Source Group Status

11/11/19 (Poelker)

**CEBAF-related**

CEBAF (today):

Shutdown work: the modified mushroom electrode was installed, the krypton line was improved, but the electrode suffered significant field emission. Krypton processing in a NEG coated chamber….is that the issue? There are other possible explanations - dust, turbulent venting, NEGs in the feed and exhaust lines, sharp points on ground screen, contaminated polishing media, etc., - hopefully tests at UITF and CEBAF will shed light.

The modified mushroom electrode was removed from gun last week and the original stainless steel tee-shaped electrode was re-installed – this electrode had been HV processed with krypton at UITF to ~ 230 kV and showed no FE at 200 kV under vacuum conditions. So the stainless steel tee-shaped electrode could be our “final” CEBAF 200 kV gun.

* Finish bake of gun and condition under vacuum, to reach 130 kV without field emission, then run the program.
* Move photocathodes from suitcase to prep chamber. Heat and activate a photocathode
* Work with UVa to align the RTP cells, Caryn Palatchi owns this job, appears to be going well. Shukui and Joe assisting. Align the photocathode to achieve desired HC asymmetries.
* Repair the little SF6 tank with conditioning resistor, so we avoid pumping out the HV tank. Configure the big SF6 tank as required, resistor/no resistor.
* Fix the SF6 rough pumps, fix DILO, get new DILO
* Change out the fiber optic connections to increase power delivered to the amps

Preparing for CEBAF 2020:

* Gabriel Palacios modeled the Wien filter and modified the UITF Wien filter, now testing at plate voltage up to +/-20 kV, required for 90 degree rotation of 200 keV beam, with full magnet current
* Danny working to get Wien magnets made, in house or local company Dave Kashy found.
* Working with Danny Machie to implement the new solenoid magnets that Jay recommends for improved parity quality. PR to follow soon.
* Working with Kazimi and injector group on the beamline region between the chopper and the QCM
* Need to finalize the baked beamline layout of the re-configured Two Wien Spin Flipper. Danny has a good first-pass layout but need girders, etc.,
* Need to model the new injector layout with a particle tracking code. Are the bpms in the right place, to permit accurate Helicity Correlated position asymmetry measurements?
* Need to list all the jobs related to removing old ¼CM and installing the new booster: including removing ARC magnets, beampipe and stands, removing u-tubes and restabbing them, installing new girders

**UITF:** commission the waist-height beam line November, 2019, ERR for HDIce, beam through empty target by…..and then 4 more runs before May 2020.

To-do tasks include:

* Move from Construction to Commissioning to Operations
* Pre-ops checklist, Beam Authorization tool, Operational Restrictions web page, HCO tool, UED complete, MPS with three zones, Commissioning Plan
* Dress ion pump cables, cut to length?
* Yao bunchlength electronics
* ~~SSA local on/off~~ use 180 W amp
* Buncher on resonance at ~ 100 W rf drive power, need to heat the buncher….
* Characterize the buncher (Yan)
* Test the Brock polarimeter, does the valve to spectrometer leak?
* Set pockels cell voltages with DAC, ask Keith for help
* Build a chamber to install new photocathodes, pseudo-suitcase
* Build and operate a little SF6 tank with conditioning resistor, so we avoid pumping out the HV tank
* ~~Some permanent means to leave the roof from the north side~~
* Float beam through QCM, calibrate the BCM (beam small enough for this?)
* UED, validate it, BLMs added to UED with correct names
* Steering magnets for HDIce line, 3” pipe or switch to 2.5” pipe and use haimsons. Have the machine shop make us steering magnets, or local company
* Another PSS rack for the PSS BCM stuff (add channel to elevate the rack)
* ~~MPS: implement the zoned approach, need the “good” valve chassis~~
* ~~Valve chassis for MeV beamline, the global solution that permits three zones for MPS~~
* Harps, do they work?
* MeV elevated beamline BPMs
* MeV viewers and video signals
* Water flow through dumps and cups
* Raster magnets and electronics, functional
* pA BPMs, in-line fiber modulator
* Need a signal generator for this, with line to modulator and line to the rack of lockin-amplifiers as reference
* How will we use the lockin amplifier signal to trip OFF beam!
* Go-No Go detector for HDIce, near apertures, add these as fsd nodes, ion chamber? We can use Decarad but won’t be formal FSD (no 5 MHz signal)
* Need fiber cables run to HDIce for polarization helicity info
* Summarize MPS/FSDs, install them, test them
  + Gun high voltage
  + Dipole magnet at 15 degree bend
  + Vertical chicane dipole (or is this PSS?)
  + Go-No Go sensor near HDIce, at one or both apertures
  + HDIce apertures
  + HDIce dump solenoid
  + Vacuum interlock to valves
  + Vacuum interlock to chopper rf power, buncher power?
  + BLMs, need to put them on beamline
  + QCM liquid level
  + Water flow to buncher, chopper cavities
* Modifications to PSS?
  + How does SSG want to interlock the vertical chicane dipole to PSS? What will it do?
  + Rack for PSS BCM electronics
* Clean up the caves and roof top, buy a vacuum cleaner
* Labels applied to everything?
* Add lead to the dumps, waiting for the iron boxes

