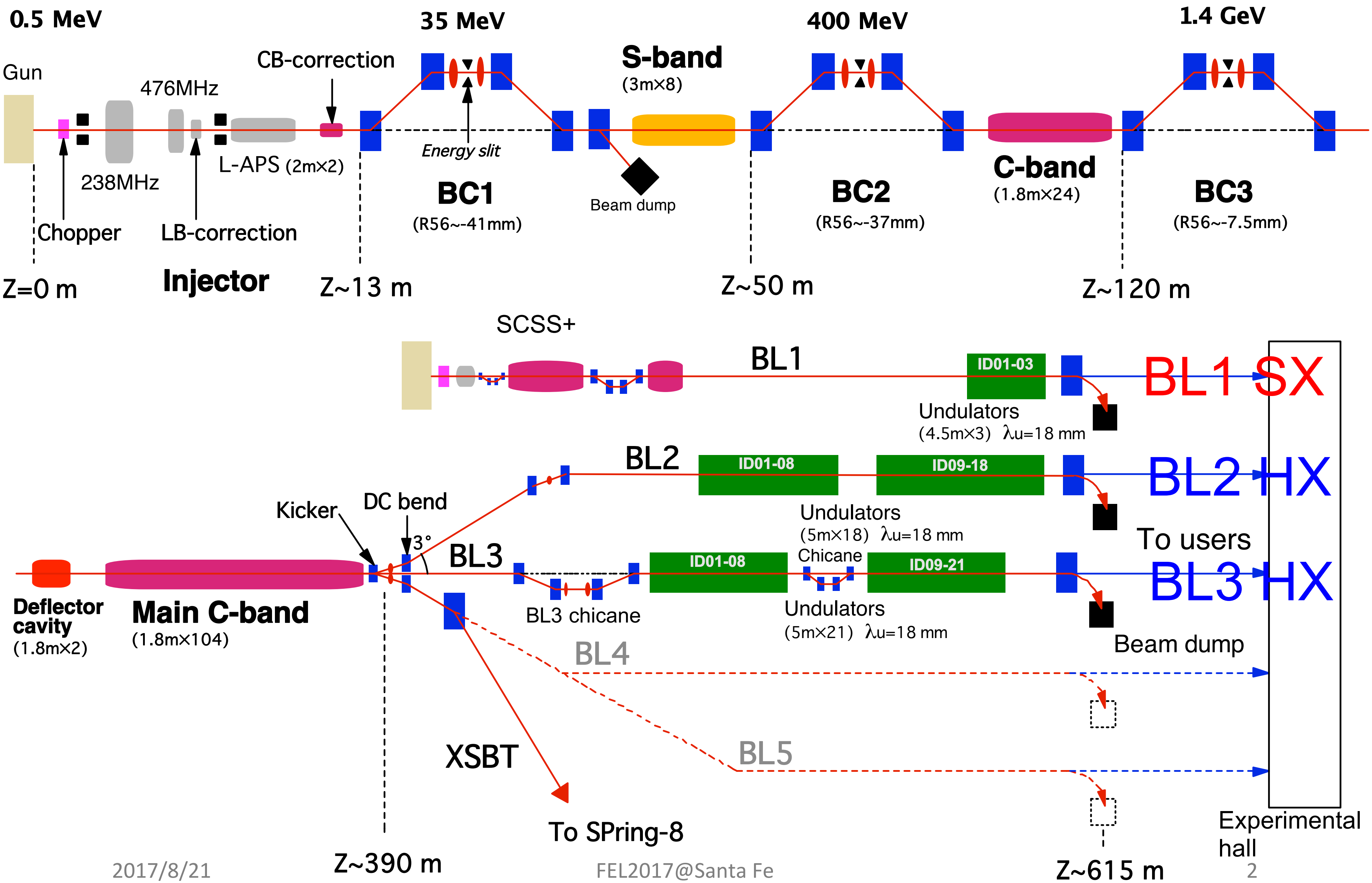
Present Status of SACLA,
World's First Compact XFEL Facility

