LASERLAB-EUROPE

The Integrated Initiative of European Laser Research Infrastructures IV

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Work package 5 – Training and Development of User Communities

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Deliverable Type	
R = Report DEM = Demonstrator, pilot, prototype, plan designs DEC = Websites, patents filing, press & media actions, videos, etc. OTHER = Software, technical diagram, etc.	R
Dissemination Level	
PU = Public, fully open, e.g. web CO = Confidential, restricted under conditions set out in Model Grant Agreement CI = Classified, information as referred to in Commission Decision 2001/844/EC	PU

1 Introduction

The training of new generations of future users is considered as one of the main tasks of Laserlab-Europe. The objectives of Work Package 5 “Training and Development of User Communities” are:

- Train a new generation of researchers and technical staff to enable them to make optimum use of laser facilities, to exploit new experimental and theoretical approaches in photonics and laser-related science and to use them in novel applications with high industrial and societal impact;
- Develop new laser user communities in domains of science such as bio photonics, medicine, pharmacy, ICT, material research, environment, in industry, and in European regions where laser user communities are still less developed;
- Increase efficiency in these activities through cooperation with externally funded activities, aiming at a similar development of human resources, and in close collaboration with other European facilities, networks, projects and industry, such as FELs of Europe, ELI, EuroBioImaging, Photonics21, EOS, etc.

2 Objectives of Task 2 – Short-Term Training Visits for Technical Staff and Scientists (Staff Exchange)

Short-term training visits are designed to i) increase the “hands-on” experience of potential European laser users and to improve specific experimental skills and competences for scientists, and ii) to assure that the operators and technicians of Laserlab-Europe infrastructures are trained at the highest possible level through sharing of expertise, procedures and knowledge. Support for short-term training visits is granted for proposals positively evaluated by a committee of experts under supervision of the Networking Board.

3 Implementation

During the second half of the project (month 25 – month 48), Laserlab-Europe has issued three internal calls for proposals from Laserlab scientists or technicians for Staff Exchanges. For the evaluation of the proposals a Project Selection Panel, composed of representatives of the different Laserlab boards and one User Representative, had been set up at the start of the project. Proposals were evaluated in view of the following criteria:

- Relevance of the objectives of the exchange and the needs of the sending institution;
- Appropriateness of the approach as well as of the host with respect to the objectives of the exchange;
- Qualification of the staff to be exchanged.

In each proposal the applicants explain how the proposed visit(s) will lead to important transfer of knowledge and/or good practice between partners of Laserlab-Europe. Out of the 15 applications received, eleven were found to be well justified and perfectly in line with the aims of the call and were selected for implementation. After selection, one proposed exchange was cancelled due to internal reasons. 15 technicians and scientists from four laboratories benefited from the training at seven different host institutions.

During the lifetime of the project, 17 staff exchange have been performed out of 36 applications received, involving 23 technicians and scientists from nine home laboratories who have been trained at eleven host institutions. 122 days of training were provided.

The following intra-consortium staff exchanges were performed during month 25 - 48:

a) MBI – VULRC

Sending Institution: Max Born Institute for Nonlinear Optics and Short-Pulse Spectroscopy, Berlin, Germany

Hosting Institution: Laser Research Center, Vilnius University, Vilnius, Lithuania

Duration: 1 week

Participating staff: Christoph Reiter

Achievements: Main subject of the visit was a CEP-stabilized OPCPA system (including 3 ampl. stages), delivering 1.6W average power at 200Hz. This system is a lab-prototype and basis for the SYLOS system, a state of the art OPCPA laser system at 1kHz.

In the following points are different operation steps and notes listed regarding to the work exchange.

1. Introducing the front end System, based on a commercial PHAROS and NOPA by Light Conversion. The same front end system is also used at MBI for seeding a high-power system in a cooperation of the MBI departments A3 and B3, where I have been taking part in several tasks.

2. Understanding the seed beam path, after stretching by a GRISM pair and stabilizing by two motorized mirrors, inclusive power and stability monitoring, manipulating the spectrum by a DAZZLER and final seeding the OPCPA stages. The pump amplifiers are also seeded by the front end. The optimal spectrum for the OPCPA is achieved by the chirp derivation by using a SHG signal, generated from a fraction of the output for spectrometer input, software and the DAZZLER.

