Center for Beam Physics

Overview of
the Center for Beam Physics

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Accelerator and Fusion Research Division

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28-29 May 2003

The Center's Core Strengths

- Accelerator theory
- High performance computing
- Laser-plasma science
- Rf and beam instrumentation

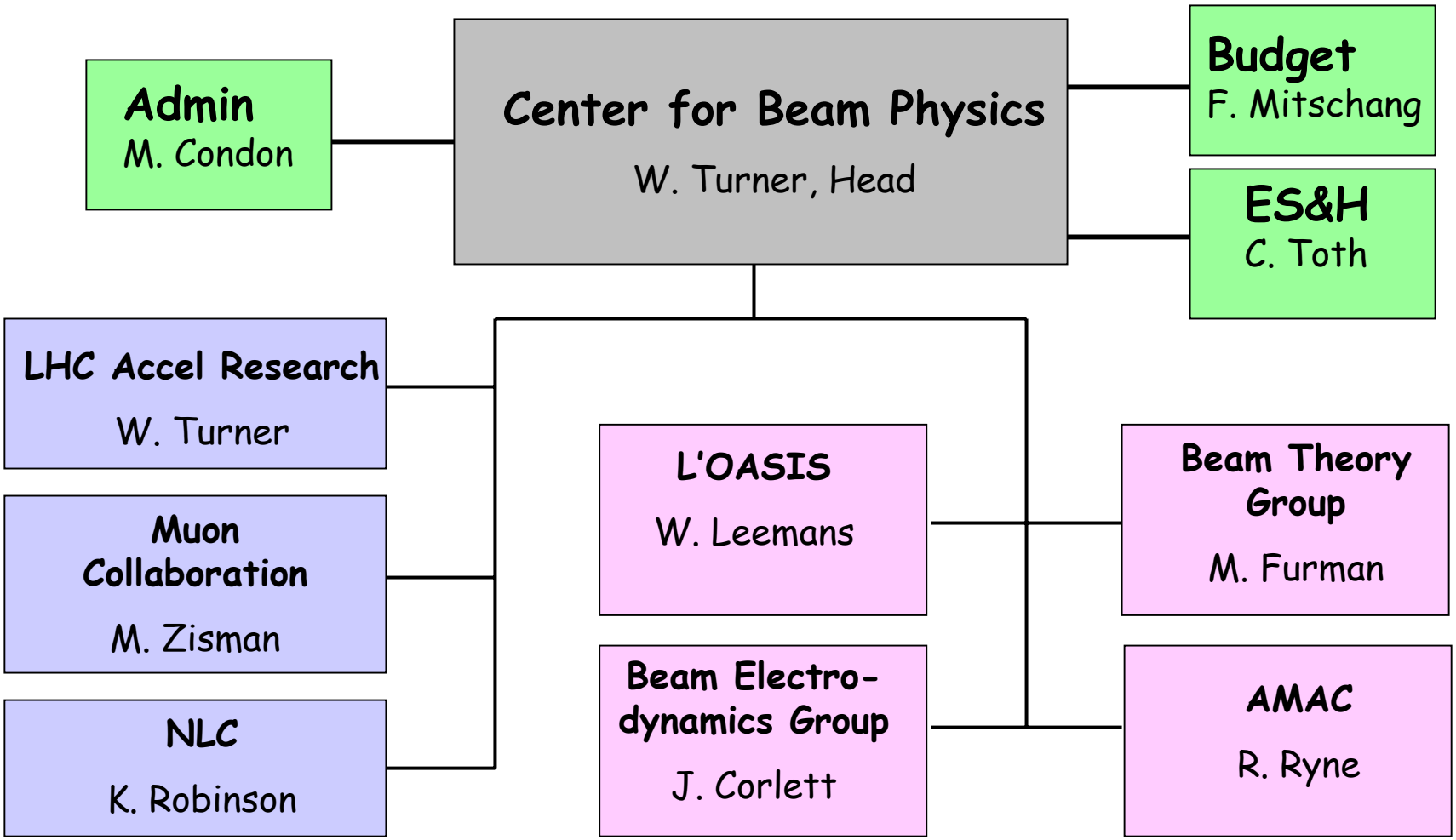
These core strengths are well suited to LBNL's infrastructure and are applied interactively to a broad range of accelerator initiatives

