Networking Activity on High Energy Lasers (NAHEL)

2014 Annual Meeting, PALS, Czech Republic, 6-7 October 2014

Venue: Main building of the Institute of Plasma Physics, Za Slovankou 3, Prague 8

Introduction

The 2014 Networking Activity on High Energy Lasers Workshop will be organized by the PALS Research Infrastructure and held in the main lecture room of the Institute of Plasma Physics ASCR, Za Slovankou 3, Prague 8 on 6-7 October.
This meeting will be organized in several parts :
Two oral presentation sessions on Monday, October the 6th, will be devoted to the current status of the facilities and updates on development projects given by representatives of each of the working group members (LULI, CLF, GSI and PALS) and the guests representing new and upcoming facilities (HiLASE, ELI-Beamlines).
The 3 discussion sessions will cover technical topics identified by the participants as important for improving facility operations.
The workshop will include a tour to the recently commissioned HiLASE laboratory and the ELI-Beamlines construction site in Dolni Brezany, on Tuesday, October the 7th.

Programme

06/10

- 9:00 –9:30 Registration
- 9:30 –9:40 Opening addresses (Petr Krenek, the director of IPP, Karel Jungwirth, the director of PALS)

Presentation session 1 Chair: Karel Jungwirth, PALS

- 09:40 - 10:00 Facility update CLF, Bryn Parry
- 10:00 - 10:20 Facility update GSI, Vincent Bagnoud
- 10:20 - 10:40 Facility update LULI, Lois Meignien/J. Dessousa
- 10:40 - 11:00 Facility update PALS, Michaela Kozlová

11:00 – 11:15 coffee break

Presentation session 2 (Chair Jiri Ullschmied)

- 11:15 - 11:45 Facility progress report ELI-Beamlines, Bruno le Garec
- 11:45 - 12:15 Facility introduction HiLASE, Martin Divoký

12:15 – 14:15 lunch at Ladvi restaurant

Discussion session 1 (Chair Vincent Bagnoud + Jan Dostal, PALS; Assistant: Miroslav Krus, ELI)

- 14:15 – 16:15 ***Safety issues and EMP measurements***
  - **EMP measurements and protection**, discussion organized by B. Zielbauer (GSI)
  - **Radiation safety - procedures and measurements**, discussion organized by Stefan Götte (GSI)

16:15 – 16:30 coffee break

Discussion session 2 : (Chair Bruno le Garec, Eli + Miroslav Krus, ELI; Assistant: Jaroslav Nejdl, ELI)

- 16:30 - 18:00 **Laser System Performance and Plasma Diagnostics**
  - **Contrast measurements**, discussion organized Vincent Bagnoud GSI
  - **Target issues, on-the-target diagnostics**, discussion to be organized by Roman Dudžák, PALS
    Contribution PALS: New inductive probe for measurement of target current (short presentation by Josef. Krása and Jakub Cikhardt)
    Questions PALS:1 – see below
    Target issues RAL (David Carroll) - see below
  - **Synchronization of laser systems of different type** short presentation by Jan Dostal, PALS
    Questions PALS 2 – see below
  - **Damage of large optics**
    Questions prepared by Loic Meignien (LULI):
  - **Need of simulation** (Miro or Zeemax, other) Ji Ping Zou
    Topics for discussion - see below

o 18:00-18:30 Visit to the PALS-U facility (TW iodine laser with a synchronized Ti:Sa laser)

18:30 Depart for Brezineves

- 19:00 - 21:30 Working dinner at the Golem restaurant Březineves

07/10

8:45 !! Get together of the excursion participants in front of the IPP building !!
9:00 Depart for Dolni Brezany

o 9:45 – 12:15 Visit to the HiLASE Research Centre
Visit to the ELI-Beamlines construction site

12:15 Return to Prague
13:00- 14:30 Lunch at Ladvi

Discussion session 3 (Chair Steve Hawkes, RAL, + Jaroslav Nejdl, PALS/ELI; Assistant: Jan Dostal, PALS)

- 14:00 – 15:30 **Wavefront Control and Focal Spot Quality**
  - **Spatio-temporal characteristics of laser beams, discussion organized by J. Nejdl, PALS**
  - **Focal spot measurement, discussion to be organized by Donald A. Peyrot, ELI**
  - **Alignment discussion to be organized by Roberto Ziano, ELI**

