

# ASTA Commissioning Activities & Recent Results

Elvin Harms  
ASTA Users Meeting  
23-24 July 2013

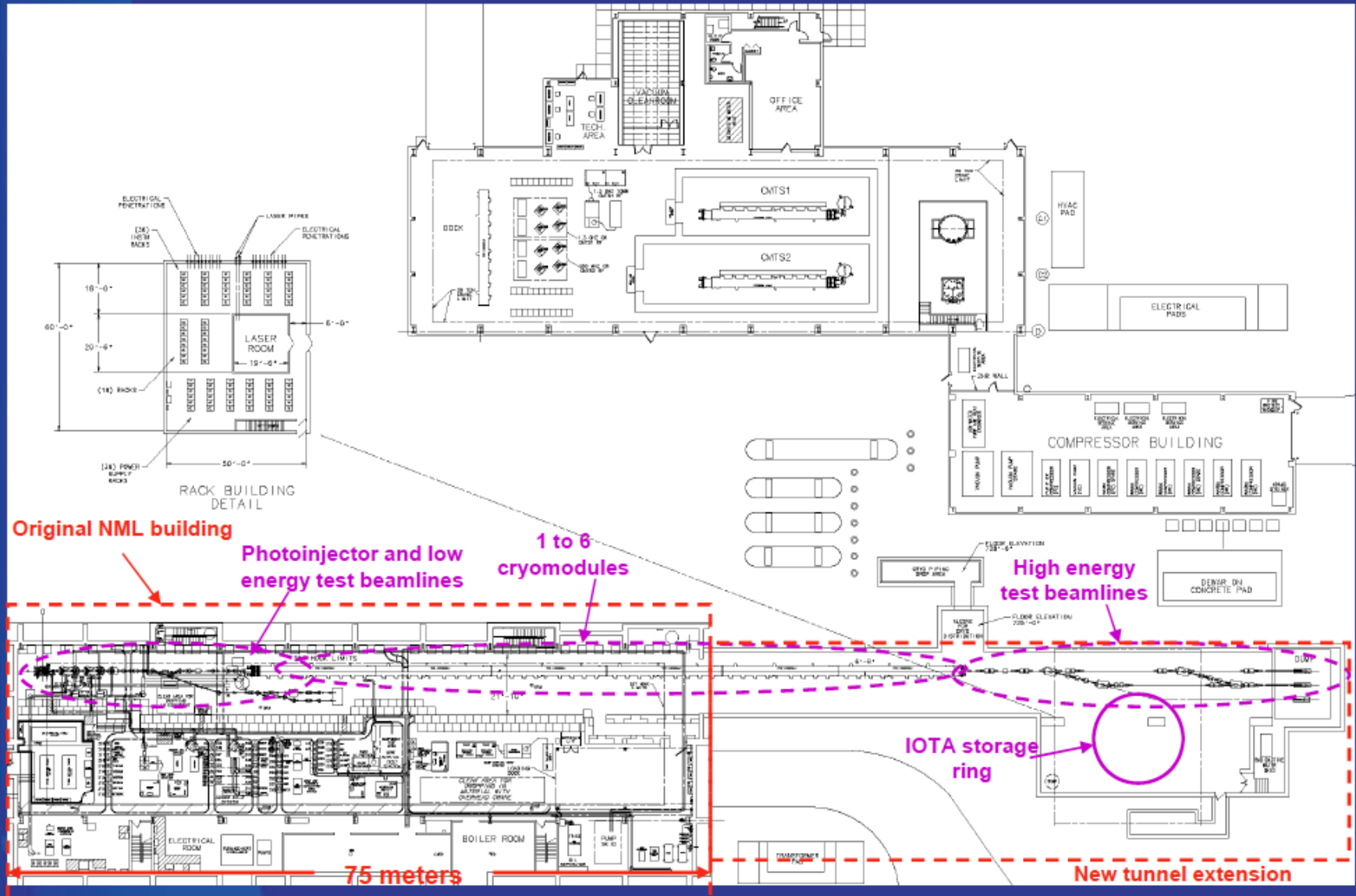


# Talking Points

- Introduction/ASTA Layout
- Status of Subsystems
  - Photoinjector Gun
  - Laser – see Jinhao's talk
  - Capture Cavities
  - Cryomodule(s)
- Electron Production
- Next Steps
- Summary

