EuroFEL NEWS

12|10

3rd issue · www.eurofel.eu

Dear readers,

the IRUVX-PP project is nearing its end; the partners just agreed to finish the project in time by the end of March 2011. How will we proceed towards EuroFEL? The directors of the participating facilities discussed this issue at a meeting at PSI on November 25/26 and agreed on the next steps towards a Memorandum of Understanding as a frame for their collaboration in the near future (see page 6). A few days later another important decision was made by ESFRI: Based on the strong support by Italy, Sweden and Switzerland it decided to keep EuroFEL on the updated roadmap 2010. The preceding discussions at the ESFRI and EC level on whether EuroFEL would qualify as a distributed research infrastructure according to the ESFRI definition caused some turbulence, but also helped significantly to sharpen the EuroFEL profile and to discuss the project with the main stakeholders.

All the best for the new year

Josef Feldhaus, Ute Krell & Matthias Kreuzeder, *IRUVX-PP Coordinator Team*

FERMI@Elettra

In the first week of November 2010 the Sincrotrone Trieste team celebrated the tremendous progress made in 2010 on FERMI@Elettra. They are now set to accomplish their goal of producing the first flashes of laser light before the end of the year. This state-of-the-art seeded Free Electron Laser (FEL) user facility is now on the cusp of beginning operations for the initial planned experiments and user community.

Presently the entire linac and related systems have been installed and operated to just above 1.2 GeV, with an expectation to reach the project goal of 1.5 GeV by mid 2011. Once accelerated to the desired energy – compressed, suitably focused and transported through the length of the linac – the highquality electron beam is transferred to the undulator hall and through the fields of the undulator magnets where it will radiate laser-like light at well-defined and chosen wavelengths. This light is split from the electron beam and sent onward through various diagnostics and mirrors where it finally enters the experimental hall and reaches the experimental stations. Through the use of two complementary FEL lines (one completed and being commissioned), FERMI is designed to be capable of being tuned over a wide range of photon wavelengths (from 100 to 4 nanometers) and so be applicable to a broad user community. Through strong collaborative efforts with members from Europe and around the world, the experimental programme is also proceeding rapidly with three experimental programmes currently funded: Low Density Matter, Elastic and Inelastic Scattering, and Diffraction and Projection Imaging. Moreover, the experimental programme Magnetic Dynamics has also been approved. 2011 will thus be a year of transition to full experimental programs operation. *SM, BP*

IN THIS ISSUE

EuroFEL
FREE ELECTRON LASERS OF EUROPE

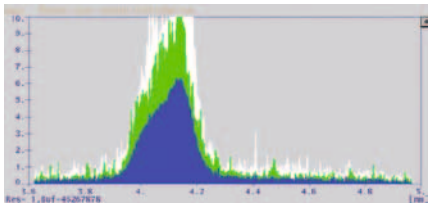
EuroFEL will integrate the national activities in Europe to deliver a unique, distributed European research infrastructure of Free Electron Laser light sources. EuroFEL is part of the ESFRI Roadmap 2008. The preparatory phase of EuroFEL (IRUVX-PP) is funded by the European Commission under FP7.

ATOMIC TERRA INCOGNITA

This is our new "corner" with interesting information for potential new users. We try to inform about major developments and future research perspectives at FELs.

This is particularly interesting for the investigation of biological samples:

After the recent upgrade, FLASH at DESY for the first time generated intense laser light in the so-called water window at a wave-length of 4.1 nanometres. The water window is the wavelength region between 2.3 and 4.3 nanometres, ie. between the K-edges of oxygen and carbon. In this wavelength region, soft X-ray radiation is able to penetrate several micrometres into water while it is strongly absorbed by carbon. Therefore, the water window is particularly interesting for the investigation of organic material in its natural aqueous environment. For example, it is possible to produce images of biological objects in small droplets or of cells, with a resolution of less than 10 nanometres. Such images can be taken of a flying object in a single shot, while at synchrotrons long exposure times are required which cause radiation damage, making it necessary to freeze the samples.

