



XLS 1st Annual Project Meeting

Barcelona, December 10-12, 2018

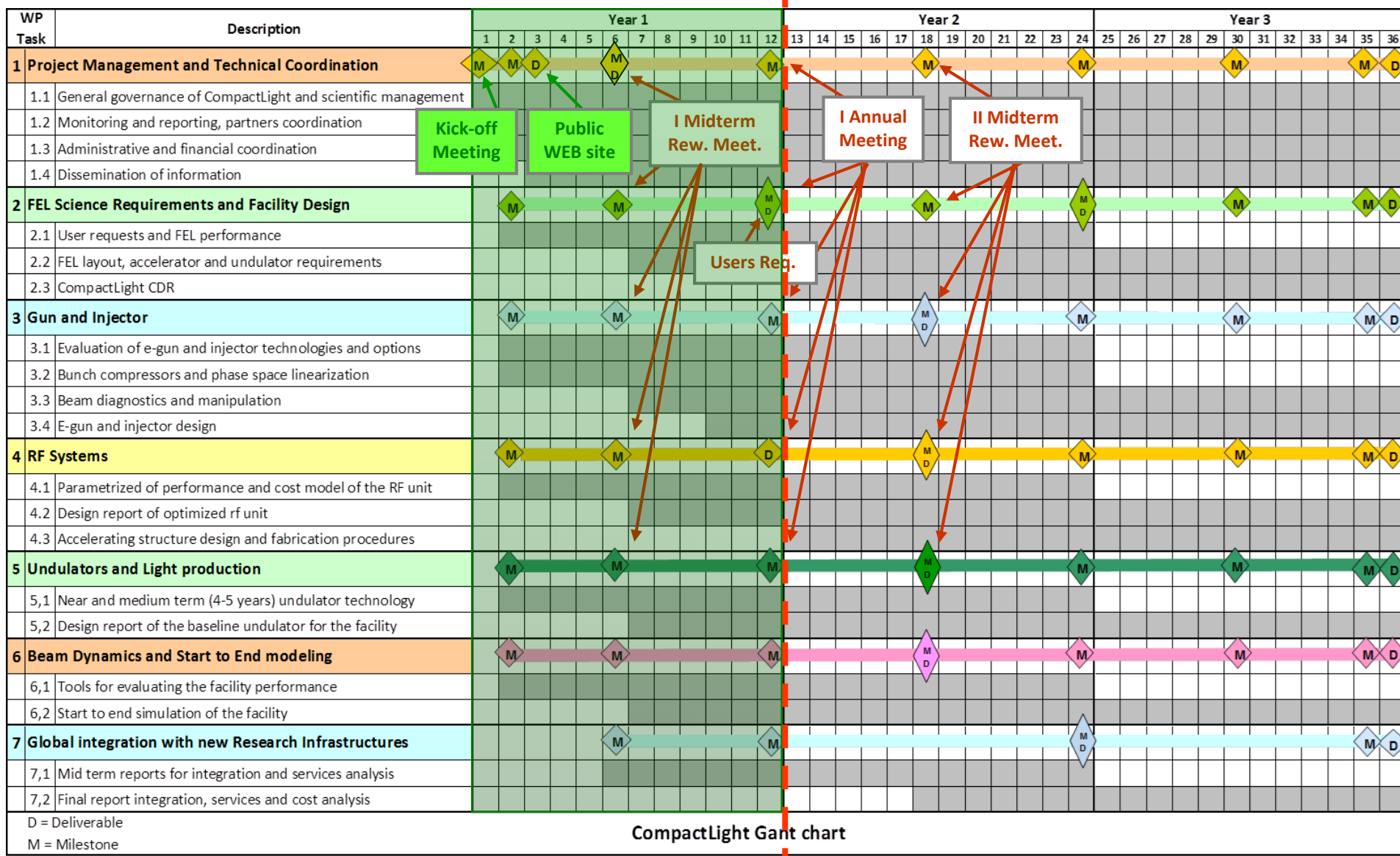
<http://compactlight.eu>





Meeting Agenda

Monday, 10 December 2018			
14:00	14:15	Welcome	Francis Perez/Gerardo D'Auria
14:15	14:45	XLS Status	Gerardo D'Auria
14:45	16:00	WP2 Activity Report and Discussion	WP & Task Leaders
16:00	16:30	Coffee Break	
16:30	17:45	WP4 Activity Report and Discussion	WP & Task Leaders
Tuesday, 11 December 2018			
09:00	10:15	WP3 Activity Report and Discussion	WP & Task Leaders
10:15	10:55	WP5 Activity Report and Discussion	WP & Task Leaders
10:55	11:25	Coffee Break & Meeting photo	
11:25	12:00	WP5 Activity Report and Discussion	WP & Task Leaders
12:00	13:15	WP6 Activity Report and Discussion	WP & Task Leaders
13:15	14:15	Lunch	
14:15	14:45	Discussion on parameters list	All
14:45	16:15	Supplementary Presentations & Partner Activity Reports	Parallel Sessions
		SAC Internal Discussion	
16:15	16:45	Coffee Break	
16:45	17:45	XLS-SAC Joint Session	All
20:00	22:30	Dinner at Arenal Restaurant - Busses will leave from Campus Hotel at 20:00	
Wednesday, 12 December 2018			
09:00	09:30	WP7 Activity Report and Discussion	WP & Task Leaders
09:30	10:00	WP1 Activity Report and Discussion	WP & Task Leaders
10:00	11:00	General Discussion: - Six months ahead activity plans - Deliverables - Next meeting ...	
11:00	11:30	Coffee Break	
11:30	12:30	Collaboration Board Meeting	CB Members
13:30	14:00	Lunch	
14:00	16:00	Guided Tour of the ALBA Synchrotron	
16:00	17:30	Time for eventual WP or Working Group Meetings	



Milestones MS1-MS12 reached

Milestone Number	Milestone title	Due date (in months)
MS1	Kick-off Meeting.	Jan 2018
MS2	Official bodies	SAC (May 2018)
MS3	Installation of governance bodies.	During Kick-off Meeting
MS4-MS8	First meetings of WP2-WP6.	June 2018
MS9	First Meeting of WP7	June 2018
MS10	1 st WP2-WP6 Joint Meeting – Hardware assessments.	June 2018
MS11	1 st Mid-term Project Review.	June 19-20, 2018
MS12	1 st Annual Meeting and Project Review Joint Session.	12
