Biennial Review for 2013-2015
Center for Pulsed-Power-Driven High-Energy-Density Plasmas*

High Energy Density Plasma Studies with Pulsed Power Machines

Laboratory of Plasma Studies, Cornell University
November 12-13, 2015

*Sponsored by the NNSA Stewardship Sciences Academic Programs under DOE Cooperative Agreement DE-NA0001836 (2012-2017)
Thank you for Coming!

Outline of this talk

• Introduce the Center
  • Mission, organizations, people
• Major elements of the proposal
• Brief comments on the technical agenda
• Make way for the interesting talks
Review includes research partially sponsored by individual investigator grants that (purposely) benefit from Center facilities (COBRA, XP and associated diagnostics) and technical support.

NNSA – Greenly and Seyler (Reconnection)
NNSA-DOE Joint Program – Kusse (Plasma Jets)
NNSA-DOE Joint Program – Hamlin and Seyler (Relativistic XMHD)

About 33% of Center funding supports collaborations.
Mission of the Cornell Center

- Advance the understanding of current-driven High Energy Density (HED) plasmas through experiments carried out in various configurations supported by computer simulations and theoretical modeling.
  - Help validate computer codes and test theoretical models
  - Improve the state-of-the-art of experiments and simulations
- Contribute to the application of current driven HED plasmas to inertial fusion energy, intense radiation generation, laboratory plasma astrophysics, etc.
- Develop new HED diagnostics for HED research
- Train a new generation of HED research scientists
Center Faculty, Staff and Students at Cornell (2015-’16)

Faculty: David Hammer (ECE), Bruce Kusse (AEP), Charles Seyler (ECE)

Senior Scientists: John Greenly; Steve Lantz
Visiting Senior Scientists: Sergei Pikuz, Tatiana Shelkovenko; Niansheng Qi

Postdoctoral Associates: Nathaniel Hamlin and Philip De Grouchy (now with I. C.)

Graduate students: Levon Atoyan, Jacob Banasek, Tom Byvank, Adam Cahill, Joseph Engelbrecht, Sophia Rocco, Shihao Tian

Technical Staff: Todd Blanchard, Dan Hawkes, Billy Potter, Harry Wilhelm

Undergraduates this semester: Dillan Chang, Robert Duggan, Daniel Liang, Hannah Moore, Lauren Ransohoff

Administrative Staff: Cindy Vanostrand
Center for Pulsed-Power-Driven High-Energy-Density Plasmas

Collaborations
Simon Bland, Imperial College
Simon Bott-Suzuki, University of California, San Diego
Nathanial Fisch, Princeton University
Yitshak Maron, Weizmann Institute of Science
Sergei Pikuz, P. N. Lebedev Institute

Other opportunities that may arise

Center Science Advisory Committee (CSAC)
Mike Cuneo (Sandia)
Jim Hammer (LLNL)
John Kline (LANL)
Tom Antonsen (University of Maryland)
John Sethian (NRL - Retired)
Major Elements from the Proposal

Gas-Puff Z-pinches
Thin Foils
Liners
Shocks, flows and jets
HED Reconnection
Novel configurations
XMHD Code development
Diagnostic Development
Breadth of Center Activities

Experimental and Theoretical/Computational Research
Development of new diagnostic capability
(plus keeping the pulsed power machines going)

**Fundamental Physics** (e.g., instability studies, HEDP turbulence, shocks)

**Applications** (e.g., X-ray sources, benchmarking atomic physics codes, ICF-MLIF)
COBRA – 0.9-1.2 MA, 95-250 ns rise time
Pulsed Power Generator

Change pulse length by adjusting timing of the 4 output switches

Change polarity with a convolute that has + and – mode with the same inductance

Facility has many active and passive diagnostics that will be discussed in the individual talks
COBRA

Used for gas puff, cylindrical liner, reconnection, power flow, plasma jet experiments. Also some diagnostic development and exploratory experiments.
Some Major Diagnostics for COBRA

10 J, 3 nsec 527 nm Laser For Thomson Scattering

PLIF System for Gas Puff Neutral Density Measurements; Spectrometers and Optical Streak Camera
XP-System

300-400 kA, 50-100 nsec, 0.5 Ohm

Used X-Ray Absorption spectroscopy, visible spectroscopy
Studies with different X-Pinch configurations, diagnostic development
Agenda for Thursday, November 12, 2015

9:15 – 9:35 – Liner experiments: cylinders and wrapped foils (Levon)
9:35 – 9:55 – Magnetized Plasma Jets (Tom, Dillan C.)
9:55 – 10:15 – X-ray absorption spectroscopy (Adam)
10:15 – 10:35 – Break
10:35 – 10:55 – Theoretical work at Princeton (Seth Davidovitz)
10:55 – 11:25 – Effect of asymmetric contacts .... (Simon B., UCSD)
11:25 – 11:55 – Gas puff z-pinch research at the Weizmann Institute (Yitzhak)

12:00 -1:30 pm – Lunch followed by posters
Center for Pulsed-Power-Driven High-Energy-Density Plasmas

12:00 -1:30 pm – Lunch followed by posters
1:30 - 2:30 – Gas-puff z-pincho experiments at Cornell (Lauren R., Phil, Joey)
2:30 – 3:15 - Code development and comparison with experiments (Charlie, Shihao)
3:15 – 3:30 – Discussion of COBRA Facility (Bruce, Robert D.)
3:30 – 4:00 – COBRA tour and coffee break (in the lab)
4:00 - 4:20 – Facility improvements, new instruments, facility stats (Bruce)
4:20 – 4:40 – Plasma spectroscopy developments (Jacob)
4:40 – 4:50 – Recent results from the Lebedev Institute (Sergei)
4:50 – 5:15 – Open discussion
5:15 - 5:45 – Executive Session

6:30 – 8:30 PM – Dinner at The Heights Café, Cayuga Heights
Center for Pulsed-Power-Driven High-Energy-Density Plasmas

Friday, November 13, 2015

8:00 - 8:30 am – Continental Breakfast and Good mornings
8:30 - 9:00 – Magnetized plasma flows and other topics (Simon B. and Guy B., IC)
9:00 - 9:30 – Electrode plasmas and plasma skin current experiments (John)
9:30 – 10:00 – Relativistic XMHD (Nat)
10:00 - 10:20 – Break
10:20 – 11:00 – Discussion
11:00 - 12:00 – Executive session
12:05 - 12:30 pm – Feedback from the committee
12:30 - 1:00 – Lunch and further informal outbrief; departures as needed