CompactLight

H2020 Design Study Proposal

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on behalf of the CompactLight Collaboration

CLIC Workshop
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Previous bid and EU feedback

The XbFEL Design Study was submitted Sept 2014 (INFRADEV-1-2014-1) with the intend **to validate the use of the X-band technology for the construction of future FEL based photon sources** and to promote the construction of a new generation of FELs based on a technological solution more efficient (cost, space, power consumption).

Our aim was to demonstrate the maturity of the concept through a dedicated design study.

- Duration 3 years
- 12 paricipants, lead Institute: ELETTRA - Sincrotrone Trieste

Feedback from EU:

- **Very positive/very highly scored, but……**
  - ***Too much emphasis on demonstration of (X-band) brilliant technology instead of designing a fully fledged user facility***
  - ***More clarity needed on how XbFEL fits into ESFRI landscape***

CompactLight Objectives

Our aim is to facilitate the widespread development of X-ray FEL facilities across Europe and beyond, by making them more affordable to construct and operate through an optimum combination of emerging and innovative accelerator technologies.

(Clear focus on conceptual design of a Facility rather than demonstration of the technical maturity of the X-band technology)

We will design a Hard X-ray FEL facility using the very latest concepts for:

- **bright electron photoinjectors**
- **very high gradient accelerating structures**
- **novel short period undulators**

The resulting facility will benefit from:

- a **lower electron beam energy** than current facilities, due to the enhanced undulator performance
- will be **significantly more compact** due to lower energy and high gradient structures
- will have a **much lower electrical power demand** than current facilities
- will have **much lower construction cost and running cost**

