Accelerator R&D and Test Facilities at Fermilab

The accelerator R&D and test facilities found at Fermilab are world-class and cover a broad-range of capabilities to support future accelerator-based initiatives. Beam-capable facilities as well as component testing areas for both room temperature and superconducting devices exist. Many of the areas have already proven their capabilities while others are in various stages of becoming operational. All are staffed by highly motivated teams of people with proven expertise.

Facility	Purpose	Beam-type	Energy	Uniqueness	Status
ASTA	SRF, high intensity beam R&D	e^-	50 MeV and 300 MeV	High repetition rate, high peak & average bright-ness beam	Commissioning, ~20 MeV electrons expected in CY 2014
IOTA	R&D towards multi-MW beams	e^-/p	2.5 MeV (p) 150 MeV (e^-)	Ring suited for integrable optics and SC-compen-sation expt's	Under construction, operational estimated in 2017
PXIE	PIP-II	p	30 MeV	High-*I* CW, SRF, chopped beams	Ion source operational
CMTS-1	SRF cryomodule testing	n/a	n/a	CW and pulsed RF at various frequencies	Under construction, operational FY2016
VTS	SRF	n/a	n/a	325/650/1300 MHz bare cavities	2/3 stands operational
MDB	SRF	n/a	n/a	325/650/1300/ 3900 MHz dressed cavities and couplers	3/4 areas operational
SC magnet	High-field magnets	n/a	n/a	1.9K-4.5K, 30kA ∅0.6m x 3.7m	Operational
HBESL	e^- source R&D, stewardship, education	e^-	≤5 MeV	Electron source coupled with multiple laser systems, emittance exchange	Operational
MI-8 targetry	High Power Targetry	n/a	n/a	200 kA pulsed PS for horn testing, CNC TIG welder	Operational
MTA	Muon source R&D	p/H-	400 MeV	Combination of beam, RF, SC magnet, cryo	Operational

Brief Description of each area

NML – Integrable Optics Test Accelerator (IOTA) & the Advanced Superconducting Test Accelerator (ASTA)

IOTA is a 40 m circumference storage ring intended to operate with 2.5MeV protons and 150 MeV electrons to prove new methods to control space charge dominated beams via either integrable optics or space-charge compensation.

ASTA consists of an injector with a photoinjector gun, UV laser to illuminate the electron-producing Cs_2Te cathode, two SRF booster cavities, beam line with space for experimental set-ups. Beyond the injector section is an 8-cavity TESLA/ILC-style cryomodule which operates at 2K and has achieved the highest gradients of any in the world to date (>30 MV/m per cavity). Space exists for two or more additional cryomodules. ASTA terminates in beam lines which deliver electrons to IOTA or/and can be configured for various AARD.

CryoModule Test Facility/PXIE

Adjacent to NML, CMTF houses two SRF test areas and a 500 Watt, 2 Kelvin cryogenics plant. PIP-II front end R&D is ongoing at PXIE. SRF Cryomodules will be tested (no beam) for LCLS-II and PIP-II in CMTS-1.

MuCool Test Area

MTA exists to develop and test components for muon ionization cooling making use of the 400 MeV H- beam from the Fermilab Linac. The enclosure includes a 5-Tesla superconducting solenoid with a 44-cm bore and infrastructure for liquid and gaseous hydrogen. RF power is available at two frequencies (12 MW at 805 MHz, 4 MW at 201 MHz). MTA is the only facility in the world with the combination of high-power RF, large magnetic field and high-intensity H-/p beam. Both vacuum and high-pressure hydrogen-filled cavities are being studied and the present configuration includes a single-cavity test system housing the first MICE cavity.

High Brightness Electron Source Laboratory

HBESL is supported by NIU and the NICAAD consortium. Its major components are an RF Photoinjector, transport beamline with extensive diagnostics and a laser laboratory. It is used for the development of novel electron sources and training of students in accelerator technologies and beam diagnostics. It has also been utilized by several university and industrial collaborators.

Industrial Buildings – Magnet Test Facility (MTF), Vertical Test Stands (VTS)

Superconducting component test facilities which support a wide variety of project-related tests and QA activities, as well as R&D activities supported by projects as well as by GARD program, e.g., such as R&D towards cost-effective SRF accelerators and core high-field magnet program. Superconducting magnets, RF cavities, and solenoids have dedicated test areas.

MI-8

Several areas for the development and test of High Power Targetry components (targets, magnetic horns, instrumentation, beam windows, etc.) are housed at MI-8. The work here is currently supported mostly by HEP experiments/projects including NuMI/NOvA and MiniBooNE.

MDB

The MDB SRF test areas provide facilities for testing dressed cavities and input couplers before assembly into a cryomodule. Three facilities are operational: Horizontal Test Stand (HTS, 1300 and 3900 MHz), Spoke Test Cryostat (STC, 325 MHz) and Coupler Test Stand (CTS, 325 and 650 MHz). A fourth test stand, HTS2, will test 650 MHz cavities and is under design in India.