RHIC Retreat 2009

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Instrumentation
July 16, 2009

SIXTY YEARS
OF DISCOVERY
1947-2007

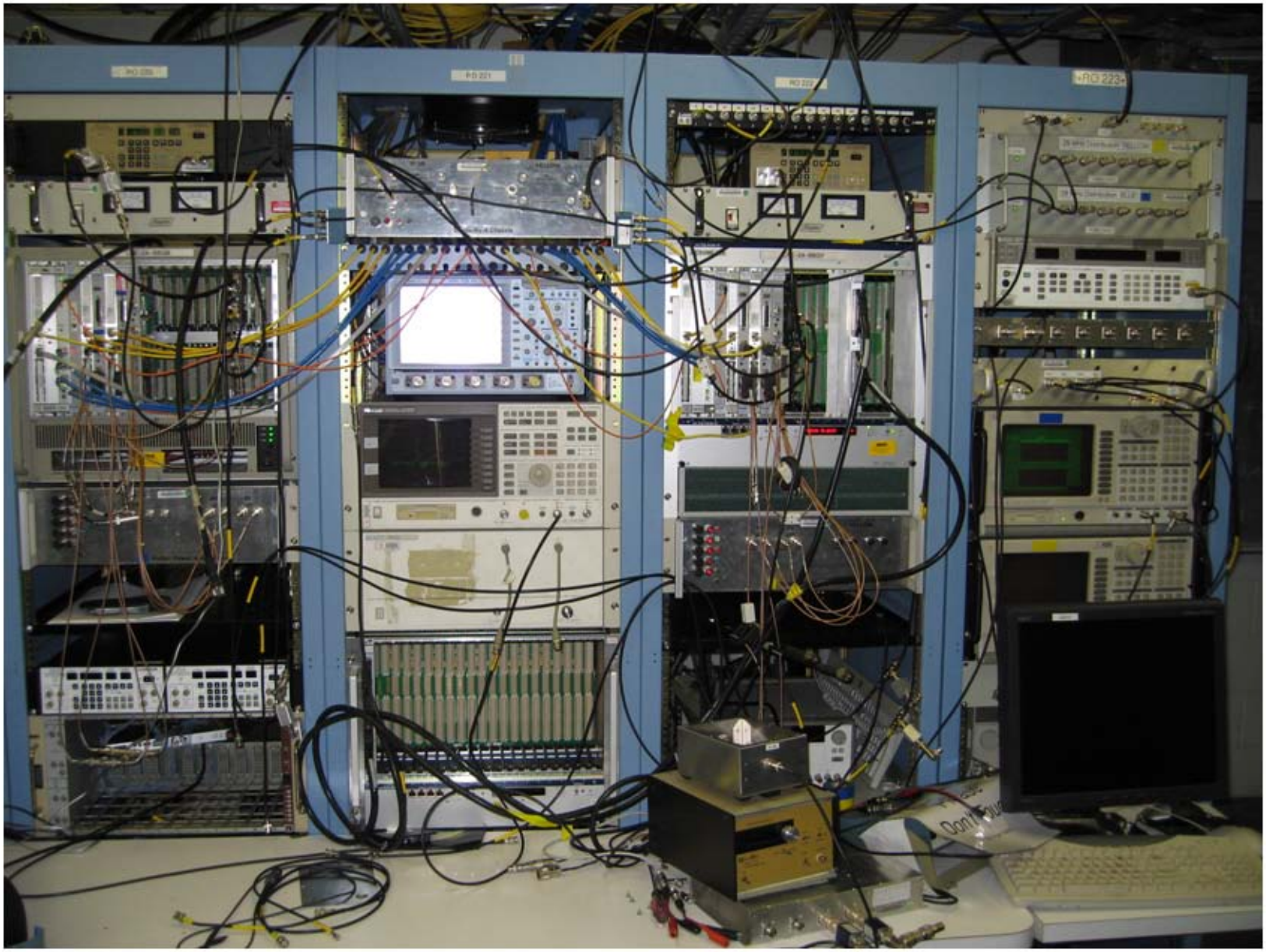
BROOKHAVEN
NATIONAL LABORATORY

Office of Science
U.S. DEPARTMENT OF ENERGY

BBQ Hardware and Software Modifications

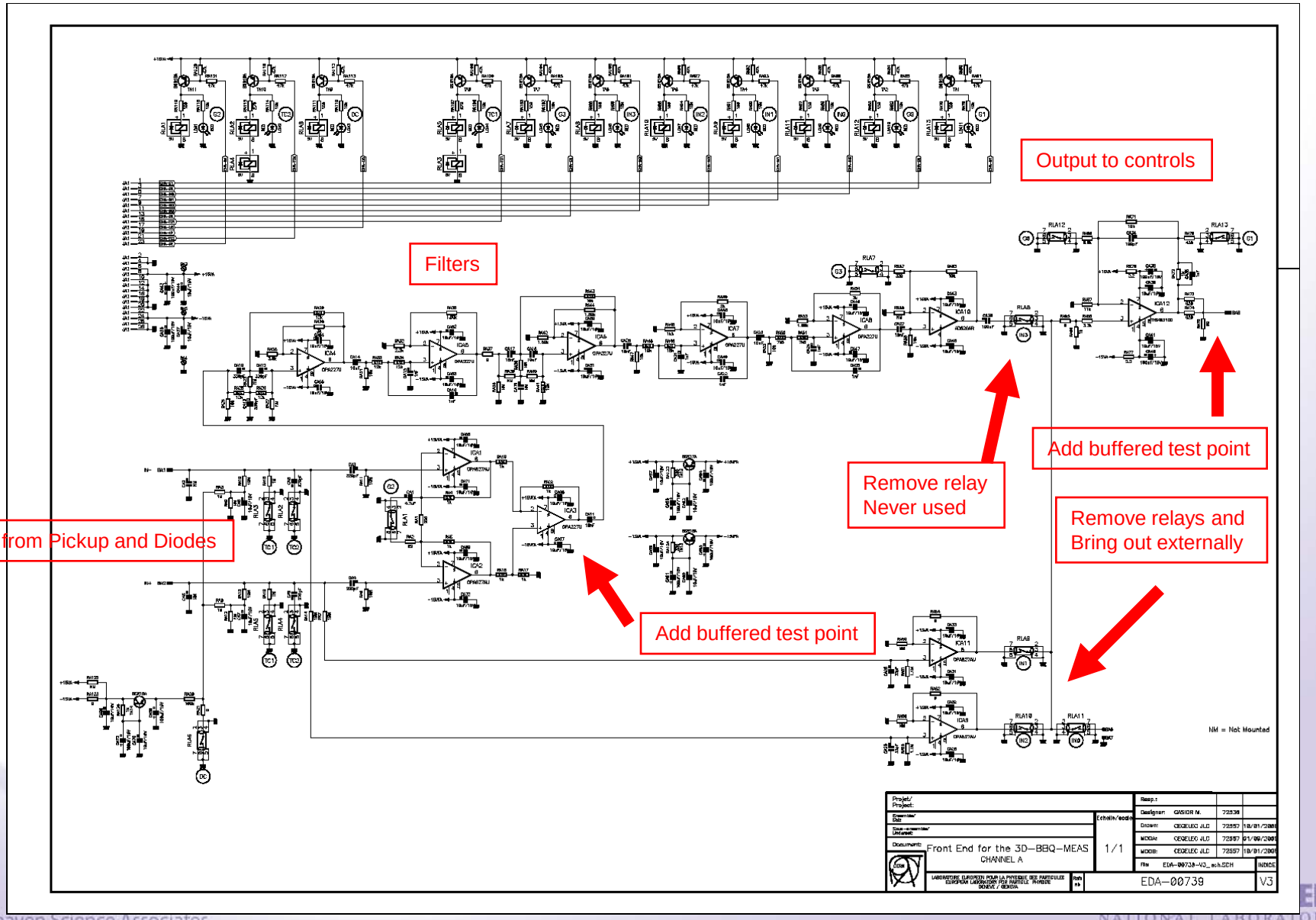
- Hardware basic topology “fixed” for the entire run.
- Numerous repairs and additions (~70 so far): http://www.cadops.bnl.gov/RHIC/Instrumentation/bbq/index.html
- Examples: repair of RF connections in the ring, re-arranging racks
- Test points were added to provide useful insight into the circuit during operation – without disconnecting any cables.
- Addition of Michiko’s DSA’s connected to the differential output provide online beam spectrum all the time.
- Added calibrated readbacks for kicker current for repeatability – we are trying to reduce “arbitrary units”.
- We are attempting to calibrate the sensitivity of the BBQ by exciting the beam with the AC dipole and comparing with million turn BPM data. Best data so far shows them within 50%. Spectra are identical…….
- The system is now used by the MCR operators reliably
- We still have a lot of work to do – trying to resolve phase jumps, mains harmonics……

