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Short WP5 Status Report

WP Leaders Meeting – December 3rd

F. Nguyen on behalf of the WP5 Group

Technologies for CompactLight undulator

A.Aksoy, A.Bernhard, M.Calvi, J.A.Clarke, H.M.Castañeda Cortés, A.W.Cross, G.Dattoli, D.Dunning, R.Geometrante, J.Gethmann, S.Hellmann, M.Kokole, J.Marcos, Z.Nergiz, F.Nguyen, F.Pérez, A.Petralia, S.C.Richter, T.Schmidt, D.Schoerling, N.Thompson, K.Zhang, L.Zhang, D.Zhu

The H2020 CompactLight project is currently developing the design of the next generation of compact X-ray Free Electron Laser facilities combining the latest concepts for bright electron photo injectors, very high-gradient X-band structures, and innovative short-period undulators. Within the framework of this project, a comprehensive overview of undulator technologies has been carried out. The overview has covered technologies that are either exploited at fully operating FEL facilities or that are foreseen to be available within the next years. Main emphasis has been given to devices based on permanent magnets and on superconducting technologies, examined in terms of status and perspectives, but novel concepts with different levels of readiness have been addressed as well. A key element of this study has been a quantitative comparison of the different technologies based on a parametrization of the achievable fields as a function of undulator period and gap. Taking into account this parametrization, the expected FEL performance in terms of peak brilliance and saturation length has been determined for each technology. The resulting comparison illustrates in which way the choice of undulator technology defines the required electron beam energy and affects the layout of the facility as a whole, and based on it a nominal beam energy for the accelerator has been selected. With this choice we have looked for a compromise, trying to keep the beam energy as low as possible but at the same time allowing several viable options for the undulator technology. In the final part of the overview a tentative cost breakdown of the whole undulator system has been drawn, including fabrication and installation costs.

WP5 – Abstract from J. Gethmann & A. Bernhard

Title: Potential of variable polarizing undulators as afterburners
Abstract:
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As part of the EU funded Compact Light project, pros and cons of superconducting undulators with variable polarisation as afterburners for compact Free-Electron Lasers are discussed.
For Free-Electron Lasers that use superconducting undulators for compactness, afterburners are the most promising way to provide variable polarized light.
Until now, afterburners only exist as permanent magnet undulators which might limit the advantages of using
superconducting undulators as main amplifiers in Free-Electron Lasers.
However, variably polarizing superconducting undulators have been shown to be feasible.
In this contribution we discuss the findings of our simulations and parameter studies exploring the potential
of superconducting variably polarizing undulators as afterburners for compact Free-Electron Lasers.
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Authors: Julian Gethmann, Axel Bernhard, Sebastian C. Richter*,
Anke-Susanne Müller (all KIT, * also CERN)
Poster+Paper
MC7: Accelerator Technology
T10 Superconducting Magnets

WP5 – To do list (from the Grant Agreement)

Task 5.2. Select a few outstanding options to be considered for CompactLight.

And the European Officer will be stick to these,
asking for detailed report on the carried activities about them!

Selected options have to be selected accounting for risk, cost & TRL considerations → extra-task #1

Extra-task1 – Cost-benefit analysis of the XLS undulator

Coordinator: Thomas Schmidt

Participants: Raffaella Geometrante, Marco Calvi, Axel Bernhard, Mirko Kokole, Jordi Marcos, *et al.*

Activities: Risk assessment model, technology readiness level and cost estimates on undulator technologies, in close connection with WP7, WP2

Task 5.3. For the options selected in T5.2, perform a systematic optimization of the electron beam parameters at the linac-to-undulator interface to maximise the photon production, in close contact with WP2 and WP6.
Task 5.4. Report the conceptual design of the selected options as resulting from T5.3.

As signed on the Grant Agreement, Task 5.3 clearly points on the FEL performance as a function of the electron beam parameters →

Extra-task2 – FEL emission simulation support

Coordinator: Neil Thompson

Participants: David Dunning, Hector Mauricio Castaneda Cortes, Zafer Nergiz, Federico Nguyen, Alberto Petralia, *et al.*

Activities: FEL dynamics and schemes with the XLS electron beam distributions passing through the (chosen XLS technologies) undulator, in close connection with WP2, WP6

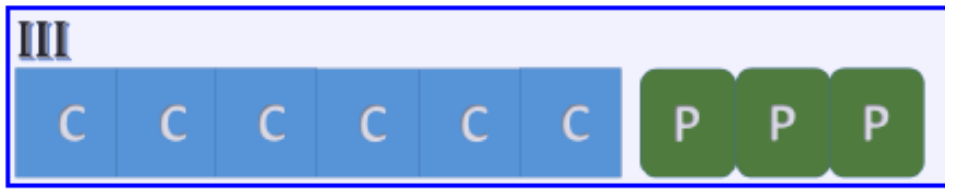
No intention ever to duplicate eventual work carried on other WP's, we have simply to bear in mind that something shall be written on the report of the Task 5.3 activities → Close contact with A. Aksoy and N. Thompson is on-going

From H. M. Castaneda Cortes

III. Undulator plus after-burner(AB)

a) Fixed (e.g. SCU with circular) polarization

b) Afterburner with variable polarization (e.g. in-vacuum PM)



We agreed on a baseline consisting of a SASE line made up of a helical SCU and the afterburner described by an in-vacuum CPMU (see talk from T. Schmidt) → work is on-going, specifying the details with S. Di Mitri, T. Schmidt, A. Bernhard

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WP5 – Inputs to Carlo Rossi & WP7