3. Introducing the power amplifiers, based on a Nd:YAG Regenerative Amplifier and several linear amplifiers plus SHG (532nm) by EKSMA. The SHG stages were partially „overpumped“ to generate a flat-top profile to increase the pump efficiency at 2nd, 3rd stage.

4. Optimizing the alignment, beam path, time delay, NLO crystals, checking spectrum and Dazzler parameters successively.

5. Final pulse compression by silica cubes (3pcs, about 15cm). The beam was expanded to 4cm diameter. After compression focusing the output beam to generate a plasma in air.

6. Additionally discussion about stability, performing temperature management esp. Nd:YAG pump lasers, and cause of a spatial filter contamination (windows, also Nd:YAG pump).

Summing up one can say that the staff exchange has been worthwhile in terms of acquiring new insights and exchanging experiences and ideas. I had the chance to see a different OPCPA system in comparison we have at MBI and learned some remarkable details. I saw different techniques to perform the required ultra short pulse duration. Last but not least I had always a pleasant and constructive communication to my hosts, that I wish there will be also an excellent cooperation for following projects.

b) MBI – CUSBO

Sending Institution: Max Born Institute for Nonlinear Optics and Short-Pulse Spectroscopy, Berlin, Germany

Hosting Institution: Centre for Ultrafast Science and Biomedical Optics, Politecnico di Milano, Milan, Italy

Duration: 1 week

Participating staff: Ahmet Akin Uenal

Achievements: During the week of my exchange I had the opportunity to visit three different laser laboratories in the Politechnical University of Milan, in the group of Prof. Mauro Nisoli.

Two of the laser labs are equipped with Ti:sapphire based oscillators with carrier-envelope phase (CEP) stabilization options, one system being the10kHz, 2mJ Pulsar amplifier from the company Amplitude Technologies and the other being the 1 kHz, 5mJ Femtopower amplifier from the company Femtolasers. The third lab runs a new 1kHz, 7mJ Coherent Astrella Ti:sapphire regenerative amplifier, which does not have the CEP option but emits a very good quality Gaussian beam profile with M-square values approaching the theoretical limit. Experimental setups attached to each of these laser labs are equipped with hollow core fiber setups to broaden spectra and compress pulse duration for the efficient generation of XUV light via high harmonics generation. All laser labs deliver ultrashort IR and XUV pulses for their end stations.

I had the chance to observe the work of scientists working with these lasers and to participate in various efforts, from practices of turning on the lasers to stabilizing oscillators' carrier envelope phases, from checking the spatial and temporal characteristics of laser beams to aligning the hollow core fiber in- and output beams. We have exchanged a lot of ideas in terms of good daily practices of operating the lasers for the stability and performance. In particular I found the CEP stabilization of the oscillator output beams of great interest as we in MBI plan similar CEP-stable measurements in the coming future. The CEP detection and stabilization of the laser oscillators in the labs I visited rely on a sum-frequency generation based interferometer (also known as f-to-2f interferometer), based on a periodically-poled lithium niobate (PPLN) crystal, that produces a beat signal via generating and simultaneously overlapping the near-IR fundamental spectrum and its sum frequency spectrum. The generated beat signal is then fed back to oscillator's pump laser, which acousto-optically modulates the pump power, thereby changing the amplitude and phase couplings in the Ti:sapphire crystal and affecting the CE phase. In our lab in the MBI, the CEP stabilization relies on a difference frequency generation interferometer (also PPLN based), which generates a beat signal between the fundamental and its difference frequency spectra (for analogy purposes one can call it a 0-to-f interferometer). But contrary to the CEP stabilization system in Milan, the beat signal generated in our CEP module is used to drive an acousto-optic frequency shifter (AOFS) which comes after the interferometer, so it does not act backward on the oscillator as the beat signal is fed forward to the AOFS. This unit, driven by an RF source, can shift the frequency of the light by tens of MHz and the measured CEO frequency is subtracted from the comb line. Although the feedback and feedforward methods are technically different, the physical meaning of both in terms of detection and stabilization of the CEP signal is the same. Therefore it was quite useful for me to see on a daily basis how the CEP detection and 'fast-loop stabilization' of the oscillators are routinely carried out in the labs I visited.

During my visit, it was not possible to operate the 1kHz Femtopower amplifier system CEP stable on the short notice, the so-called 'slow-loop' did not work as expected due to some misalignment of the f-to-2f interferometer after the amplifier.

