Cornell University
Laboratory for Elementary-Particle Physics

CesrTA Status and Planning

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ILC Damping Rings R&D Mini-Workshop at KEK

Outline

- CesrTA Proposal Status
- CesrTA Program
  - 2 Year Program
  - Milestones
  - Parameters & Capabilities
- CesrTA Preparations Status
  - Ongoing R&D
  - Wiggler & EC Diagnostics
  - Fast X-ray beam profile monitor
- CesrTA Planning

- Presentation by Joe Dehmer
  - Division of Physics
  - MPS/NSF

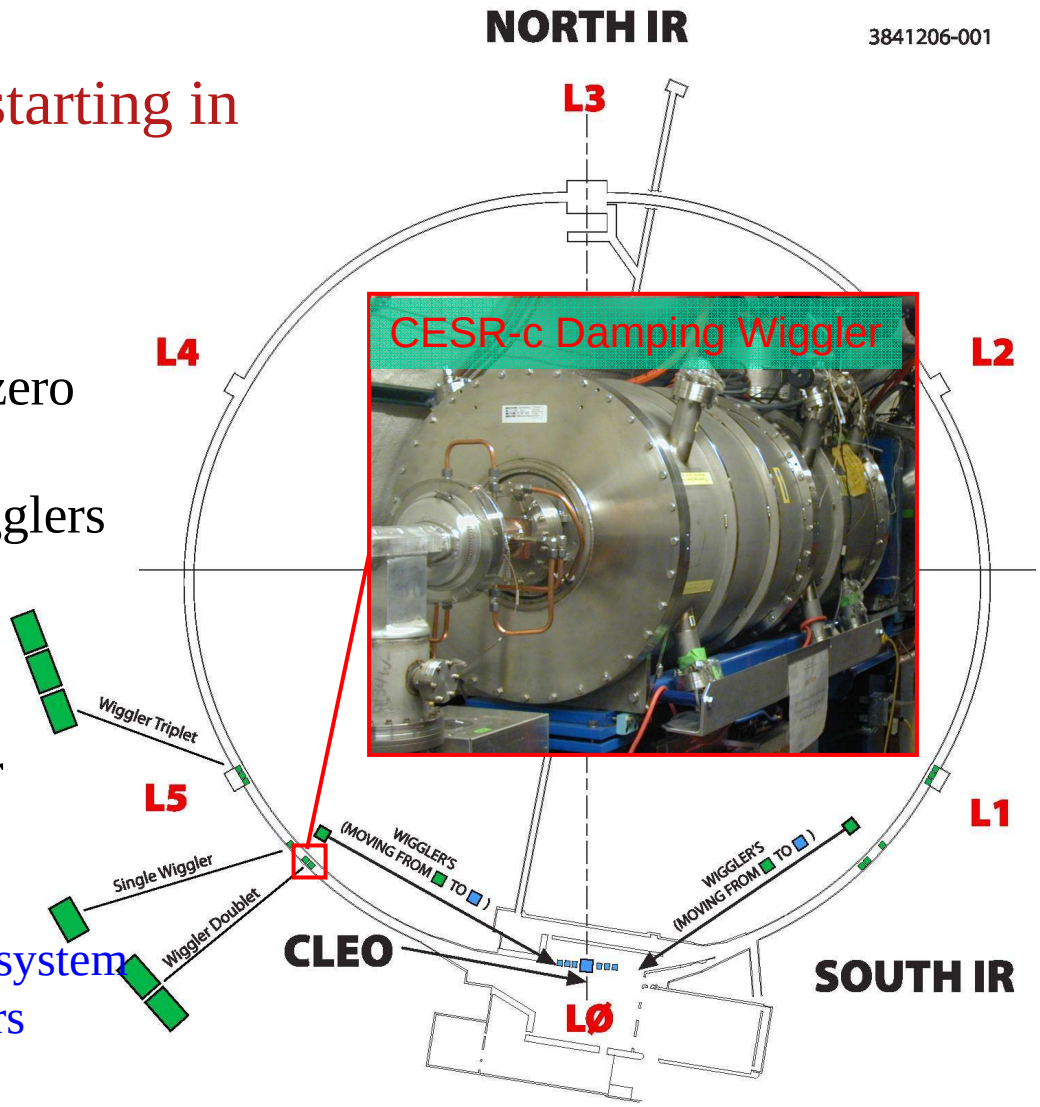
Some Recent Happenings

- At SC 07, Open Science Grid achieved milestone of >80 Gbps data flow
- Physics Frontiers Centers competition reviewed 58 preproposals, inviting 19
- DUSEL town meeting in DC involves community in discussions of initial suite
- NSF and DOE partner to enable CESR TA to perform critical path R&D for the ILC
- US and other regions participate in ASPERA
- Noticeable blossoming of POU-style physics

CesrTA Program I

- Dedicated DR R&D program starting in mid-2008

- CesrTA Configuration:
  - 12 damping wigglers located in zero dispersion regions for ultra low emittance operation (move 6 wigglers from machine arcs to L0)
  - Diagnostic vacuum chambers with EC suppression methods
  - Designated sections available for installation of test devices
  - Precision instrumentation
    - Multi-bunch turn-by-turn BPM system
    - Fast X-ray beam profile monitors
  - 4 ns bunch train operation



CesrTA Program II

- Budget and funding profile discussions underway with NSF/DOE

  (*implications of today's news from the US not yet clear*)
- Current focus is a 2 year program of ILC DR R&D
  - Reduction in scope from longer (3.5 year) program presented to NSF/DOE in July
  - Maintain 3 core research areas:
    - Electron cloud studies
    - Low emittance program
    - Development of a fast X-ray beam size monitor
      - Target bunch-by-bunch monitor capable of single-pass measurements for ILC DR
      - Integral to CesrTA program ⇨ ultra-low emittance measurements

