LASERLAB-EUROPE

The Integrated Initiative of European Laser Research Infrastructures IV

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WP4 – Scientific and Technological Exchanges

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Final report on Thematic Networks NEO, NEILS and NEBS

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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 Objectives

The combined scientific and technical expertise of the project participants is a core asset of Laserlab-Europe, making it highly attractive for users and supporting a leading role of European science in photonics research. The objectives of this work package are i) to coordinate exchange on crucial scientific and technological issues of relevance for many partners, ii) to address the multidisciplinary applications of lasers and photonics technologies by bridging towards other ESFRI infrastructures and relevant networks, and iii) to pool know-how and good practice concerning essential operational issues such as security, laboratory management and data acquisition procedures.

Many outstanding scientific and technical skills and much premier know-how are distributed among the partners of Laserlab-Europe. Thematic Networks, dealing with best practices and knowledge sharing on specific facility operation issues and in fields of common concerns are an effective way to boost the overall effectiveness of the Consortium.

2 Network on Experiments and Operation (NEO)

Task leader: CNRS-ISMO

A number of concerns are universal to all laser infrastructures: guarantee user safety, optimise technical services to users, harmonise data acquisition procedures to allow for multiple campaigns in different infrastructures, data handling and long-term storage. Such issues are discussed within the Network on Experiments and Operation.

Laserlab Workshop on Data Handling and Open Data, 7 December 2018, Lisbon, Portugal

Following up on the first workshop on Data Handling and Open Data in 2017, a second workshop on this issue was organised.

In view of the increasing importance of data handling issues in research, the second workshop of the Network on Experiments and Operation (NEO) was conceived as a follow-up of the first workshop on data handling and open data. The workshop took place at Instituto Superior Tecnico in Lisbon, Portugal, and was co-organised by the ELI Delivery Consortium.

Data management and open data are core concepts within Horizon 2020. Initiatives such as the Open Science concept and the adoption of the European Open Science Cloud Implementation Roadmap earlier this year imply that EU researchers will very soon work in an environment where data sharing, access and reuse are the norm. With the increasing amount, size and complexity of the data generated at laser research facilities, it becomes necessary for individual infrastructures to become proficient and invest more resources in data management. Simultaneously, there is a need for streamlining and standardising these procedures across the European facilities in order to enhance the services to the user community.

Following the first workshop on data issues, where the concepts of data management and open data were introduced and discussed within the Laserlab-Europe network, the second workshop built on the outcomes of the first one with a special focus on the strategy for data management applied by Laserlab-Europe partners and the Extreme Light Infrastructure. The programme (see further below) included talks by speakers from different communities. Both external experts and Laserlab partners presented examples of their experience and best practices in these issues, and the participants contributed by sharing their experiences in data management and related topics in lively discussions. As a next step, a working group on data handling will be established.

About 25 participants attended the workshop, including representatives of ELI. The presentations are available at

www.laserlab-europe.eu/events-1/laserlab-events/2018/7-december-data-handling-lisbon

Laserlab Workshop on Data Handling and Open Data

7 December 2018

Instituto Superior Tecnico, Lisbon, Portugal
Avenida Rovisco Pais 1, Lisbon

Congress Center, Room 02.1

Programme

09:00	**Welcome and introduction**
09:10	**Open Research Data in H2020 and the Data Management plans requirements** Pedro Principe, Open Access Project Manager, University of Minho / OpenAIRE
09:40	**PaNOSC – Photon and Neutron Open Science Cloud** Andy Götz, ESRF
10:15	Coffee break
10:45	**Making FAIR data a reality – Reflections on ESRF's experience** Andy Götz, ESRF
11:15	**Planning ahead data management at ELI – state-of-play and open questions** Tamás Gaizer, ELI-ALPS (tbc) / Florian Gliksohn, ELI-DC
11:50	**Research data management at Laserlab institutions – exchange of experience**
12:30	Lunch
13:30	**High performance computing and data management requirements related to computer simulations** Michael Bussmann, HZDR
14:00	**Data management plan for Laserlab-Europe** Guido Juckeland / Uwe Konrad, HZDR
15:30	**Discussion and next steps**
16:00	End of meeting

3 Network on Extreme Intensity Laser Systems (NEILS)

Task leader: GSI jointly with CLPU

Extreme intensity laser systems comprise various frontier technologies pushing peak power and peak intensity through either long pulse kilojoule energy class installations, or with ultrashort pulse petawatt class laser systems. All systems exhibit dedicated demands and very specific procedures for operation, instrumentation, metrology, safety and further development.

