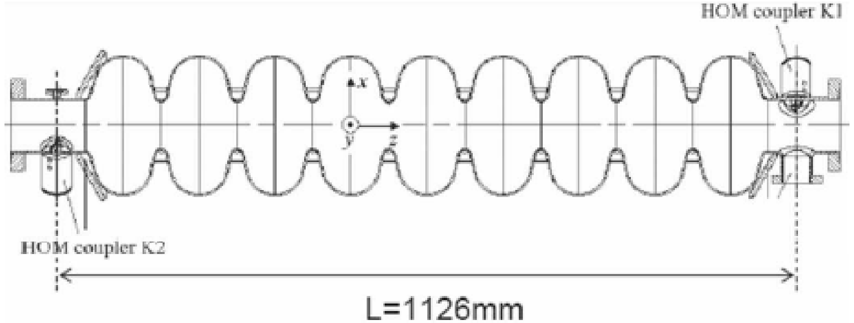
On-Axis Wake and RF Cavity Kicks

DESY-FNAL-SLAC collaboration to compute these kicks – final results show they are fairly benign in the ILC Main Linacs



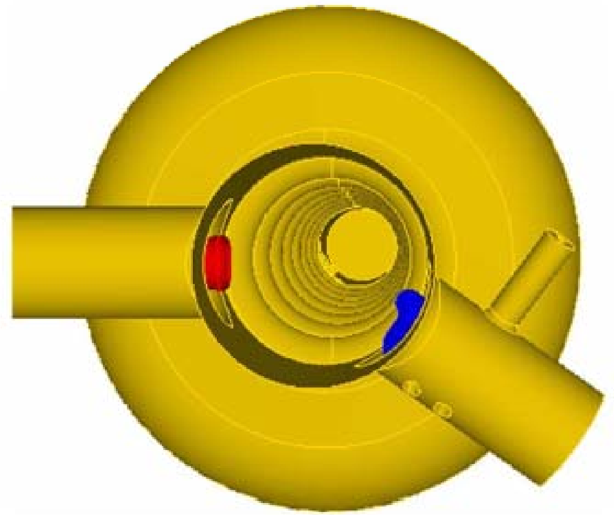


Table 1: Wake kick on-axis (k_{x0},k_{y0}) due to coupler asymmetry, for bunch length $\sigma_z = 1$ mm, in [V/nC] (ECHO).

Case	**Numerical**	**Analytical**
Couplers in pipe	$(-21.2, -18.6)$	$(-20.8, -17.1)$
Couplers in cavity	$(-10.8, -10.0)$	$(-12.7, -7.0)$
Steady-state solution	$(-7.6, -6.8)$	

Table 2: RF kick on-axis due to coupler asymmetry in [kV]. Re(V) is the in-phase, Im(V) the out-of-phase kick.

Region	$\mathbf{V}_x$	$\mathbf{V}_y$
Upstream	$-1.82 + 0.22i$	$-1.29 - 0.11i$
Downstream	$-0.79 - 1.62i$	$+1.15 + 0.28i$
Total	$-2.61 - 1.40i$	$-0.13 + 0.17i$

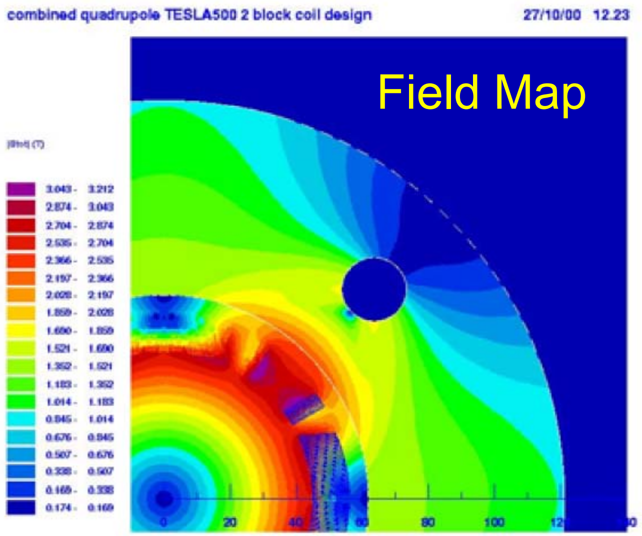
From EPAC08 paper TUPP019

SC Linac Quad & BPM

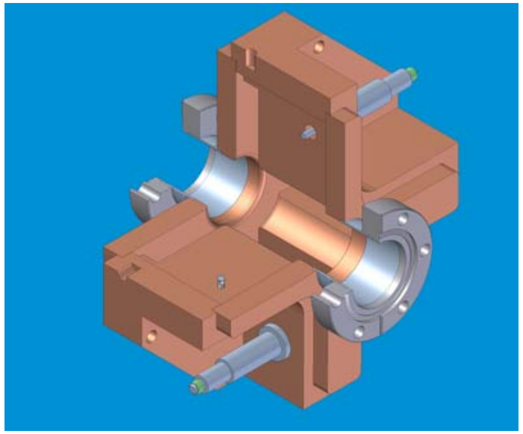
- **Goals:**
  - Characterize field properties of a prototype linac SC quad.
  - Verify quad center moves < ~ 1 microns when the field strength is changed by 20% as required for beam based alignment.
  - Develop cavity BPMs with micron-scale resolution for multi-bunch (200 ns spacing) operation.
- **Project Status:**
  - In FY06, acquired a prototype SC linac quad from CIEMAT/DESY.
  - Construction of a warm-bore cryostat to operate this magnet at 4 K was completed after many problems.
  - A custom rotating coil system, originally developed for NLC, is being used to characterize the quad and dipole fields
  - The S-band rf cavity bpms were built and tested successfully with beam in End Station A (ESA). Data taken there the last few years is being analyzed to understand the stability of the relative bpm alignment.