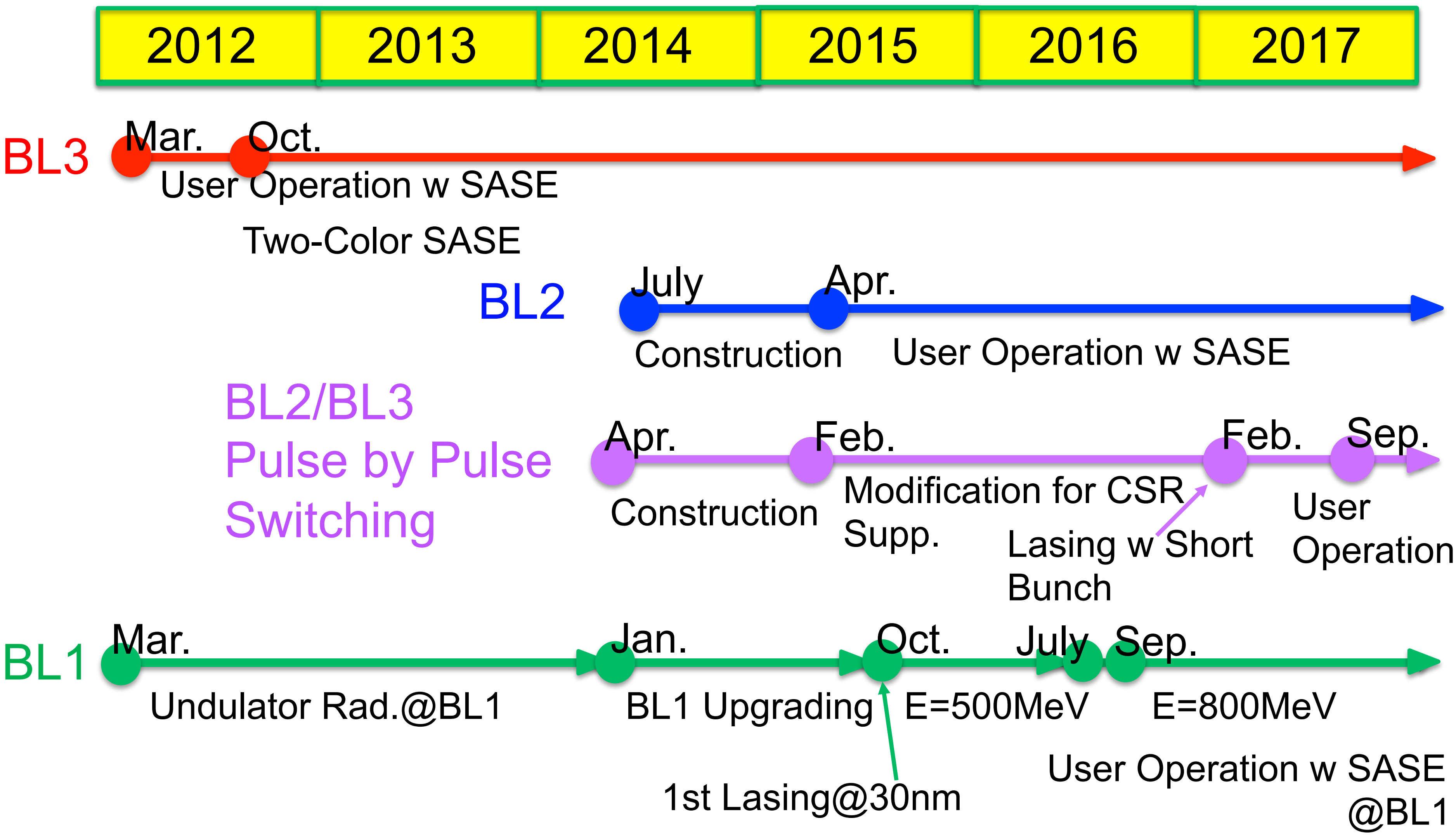
<u>Hitoshi Tanaka</u>

RIKEN SPring-8 Center

3 FEL(2X+1SX) Beamlines Available



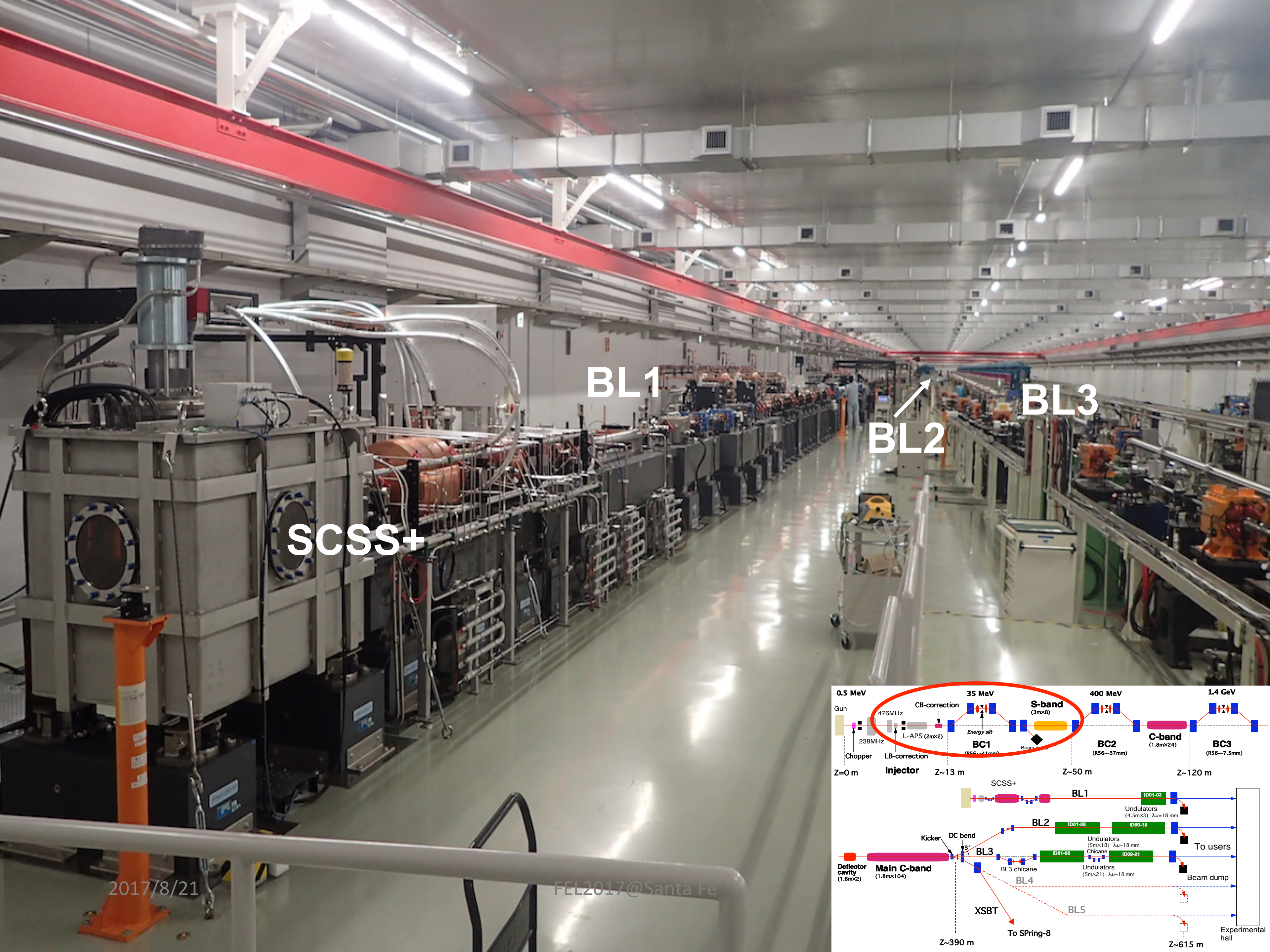
Progress of Facility Upgrade



FEL Performance at SACLA

	BL3	BL2	BL1
Max. Electron Energy (GeV)	8	8	0.8
Number of Undulators	21	18	3
Photon Energy (keV)	4~15	4~10	0.02~0.1
Intensity (mJ/pulse)	0.4~0.6	0.4~0.5	~0.1
Peak Power P (GW)	P > 30	P > 30	-
Repetition (Hz)	Max. 60	Max. 60	Max. 60
Pulse Width (fs; FWHM)	<< 10	<< 10	
Stability Intensity $\sigma_{\delta I/I}$ (%) Pointing $\sigma_{\delta z}/z$(FWHM) (%) Wavelength $\sigma_{\delta\lambda}/\Delta\lambda$(FWHM) (%)	 $\leq$ 10 3 ~ 7 0.1	 $\leq$ 10 3 ~ 7 0.1	 10~20 - 0.3
Two Color SASE	Available	not yet	not yet


SCSS+
BL2
BL3
To SPring-8
2017/08/15
0.5 MeV
35 MeV
400 MeV
1.4 GeV
Gun
476MHz
CB-correction
S-band
(3m×8)
Energy slit
238MHz
L-APS (2m×2)
BC1
(R56~-41mm)
Beam dump
BC2
(R56~-37mm)
C-band
(1.8m×24)
BC3
(R56~-7.5mm)
Chopper
LB-correction
Z=0 m
Injector
Z~13 m
Z~50 m
Z~120 m
SCSS+
BL1
ID01-03
Undulators
(4.5m×3) λu=18 mm
BL2
ID01-08
ID09-18
Undulators
(5m×18) λu=18 mm
Kicker
DC bend
3°
BL3
Chicane
ID01-08
ID09-21
To users
Deflector cavity
(1.8m×2)
Main C band
(1.8m×104)
BL3 chicane
Undulators
(5m×21) λu=18 mm
Beam dump
BL4
BL5
XSBT
To SPring-8
Z~390 m
Z~615 m
Experimental hall


