

PITZ Run Coordination (2019 / week 33)

Gun4.2 run

M. Krasilnikov
Zeuthen, 15.08.2019

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	QE @MMMG, MMMG-20 Cathode imaging	BPM tests		Flattop shaping			Morn. 07:00						
Late 15:00 to 23:30	Thermal imaging map	ESMY1 screen (Summer student)	<i>40 MV/m vs BSA (Gaussian)</i> RC		Slice emittance BPM tests			THz Radiation measurements						
Night 23:00 to 07:30	QE map (6.3MeV/c, MMMG-20)	QE map (6.3MeV/c, MMMG)									Georgiev	Yeremyan	Yeremyan PWFA	
Resp. Phys	Vashchenko	Vashchenko											Resp. Phys	

- 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 → μ TCA):
 - 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:

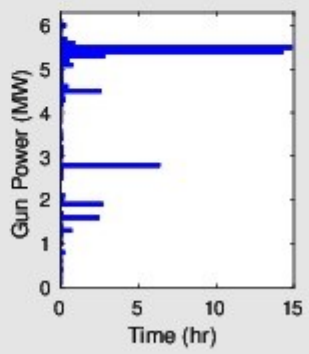
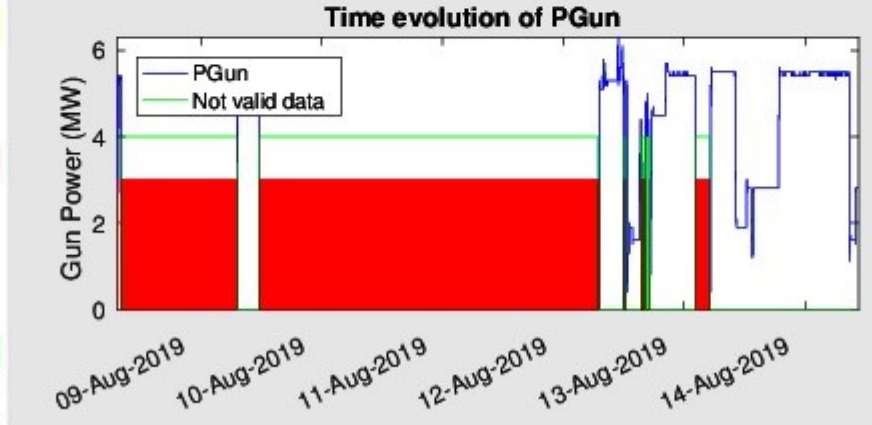
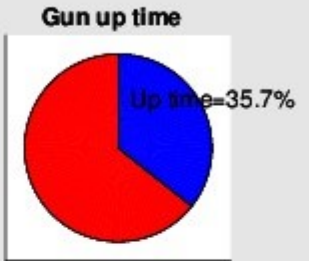
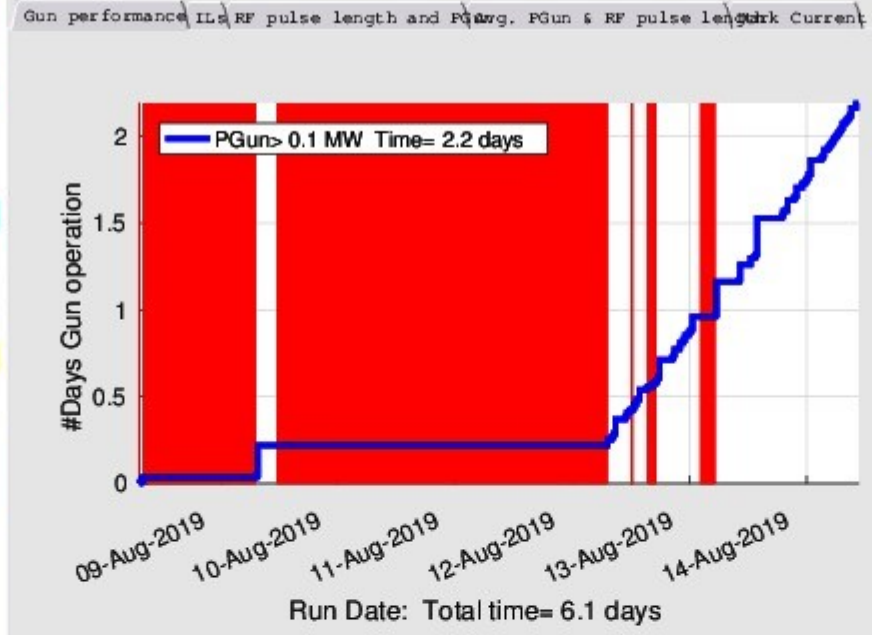
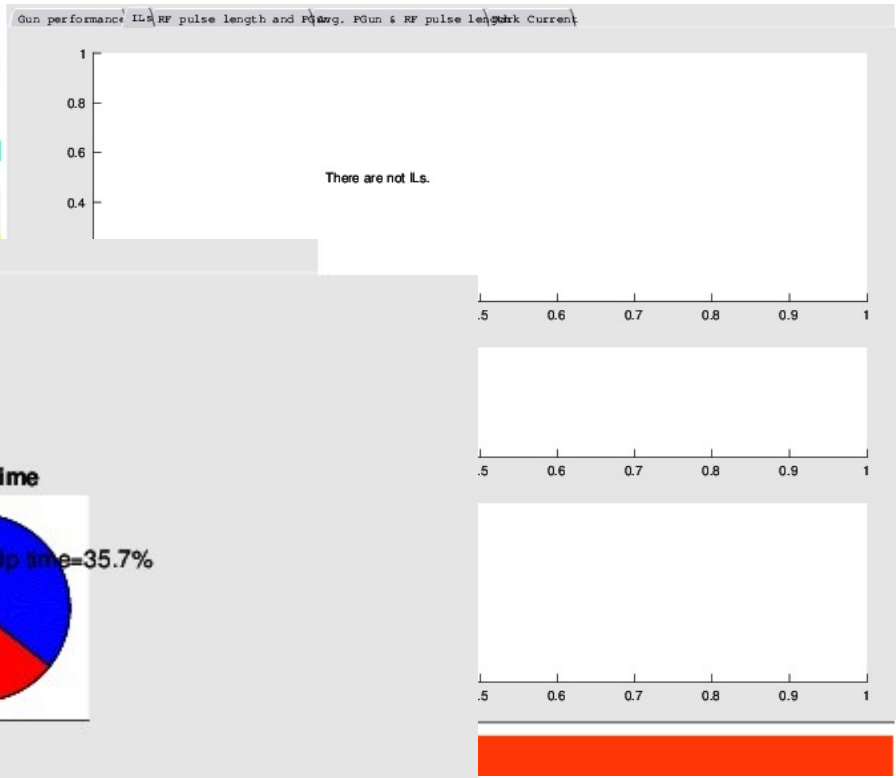
- 18,5ns (54MHz) laser pulse jumps – solved by Mario (cable termination)
- Laser distribution at VC2 is inhomogeneous – fixed by laser alignment at BSA
- Water pipe was blocking LEDA viewport. Tunnel had to be opened to fix this problem. Nevertheless due to pipes distribution in the vicinity of LEDA 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?