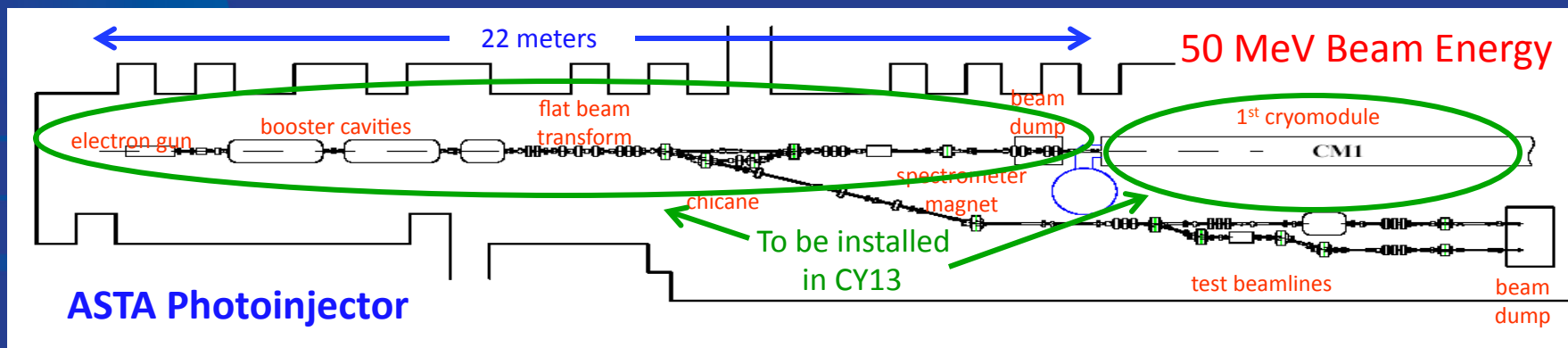


# Full ASTA Layout

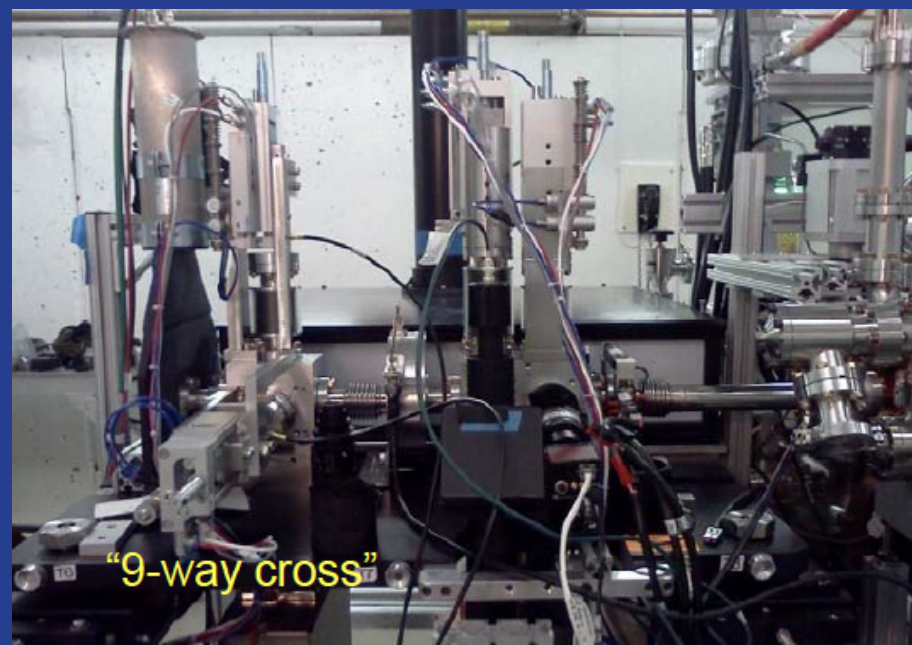
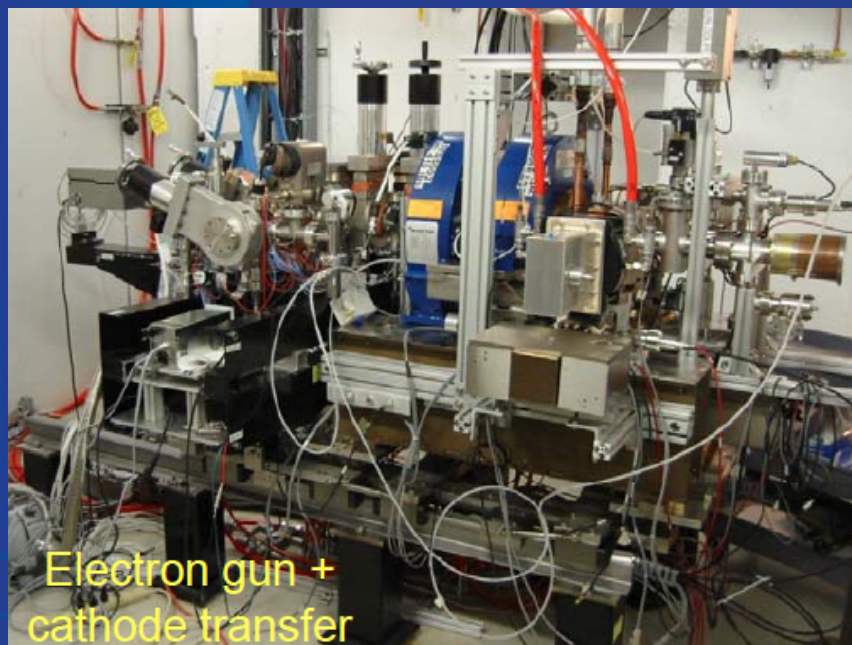


# CY13 - 50 MeV Injector + 1 Cryomodule

- Goal: installation complete and beam commissioning started by end of CY13
  - RF gun + RF system and photocathode laser system
  - 2 SRF booster cavities (CC1 and CC2) + RF systems
  - 50 MeV beam line elements and instrumentation to the low energy dump
  - Low energy beam dump
  - SRF cryomodule (RFCA002/CM2)
- Installation of 1st AARD experiment (high brightness X-ray channeling source)