The Center's HEP Mission

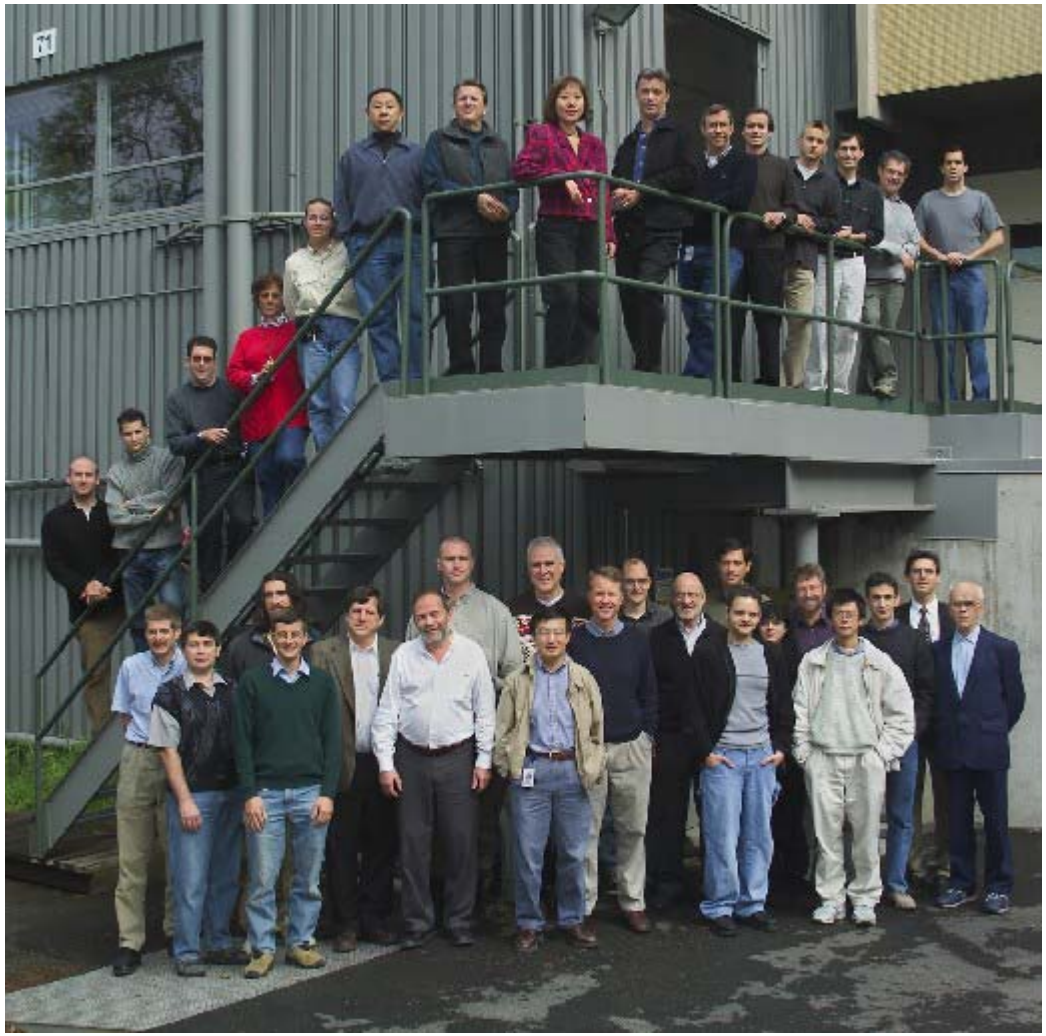
The Center's HEP mission is to apply the core strengths to