Start date= 08-Aug-2019 07:00:00
 8 8 2019 7
 Stop date= 15-Aug-2019 07:00:00
 15 8 2019 7
 Select 2019 week 1
 Performance summary
 Min PGun= 0.1 (MW) 0.1
 Total time = 6.1 d 100.0 %
 Time PGun>0.1 (MW)=2.2 d 35.7%
 ILs summary
 Min nbr ILs= 1
 GUN_IN-COUPLER_pmt
 GUN_WG1_VW_water_flow
 GUN_IN-COUPLER_e-det
 GUN_WG1_VWV_pmt
 GUN_WG1_VWA_pmt
 GUN_WG1_AW_pmt
 GUN_WG2_VWA_infrared
 GUN_WG1_VWA_infrared
 GUN_WG2_VWV_pmt
 GUN_WG2_VWA_pmt
 Restore ILs
 RF pulse length and Pgun
 Pgun granularity= 10
 PGun threshold (MW)~= 6
 Pressure overview
 Print to Elog

Start date= 08-Aug-2019 07:00:00
 8 8 2019 7
 Stop date= 15-Aug-2019 07:00:00
 15 8 2019 7
 Select 2019 week 1
 Performance summary
 Min PGun= 0.1 (MW) 0.1
 Total time =
 Time PGun>0.1MW =



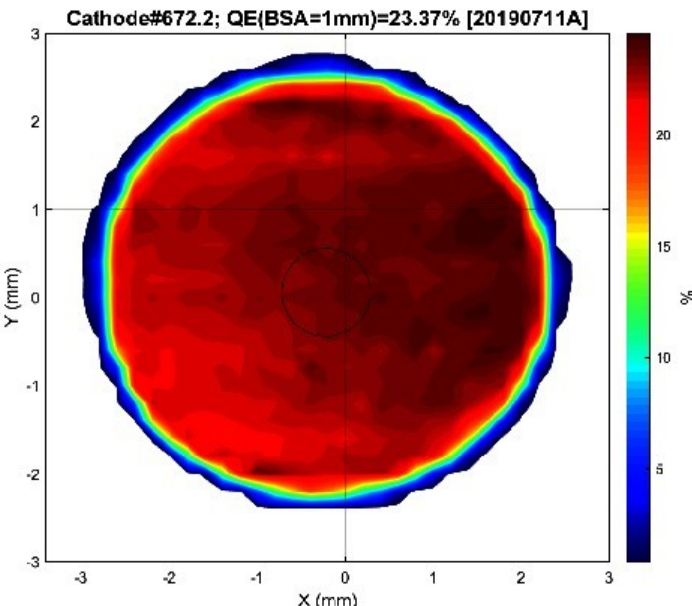
Pwrmeter 10MW Max.	25	ECO
Pwrmeter Preamp Max.	24	ECO
Pwrmeter Gun WG2 Max.	23	ECO
Pwrmeter Gun WG1 Max.	22	ECO
GUN_IN-COUPLER_39_temp	21	ECO
GUN_inner_conductor_30_temp	20	ECO
GUN_outer_conductor_33_temp	19	ECO
GUN_IGP2_vacuum	18	ECO
GUN_IGP1_vacuum	17	ECO
GUN_WG1_e-det	16	ECO
GUN_WG2_e-det	15	ECO
GUN_WG2_AW_pmt	14	ECO
GUN_WG2_VWA_pmt	13	ECO
GUN_WG2_VWV_pmt	12	ECO
GUN_WG1_VWA_infrared	11	M
GUN_WG2_VWA_infrared	10	M
GUN_WG1_AW_pmt	9	ECO
GUN_WG1_VWA_pmt	8	ECO
GUN_WG1_VWV_pmt	7	ECO
GUN_IN-COUPLER_e-det	6	ECO
GUN_WG1_VW_water_flow	5	ECO
GUN_IN-COUPLER_pmt	4	ECO
GUN_sum_rf_enable	3	ECO

Done. Gun performance calculated for selected time interval.

