

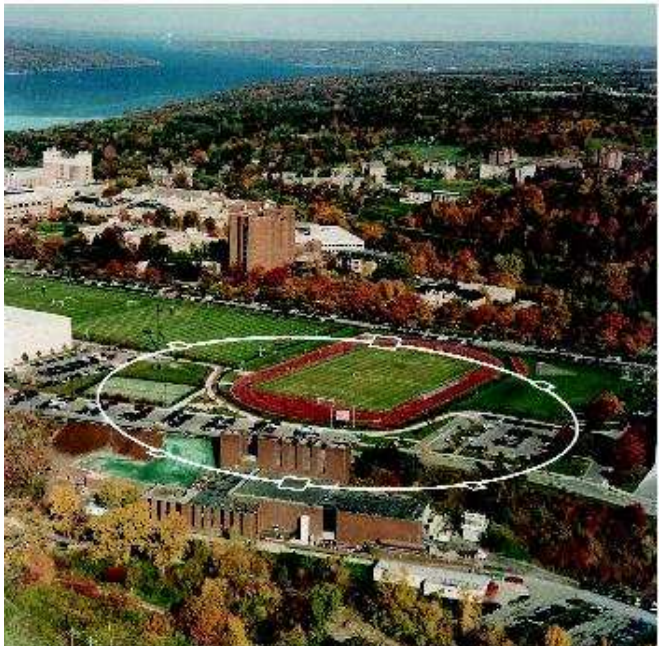
Cornell University
Laboratory for Elementary-Particle Physics

CesrTA Status, Schedule, and Recent Results

M. Palmer

for the CesrTA Collaboration

November 17, 2008







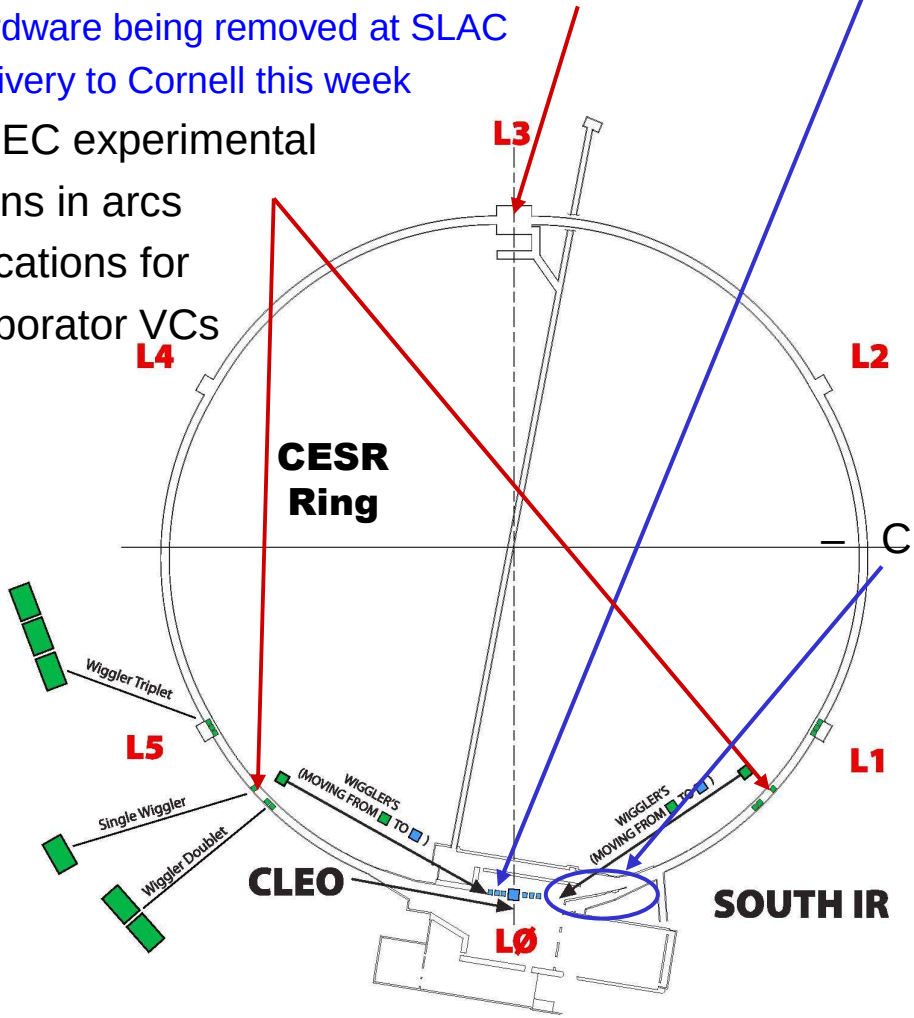


Outline

- CESR Reconfiguration
- CESR Startup
- CesrTA Commissioning Run Highlights
- Upcoming Schedule
- General Information
- Summary

CESR Reconfiguration

- Electron Cloud Diagnostics
  - L3 region prepped for arrival of PEP-II EC hardware including diagnostic chicane
    - Hardware being removed at SLAC
    - Delivery to Cornell this week
  - New EC experimental regions in arcs w/ locations for collaborator VCs
  - L0 region reconfigured as a wiggler straight
    - Instrumented with EC diagnostics
    - Wiggler chambers with retarding field analyzers (fabricated at LBNL) - scheduled for installation ~Oct 23rd
    - Chambers with EC mitigation (TiN coatings by SLAC)
  - CHESS D-line
    - Windowless (all vacuum) x-ray line upgrade
    - Addition of x-ray optics box
    - Detector setup in CHESS hutch
    - Option for longer optical lever arm by extending line to detector located in L0



CESR Startup

- Reconfiguration down concluded in early October. Highlights:
  - CESR vacuum closed week of Sept 29th
  - Linac/Synchrotron startup commenced Oct 2nd
  - First injection into CESR took place Oct 8th
  - Stored beam in CESR early Oct 13th
    - Magnet coil problem
  - Diagnostic wigglers installed Oct 23-24
  - Operation at 5.3 GeV through morning of Nov 3
    - Machine processing
    - CesrTA machine studies (particularly hardware checkout)
  - 2.0 GeV CesrTA Experiments : Nov 3-Nov 10