- Responding to LBNL, National and International Accelerator needs
  - HEP accelerators - Tevatron, LHC, NLC, Muons
- Investigating advanced approaches to HEP accelerator technology
  - Laser acceleration
  - Hadron collider luminosity and beam density instrumentation
- Providing a stimulating environment for training post docs and students in accelerator science
  - 2 Post docs, 6 PhD students, 2 undergraduates

CBP Organization



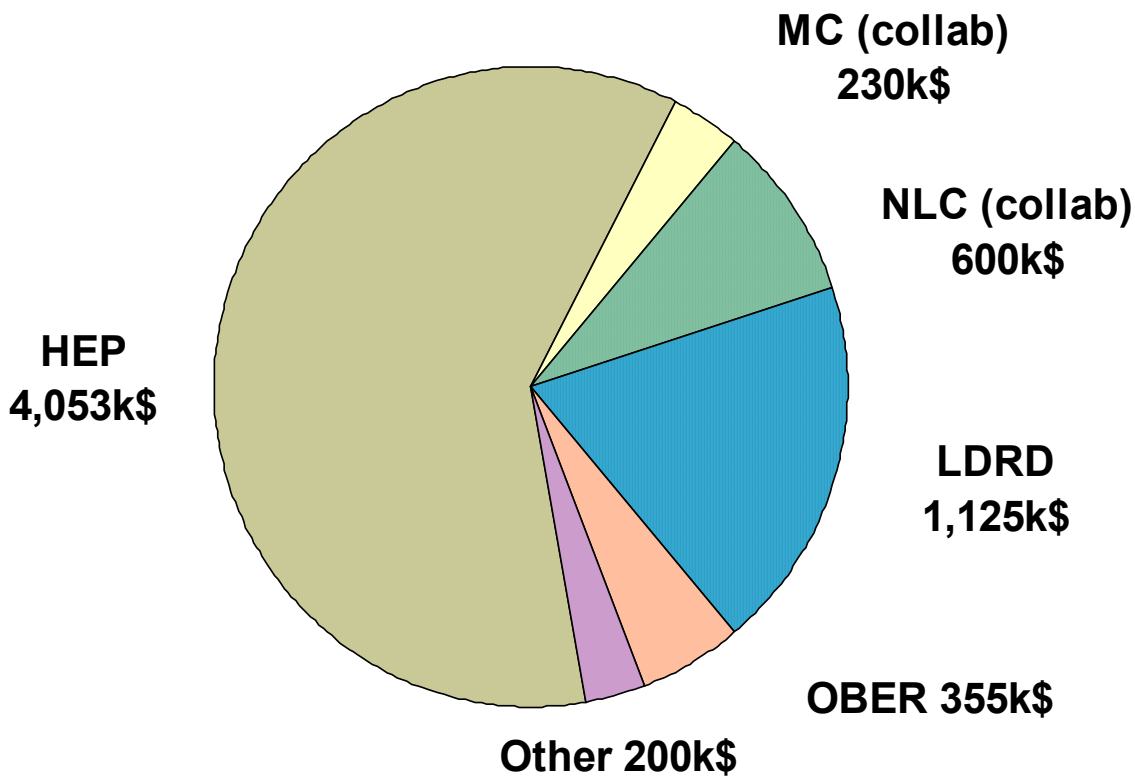
CBP on 17 Apr 2003; 20 scientists, 6 students 3 visiting scientists and support staff



CBP budget for FY03; ~75% HEP and ~17% LDRD initiatives

Operating: ~ 6,385 k$

Equipment: ~ 328 k$



The Center's LDRD supported initiatives are important for launching new science

PI	Title	Award (k$)
Corlett et al	Ultra-fast x-ray source for fsec dynamics	550
Leemans	Novel coherent THz and IR source using a laser wakefield	200
DeSantis	**Synchrotron and wiggler radiation measurement of longitudinal bunch distributions in storage rings**	**175**
Ryne, Ng, Sabbi	**Optimal solvers for infinite dimensional Hamiltonian systems**	**150**
Vay	**Electron Production and Collective Field Generation in Intense Particle Beams**	**125**
Colella,Ryne, Leemans	**Advanced Simulation of Complex Beam Systems**	**75**