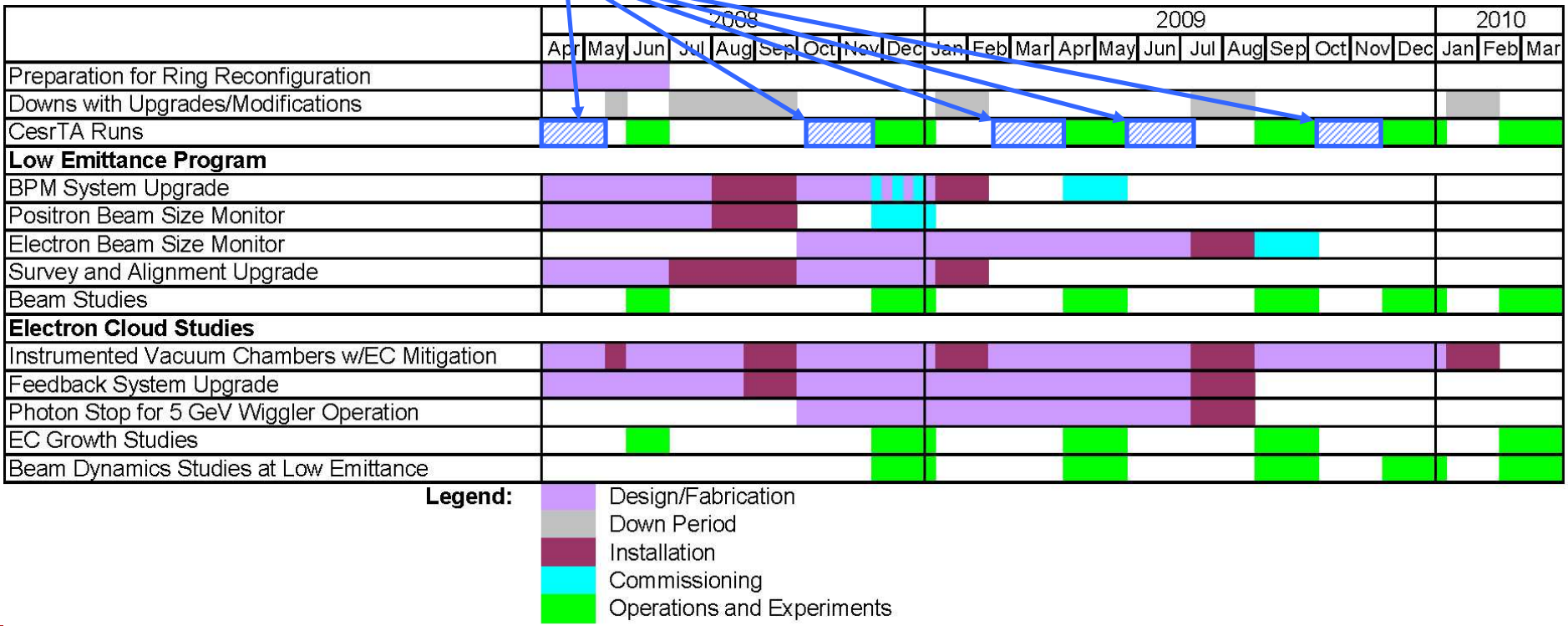
CesrTA Program III

- Implications of de-scoped program
  - Eliminates fast ion instability studies
    - R&D being pursued elsewhere
      - KEK-ATF – see talk by N. Terunuma tomorrow
      - Studies also proposed for the LBNL-ALS
      - Other?
  - Minimizes time available for testing ILC prototype hardware
  - Increases program risk
    - Limited time to develop low emittance measurement capabilities and to achieve ultra low emittance goals
    - Attempt to front-load key instrumentation upgrade work ⇨ BUT likely funding profile will constrain our ability to do this fully

Overview of 2 Year Schedule

- Operations Schedule
  - 2 experimental runs in 2008
  - 3 experimental runs in 2009
  - 1 experimental run in 2010
  - Avg ~40 days/run
- Down Periods
  - Major Reconfiguration down Jul-Sep 2008
  - Hardware installation downs
    - 2 in 2008
    - 2 in 2009
    - 1 in early 2010

Proposed CHESS Runs



Milestones I

Period	Proposed Start	Proposed Duration	Tasks & Milestones
Down 1	5/15/08	15 days	Install instrumented wiggler chambers a. One with diagnostics (control) b. One with diagnostics and TiN coating
Run 1	6/3/08	28 days	1) Beam tests of wiggler chambers at 2-2.5 GeV 2) Low emittance operation and alignment studies in CESR-c configuration
Down 2	7/1/08	92 days	1) Reconfigure CESR for low emittance a. Wiggler moves (from arcs to L0) b. Vertical separator removal (L3) 2) Instrumented copper vacuum chambers (RFAs) a. Wiggler chambers with additional EC mitigation techniques (L0 installation) and adjacent drift chambers. b. Dipole and drift chambers in arcs (regions where wigglers removed). At least one dipole control and one coated chamber (NEG?) c. Drift chambers in L3 3) Optics line for X-ray beam size monitor (positrons) 4) Deploy upgraded BPM system around majority of ring 5) Upgraded leveling and adjustment system for quadrupoles