MS13	2 nd WP2-WP6 Joint Meeting – Hardware specification.	18
MS14	2 nd Mid-term Project Review.	18
MS15	2 nd Annual Meeting and Project Review Joint Session.	24
MS16	3 rd WP2-WP6 Joint Meeting – Hardware Design.	30
MS17	3 rd Mid-term Project Review.	30
MS18	Final Annual Meeting and Project Review Joint Session.	35



Deliv.	Deliverable name	WP Lead part.	Type Del. date	
D1.1	CompactLight Public Website.	WP1-ST	DEC-PU-M3	2
D1.2	Data Management Plan	WP1-ST	ORDP-PU-M6	0
D2.1	Report providing users requirements and FEL performance specification.	WP2-STFC	R-PU-M12	1
D3.1	Evaluation report of the optimum e-gun and injector solution for the XLS CDR.	WP3-INFN	R-PU-M18	8
D3.2	A review report on the bunch compression techniques and phase space linearization	WP3-INFN	R-PU-M18	
D4.1	Computer code report for RF power unit design and cost optimization.	WP4-CERN	R-PU-M18	2
D5.1	A review report comparing the different technologies for the CompactLight undulator.	WP5-ENEA	R-PU-M18	0
D6.1	Review report on the most advanced computer codes for the facility design	WP6-UAIAIAT	R-PU-M18	1
D2.2	Report summarizing the FEL design with accelerator and undulator requirements.	WP2-STFC	R-PU-M24	9
D7.1	Mid-term report with CompactLight global integration and cost analysis	WP7-ST	R-PU-M24	
D3.3	Design report of the injector diagnostics/beam manipulations based on a X-band cavities	WP3-INFN	R-PU-M36	
D3.4	E-gun and injector Design Report with diagnostics and phase space linearizer	WP3-INFN	R-PU-M36	
D4.2	Design report of the optimized RF unit	WP4-CERN	R-PU-M36	
D4.3	Report on RF unit design and fabrication procedure	WP4-CERN	R-PU-M36	2
D5.2	Conceptual Design Report of the undulator	WP5-ENEA	R-PU-M36	0
D6.2	Final report with start to end facility simulations	WP6-UAIAIAT	R-PU-M36	2
D7.2	Final report with CompactLight global integration analysis, services and cost.	WP7-ST	R-PU-M36	0
D2.3	Hard X-ray FEL Conceptual Design Report.	WP2-STFC	R-PU-M36	
D1.2	Production of a short monograph summarizing the Conceptual Design Report.	WP1-ST	R-PU-M36	