# Status – Photoinjector Gun



## Status – Photoinjector Gun

- Conditioning of three components:  
**Cavity + Coupler + Window**
- RF Vacuum Windows
  - High power tested (conditioned) in 2011
  - Up to 3.7 - 4 MW (20  $\mu$ s pulse width) of fully reflected power (similar to what the window will experience during filling time of the cavity)
  - Up to 3.8 MW (1 ms pulse width) of fully transmitted power (similar to the window will experience after filling time of the cavity)

*courtesy of Ding Sun*

## Status – Photoinjector Gun (2)

- Gun-cavity Conditioning
  - First stage of conditioning completed
  - Gun-cavity conditioned to 1.2 MW, 1 ms pulse width and 5 Hz repetition rate
  - Solenoids OFF and ON
  - Maximum power limited by arcing problem in the circulator.

*courtesy of Ding Sun*



## Status – Photoinjector Gun (3)

- Second stage of conditioning in progress
  - Up to 2.55+ MW, 200  $\mu$ s, 1 Hz into the gun-cavity (maximum output power from the current Klystron)
  - Typically running at  $\sim$  1.8 MW (into gun-cavity) with solenoids on (248 A/52 A)
  - This stage will end at 2.55 MW / 1ms / 5 Hz
- Klystron will be upgraded to a 5 MW model
  - Gun-cavity will be conditioned up to  $\sim$  4 MW / 1ms / 5Hz.

*courtesy of Ding Sun*

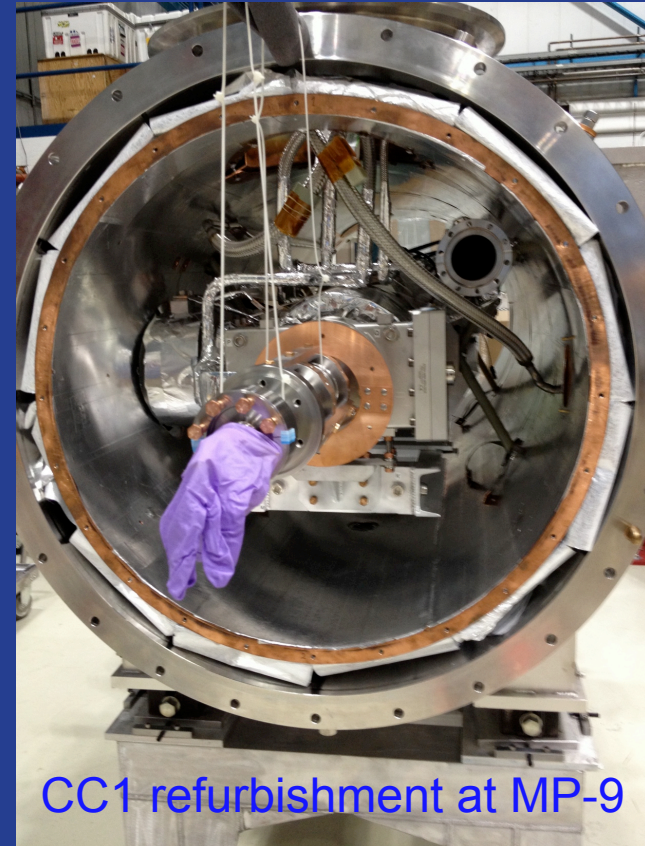
# Status – Capture Cavities

- Two ‘Booster’ cavities – single cavities each in their own cryomodule
  - Capture Cavity 2 - first SRF device delivered and operational at NML
    - Last operated in February 2012
    - 22 MV/m, 1 ms pulse, 5 Hz
    - LLRF & LFDC operational
  - Capture Cavity 1 was previously the A0 Photoinjector workhorse
    - Upgrade in progress
    - Achieved ~29 MV/ m in January test at HTS
    - ‘Modern’ cryomodule
    - Some delays – upgrading cryomodules is never simple!
    - Installation expected in September

