Laboratoire d'Annecy-le-Vieux
de Physique des Particules

LAViSta Project

Particles beam displacement control of the future linear collider at the interaction point

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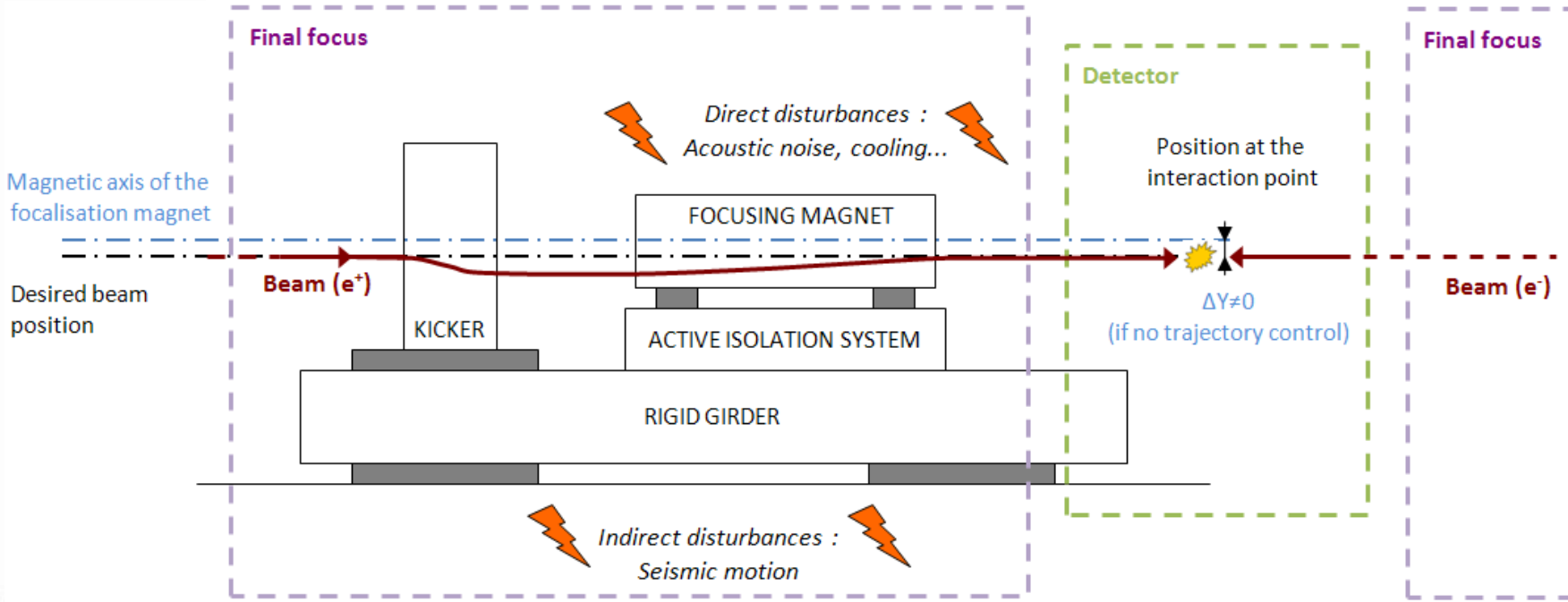
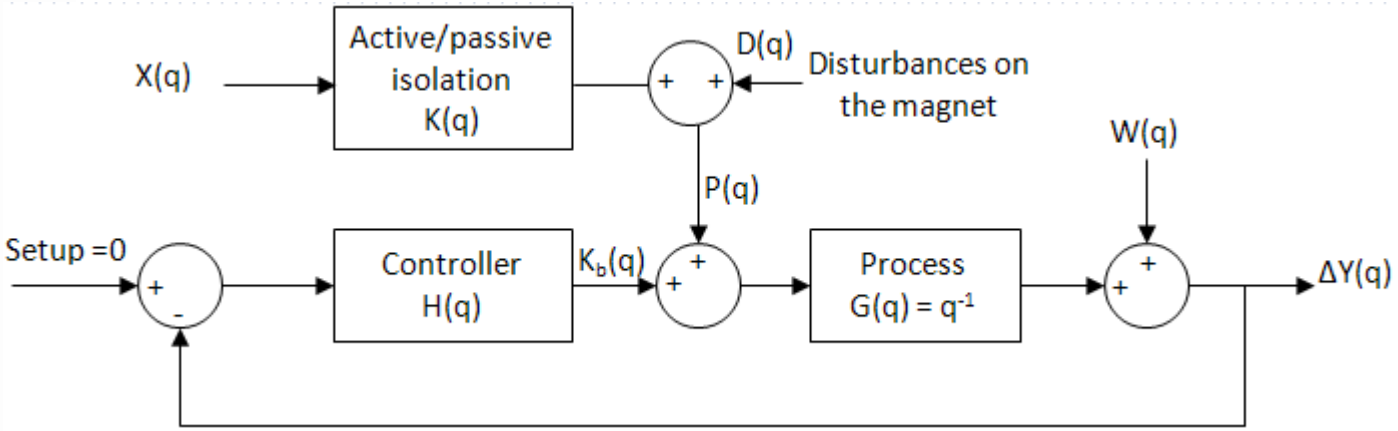
Final focus Layout