Coming
6 months!



Budget

Compact



Second Payment:
35% of total budget
to be released in
January 2019

Partner	Total Budget (€)	First Tranche (35%)	Second Tranche (35%)	Third Tranche (5%)	Remaining* (25%)
		June 2018	January 2019	January 2020	> Dec. 2020
1-ST	380.000,00	133.000,00	133.000,00	19.000,00	95.000,00
2-CERN	303.000,00	106.050,00	106.050,00	15.150,00	75.750,00
3-STFC	328.500,00	114.975,00	114.975,00	16.425,00	82.125,00
5-IASA	67.500,00	23.625,00	23.625,00	3.375,00	16.875,00
6-UU	131.500,00	46.025,00	46.025,00	6.575,00	32.875,00
9-UA-IAT	96.500,00	33.775,00	33.775,00	4.825,00	24.125,00
10-ULANC	106.250,00	37.187,50	37.187,50	5.312,50	26.562,50
11-VDL ETG	102.500,00	35.875,00	35.875,00	5.125,00	25.625,00
12-TU/e	102.500,00	35.875,00	35.875,00	5.125,00	25.625,00
13-INFN	212.500,00	74.375,00	74.375,00	10.625,00	53.125,00
14-Kyma	92.000,00	32.200,00	32.200,00	4.600,00	23.000,00
15-SAPIENZA	72.500,00	25.375,00	25.375,00	3.625,00	18.125,00
16-ENEA	200.000,00	70.000,00	70.000,00	10.000,00	50.000,00
17-ALBA-CELLS	163.250,00	57.137,50	57.137,50	8.162,50	40.812,50
18-CNRS	81.875,00	28.656,25	28.656,25	4.093,75	20.468,75
19-KIT	134.000,00	46.900,00	46.900,00	6.700,00	33.500,00
20-PSI	128.000,00	44.800,00	44.800,00	6.400,00	32.000,00
21-CSIC	80.000,00	28.000,00	28.000,00	4.000,00	20.000,00
22-UH/HIP	58.125,00	20.343,75	20.343,75	2.906,25	14.531,25
23-VU	96.500,00	33.775,00	33.775,00	4.825,00	24.125,00
24-USTR	62.500,00	21.875,00	21.875,00	3.125,00	15.625,00
Total	2.999.500,00	1.049.825,00	1.049.825,00	149.975,00	749.875,00

* Remaining funds from EU (20%) + EU Guarantee funds (5%)



Consortium Agreement



**Signed in September 2018
(9 months to finalize it!!!)**

Non Disclosure Agreement



**To be finalized ASAP!!!
(Still receiving feedbacks
from Partners)**



WPs Ongoing activities



Objective: provide the overall design of the hard X-ray FEL facility.

Starting from the performance specification of the FEL, based on user-driven scientific requirements, the aim of WP2 is to identify and choose the most appropriate technical solutions for the FEL considering cost, technical risk and performance.