- 16:00 – 16:10 Closing ceremony

Sub-topics for discussions

Discussion Session 1 Safety issues and EMP measurements

EMP measurements and protection, discussion organized by B. Zielbauer

- Is equipment (IT/electronics/other hardware) in the target area or in other areas (where) suffering from temporal/permanent failures or disturbances due to radiation coming from the target on shot? If yes, what type of equipment, and what kind of damage?
- Does EMP impair measurements at your facility? If yes, please rate the problem for each device from 5 (acute: no measurement possible) to 1 (very rare event: does not influence the outcome of one experiment)
- Did you try to find the exact cause (EM/x-rays/particles/ground issues) of such problems?
- What measures do you take to handle or prevent such problems?
- Do you do modelling for EMP/X-ray emission? If yes: which what type of code? Is this dealt with internally or done by a different department
- Do you/ did you search empirically for solutions?
- Do you feel grounding schemes/approaches play a role in EMP shielding? If yes, can you describe the grounding scheme at your facility?
- What is the spatial distance and temporal window in which these effects are problematic?
- Do you actively shield equipment from EMP: a) in the target chamber; b) outside the target chamber
- What measures do you generally recommend for fielding highly sensitive diagnostics in the like microchannel plates, oscilloscopes, CCDs ?
- Can you recommend special components or materials which help in dealing with such problems?

Discussion session 2 : Laser System Performance and Plasma Diagnostics

Questions on temporal contrast by V. Bagnoud

- Rate the importance of the temporal contrast problematic at your facility (from 1 to 5)
  1. very important, a decisive parameter for nearly all experiments
  2. important parameter that comes in question in at least 60% of the experiments
  3. a parameter that concerns between 1/3 and 2/3 of the experiments, but for which the exact knowledge of the temporal contrast is important.
  4. a parameter that concerns less than 1/3 of the experiments and for which the exact knowledge of the temporal contrast is of little significance.
  5. Not a concern
- On the sources for temporal contrast degradation

  What is causing the most problem in experiments at your facility?
  1. The ASE pedestal
  2. nanosecond pre-pulses
  3. picosecond pre-pulses
  4. the coherent contrast (slow rise of the intensity before the main pulse)
  5. we do not know, maybe everything

  How would you qualify the stability of the temporal profile of the pulse at your facility?
  6. Whatever contrast level is achieved, the contrast level (ASE) and pre-pulses are stable over periods of months. Our components are designed to be pre-pulse free. Even after an exchange of optical component, a full characterization of the system is not necessary. A measurement of the temporal contrast is made available upon request.

7. We observe a drift in temporal parameters that impose a full characterization after each beam-time and an alignment/optimization of sensitive components.
8. We observe a drift in temporal parameters over a few days that impose a constant monitoring of the temporal contrast.
9. The temporal contrast is affected by parameters that change with the laser settings (B-integral, fluorescence etc.). We cannot guaranty the contrast profile of the pulse.

What type of measure do you use to improve the temporal contrast

1. Pockels cells (yes/no): if yes: how many Pockels cells are used as pulse picker?
2. Low ASE front end (yes/no): if yes comment.
3. Other? (yes/no) comment

Other parameters that influence the temporal profile of the pulse

1. What is the nominal B-Integral of the pulse
2. Are all your components wedged to avoid post-pulses?
3. What is the ratio between small signal gain and effective gain in your main amplifier?

- On measurements

If you use a sequoia

1. How many people are able to perform a sequoia trace measurement? How are they trained?
2. What is the background level achieved by the sequoia? If it is higher than 10^{-11}, what are the limiting factor to your measurement
3. How do you measure between -1 ns and -400 ps?
4. If you could improve the parameters window of the sequoia, what would you choose as dynamic range, energy requirement, scanning window and temporal resolution

Do you use single shot contrast measurement as a standard built-in measurement?

1. Single shot cross correlation (Yes/No): if yes please describe.
2. Photodiode (Yes/No): if yes, can you provide a trace of the measurement and describe the hardware. What are the typical dynamic range and performance of the setup?

Were you successful in making single-shot measurements with higher performance for demonstration purpose (yes/no):

1. if yes, please describe
2. if yes, what prevents this measurement from being deployed as standard measurement?

Do you employ plasma mirrors to improve the contrast (Yes/No):

1. If yes, how is it handled from an operation stand point?
2. The operation team is responsible for specifying and procuring the PMs. The operation team sets the PM at the right location at an intermediate focus location to be independent of the experiment geometry and drives them during operation.
3. The operation team is responsible for specifying and procuring the PMs. The PM is used in single or double reflection geometry near the target. The operation team is responsible for the PM.
4. The operation team is responsible for specifying and procuring the PMs. The operation team gives advices on the use of PM in form a written procedure or oral explanation. The PM is controlled by the experiment.
5. The PMs are specified and ordered by the experiment because of resource limitations or because of the ever changing requirements (geometry, reflectivity). The operation team is giving advice in the experiment preparation. The experiment is responsible for the alignment of the PM.
6. When PMs are needed, the experiment is responsible for planning and operation of the PM without interaction with the operation team.
7. In case of answer 1-3: What is the typical reflectivity (AR) of the cold mirror, what is the reflectivity of the ignited mirror

Questions ELI 1

- Can we use full aperture calorimeters as beam dumps?
- How to design a beam shutter at 10 PW level or at 1PW/10 Hz level How to sample the beam, what are the limitations
- Feedback from other users facilities?
- Pulse duration measurements in the femtosecond regime.
- How to sample the beam, what are the limitations ?