Making X-ray FELs affordable

Participants

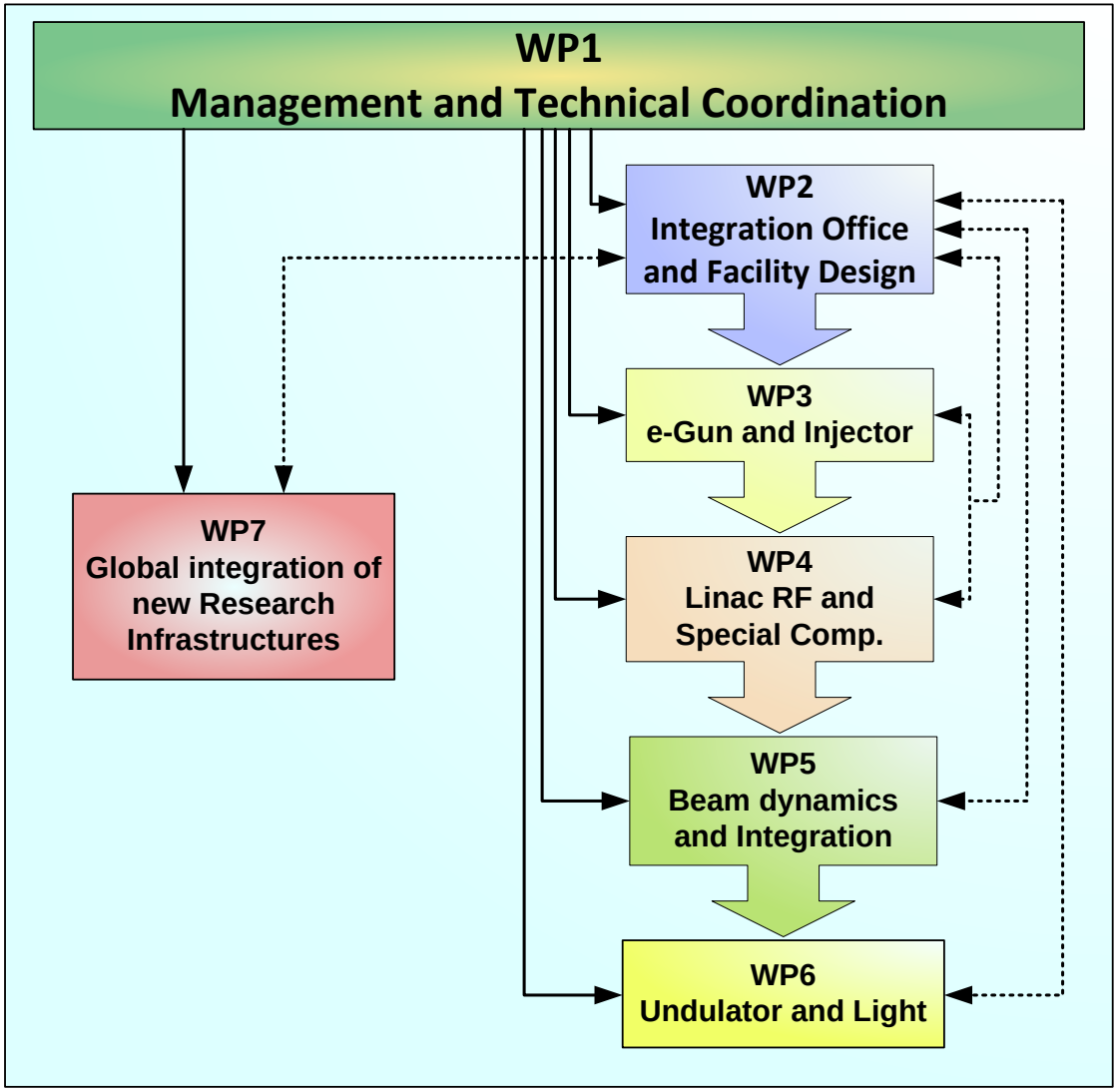
1 (Coordinator)	Elettra – Sincrotrone Trieste S.C.p.A.	Italy
2	CERN – European Organization for Nuclear Research	International
3	STFC – Daresbury Laboratory	UK
4	SINAP, Chinese Academy of Sciences	China
5	Institute of Accelerating Systems and Applications	Greece
6	Uppsala Universitet	Sweden
7	The University of Melbourne	Australia
8	Australian Nuclear Science and Tecnology Organisation	Australia
9	Ankara University Institute of Accelerator Technologies	Turkey
10	Lancaster University	UK
11	VDL Enabling Technology Group Eindhoven BV	Netherlands
12	Technische Universiteit Eindhoven	Netherlands
13	Istituto Nazionale di Fisica Nucleare	Italy
14	Kyma S.r.l.	Italy
15	University of Rome "La Sapienza"	Italy
16	Italian National agency for new technologies, Energy and sustainable economic development, ENEA	Italy
17	Consorcio para la Construccion Equipamiento y Explotacion del Laboratorio de Luz Sincrotron	Spain
18	Centre National de la Recherche Scientifique, CNRS	France
19	Karlsruher Institut für Technologie	Germany
20	Paul Scherrer Institut PSI	Switzerland
21	Agencia Estatal Consejo Superior de Investigaciones Científicas	Spain
22	University of Helsinki – Helsinki Institute of Physics	Finland
23	Pulsar Physics	Netherlands
24	VU University Amsterdam	Netherlands
Third Parties	**Third party's organisation name**	**Country**
	Universitetet i Oslo – University of Oslo	Norway
	Advanced Research Center for Nanolithography (JRU of VU)	Netherlands

Italy	5
Neth.	4+1
UK	2
Spain	2
Austr.	2
China	1
Greece	1
Sweden	1
Turkey	1
France	1
Germany	1
Switz.	1
Finland	1
Norway	0+1
Internat.	1

WPs top level summary

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Key deliverable
	Management and Technical Coordination	Integration Office and Facility Design	e-Gun and Injector	Linac RF and Special Components	Beam Dynamics and Integration	Undulator and Light Production	Global Integration of new Research Infrastructures	
Hard X-ray FEL	X	X	X	X	X	X	X	CDR UK compatible (Main deliverable)
Soft X-ray FEL	X	X	X	X	X	X	X	CDR (sub deriv.)
Upgrading of existing machine	X	X	X	X	X	X	X	CDR (sub deriv.)
Deliverables, Activities, Comments	Administration, Reporting, Management Dissemination, Applications, User-Commun. Political issues/relations	Facility design Project Office, CDR authors, parameters, drawings, cost and power Industry relations and involvement	State of art e-Gun Development of new e-Guns Prototyping and tests	Accel. Struct. Design XBOX and beam tests at TWA in AERES LLRF systems, RF deflectors, linearizers, klystrons	Modelling S2E simulations. Delivery consistent tools Parameters for all machines	State of art Undulators and future development Comparative studies of "ambitious" undulators on the time scale of 4-5 years, matched to averall design	Global integration for new Research Infrastructures. Research services to be provided at International level Preliminary estimation of constr/operat costs.'	