BL1
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SCSS+
0.5 MeV
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Chopper
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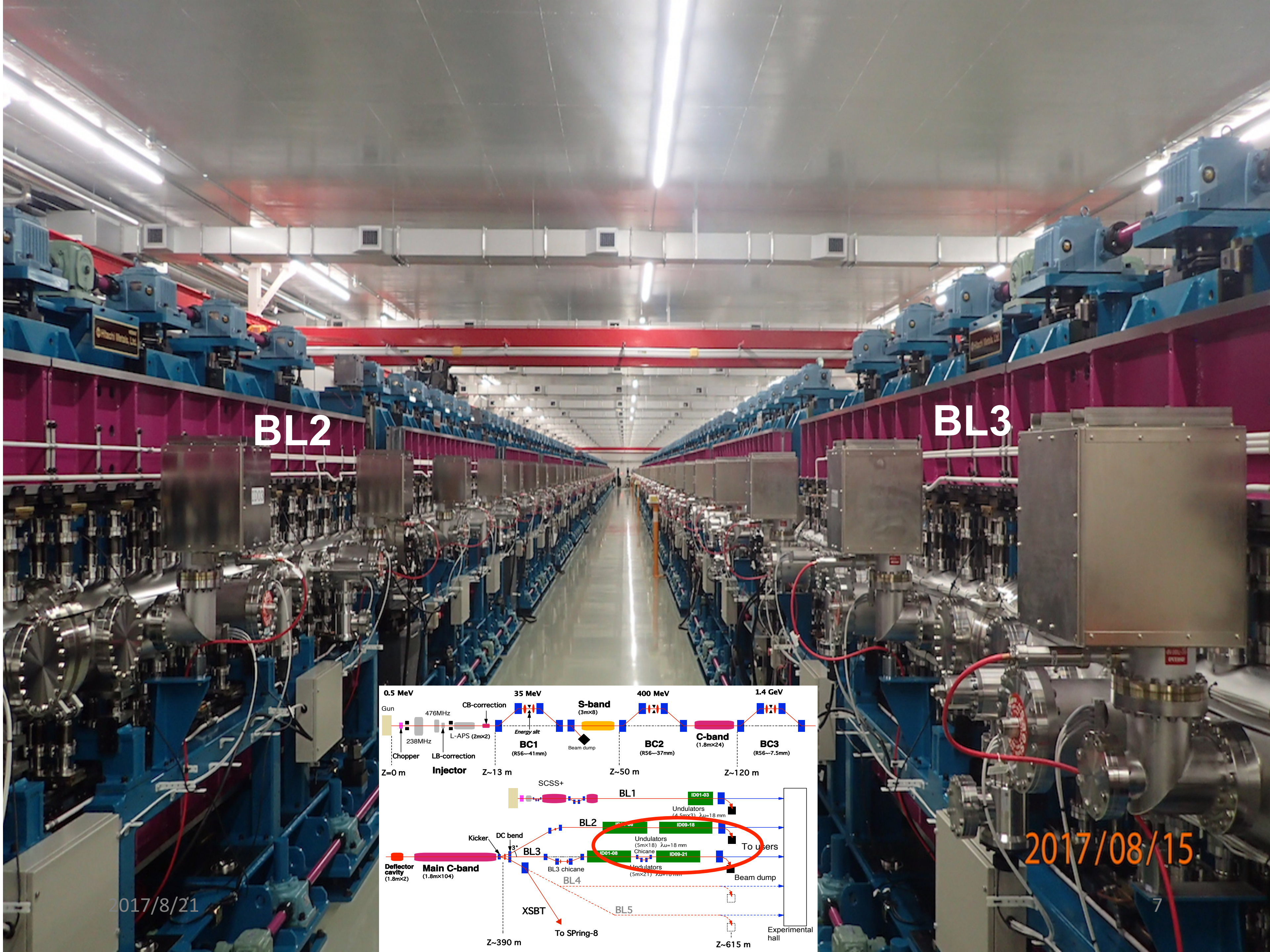
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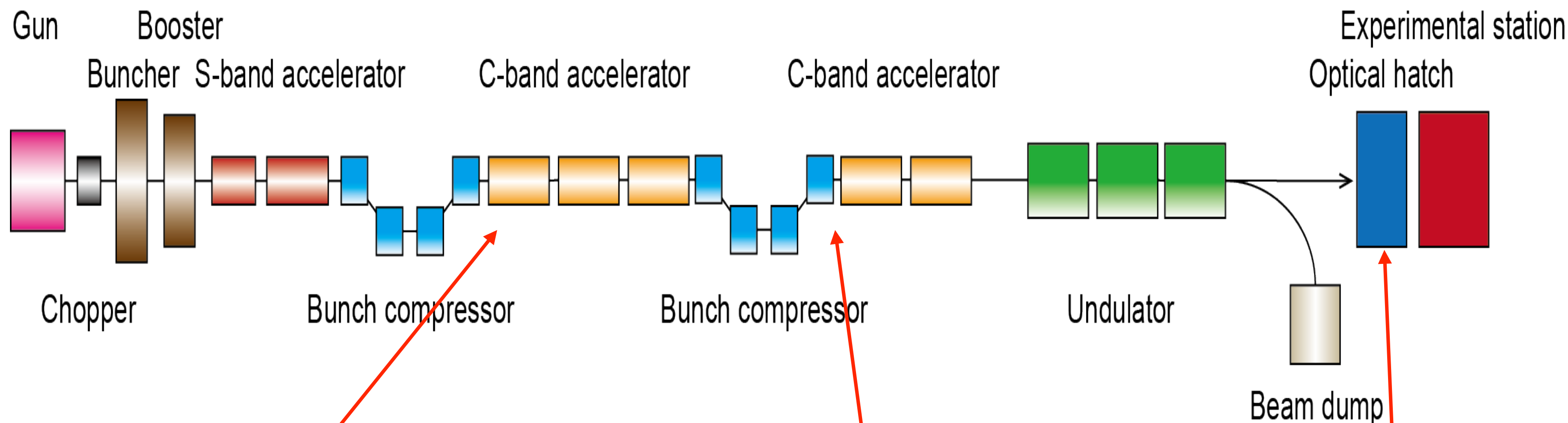
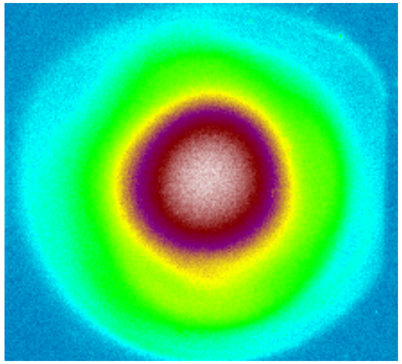
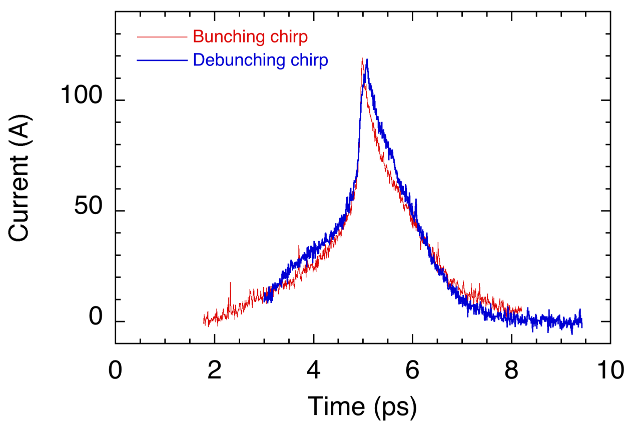
Present Status of SCSS+(BL1)