High energy systems in Europe are presently operated in the Czech Republic, France, Germany, and United Kingdom, providing a common basis for knowledge exchange on components such as large optics and complex opto-mechanical setups and on the specific requirements for instrumentation, data acquisition and even theoretical approaches. Ultrashort-pulse petawatt technology is a new frontier for laser infrastructures with several facilities becoming operational, among them facilities in France, UK, Germany and Spain, and at ELI. For such new installations it is essential to exploit the existing know-how and experience of high-energy laser facilities, especially in the field of short pulse intense laser technology where Europe is world leader.

While operating parameters between the laser facilities vary, core operational and technical issues such as pulse diagnostics, optics handling, or target fabrication are of crucial importance to all these laser facilities. The objective of this networking activity is to establish a regular laser science forum in which knowledge will be shared and best practices will be developed.

Network on Extreme Intensity Laser Systems NEILS Annual meeting, 23-25 May 2018, Bordeaux, France

The third NEILS meeting was held at CEA-CESTA, close to Bordeaux in France and gathered 32 scientific staff members from Laserlab members and associate partners, namely AWE, CEA-CESTA, CELIA, GSI, HIJ, IoP CAS, LP3, LULI and STFC-CLF.

Two sessions were dedicated to the update of the facilities and 10 presentations were given. Ten industrial partners presented their activities during 3 minutes each and they sponsored a lunch-buffet which allowed fruitful discussions between the industrials and the scientists. The core of the meeting was organized through five round table discussions that took place on various topics: beam quality, laser damage, front-end technology, electro-magnetic pulses, and increase of repetition rate. Each round table discussion was prepared by the chair with a questionnaire sent to each participant. It usually started by a summary of the answers. Then all the institutions wanting to participate to a given topic presented a few slides and discussions occurred with the speaker and within the audience. As opposed to a conference, not only the successes but also the difficulties were addressed. A visit of the LMJ-PETAL facility was also organized during the meeting.

A detailed meeting report may be found on the following pages.

Report – third NEILS meeting

CEA-CESTA, 23-25/05/2018

Executive Summary

The third NEILS meeting was held in CEA-CESTA, close to Bordeaux in France and gathered 32 scientific staff members from Laserlab members and associate partners, namely AWE, CEA-CESTA, CELIA, GSI, HIJ, IoP CAS, LP3, LULI and STFC-CLF.

Two sessions were dedicated to the update of the facilities and 10 presentations were given: ORION (AWE), PETAL(CEA-CESTA), PHELIX (GSI), JETi200 (HIJ), Bivoj (HiLASE, IOP CAS), ASUR (LP3), Apollon (LULI), LULI2000 (LULI), CLF (STFC), and ECLIPSE (CELIA). Ten industrial partners presented their activities during 3 minutes each and they sponsored a lunch-buffet which allowed fruitful discussions between the industrials and the scientists. The core of the meeting was organized through five round table discussions that took place on various topics: beam quality, laser damage, front-end technology, electro-magnetic pulses, and increase of repetition rate. Each round table discussion was prepared by the chair with a questionnaire sent to each participant. It usually started by a summary of the answers. Then all the institutions wanting to participate to a given topic presented a few slides and discussions occurred with the speaker and within the audience. As opposed to a conference, not only the successes but also the difficulties were addressed. A visit of the LMJ-PETAL facility was also organized during the meeting.

Detailed report

Session 1: Beam quality

Chair: Udo Eisenbarth (GSI)

Minutes: Claire Grosset-Grange (CEA-CESTA)

To introduce beam quality topic, Udo Eisenbarth (GSI) synthetized the answers he received on beam quality improvement survey, and in particular on wave front control. This showed there are different strategies selected over subjects such as hardware and its localization, software, homemade or commercial development. The topic was also very dense, so not all topics according to the questionnaire could be discussed because of time limitations.

