Graduate students currently engaged in research using BaPSF

Student	Institution/Group	Mentor(s)
Xin An	UCLA (Atmospheric and Oceanic Sciences)	J. Bortnick
Anton Bondarenko	UCLA	C. Niemann
Jeffrey Bonde	UCLA (BaPSF group)	W. Gekelman, S. Vincena
S. Eric Clark	UCLA	C. Niemann
Paul Crandall	UCLA	F. Jenko
Tim DeHaas	UCLA (BaPSF group)	W. Gekelman
Erik Everson	UCLA	C. Niemann
Daniel Guice	UCLA (BaPSF group)	T. Carter
Dooran Hong	UCLA (BaPSF group)	W. Gekelman
Mike Martin	UCLA (BaPSF group)	W. Gekelman, T. Carter
Samuel Nogami	WVU	M. Koepke
Adam Preweisch	UC Irvine	W. Heidbrink
Jeffrey Robertson	UCLA (BaPSF group)	T. Carter
Giovanni Rossi	UCLA (BaPSF group)	T. Carter
James Schroeder	U. Iowa	C. Kletzing, F. Skiff, G. Howes

Advanced degrees granted, last 5 year period

Student	Degree	Granting institution	Graduate advisor	Year
Nathaniel Moore	Ph.D.	University of California, Los Angeles	W. Gekelman	2015
Yiting Zhang	Ph.D.	University of Michigan	M. Kushner	2015
William Farmer	Ph.D.	University of California, Los Angeles	G. Morales	2014
Adam Kullberg	Ph.D.	University of California, Los Angeles	G. Morales	2014
Derek Schaeffer	Ph.D.	University of California, Los Angeles	C. Niemann	2014
Kris Kersten	Ph.D.	University of Minnesota	C. Cattell	2014
Brett Friedman	Ph.D.	University of California, Los Angeles	T. Carter	2013
David Schaffner	Ph.D.	University of California, Los Angeles	T. Carter	2013
Yuhou Wang	Ph.D.	University of California, Los Angeles	W. Gekelman	2013
Chris Cooper	Ph.D.	University of California, Los Angeles	W. Gekelman	2012
David Auerbach	Ph.D.	University of California, Los Angeles	T. Carter	2012
Shu Zhou	PhD.	University of California, Irvine	W. Heidbrink	2011
Gregoire Hornung	M.S.	Gent Universiteit, Belgium	G. Van Oost; J. Maggs, G. Morales	2010
Andrew Collette	Ph.D.	University of California, Los Angeles	W. Gekelman	2010
Kim De Rose	M.S.	University of California, Los Angeles	W. Gekelman	2010
Brett Jacobs	Ph.D.	University of California, Los Angeles	W. Gekelman	2010
Alexey Karavaev	Ph.D.	University of Maryland	K. Papadopoulos	2010
Nathan Kugland	PhD.	University of California, Los Angeles	C. Niemann	2010
Eric Lawrence	Ph.D.	University of California, Los Angeles	W. Gekelman	2010
Franklin Chaing	Ph.D.	University of California, Los Angeles	J. Judy	2010

Current active external user groups

Independent experimenter user groups

1. "Laser Driven shock waves in the LAPD", C. Niemann, C. Constantin (Dept. of Physics and Astronomy, UCLA.)
   High power lasers are used to drive collisionless magnetized shocks in LAPD. A high power (up to 50J) Nd-Yag laser (repetition rate 10 minutes) is focused on a target in the LAPD plasma. Measurements and simulations corroborate the generation of a collisionless shock $(M_A) \approx 2$ across the LAPD background field in the presence of the dense, LaB_6 plasma. The interaction is studies with the use of multiple magnetic and Mach probes, fast (3 ns) photography, and spectroscopy.

2. "Laboratory Investigation of Auroral Alfvén Electron Acceleration", C. Kletzing, F. Skiff, (Dept. of Physics, University of Iowa).
   This is a study of shear Alfvén waves with short perpendicular wavelengths as well as investigations of field-aligned acceleration of electrons due to the electric field of the waves. A series of antennas, which are phased arrays, has been developed at the University of Iowa and put on the LAPD. The propagation of waves launched by these antennas is studied and their dispersion mapped. Electron distribution functions perturbed by the Alfvén waves are measured using a novel whistler wave diagnostic developed by the Iowa group. The results will be compared with spacecraft measurements made in the Earth's auroral region.

3. "Development and testing of LaB_6 sources for Tri-Alpha Energy," D. Bui, A. Song (Tri Alpha)

4. "Development of plasma microprobes," J. Judy (UCLA EE).