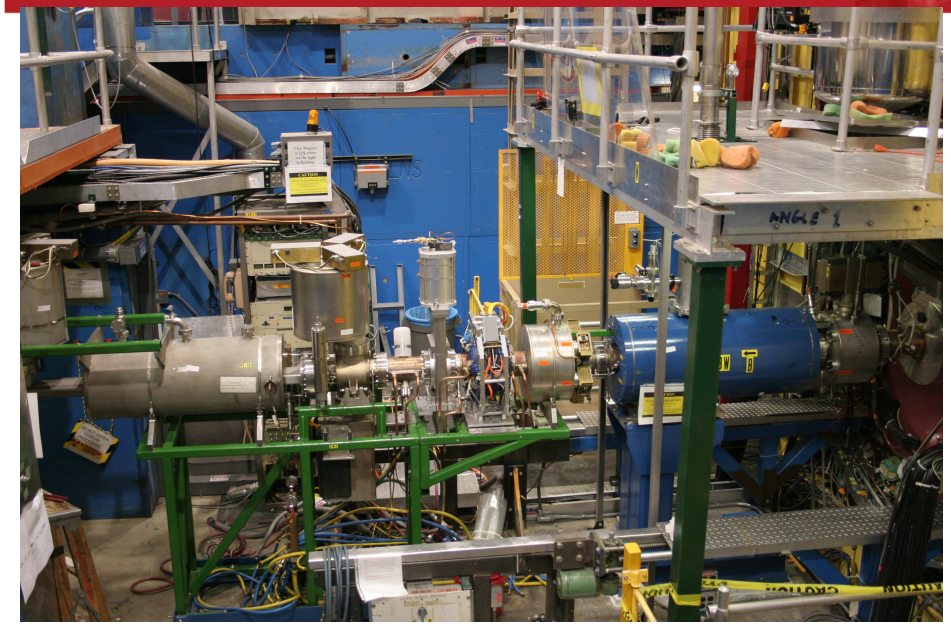
    Electron Cloud Experiments

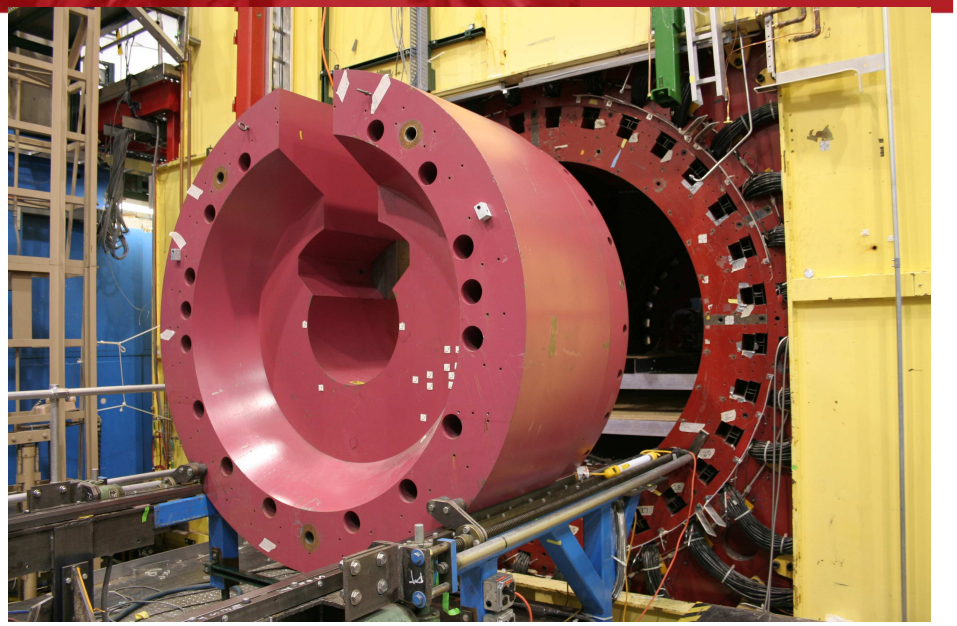
    Low Emittance Optics

    X-ray Beam Size Monitor

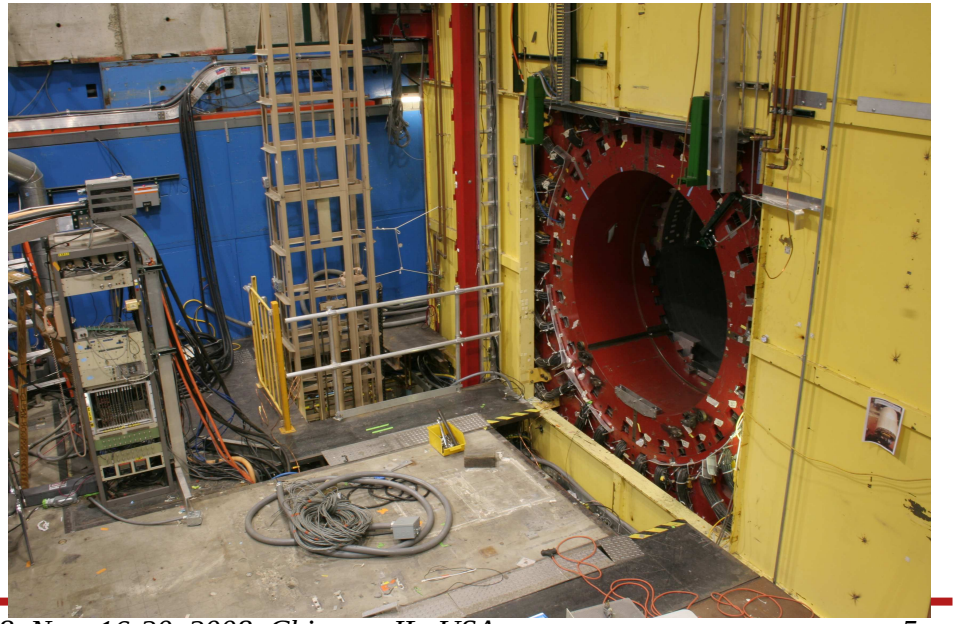
    Instrumentation Checks

L0 Modifications

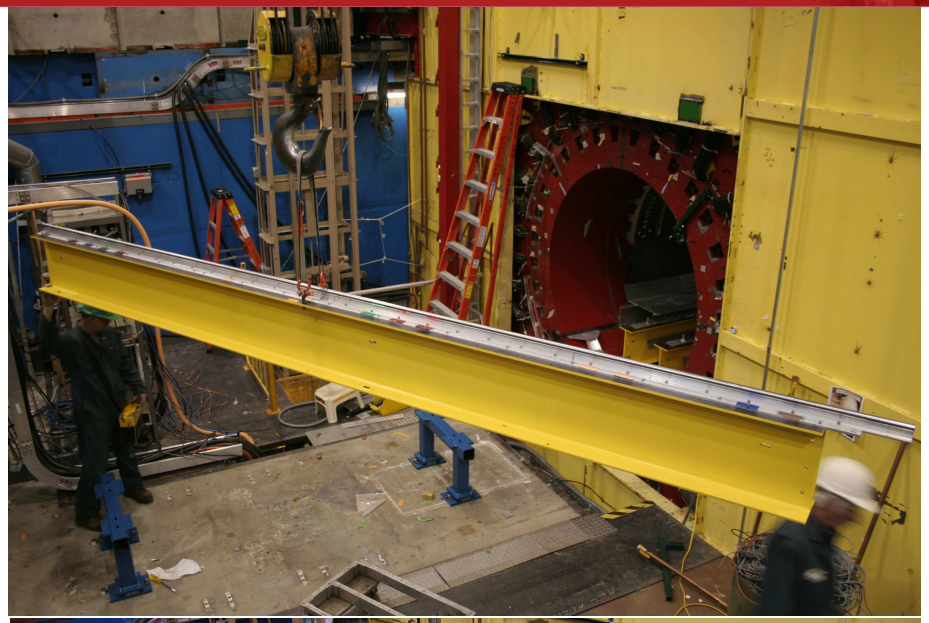


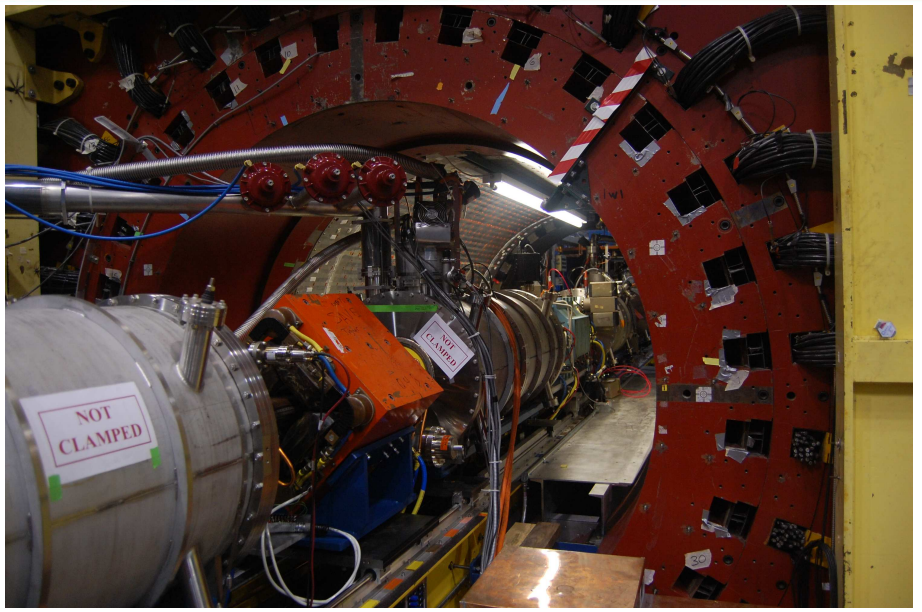


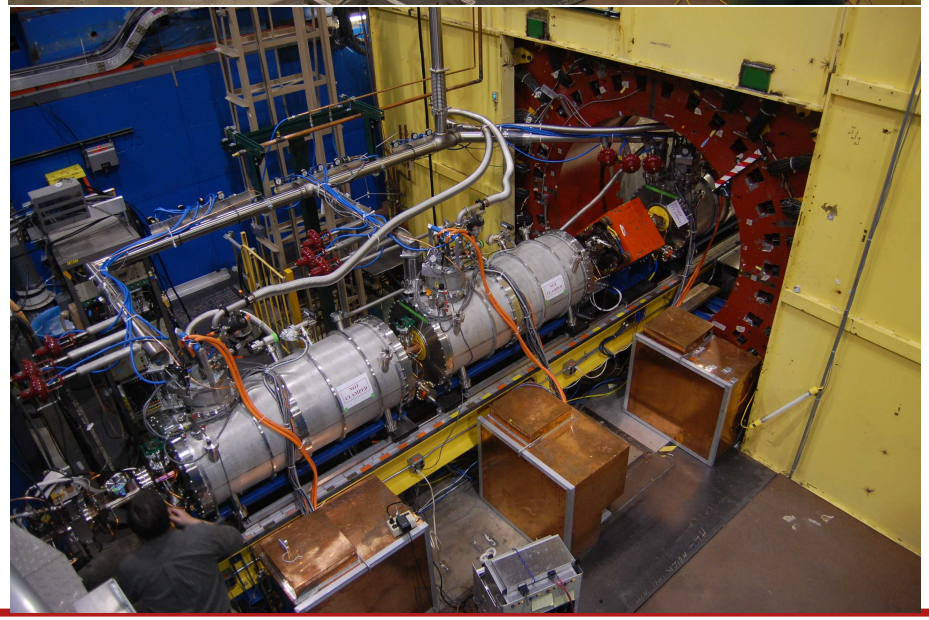


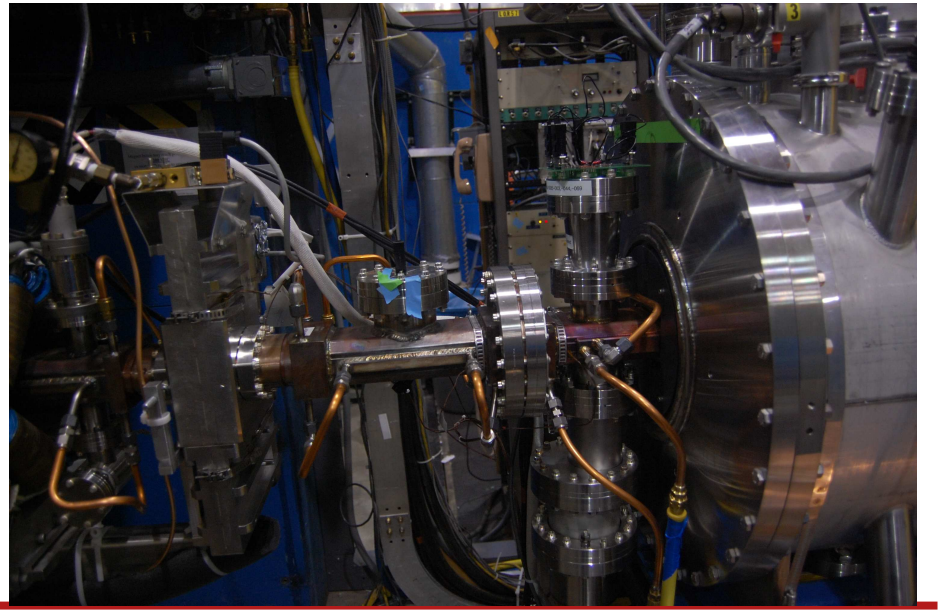


L0 Modifications



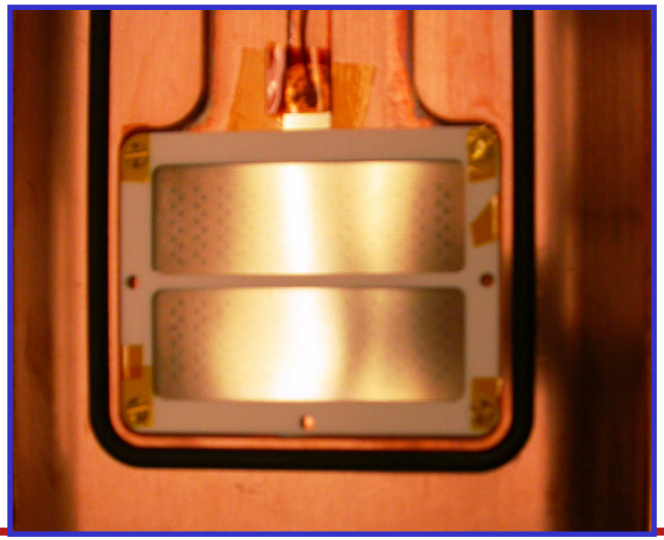






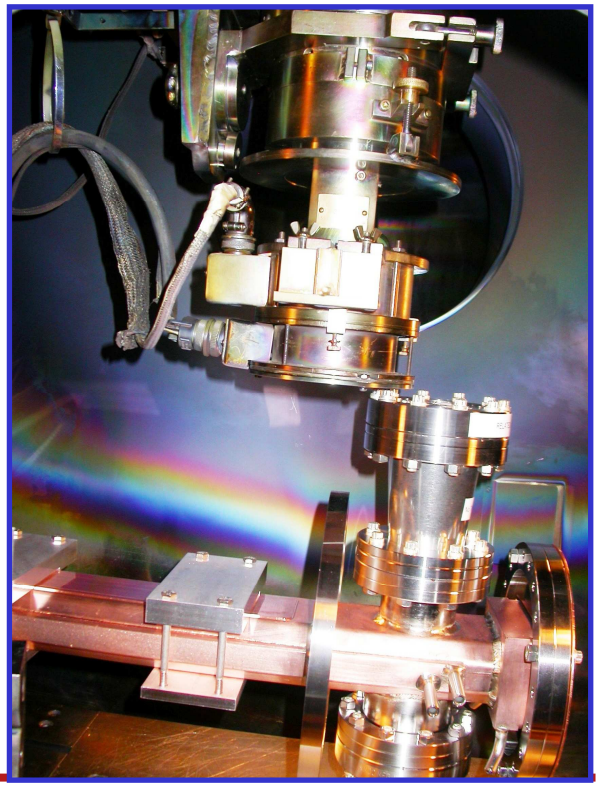
Wiggler EC Diagnostics

- RFAs assembled and checked for both VCs
- E-beam welding
  - 1st VC complete
  - 2nd VC on Oct 10
- Installed into cryostats week of Oct 14
- Installed into CESR Oct 23-24