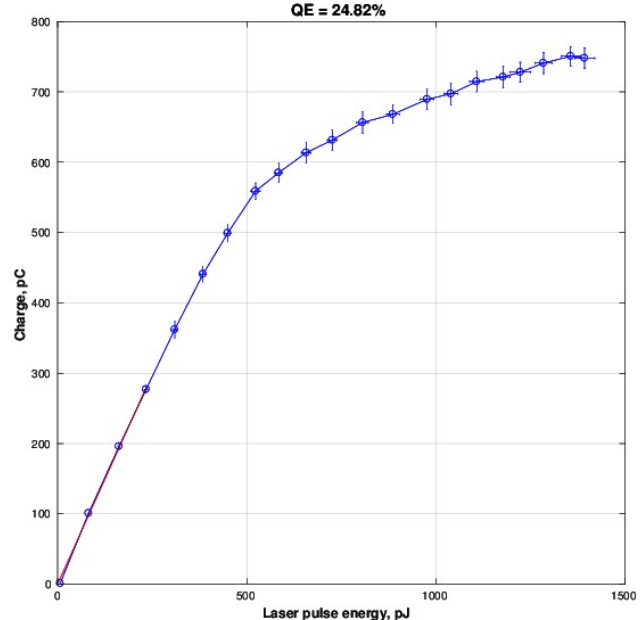
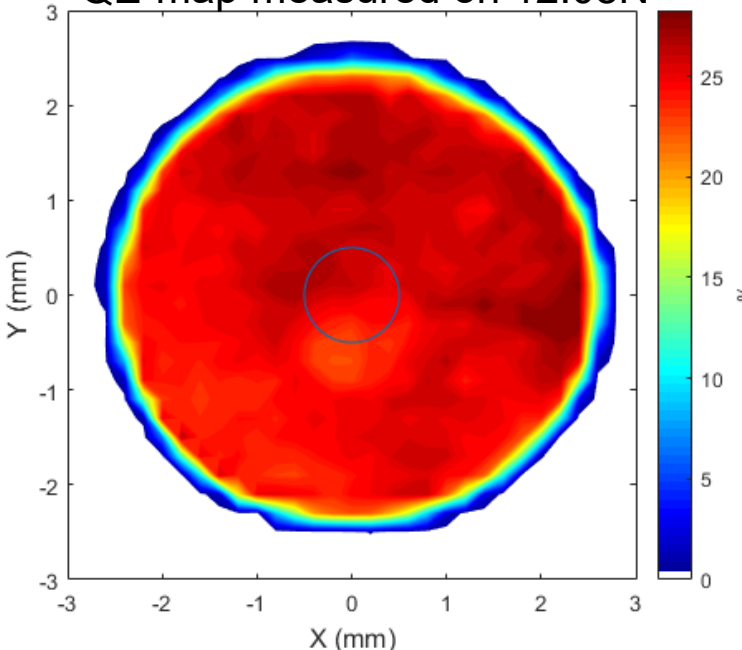
QE and QE map

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

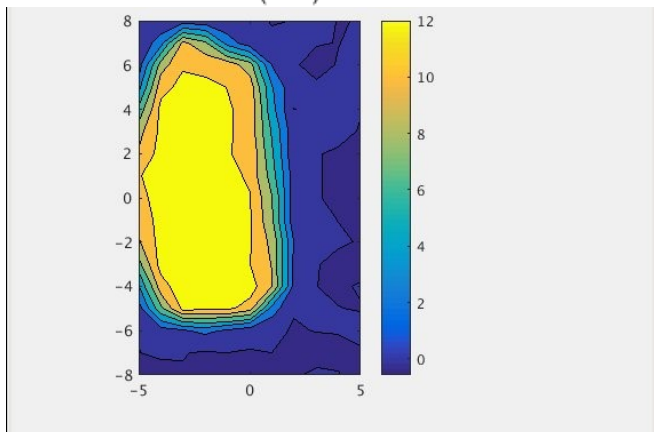
Cathode#672.1 (10nm) fresh
QE-map measured on 11.07A



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



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

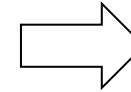


Emittance 40MV/m, Gaussian laser pulses (FEL2019 paper)

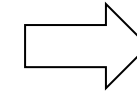
“PITZ experimental optimization for the aimed cathode gradient of a superconducting CW RF gun”

Motivation:

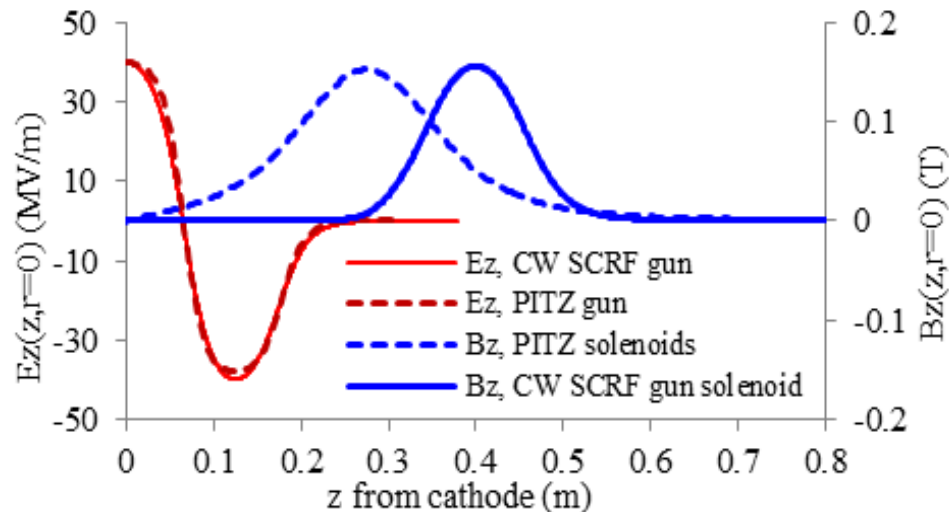
- CW SCRF gun (“TESLA-like” 1.5-cell cavity with $E_{\text{cath}}=40\text{MV/m}$) + solenoid after gun + ACC1 (8xTESLA cavities 14.5MeV/cavity), Gaussian laser pulses $\sigma_t=4\text{ps}$, $Q=100\text{pC}$
→ optimization $\{\sigma_{xy}^{\text{laser}}, \text{peak solenoid field, gun phase}\}$