# Status – Capture Cavities



CC2 installed at ASTA

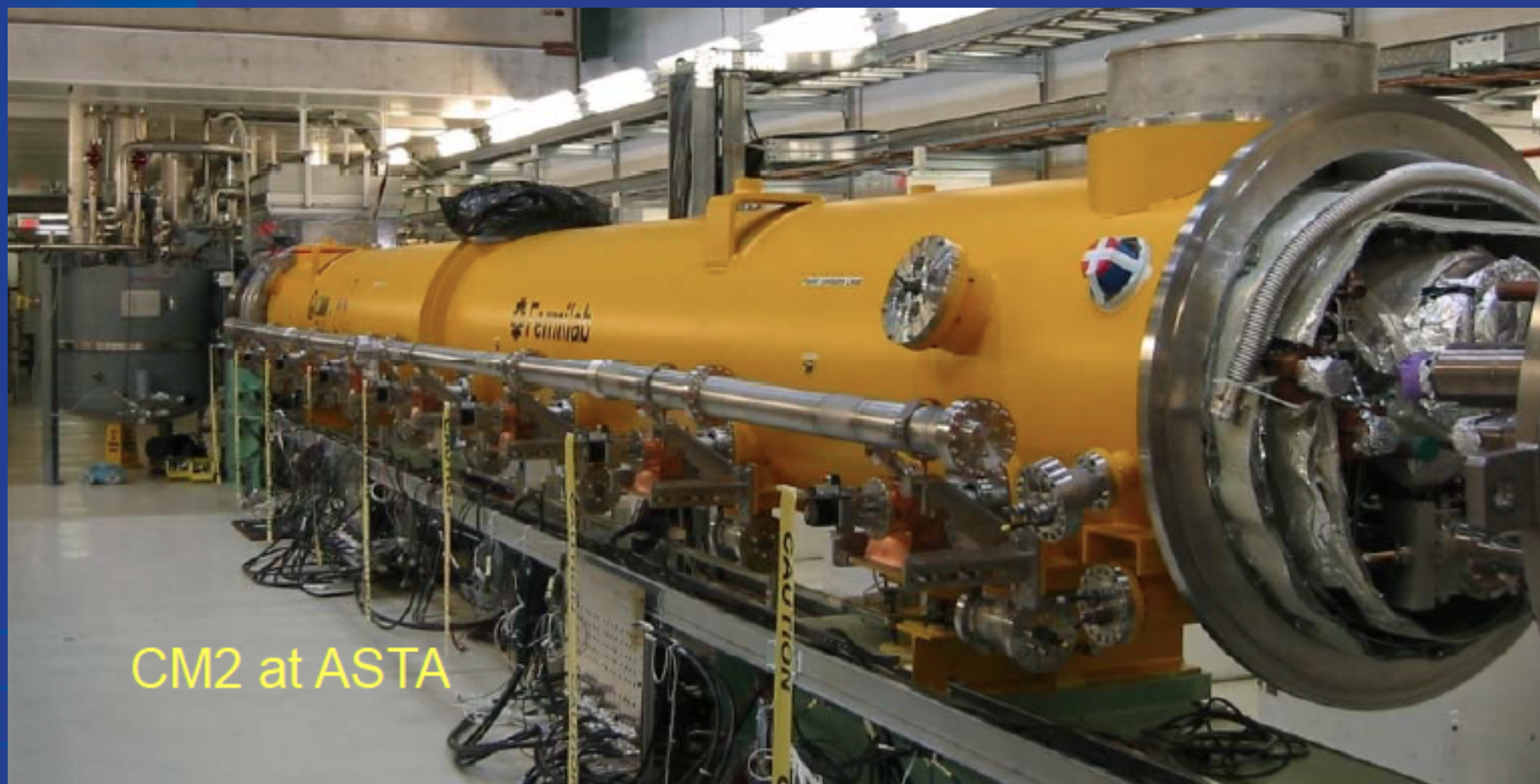


CC1 refurbishment at MP-9

## Status – Cryomodule

- RFCA002/CM-2 Commissioning in progress
  - Cryomodule installed in April 2013 – for the 2<sup>nd</sup> time
  - Welding and cryo circuits leak checking and pressure testing complete as of last week
  - Warm Coupler conditioning complete (9 May – 18 June)
    - Each cavity powered to up to ~1MW short pulse ( tens of  $\mu\text{s}$ 's)
    - 500 kW long pulse (up to 1 ms)
    - 5 Hz operation
  - Begin final instrumentation installation/checkout and vacuum work this week
  - Cooldown expected in a few weeks

# Status – Cryomodule



CM2 at ASTA

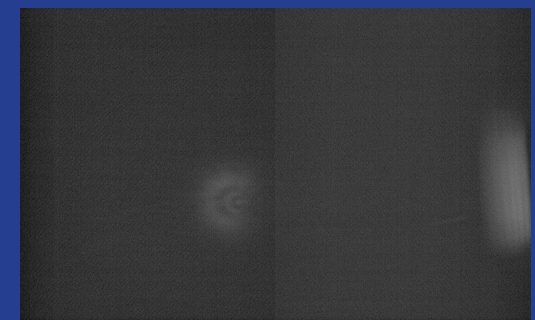
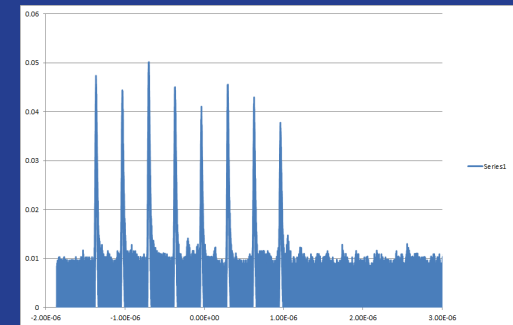
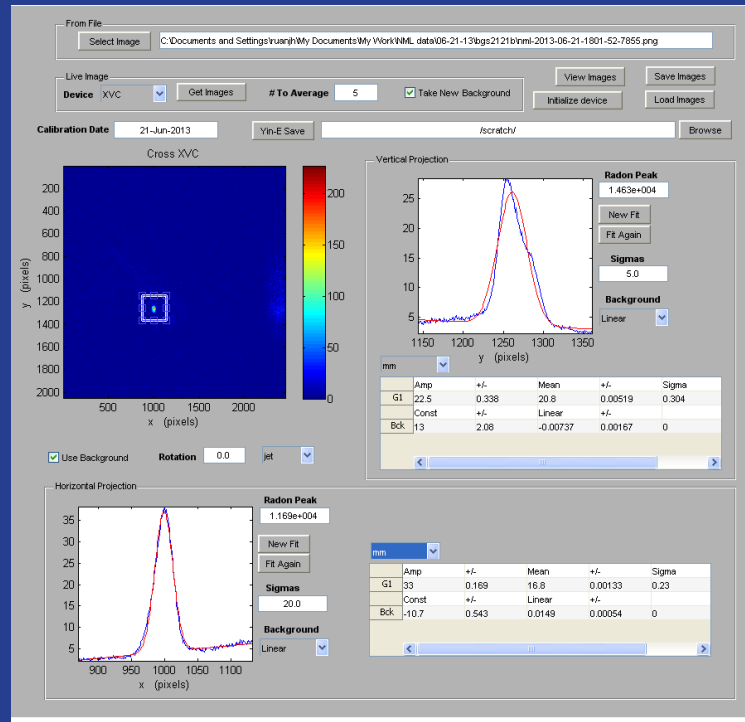
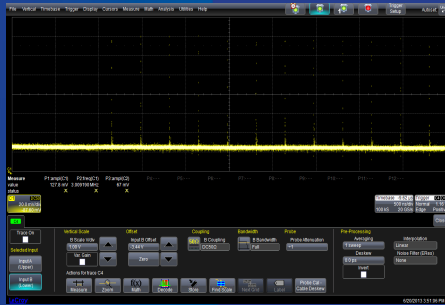
## Status – Ancillary Systems