Milestones II

Period	Proposed Start	Proposed Duration	Tasks & Milestones
Run 2	11/18/08	42 days	1) Tests of EC growth in vacuum chambers at 2-2.5 GeV. Characterize growth as a function of bunch spacing, intensity, train configuration, emittance. 2) Continue beam-based alignment program to achieve ultra low emittance 3) Experiments at low emittance to explore instability thresholds and emittance dilution due to the ECI and FII 4) Commission positron X-ray BSM
Down 3	1/6/09	43 days	1) Complete alignment/survey upgrade 2) Install 2 additional instrumented dipole chambers with EC mitigation 3) Install 3 instrumented quad chambers (L3) with EC mitigation 4) Complete BPM system upgrade 5) Install solenoid windings in drift regions
Run 3	4/7/09	42 days	1) EC growth measurements in chambers in 2-5 GeV range 2) Continued work to achieve ultra low emittance 3) Instability and emittance dilution experiments
Down 4	7/7/09	49 days	1) Install optics line for electron X-ray beam size monitor 2) Complete longitudinal feedback upgrade 3) Installation of additional vacuum chambers with EC diagnostics and mitigation as determined by results of CesrTA runs 1-3, perhaps at a reduced level, depending on funding. 4) Install photon stop for 5 GeV wiggler operation in L0

Milestones III

Period	Date	Duration	Tasks & Milestones
Run 4	8/25/09	42 days	1) Complete evaluation of electron cloud growth in wiggler, dipole and quad chambers. Compare with simulation and prepare evaluations for ILC EDR 2) Continue program to achieve ultra low emittance 3) Detailed experiments at the lowest achieved emittance to characterize EC and FII instability thresholds and emittance dilution 4) Commission electron X-ray beam size monitor 5) Measure electron cloud growth and mitigation in wigglers at 5GeV
Run 5	11/24/09	42 days	1) Continue program to achieve ultra low emittance 2) Experiments to characterize instability thresholds and emittance dilution and prepare evaluations for the ILC EDR
Down 5	1/5/10	49 days	1) Install additional vacuum chambers with EC diagnostics and mitigation as determined by results of CesrTA and other ILC experimental programs, perhaps at a reduced level depending on funding
Run 6	2/23/10	42 days	1) Complete program to achieve ultra low emittance 2) Characterize electron and positron instability thresholds and emittance-diluting effects at the lowest achievable vertical emittance for both electrons and positrons

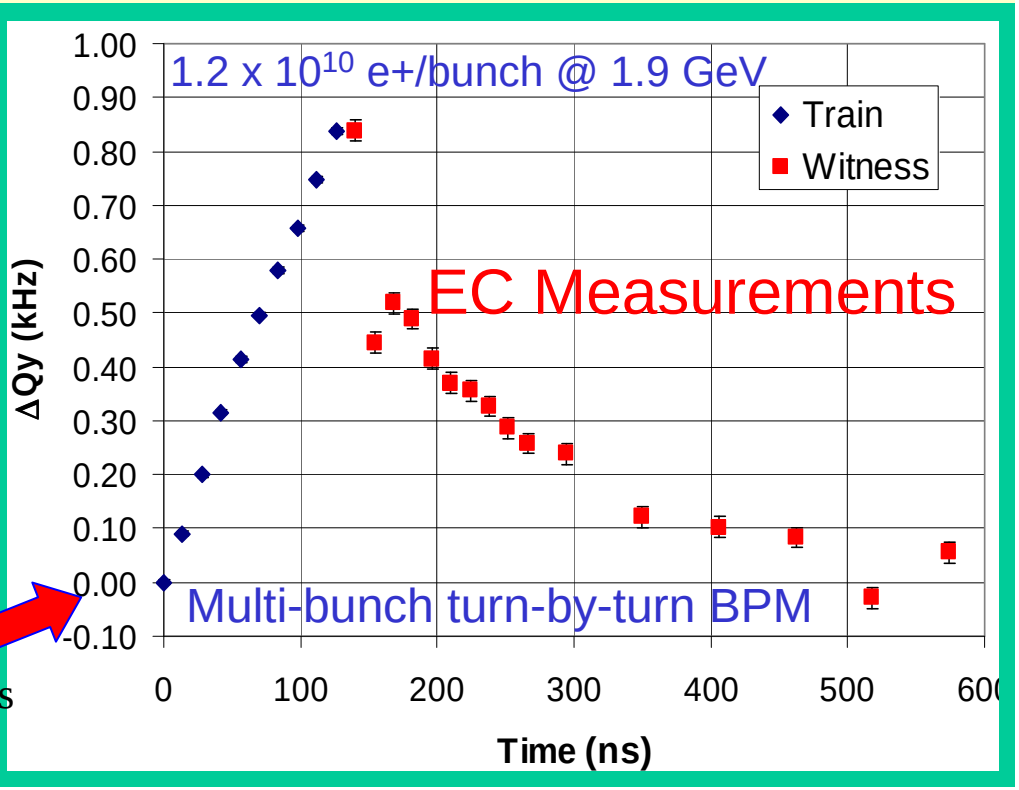
CesrTA Parameters & Capabilities

Baseline Configuration

Parameter	Value
No. of Wigglers	12
Wiggler Field	2.1 T
Beam Energy	2.0 GeV
Energy Spread (ΔE/E)	8.6×10^{-4}
Target Vertical Emittance	5 – 10 pm
Horizontal Emittance	~2 nm
Damping Time	47 ms
Bunch Spacing	4 ns
Bunch Length	9 mm

- Parameters:
  - Baseline optics at 2 GeV for ultra low emittance studies
  - Energy flexibility will allow EC growth studies at 5 GeV as specified for the ILC DR

- EC Measurements:
  - Multi-bunch turn-by-turn instrumentation has been commissioned
  - Measured vertical tune shift along a train generating the electron cloud and for witness bunches trailing the train at various intervals