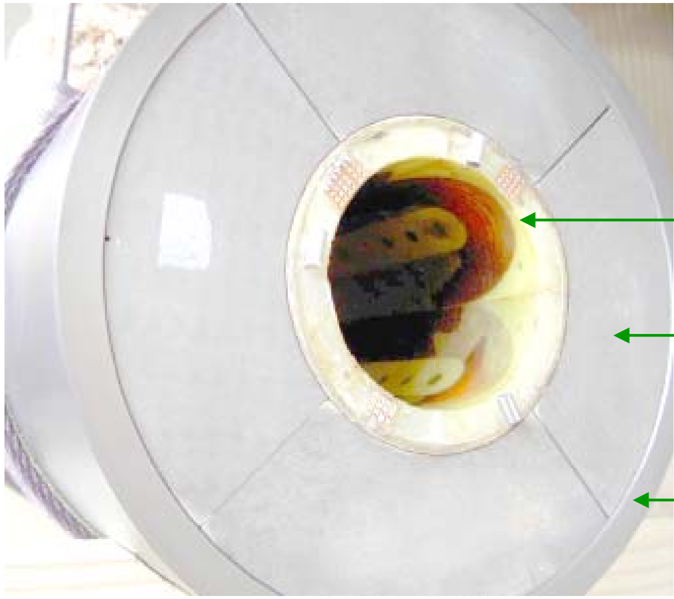
ILC Linac SC Quad/BPM Evaluation

Cos(2Φ) SC Quad
(~ 0.7 m long)



S-Band BPM Design
(36 mm ID, 126 mm OD)