- Gun, CC2, Cryomodule RF systems in place and operational
  - some upgrades, improvements planned
- CC1 RF installation in progress
- Protection systems, Vacuum, water, Controls verified functional
- Some life testing carried out as part of commissioning systems
- Diagnostics calibration and set-up in progress – see N. Eddy's talk

## Status – Electrons

- Photoelectrons first produced at ASTA on 20 June
  - Molybdenum (uncoated) cathode
  - First visible on Loss Monitor, Faraday cup and Wall Current Monitor
- Days of electron operation scheduled regularly in past two weeks
  - 80  $\mu$ s pulse typical
  - Calibrate FC, WCM, look for BPM signals
  - Phase scans
  - LLRF operated in closed loop (see B. Chase's talk)
  - Extend pulse length/laser for more bunches
  - Exercising trim dipoles – see beam movement

# First Electrons



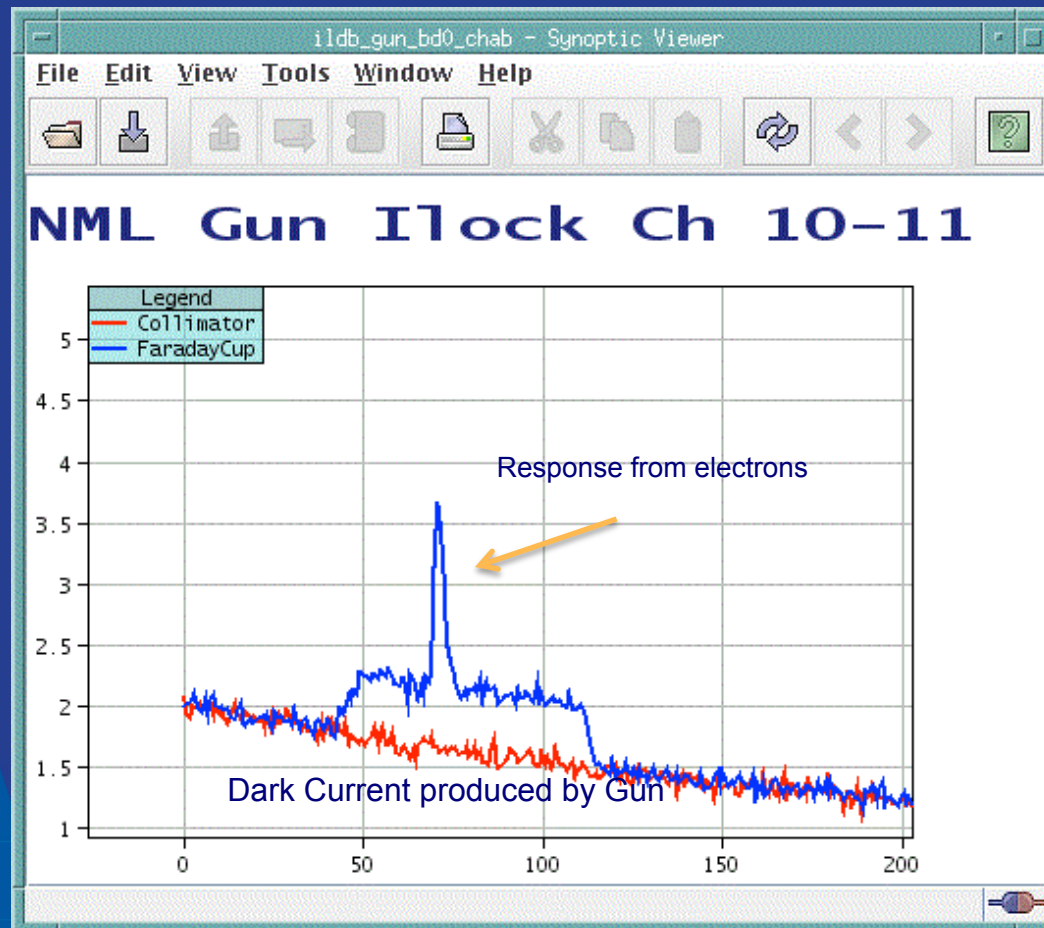
5280, Mike Church (church), Thu, 06/20/2013 17:53:24

Gun/Commissioning

Summary of this afternoon's activities: We successfully produced our 1st photoelectron beam from the gun into a Faraday cup. 8-15 pulses at 1 Hz rep rate. Conditions were approximately as listed in entry [Entry #5273](#). Signal was observed on the resistive wall monitor, loss monitor, and YAG screen as shown in the last 3 entries. Hooray!

