

European Organization for Nuclear Research





IWLC2010 International Workshop on Linear Colliders 2010

Hard or Soft ?

C. Collette, K. Artoos, S. Janssens, P. Fernandez-Carmona, A. Kuzmin, M. Guinchard, A. Slaathaug, C. Hauviller



The research leading to these results has received funding from the European Commission under the FP7 Research Infrastructures project EuCARD



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Hard or Soft ...active isolators to stabilize the main beam quadrupoles of the CLIC ?

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- Passive vibration isolation
- Active vibration isolation
- □ Soft active support vs stiff active support
- CLIC quadrupole stabilization







Trade off between magnification at resonance and isolation













- (i) Improves the isolation
- (ii) Make the payload more sensitive to external forces Fa





 10^{2} <u>1909:</u> US 970,368 - No DVA ■ c_a Low DVA ----c_a Optimal m_a 10^{1} $k_a \not \models \neg c_a$ Ξ ${\boldsymbol{x}}$ 10° mk 套 中 cw 10^{-1} 10^{1} [Hz]

• Spurious peaks

8

- Difficult to make an efficient compact design
- Either damping, or isolation for narrow band excitation



Anti-resonant isolators



9





































1994: Proc. SPIE vol. 2264











Only active isolation can provide both:

- Isolation in a broad frequency range between 1Hz and 20 Hz
- Dynamic stiffness for robustness to disturbances and compatibility with alignment

Conditions:

- Measure the vibrations
- Process the signal in real time
- Apply small dynamic forces







Very Soft (1 Hz)	Soft (20 Hz)		Stiff (200 Hz)	
 Pneumatic actuator Hydraulic actuator 	 Electromagnetic in parallel with a spring Piezo actuator in series with soft element (rubber) 		• Piezoelectric actuator in series with stiff element (flexible joint)	
COMPARISON				
 + Broadband isolation - Stiffness too low - Noisy - Noisy - Low dynami - Low compatialignment and 		lation at high freq. ic stiffness tibility with id AE	 + Extremely robust to forces + Fully compatible with AE + Comply with requirements - Noise transmission - Strong coupling 	





18



 $\Phi_n = |SKG|^2 \Phi_{n_1}$ $+ |SG|^2 \Phi_{n_2}$ K = CHS = 1/(1 + KG)

No significant difference in the noise transmission





















- 21
- Active control can improve the isolation at low frequency without enhanced sensitivity to disturbances.
- □ Main concepts presented on one d.o.f. systems.
- Stiff and soft active supports provide similar stabilization at low frequency.
- Stiff active supports successfully applied for the stabilization CLIC quadrupoles.
- Performances will be improved with a more adapted sensor (under development).