad. Experimental studies for this parameter space have been done at PITZ and yielded emittance values of ~0.3-0.4 mm mrad. The difference in optimized emittance between PITZ and CW SCRF PI setups is mainly related to the main solenoid position w.r.t. the gun cavity.

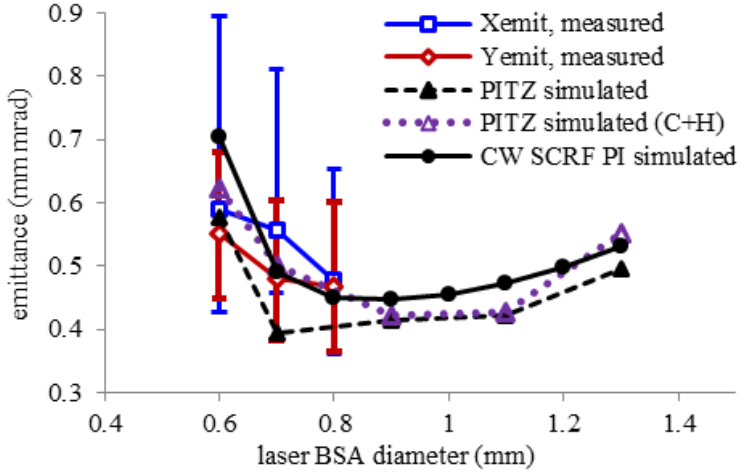
Emittance 40MV/m, Gaussian lase pulses

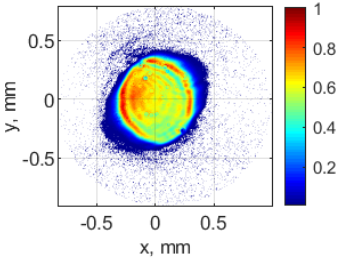
Experimental optimization (measurements of week 33 → gain=0dB)

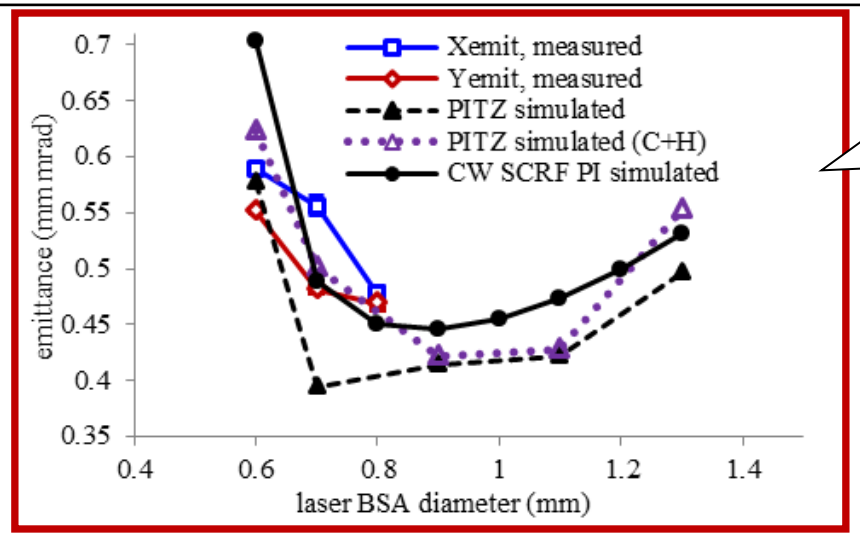
Gain=12dB	Gain=0dB







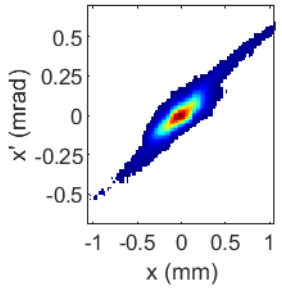
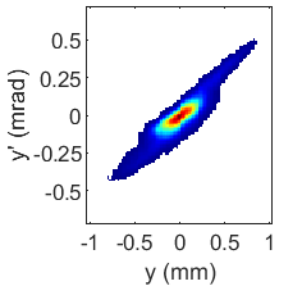
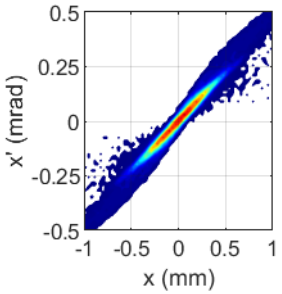
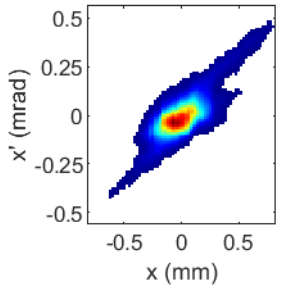
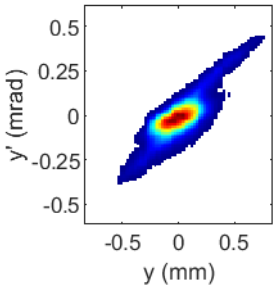




