Conceptual Design of the Final Magnet Support for NLC

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11-8-00

Structural support path

From the inside of Q1-

Magnet block (potted to collar)

Collar (organizes magnet blocks into sections)

Material should have similar CTE with magnet blocks
(SmCo5 CTE = 7 to 13 $x10^{-6}$ /deg K)
Ti is a nice match CTE = $9.5x10^{-6}$ /deg C
(stainless is worse CTE = $17.3x10^{-6}$, Al is bad CTE = $23.6x10^{-6}$)

CTE argument- We are trying to thermally stabilize the magnet, so why do we need a CTE match? Nanometers are very small. CTE's are typically in the 10**-6 div / div per deg C range while we are looking for 10**-9 stability. CTE matching helps to reduce the magnitude of thermal distortion.

Collars are compressed by axial rods

Support Rods are to be potted to avoid resonance or removed later

Compressed collar slice stack is potted in support tube

The outer support tube is the structural element

Collars are dead weight

Support tube layup may be tuned to avoid several modes

This carbon fiber support tube is stiff and light
(and thus has a high frequency resonance)

Metallic blocks are to be sandwiched within the layup as local stiffeners and tap plates

Magnet Support-

Magnet support tube is held by flexures and actuated with two piezo stacks

Initial design had single flexure at base

Flexure had to be wide to avoid torsional mode

A later modification added an upper flexural guide

Now, support is the nanometer version of an automotive, double wishbone suspension. Torsional stiffness is dramatically increased due to proper support placement

Solids model reflects independent supports for each flexure

Further developments combined many components in to one part

A box beam surrounds the magnet as the new intermediate support beam

Current design combines: Intermediate support beam
Upper flexure supports
Inner beam pipe stabilizer

Current design maximizes stiffness while minimizing volume

This design further isolates the magnet from thermal cross talk

Upper flexure reaches through intermediate support beam to stabilize inner magnet

Support looks like nested box beams

Intermediate support beam rests on cam system

A cam / bearing / support / power transmission system has been developed

The non-magnetic requirement had been a leading concern

We have talked to the various harmonic drive and bearing companies.

Non-magnetic components will generally be custom components.

Due to vendor's hesitancy, the design minimizes variety and complexity of purchased parts.

We have selected bare harmonic drive components (as opposed to a drive assembly)

100 : 1 gear reduction is local to cam to avoid shaft windup

Torque tubes are used to transmit torque from motors located outside the magnetic field to the harmonic drives

Due to the beam crossing angle and the restricted outer diameter, the torque tubes will be at various angles with respect to the harmonic drives.

Flexible torque couplings will be used at each end of the torque tubes.

Torque tube polar moment of inertia will be maximized to reduce wind up and to remove intermediate support requirements.

- Cam mechanism support
  - Several different attachment methods are being considered
    - Single plate support
    - Dual wedge support
    - Support from outside tube
  - Issues
    - Size of mechanism
      - What will fit best?
    - Coarse alignment
      - Shims
      - Adjustable plates
      - Set screws
    - Stiffness
    - Assembly procedures