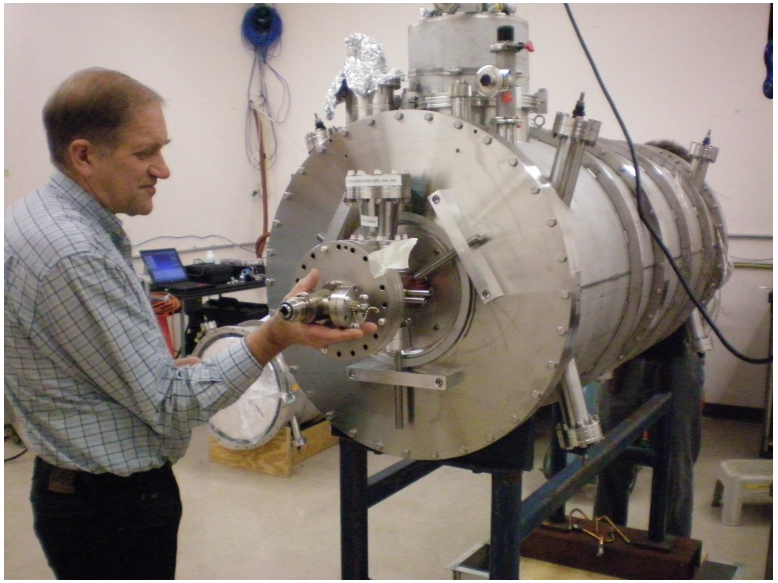






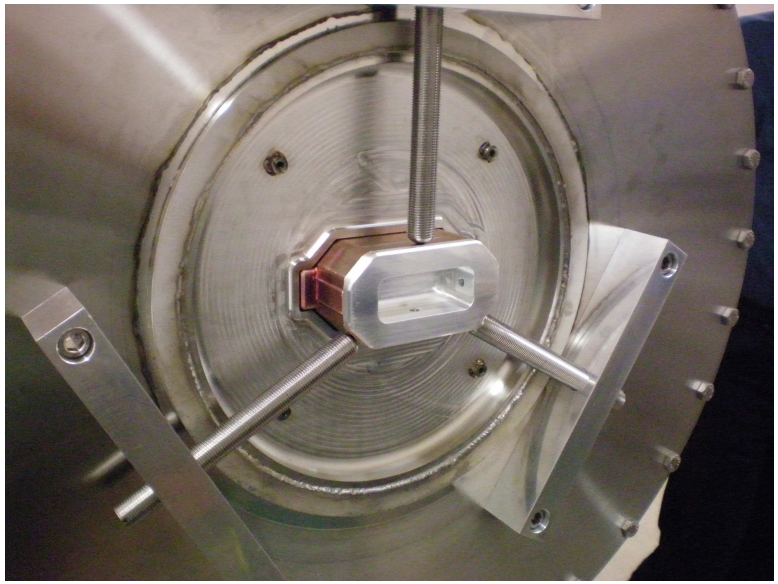


Wiggler VC Cryostat Installation





1st VC ready for welding into cryostat





CesrTA - xBSM

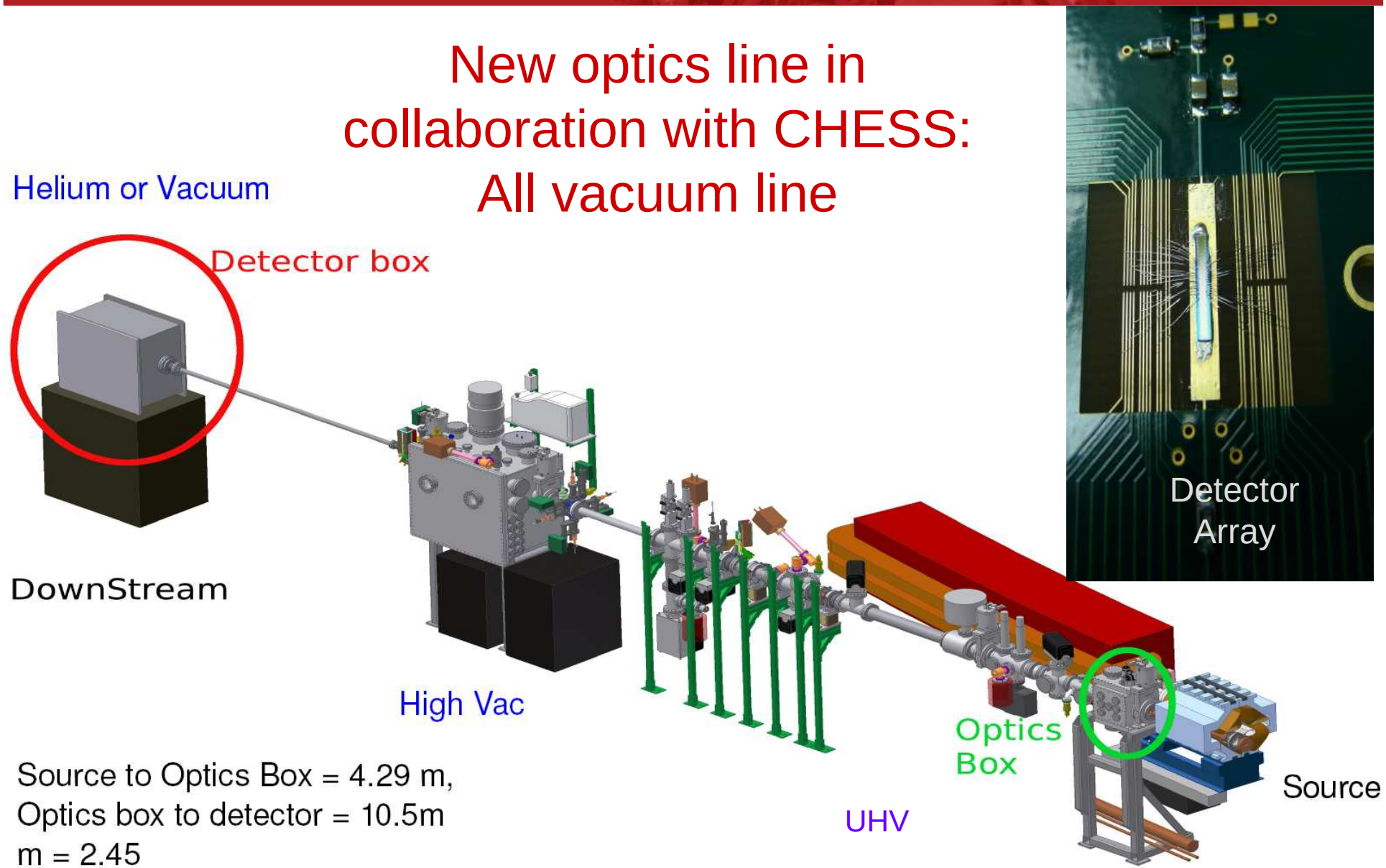
- X-ray beam size monitor
  - Upgrade of the positron x-ray beam line is complete (windowless line)
    - 4μm diamond window to isolate storage ring and beam line vacuum will be tested with a beryllium backup in January run
  - X-ray optics
    - "Simple" optics (adjustable slit and 3 slit coded aperture) for Oct-Nov 2008
    - Optical Array Element from Applied Nanotechnologies arrives in December
      - 230 ring fresnel zone plate and 41 element coded aperture on a single substrate
  - X-ray detectors
    - Detectors (from 3 different vendors) tested in Oct-Nov

X-ray beam size measurement

- Measurement of the size of the positron beam with few micron resolution beginning in January 2009 run
- Single bunch/single pass measurement May-June 2009 run

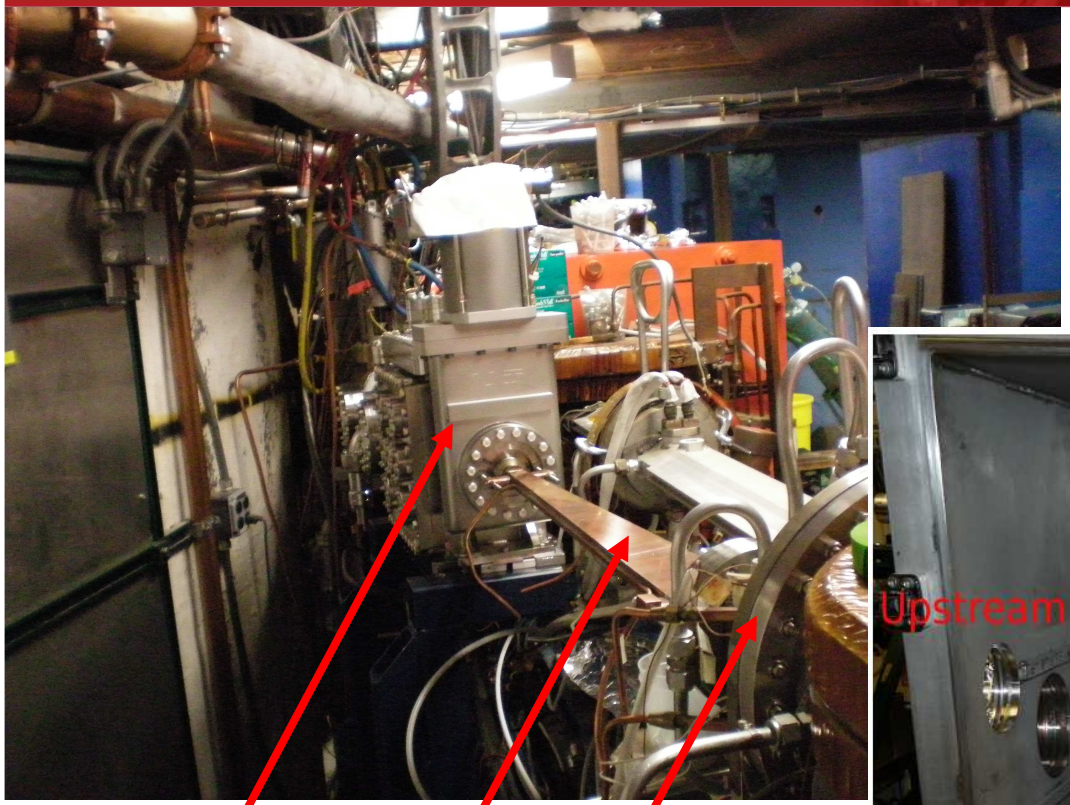
xBSM

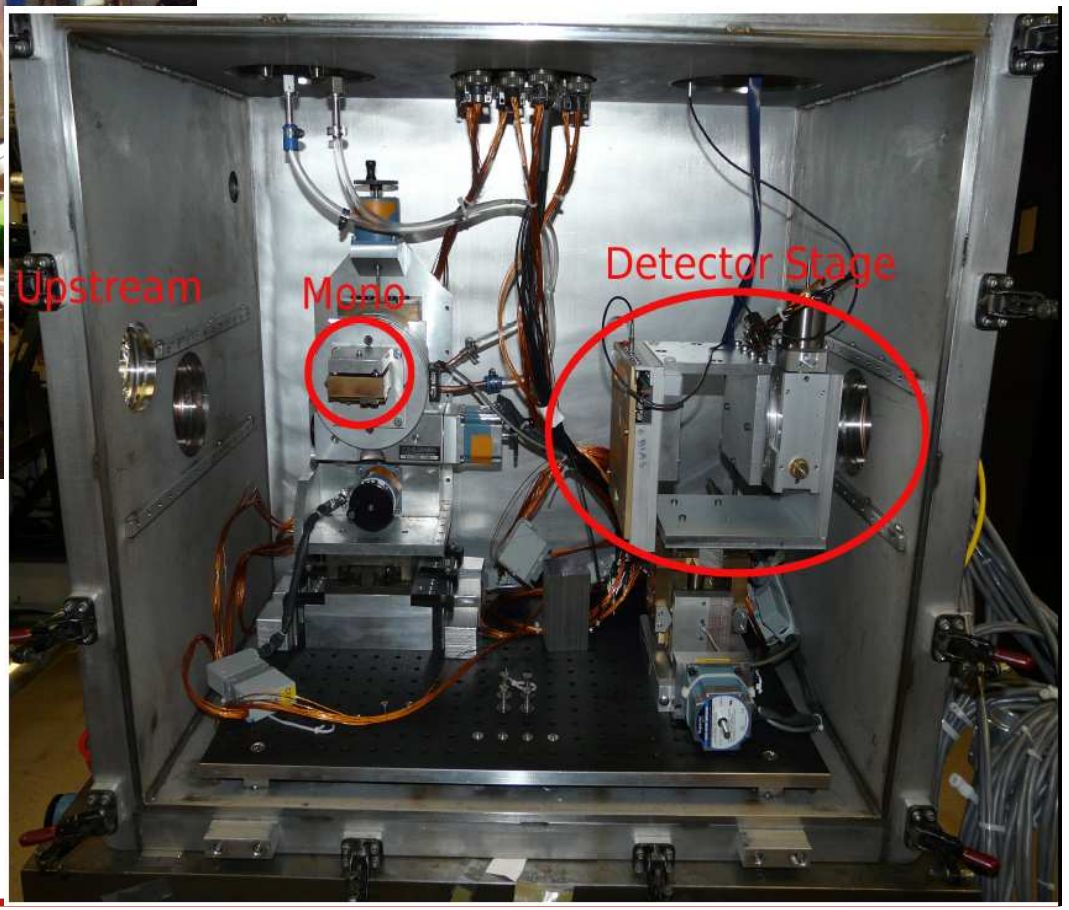
New optics line in collaboration with CHESS: All vacuum line



Source to Optics Box = 4.29 m,
Optics box to detector = 10.5m
m = 2.45

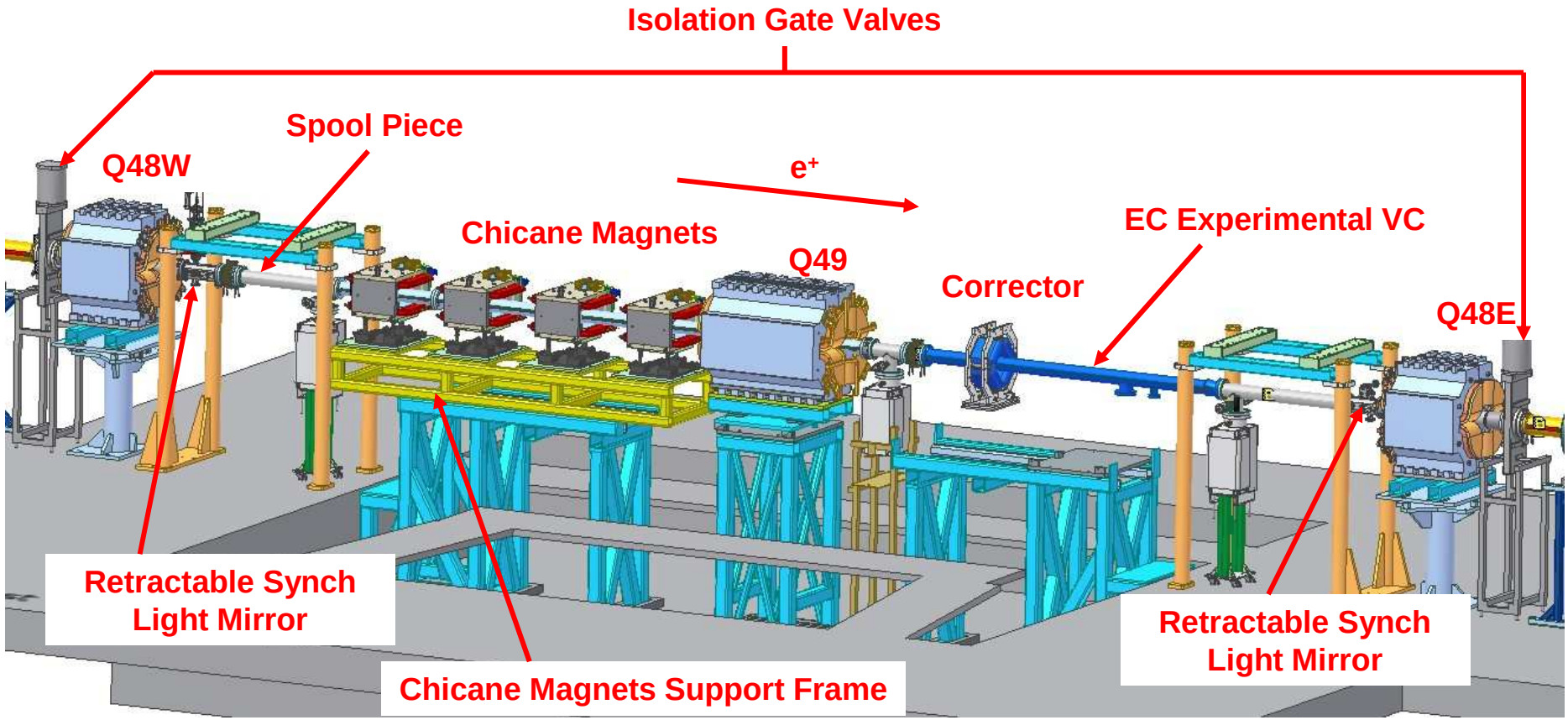
xBSM Optics Box





L3 Preparations

- In L3, removed vertical separators and installed gate valves to isolate experimental region
- PEP-II EC Hardware to arrive at Cornell by end of this week