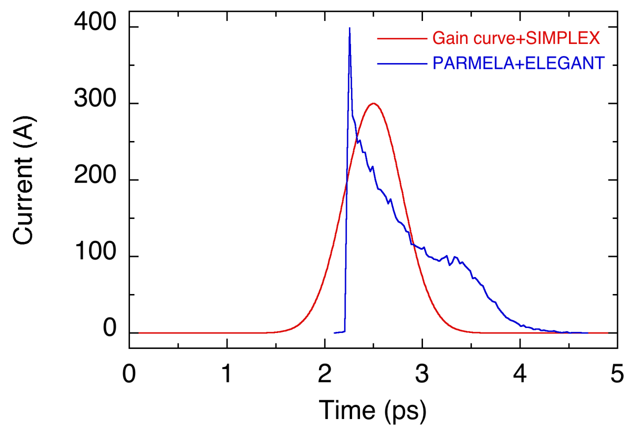
Measured Laser Profile
@12nm



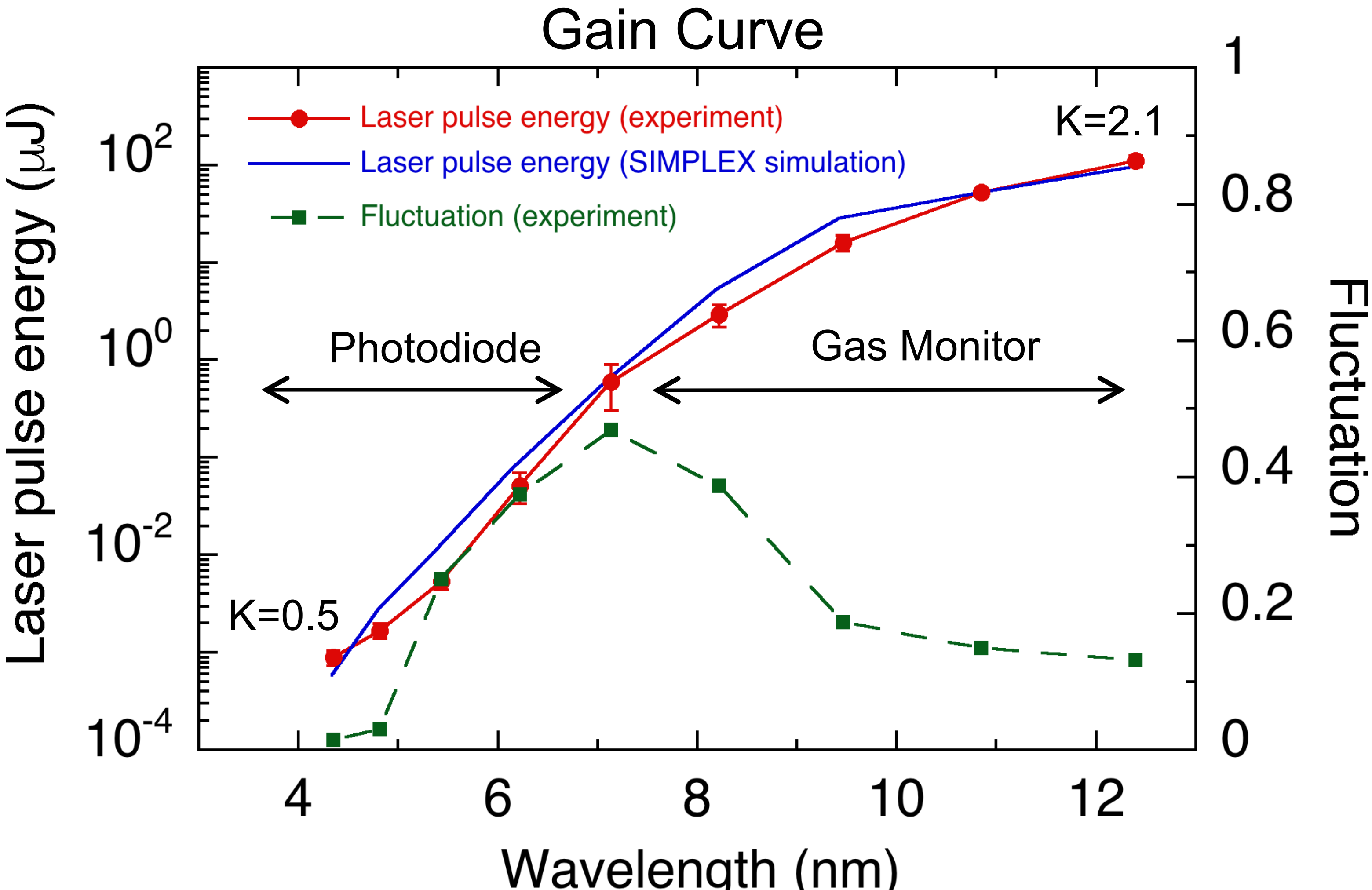
Measured Current Dist.



Simulated Current Dist.

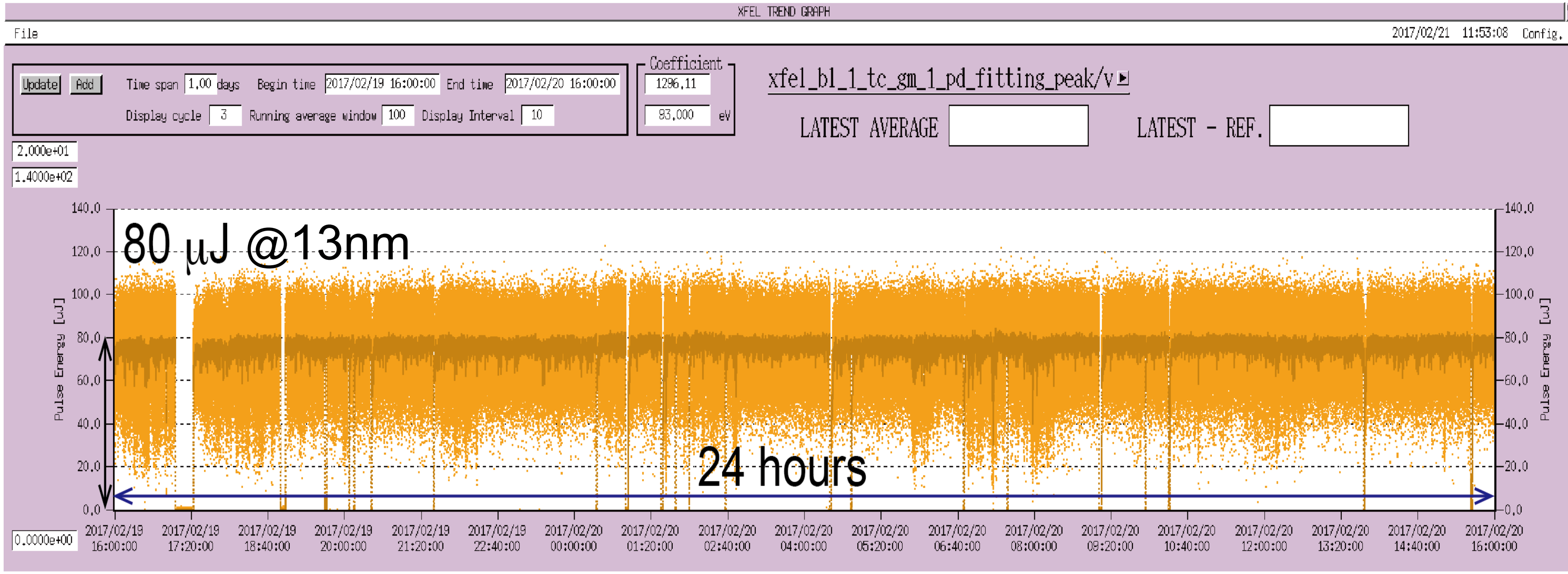


Present Status of SCSS+(BL1)