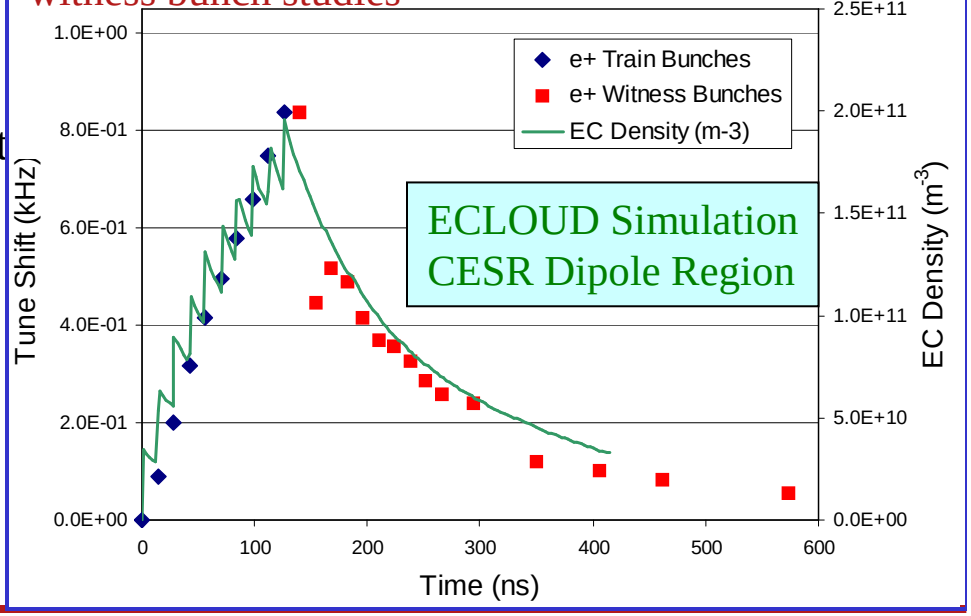
Status of CesrTA Preparations

- Ongoing machine studies program
  - Final CHESS run in current program has just finished
  - Primary focus will be CLEO-c production until March 31st
  - CesrTA machine studies focused on topics important for machine conversion
  - Parasitic studies with prototype X-ray beam size monitor optics

- Design and Fabrication work
  - Diagnostic wiggler vacuum chambers (collaboration with LBNL/SLAC)
  - Updated vacuum chambers with EC diagnostics for machine conversion
  - EC diagnostics and readout development
  - Beam instrumentation and feedback development
    - Turn-by-turn BPM upgrade
    - 4 ns bunch train operation
    - X-ray beam size monitor
  - Alignment and Survey improvements

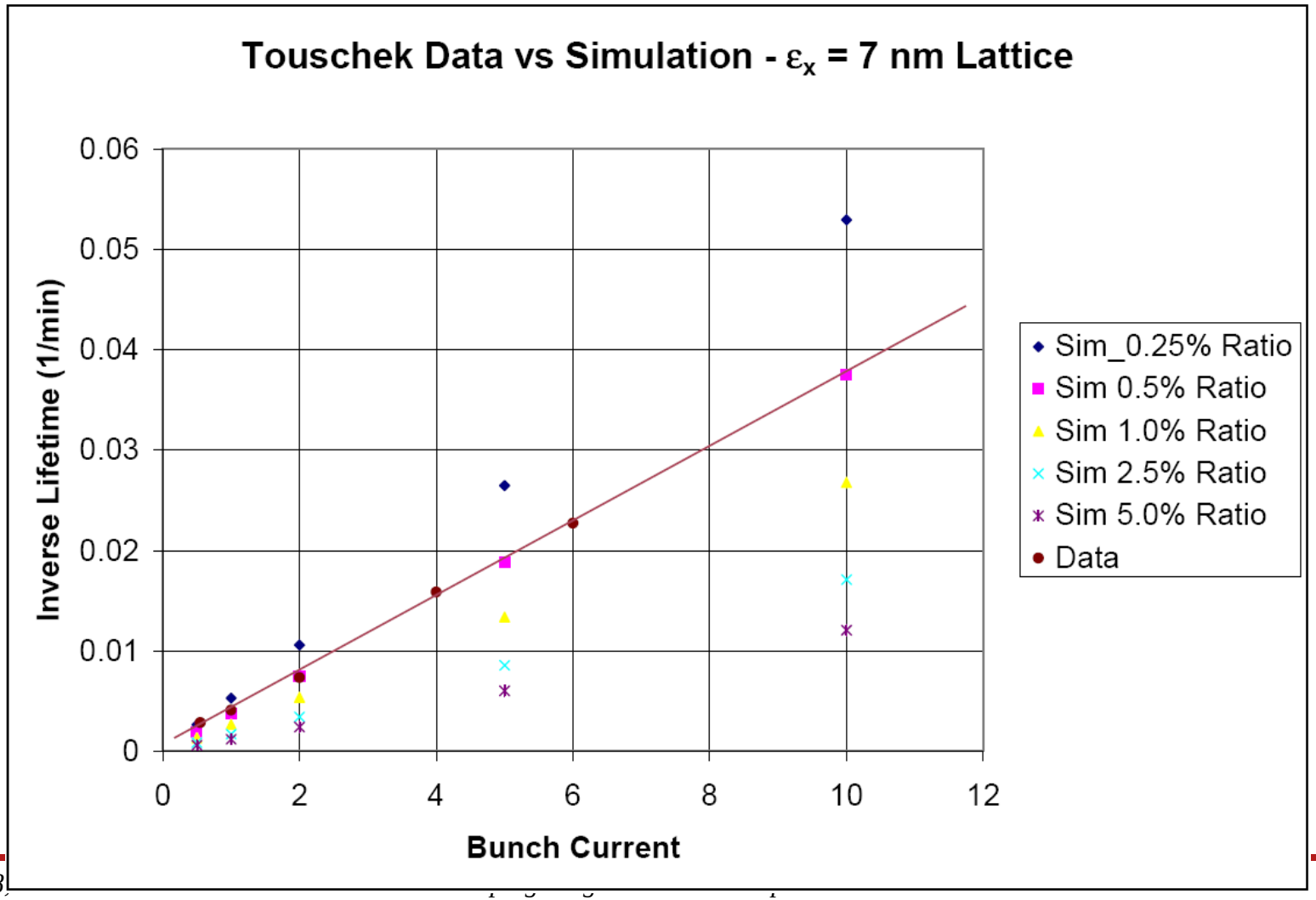
Work on Data-Simulation Comparisons

Seeing qualitative agreement with shape of electron cloud growth/decay and vertical tune shift data from witness bunch studies