Task 2.1 - FEL user scientists and potential users will provide specification for the Hard X-ray FEL output parameters (in terms of wavelength range, pulse energy, polarisation, beam structure, pulse duration, synchronisation to external laser, etc.).



D 2-1 - A report summarising the requests from the users and defining the performance specifications for the FEL, **(R, PU, M12)**.

XLS User Meeting

CERN 27th and 28th November 2018

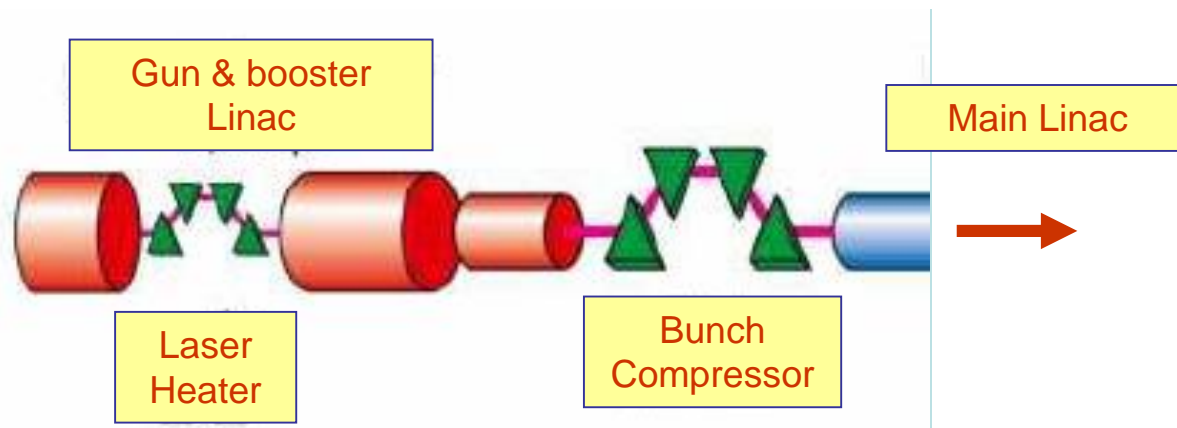
<https://indico.cern.ch/event/75079>

The aim of the meeting was to collect, from the FEL Scientific Community, the future requirements, in term of photon beam characteristics, for an ambitious future FEL Facility design, in the medium and long-term perspectives.

- 27 participants
- 10 presentations from Users

See the report from Vitaliy Goryashko, WP2

- The objective of WP3 is to provide the technical specification and the “optimum design” of the electron gun and Linac Injector up to 300-350 MeV.
- Short bunches can be produced by means of Velocity Bunching (VB) technique or by Magnetic Chicanes (BC).
- The main goal is to design a compact High Brightness Injector able to provide the proper matching with the downstream X-band linac.



Courtesy of M. Ferrario

➤ Gun design (RF, Solenoid, Cathode, Laser, Diagnostics)

- *S-Band Gun RF Design (CNRS + IASA+UAIAT-INFN+ALBA)* → A review will be presented by Angeles
- *C-Band Gun RF Design (INFN +IASA+Sapienza)* → Preliminary simulations by Michele
- *X-Band Gun RF Design (CSIC-IFIC + UAIAT+ Sapienza)* → Preliminary ideas, no numbers yet
- *DC Gun Design (TU/e)* → June presentation in Trieste, no further data available
- *Laser/Photocathode (IASA+CNRS+INFN)* → A review will be presented by Evangelos

➤ Compressor Design (Velocity Bunching, Magnetic Chicane)

- *S-Band Velocity Bunching (TU/e + IASA+ALBA)* → Preliminary simulations by Anna
- *C-Band Velocity Bunching (INFN +IASA+TU/e)* → Preliminary simulations by Michele
- *X-Band Velocity Bunching (Sapienza+CERN+IASA+INFN)* → Preliminary ideas, no numbers yet
- *Magnetic Compressor (ST + CERN+INFN+CNRS)* → Preliminary simulations by Simone

➤ X-Band Diagnostics (Transverse RF Deflector)