L3 Region Isometric View for February 2009

Commissioning Run

- Short 2 week commissioning/machine processing run
  - 1st week at 5.3 GeV (hardware commissioning)
  - 2nd week at 2.0 GeV (wigglers on/low emittance lattices)
- Key Goals
  - Electron Cloud Studies
    - Deploy and commission wiggler RFAs, carry out a minimal set of RFA experimental measurements
    - Study of systematic effects in multi-bunch tune measurements
    - Set up TE wave measurements in new wiggler straight
  - Optics and LET
    - Commission new ring layout and optics
    - Begin work on optics correction
  - Instrumentation and Feedback
    - X-Ray Beam Size Monitor (xBSM)
      - Commissioning of upgraded CHESS D-line, x-ray optics, and detectors
    - Beam Position Monitor System Tests
    - Feedback System (4ns)
      - Test upgraded transverse feedback system
      - Longitudinal instability threshold measurements and upgrade specifications
- All tasks time-limited
  - Initial checks only
  - Provide guidance for longer dedicated run in January 2009
- A few highlights are shown on the following pages…

Wiggler Straight



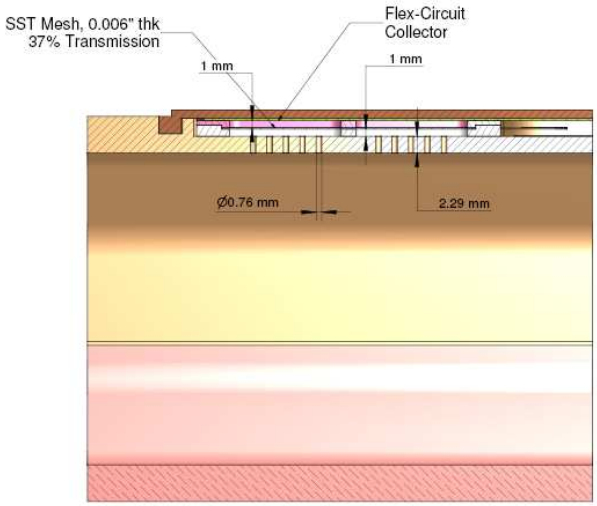
- Zero dispersion straight for low emittance
- Wiggler experimental region – local EC measurements
  - Retarding Field Analyzers
  - TE Wave Transmission Experiments

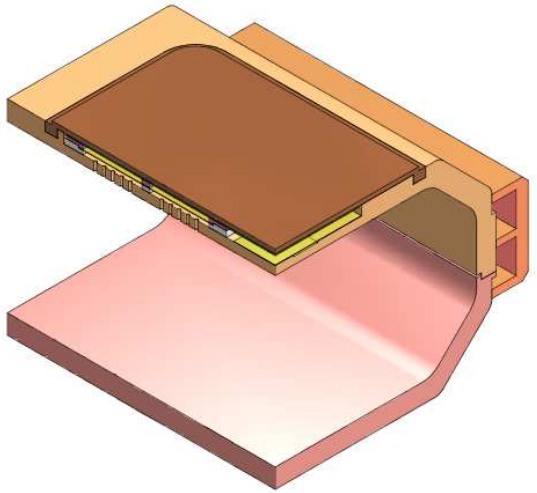
Optics

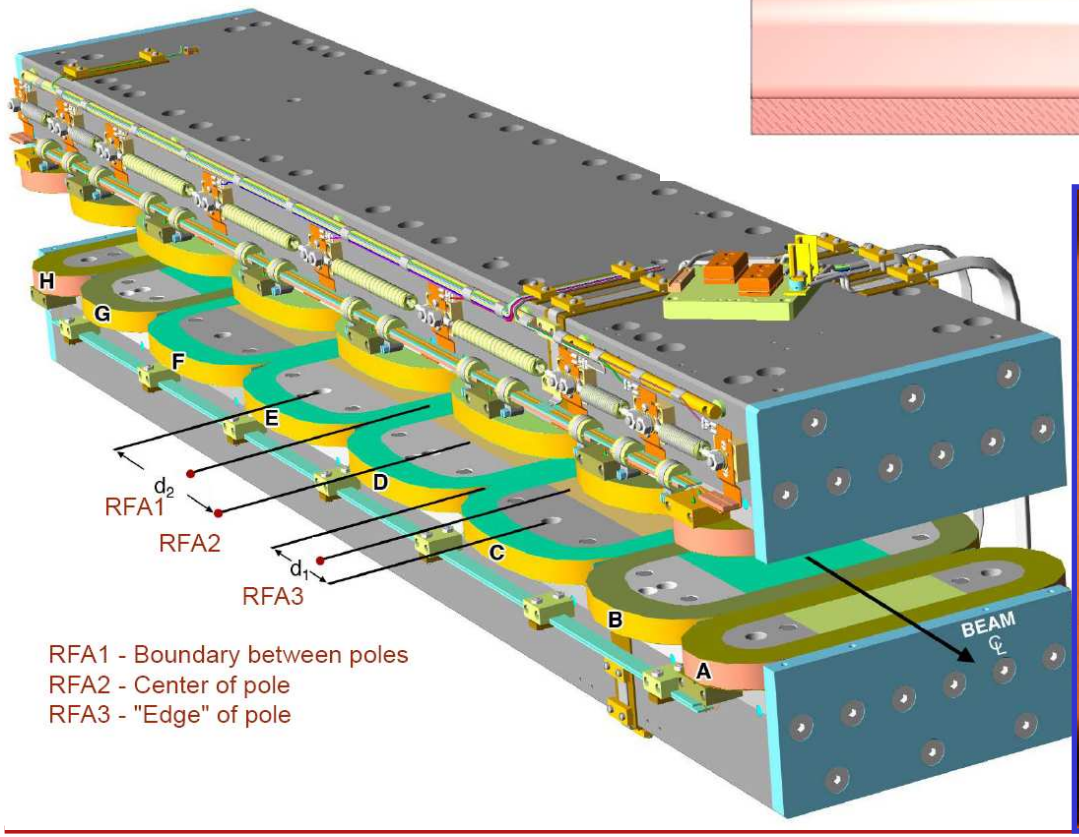
- A sequence of low energy optics was employed
  - Low energy "startup-optics"
    - Qx=10.57, 2.085GeV
    - Arc quads same as June 08 low energy operation (differences only in L0 and L3)
    - Wiggler field 1.9T
  - High tune - intermediate emittance optics
    - Qh=14.57, same L0 quads as "start-up", 2.085GeV
  - High tune - low emittance (2.6nm)
    - Tune up electron and positron injection.
    - Begin process of correcting betatron phase, coupling, dispersion
    - Create and tune orbit bumps to direct light onto xBSM
    - Good injection efficiency indicates that dynamic aperture is adequate
- Commissioning emphasis during run provided time for loading optics and establishing initial conditions but essentially no time for low emittance tune-up.

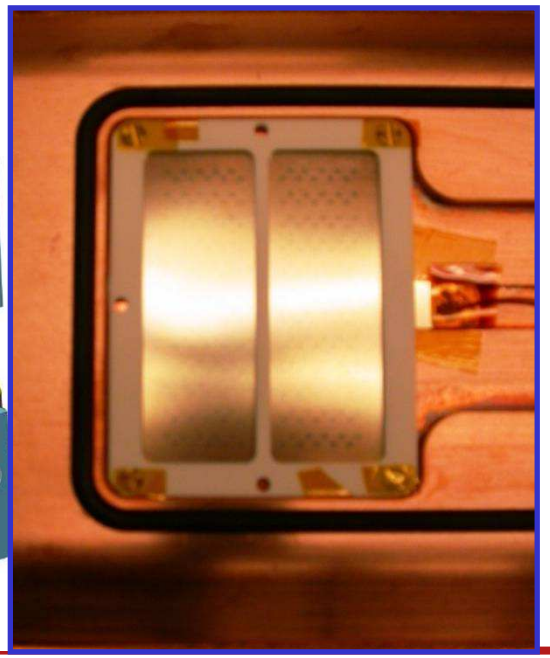
Wiggler RFAs

- RFA chamber during assembly and locations of detectors in superferric wiggler. 3 RFAs in each vacuum chamber at different field locations. (CU/KEK/LBNL/SLAC)





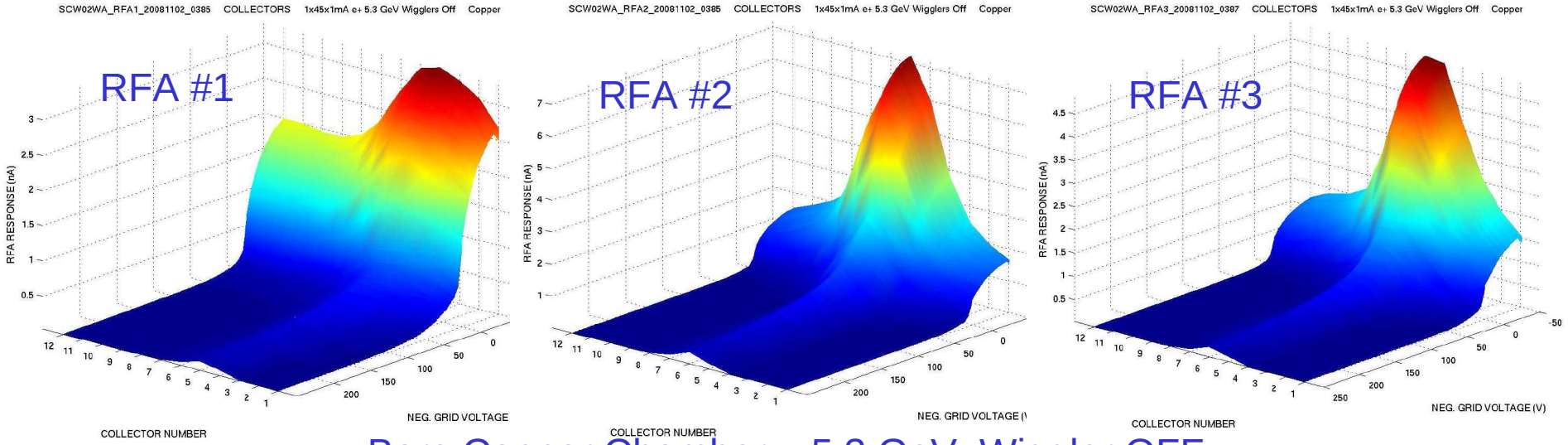




12 collectors across top of vacuum chamber

1 retarding grid spans the 12 collectors

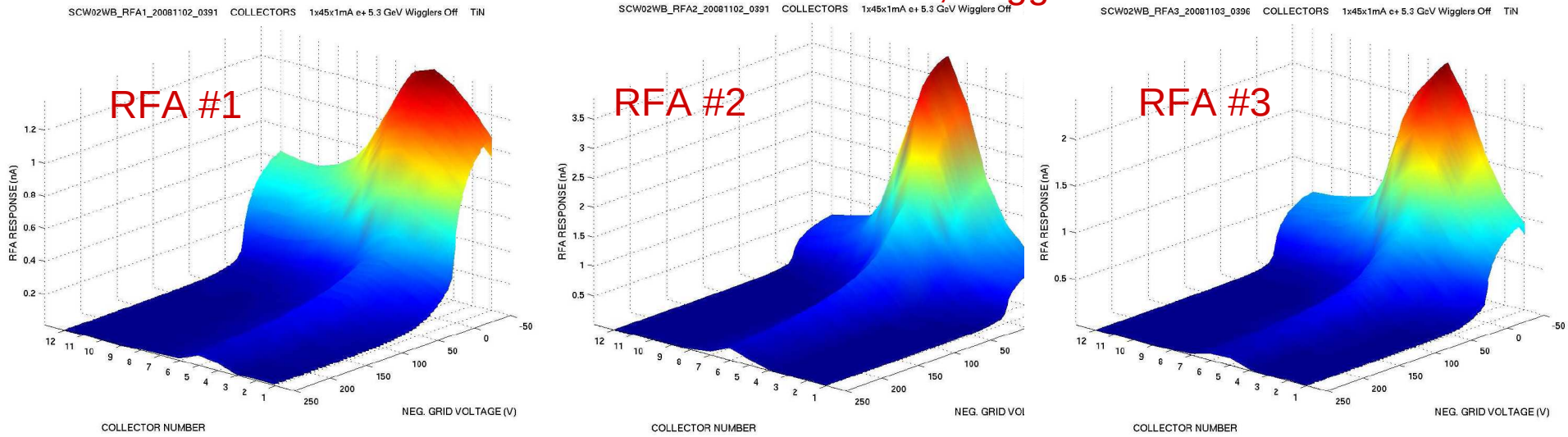
Wiggler RFA Characterization



Bare Copper Chamber – 5.3 GeV, Wiggler OFF

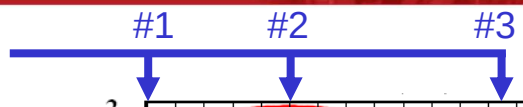
1x45x1mA positron beam, 14 ns bunch spacing Some Residual Field Present