Theory-driven studies

1. Colestock?

2. "Whistler Wave Pitch Angle Scattering of Electrons", Jacob Bortnick (UCLA Earth and Space Science), R.M. Thorne and Xi An (UCLA Department of Atmospheric and Oceanic Sciences)
   This is a study of whistler wave scattering of a beam of energetic electrons. A low-density electron beam, with adjustable pitch angle relative to the background magnetic field, will form the energetic electrons. The velocity distribution function will be measured with small velocity analyzers. This will be done with and without background whistler waves. The waves will be launched with a small loop antenna. Results will be compared to theoretical predictions.

3. "Tearing of a Current Sheet into Magnetic Flux Ropes", W. Daughton, J. Finn (LANL), H. Karimabadi (UCSD)
   A fully 3D kinetic code developed at Los Alamos and using the largest multiprocessor computer in the world will be used to model the tearing of a current sheet into multiple magnetic flux ropes. In full 3D computations it has been observed taht the magnetic islands, which are the result of the tearing of the current sheet are helical flux ropes which interact with one another.

A new high emissivity cathode, (installed in the summer of 2013) will be masked to make a thin (dy/dx=20) current sheet. The full three-dimensional evolution of the current will be measured in the LAPD and detailed comparisons with theory and the petascale simulations will be done.

4. Kushner?

5. "Investigation of Sheaths near RF antennas for fusion"
   D. D'Ippolito, J. Myra (Lodestar)
   Study of the RF sheaths on antennas immmersed in a magnetoplasma. The antennas radiate in the ICRF, Fast Wave, regime. Antennas will be constructed at UCLA and waves launched at low and high powers into the LAPD edge plasma. A variety of probes and optical techniques will be used to study the sheath plasma waves and their coupling to fast waves and under appropriate conditions to shear Alfven waves. The experiments will be complemented with a modeling effort at Lodestar.

6. "Experimental and Numerical Studies of Whistler Wave Ducting," A. Streltsov (Embry-Riddle Aeronautical University)
   This study is aimed at studying the propagation of VLF whistler modes in a laboratory plasma and to compare these results with numerical predictions. A key goal is to model the propagation in magnetic field-aligned irregularities (also called channels or ducts). High frequency $(f \geq f_{ce}/2)$ and low-frequency $(f \leq f_{ce}/2)$ cases are examined.

7. "Search for electron solitary structures," L.-J. Chen (University of New Hampshire)
   This project is motivated by the ubiquitous observation made on board spacecraft of electrostatic solitary structures known as "electron holes". The major outstanding questions are related to the generation, dynamics and statistics of phase-space structures of spatial dimension comparable to the Debye length. These features have been investigated by injecting a small suprathermal electron beam into the LAPD plasma and measuring the small structures with novel MEMS microscopic probes that sample the structures at rates much higher than the plasma frequency. The measured scales and amplitudes of these structures are comparable to those derived from observation in the magnetosphere. However, the measured velocities indicate that they are not generated by an instability driven by the initially injected beam. Instead, the solitary structures have the same scales and propagate at the same speed as coherent wave packets and background fluctuations that are identified as electrostatic whistler waves in a strongly Landau damped regime.

8. "Experimental study of Alfvén wave damping processes relevant to the solar corona," Daniel Wolf Savin, Michael Hahn (Columbia University)
   Shear Alfvén wave damping and heating will be studied in the context of explaining heating in solar coronal holes. The waves will be launched in magnetic field and density gradients and their propagation will be studied and wave damping evaluated in a number of scenarios. Of special interest is the propagation of waves in cross-field density gradients,. The gradients will be created using grids with variable transparency across B_0 . Another area of study will be the reflection of shear Alfvén waves in large magnetic field gradients.

Campaigns

The campaigns are listed as: "campaign title", "campaign leader (affiliation)"; external participants:"name (affiliation)" followed by a description.

1. "Fast-Ion Campaign"
   W. Heidbrink (UCI); participants: M. Van Zeeland (General Atomics), B. Breizman (U.Texas, Austin), H. Boehmer (UCI), I. Furno (Lausanne), F. Jenko (MPI/UCLA), S. Tripathi, S. Vincena, T. Carter (UCLA)
   An ion beam (25 kV , 0.5-3 A) will be injected at a variety of pitch angles into the LAPD plasma. The beam which will spiral along the magnetic field will match the phase velocity of Alfvén waves in the background LAPD plasma. The waves are expected to be generated by Cherenkov emission from the fast ions. The goal is to create an analogue of TAE modes and study them in great detail. The helium ion beam been constructed and suvccesfully tested The project also has related side studies such as the study of the propagation of shear waves in multiple mirrors. Measurement of transport in velocity and configuration space caused by harmonic heating with compressional Alfvén waves, resonances with shear Alfvén waves, and drift wave turbulence.