WPs Structure



WPs description

WP1: Project management and coordination

WP1 carries the overall management of the XLS Design Study to ensure timely achievement of project results through technical and administrative management. It will be lead by the Project Coordinator and be focused on the effective management and coordination of all the WPs and deliverables, the budget and the project implementation plans.

WP2: FEL science requirements and facility design

The objective of WP2 is to provide the overall design of the FEL. It will determine performance specification for the Facility based on user-driven scientific requirements. It will identify and chose the most appropriate technical solutions considering cost, technical risk and performance.

WPs description

WP3: Gun and injector

The objective of WP3 is the comparative assessment of advanced gun and injector designs. Options considered:

- A full-X-band solution, inclusive of higher-harmonic linearization in K band. This aims to utilize the recent achievements in the design of X-band guns and reduce limitations of machine repletion rate currently given by the injector.
- High-gradient injectors at existing gun frequencies, S and C bands (towards lower emittance guns).

WP4: RF systems

The primary objective of WP4 is to define the rf system for the linac of the XFEL in the main and sub-design variants.

Additionally the WP will take responsibility for defining specialized rf hardware in other systems, for example for an eventual 36 GHz lineariser system in the injector and deflectors for longitudinal profile measurement systems.

A key goal will be to define a standardized rf unit:

- simplify the preparation of future construction projects
- cost savings (industrialization of linac hardware)

Work Packages description

WP5: Undulators and light production

The primary objective of WP5 is to determine the undulator design for XLS. It will start by investigating state of art undulators and then consider on-going developments. "Ambitious undulators" will be compared with the boundary conditions of technologies available on 4-5 years time scale. These will include:

- novel short period undulators
- superconducting undulator
- RF-microwave undulators

WP6: Beam dynamics and start to end modelling

The main objective of WP6 is to provide key parameters and performance estimates of the Facility. Consistent tools for modelling the machine, as the basis for the integrated performance studies, will be developed.

- S2E simulations from the cathode to the undulator exit.
- Tolerance studies will be also performed.
- Beam-based alignment and tuning methods that can relax the tolerances.

WPs description

WP7: Global integration with new Research Infrastructures

WP7 will address strategic issues related to the objectives of XLS, namely the impact and benefits for the user community, in both the public and private sectors, at the scientific and technical level. The results of this work package will be a series of reports which target funding agencies and policy makers and that can be used in the decision making process for the approval of new research infrastructures or the upgrade of existing facilities.

The main deliverable of CompacLight will be a Conceptual Design Report of an X-band Hard X-ray facility.

The CDR will include:

- ✓ Executive summary
- ✓ Overall concepts
- ✓ Layout and parameters
- ✓ Detailed design at the sub-system level
- ✓ Cost evaluations

Timeline and Resources

European Commission

Horizon2020

Work Programme 2016-2017

Research Infrastructures (RIs)

"Development and long-term sustainability of new pan-European RIs"

Research Infrastructures (RTD)	2016	2017	TOTAL	Single grant
CALL H2020-INFRADEV-2016-2017	**80**	***60***	***140***	
INFRADEV-10: Design studies		*20*	*20*	From 1 to 3 M€
INFRADEV-02: Preparatory Phase	40		40	Up to 4 M€
INFRADEV-03: Individual Support	30	*40*	*70*	From 2 to 5 M€
INFRADEV-04: Eur. Open Science Cloud	10		10	From 5 to 10 M€

+ 5 M€

Deadlines: **30 March 2016** **22 June 2016** ***29 March 2017***

Request from EU: 3.0M€ **Duration 3-4 years** **Assumed start date: Jan 2018**

Acknowledgement

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