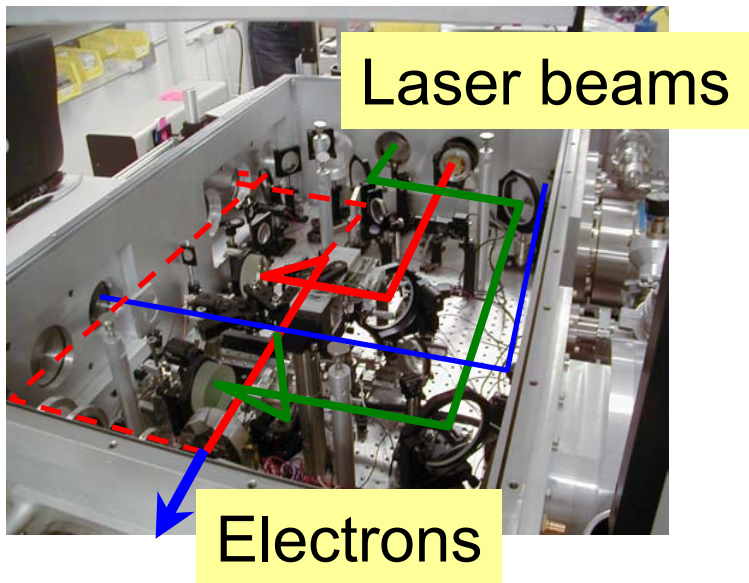
Experimental facilities are essential to the Center's mission

- Lambertson rf and instrumentation lab

— Network and specturm analyzers
— Time-domain reflectometers
— Impedance meas devices
— EM analysis workstation, MAFIA etc
— Small workshop

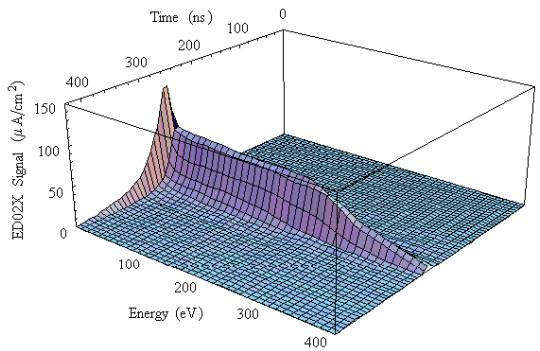
- L'Oasis laser-plasma lab

__ Main Drive + Pre ionization
.... Transmitted + Backscatter
__ Channel heater
__ Colliding pulse
__ Interferometer

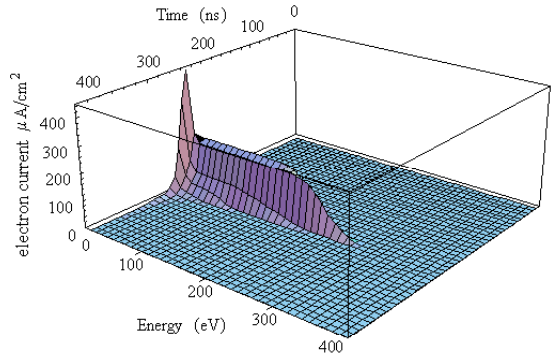


Theory and high performance computing reinforce one another

- Electron cloud simulation of PSR - factor 2-4 agreement with data

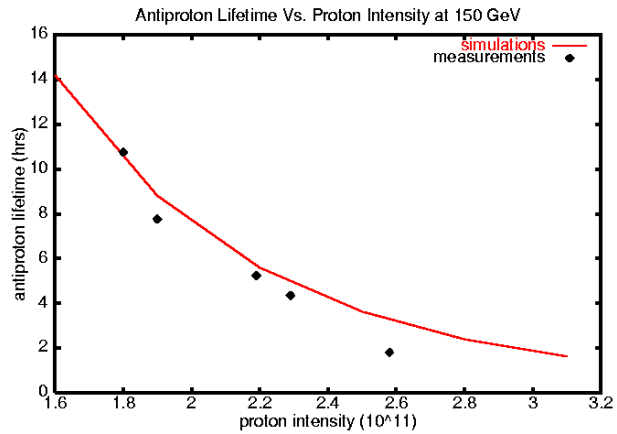


Measured in PSR
(data courtesy R. Macek, LANL)