BBQ Rack Layout (before)

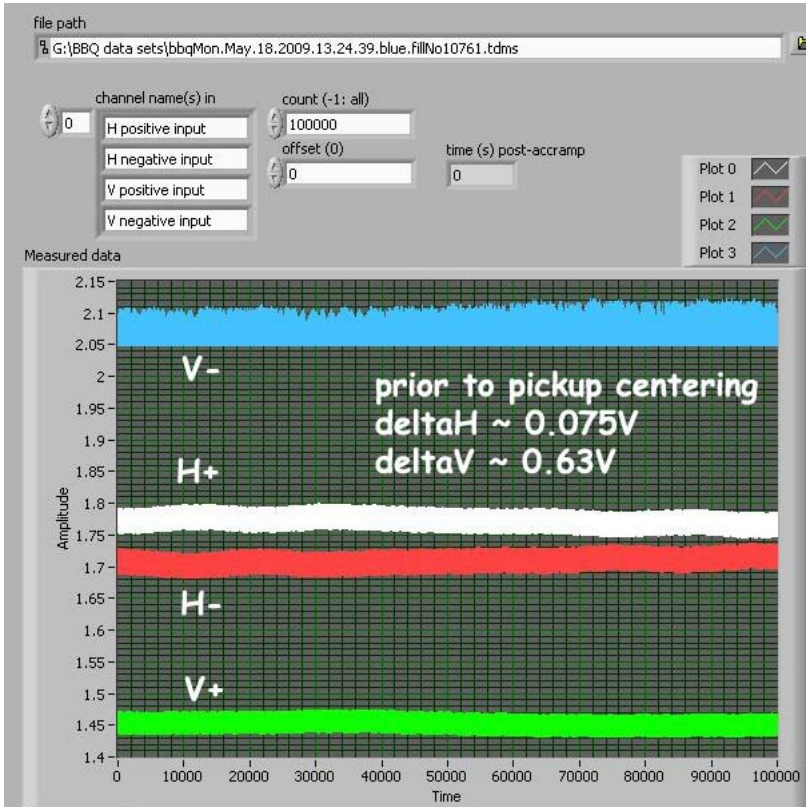


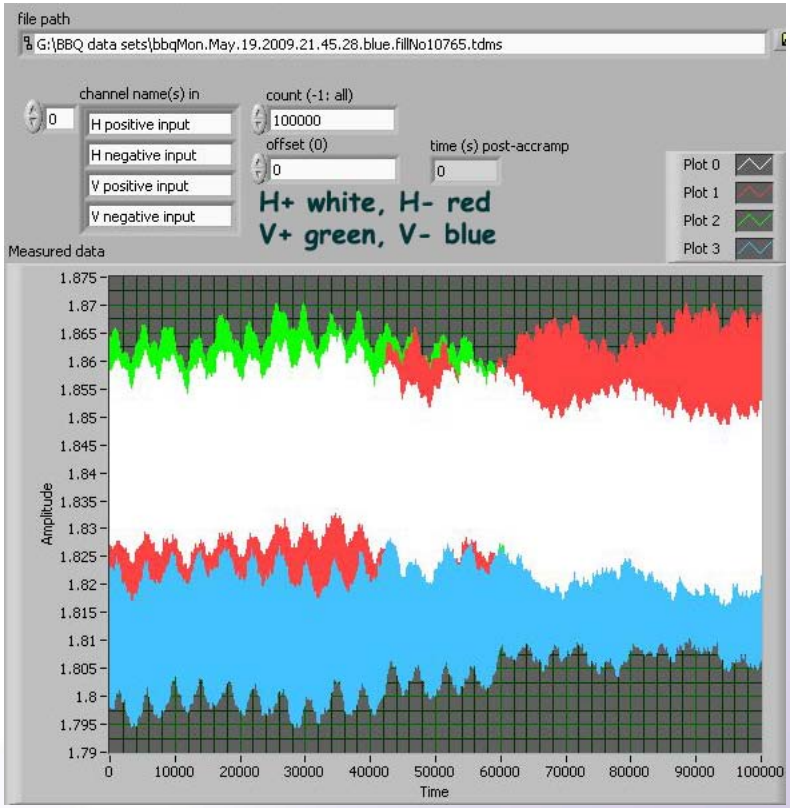
BBQ Rack Layout (after)

BBQ AFE Schematic – showing modifications – adding 16 test points x&y
Monitor 5 minutes up the ramp automatically or manual trigger. Saves 100 files.



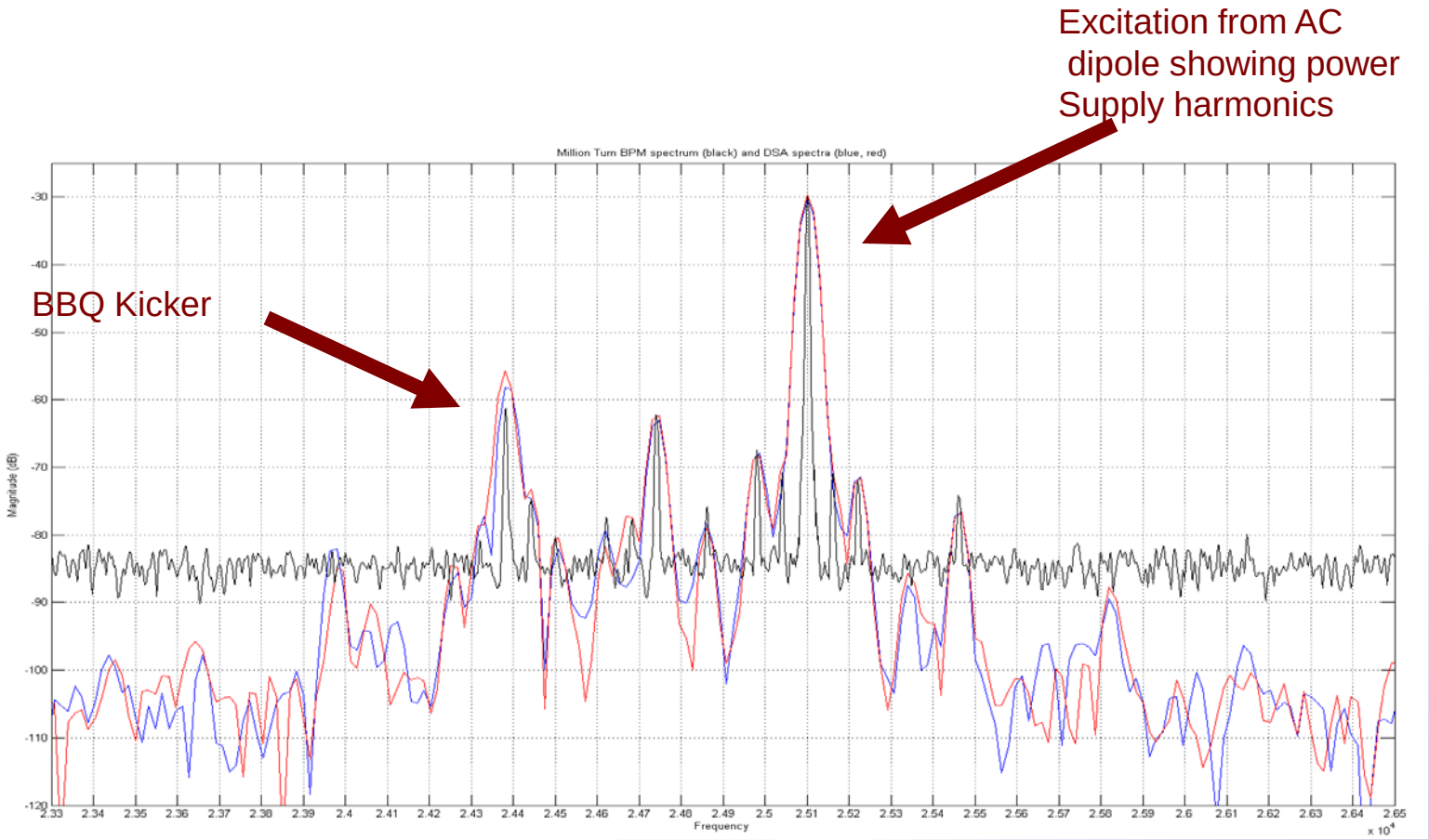
BBQ test points used for centering.
Centering the pickup then taking the (A-B)/(A+B) in voltage of each input divided by the change in position = 3%/mm. All 4 planes behaved the same.