TiN-coated Chamber – 5.3 GeV, Wiggler OFF

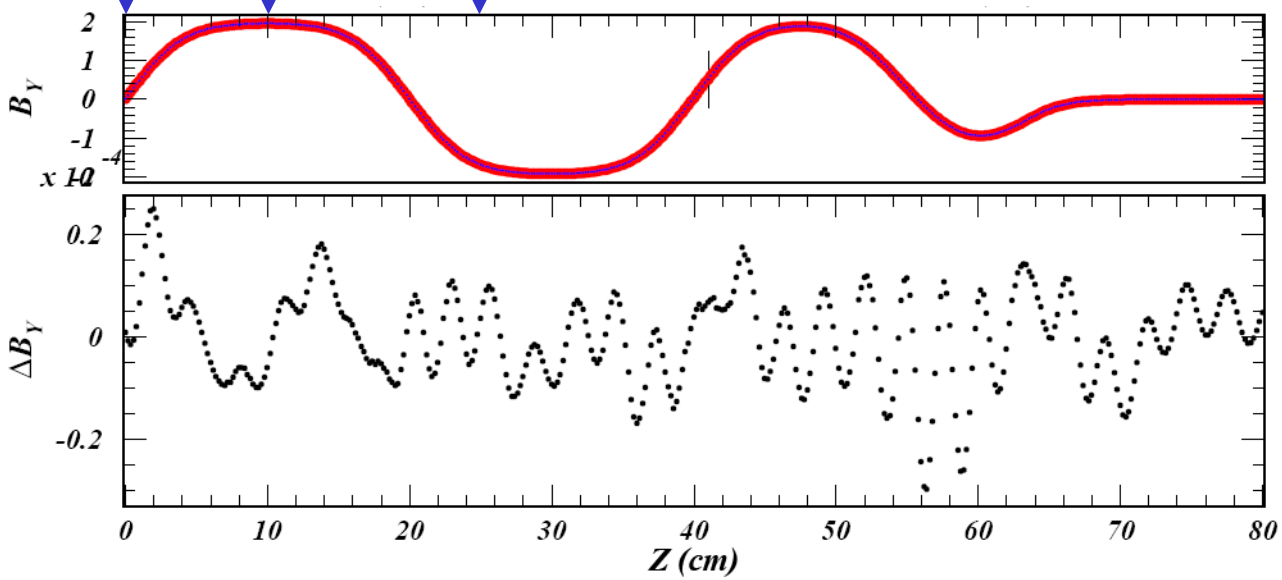


Fields in the Wiggler

Wiggler RFA Locations:

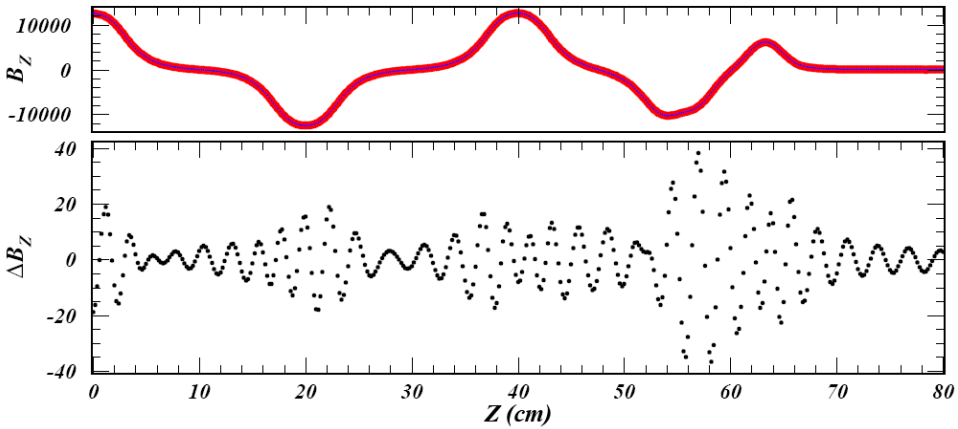


Vertical Field (G) along axis (x,y)=(0,0)



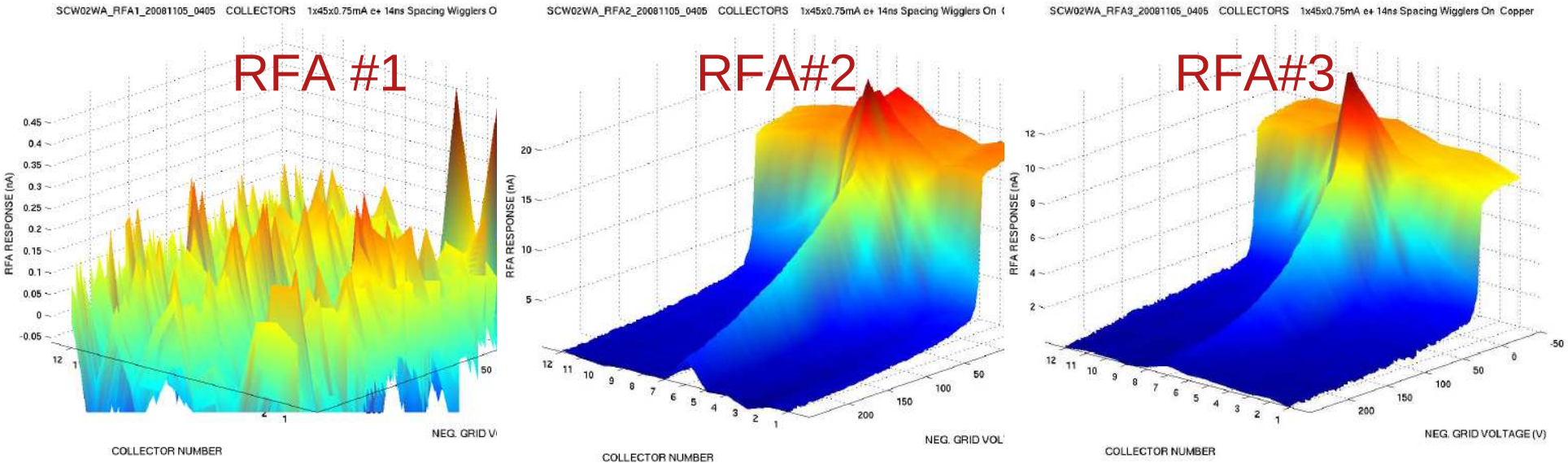
- Detectors
  - RFA #2 - choice of detector at peak field is obvious.
  - RFA #1 - should be a “canary”, ie, no EC electrons expected to penetrate longitudinal field lines with field applied.

Longitudinal Field (G) along axis (x,y)=(0,2.4) [cm]



Comparison of Wiggler RFAs

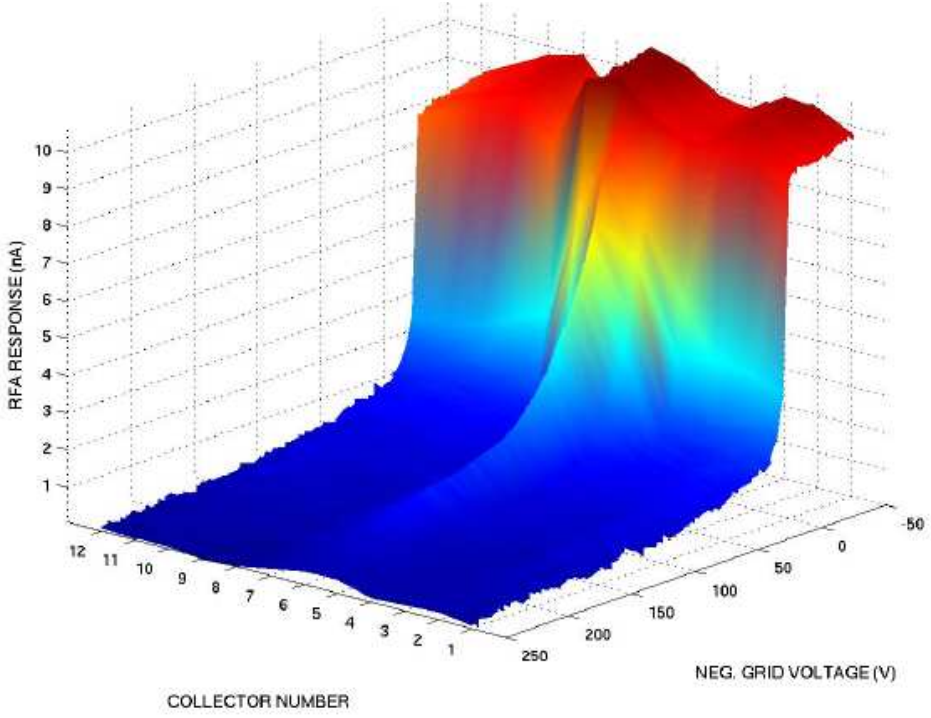
Cu Wiggler Chamber RFAs at 2 GeV:



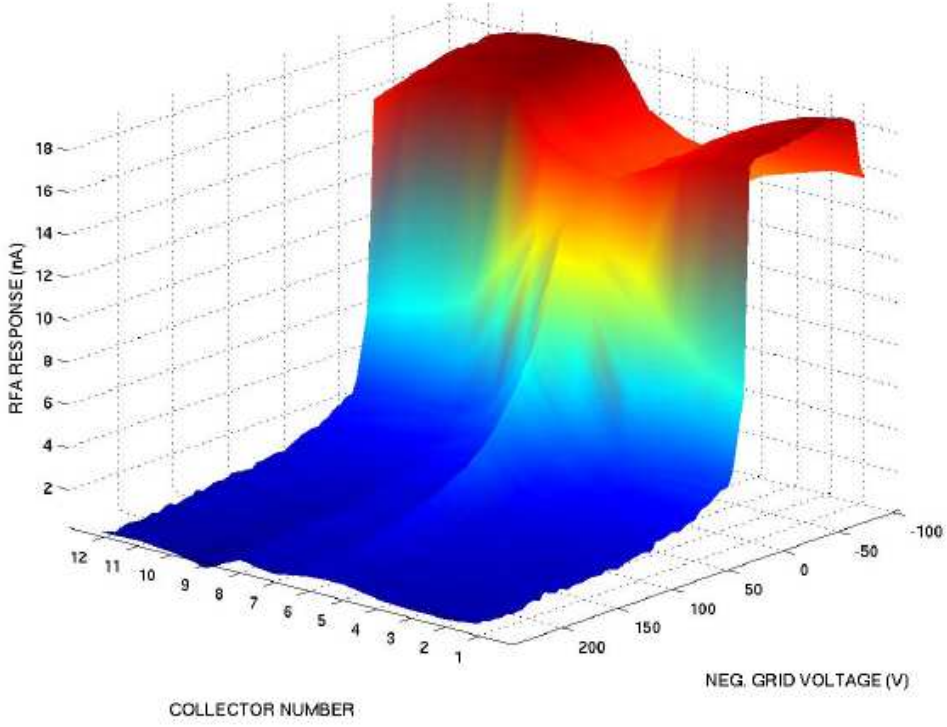
1x45x0.75mA (1.2×10^{10}/bunch)

