The ATF Operations Performance and Upgrade

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Acknowledgement

The success of the ATF made it possible due to:

- Support from Advanced Technology Program of DOE High Energy Physics.
- Support from BNL director's office and NSLS.
- ATF users and collaborators.
- Dedicated ATF staff.

ATF operations

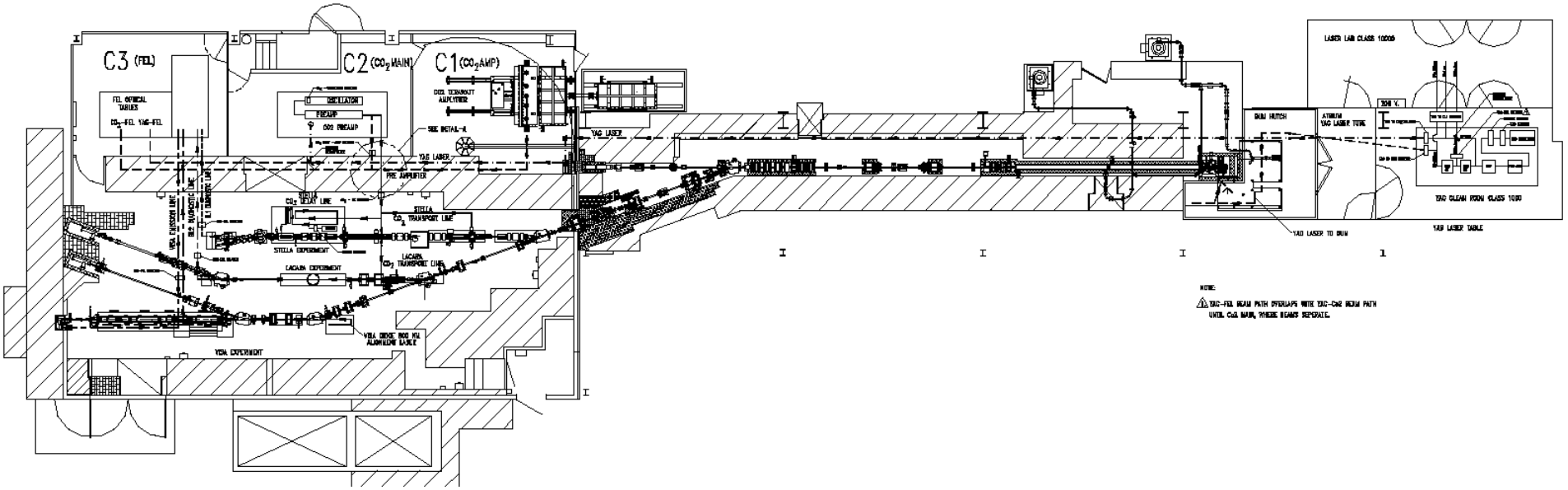
Since the last ATF user meeting, we provided about 2000 hours beam time for:

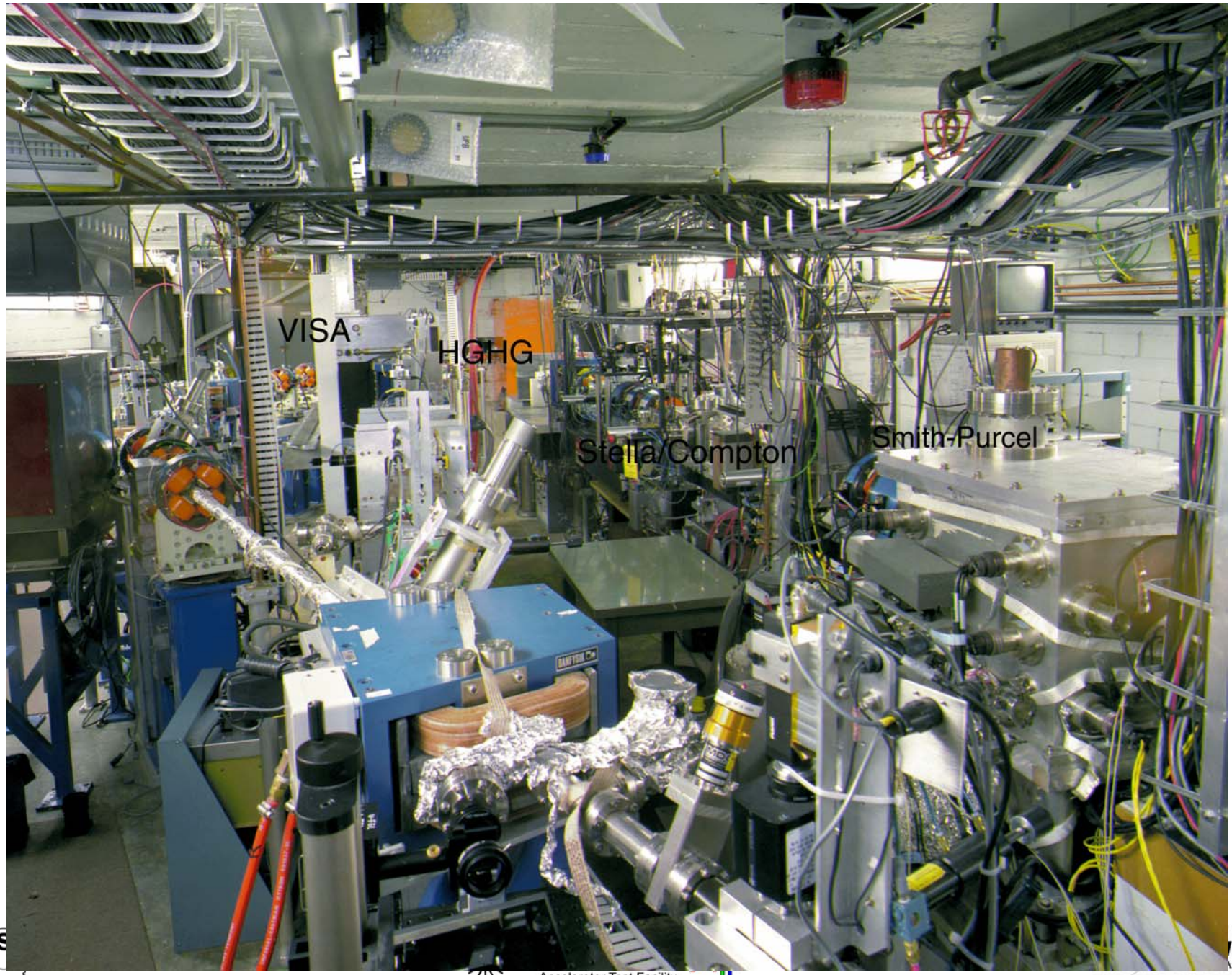
- 9 experiments – Smith-Purcell, Compton, Stella II, Dielectric Wake field, HGHG, VISA, MINOS, Optical detector, linear collider BPM.
- Two PhD thesis -
- Three experiments finished – HGHG, VISA and MINOS.

