



USPAS – *Simulation of Beam and Plasma Systems*

Steven M. Lund, Jean-Luc Vay, Remi Lehe, Daniel Winklehner and David L. Bruhwiler

Lecture: Use case: sub-fs diagnostic

Instructor: David L. Bruhwiler

Contributors: G. Andonian, UCLA / RadiaBeam Tech
N. Sudar, UCLA



U.S. Particle Accelerator School sponsored by **Old Dominion University**

<http://uspas.fnal.gov/programs/2018/odu/courses/beam-plasma-systems.shtml>

January 15-26, 2018 – Hampton, Virginia

This material is based upon work supported by the U.S. Department of Energy, Office of Science, Offices of High Energy Physics and Basic Energy Sciences, under Award Number(s) DE-SC0011237 and DE-SC0011340.



U.S. DEPARTMENT OF
ENERGY

Office of Science

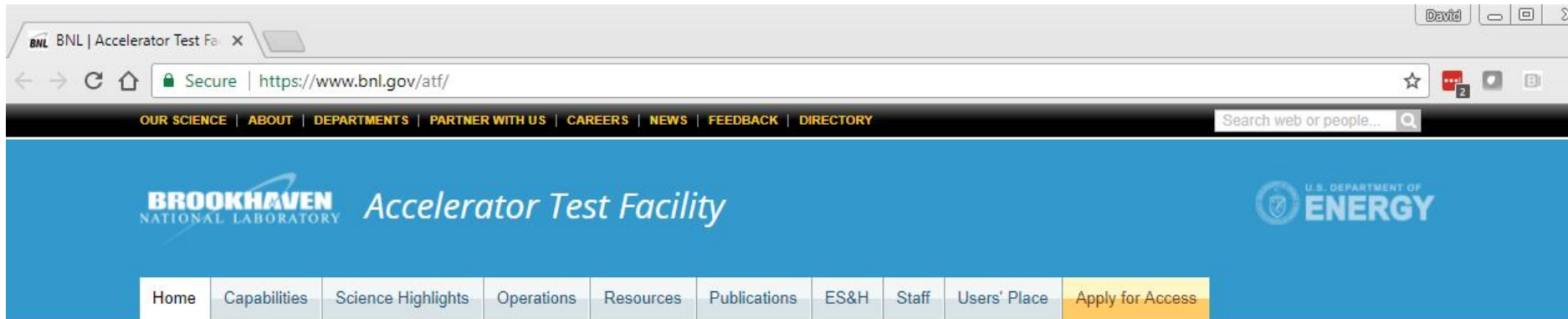
Goals

- Learn a little about the Accelerator Test Facility (ATF) at BNL
 - bright electron beams, lasers, plasmas
- Consider an experiment to demonstrate fs diagnostics of e- beams
 - simulation and planning of the experiment using Sirepo/elegant



The Accelerator Test Facility at BNL

<https://www.bnl.gov/atf>



The screenshot shows the website for the Accelerator Test Facility at Brookhaven National Laboratory. The browser address bar displays "https://www.bnl.gov/atf/". The navigation menu includes "OUR SCIENCE", "ABOUT", "DEPARTMENTS", "PARTNER WITH US", "CAREERS", "NEWS", "FEEDBACK", and "DIRECTORY". The main header features the Brookhaven National Laboratory logo and the text "Accelerator Test Facility" alongside the U.S. Department of Energy logo. A secondary navigation bar contains links for "Home", "Capabilities", "Science Highlights", "Operations", "Resources", "Publications", "ES&H", "Staff", "Users' Place", and "Apply for Access".



A user facility for advanced accelerator research

The Accelerator Test Facility (ATF) is a proposal driven, [Program Advisory Committee](#) reviewed facility that provides users with high-brightness electron- and laser-beams. The ATF pioneered the concept of a user facility studying properties of modern accelerators and new techniques of particle acceleration over 25 years ago. It remains a valuable resource to the user community. ATF serves the U.S. Dept. of Energy [Accelerator Stewardship](#) program.

[Contact Us](#)

Electron/Laser Facility

High-brightness, 80 MeV, sub-picosecond, 3 kA electron bunches are being delivered to the experimental hall where user experiments are parked in three beam lines.