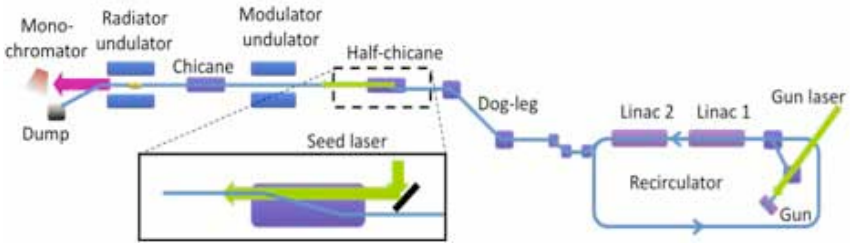


Soft X-rays in the water window will be available for users as of April 2011.

In September 2011, construction work for the extension of the FLASH facility will start. The nearly 30 Million Euro project, called FLASH II, includes a second FEL beam line and a new experimental hall. Both FELs will be driven by the same 1.25 GeV superconducting linear accelerator. Current plans envision newly developed undulators which will be able to provide laser light with variable polarisation down to ~4 nm wavelength in the fundamental. *GH*

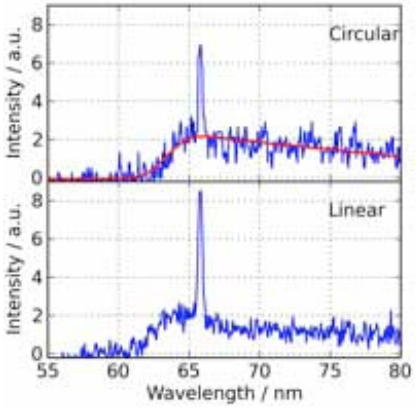
Collaboration success

The test FEL at MAX-lab demonstrates first circularly polarised harmonic generation at 66 nm (4th harmonic). This FEL is a collaboration between MAX-lab, the Helmholtz-Zentrum Berlin (Research Division Large Scale Facilities, G-I2 and G-A3) and the department for Atomic Physics at Lund University that was started during the previous EUROFEL Design Study contract (under FP6).



Overview of the test FEL installations at MAX-lab. The red arrow indicates the radiation pulses generated by seeding (green arrow) of the electron beam (blue).

HZB has provided the undulators, the magnetic system and diagnostic components, while MAX-lab has provided the electron linac source, installations and the combined gun and seed laser system (funded by EUROFEL). Scientists from both partners have successfully reached the goal of seeded circularly polarised radiation pulses. The system utilises the 380 MeV linac injector and a photo cathode RF gun providing an electron pulse compressed to 500 fs with a charge of 20-40 pC to the undulator system. The electron pulse is overlapped with a 263 nm seed laser pulse, compressed in a magnetic chicane and generates harmonics of the 263 nm seed in the radiator undulator. The radiator undulator is of APPLE II type and can thus provide both linear and circular polarisation (see figure below). The 2nd, 3rd and 4th harmonic (133, 88 and 66 nm) of the seed laser pulse have been generated. So far this is the first accelerator-driven source with the shortest wavelength in circularly polarised coherent mode. The system is not intended for user operation but focused on the development of the techniques and the building of knowledge in preparation for the seeded MAX IV facility. *JB, KH, SW*



The fourth harmonic of the 266 nm seed laser pulse in both, linear and circular mode of the radiator (narrow peaks at 66 nm). The plateau is the background spontaneous undulator radiation. The red line is the simulated spontaneous radiation.

Inauguration of the SwissFEL Injector Test Facility

An important milestone for the realisation of the new SwissFEL facility was reached on 24th August 2010, when the core of the new Swiss Free Electron Laser facility (SwissFEL), was set into operation at the Paul Scherrer Institute. Guest of Honour, Bundesrat Didier Burkhalter, pressed the red button, and the SwissFEL Injector Test Facility produced its first electron beam.

In his welcome PSI Director Joël Mesot appealed to the present political representatives: "With SwissFEL we have the unique opportunity to offer our researchers a competitive advantage, and in this way contribute to Switzerlands global leading position in research." Bundesrat Didier Burkhalter, in whose jurisdiction PSI falls, said: "With SwissFEL, Switzerland will have one more masterpiece in its scientific collection. The new X-ray laser is an excellent example of PSI's will to fight for success, and to stay on top." More information: www.psi.ch *MvD*

PSI-Director Joël Mesot in dialogue with Bundesrat Didier Burkhalter.