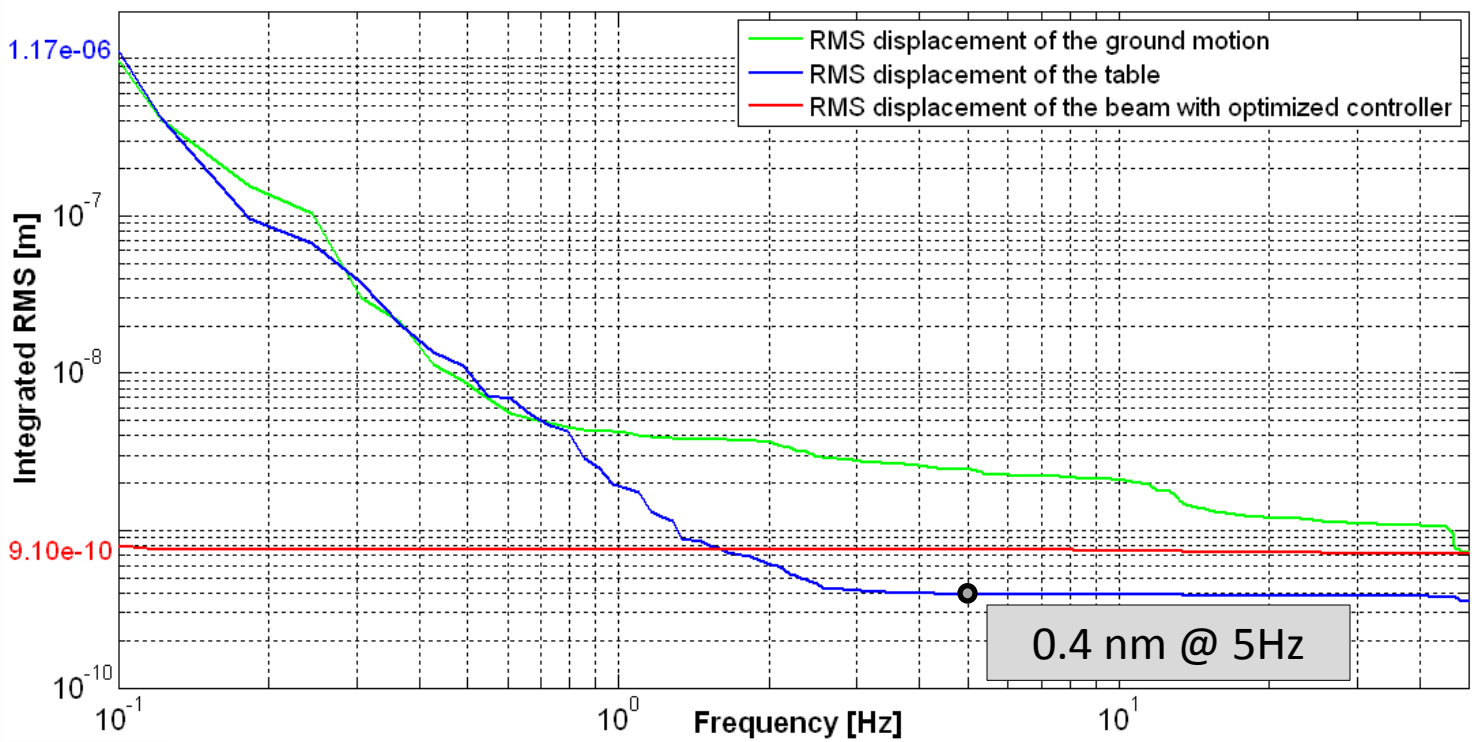
TMC table + Feedback



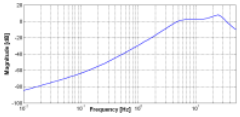
- *Parametrical optimization of the controller:* $H(q)=\frac{b_0+b_1q^{-1}+b_2q^{-2}}{1+a_1q^{-1}+a_2q^{-2}}$