ATF experiments continue to produce good physics:

1. Stellar experiment.
2. Only facility has both laser seeded and SASE FEL saturated, shortest gain length and the highest gain.
3. Record X-ray yield from Compton Experiment.
4. First observation of coupling between the longitudinal distribution and transverse detection in cavity BPM.
5. And many more …

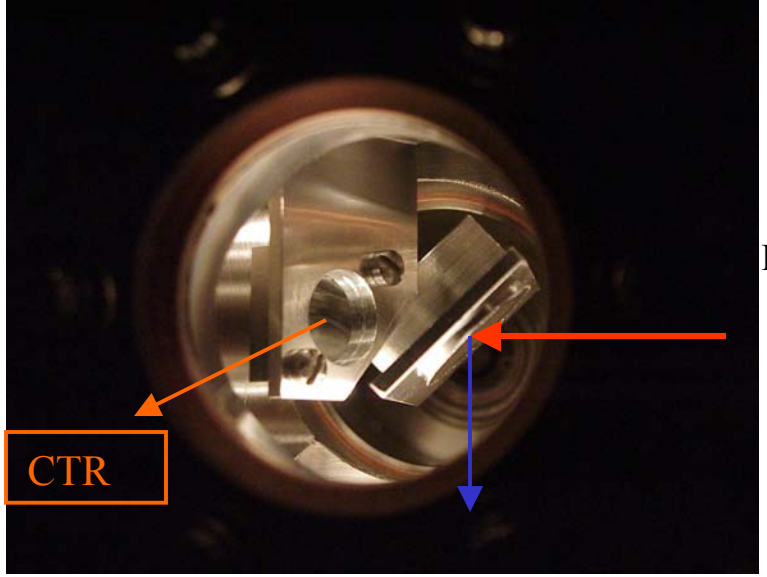
Accelerator Test Facility Layout

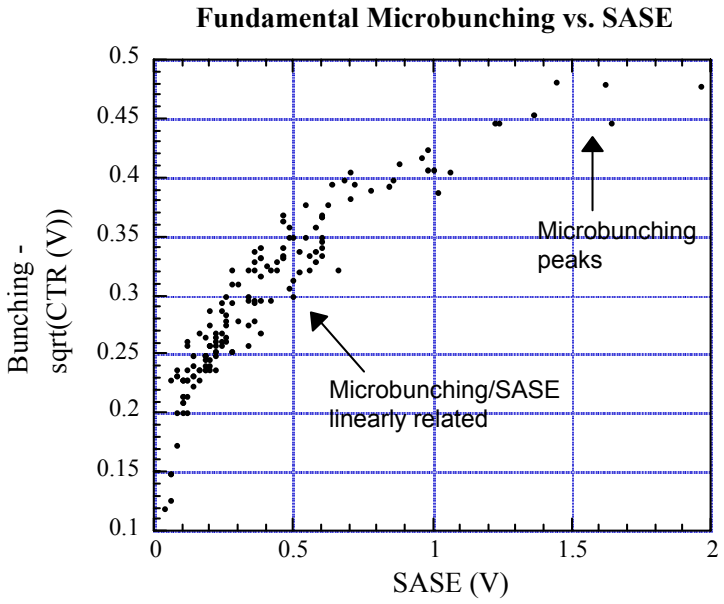


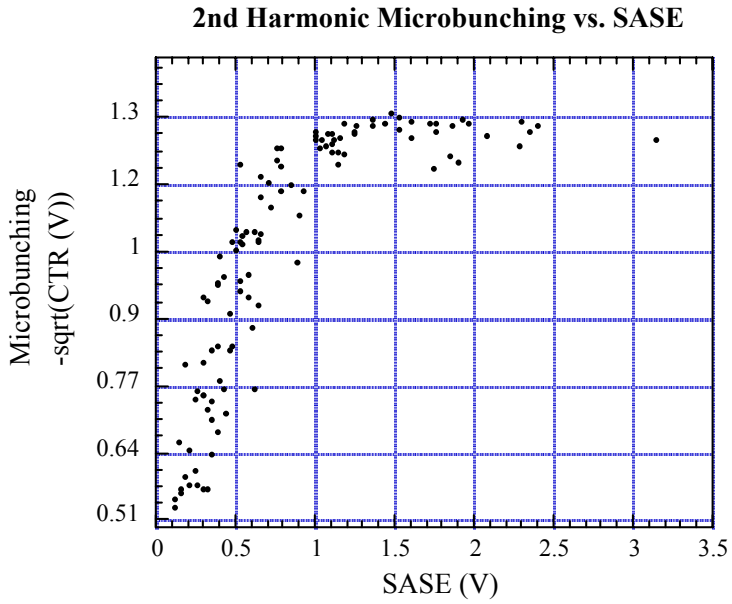

VISA
HGHG
Stella/Compton
Smith-Purcel

VISA

Micro-bunching measurements







ATF operations

ATF had added new capabilities and carried out exploratory R&D:

1. *TW CO_2 Amplifier starts to serve users.*
2. *Permanent magnets for small beam production.*