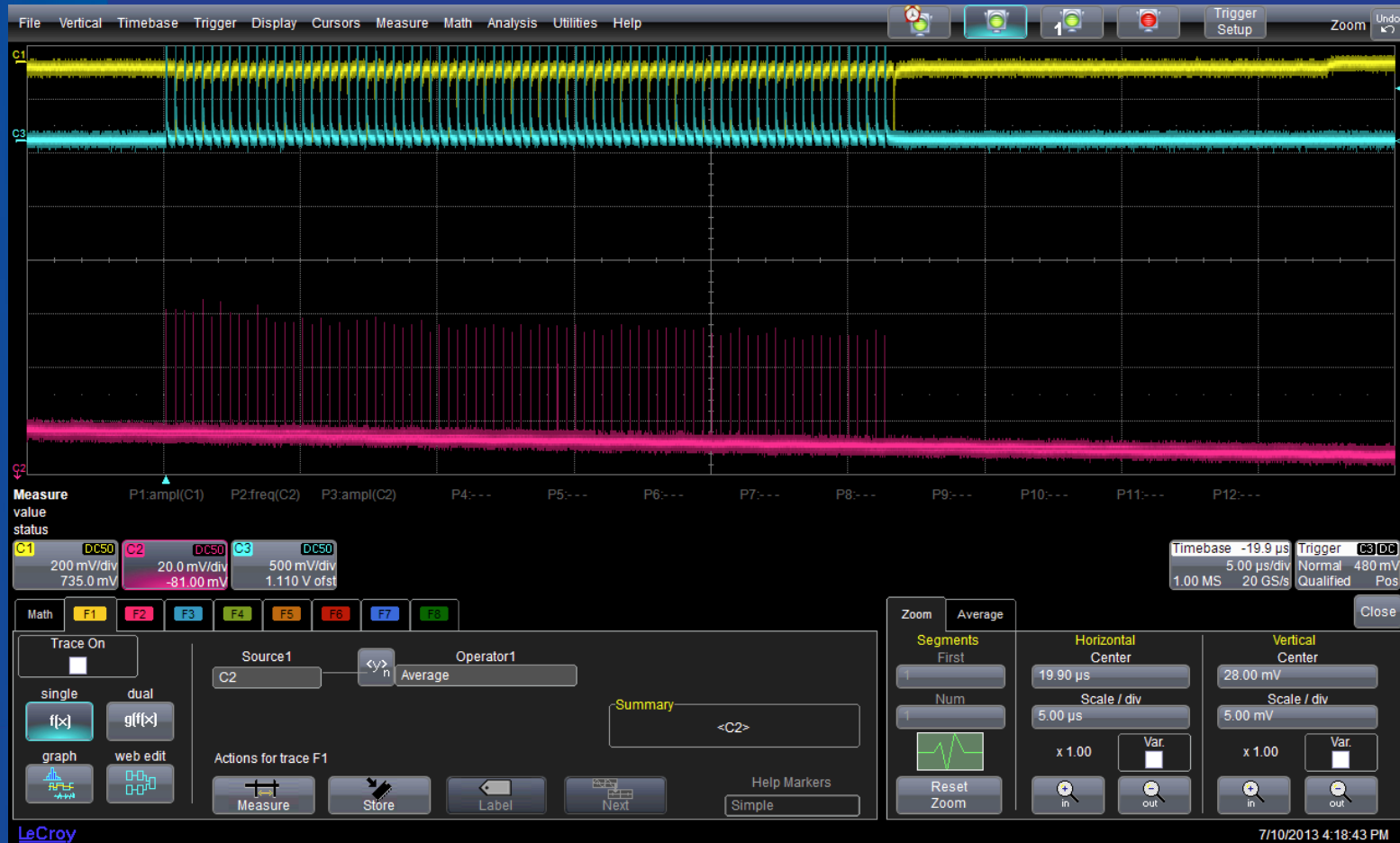


# Status – Electrons



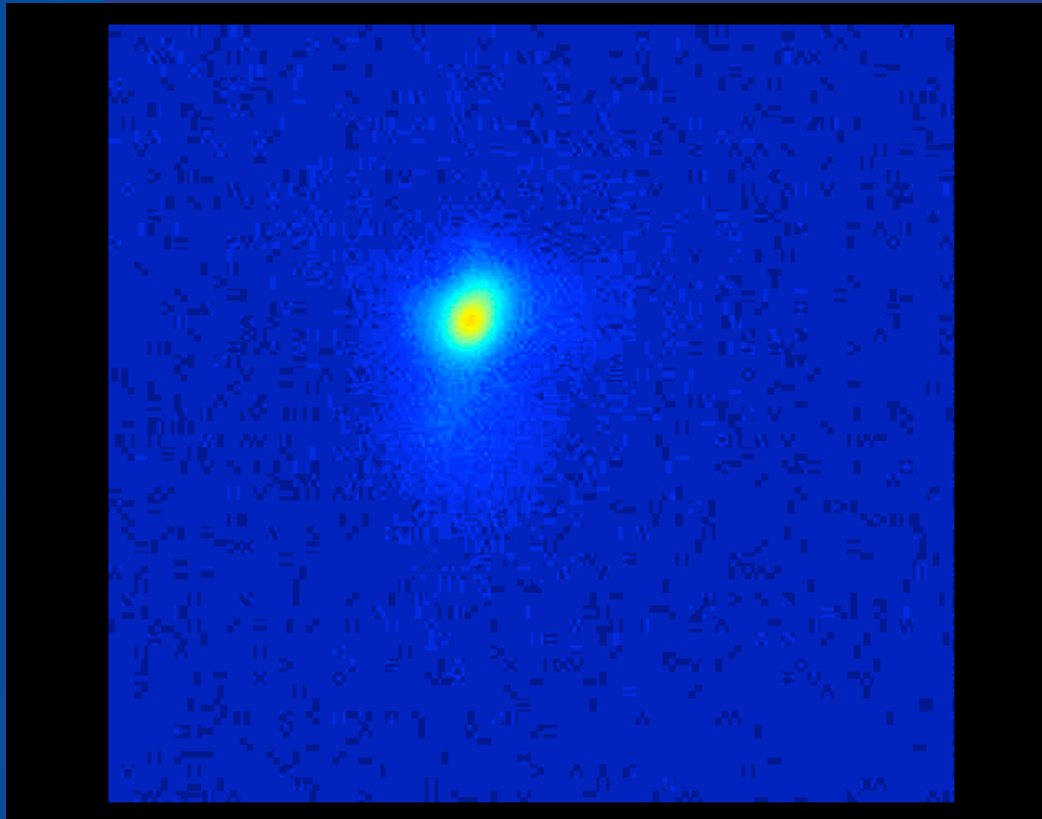
## Faraday Cup – 1 Bunch

# Status – Electrons

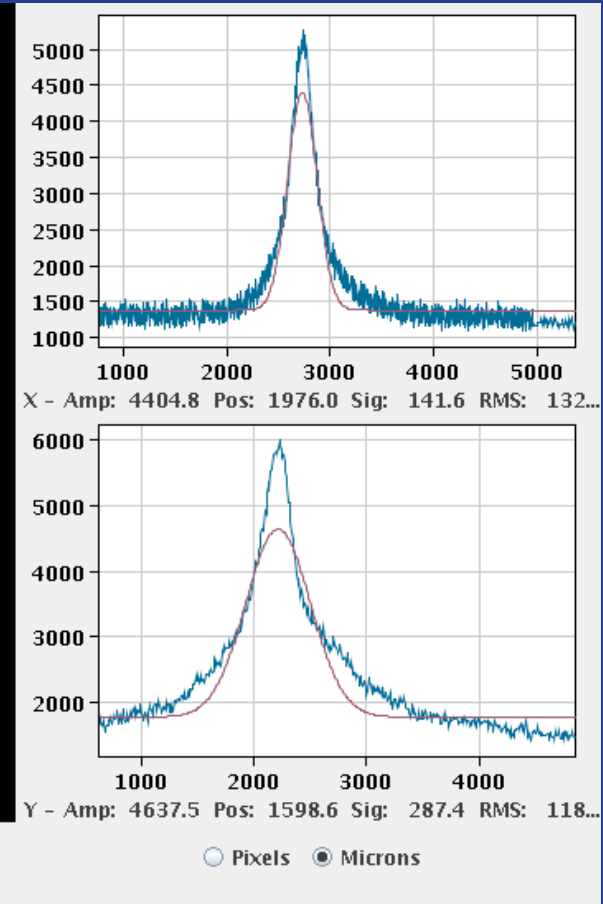


## Wall Current Monitor– 80 Bunches

# Status – Electrons

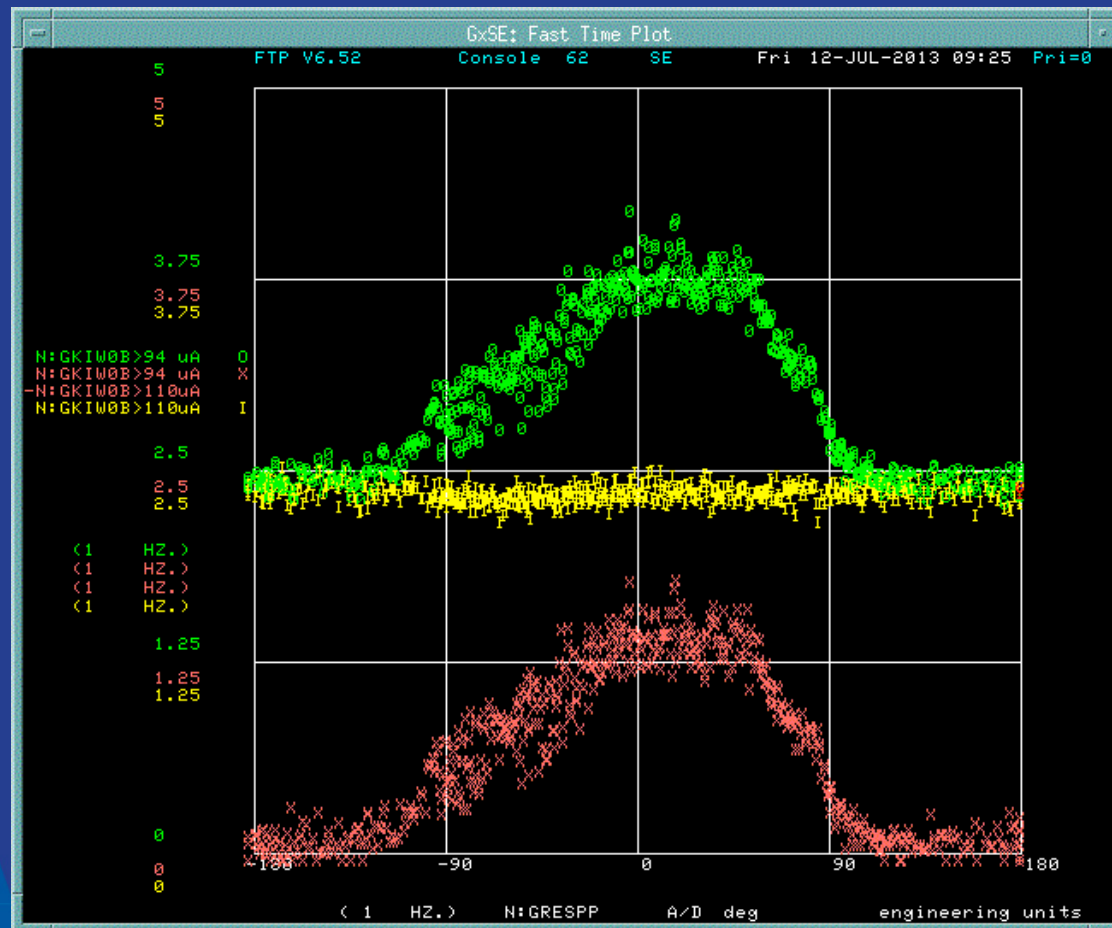


2013-07-10 16:38:03.200 (78 ms ago) Size: 5.1 KBytes Quality: 82 Scale: 1  
Position: 2484.0um, 4104.0um Intensity: 127  
ROI is: 756.0, 615.0 - 1269.0, 1086.0 Height: 471.0um Width: 513.0um Active