Overall I found the interaction with Prof. Nisoli and his fellow group members and PhD students very useful and motivating for my daily work in my home institute. I have learned many new features of different laser amplifiers as well as experimental setups, and I benefited in particular from the discussion of CEP detection and stabilization phenomena with the attosecond laser scientists of Politechnical University of Milan.

c) CLPU – HZDR

Sending Institution: Centro de Laseres Pulsados, Salamanca, Spain

Hosting Institution: Helmholtz-Zentrum Dresden Rossendorf, Germany

Duration: 1 week

Participating staff: Marine Huault

Achievements:

A scintillator-based 2D ion detector for high repetition rate experiments has been designed and built at CLPU. It has been tested and calibrated using a mono energetic proton beam at the accelerator of the Centro de Micro-Análisis de Materiales, in Madrid but still not tested with laser-driven proton acceleration. The main objective of the staff exchange was to test and development the detector with the laser system Draco available at HZDR.

Laser-driven proton beam are becoming more and more important for several applications in different fields of physics, chemistry and material science as well as biology, medicine and cultural heritage. For this, the spatial and energy characterisation of the proton beams can play nowadays an important role for the potential use of such sources. The possibility to extend this technique to HRR mode of operation is nowadays a challenge in the laser plasma community and several laboratories and research groups are working on this. The main idea is to substitute the active RCF layers with scintillator detectors capable of transforming the ion energy deposition into light that can be then collected by an optical CCD camera.

A first visit took place in June 2019 at the HZDR laboratory in order to take the necessary measurements of the interaction chamber to build a custom made scintillator detector. The scintillator was composed of two cameras: one of them imaging from one side the odd layers, and from the other side the pair layers. The work for the build of the scintillator was split in two: the HZDR team worked on the imaging system and the preparation of the CCD camera suitable for vacuum operation mean while the CLPU team worked on the scintillator part and the support box.

The second visit took place in August 2019. The HDZR laboratory provided us the laser system Draco, ~ 30fs, 150 TW and the technical support during the campaign. The plan was to shot at high power laser on a 2 um Aluminium Target, placed at 45º according to the laser axis propagation. The scintillator detector was placed at 3 cm behind the target in order to see the scintillation emission from the interaction of the proton beam and the scintillator layers. Secondary diagnostics where implemented to have a reference in term of proton energy distribution. A Thomson parabola was used to obtain the proton spectrum and electron spectrum as well Radiochromic films for the proton spectrum. Proton up to 18 MeV where detected and visible on the scintillator detector.

We have proved during this experimental campaign that the detector is able to work at HRR, and give an online result for each shot. We plan to do future collaboration with the HZDR in order to improve the scintillator detector concerning the light collection and angle of view. The signal was low in the last layers compare to the first one, due to the spectral distribution of the proton beam but also caused by the higher light emission from the first layers which create light background when imaging the last layers. For this, we plan to place two cameras on each side of the detector, in order to separate the light collection of the first layers and last layers. This will also improve the field of view of each layer. The analysis is in progress in order to reconstruct the proton spectrum from the scintillator results.

d) INFLPR – HIJ

Sending Institution: National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania

Hosting Institution: Helmholtz Institute Jena, Germany

Duration: 12 days

Participating staff: Georgiana Giubega

Achievements: Between 02 and 14 of June 2019 I was at Helmholtz Institute Jena, Germany, together with my colleague Dr. Constantin Diplasu, for a training stage in the staff exchange programme. I participated in this program, as a junior scientist in CETAL-PW lab, INFLPR, where a PW class laser system with parameters similar to JETI 200 is available.

My objectives for this visit were: improving my knowledge about diagnostic techniques for electron acceleration experiments, enchancing the experience with particle detectors used in laser-plasma acceleration; increasing the "hands-on" experience on experimental set-ups development and specific alignments for electron detection, experimental data acquisition and data analysis (e.g. tools used in data acquisition, methods and software for data analysis, etc)

Lab Status at our arrival: just after a major upgrade of the laboratory - Interaction Chamber enlarged and moved; the beam line modified accordingly. The alignment of the optical components not accomplished yet.