Courtesy: Michelle Wilinski and Kevin Mernick

Graph comparing spectrum of million turn BPM and BBQ

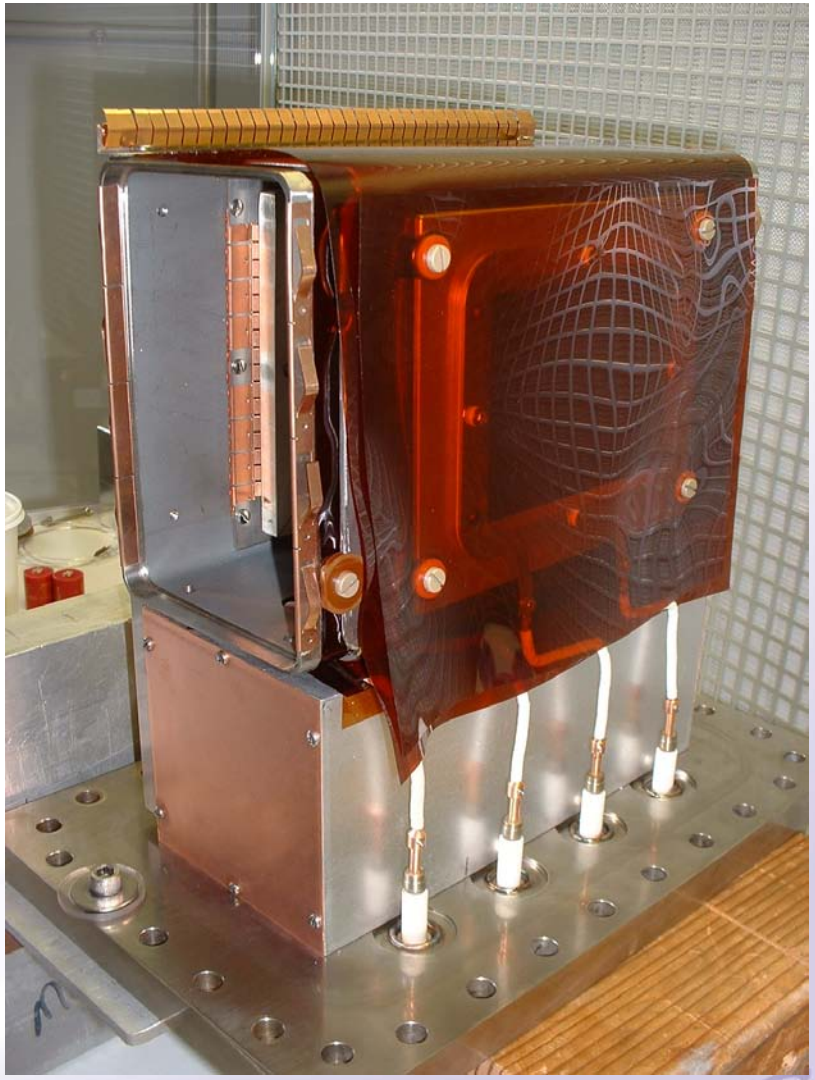


Courtesy: Kevin Mernick

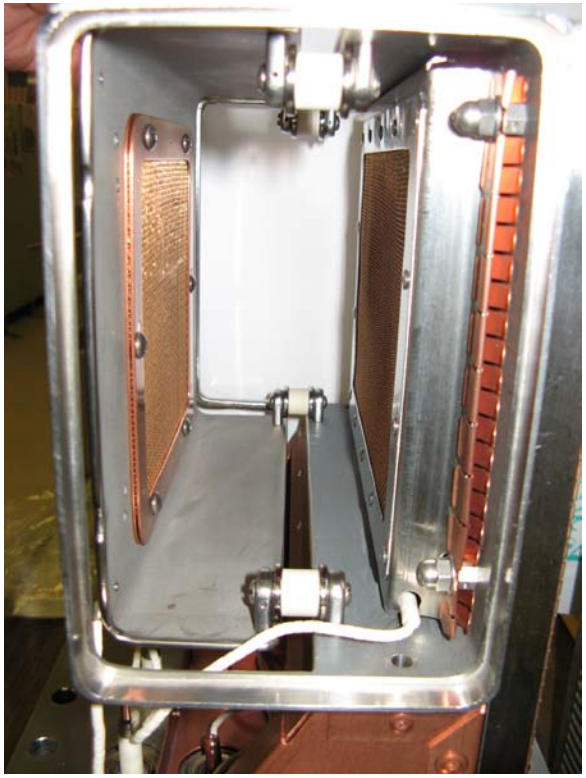
RHIC IPM

- RHIC IPM micro channel plates have significantly decreased performance. YH is almost completely dead.
- A few years ago we modified yellow V with a new improved high vacuum and voltage geometry. Also RF shielding is improved.
- A final design was developed by Jesse Fite and Roger Connolly. There will be no plastics and higher bakeout temperatures will be obtained.
- A critical milestone was hipotting the pulsed grid – passed.
- We are now waiting for ceramic circuit boards due end of August.
- Horizontals will be relocated for better performance. This is a big vacuum job, but most of the cables and infrastructure are already there.