Jonas B Ohland (GSI) presented wave front control on PHELIX. They developed homemade Shack-Hartmann wave front sensor and software in order to keep versatile with camera type and analysis demands. They have 2 loops. They investigate to have a third loop to control the focus on the target, to add deformable mirror just before the parabola, to improve alignment to including wave front control and also simultaneous compensator control, and to work on criteria for wave front control. We discussed on thermal aberration compensation and cumulative effect which limits the repetition time to 90 minutes, and on mirror management and daily degauss procedure.

James McLoughlin (AWE) detailed ORION wave front control enhancement. Already available for nanosecond lines, they added insertable phase plate to compensate on-shot mean thermal aberration. For femtosecond line, they improved parabola alignment thanks to wave front measurement instead of judgement calls on focal spot quality. This also allowed improving wave front error compensation thanks to a deformable mirror. At the moment they work on multi pass rod amplifier astigmatism compensation thanks to beam rotation inside the amplifier. We discussed about phase plate: it is made by Optimask and Rochester with MRF technic. All slabs are pumped every time: the energy level is set by front end energy level.

Nathalie Blanchot (CEA-CESTA) showed PETAL wave front control architecture. The beamline includes 3 deformable mirrors (one of them is a segmented mirror for segment inter-phase compensation), and several diagnostics along the line. She explained the wave front alignment step by step for energy shot. An apodizer is used for shots higher than 200 J in order to increase beam profile flatness. Unlike ORION, the number of activated slabs varies according to the energy required on the target. We discussed about wave front performance on high energy shot, and in particular on absolute or relative measurement, and on diagnostic aberration calibration.

Ji Ping Zou (LULI) talked about APOLLON system which is free of on-shot thermal aberration in order to allow high repetition rate. The system includes one wave front loop before compressor. They are studying a second loop after compressor. As pulse duration is very short, they meet very stringent topics such as compressed pulse quality versus focal spot optimization and the link between compressed pulse performance and spatio temporal coupling: they made simulation in order to evaluate the 6 topics they pointed out.

Finally Olivier Utéza described the ASUR Platform at LP3. Wave front compensation is achieved thanks to different commercial hardware and software. They also worked on phase retrieval technic in order to focus spot optimization where they have very good results. They also worked on on-shot thermal aberration, thermal aberration drift and their compensation. We discussed on spatio temporal coupling: they noticed the coupling but it keeps limited, including when laser intensity increases.

Session 2: Damage

Chair: David Carroll (STFC)

Minutes: Laurant Lamaignère (CEA-CESTA)

During the second session of the first workshop day, 6 presentations have been given dealing with the following issues:

A. Experience of LIDT on facilities and mitigation approaches

- David Hillier, AWE (U.K.)
  - David Hillier has reported localized damage to the coatings of the filtering lenses (sol-gel coatings) even at low fluences (~6 J/cm²). This is made more severe due to the four-pass in the amplification section, each damage site being generating additional damage sites on the lenses. The solution is a mask placed in the injection section. The mask is made of a 50 □m thick tantalum foil on a carbon fiber stalk. This solution stops the growth and propagation of the damage allowing safe operation of laser and extending the operation lifetime of the lenses. It was noted that one beam line did not have this issue where the lens had a soft coating instead – switching to soft coatings was not practical in the long term
  - The long term plan is to implement a spatial light modulator (SLM) to ensure a flat intensity profile.
- Eric Lavastre, CEA – PETAL (France)
  - Eric Lavastre has shown that the optimization of the coating design by adjusting the EFI (Electric Field Intensification) in the dielectric coatings of the PETAL mirrors (PETAL works at 1053nm and in the sub-picosecond range) increases significantly the LIDT of the mirror.
  - The PETAL operating conditions minimize the damage growth and enable operation of the laser safely.
  - An on-line inspection is made after each shot (one shot/day) in order to inspect the transport mirrors and the focusing parabola. A Maglite is used to light the components and a camera is used to take pictures and follow the damage evolution shot after shot.
  - In the meantime, witness mirrors are damage tested in laboratory in order to evaluate their LIDTs. A good correlation is found between the LIDTs determined in lab and the observed damage on PETAL facility.
- Alexander Sävert, HIJ (Germany)
  - Alexander Sävert has shown the damage of gratings on-line. The first solution to avoid this is to simply increase the size of the beam, from 80 to 100mm in order to reduce the beam fluence.
  - The LIDTs drastically depends on the coating technique.
  - The LIDT in vacuum is much lower than in air environment, due to residual gases.
  - It appears that the damage doesn't occur at the highest fluence in the laser beam. It means in that case that the damage is likely due to defects in the coatings.
- Ji-Ping Zhou, LULI (France)
  - Ji-Ping Zhou indicates that on-line inspections are systematically done after each plasma experiment and during each laser maintenance.
  - The damage test measurements of the optical components should be realized on the APOLLON laser itself, on a specific arm that uses a large flat-top beam (18mm). It seems that it is not always the case and then it is not enough.
  - A point reported by Ji-Ping Zhou is that it is difficult to specify the LIDT of the optics with one shot (1on1 procedure) or few shots when the laser operates a huge number of shots. This remark is often reported by the all the attendees.