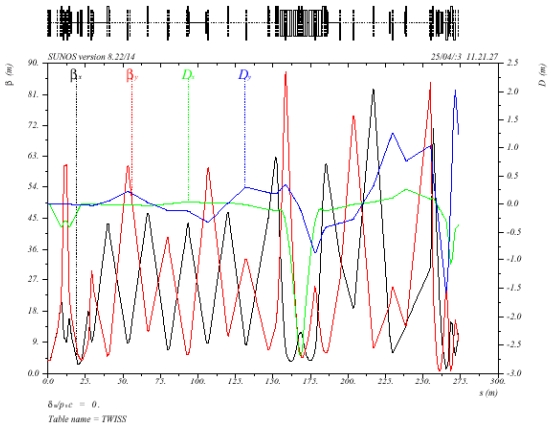
Simulated with code POSINST
(results courtesy M. Pivi, LBNL)

- Parallel Beam-beam interaction code upgraded from Gaussian approx to fully self consistent PIC code and applied to Tevatron

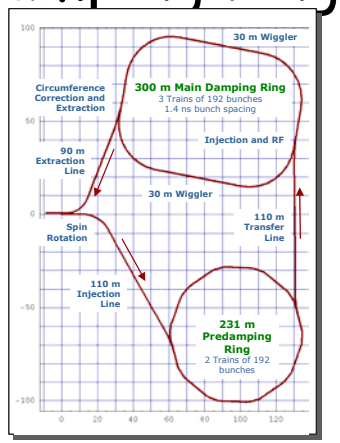


The skills of the Center are applied to frontier HEP accelerator initiatives

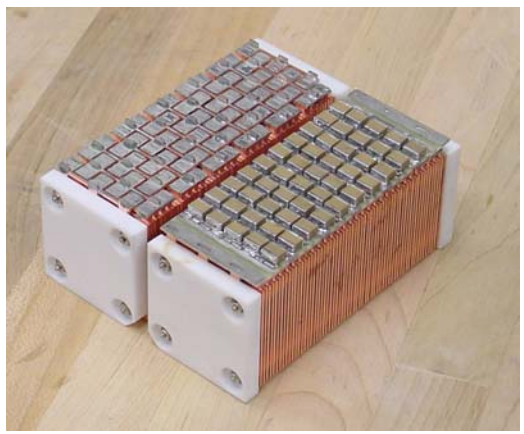
- Tevatron AP2 lattice study



- NLC damping ring design



- LHC beam instrumentation



- Muon cooling

A CBP role in the Tevatron Run II luminosity campaign is being defined

- During the past year we have been working with FNAL (Holmes, Dixon, Church, Shiltsev) to define ways LBNL can assist with Tevatron Run II operations
- Since Nov. 2002 Mike Zisman has spent approx 25% of his time at FNAL and assisting in the Tevatron control room
- AP2 lattice study started (I. Reichel and M. Zisman)
- Parallel PIC Beam-beam code developed and being applied to Tevatron (J. Qiang, M. Furman and R. Ryne)
- Future possibilities have been identified
  - Recycler vacuum
  - Transverse feedback
  - Longitudinal density measurement
- This activity has the potential to be an excellent model for the accelerator physics and beam instrumentation parts of the U.S. LHC Accelerator Research Program

