

# ILC Damping Wiggler:

## Physics & Engineering Design

Jeremy Urban & Mark Palmer
Cornell University

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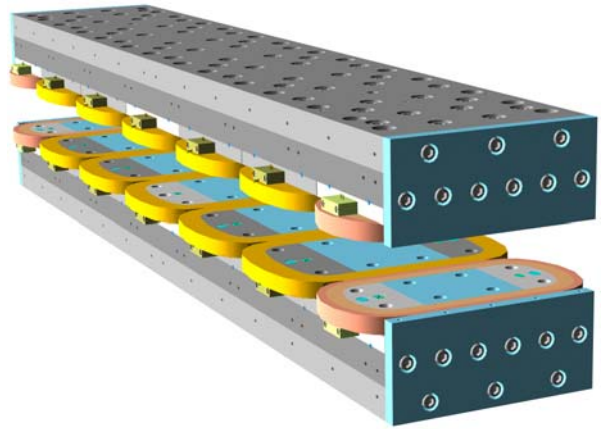
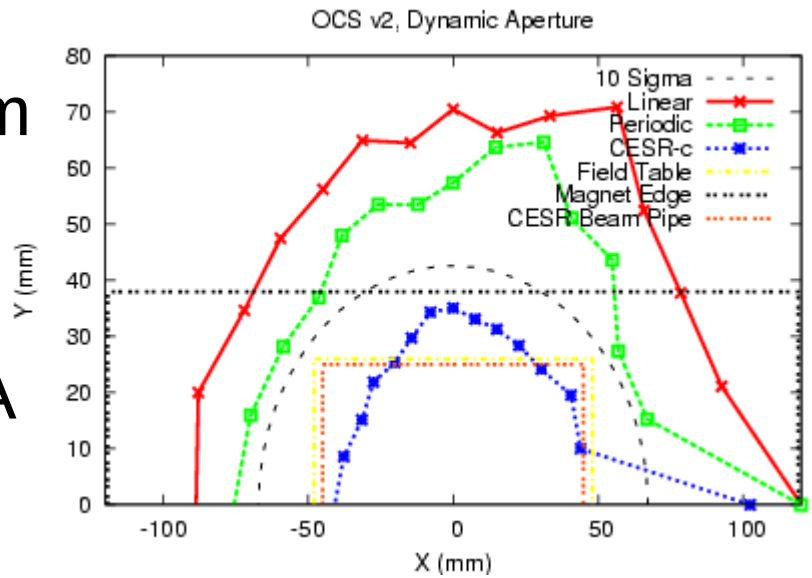
# Modified CESR-c Wiggler

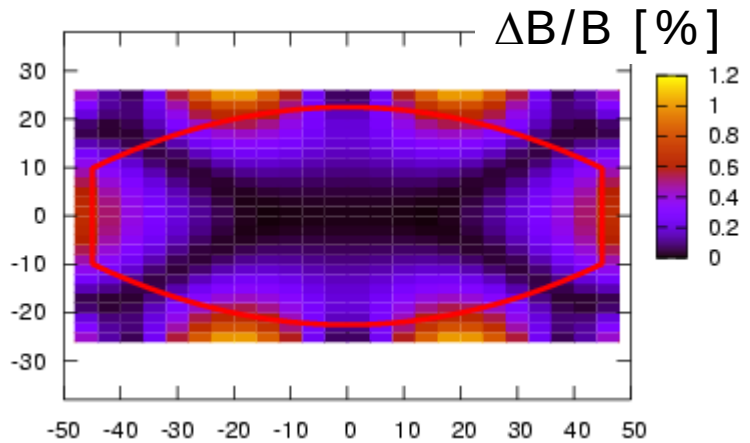
- $B_{peak}$ = 1.67 T
- $\lambda$ = 40 cm
- 5 periods + end poles
- Pole Width = 238 mm
- Pole Gap = 76 mm
- Beam Stay Clear = 50 mm
- Performed well in all BCD option DRs...too well?
- OCS v2: $DA_{linear\ wiggler}$ > PA > wiggler map



