SCIENTIFIC NEEDS WORKSHOP: HIGH-POWER MID-IR LASERS FOR ADVANCED ACCELERATOR AND LASER RESEARCH

The increasing importance of lasers in advanced accelerators and related R&D puts user facility resources in high demand. This is particularly so in the case of high-peak-power, mid-IR (9-11μm regime) lasers, which are much less common than high-peak-power ~1um lasers and not widely available to the academic/research communities. As the home of the world's only TW class mid-IR (centered around λ=10 μm) laser user facility, Brookhaven National Lab will host a workshop to obtain and evaluate community input relating to future laser needs in this regime.

OBJECTIVES

The overall goal of the workshop is to assess the scientific needs of the community for mid-IR (9-11 μm regime) laser capabilities. This includes reviewing the present experimental efforts, future research directions, and potential paths to achieving the necessary technological infrastructure to enable advanced accelerator research. Thus, the workshop aims to:

- Identify priorities in laser development (such as power, pulse duration, repetition rate) and relate them to the experimental landscape;
- Identify the major technological barriers to developing laser technology (centered around λ=10 μm) towards satisfying the needs of the accelerator community;
- Identify possible conflicts and develop prioritizations for user science paths in the case of conflicting interests;
- Provide an assessment of the suitability of currently available facilities and capabilities that are needed to support the user community over the next decade.

EVALUATION CATEGORIES

In order to best assess the needs of the accelerator and laser research community, the workshop will consider the scientific and technology needs for both standalone laser and combined laser/accelerator facilities. The workshop will focus on three primary experimental thrusts:

1. Mid-IR (9-11μm regime) laser research including laser technology development, high power beam studies, etc.
2. The study of laser-plasma interactions including wake characterization, ion generation, high energy density plasmas, and laser wakefield acceleration of charged particle beams.
3. The study of techniques using combined laser and electron beam capability, including IFEL R&D, Compton scattering experiments, dielectric laser acceleration, etc.

Three working groups will be formed to address each of these topics.

WORKING GROUP 1: TOPICS IN MID-IR LASER RESEARCH

Leader: Jeffrey Moses (CU)

Advisor: Daniel Gordon (NRL)

User Community Representative: Yu-hsin Chen (NRL), TBC

This working group will focus primarily on laser R&D and the user experiments driving "laser-only" research. Consideration should be given to the suitability of currently available facilities for these types of experiments and identify the facility developments required to address the most pressing research needs. This group should explicitly comment on: the path for mid-IR laser development required to support future particle accelerator needs; and, the availability and future development of suitable materials and technologies needed for high-power mid-IR (9-11μm regime) lasers.

WORKING GROUP 2: TOPICS IN LASER-PLASMA INTERACTIONS AND LASER WAKEFIELD ACCELERATION

Leader: Stuart Mangles (ICL)

Advisor: Jean-Pierre Delahaye (CERN)

User Community Representatives: Navid Vafaei Najafabadi (SUNY-SB), Aakash Sahai (ICL)

This working group will focus on research needs involving laser-plasma interactions with mid-IR laser systems. This working group is expected to interact with WG1 in terms of specifying the laser requirements to support the critical research thrusts, but participants should focus primarily on experimental requirements as opposed to laser R&D issues. Major consideration should be given to significant milestones in laser plasma interactions and in developing particle acceleration applications utilizing mid-IR (9-11μm regime) laser Systems. Specifically, this working group should specify the experimental conditions that are needed to achieve these milestones and describe how well they match up with current and planned facilities. In the case of laser wakefield acceleration schemes where external beam injection may be desirable, the relevant electron beam requirements should also be described.

WORKING GROUP 3: TOPICS IN LASER-ELECTRON BEAM INTERACTIONS

Leader: Felicie Albert (LLNL)

Advisor: Bruce Carlsten (LANL)

User Community Representative: Gerard Andonian (Radiabeam/UCLA)

Working group three will consider optimal experimental conditions for electron-photon interactions and for acceleration techniques using laser-pumped structures. Thus, WG3 spans topics such as Compton scattering experiments, IFEL acceleration, and Dielectric-based Laser Acceleration and should comment on what is achievable with present facilities and what capabilities will be needed to support research efforts over the next decade. This working group is expected to interact with WG1 in terms of specifying the laser requirements to support the critical research thrusts, but participants should focus primarily on identifying the key experimental deliverables and milestones as opposed to the laser R&D required to support those deliverables.

PROVIDING COMMUNITY INPUT

- Community Survey: https://surveys.external.bnl.gov/n/ATFScientificNeeds.aspx
- Workshop Web-Site: https://www.bnl.gov/asnw/