First lasing of the ALICE FEL

The Infra Red Free Electron Laser installed on the ALICE accelerator at STFC Daresbury Laboratory lased for the first time on 23rd October 2010 – the first energy recovery driven FEL within Europe – see *www.astec.ac.uk/news/FEL_lasing.htm*. Once established, the FEL lased for several hours at about 8 microns wavelength and appeared quite tolerant to machine settings. So far, the maximum output power observed is ~30mW, with scanned output power vs. cavity length showing the expected detuning behaviour. The measured spectrum suggests the light pulse generated has a FWHM of ~800fs, agreeing well with simulations. Thorough characterisation of FEL performance and output as a function of wavelength, cavity length etc. will follow. *GB-W*

MAX IV construction site opening ceremony

22 November 2010 was a great day in the history of MAX-lab. On that day an opening ceremony for the construction site of the MAX IV building was held.

Among others, the Swedish deputy prime minister, Mr Jan Björklund gave a speech. He stressed that MAX IV is of huge importance for Sweden, Southern Sweden and for the city of Lund. He said in his speech that MAX IV is the largest research infrastructure project in Sweden so far. After the celebration at the building site – where the vibrations in the ground were tested by one hundred twelve-year-olds, jumping at the same time, instructed by children's TV star Ola Selmén – the festivities continued at the University Hall with a light lunch, more speeches and open lectures. *KL*

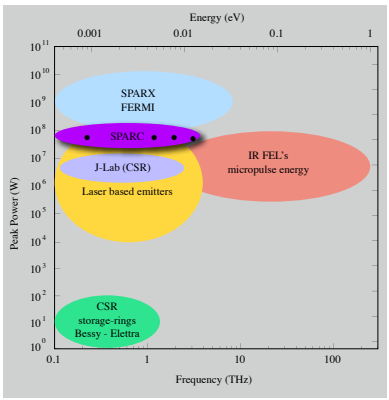
The Berlin Energy Recovery Linac Project B*ERL*InPro

On 8 October 2010 the Senate of the Helmholtz-Association unanimously voted to contribute €15 million to the Energy-Recovery-Linac (ERL) demonstration project B*ERL*inPro to be constructed at the Berlin-Adlershof campus of the Helmholtz-Zentrum Berlin. The collaborative project of HZB and DESY will receive additional financial support from the Berlin Senate (€ 5M) and HZB itself (also € 5M). The five-year project is scheduled to start in 2011. The primary goal of the B*ERL*inPro is to advance existing ERL technology to the high current, low emittance regime. The principle of ERL shall be demonstrated by producing beams with highly desirable characteristics never achieved before, while aspects of beam stability, control of beam loss and the flexibility of the beam parameters shall be studied.

Even though B*ERL*inPro is not designed as a user facility, it will most likely help answer fundamental questions in "proof of principle" experiments. *IH, BK*

High power THz radiation from high brightness electron beam at SPARC

Broadband Coherent Transition THz Radiation (CTR) has been produced at SPARC; the intense (~10 μJ) radiation is emitted by an ultra-short high-brightness electron beam at femtosecond scale. High power, quasi-monochromatic, THz radiation can also be generated through a longitudinally modulated electron beam.



A detailed study of the CTR spectral emission has been performed in the velocity bunching regime with a beam compressed down by a factor of 14, ie. 260 fs RMS length, 500 A peak current and projected transverse emittance lower than 3 mm mrad. As shown in the figure, the CTR peak power measured as a function of the frequency confirms the extension, predicted by simulations, of the CTR spectrum to values as high as 5 THz and a gain, in both peak power and energy per pulse, with respect to other THz sources. The THz radiation source at SPARC opens the possibility to perform exciting experiments in different fields of science as, for instance, linear spectroscopic investigation of new classes of superconductors or THz-pump THz-probe experiments. *EC*

2011

Partners of IRUVX-PP – the preparatory phase of EuroFEL

EuroFEL
FREE ELECTRON LASERS OF EUROPE

Print this in A3 and hang it on your office wall!