IPM upgrade – original design

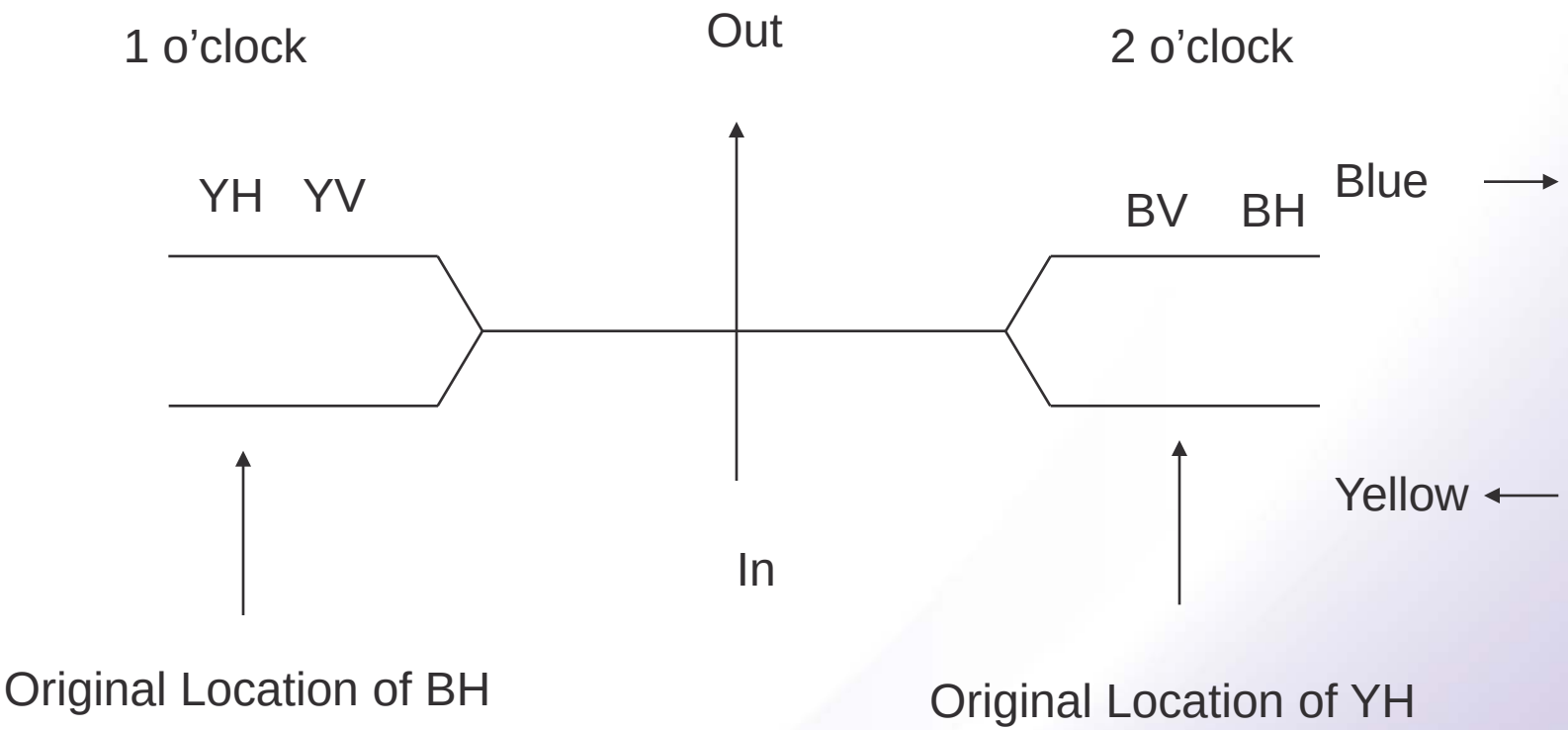


IPM upgrade comparing prototype (left) with new design (right)



Courtesy: Jesse Fite and Roger Connolly (Right photo)

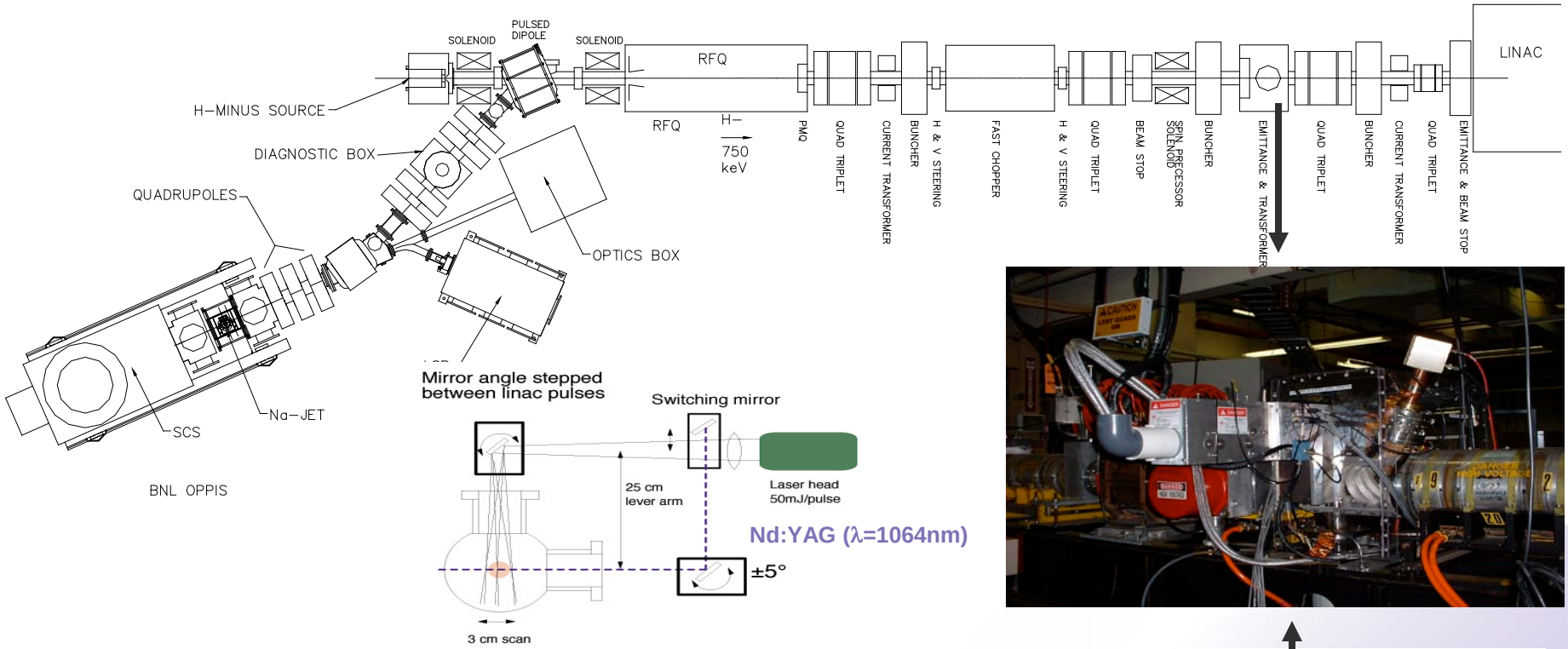
IPM LOCATION



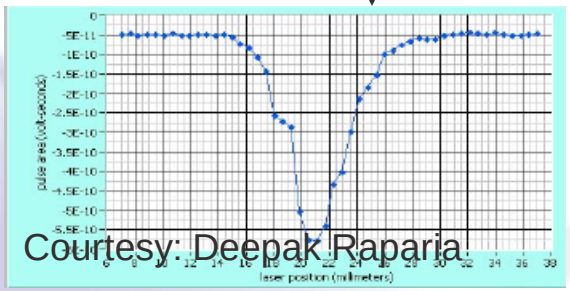
Linac Laser Profile Monitor

- Development of a device for linac that will measure energy (for blip and PP) and energy spread (PP only) after tank 9.
- Leveraging off the device that Roger Connolly built for Fermi lab
- Energy selection requires 100 to 115 kV – this is slightly beyond what parts we have in house now…. This is the technical challenge at this point.
- Many of the parts are COTS and have been ordered.
- Lenny DeSanto has contacted Kyocera to quote on a 150 kV feedthru.