3. *New electron beam spectrometer.*
4. *New linac water system.*
5. *New magnet power supply.*
6. *New Leak detector and IR camera.*
7. *High-brightness electron beam R&D.*
8. *Vacuum acceleration and surface roughness studies.*

Performance

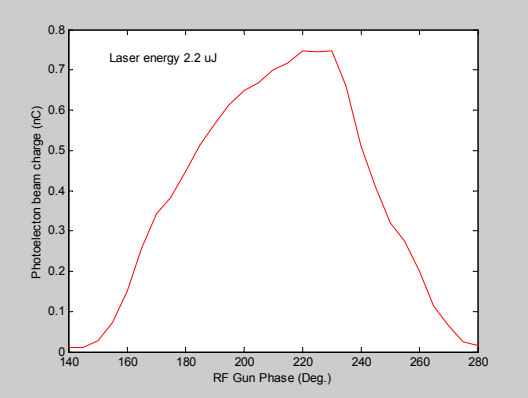
- **Photocathode RF gun – the brightest photoelectron sources in the world.**

  1. Bunch charge from 1 pC to nC, bunch length from 1 ps to 10 ps (FWHM).

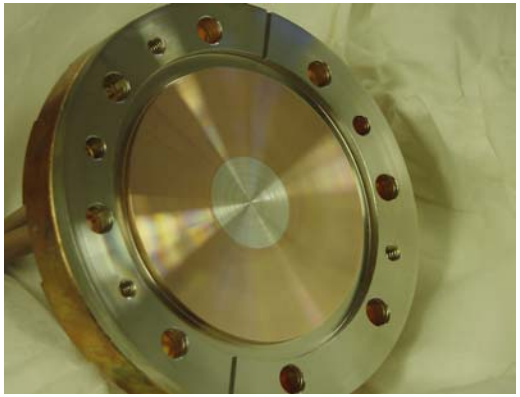
  2. Emittance as small as 0.8 mm-mrad for a 100 A peak current, routinely delivery < 2mm-mrad.

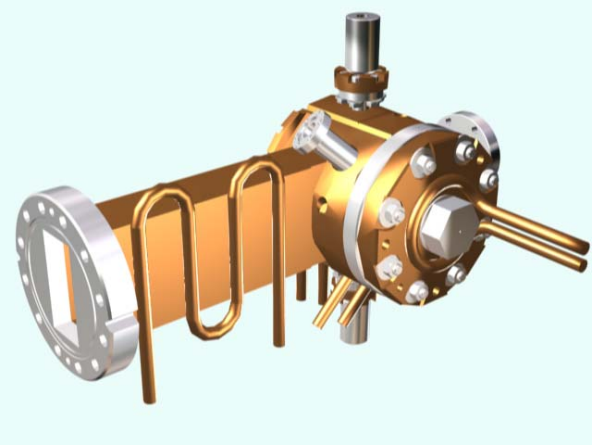
- **ATF laser systems – Yag laser provides the most stable beam for photocathode RF gun, CO2 starts showing its potential.**