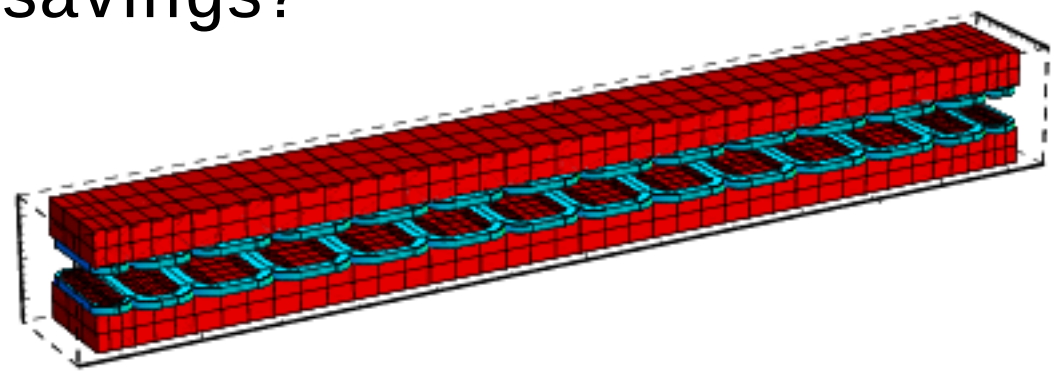


# Physics Design Optimization

- CESR-c wiggler optimized specifically for CESR-c conditions
  - gap, width, coil shape, pole cutout/shim
- Field quality greater than necessary for ILCDR
- Potential for cost savings?
  - Field quality
  - Total number