- PITZ setup with $E_{\text{cath}}=40\text{MV/m}$, CDS (acceleration $\sim 1^{\text{st}}$ cavity of ACC1), Gaussian laser pulses $\sigma_t=2.6\text{ps}$, $Q=100\text{pC}$
- Simulations for the PITZ experimental setup (radially homogeneous laser and C+H)



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

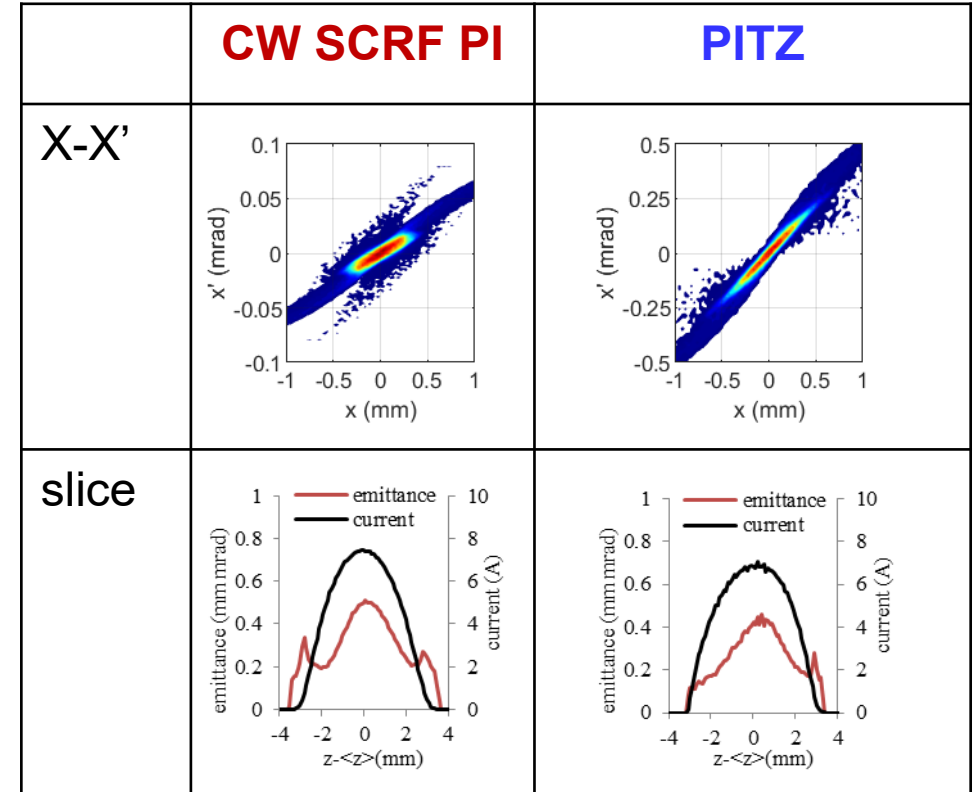
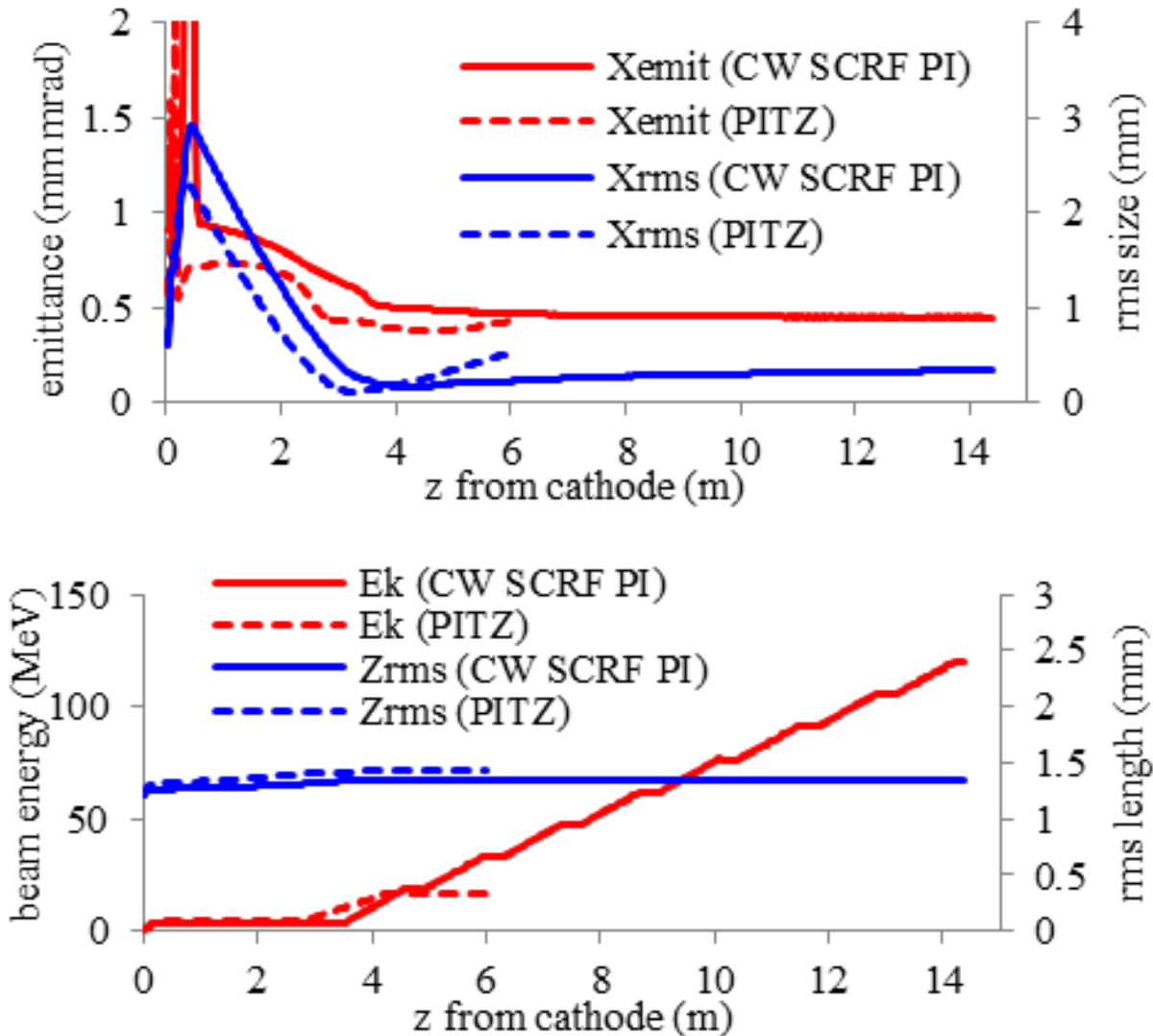