In the following I will point out the things I learned during these two weeks, with the help of Dr. Alexander Savert and Mr. Georg Schäfer:

Useful information regarding:

- the laser and gas parameters to obtain first accelerated electrons and then to optimize the acceleration process
- electron detection and characterization
    - electron detector (scintilaiting screen- LANEX) calibration
    - calibration of the optical system with which the LANEX is monitorized.
- laser focus optimization by wave-front corrections and off-axis parabolic mirror
- acceleration plasma diagnostics
- laser beam dump used in laser-gas target interaction

Hands-on experience on (individual tasks and helping activities):

- optical set-up for pre-alignment laser beam, setting the axis of the experiment
- align the entire chain of interaction chamber's extension tubes with the pre-alignment laser beam
- align the beam-line transport
- set far-field and near-field diagnostic near the interaction chamber
- set and align the optical system needed for wave-front measurements near the interaction chamber

Unfortunately, the experimental set-up needed more time to be finished than our visit and we couldn't see how the experiment itself is organized. But the staff was very kind and they invited us to join them at the shooting campaign.

The information gathered during our visit at Helmholtz Institute Jena, is very useful for preparing a similar experiment at CETAL-PW and for all settings and parameters adjustment during the electron acceleration experiment itself.

e) INFLPR – HIJ

Sending Institution: National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania

Hosting Institution: Helmholtz Institute Jena, Germany

Duration: 12 days

Participating staff: Constantin Diplasu

Achievements: Between 02 and 14 of June 2019 I was at Helmholtz Institute Jena, Germany for a training stage in the staff exchange program, organized by Laserlab-Europe. I participated in this program, as a scientist in INFLPR, CETAL-PW lab that hosts a PW class laser system similar to JETI 200 in Helmholtz Institute Jena. During the entire visit I was accompanied by my colleague dr. Georgiana Giubega.

The objective of my visit was improving my knowledge about the methods and techniques mostly used to characterise the laser produced plasma in acceleration experiments; increasing the "hands-on" experience and experimental skills for preparation of laser-plasma acceleration experiments and for high power laser facility operation and procedures; improve the competences through sharing of expertise and knowledge regarding experimental data acquisition and processing.

Lab Status at our arrival: just after a major upgrade of the laboratory - Interaction Chamber enlarged and moved; the beam line modified accordingly. The alignment of the optical components not accomplished yet.

We started our training with safety instruction and then, during the first two days we visited the lab, both laser bay and experimental area. Dr. Alexander Sävert and Mr. Georg Schäfer presented the JETI 200 laser system, adaptive optics, plasma mirrors, the beam line, interaction chamber and all other auxiliary systems (automation, safety, etc.). They answered to our question regarding laser system functioning, electron acceleration set-up, conditions and parameters for optimum laser-gas target interaction, plasma diagnostics, etc.). We showed slides with particularities of our facility and preliminary results, and we received comments and recommendations.

On the third day we started effectively setting up the experiment of electron acceleration by laser wakefield.

Throughout the entire stage, we did both, individual tasks and helping activities. Practically we worked to install and align the components of the interaction chamber extensions which will accommodate the laser beam focusing system and accelerated electron beam diagnostics (total bunch charge measurements and energy distribution). We, also, prepared a setup for first measurements of some laser beam characteristics (wave front, focusability)

We also learnt useful information regarding how the work is organised and about safety procedures.

Since setting up the experiment lasts longer than our visit, they invited us for another visit during the laser shooting campaign (experiment itself).

They expressed their willingness to visit our lab, too.

The information gathered during our visit at Helmholtz Institute Jena, is very useful for preparing a similar experiment at CETAL-PW and for all settings and parameters adjustment during the electron acceleration experiment itself.

f) INFLPR – GSI

Sending Institution: National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania

Hosting Institution: GSI Helmholtzzentrum für Schwerionenforschung Darmstadt, Germany

Duration: 1 week

Participating staff: Mirela – Ileana TRUPINA

Achievements: Between 12 and 15 March 2019 I was at PHELIX, in the staff exchange programme, organized by Laserlab-Europe. I participated in this programme given the fact that I am the Laser Safety Officer in the Center for Advaced Laser Technologies - CETAL, a center that is subordinated to the National Institute for Lasers, Plasma and Radiation Physics - INFLPR, Romania.

The objective of my visit was to see how is organised the safety related to the laser safety.

During my visit to GSI, where I was with my colleague Alexandru Achim, we first visited the PHELIX, GSI and FAIR work areas and saw what technical and organizational measures are being implemented to ensure the protection against ionizing radiation.