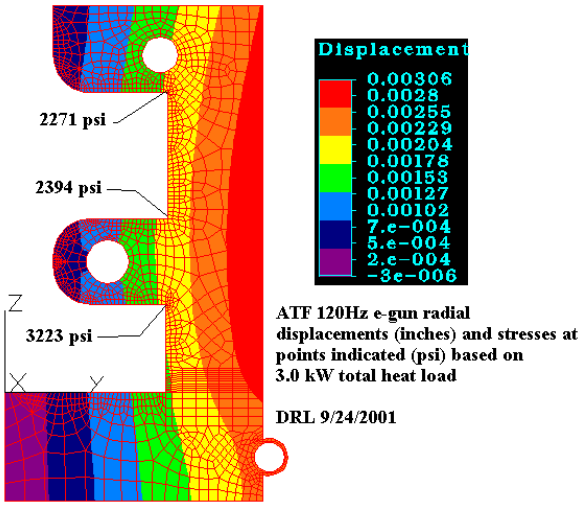
Performance –High Brightness Electron Beam R&D



Mg cathode and vacuum laser cleaning works great.

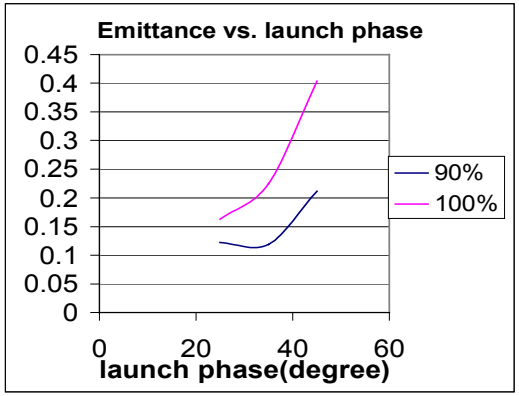


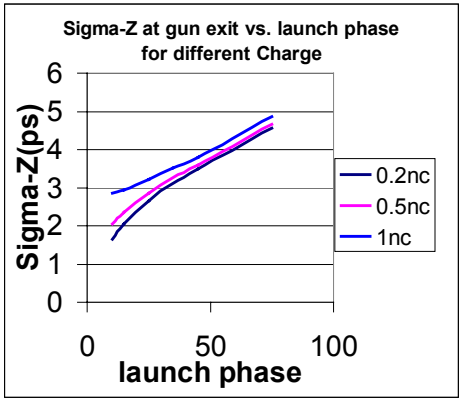




ATF 120Hz e-gun radial displacements (inches) and stresses at points indicated (psi) based on 3.0 kW total heat load

DRL 9/24/2001





Performance - YAG Laser System

- Photocathode and CO_2 slicing fully available on-demand.

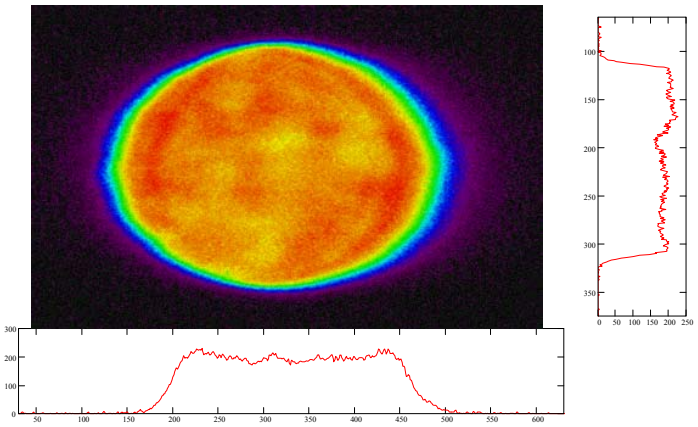
- Electron beam-synchronized optical pulses available for users:

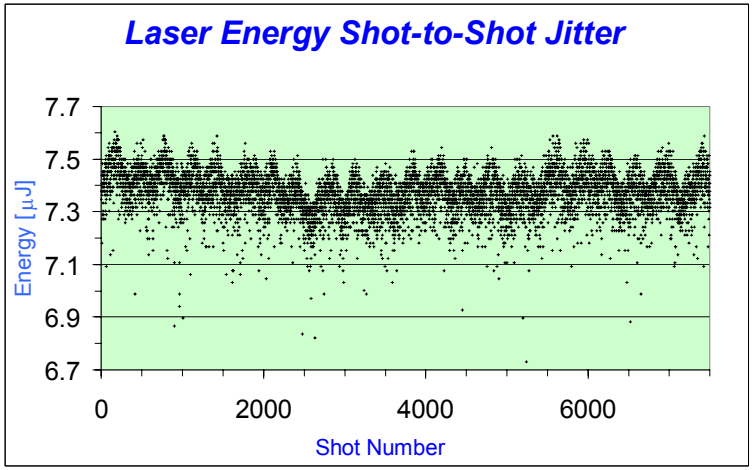
  5 mJ, 14 ps @ 1064 nm in laser lab (exclusive of slicing)
  50 mJ, 10 ps @ 532 nm in laser lab or FEL room (not yet implemented)
  50 mJ, 8 ps @ 266 nm in gun hutch and laser lab