Low Emittance Tests

- CESR-c Low Emittance Lattice with CLEO solenoid on (likely lattice for CesrTA Run 1)
  - 6 wigglers (in L1/L5 straights) at 0 dispersion
  - Without suitable emittance measurement capability, measure Touschek lifetime versus bunch current and compare with simulation for vertical beam size dominated by emittance coupling

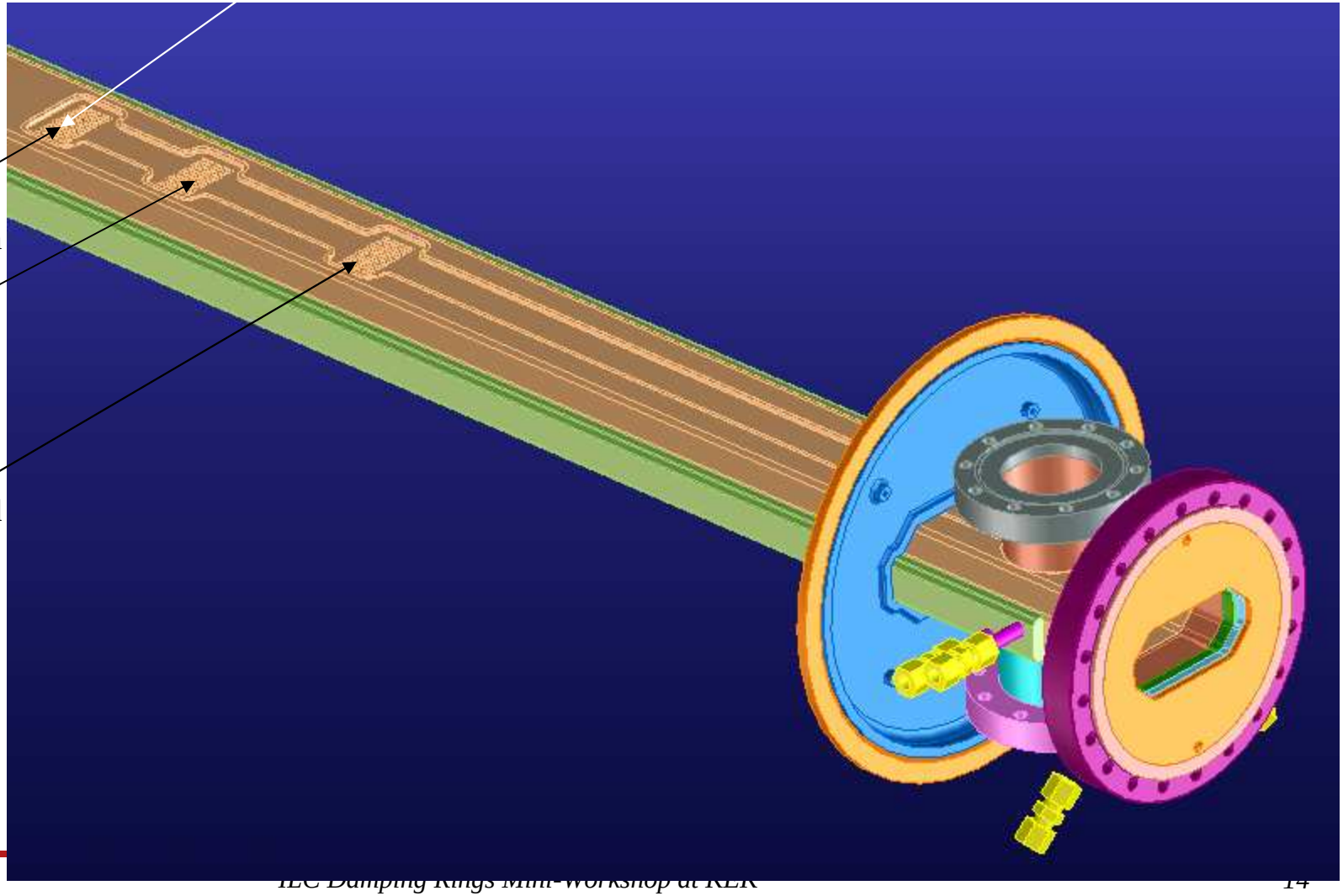


Wiggler Vacuum Chamber Design

CesrTA Electron Cloud Test Chamber 1 Assembly, 44mm Vertical Gap

Hole Patterns for RFA Assembly

(courtesy D. Plate, A. Rawlins, LBNL)