HDIce task list

* Fibers for helicity info to HDIce
* Install the fiber modulator, 1 MHz, with BNC cable or fiber cable to the rack of lockin amplifiers
* Build the apertures, with motorized bellows actuators like the chopper master slit, use Decarad to detect beam loss
* Add ion pump with pump out port to the beamline between last valve and HDIce
* pA BPMs, modulate current at kHz frequency with tune mode generator,
* Solenoid plus dump, vacuum through IBC to dump
* ERR November 19

**GTS:** Transition from photogun studies to thermionic gun studies. Install the rf-pulsed thermionic gun being constructed by sbir-partner Xelera, make magnetized beam with it, finish Mark’s thesis work.

* RF-pulsed thermionic gun: Mark’s thesis. Make 65 mA magnetized beam with 500 MHz rf-structure. Measure drift emittance, and temporal characteristics.
* Brock and company return, study TE011 cavity response to magnetized beam from tgun
* Josh to look for light coming from hydrogen ion trap created by gun solenoid, biased anode, and beamline solenoid
* Sajini, model what the gun and beamline and laser pulse should look like for nC tests part2: new electrodes? Optimum laser pulse length, can we create nsec long laser pulses? Gun voltage 400kV, can we get there?
* Rework our GTS lasers: Verdi + gain-switched fiber system moved to little table next to beamline (incorporate into PSS), big BNL laser moved to hutch, some other laser?
* Start building HV test stand for big inverted insulator (dummy ball). Design a shed, weld onto ball. Modify receptacle, design SF6 port and mating connection for receptacle into insulator. Electrostatic model the test stand? Yes, probably a good idea
* Re-plumb to SF6 plumbing to move SF6 into the bag inside the vault, get rid of the bag outside the vault
* Finish the papers that summarize LDRD project: ~~300kV gun~~, photocathode studies, 532 nm gain-switched diode laser and amp, magnetized beam low bunch charge that includes 28mA run, magnetized beam at high bunch charge, TE011 magnetometer cavity

Photocathodes:

* Max Herbert: lifetime tests bulk GaAs activated with Lithium, activate the entire photocathode to eliminate the systematic error associated with laser radial position.
* Coax samples from YQ, evaluate them in miniMott
* Get an MBE machine? Make our own high polarization photocathodes
* Euclid test samples inside miniMott
* Alkali antimonide photocathodes: NaK2Sb and substrate studies
* Ellipsometry as means to tell photocathode thickness and roughness

Lasers and Optics:

* Work with Raytum and UVa to build low voltage pockels cells for CEBAF
* ~~Replace the modelocked master oscillator at LERF with gain-switched laser~~
* Improve CEBAF lasers, buy/build modelocked fiber laser to minimize bleedthrough?
* Install BNL laser inside GTS hutch
* Build the regenerative amplifier for nC bunch generation at GTS?
* Evaluate the laser that QPeak is building (532 nm, 780 nm, and 1064 nm)?

Vacuum:

* demonstrate -13 Torr vacuum!!! Marcy has great vacuum in cryopump test stand (low -12 Torr), now turn ON the cryopump (need the chiller fixed)
* Test black vacuum chambers with Xelera: outgassing and light absorption
* LIGO tests with 316 and 1020 tube, H2 outgassing, water pump down speed, induction heater

500 kV photogun for JLIEC, LERF and UITF

Black Photogun: A photogun with internal components coated with AlTiNi would appear black, which could improve lifetime by absorbing ambient light. And the coating could reduce vacuum outgassing, providing lower base pressure.

Build a true 500 kV dc high voltage photogun using the large inverted insulators purchased by the FEL years ago. Apply voltage to cathode using plastic R350 receptacle with intervening region filled with SF6. This gun could drive the LERF, with alkali-antimonide photocathodes.

**Papers**

Accepted

1. Carlos 300 kV gun PRAB
2. Shukui, Xincun, Jijun, et al., nanostructed photocathode, Phys Rev Applied

Submitted, waiting for word

1. Shukui, Xincun, Jijun, et al., nanostructured photocathode, Optics Express
2. Marcy, little cans, ultimate pressure: paper rejected. Revise and resubmit? Another journal, post to archive?

