



## USPAS – *Simulation of Beam and Plasma Systems*

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Lecture: **Use case: sub-fs diagnostic**

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

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

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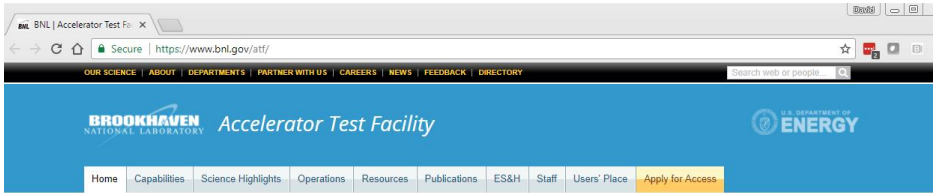
### Goals


- 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>





**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.

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### Electron/Laser Facility

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

### CO<sub>2</sub> Laser

ATF's one-terawatt, picosecond, IR (10 μm) carbon dioxide laser is unique in the world. With it, the ATF users explore ion-wavelength scaling of various

### News & Announcements

▶ 20th ATF Users' Meeting, December 5-7, 2017

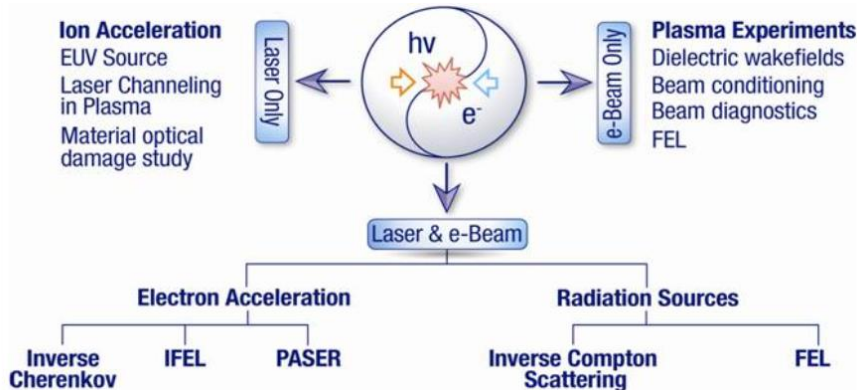


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## ATF – Overview

- 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

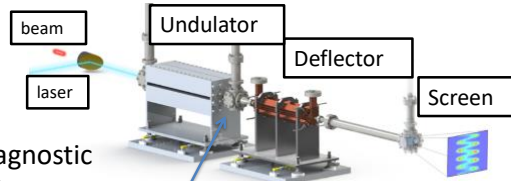


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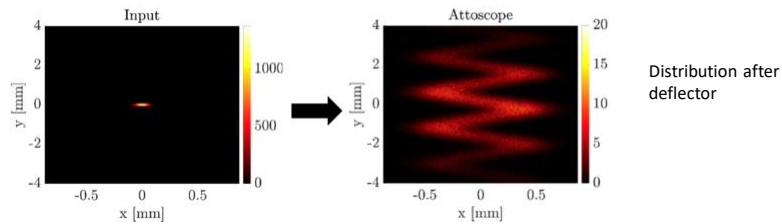
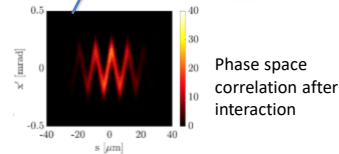
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# Use case: sub-fs diagnostic at ATF

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



## 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...