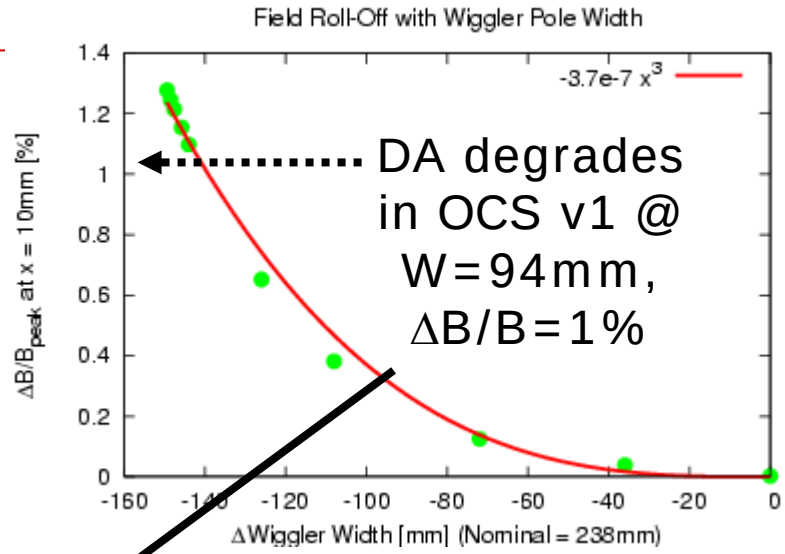


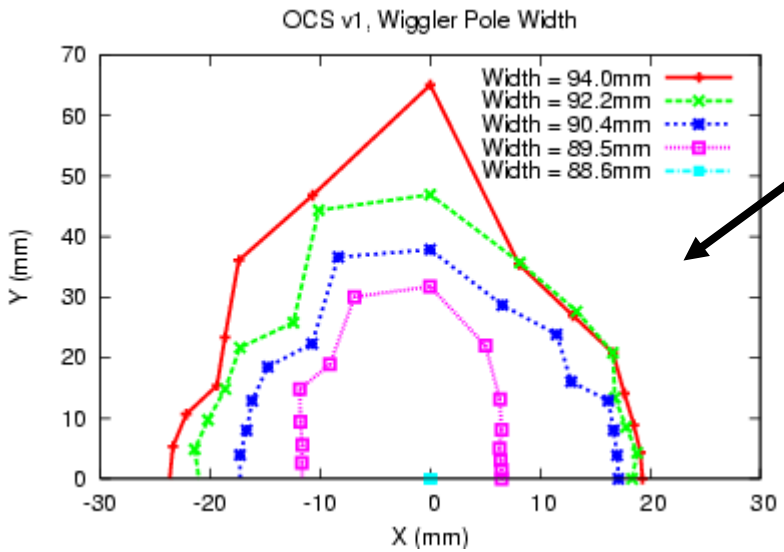

Wiggler models in Opera & Radia

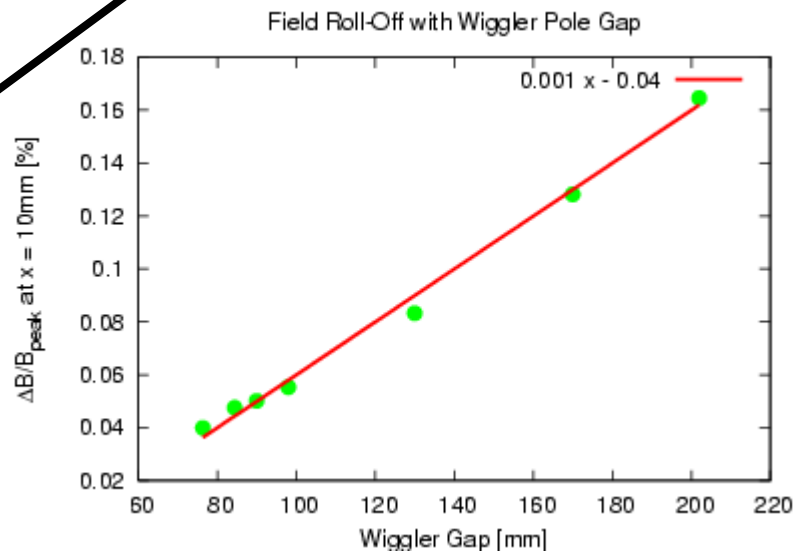


# Field Quality

- $\Delta B/B_{peak}$ @ x=10 mm
- Large OCS DA can tolerate poor field quality, but large physical aperture is still required