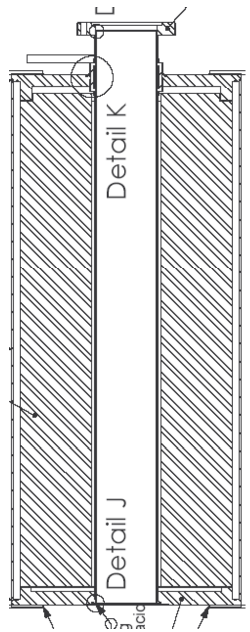


He Vessel →

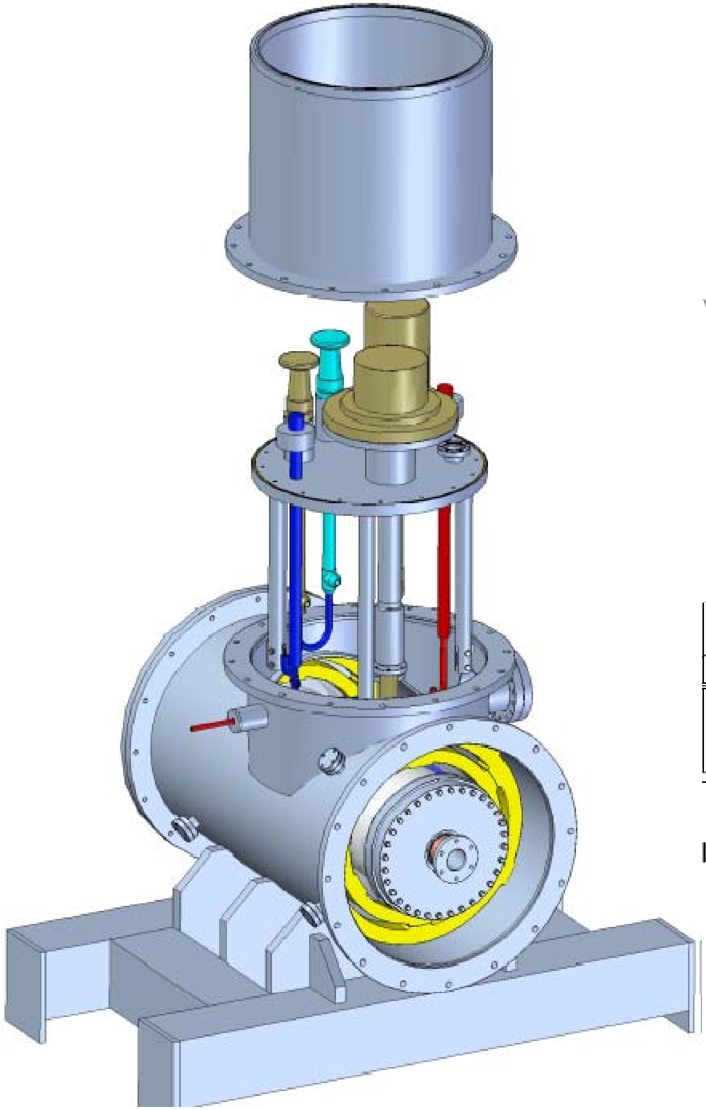
SC Coils

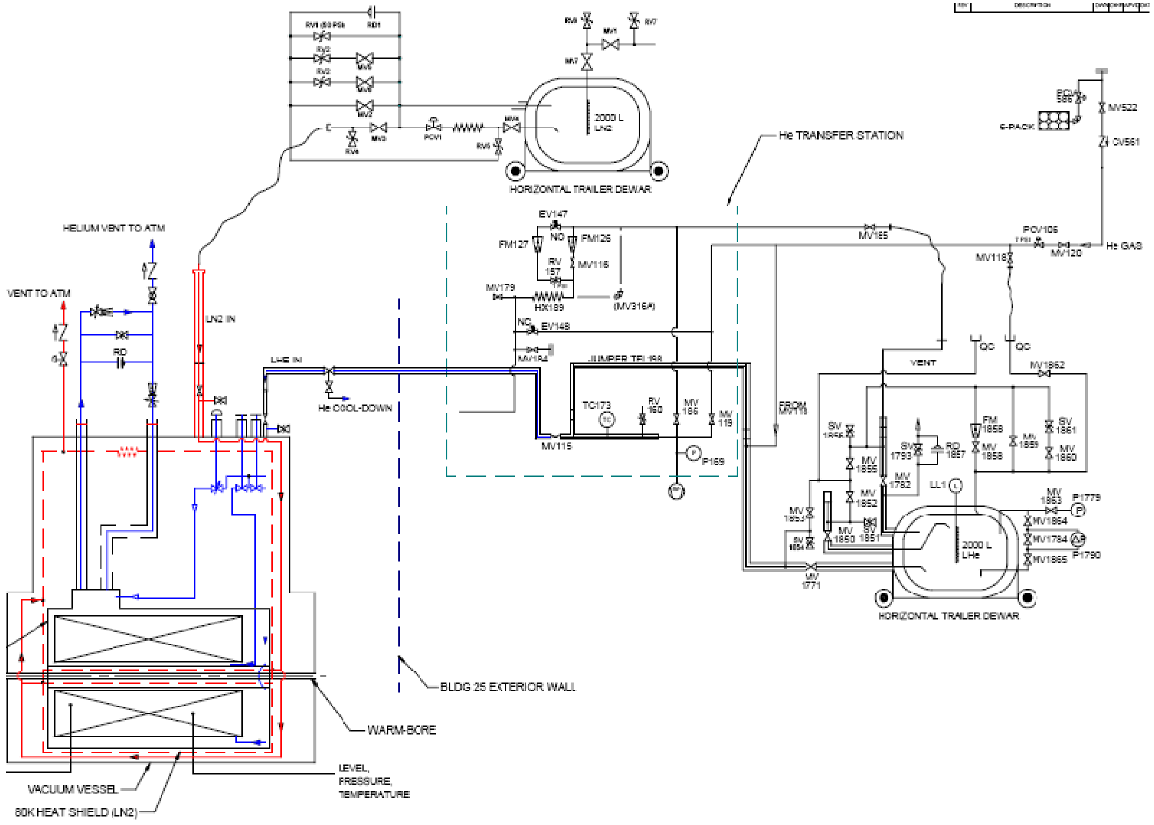
Iron Yoke Block

Al Cylinder

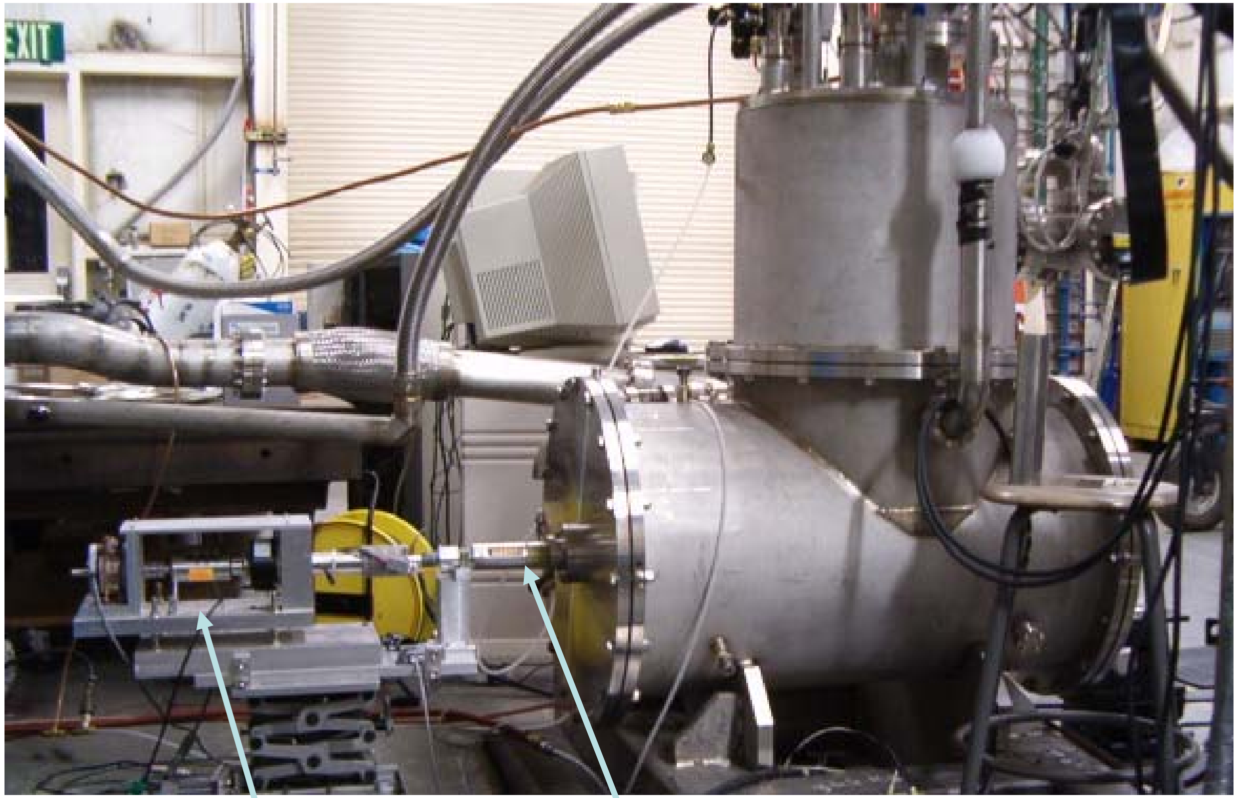


Cryostat and Cryogenic System





Cryostat and Quad/Corrector PS