- *Transverse RF Deflector (Sapienza + IASA)* → Preliminary ideas, no numbers yet

➤ Linearizer Design (RF and passive linearizers)

- *X-Band RF Linearizer (Sapienza)* → Preliminary simulations presented by Luca
- *K-Band RF Linearizer (ULANC + Sapienza)* → Preliminary simulations presented by Graeme
- *Passive linearizers (CNRS)* → An overview will be presented by Yanliang

Tentative beam parameter at the exit of the first Bunch Compressor (BC1)

XLS Hard X-ray case	Units	After VB and/or BC1
Charge (Uniform distribution)	pC	100
Beam energy	MeV	300
Rms bunch length	μm (fs)	35 (118)
FWHM Peak current	A	250
Rms energy spread	%	<1
RMS norm emittance	μm	0.4

Courtesy of M. Ferrario

Objective:

Detailed parameters, design and cost of linac rf system optimized in overall facility

Task 1: Layout and optimization of the linac rf system	Alessandro Gallo	INFN-LNF, CERN, SINAP
Task 2: Industrialization	Xander Janssen	VDL
Task 3: Modulator technology	Marek Jacewicz	UU
Task 4: Power sources for higher-harmonic systems	Adrian Cross	USTR
Task 5: Integration	Markus Aicheler	UH-HIP

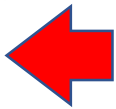
Presentations:

- X-band linac rf system (Marco - INFN)
- 36 GHz linearizing structure and waveguide network (Xiaowei – CERN)
- 36 and 48 GHz RF power sources (Adrian – USTR)
- Systems integration (Markus - UH-HIP)

Courtesy of W. Wuensch

X-band Accelerating Structure Design & Optimization

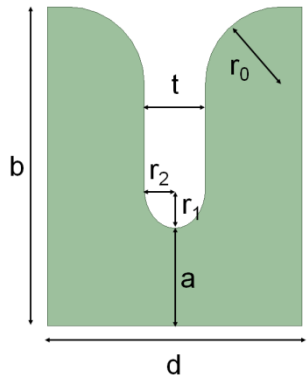
50 MW, 1.5 μ s



- Baseline accelerating gradient: 65 MV/m
- RF system and pulse compressor characteristics
- Average iris radius: 3.5 mm
- Electromagnetic parametric study of the TW cell
- Effective shunt impedance optimization by a 2D scan of the total length and the iris tapering
- Check of modified Poynting vector values @ nominal gradient
- Design a realistic RF module including power distribution network
- Finalize the electromagnetic (input and output couplers) and mechanical design

*Trade-off between
machine compactness and
RF power requirements*

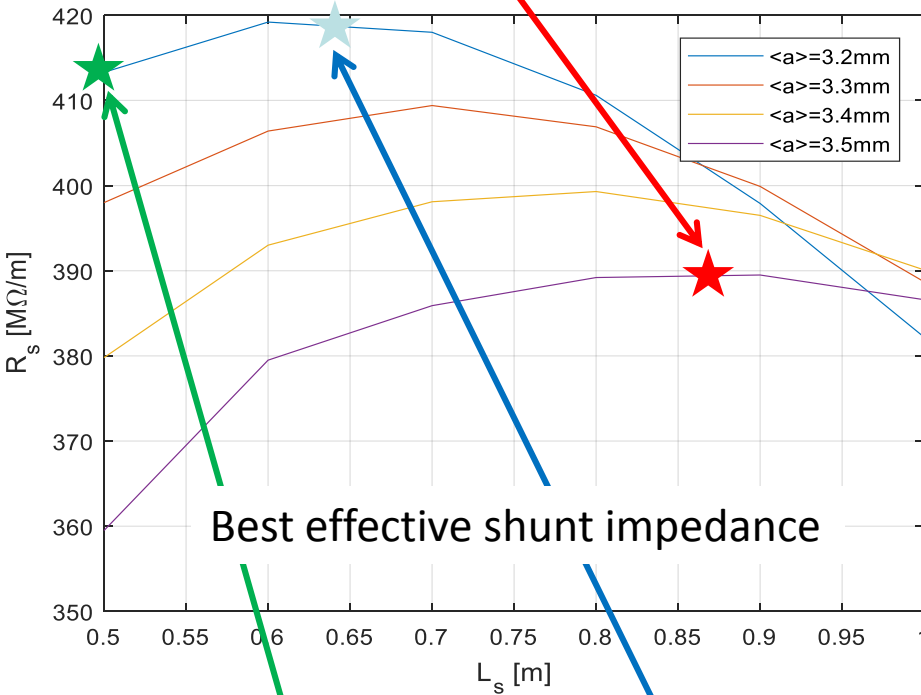
Beam dynamics requirements (BBU threshold)