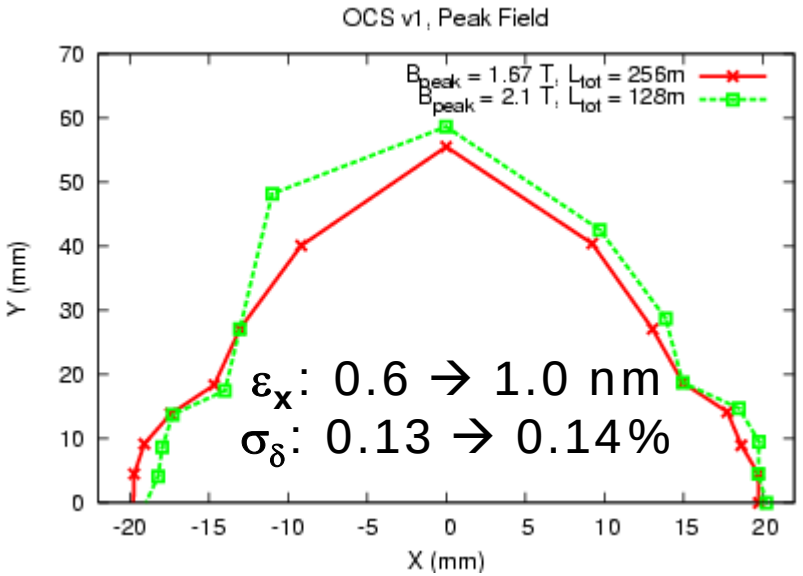


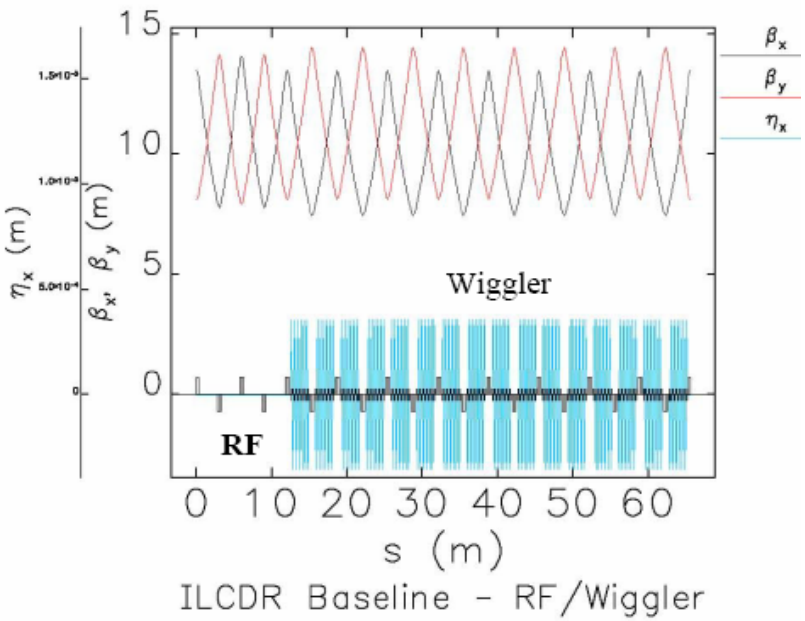



# Peak Field

- Why 1.67 T?
- Higher field → More damping → Less wigglers (either $N_{tot,wig}$ or $L_{wig}$)
- However, increases:
  - $\varepsilon_x \sim \beta * B^3 * \lambda^2$
  - $\sigma_\delta$
  - magnetic forces in wiggler assembly
  - radiated photons