No error bars and zoomed

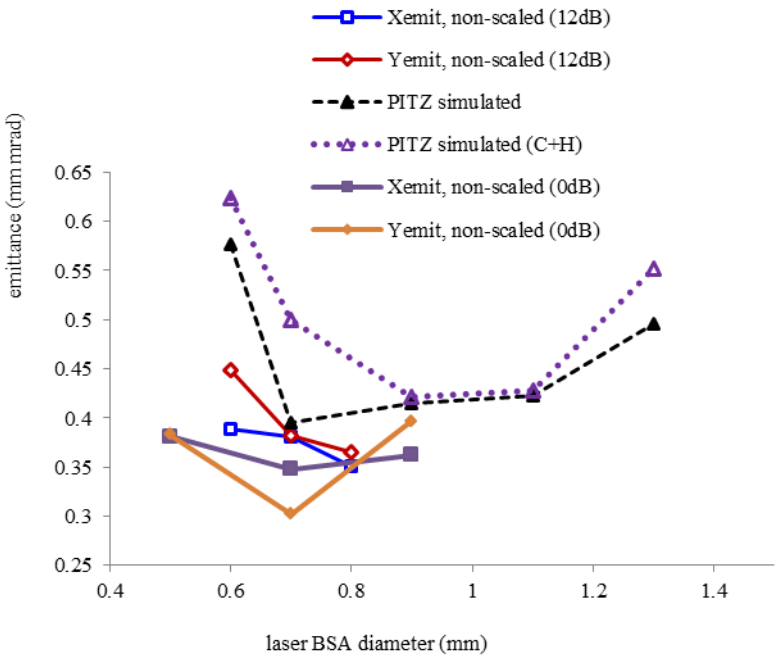
Emittance 40MV/m, Gaussian lase pulses (FEL2019 paper)

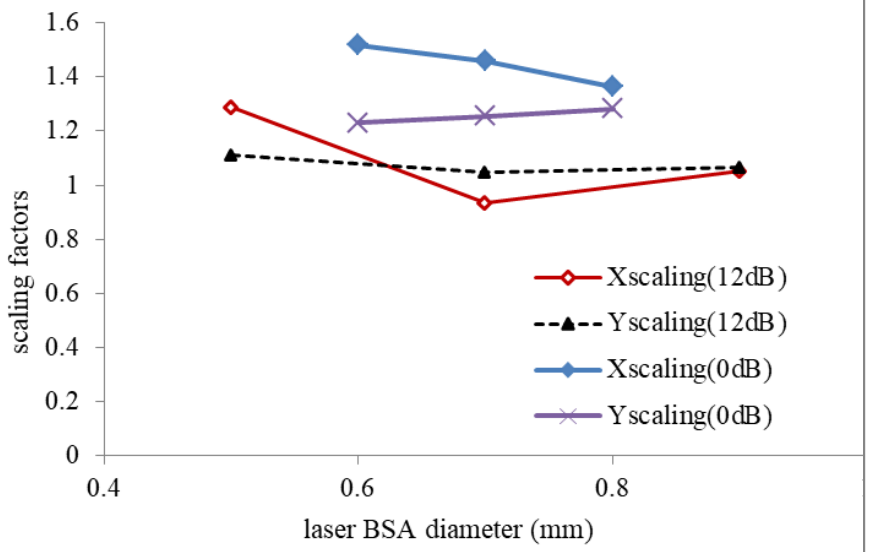
Experimental optimization (gain=0dB)

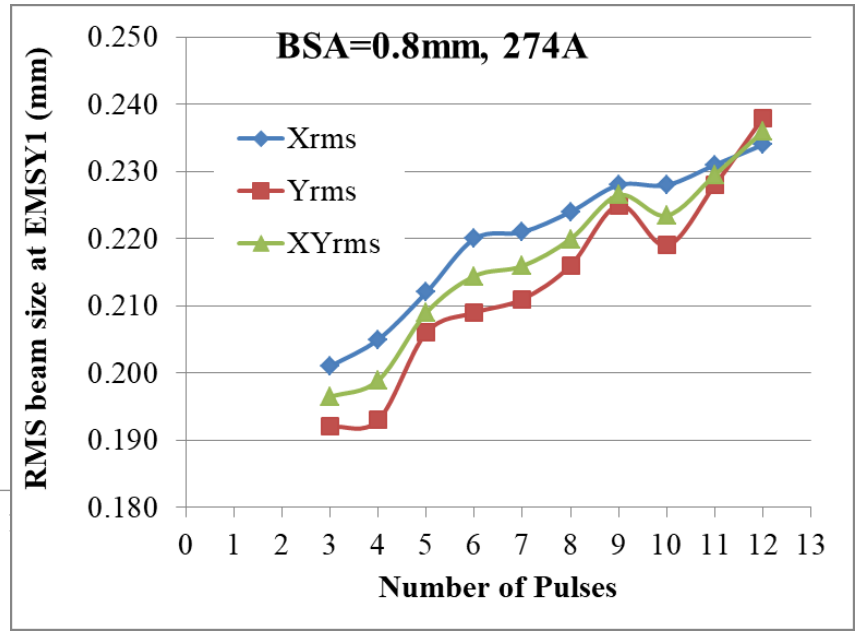
BSA	X-X', measured	Y-Y', measured	X-X', ASTRA
BSA=0.7mm			
BSA=0.8mm			

Scaling factors and beam EMSY

12dB vs 0dB







???

Shift planning for week 33

Status 12.08.2019

Gaussian laser

Flattop

Week 33	Mon Aug-12	Tue Aug-13	Wed Aug-14	Thu Aug-15	Fri Aug-16	Sat Aug-17	Sun Aug-18	Week 34	Mon Aug-19	Tue Aug-20
Morn. 07:00 to 15:30	Startup Laser BBA Thermal imaging map	QE @MMMG, MMMG-20 Cathode imaging ESMY1 screen (Summer student)	BPM tests	RC 40 MV/m vs BSA (Gaussian)	Flattop shaping	Slice emittance BPM tests?				BPM test THz Radiation measurements
Late 15:00 to 23:30										
Night 23:00 to 07:30	QE map (6.3MeV/c, MMMG-20)	QE map (6.3MeV/c, MMMG)		therm. emit. map	Georgiev	Yeremyan	Yeremyan PWFA	07:30		
Resp. Phys	Vashchenko	Vashchenko						Resp. Phys