Profile Measurement



Transverse Optical System

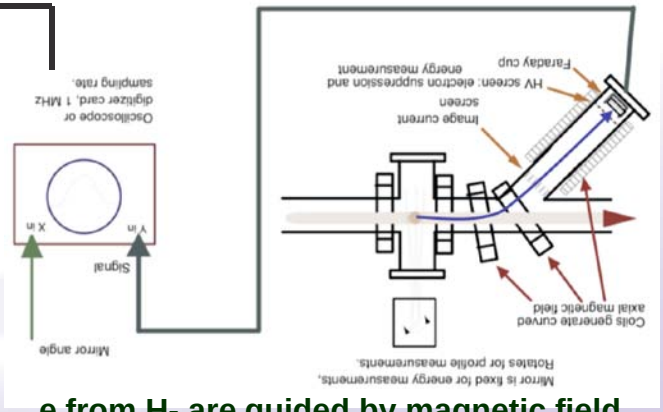


Courtesy: Deepak Raparia

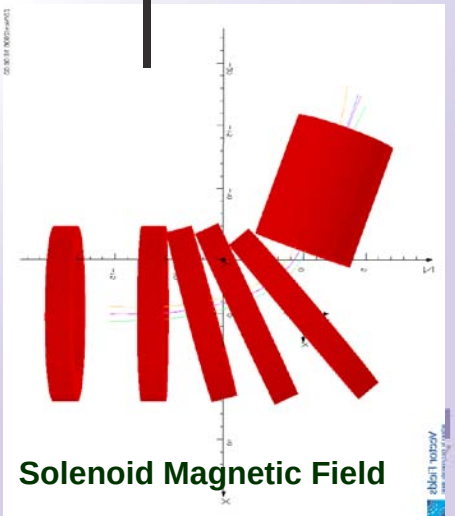
Brookhaven Science Associates

H- Beam profile

Labview

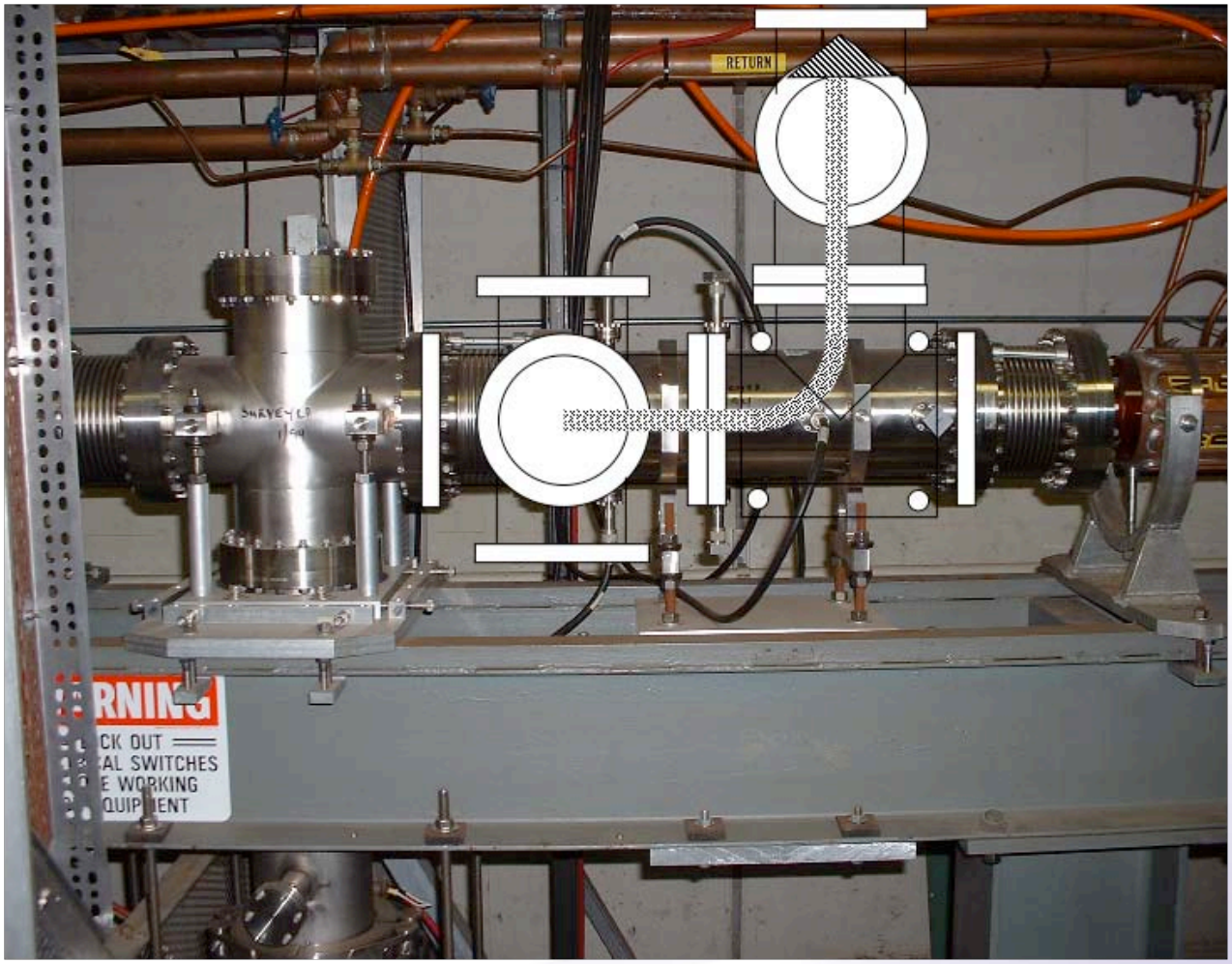


e from H- are guided by magnetic field



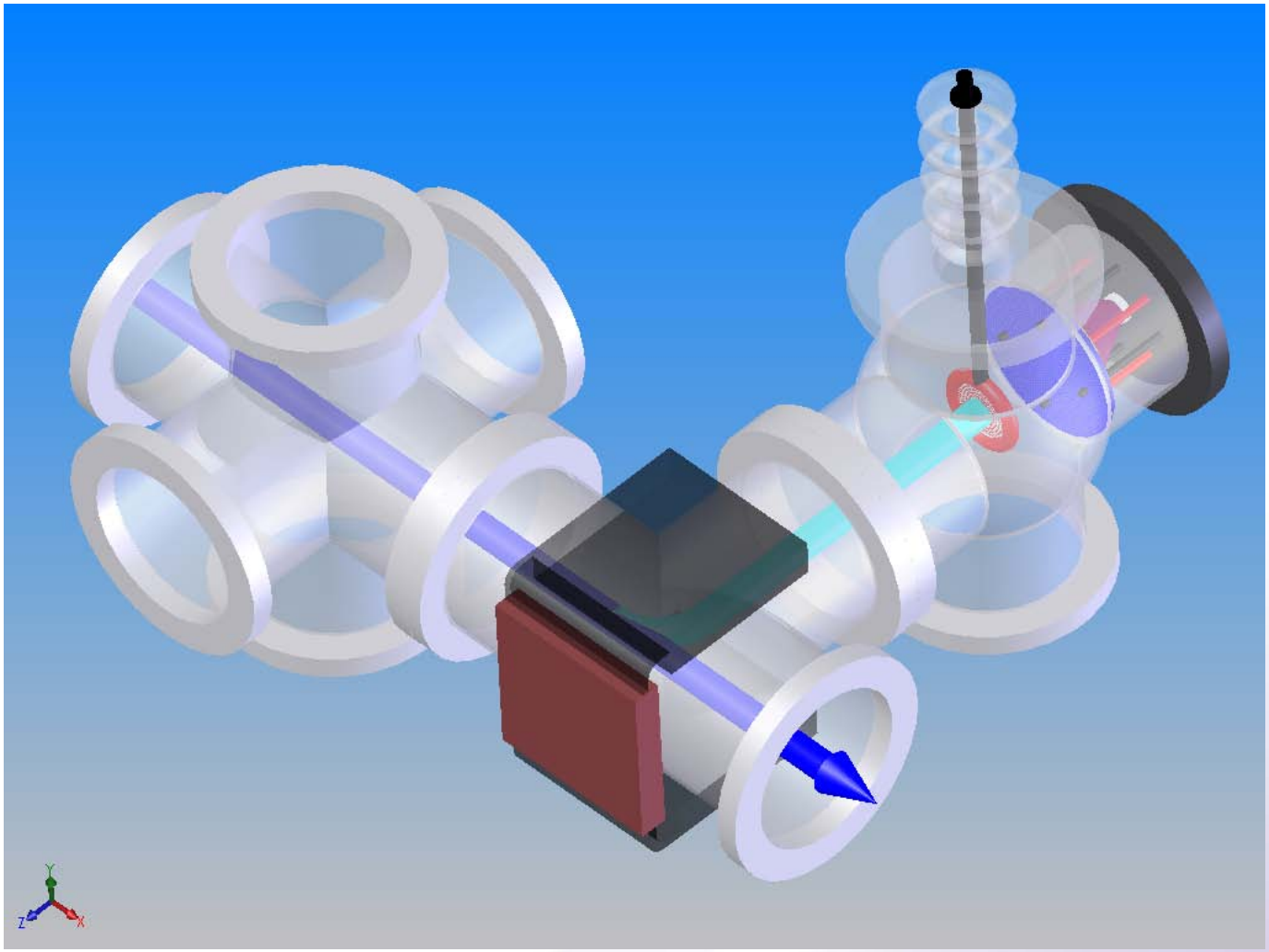
Solenoid Magnetic Field

Linac Laser Profile Monitor



Courtesy: Roger Connolly

Linac Laser Profile Monitor

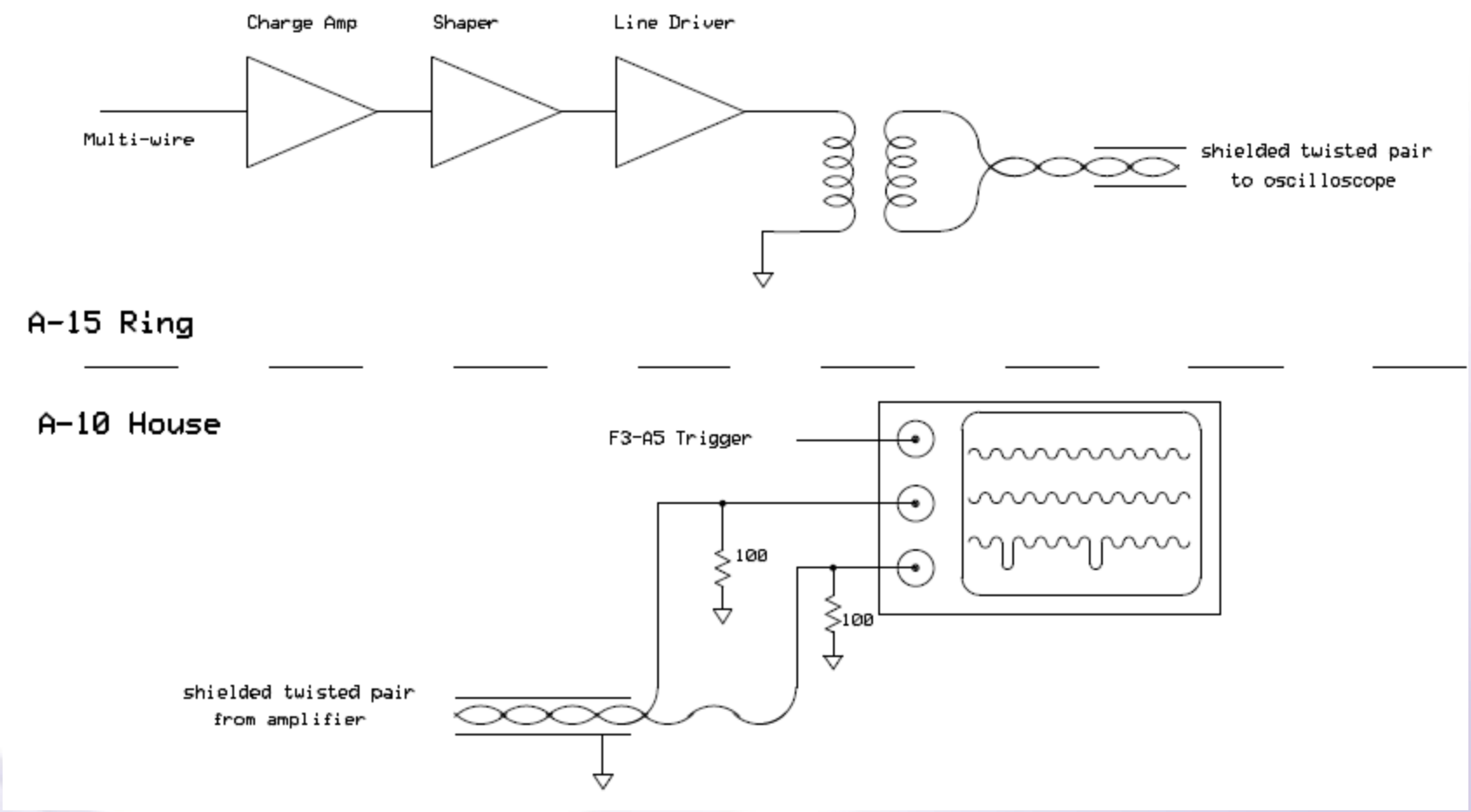