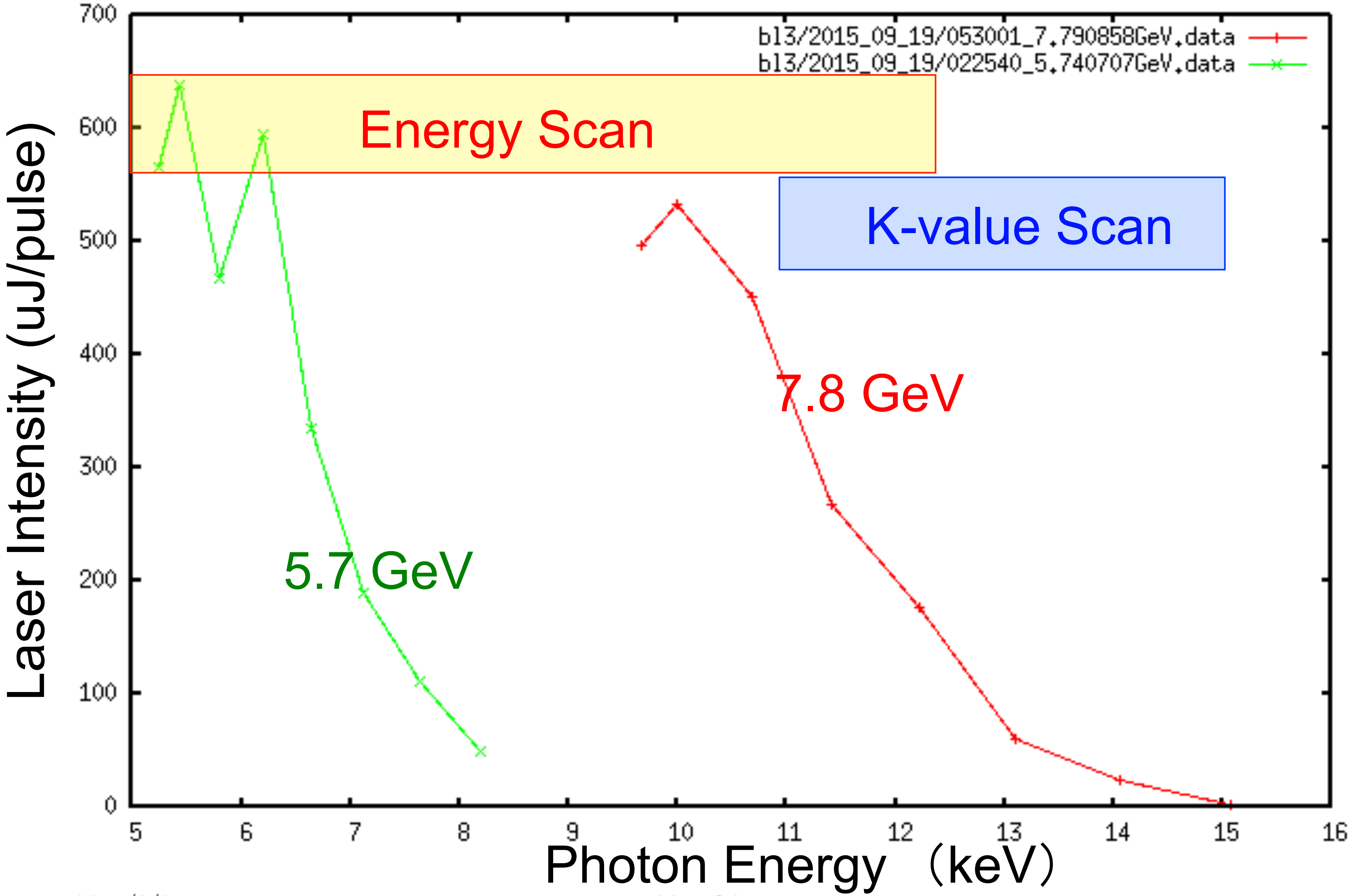
Peak Current of ~300 A and slice emittance of ~0.5π μmrad expected

Present Status of SCSS+(BL1)