B. Damage testing

- Lydek Vysin, IoP CAS (Czech Republic)
  - The presentation dealt with the XUV/X-ray range with damage events observed on FLASH and LUCA. The difficulty in this range is to precisely determine the beam area during damage experiments. To this end a linear regression between the ablated volume and the energy allows the estimation of the fluence threshold. Another issue is also to estimate the LIDTs as a function of the energy.
- Olivier Uteza, LP3 (France)
  - Olivier Uteza has presented the ASUR platform that operates at LP3 and is dedicated to the measurements of the LIDTs of optical components at 800nm and 15fs (10 TW at 100 Hz). Today tests are realized in air environment. To this end a very precise qualification of the beam has been realized in far field in order to take into account the self-focusing of the beam as function of the beam energy. There is a plan to install a vacuum chamber to perform tests in vacuum environment. The platform is operational to carry out LIDT measurements with accuracy.

2 presentations have not been presented:
- GSI (Germany)
  - The previous OAP (Off Axis Parabola made in copper) of PHELIX has been damaged due to debris from the target interaction.
  - A MLD (dielectric) parabola needs to be operated with a debris shield to protect it from target debris
  - Degradation has also been observed and attributed to liquid crystal vapor.
  - Damage can also be due to back reflection of ghost light.
- CLF – STFC (U.K.)
  - In the picosecond and sub-picosecond ranges, the limiting optical components are the gratings that damage at fluences well below the damage specifications.
  - The underlying issue of damage occurring below the LIDT on the petawatt parabolic mirror is mainly due to target debris damage to the substrate affecting recoats.
  - The maximum laser energy permitted for operation is chose in order to prevent damage occurrence and growth.

To sum-up, the different labs have reported their own experiences, questions and solutions for LIDT. The main points that we emphasis are:
- The damage issues deal mainly with the coatings whatever the pulse range (long and short pulse length) and the wavelength ;
- The teams report the difficulties to control and to measure the LIDTs of optical components. Many tests are however carried out by LIDARIS Company. It is also difficult to extrapolate LIDT estimates with few shots to laser operating with much higher number of irradiations.
- The issue of air and vacuum environments is not clear. It depends on the residual gases and the volatile components on the environment.
- A point mentioned by several labs was the suspicion that low frequency defects in coatings were the cause of underperformance of coatings with respect to their measured LIDTs. Current LIDT standard tests are suitable for comparing between different suppliers but do not give realistic limits to real-world operating conditions.

Session 3: Front-end technology

Chair: Loïc Meignien (LULI)

Minutes: Nathalie Blanchot (CEA-CESTA)

Loïc Meignien introduced the session. He made a panorama on the front end issues following the questionnaire sent.