After this tour, Mr. Stefan Gotte presented us how the activity is organized regarding the use of 1 PW laser to GSI, respectively for its use for experiments of acceleration of electrons and protons, for experiments in which non-ionizing radiations are obtained and their use in the medical field. Taking into account the applicability of the 1 PW laser, Mr. Torsten Radon presented us how the activities relating the protection to the ionizing radiation and laser safety is organized at GSI. Mr. Stefan Gotte exposed us how the safety activity is organized at PHELIX, taking into account the risk analysis. Mrs. Natasha Dausend explained to us how is done the risk assessment of the work and how is ensured the occupational safety at GSI. Mrs. Sabine Kunzer presented us which are the responsibilities of Work Safety Council and Safety Delegate.

In order to fully define how PHELIX works, Mr Bernhard Zielbauer presented us how to proceed with the external experimentalists and the procedure for analizing the beam time applications.

On the last day of our visit, Mr. Holger Brand, Dennis Neidherr and Udo Eisenbarth explained and showed how the experimental data obtained during the experiments are recorded, stored and accessed at PHELIX.

During the visit, I shared the CETAL experiences regarding to the same topics.

In conclusion, the information shared by GSI team will help us to implement at CETAL the similar rules in the benefits of the users of the research facilities.

g) INFLPR – GSI

Sending Institution: National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania

Hosting Institution: GSI Helmholtzzentrum für Schwerionenforschung Darmstadt, Germany

Duration: 1 week

Participating staff: Alexandru Achim

Achievements: Between 12 and 15 March 2019 I was at PHELIX, in the staff exchange programme, organized by Laserlab-Europe. I participated in this programme, being a software engineer in the Center for Advaced Laser Technologies - PW Laser Laboratory, a center that is subordinated to the National Institute for Lasers, Plasma and Radiation Physics - INFLPR, Romania.

The objective of my visit was to see how the laser control and diagnose system is made and also how to obtain and store in shots database experimental data.

During my visit to GSI, where I was with my colleague Mirela Trupina, we visited for the start UNILAC accelerator, specially we go the UNILAC control room where the experiments are supervised and controlled, then we visit the new FAIRE working areas.

After this tour, Mr. Stefan Gotte, presented us how the activity is organized regarding the use this laser facility to GSI, respectively for its use for experiments of acceleration of electrons and protons, for experiments in which non-ionizing radiations are obtained and their used in the medical field. In the first 2 days Mr. Stefan Gotte exposed us how the safety activity is organized at PHELIX, taking into account the risk analysis and to define how the PHELIX works, Mr Bernhard Zielbauer presented us how to proceed with the external experimentalists and the procedure for analizing the beam time applications.On the last day of our visit, Mr. Holger Brand, Dennis Neidherr and Udo Eisenbarth explained and showed how the experimental data obtained during the experiments are controlled, stored and accessed at PHELIX. They explain us that the Phelix Control System (PCS) is spit in 4 sub-systems and is based on a distributed network protocol - DIMM (which is used at CERN) and all applications. The Phelix Interlock System take control of laser safety shutters and doors control access, Phelix Timing System take control of trigger and delay signals, Phelix Beam Inspector was the main application which control the shots and finnaly the Phelix Shot Database store (PSDB) and manage experimental data directed connected to the beam inspector. All this system except PSDB, where made in LabView programming. The presentation of these systems was very precise and well documented.

In conclusion, the information shared by GSI team will help us to implement very soon at CETAL-PW laser a similar control and data acquisition system in the benefits of the users of the research facilities.

h) MUT-IOE – HZDR

Sending Institution: Institute of Optoelectronics, Military University of Technology, Warsaw, Poland