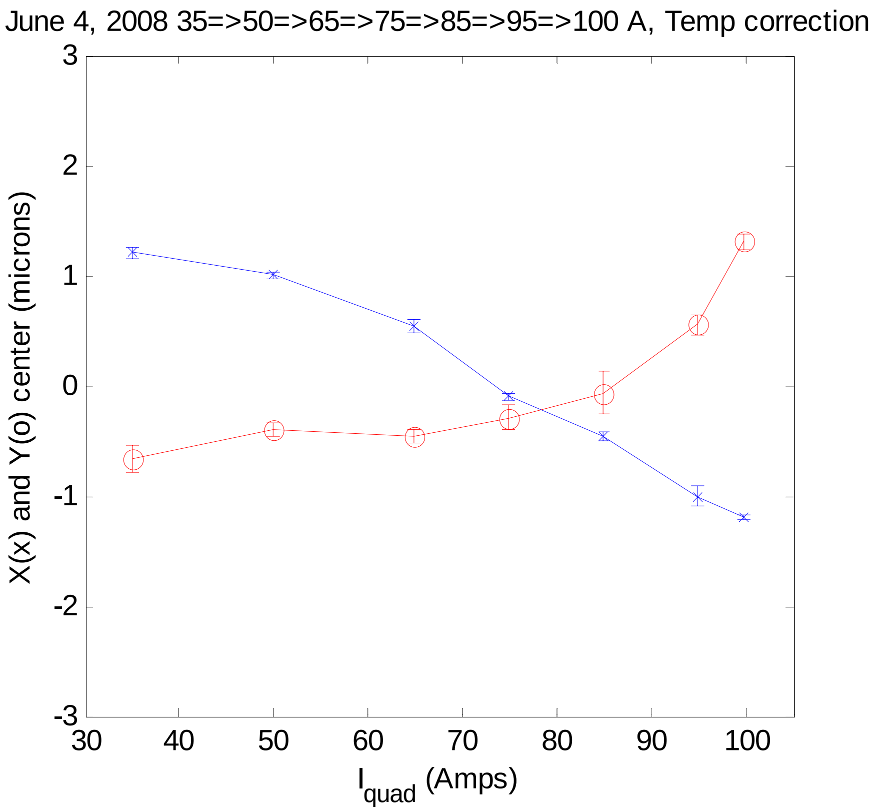


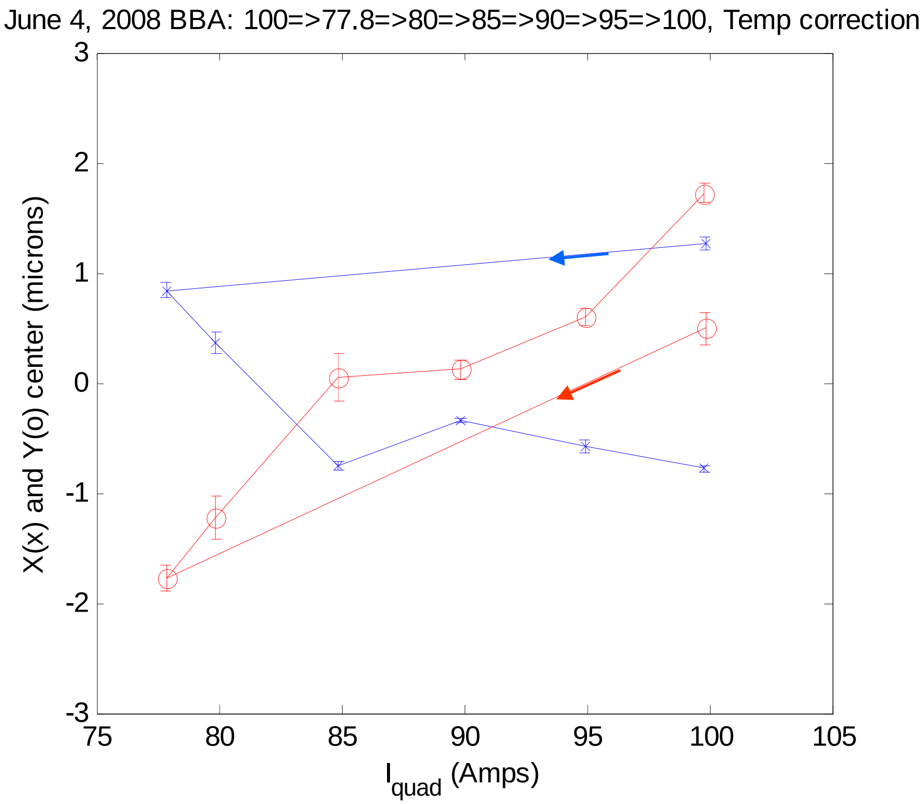
Microstepping
Motor & Encoder

Rotating Measuring Coil

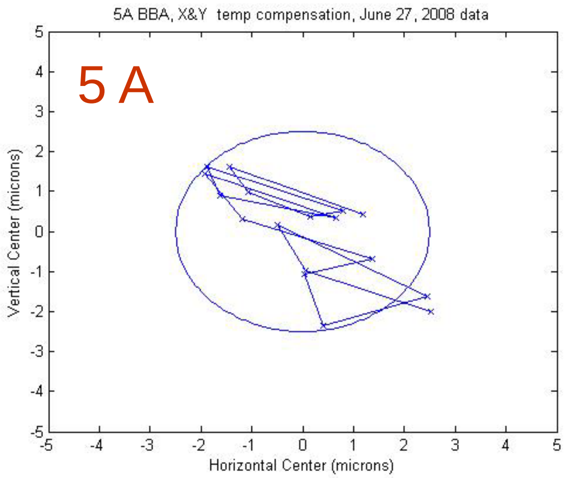
World's First High Precision Measurement of the Magnet Center Stability of a SC Quad

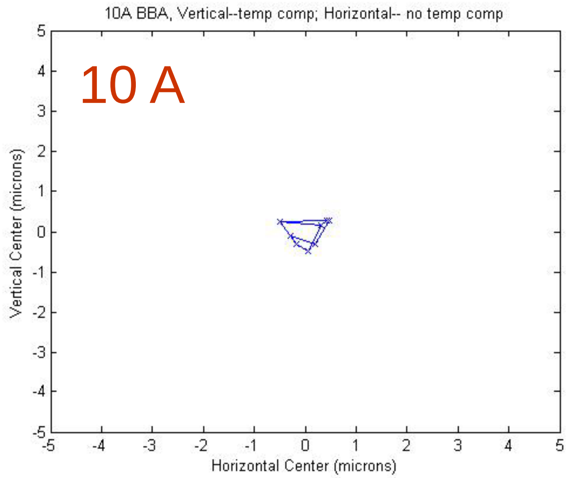