Drafts prepared or in preparation:

1. 5 MeV Mott, Charlie being obstinate, two versions, his and ours? Post to archive?
2. Yan photocathode paper, re-evaluating composition, refining message…
3. Green-light drive with gain switched master oscillator and fiber amplifiers: high power data from LERF work with components of Advanced Drive Laser?
4. Bubble Chamber

Data in hand, paper could be written today:

1. Magnetized beam at 28 mA
2. mA lifetime vs laser spot size, PSTP17 paper but wanting IBSimu simulations to help explain results
3. Polarization measurement at 1mA
4. 4 laser and 750 MHz separators, Reza has a good start from IPAC19
5. CEBAF injector for parity violation experiments

(some) Data in hand:

1. Magnetometer, some data in hand, need more
2. Ion trapping, light generation, ghost beam
3. CEBAF biased anode, lifetime enhancement

Still a long way to go:

1. Resonant polarimeter
2. Ion clearing gap, gas bremsstrahlung
3. LiCsF:GaAs lifetime study
4. UITF accelerator

“Side projects” we should continue to explore

1. Gas bremsstrahlung, clearing gap at CEBAF
2. Alkali-antimonide photocathodes and substrate dependence
3. NaK2Sb
4. Ion generation, clearing, ghost beam
5. Ionization of residual gas, by photobeam, and by ejected electron: ion tracking and bombardment
6. LIGO-related vacuum studies: materials including cheap steel, hydrogen OR, water pump down speed, coatings, induction heater
7. High voltage tests using a new chamber, with goal of reaching 500 kV with inverted insulator
8. AlTiN coated electrodes
9. LiCsF:GaAs lifetime using full active area photocathodes at UITF
10. Resonant polarimeter
11. Magnetometer
12. nC bunch charge
13. nanostructured photocathodes: lifetime, polarization and FE
14. Brock bunchlength monitor with MeV beam, and 1 ps bunches, two bunches and pump/probe?
15. Smedley, visit NSLSII during photocathode fab studies at x-ray light source
16. Lifetime: green vs red, thick bulk vs thin
17. Lifetime vs bias voltage
18. RF pulsed tgun
19. PEPPo revisited
20. Bubble at UITF
21. Ramsey spectroscopy technique using two ion traps and electron beam

All of CIS obligations:

* CEBAF full energy upgrade: 200kV gun, 200 kV Two Wien Spin Flipper, new QCM
* CEBAF parity program: assist UVa with fast polarization flipper, fast helicity quad magnets, new chopper?, Moeller liaison,
* JLEIC: gun development, vacuum modeling
* Isotope project at LERF: gun and drive laser
* HDIce: Andy wants 5 months of beam! Who will operate UITF for that?
* Students: Yan Wang, Sajini, Mark Steffani, Gabriel Palacios, Josh Yoskowitz
* Fay needs a laser for nanostructured photocathode
* Summer students
* SBIR Partners:
  + QPeak 532, 780 and 1064 nm laser
  + Electrodynamic non-invasive polarimeter and magnetometer
  + ~~Electrodynamic harmonic arbitrary waveform generator, fast kicker, energy booster~~
  + Raytum polarization controller
  + Xelera rf-pulsed thermionic gun
  + Xelera and Euclid “black gun”
  + Euclid: nano-structure photocathode
* LDRD magnetized beam: write it all up, we owe Stuart many papers
* ~~LDRD EDM experiment~~
* Charlie Sinclair
* Tim Gay? Optical polarimeter?
* Eric Voutier/Hugh Montgomery ILC PEPPo
* Quantum Computing solicitation: PEPPo work revisited
* BNL (Thomas Tsang, Erdong)?
* Darmstadt Max Herbert
* Grigory Eremeev, test the coated ¼ CM
* Gigi and Fay, waste-water treatment

UITF Hot Check Out tasks

I&C tasks

* MeV BPMs
* MeV viewers
* MeV harps
* MeV ion pumps
* MeV valves
* MeV cups and dumps
* Decarad near HDIce
* Stepper motors on apertures
* Pull optical fibers from helicity board to HDIce

DC Power

* MeV magnets, on the beamline and wired up

RF group tasks

* Yao cavity electronics
* SSA on/off via epics
* Get buncher to work, on resonance, heater

Phil, Bubba, Marcy tasks

* New nipple for raster magnets, pump down elevated beamline, light bakeout
* Install the apertures for run#2
* Install the dif pump can, connect to HDIce
* Water and compressed air to all things
* Dress ion pump cables, replace long ones with short ones where possible

Shukui

* Nufocus modulator, in line fiber, signal generator

OPS Software

* MPS
* UED updates
* Software for all things MeV
* Brock scope#2 (need to buy scope and plugin)
* Beam Authorization Tool
* Hot Checkout Tool