X.-K. Li



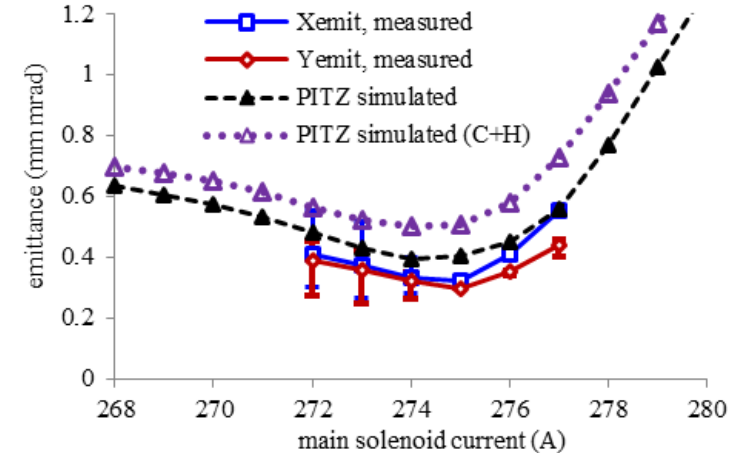
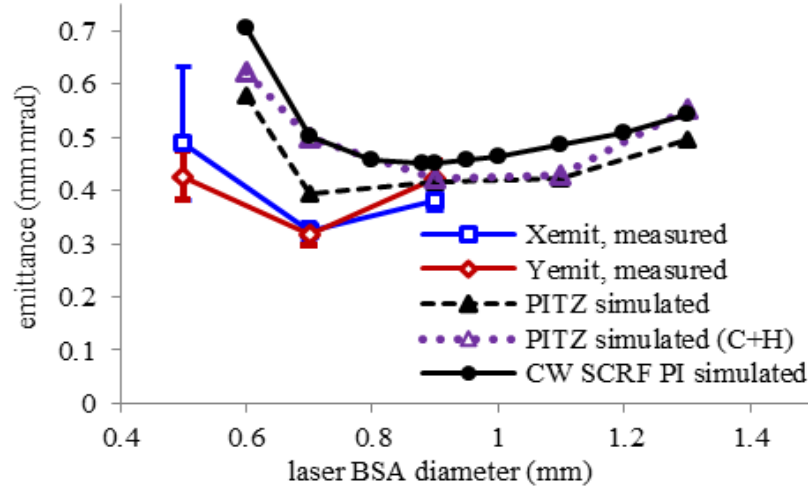
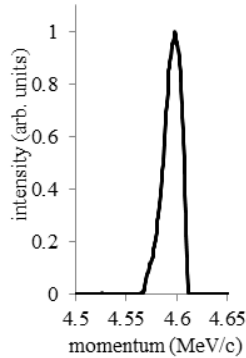
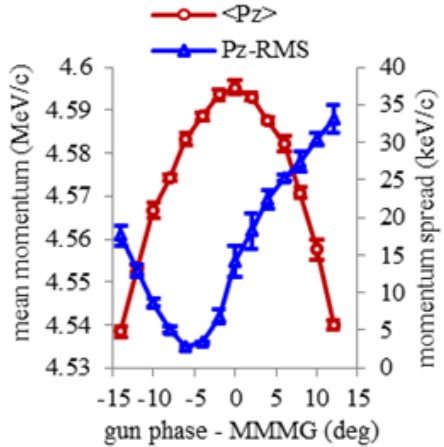
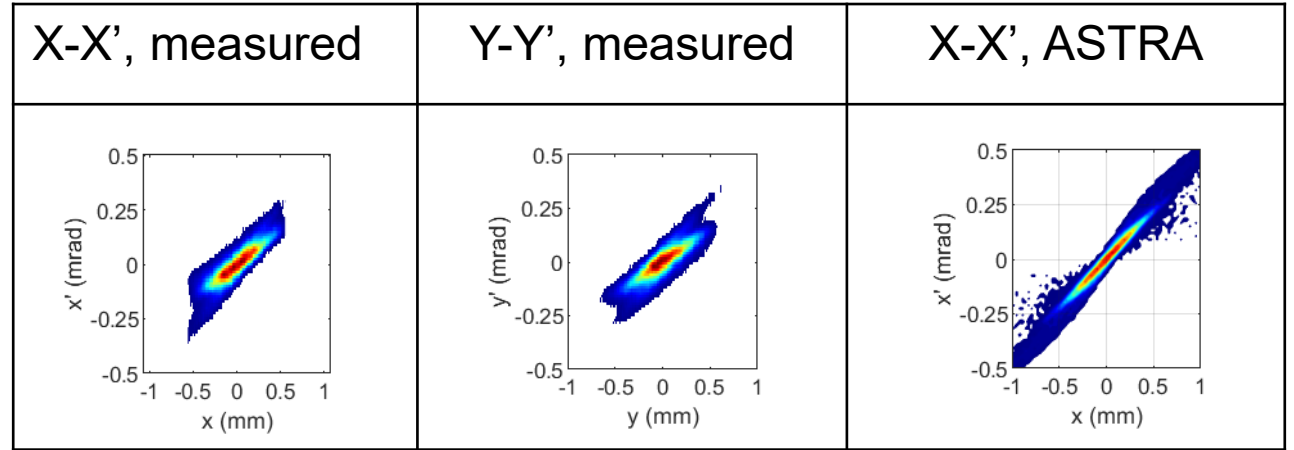
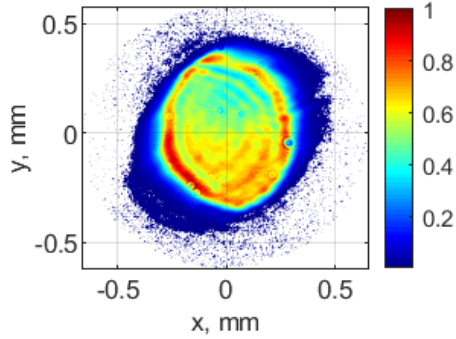
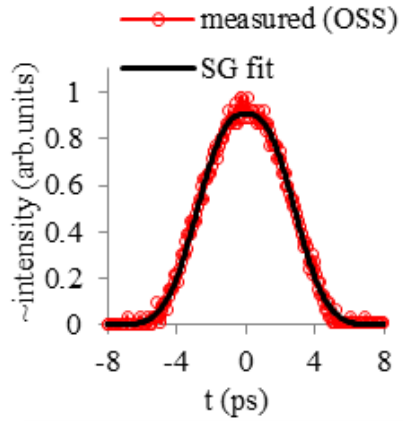
Emittance 40MV/m, Gaussian lase pulses (FEL2019 paper)

ASTRA simulations



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

Experimental optimization (gain=12dB)