January

1	SAT	CH, DE, FR, IT, PL, SE	
2	SUN		
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22	SAT		
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24	MON		4
25	TUE		
26	WED	European XFEL Users' Meeting at DESY, Hamburg, Germany	
27	THU	Joint sessions Hasylab/European XFEL at DESY, Hamburg, Germany	
28	FRI	Hasylab Users' Meeting at DESY, Hamburg, Germany	
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February

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22	TUE		
23	WED		
24	THU		
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26	SAT		
27	SUN		
28	MON		9

March

1	TUE	EuroFEL Workshop on Photocathodes for RF guns, Lecce, Italy	
2	WED	EuroFEL Workshop on Photocathodes for RF guns, Lecce, Italy	
3	THU		
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19	SAT		
20	SUN		
21	MON		12
22	TUE		
23	WED	3rd IRUVX-PP Annual Meeting	
24	THU	3rd IRUVX-PP Annual Meeting	
25	FRI	3rd IRUVX-PP Annual Meeting	
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April

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12	TUE		
13	WED		
14	THU		
15	FRI		
16	SAT		
17	SUN		
18	MON	Advances in X-ray Free-Electron Lasers, Prague, Czech Republic	16
19	TUE	Advances in X-ray Free-Electron Lasers, Prague, Czech Republic	
20	WED	Advances in X-ray Free-Electron Lasers, Prague, Czech Republic	
21	THU	Advances in X-ray Free-Electron Lasers, Prague, Czech Republic	
22	FRI	CH, DE, IT, SE, UK	
23	SAT		
24	SUN	CH, DE, IT, PL, SE, UK	
25	MON	CH, DE, IT, PL, SE, UK	17
26	TUE		
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28	THU		
29	FRI		
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May

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31	TUE		

June

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August

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12	FRI		
13	SAT	10th PSI summer school, Zuoz, CH	
14	SUN	10th PSI summer school, Zuoz, CH	
15	MON	FR, IT, PL 10th PSI summer school, Zuoz, CH	33
16	TUE	10th PSI summer school, Zuoz, CH	
17	WED	10th PSI summer school, Zuoz, CH	
18	THU	10th PSI summer school, Zuoz, CH	
19	FRI	10th PSI summer school, Zuoz, CH	
20	SAT	10th PSI summer school, Zuoz, CH	
21	SUN	10th PSI summer school, Zuoz, CH FEL 2011, Shanghai, China	
22	MON	10th PSI summer school, Zuoz, CH FEL 2011, Shanghai, China	34
23	TUE	FEL 2011, Shanghai, China	
24	WED	FEL 2011, Shanghai, China	
25	THU	FEL 2011, Shanghai, China	
26	FRI	FEL 2011, Shanghai, China	
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September

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12	MON	CH	37
13	TUE		
14	WED	10 years SLS at PSI, Villigen, CH	
15	THU	Jump Joint Users Meeting at PSI, Villigen, CH	
16	FRI	Jump Joint Users Meeting at PSI, Villigen, CH	
17	SAT		
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30	FRI		

October

1	SAT		
2	SUN		
3	MON	DE EPICS collaboration meeting at PSI, Villigen, CH	40
4	TUE	EPICS collaboration meeting at PSI, Villigen, CH	
5	WED	EPICS collaboration meeting at PSI, Villigen, CH	
6	THU	EPICS collaboration meeting at PSI, Villigen, CH	
7	FRI	EPICS collaboration meeting at PSI, Villigen, CH	
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24	MON		43
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30	SUN		
31	MON		44

November

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25	FRI		
26	SAT		
27	SUN		
28	MON		48
29	TUE		
30	WED		

December

1	THU	3rd Joint BERII and BESSY II Users' Meeting, HZB, Berlin, Germany	
2	FRI	3rd Joint BERII and BESSY II Users' Meeting, HZB, Berlin, Germany	
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22	THU		
23	FRI		
24	SAT		
25	SUN	CH, DE, FR, IT, PL, SE, UK	
26	MON	CH, DE, IT, PL, SE, UK	52
27	TUE	UK	
28	WED		
29	THU		
30	FRI		
31	SAT		