- *Hypothesis:*

X: Ground motion measurement from CMS
K: model of the TMC table
ΔY : BPM

TMC table + Feedback



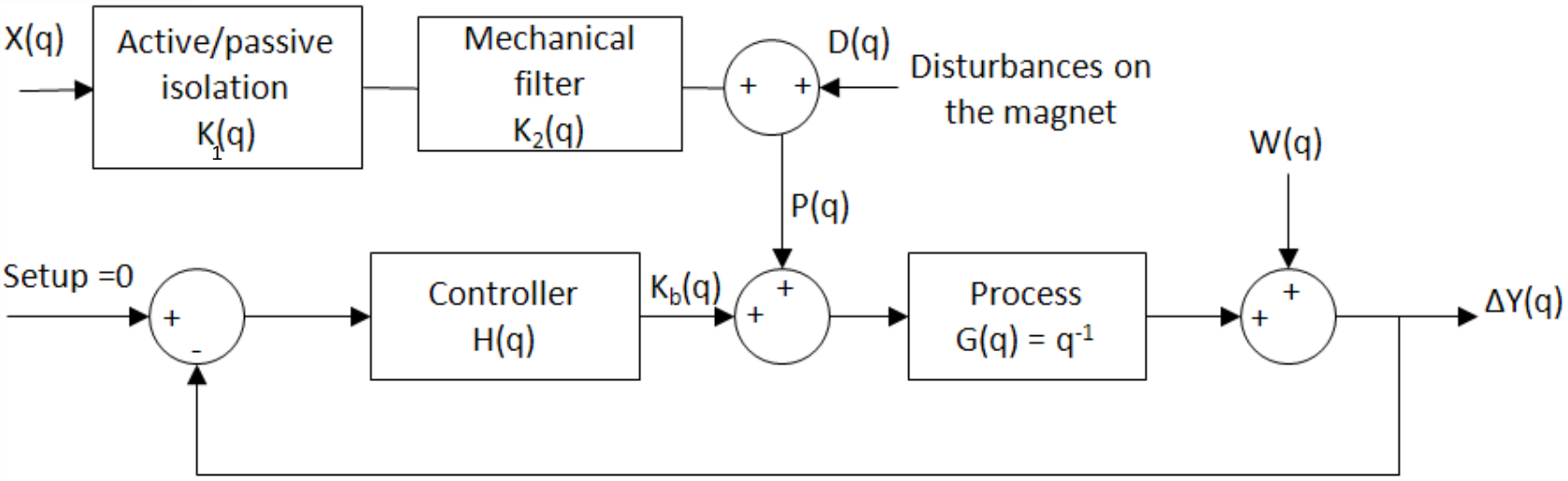
- *Efficiency of the feedback scheme: 0 Hz to 2 Hz*