Center Motion < ~ 2 microns with 20% Field Change – Close to ILC Requirement

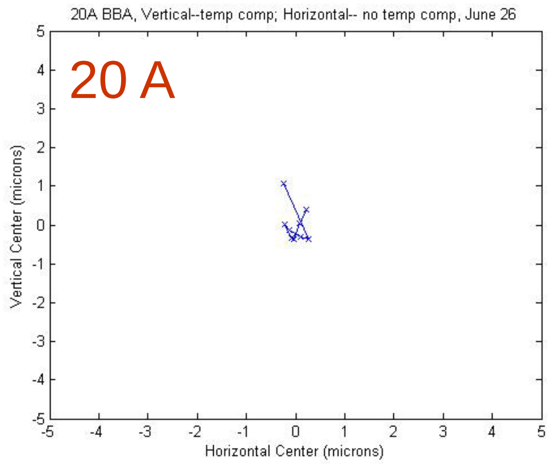


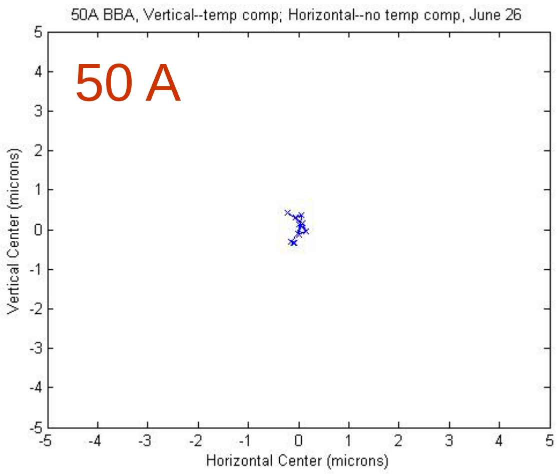


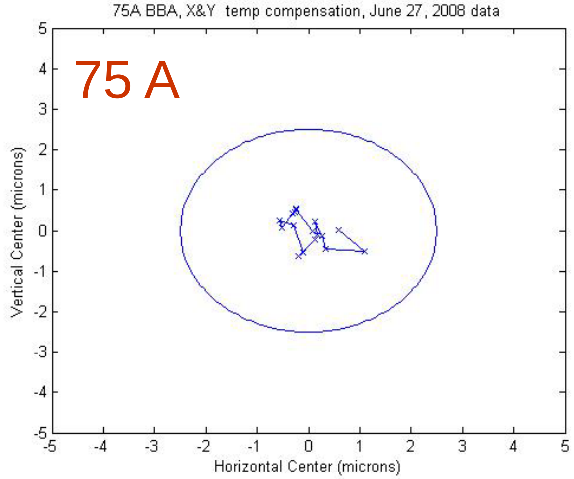
More Center Motion Data: X and Y Magnet Center Changes with 0 to -22% Changes Relative to Various Settings