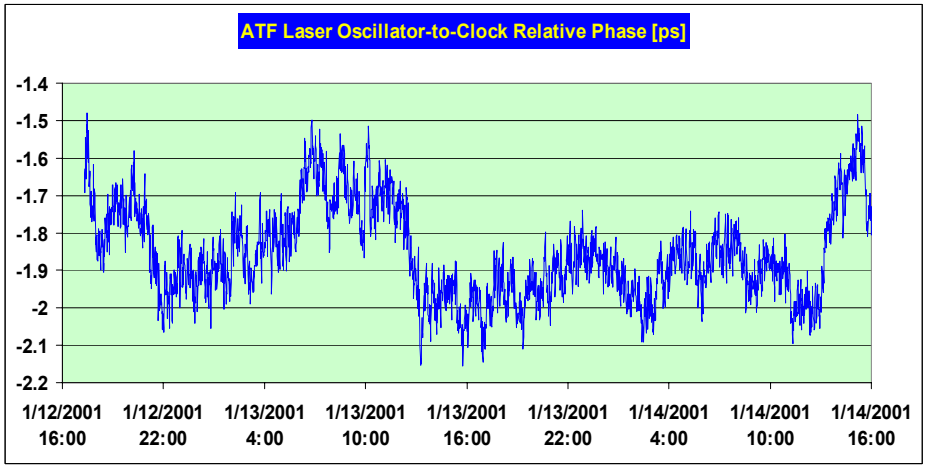
- Delivered light on 245 days since last user's meeting (June 1, 2000) Average ~10 hours/day.

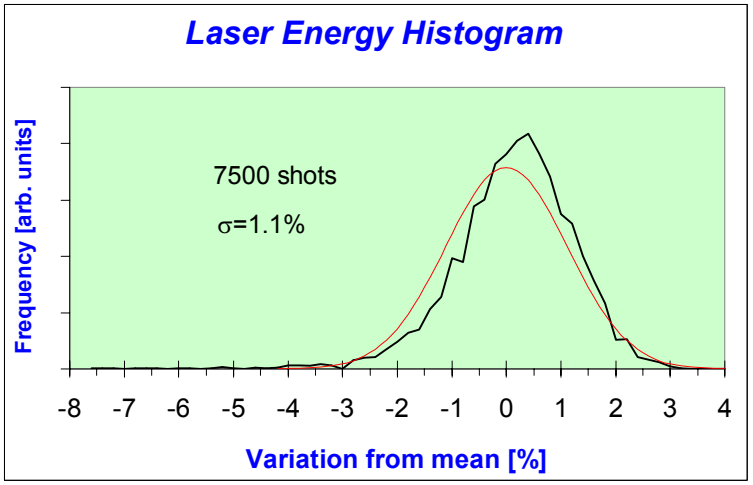
Turn-on time usually 15 minutes, including daily performance characterization. Gun operations typically underway by 9:30 AM.