Courtesy: Lenny DeSanto

AGS A15 Multiwire Test
Necessary for the development of a turn by turn monitor

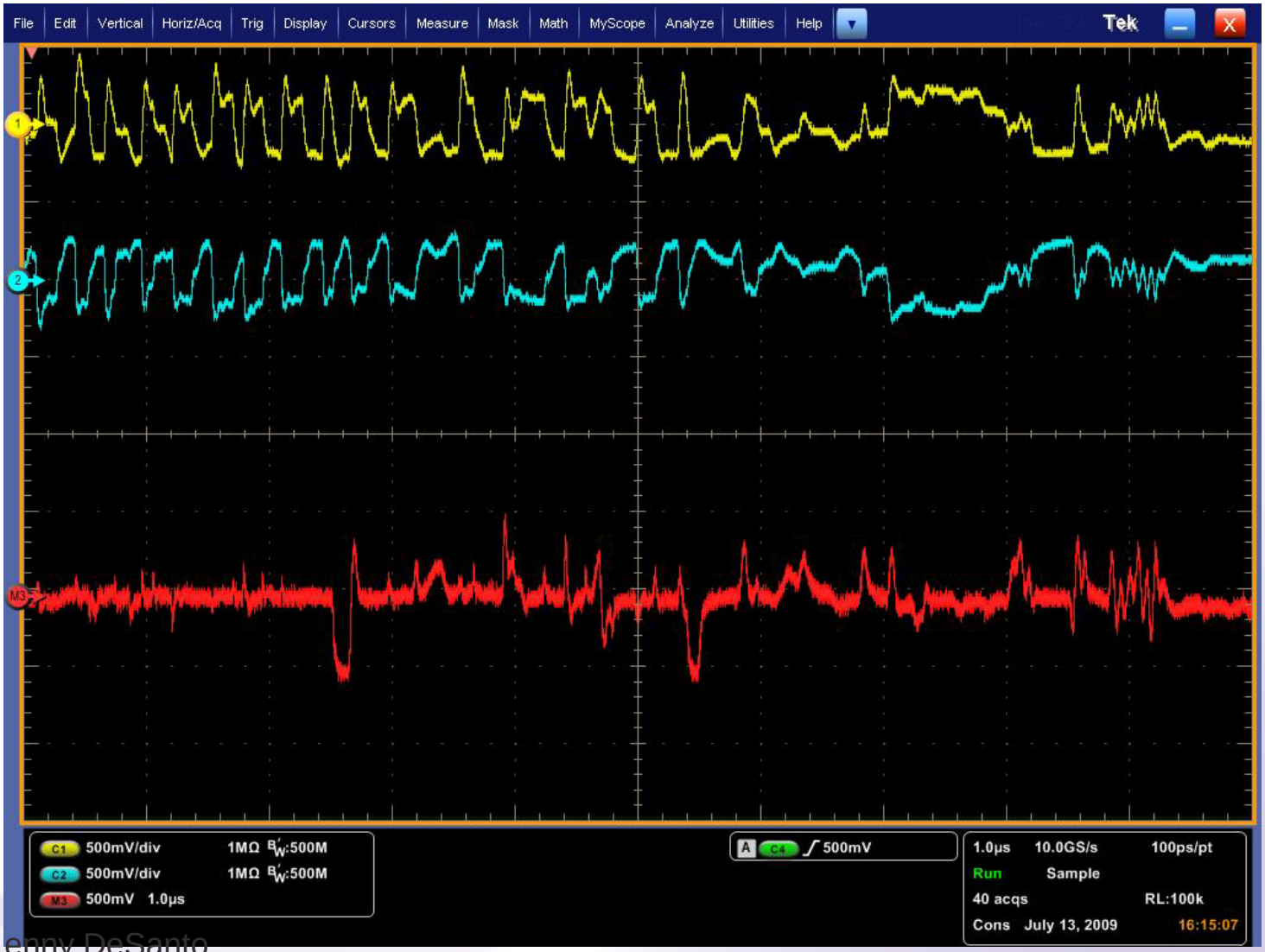
- Leveraging off pre-amps used on the RHIC IPM.
- Lenny and Craig Dawson paid a visit to Instrumentation division for advice.
- Lenny just performed a crucial test – instrumenting a single channel of the A15
- Now we need to make a plan to complete the amplifier and get the signal into the fast digitizers.