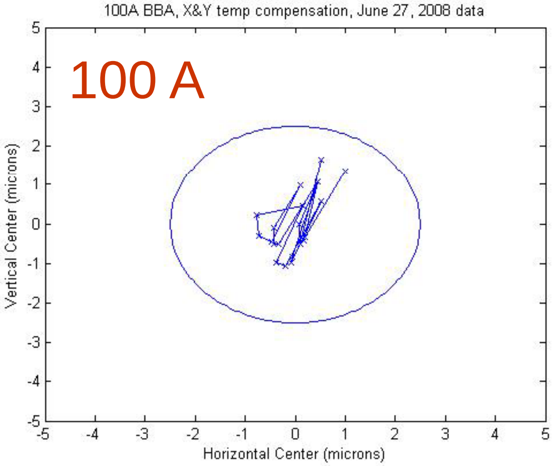




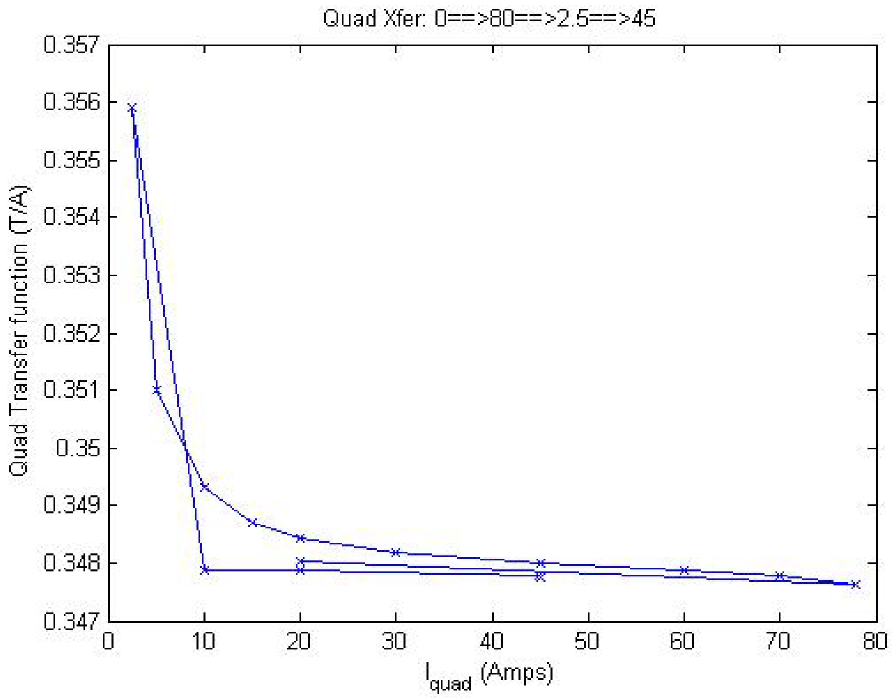


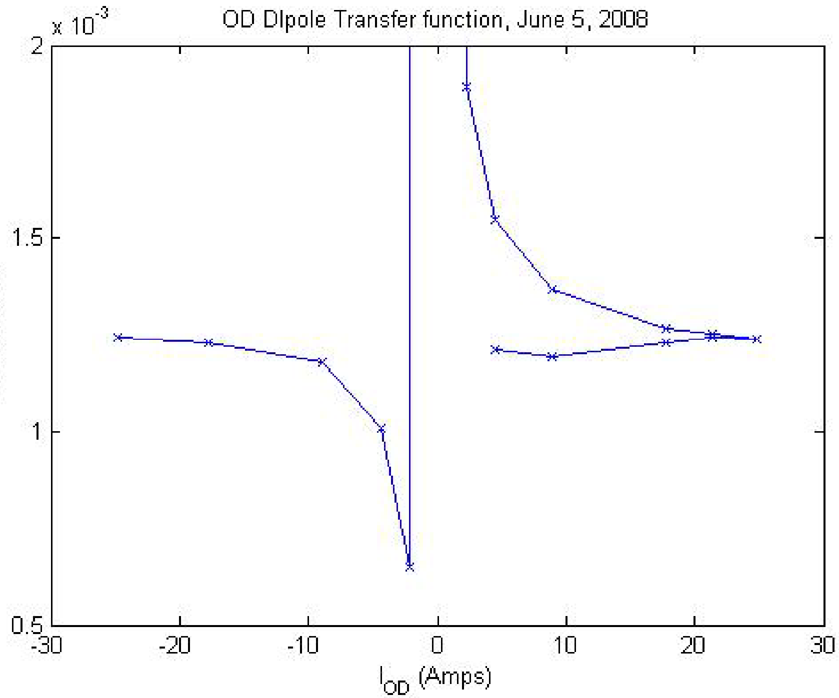






Quad and Corrector Strengths



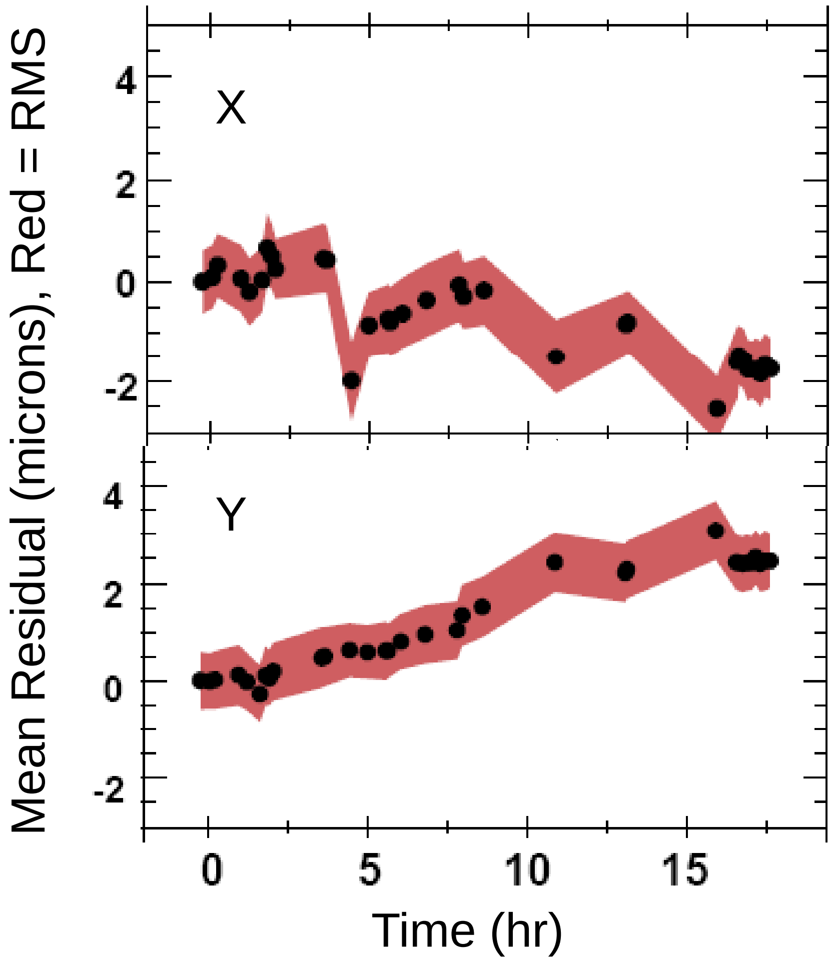


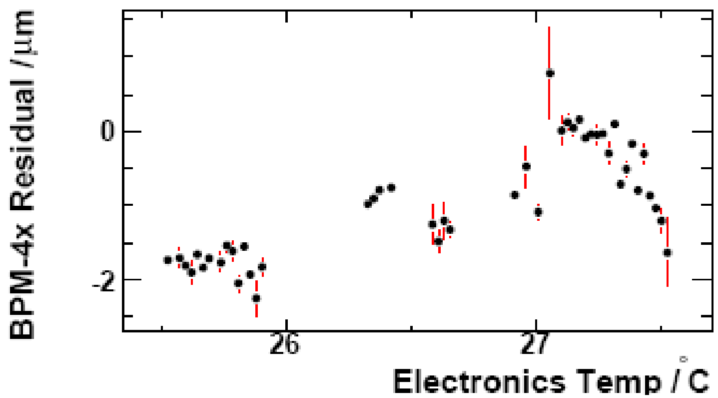
Dipole Persistent Current Effects Large (from Quad