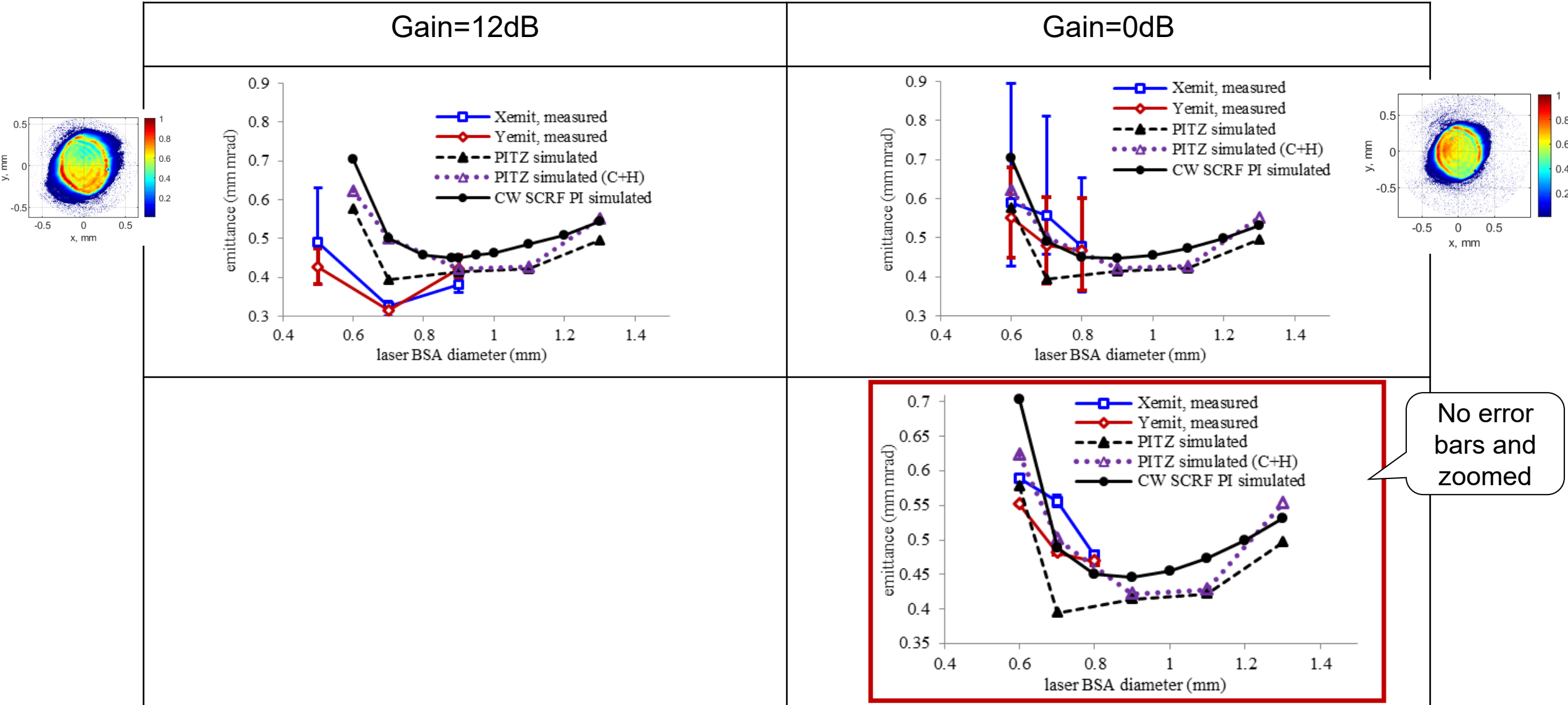


CONCLUSION

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.

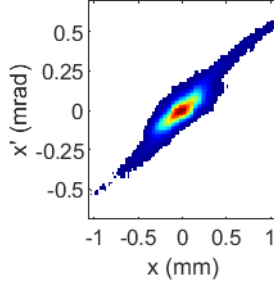
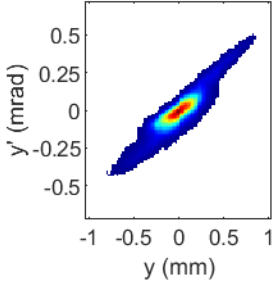
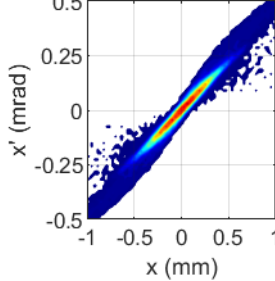
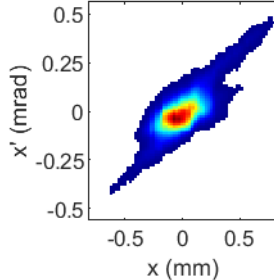
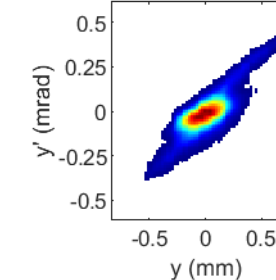
Emittance 40MV/m, Gaussian lase pulses