Performance - YAG Laser System





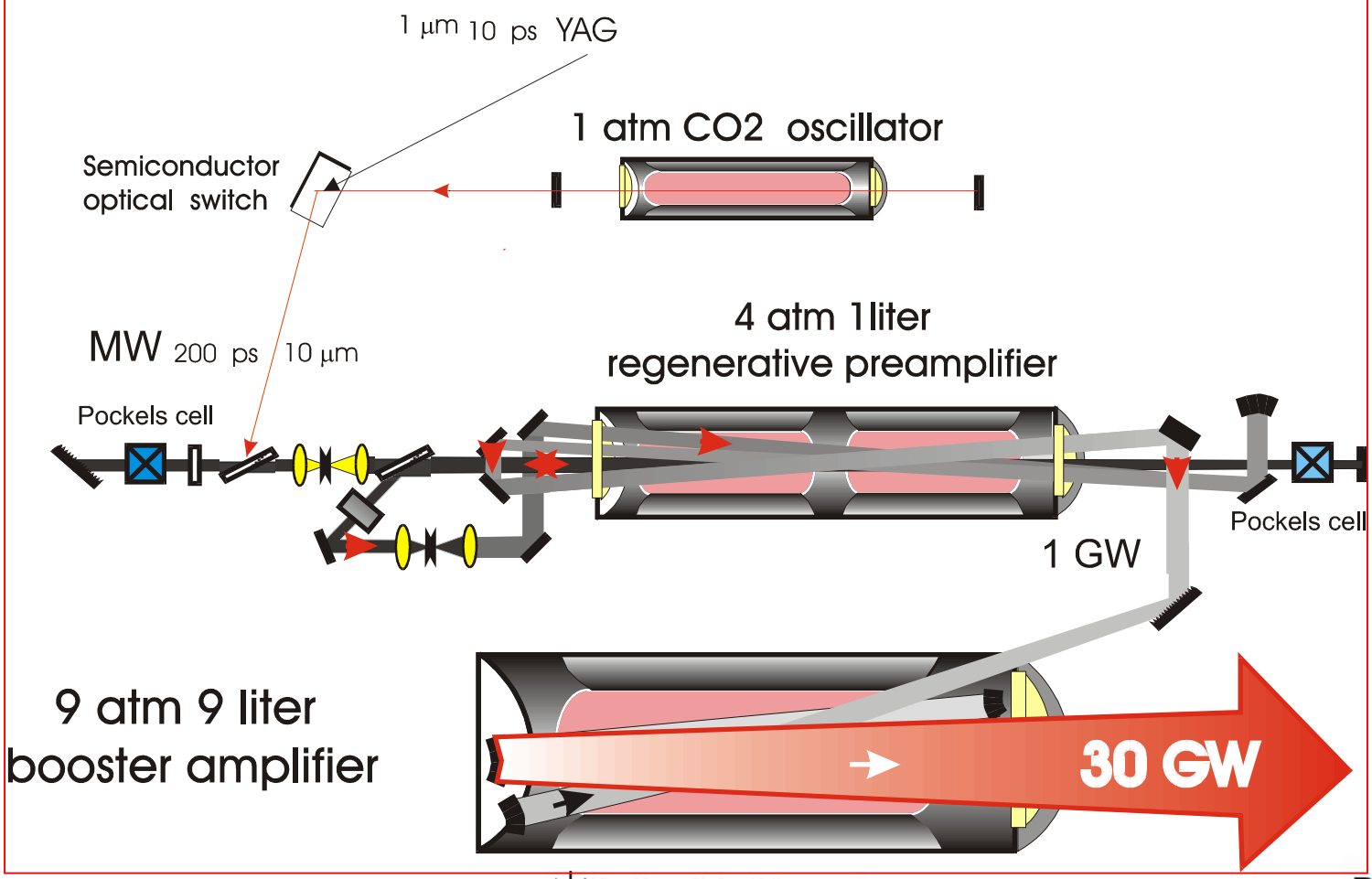




Performance - CO_2 Laser System

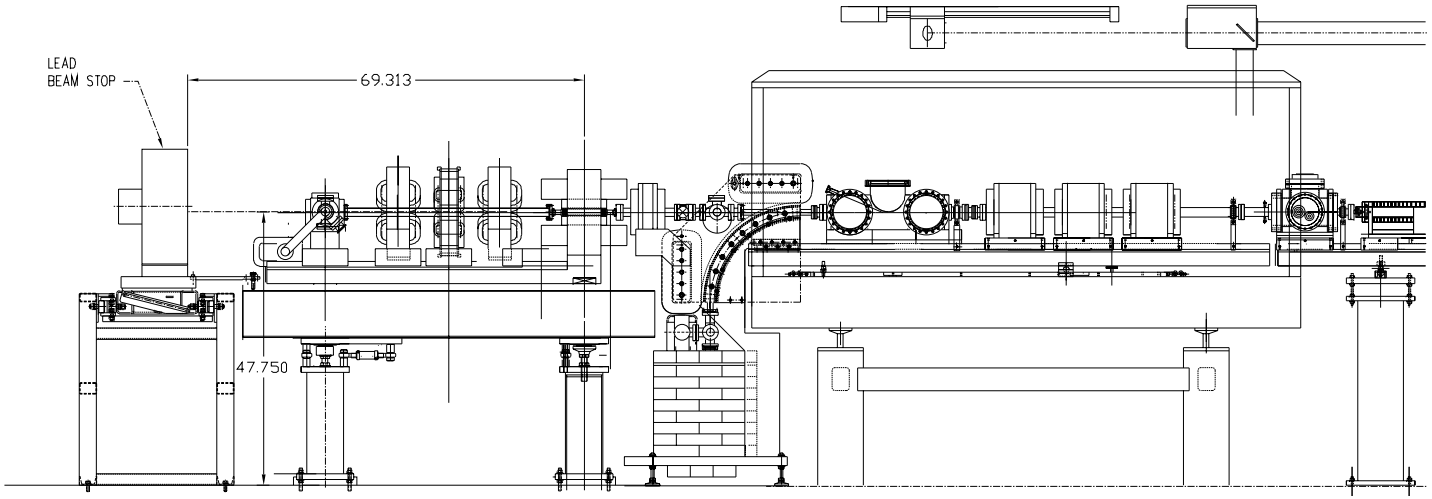
Presently operational ATF CO2 Laser System

provides 30 GW @ 200 ps



Performance - Spectrometer

- New spectrometer has classical $\pi/_2$ or 90 degrees design.
- It provides tight focus and large dispersion.
- The energy resolution is going to be of the order of 10^{-4} and will be limited by energy spread in the beam.



Upgrade

Short and medium term:

1. Shorten the ATF CO_2 laser pulse length and increase its power toward TW level.
2. Finish ATF computer system upgrade.
3. Install ATF new H-line and bunch compressor.
4. Install new ATF low level RF system.
5. New software tools for users.
6. Deformable mirror for photocathode RF gun laser optics.