Hosting Institution: Helmholtz-Zentrum Dresden Rossendorf, Germany

Duration: 1 week

Participating staff: Przemysław Zagrajek, Norbert Pałka, Michał Walczakowski

Achievements: Thanks to the visit to HZDR we had the opportunity to see the functioning of a huge research facility. HZDR employees instructed us about safety rules and before entering the facility we obtained "certificates regarding radiation protection rules", which enabled us to enter restricted areas. During the visit, we saw two free electron lasers - FELBE and TELBE. The first of them was during maintenance works, thanks to which we could see its construction and observe the elements controlling its beam and guiding the beam to the experimental path. The second laser (TELBE) was working, so entering the chamber emitting the THz beam was impossible. The emitted beam was guided through a special path and was divided into several experimental end stations. We could observe various experimental systems used in HZDR for terahertz measurements. From our point of view, both cases were very interesting and allowed us to acquire knowledge about the elements of such a large infrastructure - the number and type of elements and needed devices. The process of generating far-infrared radiation was an excellent example that showed important technical aspects such as: undulator adjustment, electron beam and photon beam alignment, vacuum parameters, building and construction requirements, radiological shielding and safety procedures. The other part was made up of elements used for THz beam propagation and laboratory equipment needed by end users. Thanks to a fruitful discussion with HZDR employees, we learned methods for defining focusing mirrors and special windows for high-energy radiation, as well as procedures for regulating this type of elements and beam guiding. In the experimental laboratories, measurements of the radiation spectrum were described, including equipment with different properties. A self-designed configuration for measuring short pulses was presented and explained as an example of possible end station experiment. In addition, in the TELBE laboratory we could observe the procedure for preparing measurements by the user.

All this knowledge referred to above will be used during the implementation of a new facility prepared at that time in Poland - PolFEL. A seminar on the parameters assumed in the construction of PolFEL and proposed end stations was presented. It enabled additional discussion on specific solutions to be found in the PolFEL facility.

i) CLPU – LLC

Sending Institution: Centro de Laseres Pulsados, Salamanca, Spain

Hosting Institution: Lund Laser Centre, Lund University, Lund, Sweden

Duration: 9 days

Participating staff: Irene Hernández Palmero

Achievements: During her stay for one week at the Lund Laser Centre, Irene Hernández has been supervised by Dr. Anders Persson. She has followed some methods of cleaning optics, in particular gratings.

1. She has followed the cleaning of the gratings mounted in the vacuum chamber compressor with an UV lamp:
   - The required supplies.
   - The correct set-up of the UV lamp.
   - The times needed to clean the optics.
2. She has followed the cleaning of a small grating with distilled water.
3. She has followed the installation of a new mount for the first mirror in the butterfly amplifier, in order to use the leak for checking the stability of the seed with a camera.
4. They also exchanged ideas on general laser maintenance.

She learned how to proceed in these cases, the resolution of troubles that can appear and how to solve it. The application of the procedure indicated in Lund to CLPU’s compressor cleaning protocols has already started.

j) MUT-IOE – FERMI

Sending Institution: Institute of Optoelectronics, Military University of Technology, Warsaw, Poland

Hosting Institution: FERMI Lightsource, Elettra-Sincrotrone Trieste S.C.p.A, Trieste, Italy

Duration: 1 week

Participating staff: Henryk Fiedorowicz, Andrzej Bartnik, Przemysław Wachulak, Karol Janulewicz

Achievements: The staff-exchange visit was related to the construction of a free electron laser in Poland (PolFEL project), in which the MUT-IOE team participates. The MUT-IOE team is responsible for the desing and construction of the vacuum ultraviolet (VUV) beamline on a new infrastructure. FERMI is the free electron laser facility that operates in the VUV spectral region and the FERMI team is recognized as leader in this field of science and technology in the world. Scientific consultations regarding the construction of the PolFEL beamline and the end-station operating in the vacuum ultraviolet (VUV) spectral range were the puropse and aim of the visit.

The MUT-IOE team was greeted at FERMI by Luca Giannessi, Head of Machine Physics at FERMI. Than, Marco Zangrando, coordinaotor of the PADReS (Photon Analsis Delivery and Reduction System) beamline provided detailed information on the FERMI beamline, optical components and electromechanical systems for their attachment and manipulation, construction of the end-station and its equipment, as well as the vacuum systems of the beamline and the end-station. It took in the form of a laboratory tour, during which MUT-IOE members could get acquainted in detail with the construction of the beamline at FERMI and the end-stations.

After the laboratory visit the members of the MUT-IOE presented the POLFEL project and works performed to date on the design of the VUV beamline. The presentation, entitled "Free electron laser – PolFEL, a new research infrastructure in Poland. VUV beamline proposal", was provided during the seminar (https://www.elettra.trieste.it/science/seminars-archive.html?xid=20190021).

After the seminar Luca Giannessi organized a meeting of the MUT-IOE team with a group of experts form FERMI in the form of a round table discussion, during which various detailes of the planned VUV beamline at PolFEL were discussed. The construction of the beamline and the end-station as well as experiments planned during the commissioning of the new research infrastructure were considered. The possibilities for further cooperation have been also discussed.

Information obtained by the MUT-IOE team during the visit at FERMI will be highly helpful in the implementation of the PolFEL project.