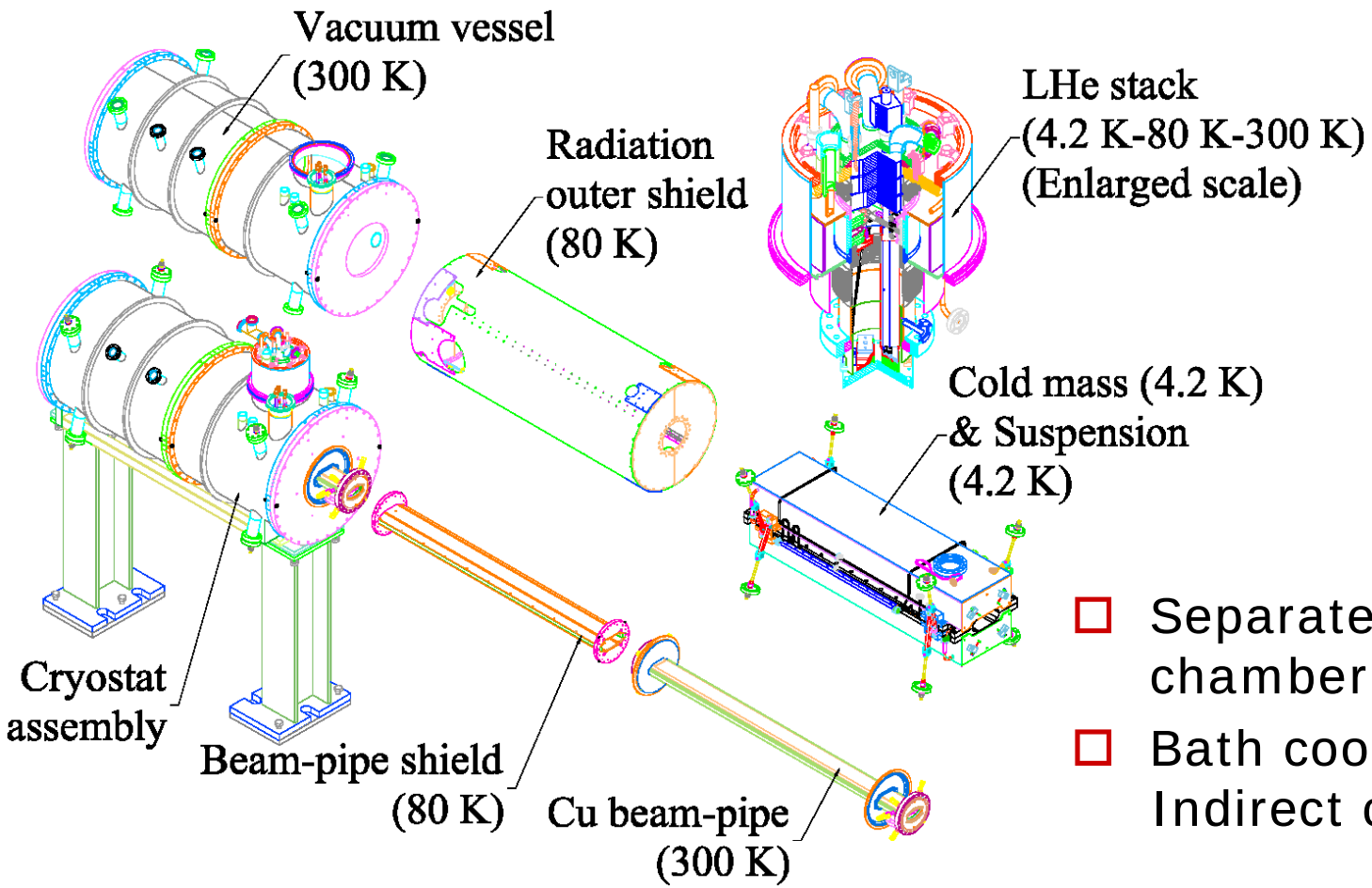



# Engineering Design Optimization

- CESR-c: 12 x 1.3 meters
- ILCDR: 3 x 80 x 2.5 meters
- Engineering issues under consideration
  - Wiggler
    - Optimum length, pole gap, and field
  - Vacuum chamber
    - Separate bakeable chamber
      - Pumping requirements
    - Synchrotron radiation load issues
    - Electron cloud suppression
  - Cryostat
    - Modifications for no $LN_2$ in ILC tunnel
    - Investigate indirect (vs bath) cooling for cold mass
    - Simplify production