Long term:

1. ATF linac system upgrade to 120 MeV.
2. New ATF beam lines and experimental hall.
3. Solid state modulator and 1 kW amplifier.
4. New solid state laser system for photocathode RF gun.
5. TW femto-seconds solid state laser.
6. Beam based feed back and control system system – test bed for remote accelerator operation.

Upgrade -ATF CO_2 Laser System

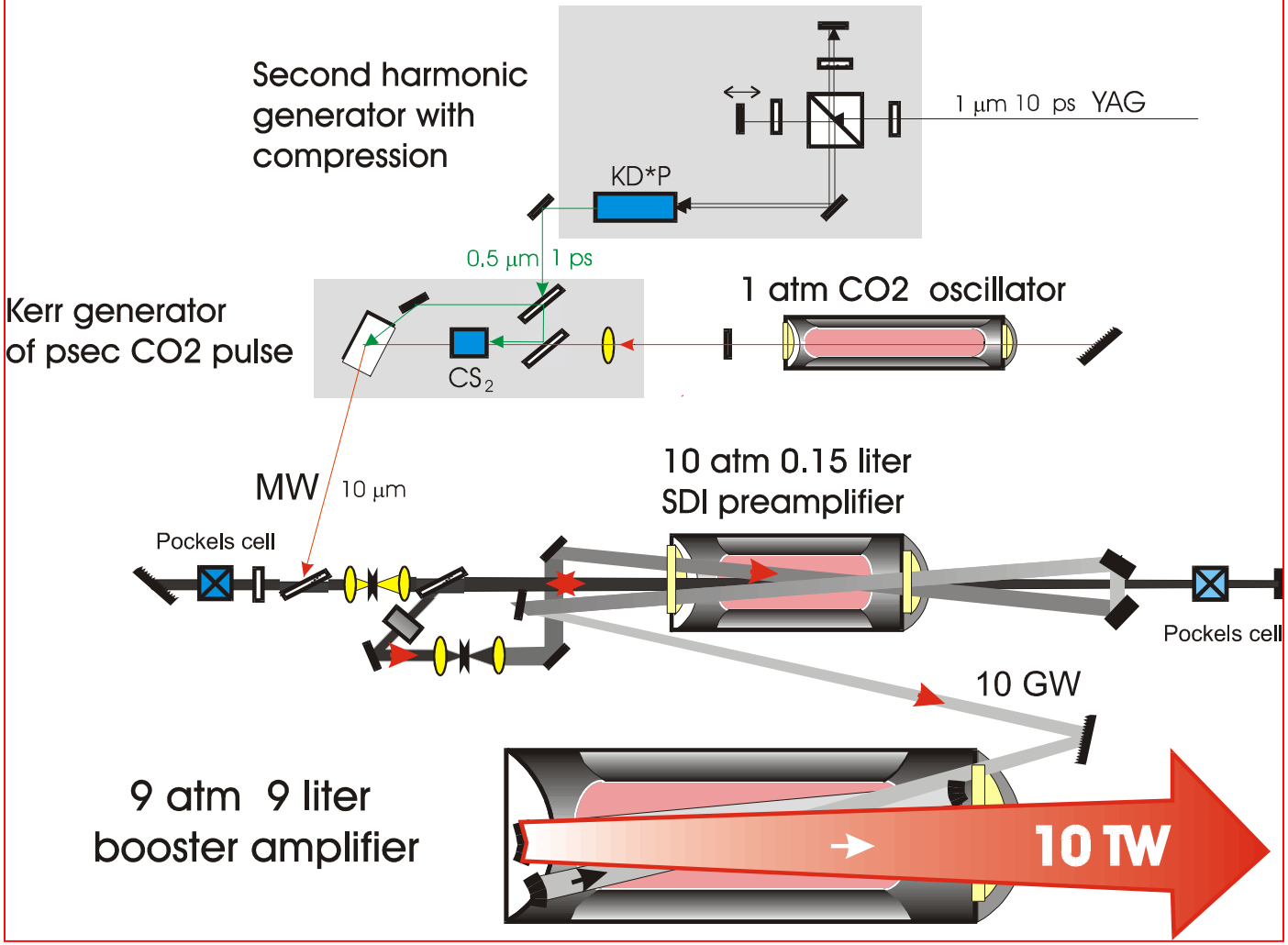
A Panel was assembled on Sept. 10 and 11, 2001 to review and advise the ATF on the CO Laser system upgrade plan:

1. Considering other CO_2 pulse shortening technique.
2. New high pressure pre-amplifier.
3. Improve the oscillator performance.
4. Optimize the Amplifier performance.