Equipment Layout



Courtesy: Lenny DeSanto

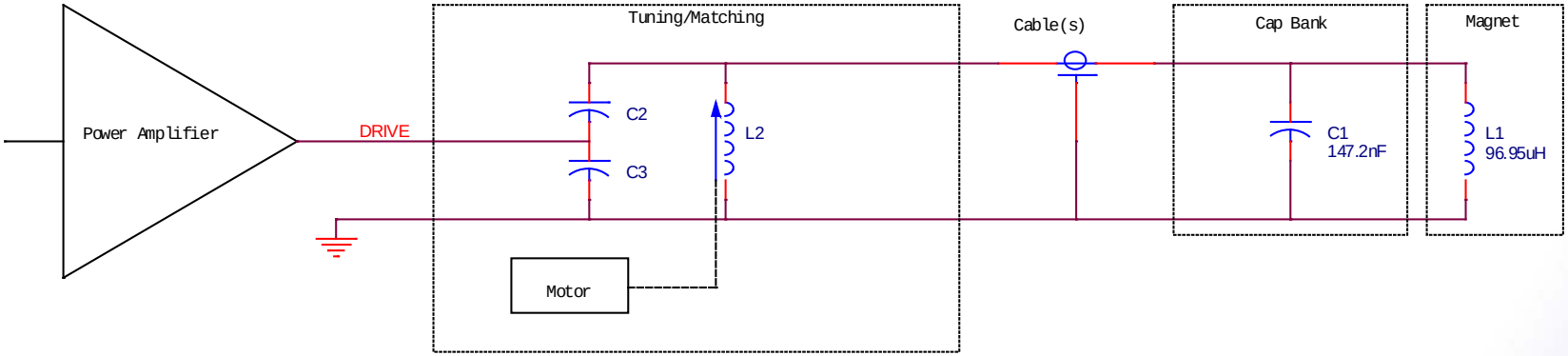
1.5E11 Single shot wire #16 beam on (background subtracted) 090713-161500

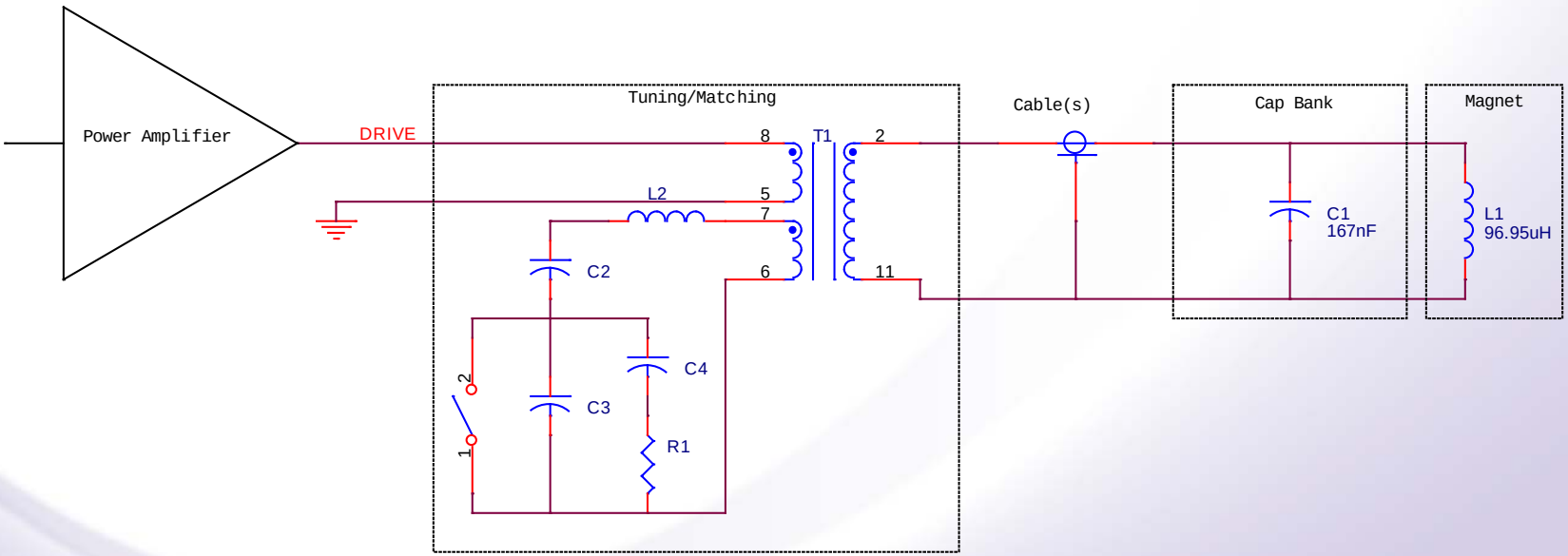


Courtesy: Lenny DeSanto

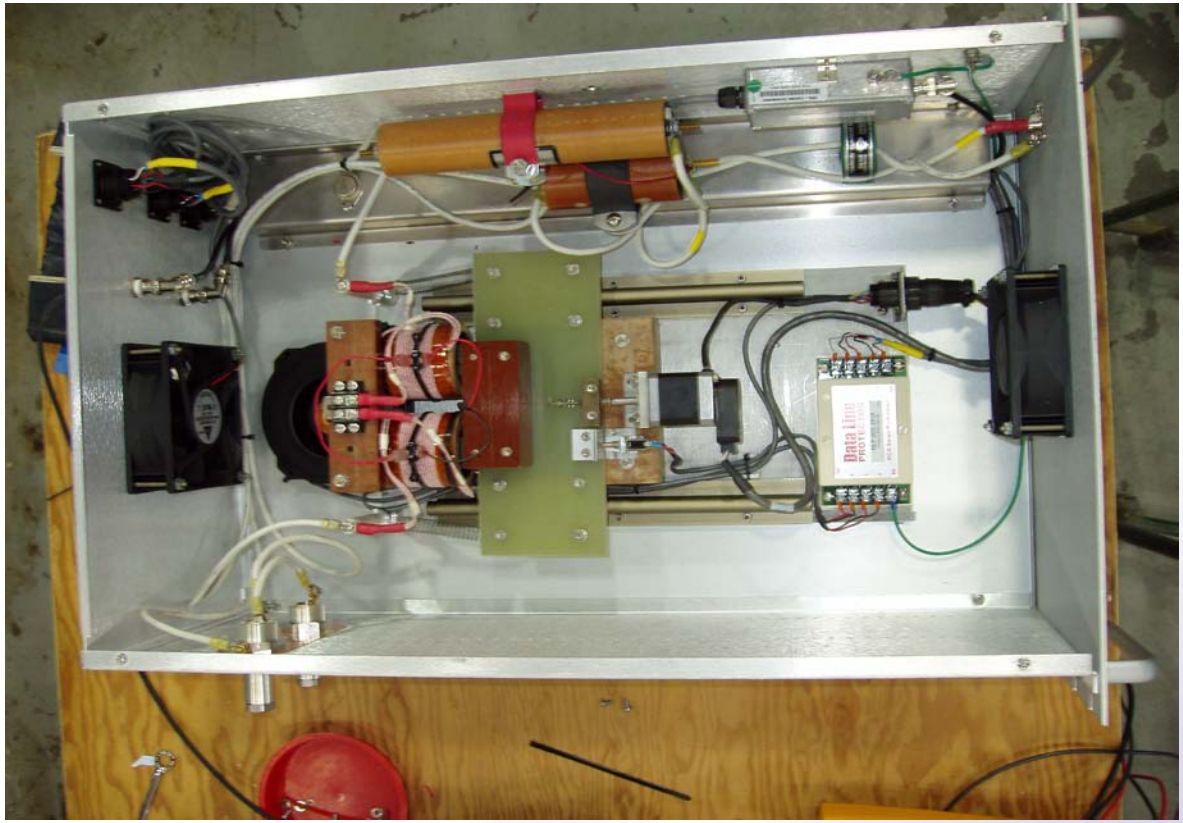
AC Dipole Power Supply

- We faced technical challenges with trying to develop Peter's original concept of dynamically switching C in and out of the circuit to change resonance.
- The coupling transformer proved to be the challenge – 3 layers of Litz wire interleaved with copper sheets were too difficult to build. We simplified the design to an inductor using only Litz wire. This inductor cancels the capacitance of the long cables from the ring.
- We used a capacitor network to match the impedance of the drive amplifier.
- The inductance was varied by mechanically separating the halves of the ferrite core.
- This system works, but there are limitations.
- We may try to go back to the electronic dynamic tuning……


Power Amplifier
DRIVE
Tuning/Matching
C2
C3
L2
Motor
Cable(s)
Cap Bank
C1
147.2nF
Magnet
L1
96.95uH


Power Amplifier
DRIVE
Tuning/Matching
8
T1
2
L2
5
7
6
11
C2
C3
C4
R1
2
1
Cable(s)
Cap Bank
C1
167nF
Magnet
L1
96.95uH