Questions PALS 1

- **Optics**
  1. which optics do you use inside the interaction chamber
  2. how do you protect it
  3. influence of this protection to the diagnostic beam
  4. what is the lifetime of optics in the interaction chamber
- **Parabolic mirrors**
  1. most efficient alignment procedure
  2. how many mirrors do you employ for introduction of the beam on the parabolic mirror
  3. how do you ensure the angle between incoming and reflecting beam on the parabola
  4. optimization of the focal spot – what rep. rate, what energy or using another alignment laser beam
  5. how often it is necessary to check and repair alignment of the beam for optimal focal spot
  6. parabolic mirror with a small hole for alignment - does it facilitate the alignment
  7. protection against debris, influence of the protection to the position and profile of the focal spot
- **Target positioning**
  1. how do you ensure correct position of the target
  2. which camera do you employ for positioning targets – resolution, type of connection (USB, FireWire)
  3. what is the distance of the camera from the target

4. how do you protect it during the shot

Target issues RAL

- ultra-thin (<100nm) target survivability on Vulcan for multi-shot chamber cycle (suspect shock rather than debris).
- aligning and shooting at high rep rate (initially 1 per minute but working towards 10 Hz) for thin solid targets on Gemini. RAL have been looking into this - how are other faculties addressing this?
- Making experiment setup more efficient by improving diagnostic setup time in chamber (external pre-alignment and kinematic breadboard system)

Questions PALS 2 - Synchronization of laser systems

- **Synchronization – in general**
  - what is the principle of the synchronization of your lasers (optical / electrical, combined)
  - what is the master clock frequency of your system
  - protection against EMI
  - e/o – o/e converters – what precision, long-term stability, producer
  - how do you control the delay between synchronized beams
  - how do you change the delay between synchronized beams, how do you control this change, with which precision
- **Control systems of synchronized lasers**
  - which software do you employ for control of actual state of your synchronized laser systems
  - which parameters check your control system before the shot in synchronization (communication between control systems of synchronized lasers before the shot)
  - what does your control system do in case of fault during the charging sequence or immediately before the shot, could operator decide about the next step, or the control system is fully automated
- **Spark gap issue**
  - Do any of your synchronized laser systems employ discharges driven by spark gaps? If so, could you estimate their influence to the precision of synchronization?
  - How do you monitor reliability of spark gaps?

Discussion session 3 : Wavefront Control and Focal Spot Quality, Target Issues

Target issues, on-the-target diagnostic

- **- Spatio-temporal characteristics of laser beams, discussion organized by J. Nejdl, PALS**
  Pulse duration at different parts of the beam can be short, but is it the same in the focal spot?
  Questions ELI: Pulse duration measurements in the femtosecond regime.
  How to sample the beam, what are the limitations ?
  AO developments at RAL

- **- Focal spot measurement, discussion organized by Donald A. Peyrot, ELI**
  On shot focal spot information has been collected. Luc Martin, LULI
  Question PALS:
  Measurements at lower laser energy are usually used to estimate the focusing quality. Is the B-integral sufficient way to prove that the focusing quality is the same at high energies?
  Questions ELI:
  Measuring the waist with a CCD camera at low power/energy at the focus
  How to assess the focal spot profile at high power/energy
  Beam propagation method can be used when near field data are available (wavefront and intensity profile)
  Measuring the intensity in the focal spot is the most difficult part of diagnostics?

- **- Alignment discussion organized by Roberto Ziano, ELI**
  LULI: Alignment in session 3 (short presentation by J. L. Veray)
  Questions on the last topic alignment, please send them to Sabine Kunzer (s.kunzer@gsi.de) she is the point of contact for that topic at GSI.
  Questions ELI: Topometry/static part to be outsourced ?
  Can we copy what is done for aligning a Linac for example?
  Pointing accuracy in laser facilities. What is possible and what is not ?
  Automatic alignment process. Any feedback from existing laser facilities?
  Adaptive optics close loop operation. How many loops ?
  Maximum repetition rate or time to perform the loop etc.

Questions on Simulation requirements @ laser operations by JiPing Zou

1. Actual situation/Operation aspects:
   a) How important are simulations for laser operations?
      O mandatory O important O optional O waste of time/resources
   b) Do you perform simulation to support operation?

O for every experiment O occasionally O never

c) Give an example of this simulation
d) Who perform them effectively? Do we need each time a report for simulation synthesis? How do you do to validate simulation results?

2. Actual simulation/ laser development
    a) In which situations do you need simulation tools: new project, facility upgrading, specific experiment design?
    b) What kind of codes do you use? Please to cite at least 3 of the most used.
3. Expression of simulation needs:
    a) Codes development and update,
    b) More powerful machine,
    c) Manpower& trainings,
    d) Exchange & coordination between facilities.
4. laser operations assisted by simulation (VBL)
    a) Do you use VBL?