Three main regimes can be distinguished for front-end with different materials: nanosecond (Nd:YLF, ND:Glass, Nd:YAG, Yb:Yag), picosecond (Nd:Glass, CaF2, Ti:Sa), and femtosecond (Ti:Sa, CaF2,…). For nanosecond front-end, fiber front end are now the most used. CPA is used for picosecond and femtosecond, coupled with OPA to reach energy with high contrast (fast OPCPA). Regenerative and multi-pass amplifiers are used for low gain materials.
The fundamental front-end performance are listed and concerns essentially the beam quality (near field homogeneity, wavefront, pointing), the temporal domain (pulse waveform, jitter, synchronization, measurement) and energy (measurement and stability).
Last part concerns all the constraints of environment of the front-end which have an impact on performances (integration, injection in amplifier section, security).
Four talks are given by STFC/CLF, CESTA, GSI and LULI.

Vulcan – STFC/CLF – Dave Pepler. The Vulcan history from 1975 up to 2018 is presented starting from 1 laser room and 1 target area up to now 4 laser rooms and 3 target areas. A project for 2020 is the development of a 10 J, 30 fs front-end replacing on target area.

The synchronization is based on Greenfield Technology timing system with a master clock and slaves. This architecture is possible with the development of "lock to clock" system. This allows reaching 15 to 25 ps jitter compared to the old technologies with +/- 100's ps jitter.

LEAP Project – CEA/CESTA – Jean-Paul Goossens. One part of the LEAP Project « Laser Energétique en Aquitaine pour des Applications Plasmas à haute puissance moyenne » is presented with the development of new crystal for 1053 nm applications. To limit the quenching effect, codoping is used and first laser demonstrations are presented with Nd:Lu:CaF_2 crystals. Emission linewidths, lifetimes, and cross sections are comparable to standard Nd-doped phosphate and silicate glasses. Thermal conductivity is 8 times higher than phosphate glass. Gain was demonstrated and laser operation to obtain 1J at 10Hz is under progress.

Phelix – GSI – Vincent Bagnoud. The femtosecond (20 mJ, 10 Hz, 8 nm) and nanosecond (20 mJ, 0.5 Hz, 1.5 ns) front-ends are presented. For the femtosecond front-end, an ultra-fast OPA (uOPA) is used up to 0.3 mJ, 100 fs with a 10 mJ, 1 ps pump beam to clean the pulse temporal profile. 4 pockels cells are used in the regenerative linear and ring amplifiers. A significant gain has been obtained and this improvement is measured with time-resolved shadowgraphy by observing the pre-plasma creation. Next developments will concern a low noise stretcher, a by-pass of the linear regenerative amplifier and a 2-stage uOPA. The nanosecond front–end is based on a commercial fiber system followed by a Nd:Glass regenerative ring amplifier. The synchronization precision with the femtosecond front-end is 500 ps (jitter).

Apollon – LULI – Ji-Ping Zou. The front-end of Apollon has been commissioned in June 2017: 200µJ / sub-10 fs / CR > 10^{12}. The high temporal contrast is ensured by a double XPW (BaF_2) with an increase of the spectral bandwidth from 57 nm to 105 nm, an active spectral phase control (DAZZLER) and a ps-OPCPA. The energy stability is < 3.5 % rms (120 min) and the pointing stability < 3 µrad (rms).

Session 4: Electro-magnetic pulses (EMP)

Chair: David Hillier (AWE)

Minutes: Denis Penninckx (CEA-CESTA)

We almost all suffer from laser-induced ElectroMagnetic Pulse (EMP) related equipment failures. Usually, it is "only" some lost date or equipment turning off but some permanent equipment failure may happen or their lifetime may be reduced. EMP strongly depends on laser energy for laser pulse below ~10ps, on target materials and geometry. Its effect may be mitigated by turning off equipments, shielding but also target and target-holder proper design.