TW CO_2 Laser system is expected to be operation by late 2002

PITER-I to be completed in Fall 2002

provides 10 TW capability @ 10 μm



Upgrade -ATF Computer Control System

Major effort over the last year to upgrade the control system

New hardware purchased and installed:

- **Host computer**
- **Mass storage expansion**
- **Ethernet-based CAMAC crate controllers**
- **Private Ethernet for ATF control & data acquisition**
- **For future use: Private fiber optic cables to all areas of ATF**
- **Hardware firewall to protect ATF subsystems**

New software purchased and installed:

- **Linux OS**
- **Driver libraries for Ethernet crate controllers**
- **Vsystem for Linux**
- **Portland Group compilers**

Upgrade - ATF Computer Control System

Porting ATF software:

- **All graphic operator displays have been converted for Linux**
- **All supporting databases have been converted for Linux**
- **All intermediate-level CAMAC libraries ported to Linux**
- **In progress: porting of ATF server applications**

Users can expect:

- **Same services as now (operator displays, network access, etc.)**
- **Improved throughput**
- **Better system reliability (easier to troubleshoot & maintain)**
- **New software tools**
- **Eventual support for new hardware families**

New control system will be in operation in the fall of 2002.

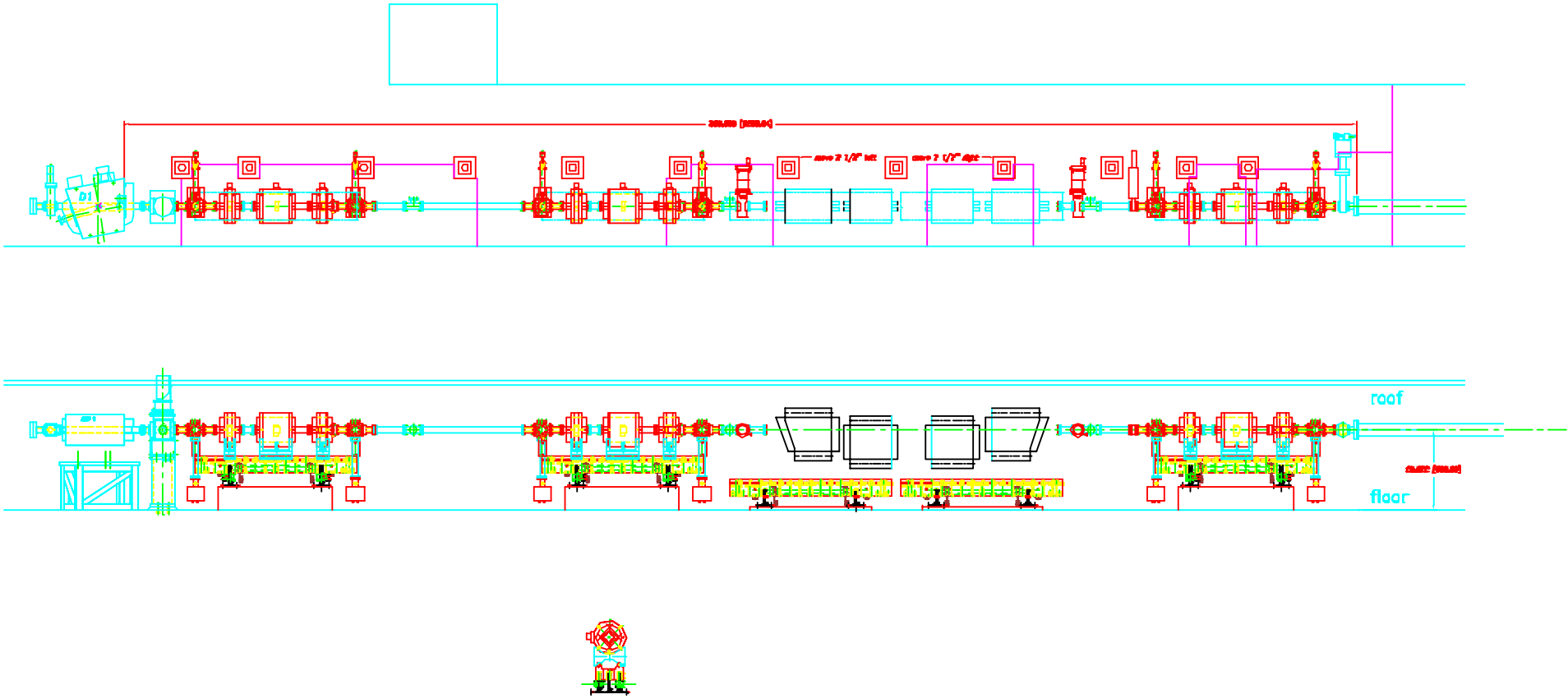
Upgrade – ATF H-line

Install new quadrupole magnets support and alignment systems, better beam diagnostics and new chicane magnet bunch compressor:

1. Beam based alignment system to better and easier preserve the high brightness electron beam.
2. Give ATF more capabilities in short bunch production and diagnostics.

ATF H-line Upgrade will be implemented in the summer 2002.

Upgrade – ATF H-line



Summary

ATF and its experimental program have delivered first class results in beam physics. We have a plan to continue its success. To realize those future successes, your support and advise are the key.

Thank you.