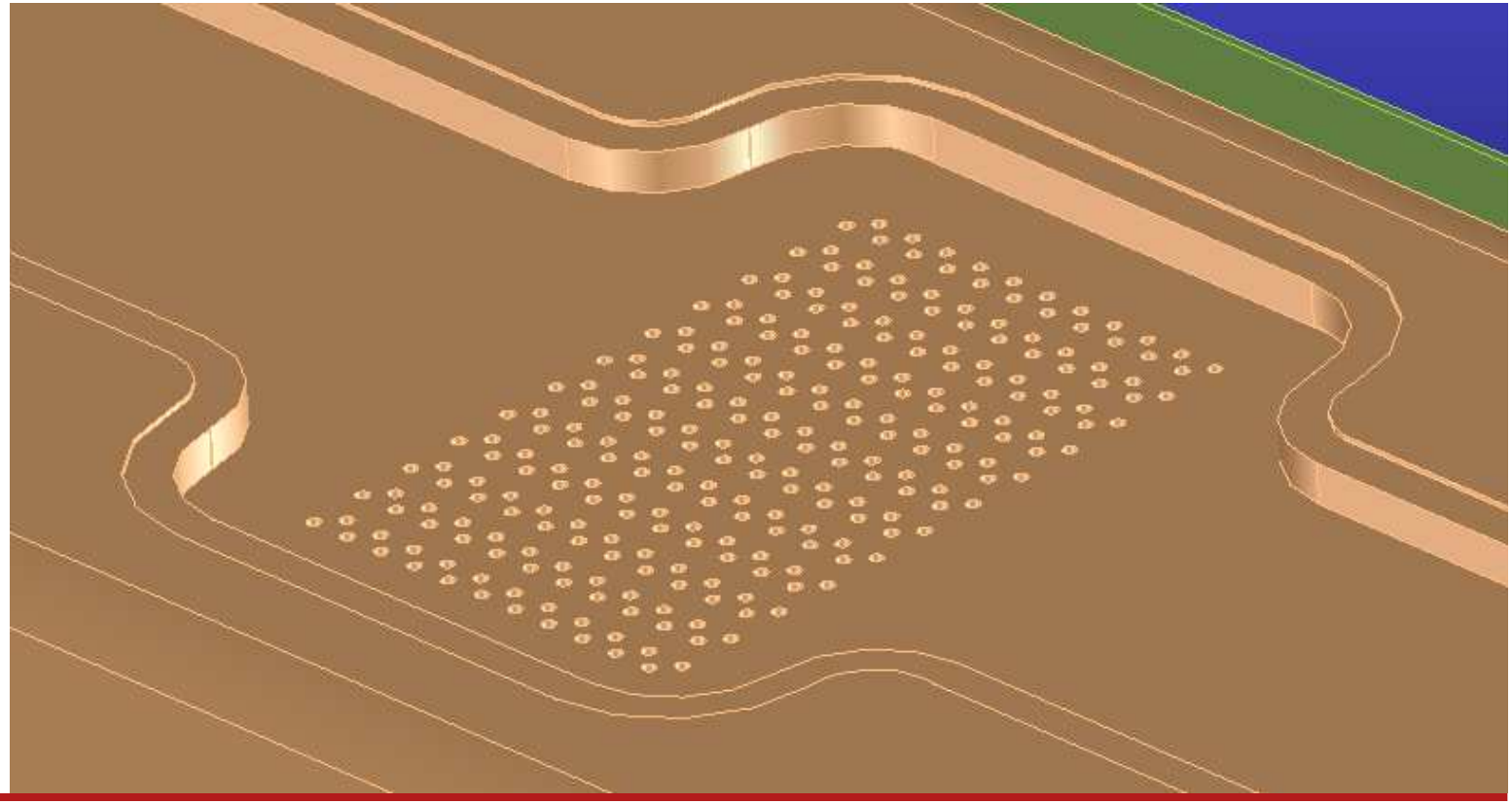


Vacuum Chamber Diagnostics

- Segmented collector (12 stripes) to obtain transverse density profile
- RFA structure to fit in 2.5 mm total depth ⇨ novel assembly

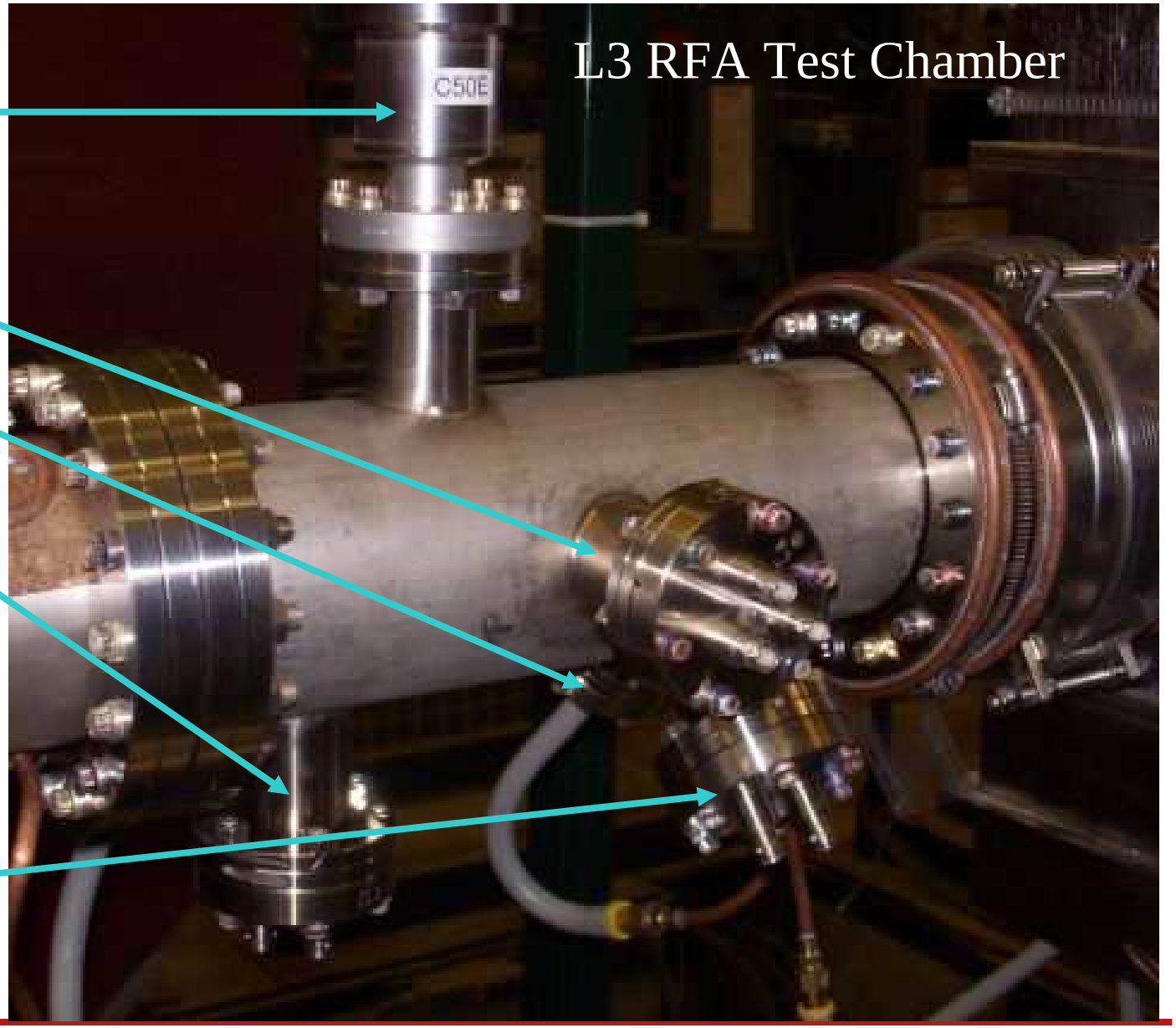
Hole Pattern for RFA Assembly
264 x .030” Dia. Holes through
.090” thick copper