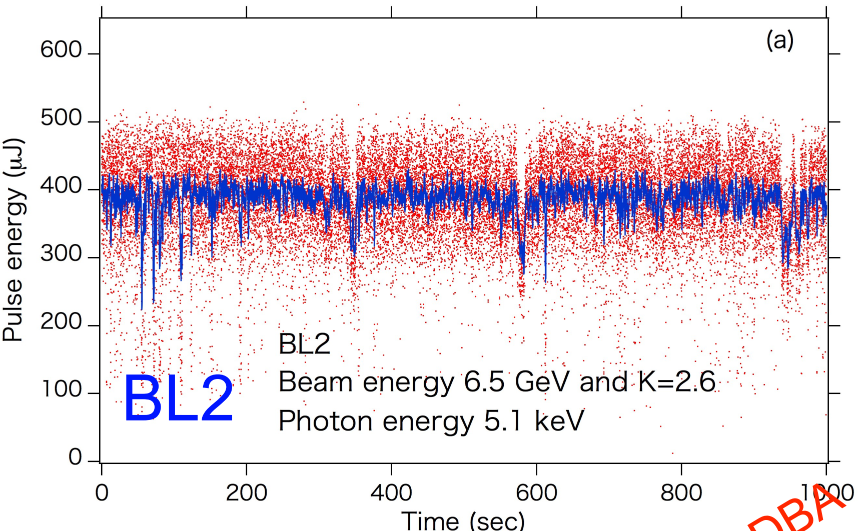


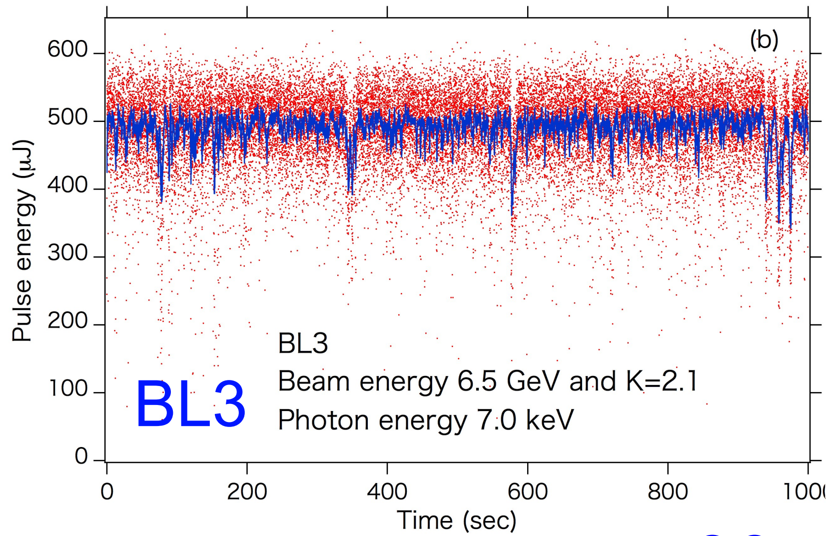
Since September 2016 SX FEL has been available for user experiments in the wavelength range from 40 eV(30 nm) to 150 eV(8nm)

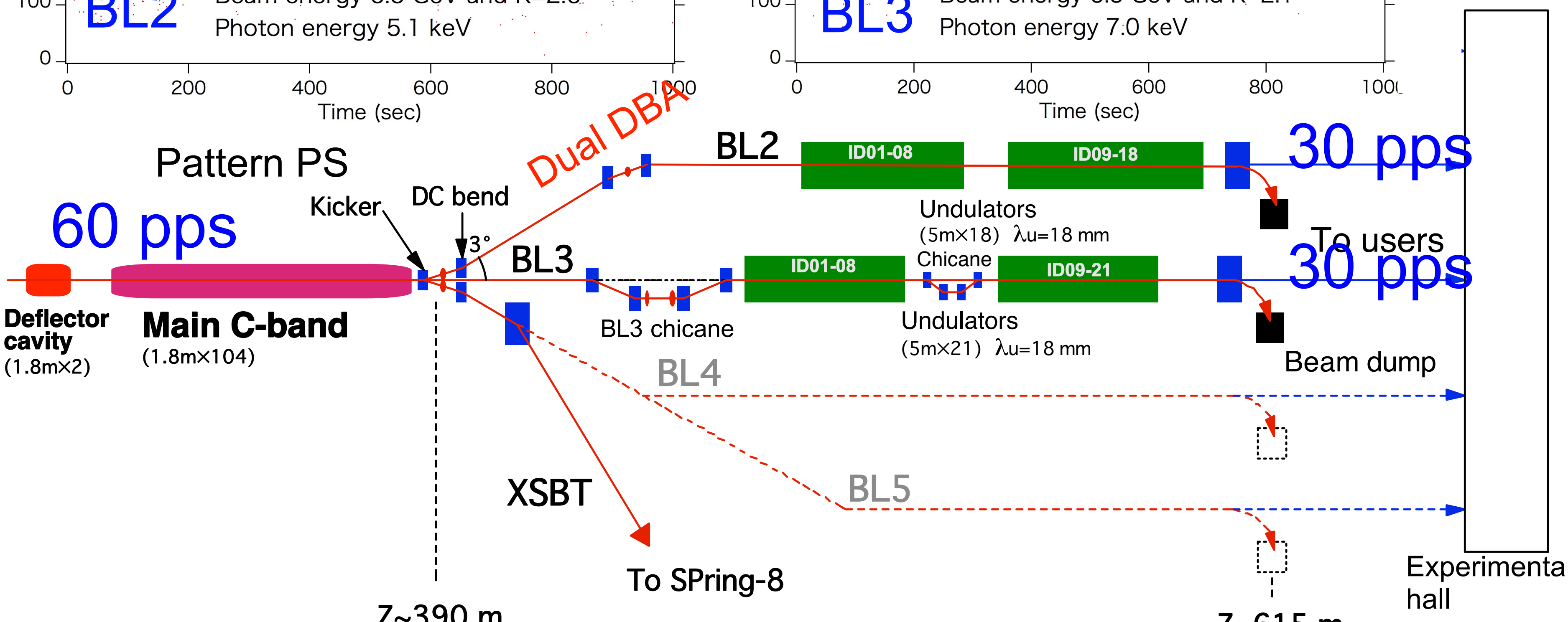
BL2/BL3 Pulse-by-Pulse Switching Operation Wavelength vs. Intensity