   "Study of Ion Transport in Turbulent Plasmas", W. Heidbrink, R. McWilliams, H. Boehmer (Dept. of Physics, University of California, Irvine.)
   Continuation of experiments investigating the interaction between fast ions and waves and turbulence in LAPD. A moderate energy (~ 1 keV), low current Lithium ion beam is mounted in the LAPD. The beam provides a source of test ions, whose trajectories can be

   spirals along the background magnetic field in an argon or helium plasma. The beam profile will be measured with probes as it moves through localized turbulent layers. The layers are generated with antennas. The beam divergence and energy spread is being studied.

2. "Auroral Physics Campaign"
   M. Koepke (West Virginia University); participants: C. Chaston (U.C. Berkeley), D. Knudsen (U. Calgary), Robert Rankin (U. Alberta), S. Vincena, W. Gekelman (UCLA)
   Magnetized plasmas are predicted to support electromagnetic perturbations that are static in a fixed frame if there is uniform background plasma convection. These stationary waves should not be confused with standing waves that oscillate in time with a fixed, spatially varying envelope. Stationary waves have no time variation in the fixed frame. In the drifting frame, there is an apparent time dependence as plasma convects past fixed electromagnetic structures. In this project, an off-axis, fixed channel of electron current (and depleted density) is created in the Large Plasma Device, using a small, heated, oxide-coated electrode at one plasma-column end while the larger plasma column rotates about its cylindrical axis from a radial electric field imposed by a special termination electrode on the same end. A variety of methods will be explored to generate EXB plasma flows in the center of the bulk plasma. These include segmented electrodes, spiral electrodes, emitting electrodes and a biased center conductor. The interaction will be studied with a variety of probes as well as LIF.

3. "Radiation-Belt Physics Campaign"
   D. Papadopoulos and R. Sagdeev, University of Maryland; participants: U. Inan, T. Bell (Stanford University), S. Sharma, X. Shao (University of Maryland), W. Scales, J. Wang (VA Tech), A. Streltsov (Dartmouth), Y. Wang, W. Gekelman (UCLA).

The campaign is focused on the interaction of energetic electrons with launched Alfvén and whistler waves. It is motivated by the desire to limit damage to satellites by using these waves to scatter mirror-trapped energetic electrons into the loss cone. Launching shear Alfvén waves of arbitrary polarization was accomplished by constructing an antenna consisting of two perpendicular coils with independent phase-controlled currents. The antenna was found to launch highly collimated, relatively large amplitude shear waves with wave decay resulting mainly from collisional dissipation. The measured radiation patterns of the right-hand mode compared favorably to the predictions of an MHD simulation by the Maryland group. The second antenna studied was a classic short electric dipole. The antenna current and voltage were measured within the dipole, avoiding transmission line effects The real and imaginary parts of the antenna impedance were measured as a function of frequency and time in a decaying, afterglow plasma. A pulsed microwave source constructed for the campaign was used to inject waves at 2.45 GHz into a local magnetic mirror established in the LAPD. The fast electrons vanish when a shear wave, launched by an antenna 5 meters away is switched on. When the wave is shut off the fast electrons reappear and persist until the microwave source is pulsed off.

Publications in refereed journals (funding cycle 2010 - mid 2015)

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11. D. B. Schaeffer, E. T. Everson, A. S. Bondarenko, S. E. Clark, C. G. Constantin, S. Vincena, B. Van Compernolle, S. K. P. Tripathi, D. Winske, W. Gekelman, and C. Niemann, Laser-driven, magnetized quasi-perpendicular collisionless shocks on the Large Plasma Device, Phys. Plasmas, 21, 056312 (2014) [http://dx.doi.org/10.1063/1.4876608]

12. Wang, Y. and Gekelman, W. and Pribyl, P. and Papadopoulos, K., Enhanced loss of magnetic-mirror-trapped fast electrons by a shear Alfvén wave, Physics of Plasmas (1994-present), 21, 055705 (2014), DOI:http://dx.doi.org/10.1063/1.4874332

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14. Walter Gekelman, Bart Van Compernolle, Tim DeHaas and Stephen Vincena, Chaos in magnetic flux ropes, Plasma Phys. Control. Fusion 56 (2014) 064002 (18pp), doi:10.1088/0741-3335/56/6/064002

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