- *Min Integrated RMS displacement of the beam : 0.4 nm @ 5 Hz*

Optimization of the needed mechanical support to damp fast motions

Feasibility demonstration: TMC table + Mechanical support + Feedback



Example: *How to improve the behavior of the TMC table*

Adding a 2nd order resonant low pass filter

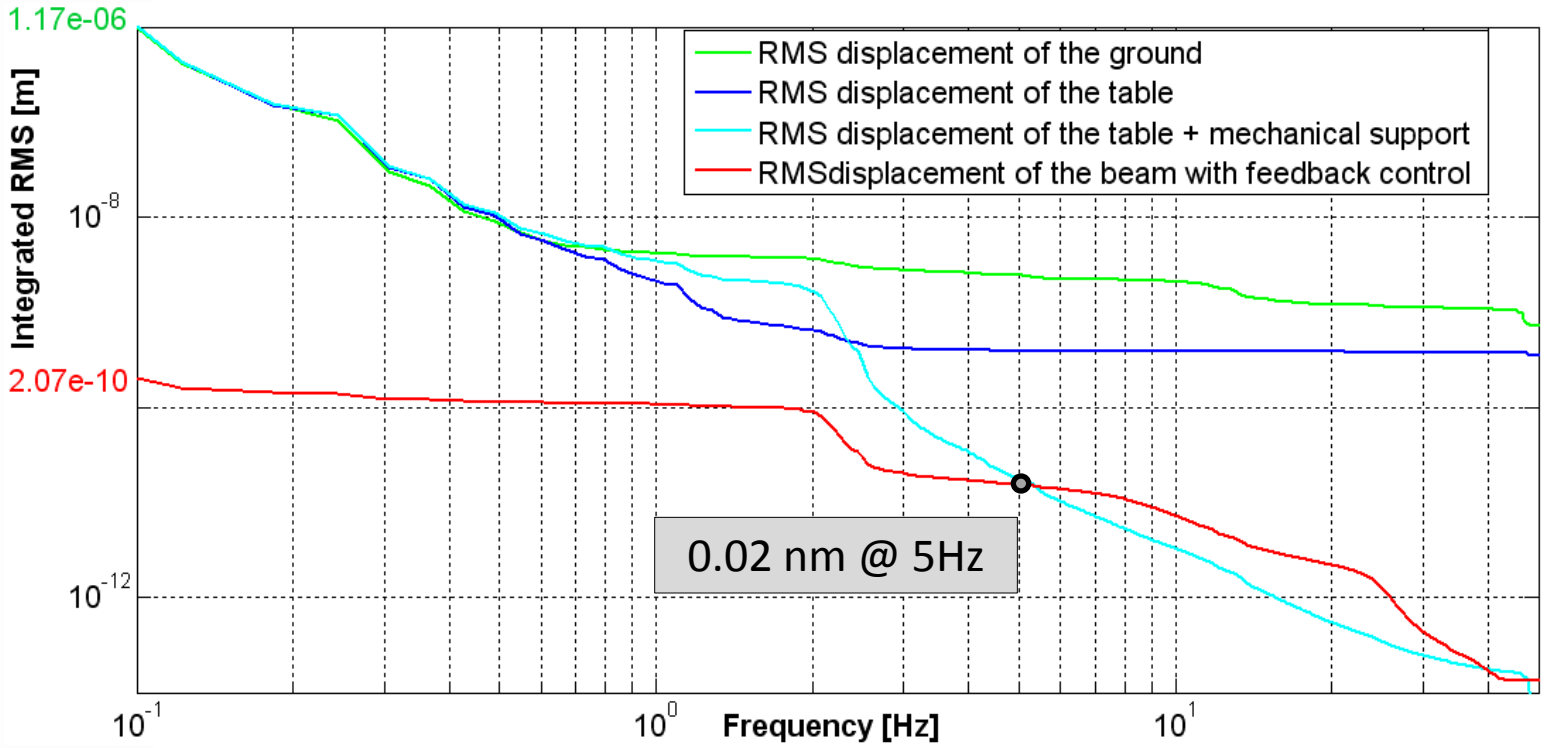
$$K_2(s) = \frac{1}{1 + \frac{2\xi}{\omega_0} s + \frac{1}{\omega_0^2} s^2}$$