Courtesy of A. Gallo



Compact Light optimum



Best effective shunt impedance

EuSPARC working point

(optimization of RF power splitting)

EuSPARC optimum

Freq. of $2\pi/3$ mode [GHz]	11.9942
Average iris radius $\langle a \rangle$ [mm]	3.5
Total length of the TW structure L_s [m]	0.9
RF pulse [μ s]	1.5
Average gradient $\langle G \rangle$ [MV/m]	65
Linac Energy gain E_{gain} [GeV]	4.5
Linac active length L_{act} [m]	69.2
Unloaded SLED Q-factor Q_0	180.000
External SLED Q-factor Q_E	21400
Iris radius a [mm]	4.3-2.7
Group velocity v_g [%]	4.5-1.0
Effective shunt Imp. R_s [MΩ/m]	389
Filling time t_f [ns]	140
Input power per structure P_{k_s} [MW]	9.8
Structures per module N_m (input power per module P_{k_m} [MW])	4 (39)
Total number of structures N_{tot}	80
Total number of klystrons N_k	20

Courtesy of A. Gallo



Objectives:

- Highest possible FEL performance (shortest gain length, highest saturation power) for a given target wavelength.
- Shortest possible wavelength for a given beam energy.
- Highest possible undulator performance (shortest longitudinal space per undulator module, shortest undulator gap width) for a given focusing scheme.

Soft X-ray case

<i>Undulator parameters</i>	
undulator period	1.7 cm
undulator gap	3 mm
deflection parameter (RMS)	1.9
<i>Bunch parameters</i>	
beam energy	4 GeV
pulse duration (FWHM)	10 fs
bunch charge	20 pC
peak current	1.9 kA
norm. emittance	0.12 mm×mrad
energy spread	0.01 %
<i>Potential reach</i>	
FEL wavelength ($\hbar\omega$)	0.66 nm (1.9 keV)
N_γ /pulse	5.6×10^{11}
E_{FEL} /pulse	0.2 mJ
saturation length	21 m

Hard X-ray case

<i>Undulator parameters</i>	
undulator period	1.3 cm
undulator gap	3 mm
deflection parameter (RMS)	1.17
<i>Bunch parameters</i>	
beam energy	9 GeV
pulse duration (FWHM)	7.5 fs
bunch charge	75 pC
peak current	9 kA
norm. emittance	0.12 mm×mrad
energy spread	0.01 %
<i>Potential reach</i>	
FEL wavelength ($\hbar\omega$)	0.05 nm (25 keV)
N_γ /pulse	2.5×10^{11}
E_{FEL} /pulse	1 mJ
saturation length	25 m

Courtesy of
F. Nguyen



		out of vac	in-vac	CPMU	SC NbTi	SC Nb ₃ Sn	HTS
Performance: K (λ/gap)	15 / 4 mm						
	10 / 3 mm						
Design							
Fabrication by Lab							
Magnetarray							
Support							
Drive System / Controls							
Vacuum System							
Optimization							
Fabrication by Company							
Installation / Infrastructure							
Commissiioning							
Operation / Maintenance	10 years						
price / m [€]							
total price [€] / saturation length [m]							