Windings) – Confirms Baseline Choice of Having Separated Quad and Corrector Magnets

BPM Triplet Stability Results

(~ 0.5 micron resolution, 1.4e10 electrons, Q of 500 for clean bunch separation)

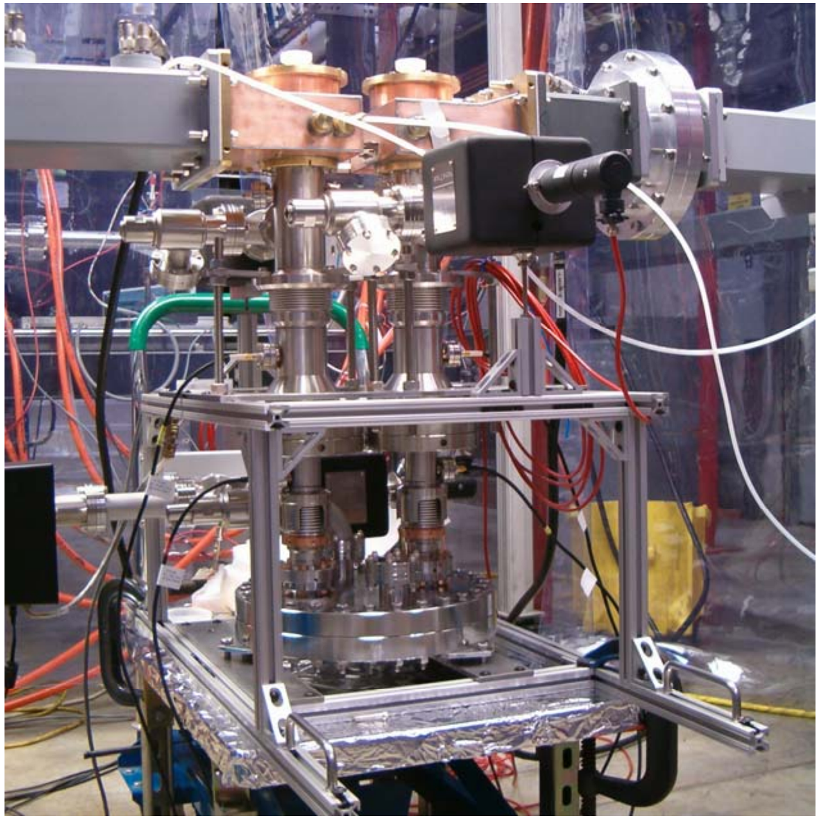
Final SLAC ESA Run Slated for June 2008 Canceled due to Budget Constraints