“Postage Stamp”
1.0” x 1.7”

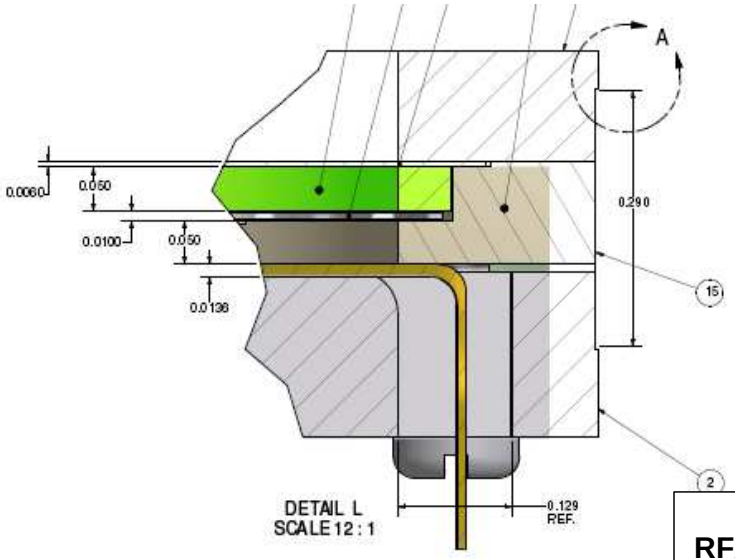


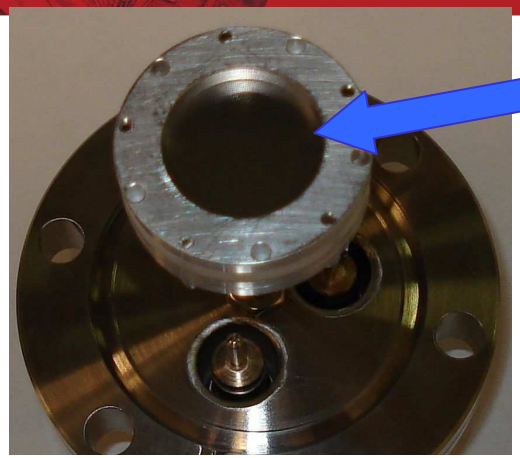
Retarding Field Analyzers in L3

- Vacuum Gauge
- RFAs
  - Radially in
  - 45 deg off radially out
  - Bottom
- Antennas
  - Loop
  - Dipole



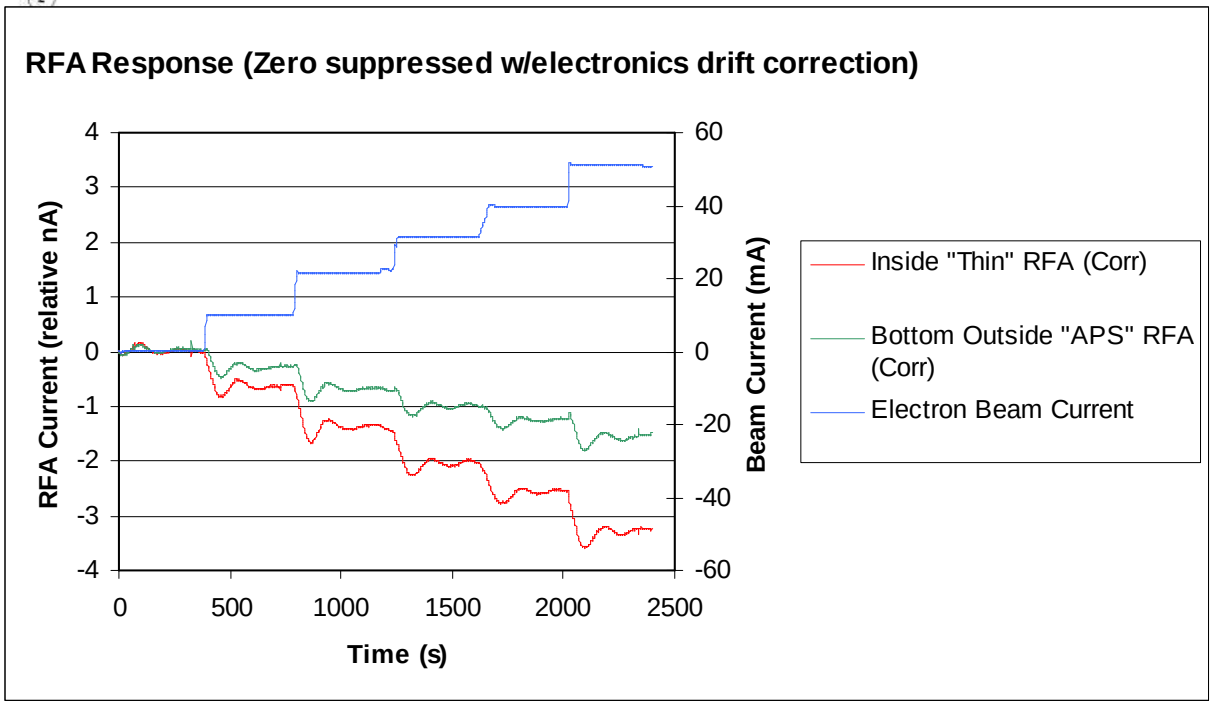
First Beam Test of "Thin RFA"