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					WP5	XLS PBS form for Costing					
Code			Machine sector	System	Sub-system	Component	Multiplicity	Estimated Cost	Tech. Uncertainty* C1 or C2 or C3	Number of Expected Offers	Technical Resp
		XLS Baseline									
6	WP2	J. Clarke	FEL 1 & FEL 2								
6.1	WP5	guyen/T. Schmidt		Undulators 1 and 2			1,00				
6.1.1					Undulator unit		n				
6.1.1.1						Magnet	n				
6.1.1.2						Frame	n				
6.1.1.3						Gap Drive	n				
6.1.1.4						Undulator Mover System	n				
6.1.1.5						Quadrupole	n				
6.1.1.6						Phase Shifter	n				
6.1.1.7						RF BPM	n				
6.1.1.8						XY Stage	n				
6.1.1.9						Beam Size & Shape Screen/Wire-Scanner	n				
6.1.1.10						Beam Current Monitor	n				
6.1.1.11						Beam Dose Monitor	n				
6.1.1.12						Undulator Control System	n				
6,2				FEL1 & FEL2 Vacuum System			1,00				
6.2.1					Vacuum Pumps and Connecting Elements		n				
6.2.2					Vacuum Power Supplies		n				
6.2.3					Vacuum Instrumentation System		n				
		XLS Upgrade 1, please enter only incremental items and costs with respect to Baseline									
18	WP2	J. Clarke	FEL 1 & FEL 2	Upgrade 1							
18.1	WP5	guyen/T. Schmidt		Undulators 1 and 2			1,00				
18.1.1					Undulator unit		n				
18.1.1.1						Magnet	n				
18.1.1.2						Frame	n				
18.1.1.3						Gap Drive	n				
18.1.1.4						Undulator Mover System	n				

T. Schmidt, A. Bernhard & R. Geometrante are filling these columns! Many thanks!

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Thank you!

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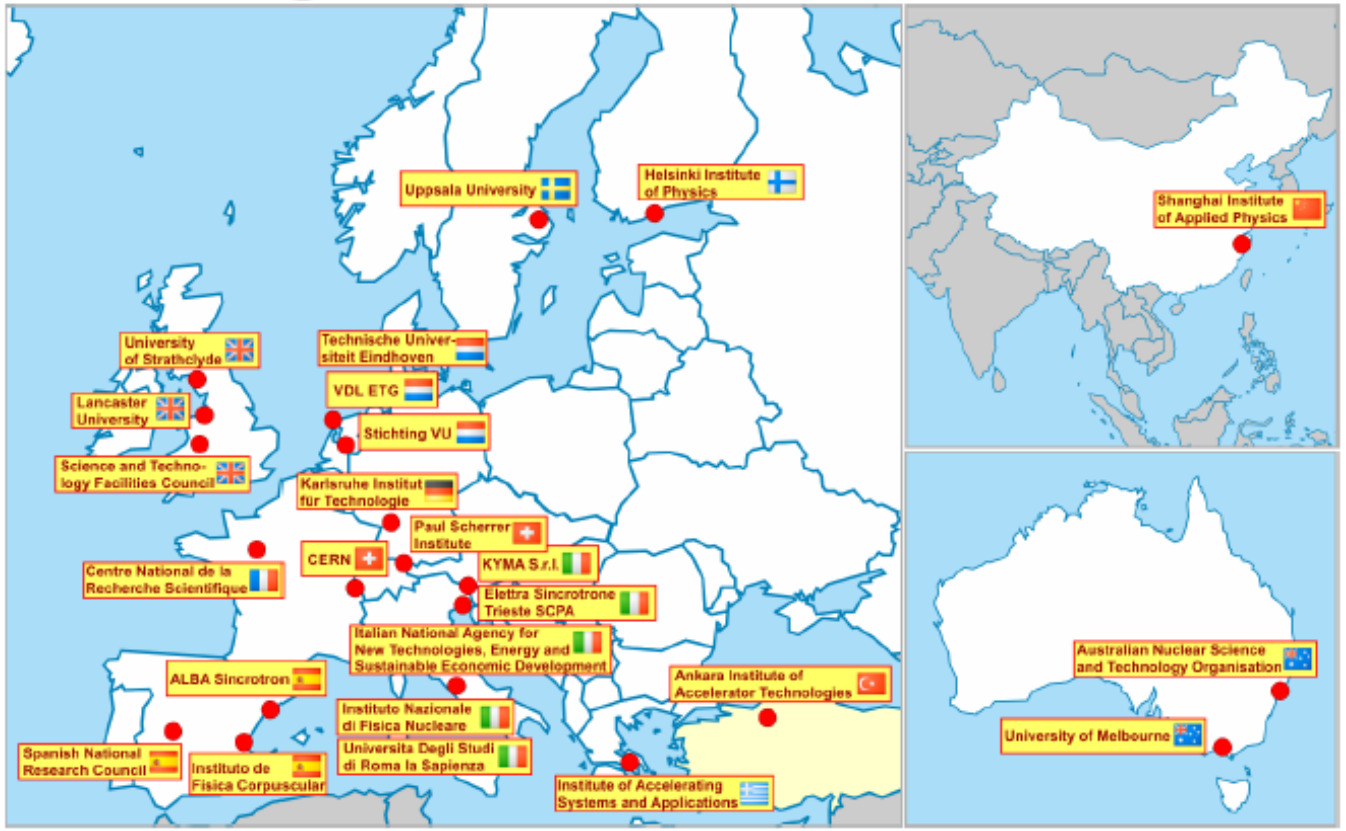

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