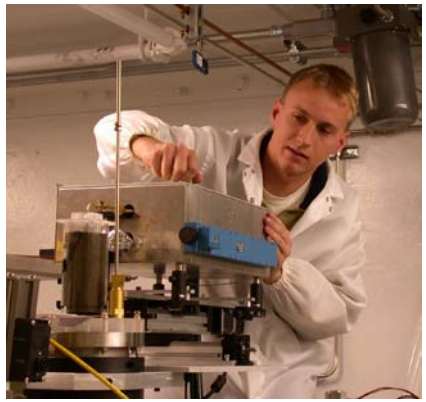
The Center's principal HEP related accomplishments in the past year

- Commissioning of 100TW, 10Hz laser system
- Measurement of 50GeV/m accelerating gradient in mm plasmas
- Demonstration of non-linear mixing of laser and synchrotron radiation measurement of longitudinal beam density
- New lattice designs for NCL damping rings
- Parallel PIC beam-beam code developed and applied to Tevatron
- 800 MHz muon cooling rf cavity and solenoid delivered and tested at FNAL

The Center is committed to the education and training of future scientists

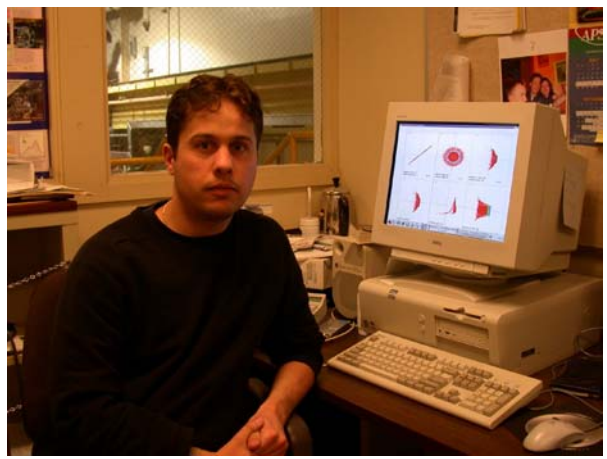
Prof Wurtele and his UCB theory students