More Cu vs TiN Comparisons

1 × 45 × 0.4 mA (0.64×10^{10}/bunch), 14ns, Cu



1 × 45 × 0.5 mA (0.8×10^{10}/bunch), 14ns, TiN

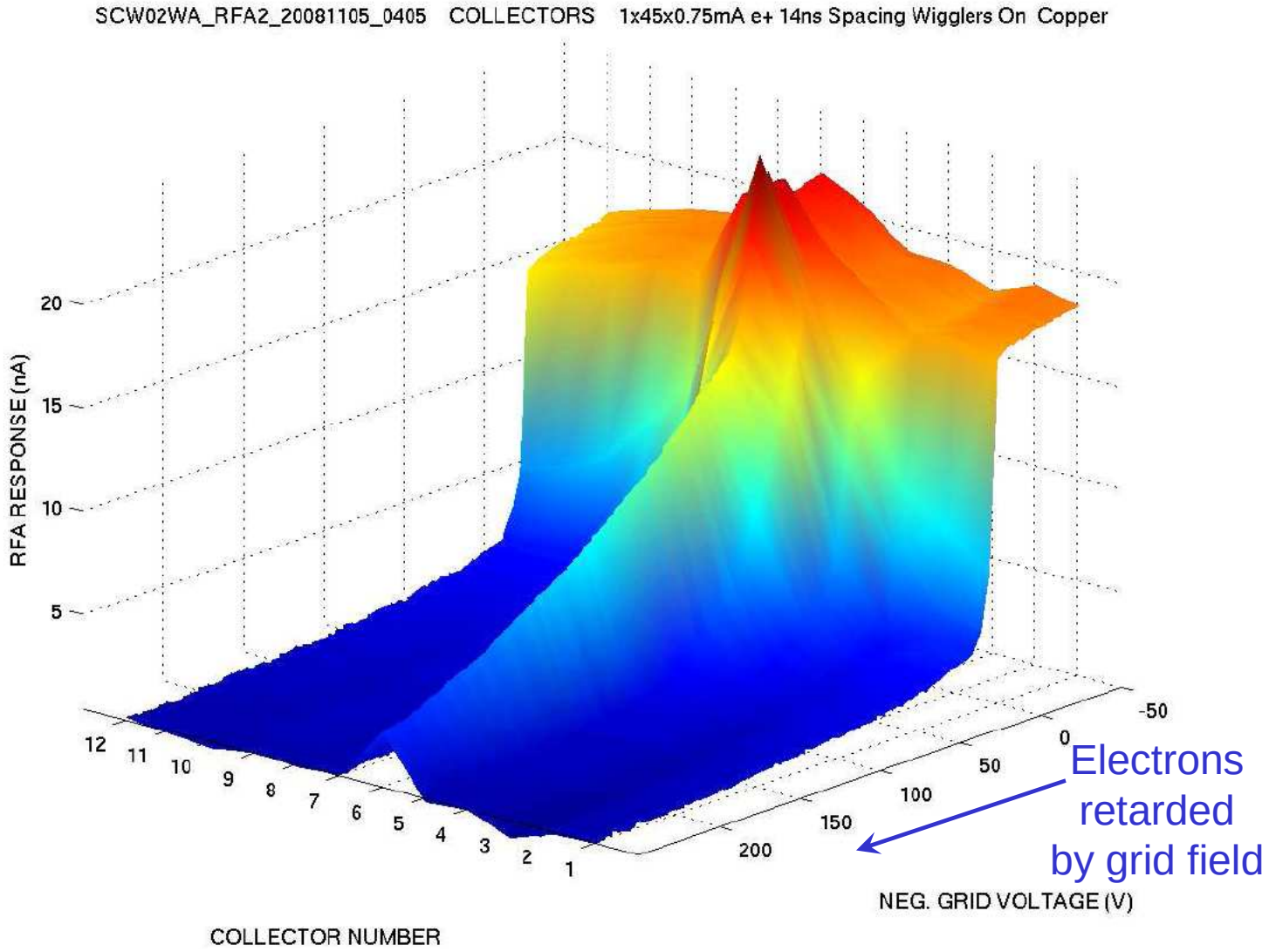


- Low bunch current checks
- RFA in center of pole for each wiggler

- Activity in central region appears suppressed

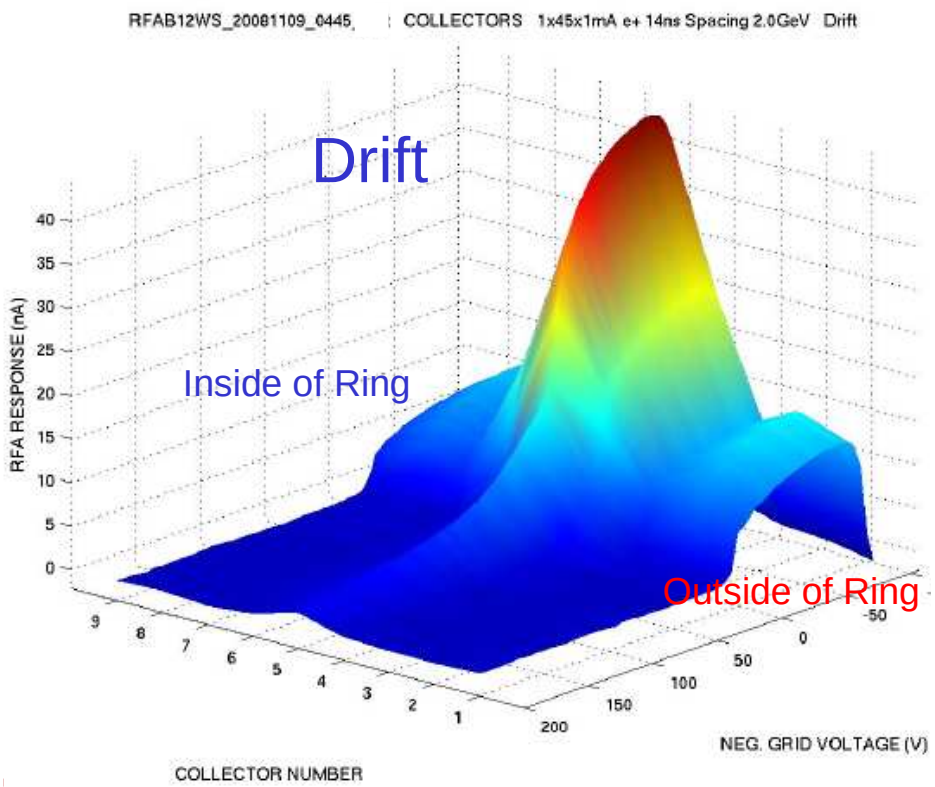
Wiggler RFA Data

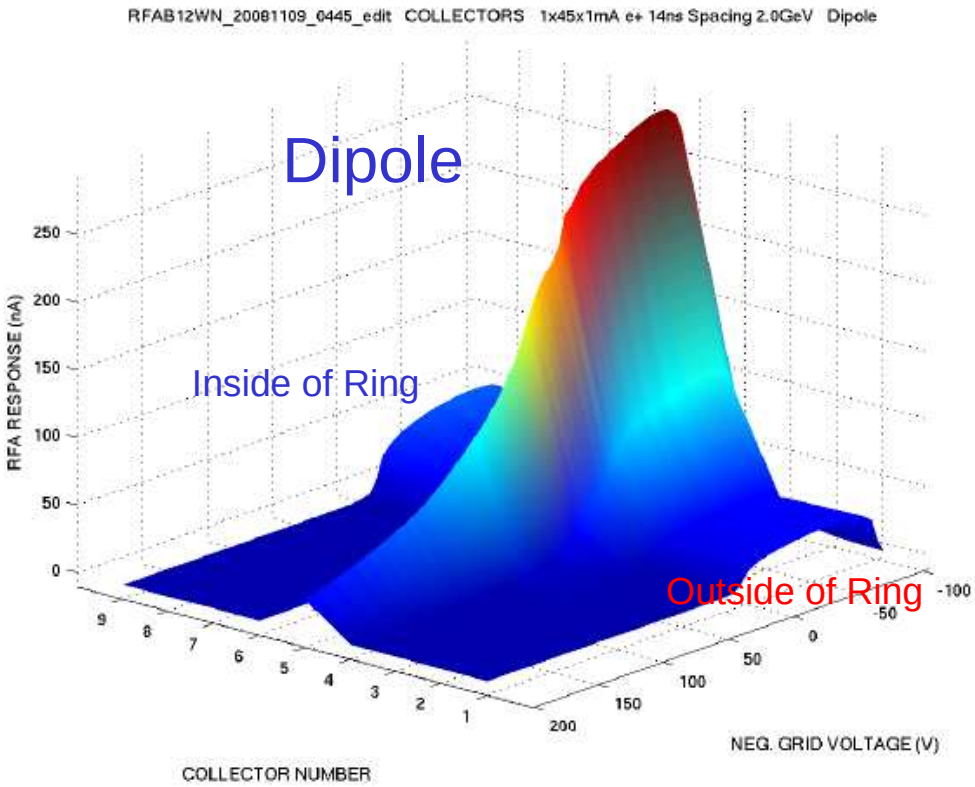
- 1 Train, 45 bunches, 1.2×10^{10} positrons/bunch



CESR Al Vacuum Chamber RFAs

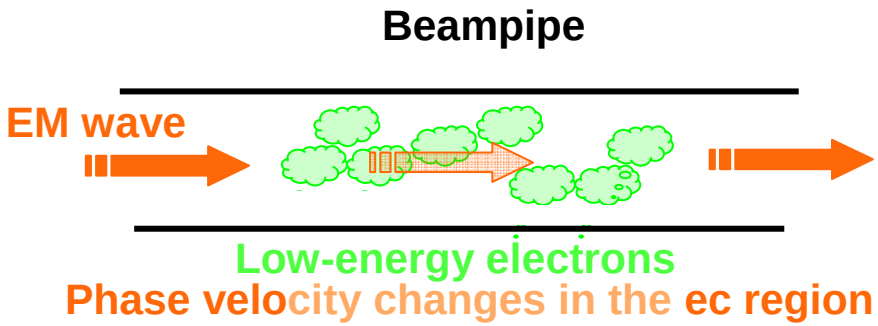
- Look at CESR vacuum chamber RFAs in drift and dipole
- 1× 45×1mA (1.6×10^{10}/bunch) at 2 GeV
  - Data smearing issue seen in June run (power supply problem) has been fixed





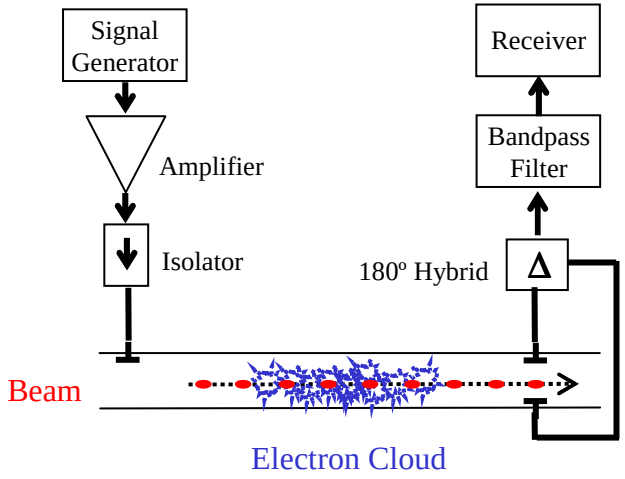
TE Wave Measurements in CesrTA

Induced phase modulation in the propagation of EM waves through the beampipe

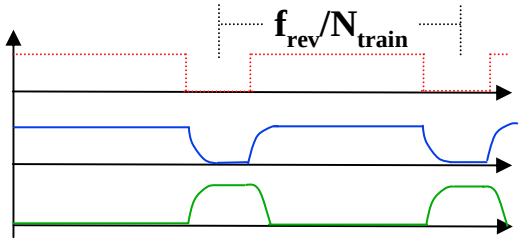


$$k^2 = \frac{\omega^2 - \omega_c^2 - \omega_p^2}{c^2}$$

plasma frequency
$2c(\pi \rho_e r_e)^{1/2}$



Experimental apparatus

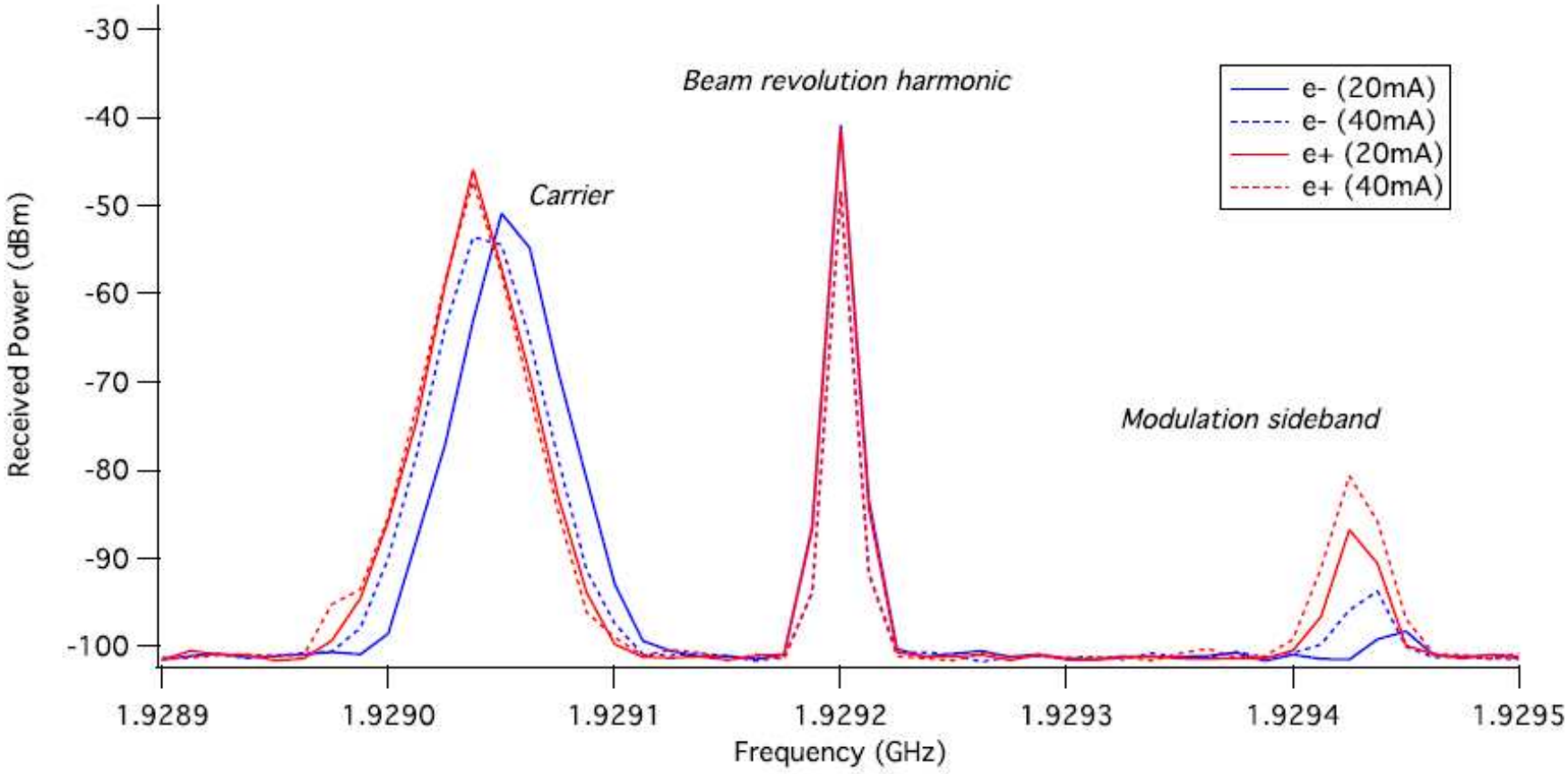


Positron current
E-Cloud Density
Relative phase shift

Gaps in the fill pattern set the fundamental modulation frequency (1st sideband). Higher order components depend on the transient ecloud time evolution during the gap passage.