CO₂ Laser

ATF's one-terawatt, picosecond, IR (10 μ m) [carbon dioxide laser](#) is unique in the world. With it, the ATF users explore long-wavelength scaling of various

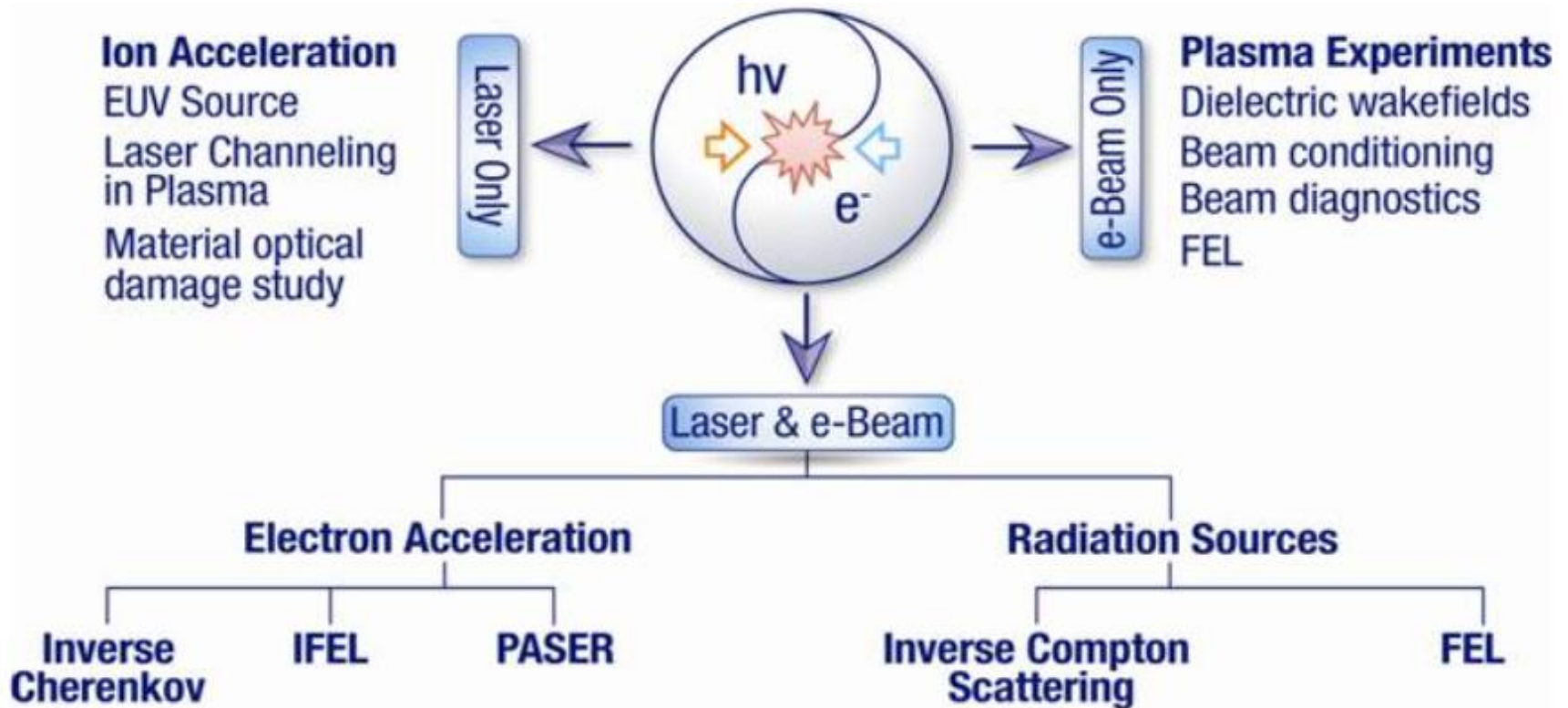
News & Announcements

- ▶ [20th ATF Users' Meeting- December 5 - 7, 2017](#)