Dynamic Tuning Chassis



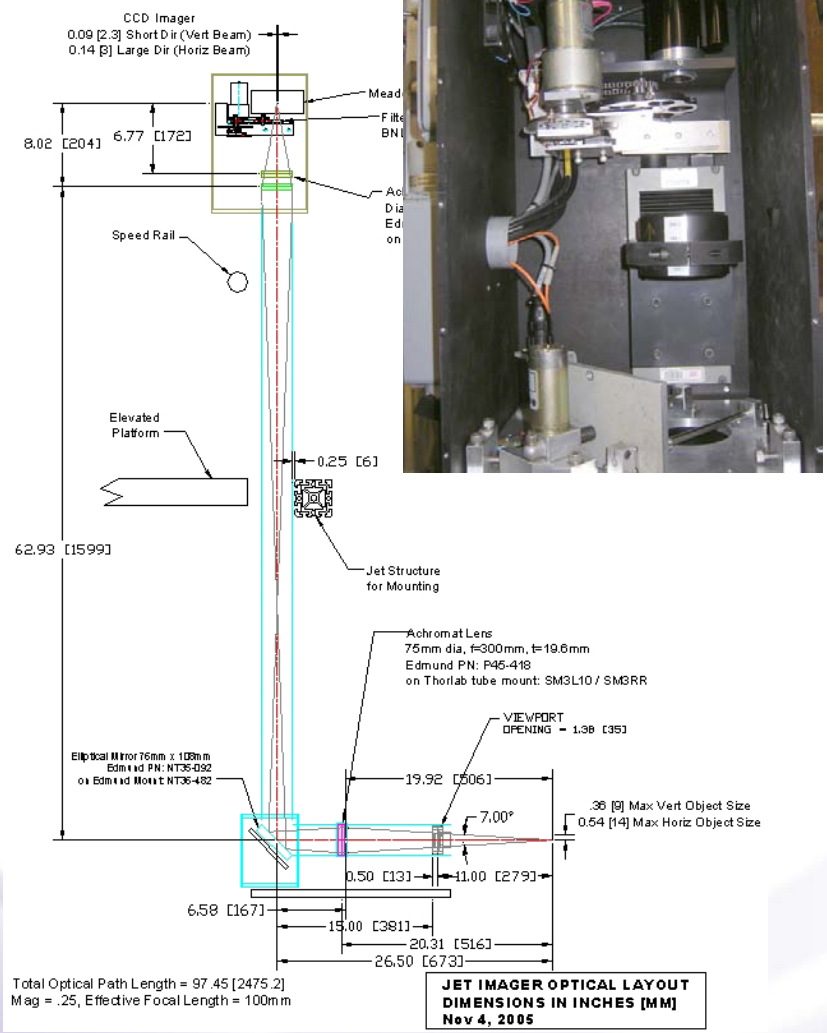
Courtesy: George Mahler, Al Ravenhall, and Joe Saetta

Luminescence Monitor Jet Camera Upgrades 2009

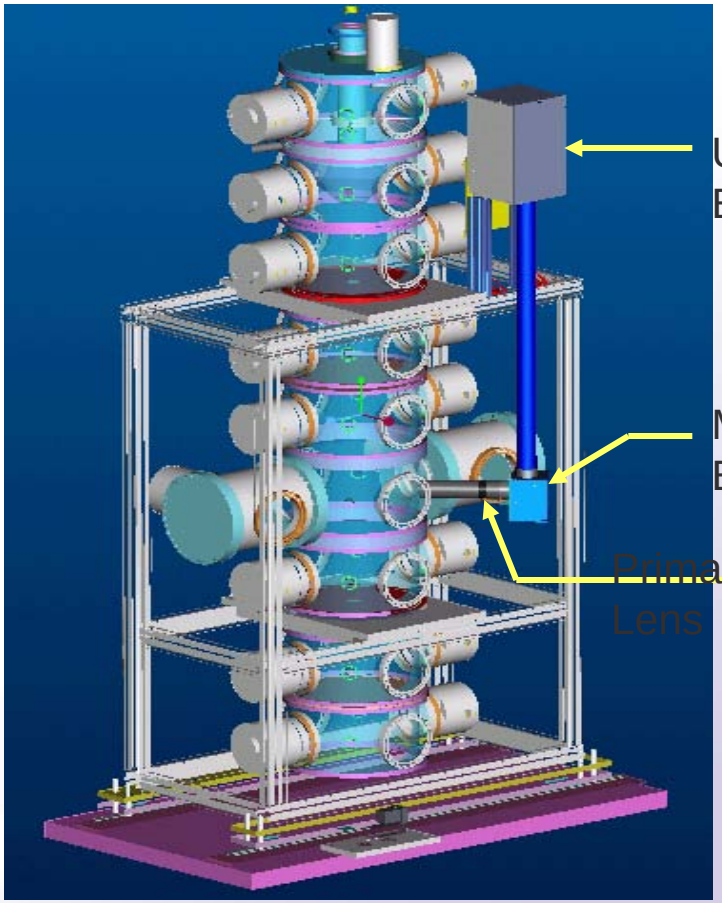
- Dave Gassner, Thomas Tsang et al replaced the CCD camera with a firewire device for near real time images back to the control room…..

RHIC Jet Beam Profile Imaging System

- Optical Layout

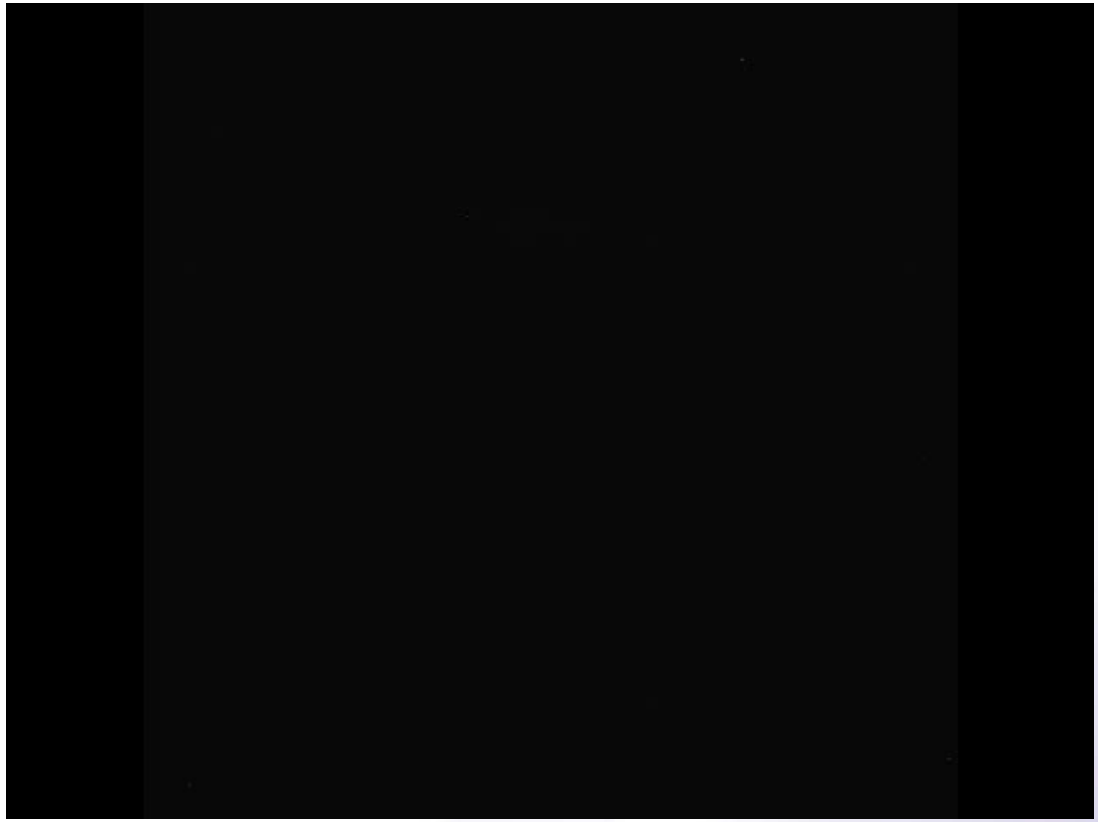


- 3-D Model



S. Bellavia

Jet Luminescence image 2009



Courtesy: Dave Gassner