CH = public holiday in Switzerland, DE = public holiday in Germany, FR = public holiday in France, IT = public holiday in Italy,
PL = public holiday in Poland, SE = public holiday in Sweden, UK = public holiday in the United Kingdom

DIRECTORS MEETING at PSI

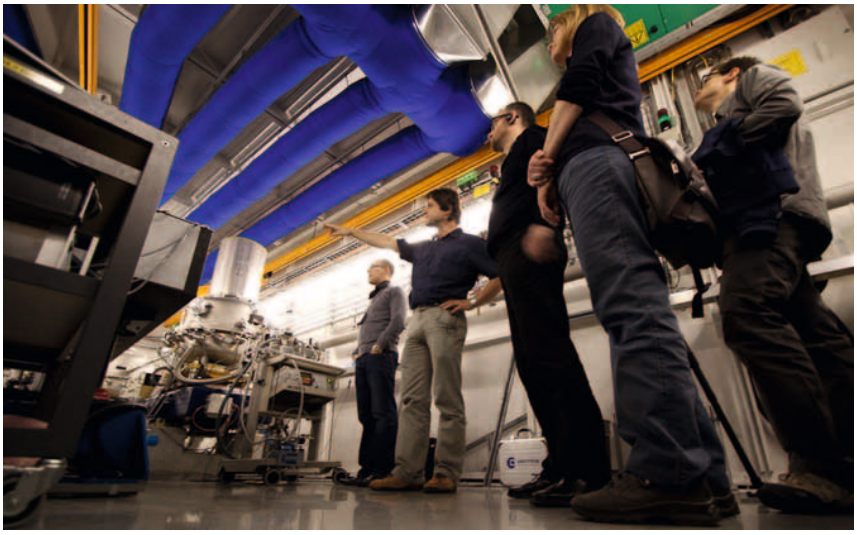
Representatives of the labs participating in the IRUVX-PP project met from 25 to 26 November at Paul Scherrer Institute in Switzerland. The main goal of the meeting was to decide on the procedure, the areas and the framework of their future collaboration. IRUVX-PP, the preparatory phase for EuroFEL, is to finish end of March 2011. The Directors of DESY, Elettra, HZB, INFN, Max-Lab, PSI and STFC agreed on drawing up a Memorandum of Understanding defining the areas of activities in which they want to collaborate in the future.

The MoU is to be signed by the lab directors shortly before the end of the IRUVX-PP project and will define the framework of the collaboration. The scientists of the IRUVX-PP project are now encouraged to propose precise activities and projects that they would like to pursue after IRUVX-PP, so that the most propelling projects can be continued in the coordinated and collaborative way that has been successfully initiated in the individual workpackages.

Directors or representatives:
E. Weckert (DESY); C. Rizzuto (Elettra); A. Föhlisch (HZB); L. Palumbo (INFN); S. Svensson (MAX-lab); R. Abela, L. Rivkin, H. Braun (PSI); J. Womersley (STFC)
IRUVX-PP prep group members: *J. Feldhaus, U. Krell, M. Kreuzeder (DESY); F. Mazzolini (Elettra); A. Föhlisch (HZB); P. Antici (INFN); M. van Daalen (PSI); G. Bushnell-Wye (STFC); A. Wrulich (WP1)*

Joint Expert Groups meeting at PSI

From 24 – 26 November 2010 several members from the IRUVX-PP workpackages 3 & 7 met at PSI in winterly Villigen. Among many other topics the scientists and engineers discussed ideas for future collaborations and joint technical projects.



The participants consented that WP7 and the EGs 4 and 5 of WP3 will merge and form one future 'group of interest'. Within a future framework of EuroFEL this group could act as a network which submits proposals to EuroFEL or as a technical working group. The following areas could be bases for continuing the collaborations:

Optical Systems and Photon Diagnostics: On the basis of the achieved technical development – some of them have already reached maturity – the group should concentrate on issues as how to handle the property rights for existing devices and new common developments.