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



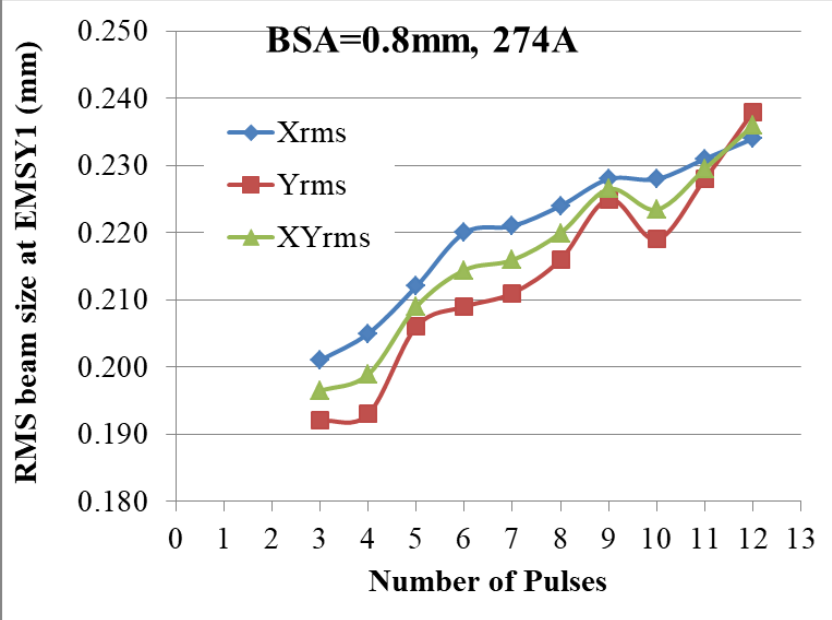
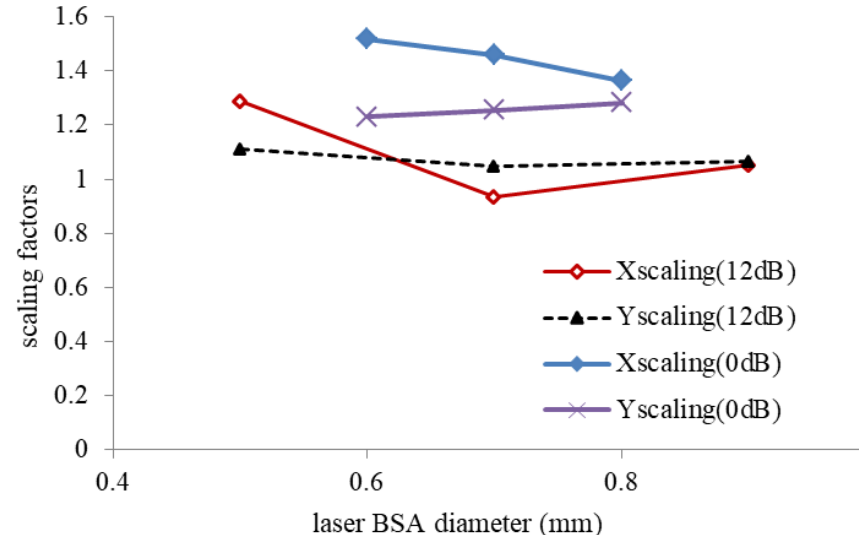
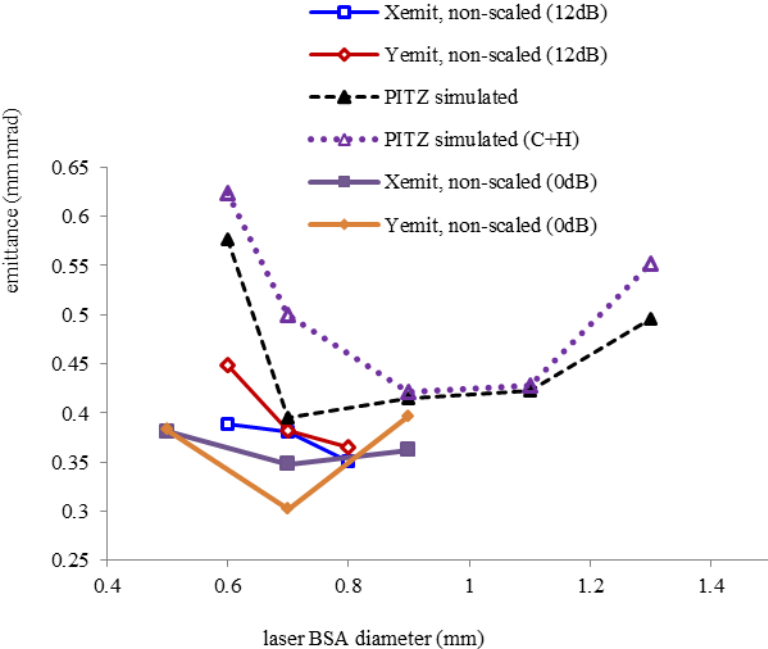
Emittance 40MV/m, Gaussian lase pulses (FEL2019 paper)

Experimental optimization (gain=0dB)

BSA	X-X', measured	Y-Y', measured	X-X', ASTRA
BSA=0.7mm	 <p>Plot of X-X' (mrad) vs x (mm) for BSA=0.7mm. The x-axis ranges from -1 to 1 mm, and the y-axis ranges from -0.5 to 0.5 mrad. The plot shows a diagonal distribution of points with a central peak, indicating a correlation between position and angle.</p>	 <p>Plot of Y-Y' (mrad) vs y (mm) for BSA=0.7mm. The y-axis ranges from -1 to 1 mm, and the x-axis ranges from -0.5 to 0.5 mrad. The plot shows a diagonal distribution of points with a central peak, indicating a correlation between position and angle.</p>	 <p>Plot of X-X' (mrad) vs x (mm) for BSA=0.7mm using ASTRA simulation. The x-axis ranges from -1 to 1 mm, and the y-axis ranges from -0.5 to 0.5 mrad. The plot shows a diagonal distribution of points with a central peak, indicating a correlation between position and angle.</p>
BSA=0.8mm	 <p>Plot of X-X' (mrad) vs x (mm) for BSA=0.8mm. The x-axis ranges from -0.5 to 0.5 mm, and the y-axis ranges from -0.5 to 0.5 mrad. The plot shows a diagonal distribution of points with a central peak, indicating a correlation between position and angle.</p>	 <p>Plot of Y-Y' (mrad) vs y (mm) for BSA=0.8mm. The y-axis ranges from -0.5 to 0.5 mm, and the x-axis ranges from -0.5 to 0.5 mrad. The plot shows a diagonal distribution of points with a central peak, indicating a correlation between position and angle.</p>	

Scaling factors and beam EMSY

12dB vs 0dB



???

Shift planning for week 33

Status 12.08.2019

Gaussian laser					Flattop						
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Late 15:00 to 23:30	Thermal imaging map	ESMY1 screen (Summer student)	40 MV/m vs BSA (Gaussian) RC		BPM tests?				Radiation measurements		
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
Resp. Phys	Vashchenko	Vashchenko									