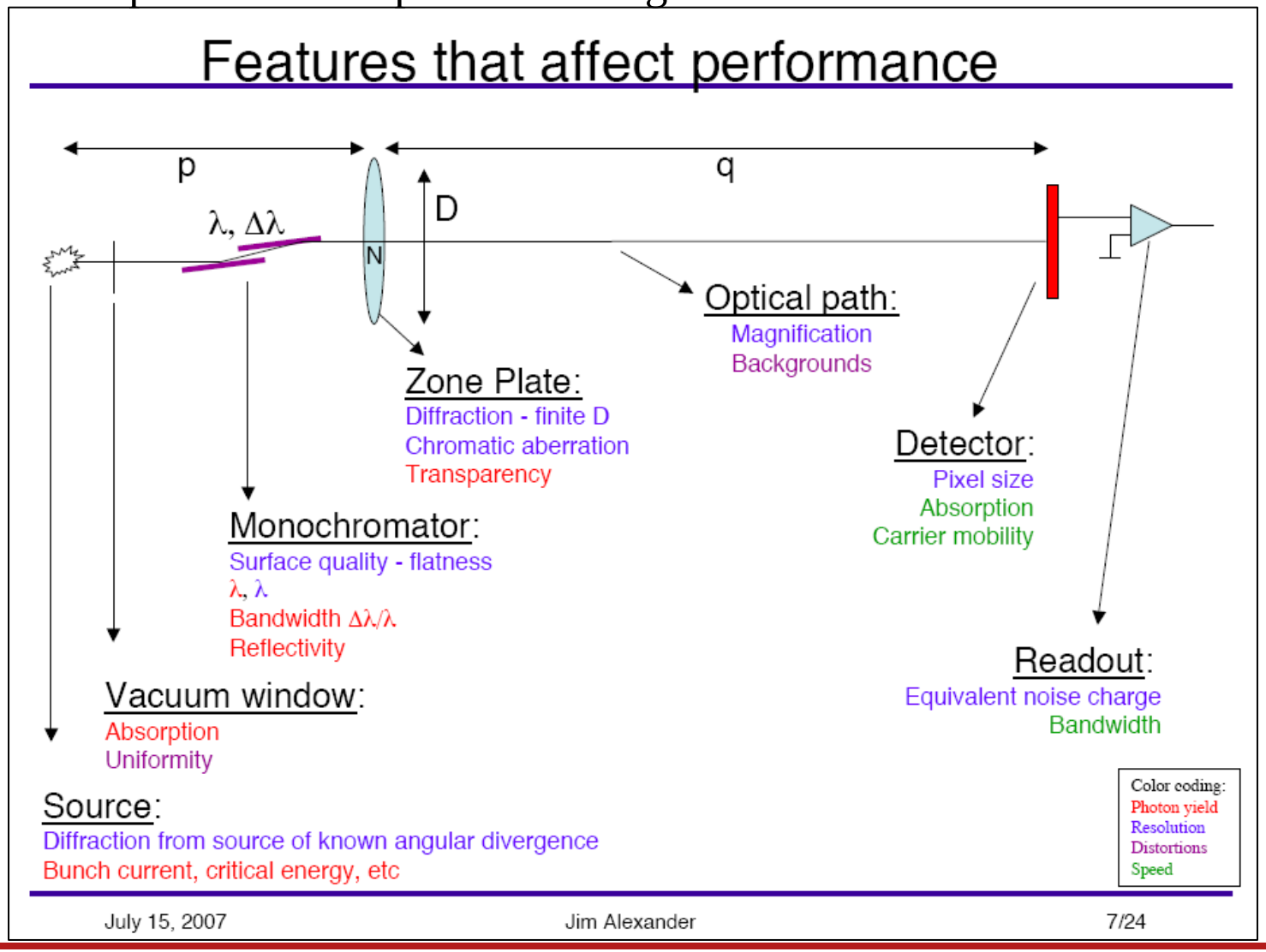
- First prototype "thin" RFA structure for wiggler chambers undergoing testing
- First beam test shows performance similar to APS-style RFAs

- Initial tests with 3mm test structure demonstrate key design aspects of the wiggler RFA
  - Calibration
  - Voltage test (no breakdown for $\Delta V = 600V$
  - Beam test
- Detailed design underway for wiggler structure
- Efficiency simulations to fully understand behavior in wiggler fields
- Finalize structure by late January



Fast X-ray Beam Profile Monitor

Test optics setup on CHESS beam line for remainder of CESR-c running
Explore and optimize final optics line design for CesrTA



CesrTA Planning

- General design and fabrication work is now underway
  - Vacuum chambers
  - Wiggler support structure for CLEO IR
  - Instrumentation
  - Miscellaneous CESR modifications
- Oversight
  - Propose that the review process be handled via the ILC ART (April reviews)
  - Also propose the formation of an advisory committee that reviews progress 6 months out of phase with the ART review
- Participation
  - Collaborators on experiments and/or hardware development are welcome

Conclusion

- Design, prototyping, and fabrication work is presently underway
- First major run planned for June
- Ring reconfiguration for low emittance planned during July-September down
- We hope to organize a CesrTA workshop for all interested parties sometime after the New Year
- Input on our designs and plans would be greatly appreciated