Courtesy of T. Schmidt



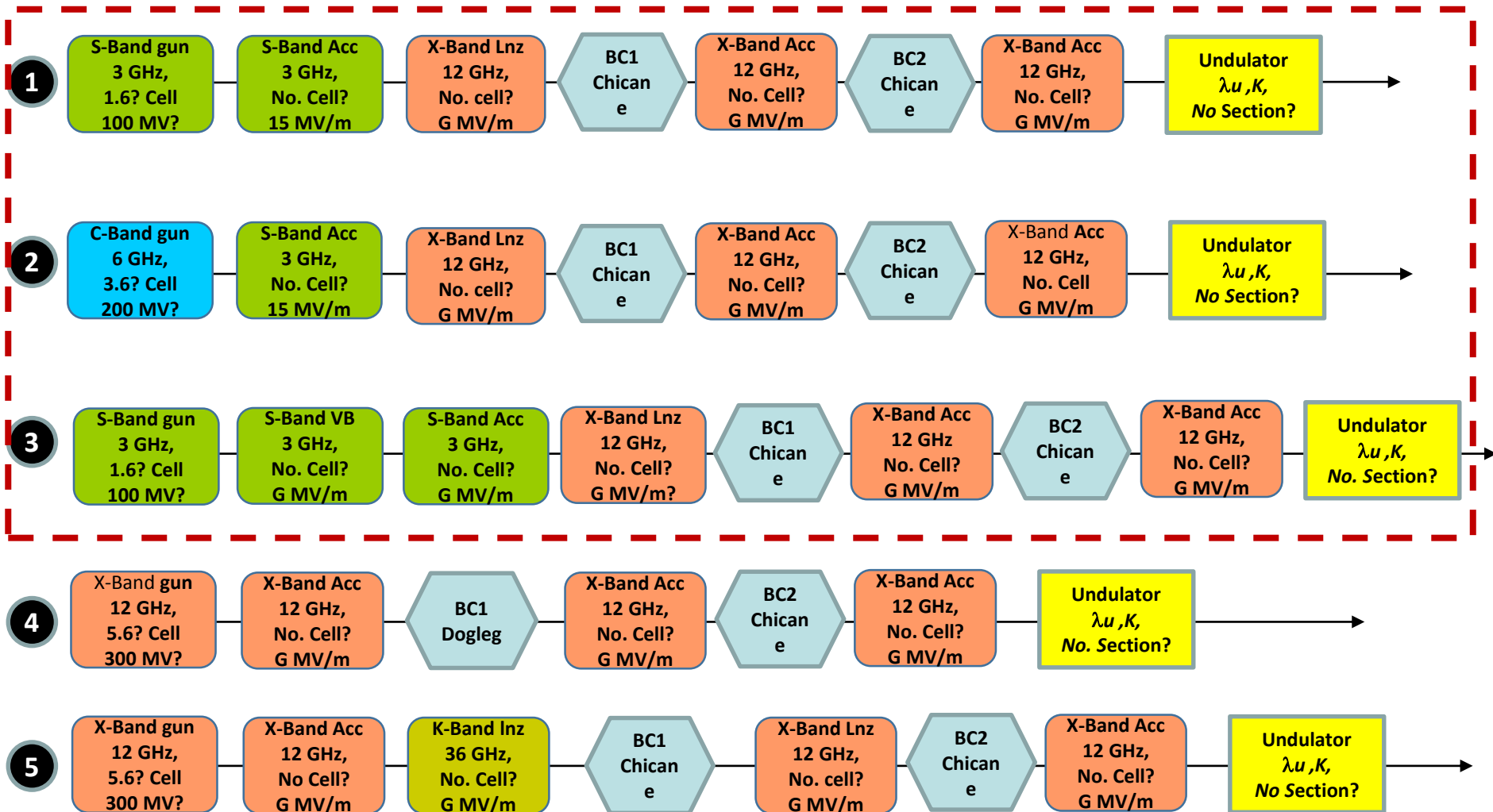
Objectives:

- Perform start-to-end simulations, which cover the beam transport from the cathode to the FEL exit, for Soft X-Ray & Hard X-Ray, including mechanical tolerance studies.
- Provide key parameters and performance estimates of the overall facility.
- Define the basis for technology choices for critical components and for developing detailed designs of subsystems and components.
- Develop tools for modeling the machine, as the basis for the final integrated performance studies.

