Advanced Accelerator Concepts Workshop
June 23-28, 2002
Mandalay Beach Resort, CA

Working Group: Laser Plasma Acceleration
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Working Group Mission:

Many successes have come to light in the past ten years (if not the past five years) in the field of laser driven plasma acceleration. These include the experimental demonstration of ultra-high gradient acceleration of electrons and the optical guiding of high intensity laser pulses in plasma channels for possible extended acceleration distances. The acceleration gradient has reached 100's of GeV/m and the optical guiding distances many tens of Rayleigh ranges. These successes have made this field the leader in the realization of some of the many promises the Advanced Accelerator Concepts Workshop initiated twenty years ago. It is the duty of this working group to look at what we have achieved, not to feel content, but to regroup and to face new challenges that would make the laser plasma accelerators closer to reality in the future.

Among the topics of importance to this group, how to make the high energy electrons generated by the laser plasma accelerators appear more like a beam and less like the tail of a hot electron distribution is at the top of the list. The high energy electrons produced so far are either background plasma electrons in the self-modulated laser wakefield accelerator or injected RF linac electrons in the plasma beatwave accelerator. There were electrons accelerated at every phase in the plasma wave cycle and therefore acquiring various energies. A phased injection of short pulse electron bunches may be the only way to obtain a useful beam like distribution for the accelerated electrons. Various all optical injection schemes will be discussed. Recent advances in pulse compression techniques for RF linacs also provide the possibility of obtaining femto-second electron bunches for injection. A joint session with "Beam Generating/Monitoring and Control" will be arranged.

Extended interaction distance is always the key issue to very high final energy acceleration. For most circumstances, the interaction distance is governed by the propagation distance of the laser. Optical guiding is the way to circumvent the natural diffraction of the laser beam. A plasma channel generated with the correct density profile can guide a high power laser many Rayleigh ranges. Thus the formation of long columns of plasma and the control of its density profile is essential to the laser plasma accelerators for producing very high energy electrons. The many methods of generating these plasma channels include axicon line focusing, cylindrical lens line focusing, capillary discharge formed plasma channels, and relativistically self-guided laser formed plasma channels. Capillary plasma channels are very promising in that they could be made to arbitrary lengths. Emphasis on the roles of wall ablation and/or filled gas will be discussed. The possibility of applying these capillaries to other advanced acceleration concepts such as the plasma wakefield accelerator is also be very interesting.(Joint session?) Pure waveguide mode guiding of a laser in a hollow glass capillary and theoretical studies of parametric instabilities in plasma channels (such as Raman scattering and filamentation instability) will also be discussed.

Novel laser plasma acceleration schemes are always a must for this working group. We need to continuously look for new concepts and new ideas so that we don't feel too content with what we have but to keep our youthful enthusiasm always on the edge. That has always been what was driving this working group and in fact workshops of yesterday years. Last but not the least, we will have presentations and discussions on numerical simulations of laser plasma accelerators. No experiments can proceed without some guidance from simulations. A joint session with the Computational Accelerator Physics Working Group is in order here.

Come and we will share our sweet results and together we will plan for even better ones in the future.

Topics (talks and discussions) in the Working Group on Laser Plasma Accelerators

1) LWFA injection experiments from LBNL, U. of Michigan, and NRL.
2) PBWA injection experiments from UCLA.
3) SM-LWFA experiments at LBNL, LOA(Ecole Polytech)/Rutherford(UK).
4) Line focus optical guiding experiments at LBNL, U. of Michigan, U. of Texas.
5) Capillary discaharge optical guiding experiment in Israel, BNL, NRL.
6) Long plasma column formation for PWFA.
7) Hollow glass capillary optical guiding.
8) Novel wakefield generation and DLA.
9) Simulations of laser plasma accelerators.

Tentative speakers in the Working Group on Laser Plasma Accelerators (in no particular order)

1) Chris Clayton, UCLA, Overview of Neptune Lab
2) Sergei Tochitsky, UCLA, Bunched beam injection in PBWA
3) Eric Esarey, LBNL, Injection of electrons in Laser Plasma Accelerators
4) Ned Saleh, Univ. of Michigan, A P.O.P. experiment of the LILAC concept
5) Sven Fritzler, LOA, Ecole Polytechnique, 200 MeV SM-LWFA
6) Wim Leemans, LBNL, Laser wakefield injection and control
7) Carl Schroeder, LBNL, Laser propagation issues
8) Dick Hubbard, NRL, Capillary plasma channels simulations
9) Amon Fisher, Israel, Gas filled capillary plasma channels
10) Rocca, U. Colorado, Capillary plasma channels (to be contacted)
11) Milchberg, U. Maryland, Recent results at Maryland
12) Mike Downer, U. Texas, Axicon formed plasma channels
13) Brigette Cros, Ecole Polytech., Intense laser pulse guiding by capillary tubes for laser-plasma accelerators
14) Dan Gordon, NRL, LWFA simulations
15) Joe Penano, NRL, Channel guided LWFA simulations
16) Dmitri Kaganovich, NRL, NRL LWFA
17) Pukhov, Max Planck Inst., Direct Laser Acceleration
18) Gennardy Shvets, Illinois Inst. Tech., Magnetically-Induced Transparency of Magnetized Plasma, and How It Can Lead to New Plasma Accelerators
19) Nakajima, KEK, Japan, Recent LWFA results from Japan
20) Tomonao Hosokai, Univ. of Tokyo, Japan, Optical Guiding of Intense Laser Pulses by Fast Z-pinch Discharges
21) Jonathan Wurtele, LBNL, PIC simulations of the colliding beam accelerator in two dimensions