Metrology of Optics: A group of interest already exists in this area coordinating efforts and sharing devices and data for high precision metrology of optical devices.

Study of Damage Thresholds of Optics: This working group could coordinate tests of radiation stability of optical devices which are important for all participating institutions.

Simulation of Beam Transport: The collaboration, which includes photon beam propagation into the electron and FEL simulations could help to define standardised interfaces between electron beam and photon beam codes. It should support training in applying the photon beam propagation codes PHASE and FOCUS for optics optimisation.

Besides exciting and lively discussions the workshop participants had the opportunity to join a very insightful guided tour through the Swiss Light Source (SLS) at PSI. *KT*

All pictures from the PSI meetings were made by Fini Jastrow who is a member of the workpackage 7. Fini Jastrow is working as an engineer for FLASH at DESY.

European XFEL

Construction of the tunnel system for the European XFEL is in full swing. The first tunnel boring machine set out in early July 2010 and is now finishing its second tunnel section. In January 2011, it will be joined by a second machine that will excavate the photon tunnels beneath the research campus. The tunnel works should be completed by mid-2012.

Unlike the LCLS and SPring-8 XFEL, the European XFEL will be based on a superconducting linear accelerator, which will take up the main part of the 2.1-kilometre-long tunnel. It is being built as an in-kind contribution by an Accelerator Consortium of 17 institutes from nine countries coordinated by DESY, which is the leading contributor to the accelerator complex. The production of 640 of the required superconducting cavities has recently been commissioned.

With a staff of more than 70 people, the European XFEL GmbH – the company in charge of the construction and operation of the facility – is growing steadily. The next major event will be the 4th European XFEL Users' Meeting on 26 – 28 January 2011. *IF*

More information:
www.xfel.eu

The tunnel boring machine TULA (TUnnel for LAser) after the first breakthrough in the Osdorfer Born building pit on 7 September 2010 .

LCLS update

The Linac Coherent Light Source is now operating over the energy range 480 eV to 10 keV with typical pulse energies of 1-3 mJ. The pulse length can be varied over 70-300 fs for hard X-rays, and 70-500 fs for soft X-rays. Shorter pulses (<10 fs) with reduced pulse energy (number of photons per pulse) can also be provided.

The LCLS is now accepting proposals for experiments to be carried out from October 2011 through February 2012. During this time, five LCLS instruments will be fully operational for studies in atomic, molecular and optical science, materials with soft X-rays, diffraction studies of stimulated dynamics/X-ray pump probe, coherent X-ray imaging and X-ray correlation spectroscopy. A sixth instrument focusing on matter in extreme conditions will be available for the X-ray range of 4 to 25 keV using the short pulse laser system. Proposals are due on January 11, 2011; more information is available on the LCLS web site: http://lcls.slac.stanford.edu/user/

Last April, SLAC received approval from the U.S. Department of Energy to develop the conceptual design for LCLS-II, a major upgrade to increase user capability and capacity. This design will be reviewed by the DOE in spring 2011. *KT*

The LCLS Undulator Hall.

Japan's XFEL starts user operation in early 2012

RIKEN, Japan's leading research institute, and the Japan Synchrotron Radiation Research Institute (JASRI), are approaching completion of a new X-ray Free Electron Laser (XFEL) facility adjacent to SPring-8, a Japanese 3rd generation synchrotron radiation facility. The new facility, to be completed in spring of 2011, is the first "compact" XFEL in the world, using three technologies developed in Japan: short-period in-vacuum undulators, a high-gradient c-band linear accelerator, and a high-quality injector system. These technologies combine to create a compact FEL in the hard X-ray region with a moderate beam energy of 8 GeV and a total length of 700 metres.

Aerial view of the SPring-8 campus and the new XFEL facility.

One of the unique aspects of Japan's new XFEL facility is its proximity to SPring-8 and the opportunities for synergetic research between the two facilities. In the XFEL-SPring-8 experimental facility, significant changes in samples induced by XFEL radiation can be accurately probed with undulator radiation from SPring-8 operating at a high repetition rate. Furthermore, the XFEL beam transport tunnel will provide high-quality electron beams to SPring-8, thus enabling dramatic improvements in SPring-8's radiation capabilities.