TE Wave Measurements

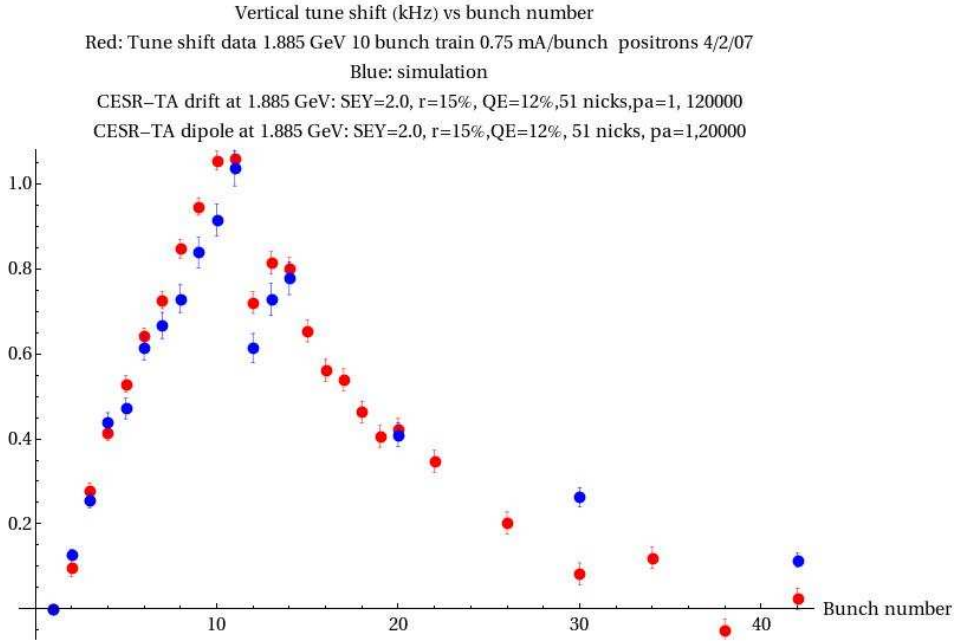
Observed modulation signal for both electron and positron beams at 14W test location in CESR.



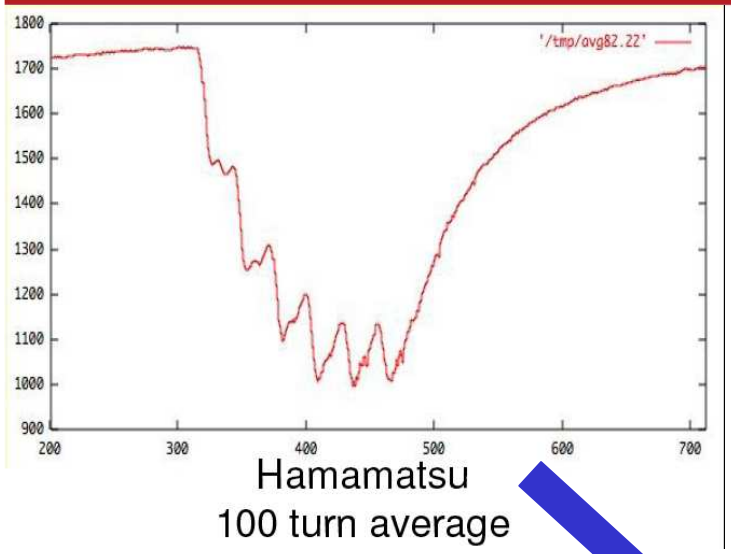
Simulation Effort

- Major effort underway to understand recent data as well as to benchmark codes.
  - RFA response
  - Data-simulation comparisons
  - Detailed comparisons between codes
- See talks in next session

Comparison with data of 4/2/07
Coherent vertical tune shifts at 1.9 GeV



xBSM Detector Time Response



Hamamatsu
100 turn average

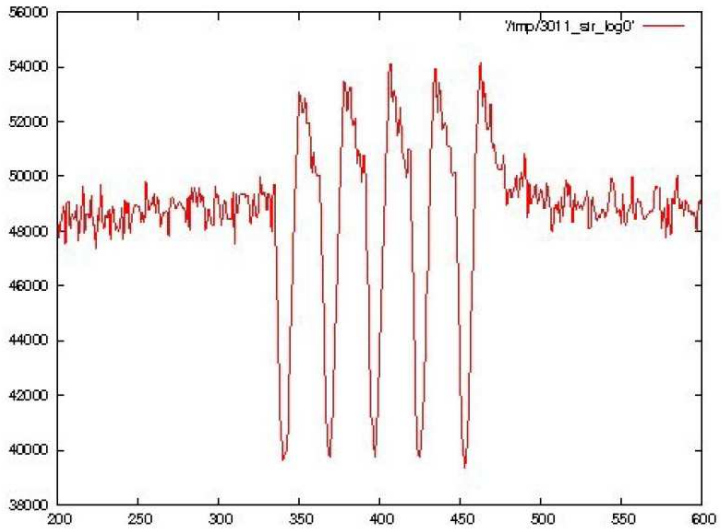
After previously discovering very slow recovery times with Hamamatsu diode arrays (fabrication issue – not fundamental), it was critical to test the response of alternate detector arrays. Excellent time response found from 2 suppliers!

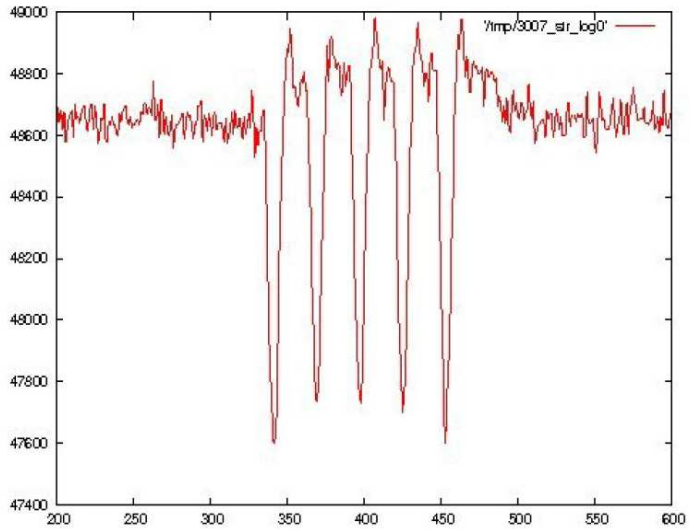
14 ns spaced bunches

Kyosemi

Amplitudes are average over 100 turns

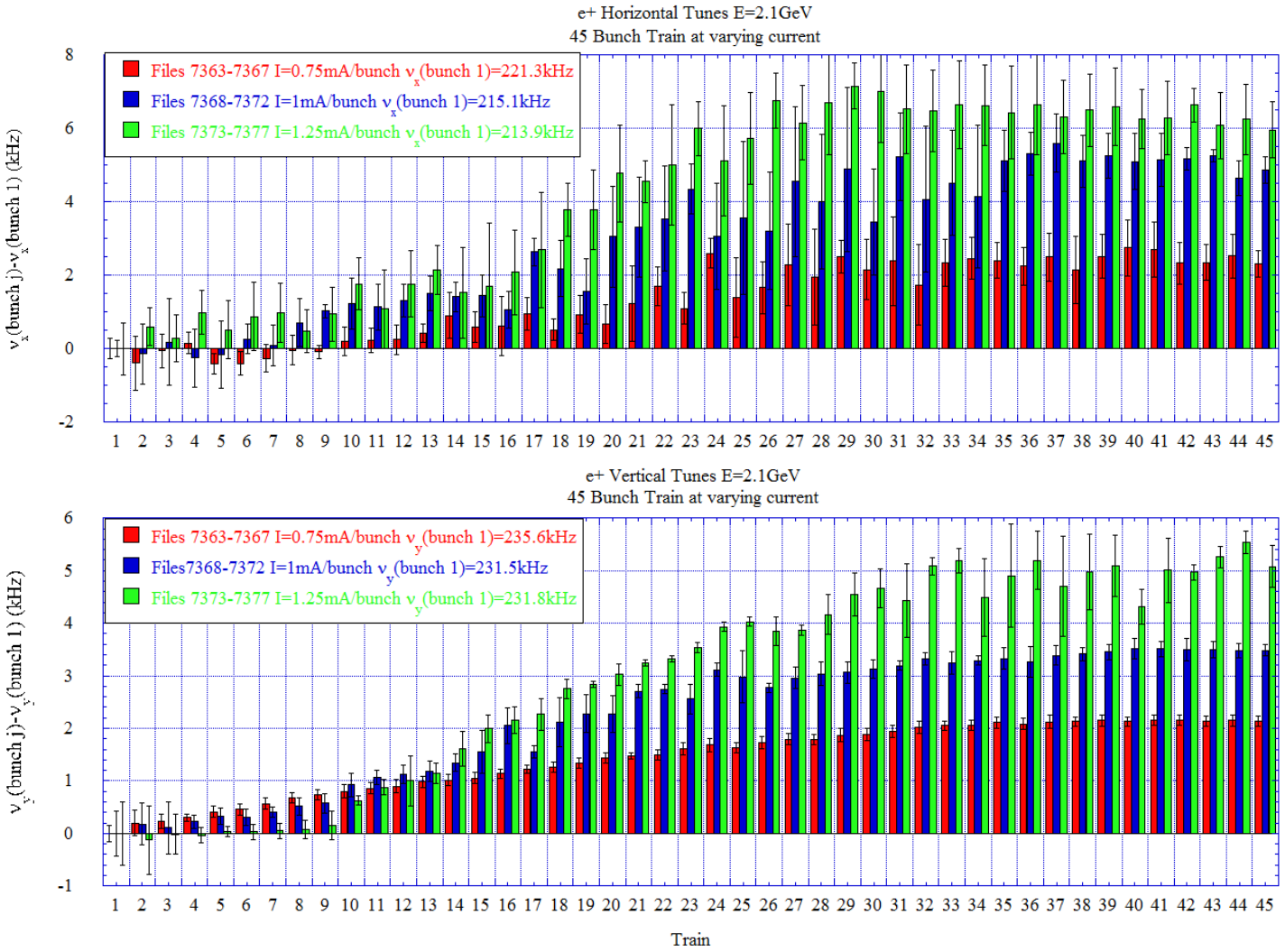
Fermionics





A Surprise

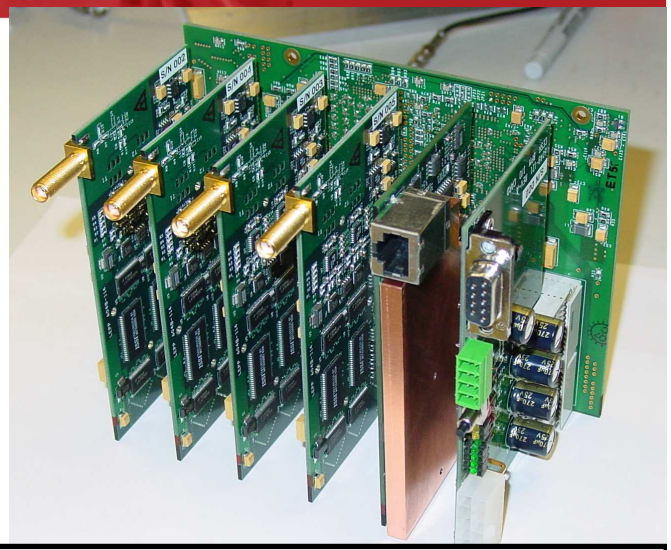
- During a brief checkout at low energy, took tune data for 45 bunch trains versus bunch current:



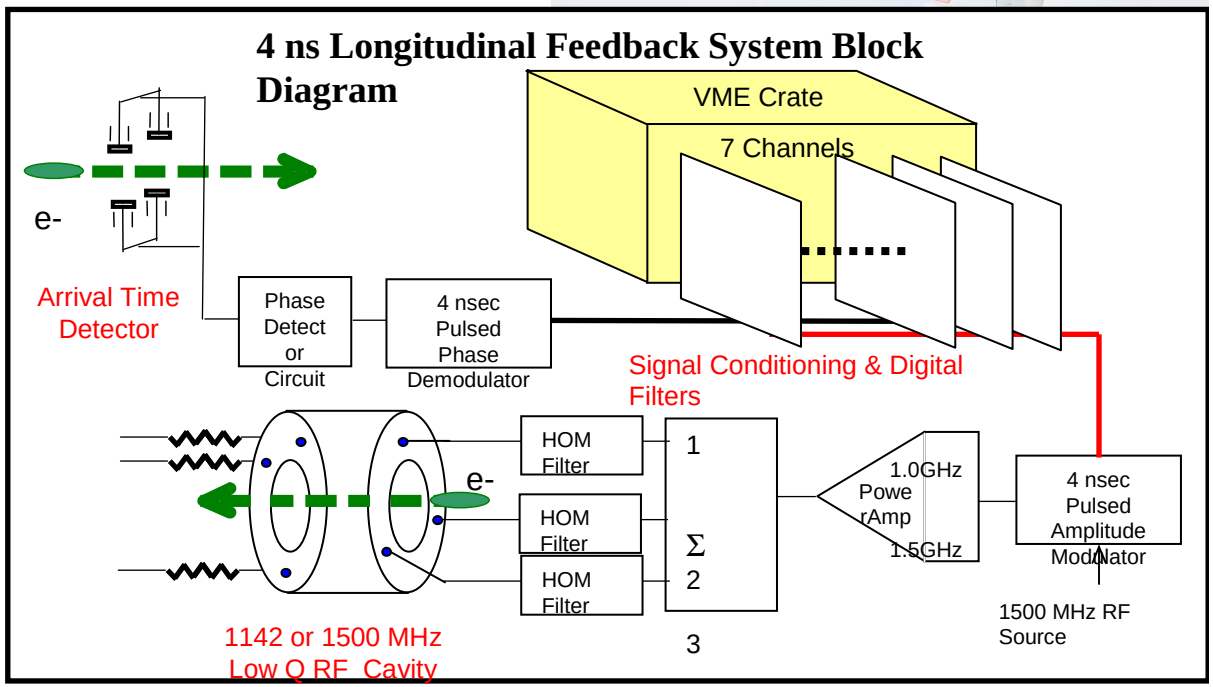
- Observe significant horizontal tune shift for the first time!!
- What is driving the difference between data taken in the CESR-c configuration and the new CesrTA configuration???

Other Work

- Continued effort on BPM system commissioning
- Measured longitudinal instability thresholds for 14ns and 14ns spaced bunches after removal of vertical separators
  - Increased threshold for 14ns but small change for 4ns
    ⇨ proceeding with 4ns longitudinal feedback upgrade



Proposed upgrade of existing CESR longitudinal feedback system for 4ns operation
NOTE: Transverse feedback upgrade in place



Major Thrusts Thru March '09

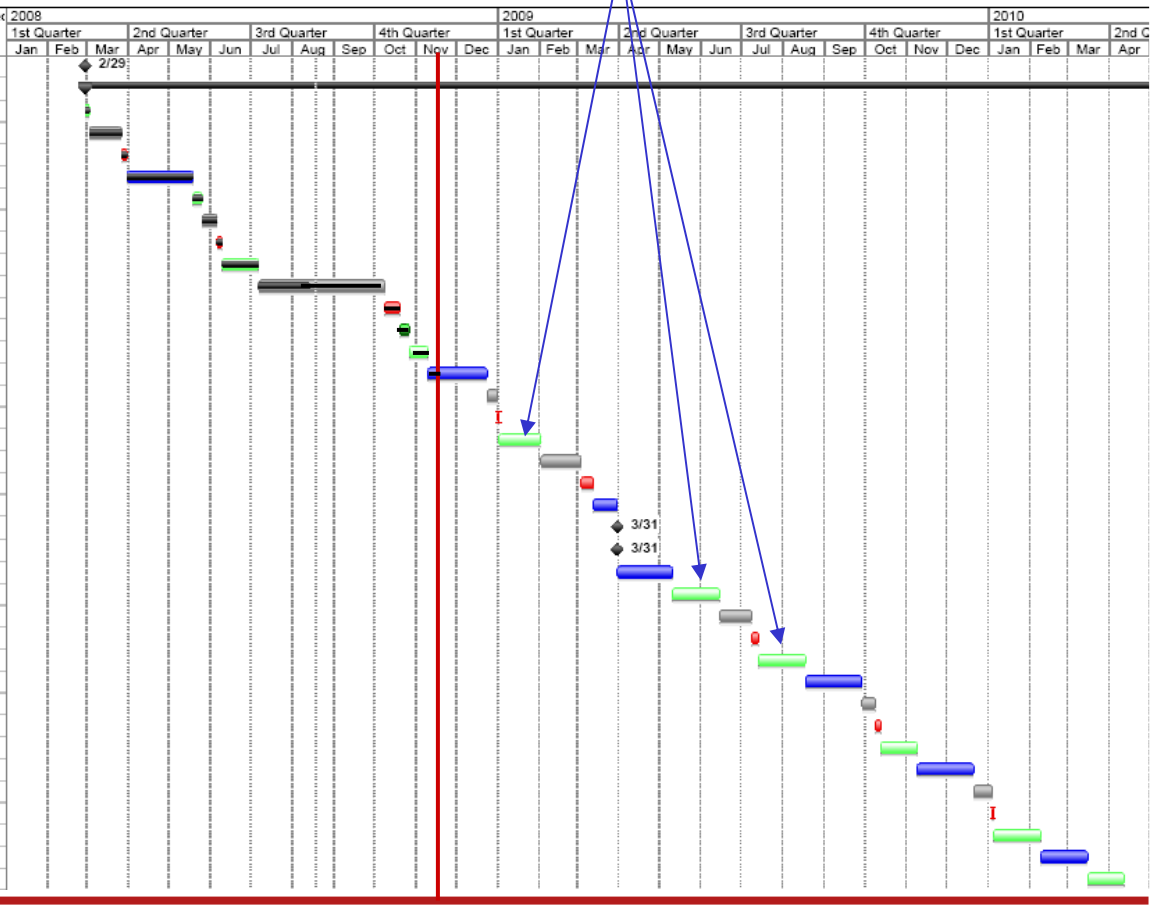
- Jan 2 – Feb 2, 2009 run
  - Developing a critical list of EC experiments – need input!
  - LET work and deployment of new BPM system
- Feb 2009 down period
  - Installation of L3 EC experimental area
    - PEP-II chicane
    - EC test chambers
  - Photon stop for 5 GeV wiggler tests
  - Work on electron x-ray beam line (completion targeted for summer '09)
  - Installation of collaborator chamber(s) in arc test location(s)?
- Collaboration
  - Move to fabrication of wiggler chambers with grooves and electrodes (CU/KEK/LBNL/SLAC)
  - EC Simulation and Measurement Effort
  - Low Emittance Tuning Effort

Schedule

- Upcoming runs (some fine-tuning of dates for runs 3 &4 still possible)
  - Run 2b: Jan 2 – Feb 2, 2009
  - Run 3: May 11 – Jun 15, 2009
  - Run 4: Jul 14 – Aug 18, 2009

Runs 2b, 3 & 4

ID	Task Name	Duration	UserDays	Start	Finish	Predec
34	CLEO Termination	0 days	0	Fri 2/29/08	Fri 2/29/08	
35	**CesrTA Modified**	**819 days**	0	**Fri 2/29/08**	**Fri 5/28/10**	
36	CTA Run 0	3 days	3	Fri 2/29/08	Mon 3/3/08	34
37	CESR Down 0	24 days	0	Mon 3/3/08	Thu 3/27/08	36
38	Recovery 0	4 days	0	Thu 3/27/08	Mon 3/31/08	37
39	CHESS Run 1	49 days	45	Mon 3/31/08	Mon 5/19/08	38
40	CTA Run 1a	7 days	7	Mon 5/19/08	Mon 5/26/08	39
41	CESR Down 1	11 days	0	Mon 5/26/08	Fri 6/6/08	40
42	Recovery 1	4 days	0	Fri 6/6/08	Tue 6/10/08	41
43	CTA Run 1b	27 days	27	Tue 6/10/08	Mon 7/7/08	42
44	CESR Down 2	94 days	0	Mon 7/7/08	Thu 10/9/08	43
45	Recovery 2	11 days	0	Thu 10/9/08	Mon 10/20/08	44
46	Cont/CTA Checkout/CHESS Setup	7 days	7	Mon 10/20/08	Mon 10/27/08	45
47	CTA Run 2a	14 days	14	Mon 10/27/08	Mon 11/10/08	46
48	CHESS Run 2	44 days	42	Mon 11/10/08	Wed 12/24/08	47
49	CESR Down 3a	8 days	0	Wed 12/24/08	Thu 1/1/09	48
50	Recovery 3a	1 day	0	Thu 1/1/09	Fri 1/2/09	49
51	CTA Run 2b	31 days	31	Fri 1/2/09	Mon 2/2/09	50
52	CESR Down 3b	30 days	0	Mon 2/2/09	Wed 3/4/09	51
53	Recovery 3b	9 days	0	Wed 3/4/09	Fri 3/13/09	52
54	CHESS Run 3a	18 days	15	Fri 3/13/09	Tue 3/31/09	53
55	CHESS Yr 1 Summary	0 days	102	Tue 3/31/09	Tue 3/31/09	54
56	CTA Yr 1 Summary	0 days	82	Tue 3/31/09	Tue 3/31/09	54
57	CHESS Run 3b	41 days	38	Tue 3/31/09	Mon 5/11/09	54
58	CTA Run 3	35 days	35	Mon 5/11/09	Mon 6/15/09	57
59	CESR Down 4	24 days	0	Mon 6/15/09	Thu 7/9/09	58
60	Recovery 4	5 days	0	Thu 7/9/09	Tue 7/14/09	59
61	CTA Run 4	35 days	35	Tue 7/14/09	Tue 8/18/09	60
62	CHESS Run 4	42 days	38	Tue 8/18/09	Tue 9/29/09	61
63	CESR Down 5	10 days	0	Tue 9/29/09	Fri 10/9/09	62
64	Recovery 5	4 days	0	Fri 10/9/09	Tue 10/13/09	63
65	CTA Run 5	27 days	27	Tue 10/13/09	Mon 11/9/09	64
66	CHESS Run 5	42 days	38	Mon 11/9/09	Mon 12/21/09	65
67	CESR Down 6	14 days	0	Mon 12/21/09	Mon 1/4/10	66
68	Recovery 6	1 day	0	Mon 1/4/10	Tue 1/5/10	67
69	CTA Run 6	35 days	35	Tue 1/5/10	Tue 2/9/10	68
70	CHESS Run 6	35 days	32	Tue 2/9/10	Tue 3/16/10	69
71	CTA Run 7	27 days	27	Tue 3/16/10	Mon 4/12/10	70



FY09 CesrTA Runs/Downs

- Experimental Periods
  - Run 2b
    - Jan 2 – Feb 2, 2009
  - Run 3
    - May 11 – June 15, 2009
  - Run 4
    - July 14 – August 18, 2009
- Down Periods
  - Feb 2 – March 2, 2009
  - June 15 – July 14, 2009
    - Last major upgrade down
    - All later downs primarily for hardware swaps
  - Sept 29 – Oct 13, 2009

Collaborator Information

- Visiting Collaborators
  - Who to contact:
    - Mark Palmer for EC studies (map36@cornell.edu)
    - Dave Rubin for LET work (dlr10@cornell.edu)
  - Forms and computer registration:

https://wiki.lepp.cornell.edu/ilc/bin/view/Public/CesrTA/VisitorsPage

  - Schedule Information:

https://wiki.lepp.cornell.edu/ilc/bin/view/Public/CesrTA/CesrTASchedule

- Where to look:
  - Main CesrTA Wiki Page:

https://wiki.lepp.cornell.edu/ilc/bin/view/Public/CesrTA/

  - CesrTA Collaboration Meetings Page:

https://wiki.lepp.cornell.edu/ilc/bin/view/Public/CesrTA/CollabMeetings

- Many areas restricted to the “CesrTA Collaboration”
  - Need to register for ILC Wiki
- Mailing List
  - CesrTA Collaboration Mailings via the new mailing list
  - Can subscribe from the main CesrTA Wiki page

Summary

- Commissioning run is now complete
- CESR is operational in the CesrTA configuration
- Critical data collected during a short 2-week run
  - New systems are successfully coming on line
  - Initial data will provide guidance for January experimental run as well as ongoing upgrade work
  - The initial commissioning work has yielded both expected results as well as some surprises
  - Ongoing collaborative effort critical to achieving full understanding and a productive project!