Collaboration with LBNL

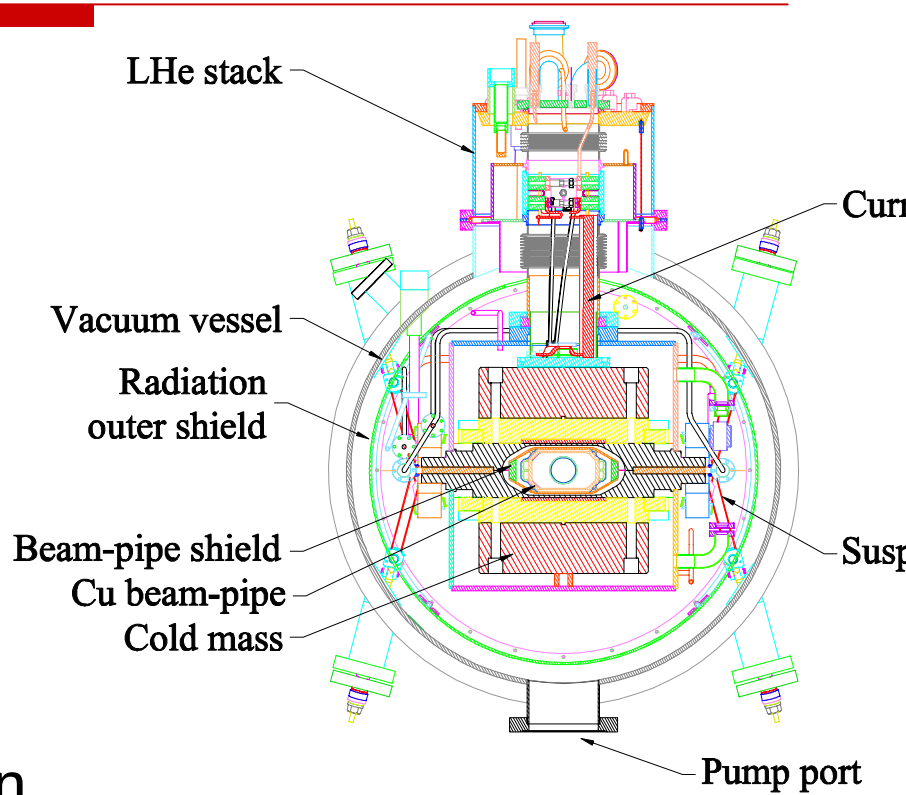
# Wiggler Assembly




- Separate vacuum chamber assembly
- Bath cooling → Indirect cooling

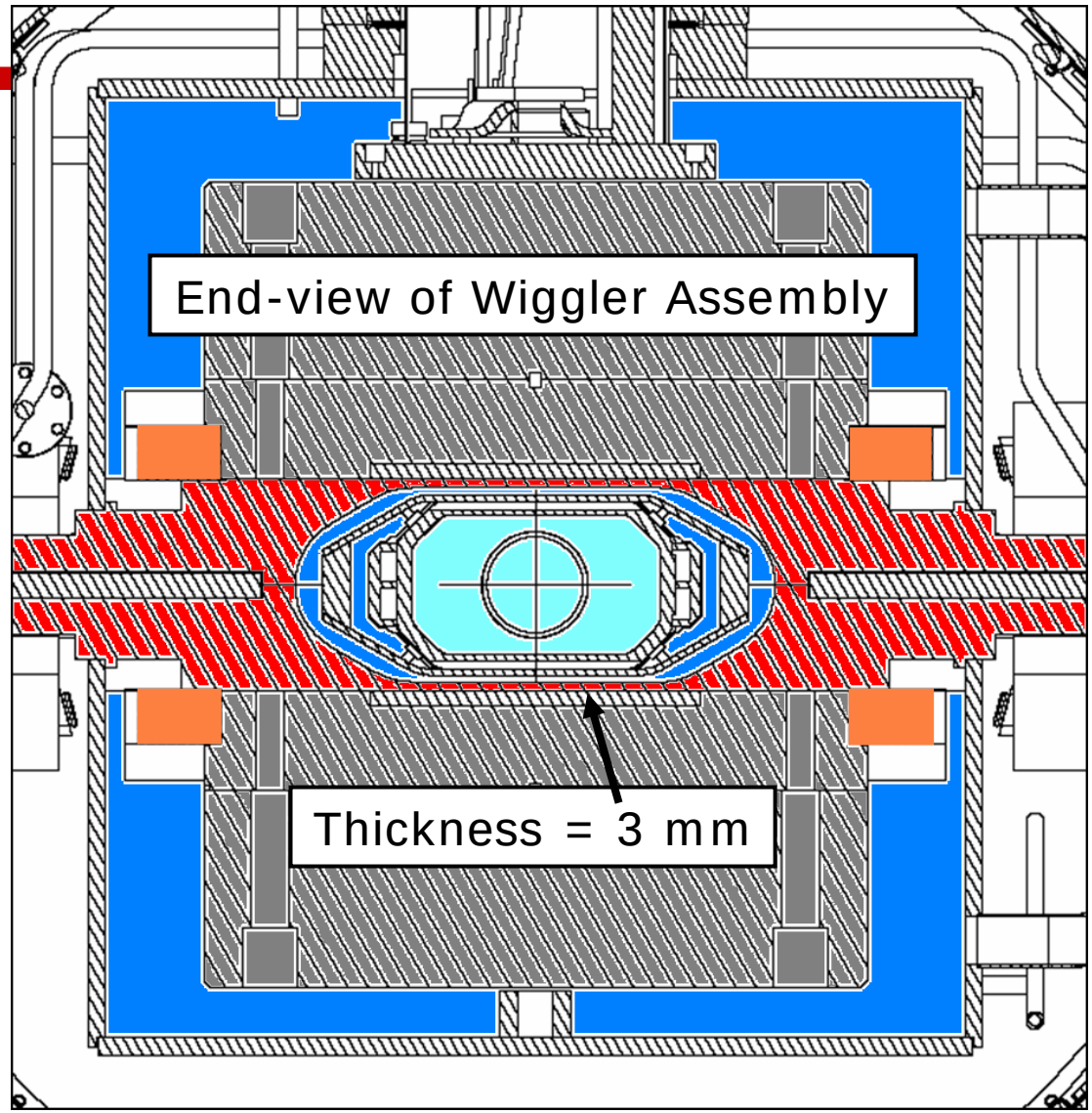
# Vacuum Chamber

- CESR-c Design:
  - CESR chamber integral to cryostat assembly
  - Cold mass bore has 17 cm horizontal aperture
  - 2.5 kW/wiggler
- ILCDR Requirements:
  - 21 ($e^+$) or 42 ($e^-$) kW/wiggler
  - 10 wigglers/60 m section
- RDR plan
  - Separated vacuum chamber compatible with present cold bore (LBNL)