J. Van Tilborg (Univ. of Eindhoven) and his THz radiation detector



C. Geddes (UCB) and his gas jet plasma channel

G. Fubiani (Univ. of Paris) and his laser-plasma simulations

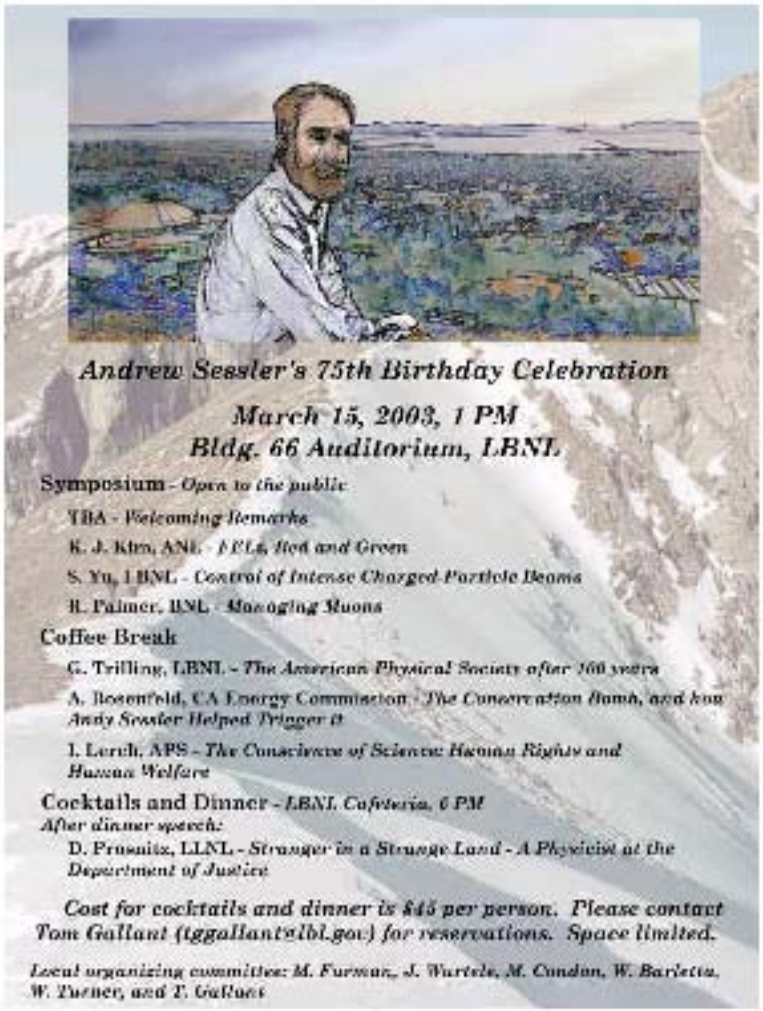


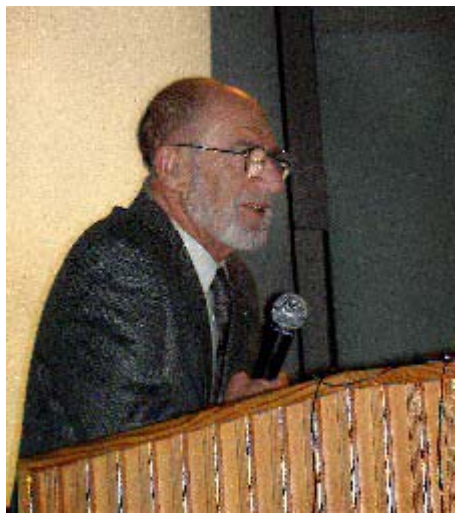
Weekly CBP seminars contribute to a stimulating AFRD research environment

Govindan Rangarajan
Indian Inst of Science, Bangalore, India
Synchronized Chaos: Stability and Pattern Formation
Apr. 4, 2003

Lazar Friedland
Hebrew Univ of Jerusalem
Synchronization in non-neutral plasmas
Apr. 18, 2003

The Sessler Symposium honored one of LBNLs most eminent scientists





W.C. Turner
Overview CBP

The Center's expertise is frequently sought for service on committees and reviews

J. Corlett	• Reviewer for Bejing e+e- collider upgrade
E. Esarey	• Member ICFA Panel for international collaboration on advanced accelerators • Member DPP APS Maxwell Prize Committee • Prog. Committee ICFA Intl. Workshop on Laser-Beam Interactions, Oxford, Jul 2003 • Sci. Adv. Comm. Workshop on Laser and Plasma Accelerators, Italy, Sep 2003
W. Leemans	• Chair of ICFA Panel for international collaboration on advanced accelerators • Prog. Committee ICFA Intl. Workshop on Laser-Beam Interactions, Oxford, Jul 2003 • Sci. Adv. Comm. Workshop on Laser and Plasma Accelerators, Italy, Sep 2003 • Steer. Comm. for Sci. Appl. of Ultra-short Ultra-Intense Lasers, Wash. DC, 2002 • NSF-DOE Review Panel for Laser and Plasma Science University Grants, 2003
J. Wurtele	• FNAL Accelerator Advisory Committee • Executive Board Muon Collaboration • NRC Committee on High Energy Density Plasmas
A. Wolski	• SLAC Scenarios Study • International Linear Collider Technical Review Commitee
W. Turner	• AFRD staff committee • US LHC Accelerator Steering Committee
M. Zisman	• AFRD and LBNL staff committees • Secty-Treas APS Division of Physics of Beams • MICE Steering Committee

Summary

- CPB continues to provide a stimulating environment for HEP accelerator research and generation of new initiatives
- Close interaction of the CBP groups allows us to maintain a critical mass of individuals working on a broad range of HEP accelerator projects; NLC, LHC, Muons and Tevatron
- The relatively large allocation of LDRD funds to CBP provides the necessary support for launching new ideas and is evidence of the LBNL Director's confidence in our work; LUX, THz radiation, beam instrumentation and high performance computing