BL2/BL3 Pulse-by-Pulse Switching Operation Achieved Performance

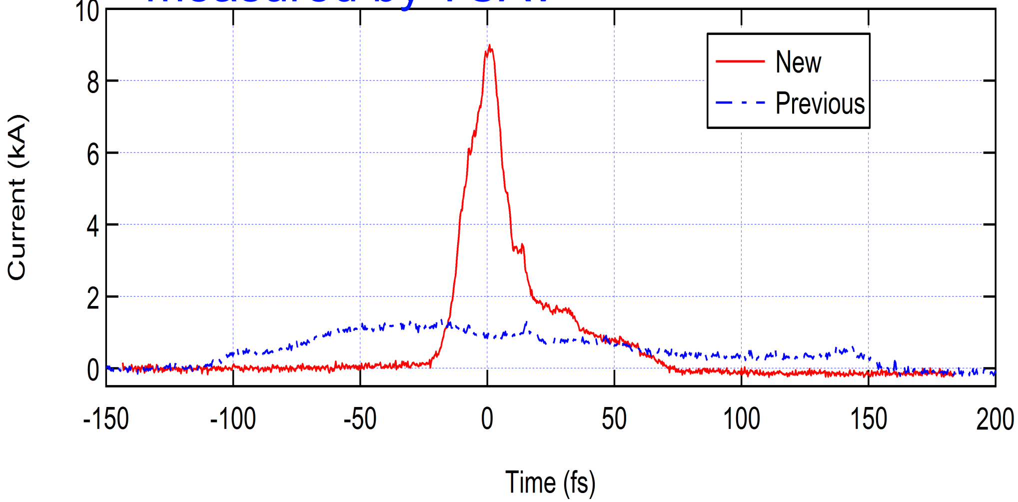




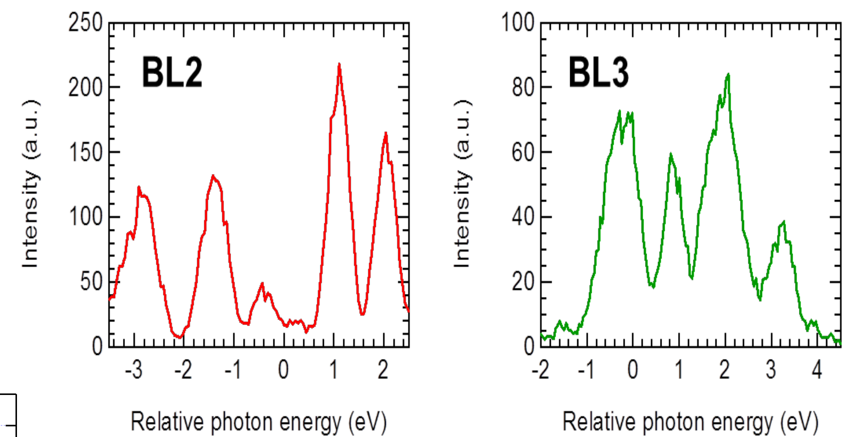


BL2/BL3 Pulse-by-Pulse Switching Operation Achieved Performance

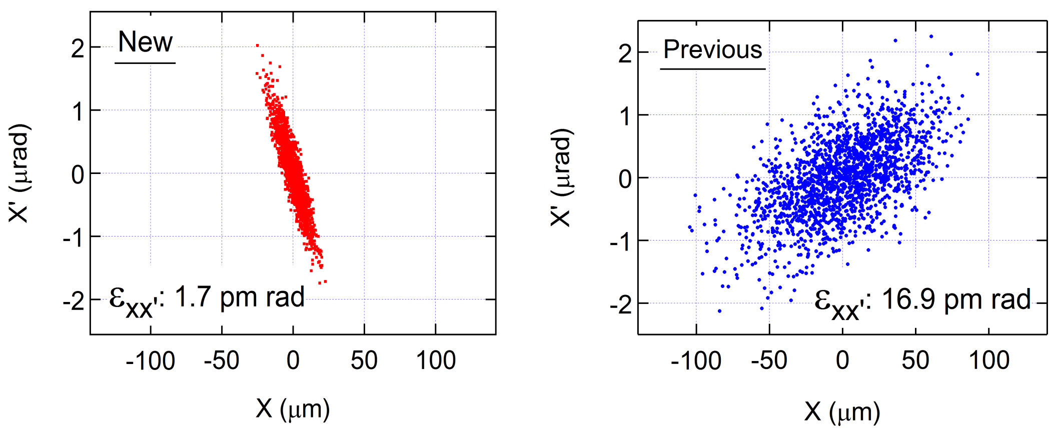
Comparison of the beam current profiles measured by TCAV



Typical single-pulse spike spectra of XFEL at BL2 (left) and BL3 (right) in the multi-beamline operation



Horizontal orbit fluctuation measured before the BL2 undulator



BL2/BL3 Pulse-by-Pulse Switching Operation Developed Systems

(1) 0.3 MW(300A, 1kV) bi-polar pattern pulse PS with 10 ppm current stability in a peak-to-peak value achieving stable XFEL switching over plural beamlines

C. Kondo, ”High-precision pattern power supply of kicker magnet for multi-beamline operation at SACLA”, presented in IPAC2017@Copenhagen

(2) Pulse-by-pulse RF precise control enabling changes of “beam energy” in a shot-by-shot manner

T. Hara, "Time-interleaved multi-energy acceleration for an XFEL facility”, PRSTAB 16, 080701 (2013)

(3) Dual phase-matched DBA based dogleg enabling a high peak current (around 10kA) operation by suppressing CSR effects on the beam degradation

T. Hara, "Suppression of the CSR effects at a dogleg beam transport using DBA lattice”, presented in TUA of this conference

Future Upgrade

(1) Advanced beam switching and timing systems enabling arbitral pulse distributions over multi-beamlines and enabling on-demand “top-up” injection requests

(2) Nonlinear energy chirp correction at BL1 using a nonlinear magnet based correction scheme for higher laser pulse energy and shorter laser pulse width

(3) Self-seeding scheme using a micro channel-cut crystal monochromator in reflection geometry