CEA-CESTA (M. Bardon) presented an overview of the modeling work done in collaboration with CELIA about the multi-scale physics involved in laser-induced EMP. It was confirmed by measurements in various facilities of Laserlab-Europe laboratories. Mitigation strategies were then considered, keeping in mind that mitigation should not add constraints to laser operating point (energy, power…), target or experimental implementation. Reducing EMP should be done through discharge current reduction using resistances, inductances and absorbers. A reduction by a factor of three in the relevant frequency bands has been simulated and measured in various facilities including PETAL. GSI (B. Zielbauer) presented pictures of the shielding of some critical measurement equipments (cameras, controllers,…) EMP is measured on every laser shot. Instructions are given to the users for their targets, in particular avoiding some conducting materials especially for large targets. Altogether, except in case these instructions are not considered, GSI has no EMP-related problem anymore. PALS (J. Krása) showed an example of measurement error due to the superimposition of the signal to be measured and an EMP. The solution was to insert a delay line so that the signal to be measured arrives later to the oscilloscope. CLF (D. Carroll) showed the importance of the target holder material and geometry. In that case the target holder was composed of a wheel and a stalk. Using longer geodesic path allowed an EMP reduction by a factor of 10 (see "EMP control and characterisation on high-power laser systems", P. Bradford et al. , High Power Laser Science and Engineering 2018, at press). CLF designed a metal box inspired by the work at GSI to shield some critical measurement devices. Target area is evacuated for full power laser shots as signal drops rapidly with distance but safety calculations are hard to handle. HIJ (A. Sävert) developed a specific stepper motor driver and controller with double shielding and a dedicated operating mode when laser is in operation with minimum communication but being able of instant on when needed.

Session 5: Repetition rate increase

Chair: Denis Penninckx (CEA-CESTA)

Minutes: Claude Rouyer (CEA-CESTA)

Denis Penninckx introduced the session. He reminded the content of the questionnaire sent before the meeting and made the synthesis of the answers provided by the different laboratories (GSI, Hilase, STFC/CLF, and CESTA).

It is essentially noted that the incentives for racing at high repetition rate and high average power are guided by the works on:

- LIDT (laser induced damage threshold)
- LSP (laser shock peening)
- Parametric experiments

Five talks were given:

Udo Eisenbarth, GSI, presented results observed on the ϕ19 mm and ϕ45 mm amplifiers of Phelix preamplifier. He showed that the steady state at 1 shot / 40 s is reached after 20 minutes. The wave front distortion is less than λ/4 as long as the defocus was compensated. He also showed that 2 missing shots need to wait 20 minutes to retrieve the steady state. He then asked "How to suppress amplification during alignment mode operation?" Several solutions are proposed like using shutters.

Gaël Paquignon, CEA-CESTA, presented the objective and the progress status of Flashdence project. The aims are to have a perfect understanding of amplification at kJ level with Nd:Glass pumped by flash and to support local industry. The approach followed consists in modeling relevant physical effects and in experimentally validating the evaluation of physical quantities.

Nicolas Bourgeois (STFC/CLF) presented the operation of Gemini at 5 Hz. Performance of the Gemini facility is reminded. The main part of the talk consisted of showing interest of bringing facility operation at 5 Hz: increased result resolution brought by the accessible averages with the higher repetition rate, on the one hand. And on the other hand, during parametric studies, experimentally research of maxima with genetic algorithm, just like what is made for modeling. Finally, it is specified that biggest problem for increased repetition rate is radiation shielding.

Ian Musgrave (STFC/CLF) presented the work done by CLF to increase the repetition rate. The results of Dipole100 were reminded: 100 J at 10 Hz (i.e. 1 kW) with DPSSL technology. Moreover, STFC/CLF is equipped with Nd:Glass amplifiers. The flash lamps are chilled with air. The increase of repetition rate from 1 shot / 20 min to 1 shot / 5 min induces birefringence and defocus. The approach to increase performance is pragmatic. The adopted solution consists of slicing amplifier slabs in 3 pieces and of chilling them with air flow. According to this principle, amplifiers are under construction.

Antonio Lucianetti (IoP CAS) presented BIVOJ (100 J / 10 Hz) facility supplied by STFC/CLF. The amplifier, chilled by helium gas, was described. It was shown that the flux is almost laminary. Turbulence is needed to remove the heat. Today, the last amplifier stage is by-passed to lead experiments at 10 J. Industrial applications were mentioned: LSP (laser shock peening), LIDT (laser induced damage threshold), compact EUV sources for lithography, precise cutting and drilling of materials for automative and aerospace industry, and micro/nanomachining.

