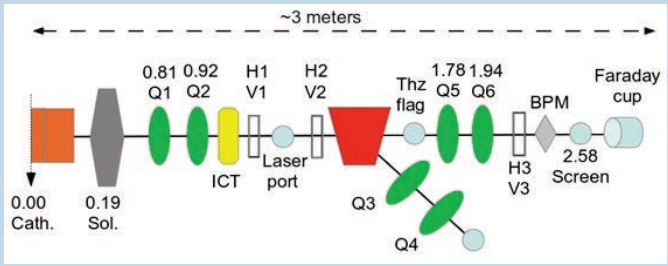
Injector Test Stand

The injector test stand (ITS) has:

- An S-band radio-frequency (rf) electron gun with up to 15-MW available rf power
- Two UV laser systems producing picosecond and nanosecond UV pulses
- Electron beamline components and diagnostics

The ITS enclosure is roughly 6-m long and 3-m wide. The beamlines fit on a 4 x 10-ft optical table, with the exception that the rf gun is supported by a separate but adjacent stand. The maximum weight the optical table can support is approximately 4000 lbs.



Schematic layout of the ITS beamlines showing a 1.5-cell rf gun and its solenoid quadrupoles (Q) and steering magnets (H/V) installed for beam focusing and trajectory control. The beam diagnostics suite includes an ICT, a beam position monitor, a screen, a spectrometer, and a Faraday cup.

An extensive rf waveguide suite is built into the ITS to power different guns with up to 15-MW total power, including:

- Single rf input for the Advanced Photon Source (APS) operational thermionic cathode gun
- Single rf input at a different location for the high-brightness Linac Coherent Light Source (LCLS)-type photocathode
- Triple rf inputs for the three cells of the ballistic bunch compression gun

While the waveguide pieces exist for all three configurations, only one configuration is used at a time.

The electron beam generated by the APS operational thermionic cathode rf gun has an energy of 3 MeV and an average current up to 400 mA (without stressing the cathode). When equipped with a dispenser cathode, the ballistic bunch compression gun has produced up to 3-nC bunch when driven by the nanosecond-UV laser, and the measured normalized emittance is ~7 µm at 6 MeV. The expected nominal beam from the copper photo-cathode LCLS-type rf gun driven by the picosecond-UV laser has a bunch charge of 20~1000 pC and beam energy of 6 MeV with sub-µm normalized transverse emittances.

The nanosecond laser is a Nd:YAG Continuum MINILITE II system. The oscillator, amplifier, and frequency conversion systems are all integrated into one laser head. The UV output wavelength is 266 nm, pulse energy is 4 mJ, beam size is 3 mm, and divergence is 3 mrad.

The picosecond laser system consists of an oscillator and an amplifier:

Oscillator—Time Bandwidth Products, GLX-200
- Wavelength: 1054 ns
- Pulse width: 200 fs, rms
- Power: 200 mW
- Rep. rate: 119 MHz, passively mode locked
- Spatial mode: TEM00

Regenerative amplifier (Regen)—Positive Light
- Wavelength: 1054 nm, 527 nm, 263 nm
- Pulse width: 1.5 ps, rms (IR, similar at 527 nm and 263 nm)
- Power: IR—20 mW (2 mJ at 10 Hz), UV—2 mW (0.25 mJ at 10 Hz)
- Rep. rate: 10 Hz, (30-Hz burst, 10-Hz average)

Examples of use:

1. High-rf-power testing of the thermionic cathode guns for APS light source operations
2. Test of a three-cell (each with its own rf input) ballistic bunch compression rf gun
3. Commissioning of a LCLS-type high-brightness photo-cathode gun with initial beam measurements
5. Dispenser cathode QE and lifetime measurements in a rf gun
6. Laser-gated thermionic cathode emission
7. THz radiation
8. Novel beam diagnostics testing