With the successful installation of the machine, conditioning operation of RF components at the new XFEL facility began last October. The first beams are expected in early 2011, and user operation is scheduled to start in early 2012. *YM*

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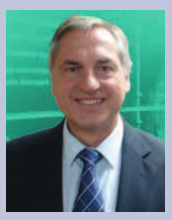
EuroFEL supports European industry

EuroFEL's main objective in collaboration with industry is to open a dialog with European industry. EuroFEL plans to focus on the initiation of collaborative R&D projects for realising advanced components and systems, and on knowledge and technology transfer to key industries for the construction of new FEL facilities. Technical workshops, an industry column on the EuroFEL web site and other communication means are planned to keep companies informed about the opportunities for their involvement.

The need for an industry engagement has been highlighted at a recent EuroFEL workshop on 'Photon beamlines and diagnostics' held at DESY in June 2010. In several areas the new FEL facilities depend on collaborative R&D and supply. They include X-ray optics such as XUV monochromators, multilayer gratings and mirrors, as well as the development of common metrology tools for standardisation of fabrication and manufacturing processes.

Collaboration with industry under the IRUVX-PP project is managed by Dr Vlad Skarda from STFC in the UK. His background is in Nuclear Science and Physical Engineering (PhD) with a



business degree (DBA). Prior to joining STFC, Dr Skarda spent 15 years in management, marketing, business and strategy development and operation of an independent commercial contract R&D department at ERA Technology Ltd, working with industry and universities across Europe. Dr Skarda can be contacted via e-mail on: industry@eurofel.eu

IRUVX-PP industry workshop reports a TT success story

Undulator development for FERMI

To promote and maximise the socio-economic impact of the publicly funded research, in coherence with the European Commission strategy, all types of possible exploitation mechanisms and exploitation partners should be considered and the most appropriate ones selected.

The FEL-1 undulators installed in the FERMI undulator hall

At the IRUVX-PP / EuroFEL industry workshop held in Döllnsee this March, examples of technology transfer and exploitation mechanisms were discussed. An inspiring example was presented by Mauro Zambelli, CEO of Kyma Srl, a spin-off company from Elettra Laboratory – Sincrotrone Trieste (ST).

Soon after the launch of the FERMI@Elettra project, a "double-object" European tender was launched to find possible suppliers/partners for the realisation of eighteen undulators, through a NewCo to be established for this purpose.

The new company was formally established in August 2007, with the two industrial companies Cosylab d.d. (Ljubljana) and Euromisure SpA (Cremona). The capital of the company was formed by 51% of shares as intangible assets supplied by ST (all the know-how and the references relevant to insertion devices) and 49% of liquid capital supplied by the partners.

In 2008, Kyma Srl took the strategic decision to locate the manufacturing activities relevant to magnetic assembling and characterisation into a building at the Business Innovation Centre in Sežana, a Slovenian town just ten kilometres away from the Elettra site.

To this purpose a daughter company of Kyma was established there in July 2008, with the name of Kyma Tehnologija d.o.o.

Today Kyma has become a true "virtual organisation", i.e. a set of interrelated and co-ordinated processes managed by Kyma from the head office at the Elettra site, and carried out at the locations of the industrial partners, and the Kyma Tehnologija lab in Sežana.

In this way eight undulators for the FEL-1 (the first Free Electron Laser line of FERMI) have been realised to date, installed and presently being commissioned. The remaining ten undulators for the FEL-2 laser are now in an advanced state of manufacturing and are expected to be delivered starting in January 2011. *MZ*

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Images: page 1 G. Crozzoli/ELETTRA; page 2/3 DESY, HZB/MAX-lab, PSI, INFN; page 6/7 PSI, Fini Jastrow/DESY, European XFEL, Brad Plummer/SLAC, Spring8/Riken; page 8 Vlad Skarda/STFC, Mauro Zambelli/KYMA/ELETTRA

Partners of IRUVX-PP – the preparatory phase of EuroFEL