Unfortunately, because of lack of time, the slides of GSI on actively cooled glass amplifier were not presented.

4 Network on Experimentation and Best Practices in Biology and Life Science (NEBS)

Task leader: UC

The increasing number of experimental campaigns in the field of laser applications to life sciences gives rise to new challenges in Laserlab-Europe: It has to increase its awareness and expertise in dealing with ethical issues, living cells handling, animal experimentation, joint experiments of correlative microscopies with non-laser systems such as X-ray sources, NMR, or electron microscopy. The requirements for life science experiments and operation of equipment are very different from atomic and molecular physics experiments or investigations into plasma physics. The objective of NEBS is to develop links with external partners and networks, such as Euro-BioImaging and representatives from medical centres, in order to share best practices and know-how and to discuss procedures and issues in experimentation, handling and ethics.

Laserlab-Europe explored synergies with the European Society for Molecular Imaging (ESMI) and co-organised a workshop on “big data in imaging”.

Big Data in Imaging - Acquisition & Extraction of Knowledge, TOPIM-TECH 2018, 9-14 July 2018, Chania, Crete, Greece

The term “Big Data” refers to increasingly large data sets. Due to their volume, the processing of big data requires specific tools and processes – also and especially related to imaging data. The emergence of big data is the result of the exponential growth: both in the availability and automated use of information, which has prompted the development of complex analytics based on algorithms to spot patterns. The conscientious collection, processing, and use of (big) data resources are an overarching theme also for researchers. And the question on how to handle and translate big data and basic research results into clinical applications is one of the key challenges.

TOPIM-TECH 2018 group picture

The TOPIM-TECH summer workshops bring together scientists from various fields and provide a “think tank” to foster new ideas and inter-disciplinary cross connections through discussions between participants. The overall goal is to spend one week at an inspiring place and to provide a platform for intensive discussions and exchange of ideas between high-level international experts, senior, and junior scientists – and to tackle the crucial questions in Imaging Science.

The 2018 summer workshop addressed relevant topics in the field of big data in imaging science, e.g. Machine Learning, Deep Learning, Generation across Scales & Modalities, Data Analysis of Complex Data, Open Data (Management and Protection), and Standardization (see programme further below). Two options for practical work on Machine Learning and the Open Microscopy Environment OME were offered in collaboration of ESMI, Laserlab-Europe and Euro-BioImaging. Laserlab-Europe members participated in the programme committee and participated in leading sessions and presenting scientific achievements. About 35 participants and 20 speakers attended the workshop. Lively discussions and exchange of experience of ESMI and Laserlab-Europe members took place during the meeting.