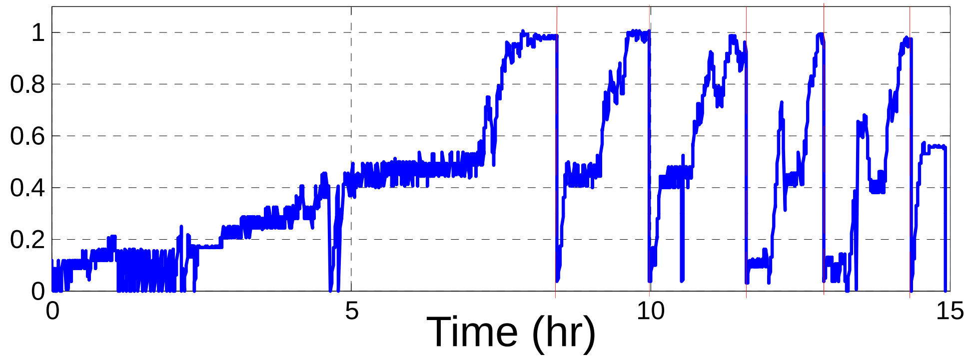


M. Slater, et al., Nucl. Instr. and Meth. A (2008), doi:10.1016/j.nima.2008.04.033

First SLAC Coupler Processing Results



Processing of First Pair after 150 °C Bake: Power (MW) -vs- Time for Pulse Widths of 50,100, 200, 400, 800, 1000 μs



Clean Room Being Constructed at SLAC

Storage Lockers

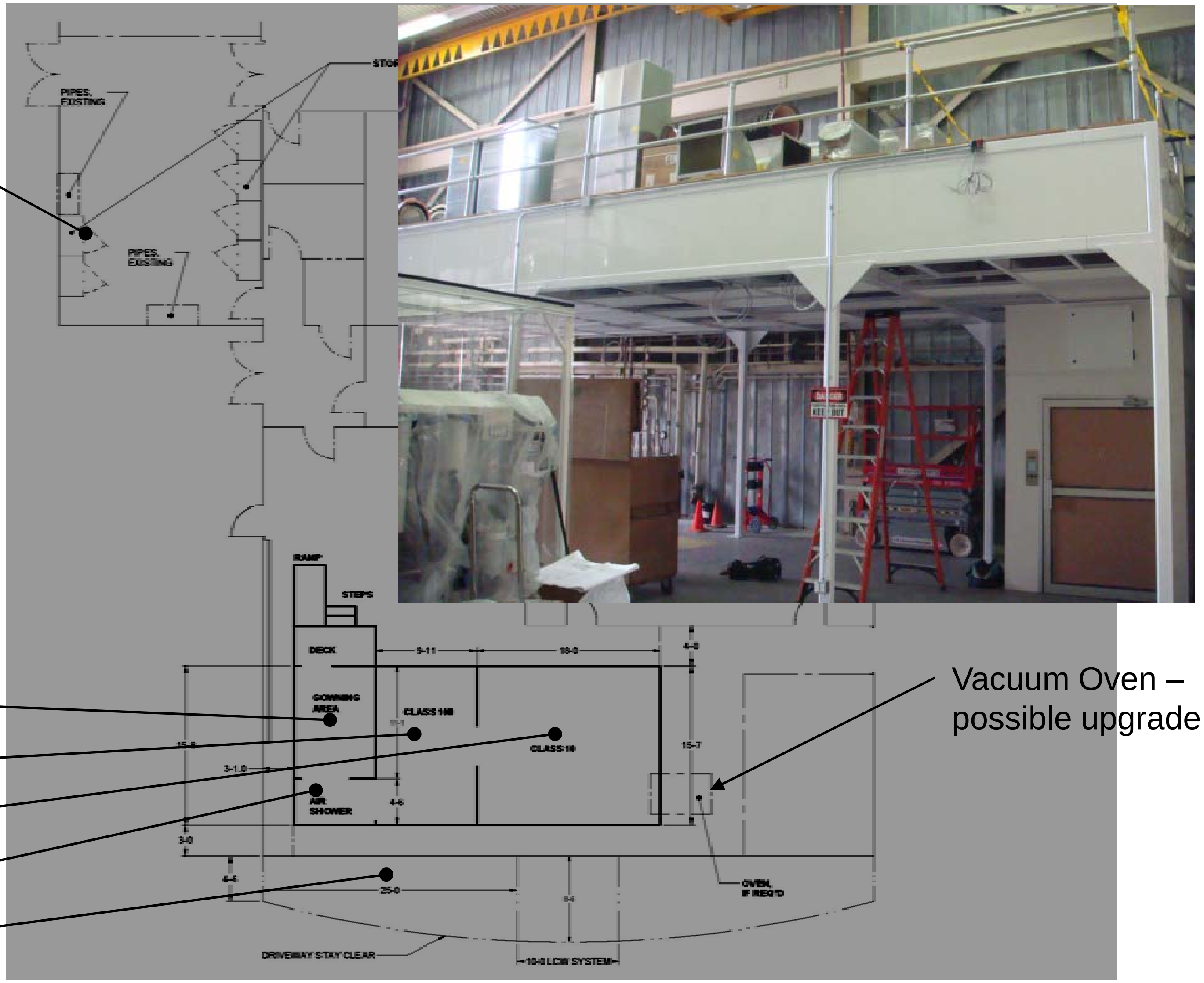
SLAC Modification to Orsay Design:

Eliminate separate material pass-through

More class 10 area

Class 1000 => 100

Remote vacuum bake



Gowning Area

Class 100

Class 10

Air Shower

Air Handling System

Vacuum Oven – possible upgrade

Fast Fault Finder

- Replaces PLC and NIM logic to protect klystron (the modulator has its own interlock system)
- All signals, fast (e.g., rf or light) or slow (e.g., flow or PS current), are pre-conditioned to the same voltage range and sampled by a 20 MHz, 12 bit ADC and sent to a FPGA to generate fast (< 1 us) or slow (< 1 ms) fault signals based on high/low thresholds of individual channels or channel differences.
- Currently, four VME boards (4 fast, 10 slow channels each) are being tested.