Courtesy of A. Aksoy



S2E simulations and FEL performance studies



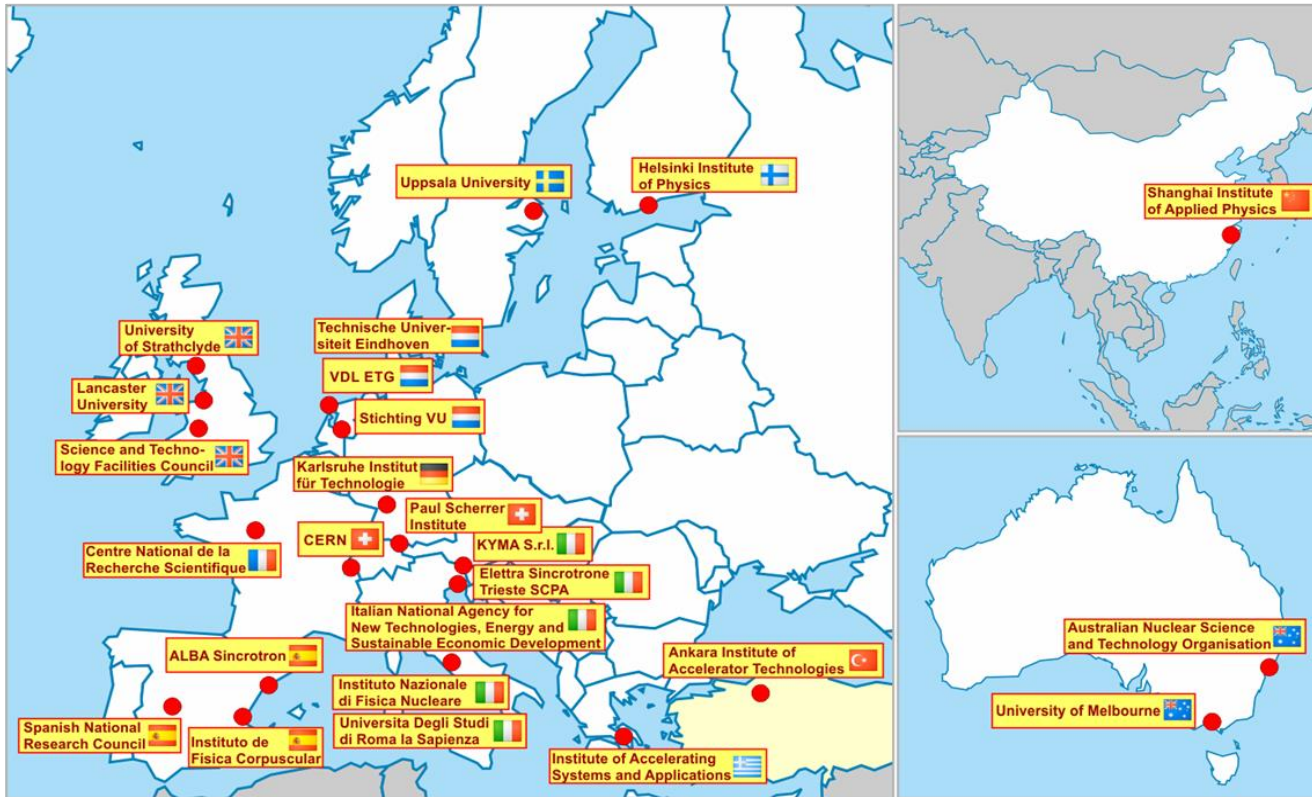
Courtesy of A. Aksoy



Thank you!

CompactLight@elettra.eu

www.CompactLight.eu



CompactLight is funded by the European Union's Horizon2020 research and innovation programme under Grant Agreement No. 777431.