## 9-way Cross YAG Screen – 5 Bunches

# Status – Electrons



Phase Scan with LLRF enabled

# Accomplishments in 2013

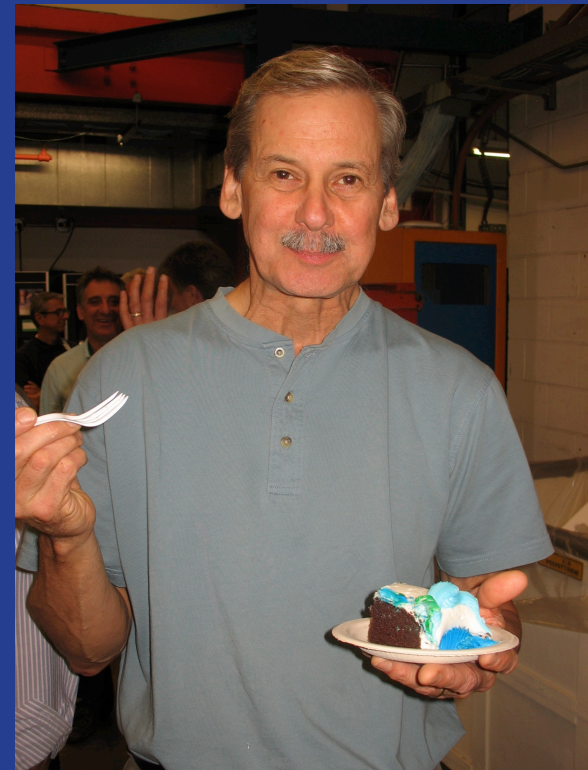
- Laser installed/UV to ASTA cave
- CM-2 Installed and nearly ready for cooldown
- Warm Coupler Conditioning completed
- Gun installed and first phase of conditioning complete
- 9-way diagnostic cross installed and operational
- **Electrons!**
  - Beam sensed on Faraday cup, Loss Monitor, Wall Current Monitor, and now BPM's
  - Calibration in progress

# Short-term Future Activities

- Continue conditioning the RF gun (goal is 45 MV/m, currently at 32 MV/m)
- Complete installation of RFCA002/CM2
- Complete upgrade and install CC1
- Cool down and commission CM2, CC1; recommission CC2
- Continue gun photoelectron studies @ 3 - 5 MeV
- Continue installation of 50 MeV beam line components
- Start commissioning 50 MeV injector into beam dump in the Fall

# Summary

- Electrons!
- Moving from more of a construction site to a (fully armed) & operational facility
- Cryomodule cooldown very soon
- 50 MeV beam by end of the CY
- Thanks Mike Church!



Thanks for Your Attention