Big Data in Imaging - Acquisition & Extraction of Knowledge – Programme

	Monday 09 July	Tuesday 10 July	Wednesday 11 July
08:45 - 08:50	ARRIVAL		
08:50 - 08:55			
08:55 - 09:00			
09:00 - 09:05		Introductory talk II **Image reconstruction: from the foundations to deep neural nets.** Michael Unser, Lausanne	**OME's Bio-Formats, OMERO, & IDR Open Tools for Accessing, Integrating Mining and Publishing Image Data@Scale** Jason Swedlow, Dundee
09:05 - 09:10			
09:10 - 09:15			
09:15 - 09:20			
09:20 - 09:25			
09:25 - 09:30			
09:30 - 09:35			
09:35 - 09:40			
09:40 - 09:45			
09:45 - 09:50			Repositorg - an Open Source Pipeline Package f the Transfer, Reposting, Standardization of Larg Data Files - Horea-Ioan Ioanas
09:50 - 09:55			
09:55 - 10:00			
10:00 - 10:05			
10:05 - 10:10			
10:10 - 10:15			VINCI - new challenges from Big Data in Imaging Stafan Vollmar, Cologne
10:15 - 10:20			
10:20 - 10:25			
10:25 - 10:30			
10:30 - 10:35			
10:35 - 10:40		coffee break	**POSTER SESSION coffee break**
10:40 - 10:45			
10:45 - 10:50			
10:50 - 10:55			
10:55 - 11:00			
11:00 - 11:05			
11:05 - 11:10			
11:10 - 11:15			
11:15 - 11:20		Introductory talk III **Machine Learning for Image Analysis, Segmentation and Classification** Daniel Ruckert, London	
11:20 - 11:25			
11:25 - 11:30			
11:30 - 11:35			
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12:40 - 12:45			
12:45 - 12:50			
12:50 - 12:55		**Science speed-dating Coffee Break** ALL PARTICIPANTS	
12:55 - 13:00			
13.00 - 13.05			**Group Excursion**
13:05 - 13:10			
13:10 - 13_15			
13:15 - 13:20			
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13:50 - 13:55			
13:55 - 14:00			
14:00-14:05			
14:05-14:10			
14:10-14:15			
14:15		Lunch	
until 18:00	**REGISTRATION 17.00h onwards**	BREAK	
18:00 - 18:05	Welcome	**Biomedical Imaging and Genetic (BIG) Data Analytics for Precision Medicine in Dementia and Oncology.** Wiro Niessen, Rotterdam	
18:05 - 18:10			
18:10 - 18:15	Introductory talk I-a **Acquire an Image** Bertrand Tavitian, Paris		
18:15 - 18:20			
18:20 - 18:25			
18:25 - 18:30			
18:30 - 18:35			
18:35 - 18:40			
18:40 - 18:45			
18:45 - 18:50		Statistical inference for image reconstruction through Multimode Fibers Daniele Ancora, Rome	
18:50 - 18:55			
18:55 - 19:00			
19:00 - 19:05	Coffee Break		
19:05 - 19:10		Coffee Break	
19:10 - 19:15			
19:15 - 19:20			
19:20 - 19:25	Introductory talk I-b **Standardization** Julia Mannheim, Tübingen		
19:25 - 19:30		High-throughput, Python-based processing pipel for pre-clinical MRI data Niklas Pallast, Cologne	
19:30 - 19:35			
19:35 - 19:40			
19:40 - 19:45			
19:45 - 19:50		A processing pipeline for big data in high-resolution microscopy Giacomo Mazzamuto, Sesto Fiorentino	
19:50 - 19:55			
19:55 - 20:00			
20:00 - 20:15			

Thursday 12 July	Friday 13 July		Saturday 14 July
Breakfast			
Introductory talk IV-a **To Deep Learn or not Deep Learning....that is the Question** Anant Madabhushi, Cleveland	**Computational Pathology and AI in Medical Imaging: Opportunities in Precision Medicine** Anant Madabhushi, Cleveland		Farewell & Departure
Introductory talk IV-b **Bioimage informatics and machine learning for quantifying cellular dynamics of stem cell decisions.** Carsten Marr, Munich	**ImageJ2 ecosystem: Image Informatics for Multidimensional Live Cell Imaging** Kevin Eliceiri, Wisconsin		
coffee break	coffee break		
Life beyond the Pixels: Phenotypic Discovery using Machine Learning and Image Analysis Methods Peter Horvarth, Budapest	**Practical Work track I:** **Machine Learning** Jonathan Disselhorst Prateek Katiyar, Tübingen	**Practical Work track II:** **Open Microscopy Enviroment** Petr Walczyski & William Moore, Dundee	
Texture analysis enables context detection in non-endoscopic oesophageal tissue samples Marcel Gehrung, Cambridge			
Metabolic heterogeneity as a PET-biomarker predicts overall survival of pancreatic cancer patients - Esther Smeets, Nijmegen			
coffee break	coffee break		
Using convolutional neural networks to create spatial predictors of response to chemotherapy - Mirela Crispin-Ortuzar	**Practical Work - track I**	**Practical Work - track II**	
Multispectral endoscopy for early detection of dysplasia in Barrett's oesophagus: a pilot study - Dale Waterhouse, Cambridge			
Lunch BREAK			
Data Fusion and Machine Learning of high(er) dimensional spectral and Image Data Thomas Bocklitz, Jena	**Practical Work - track I**	**Practical Work - track II**	
Coffee Break	Coffee Break		
Practical Work - track I: Machine Learning Jonathan Disselhorst	**Practical Work - track I**	**Practical Work - track II**	
Practical Work - track II: Open Microscopy Enviroment Petr Walczyski			