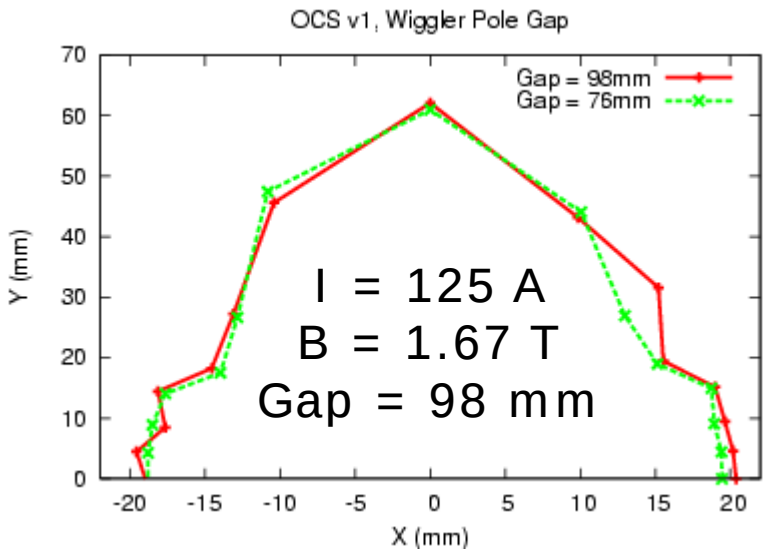
# Gap Height

- Simplify construction & add flexibility
  - Larger gap
    - Simplifies support plate construction
    - Cost savings
  - Larger gap possible
    - 76 → >98 mm @ 1.67 T



# Gap Height

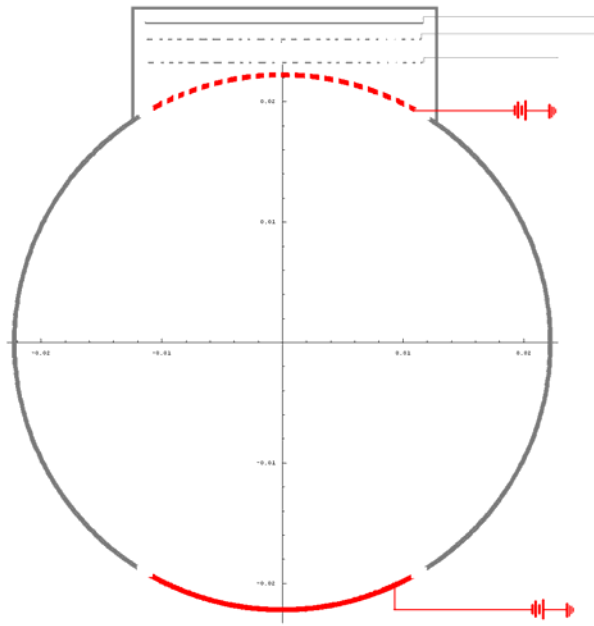
- Electron Cloud mitigation needs




Larger gap height does not detrimentally degrade field quality.

Clearing Electrodes

*Pivi, Wang, Raubenheimer, Raimondi*



# Summary

- RDR Plan
  - Wiggler and cryostat costed from CESR-c design
  - Vacuum chamber design (LBNL) for existing cold bore
  - Key areas for possible modification identified
- TDR Plan
  - Fully optimized and engineered design for ILC use
  - Optimizations:
    - Physics
    - Wiggler/cryostat engineering design
    - Vacuum chamber/cold bore interface
    - Cost
    - Compatibility with ILC technical system specifications