ATF – Overview

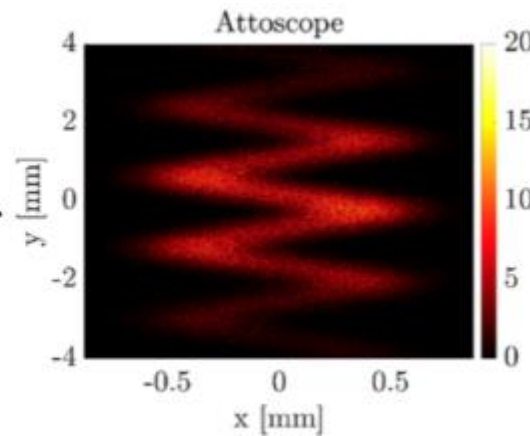
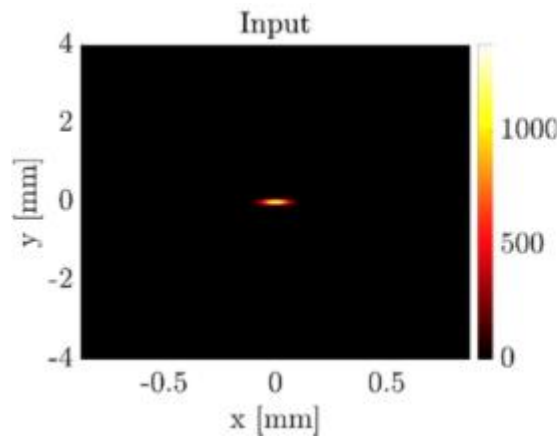
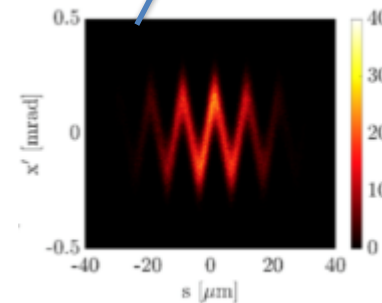
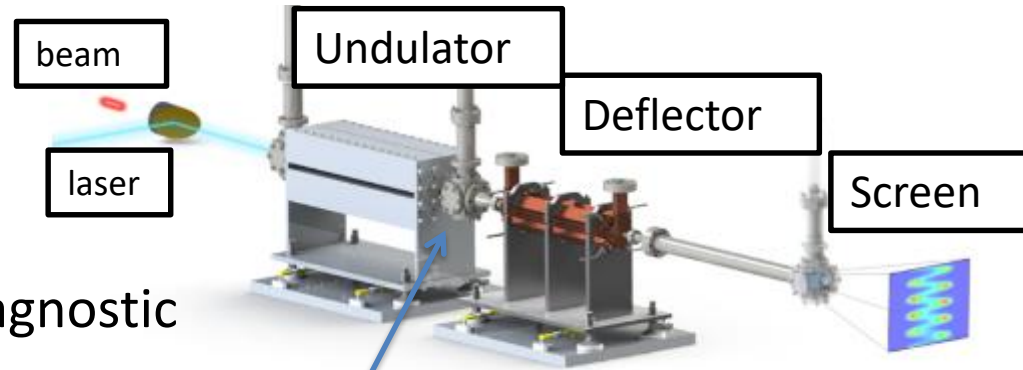
- Proposal-driven user facility, enables R&D into the physics of beams
- Unique experimental capabilities:
 - high-brightness e gun, 85 MeV Linac
 - high-power lasers, beam-synchronized at the ps level
 - high-brightness X ray source



Use case: sub-fs diagnostic at ATF

Slide courtesy of
G. Andonian & N. Sudar

- High-resolution bunch length diagnostic
 - Laser modulator (TEM10 mode)
 - RF deflecting cavity
 - Potential for sub-fs resolution
- Experiment at BNL ATF
- Images with Sirepo/elegant



Distribution after deflector

Class discussion:

- Any questions at this point?
- The rest of this lecture is a Sirepo/elegant simulation
 - we'll consider the full “Attoscope” beamline
 - **courtesy of G. Andonian (UCLA, RadiaBeam Technologies) and N. Sudar (UCLA)**
 - multiple beamline definitions
 - use of diagnostics
 - export / import of simulations via zip files
- Begin the demo...