$\omega_0 = 2\pi f_0$

$\xi = 0.01$

$f_0 = 2$ Hz

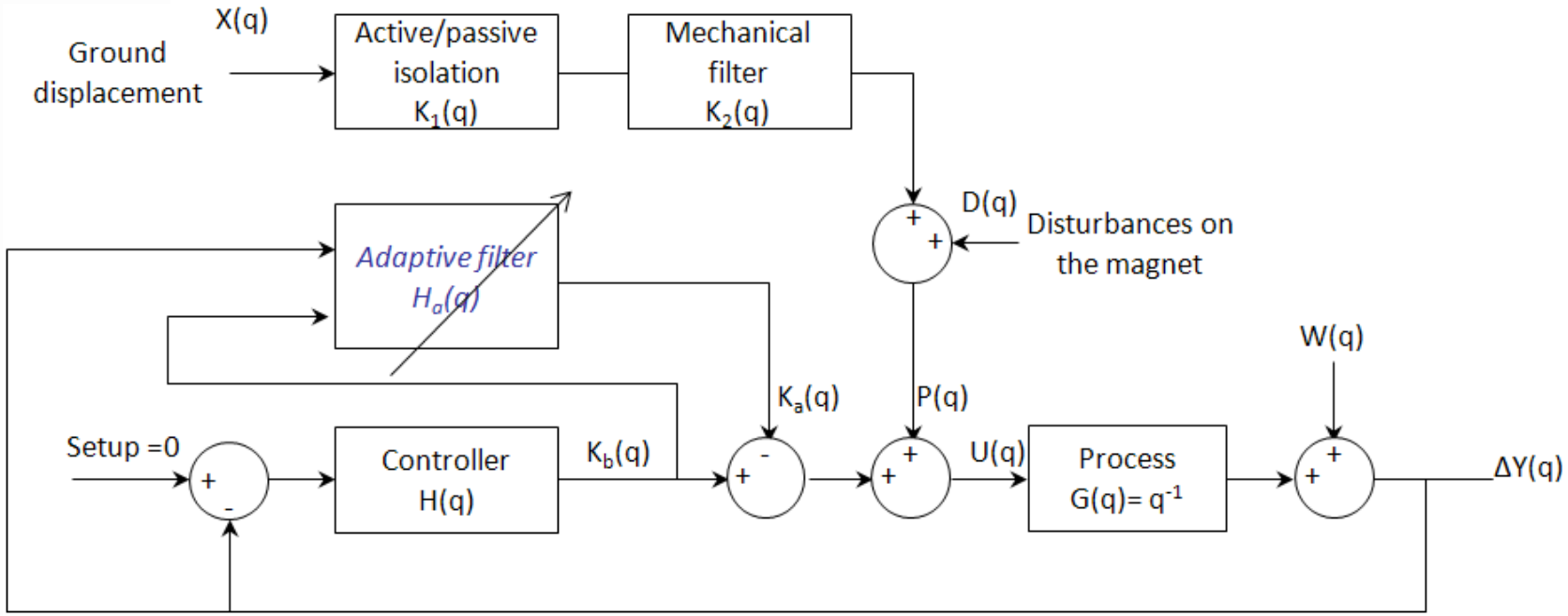
TMC table + Mechanical support + Feedback



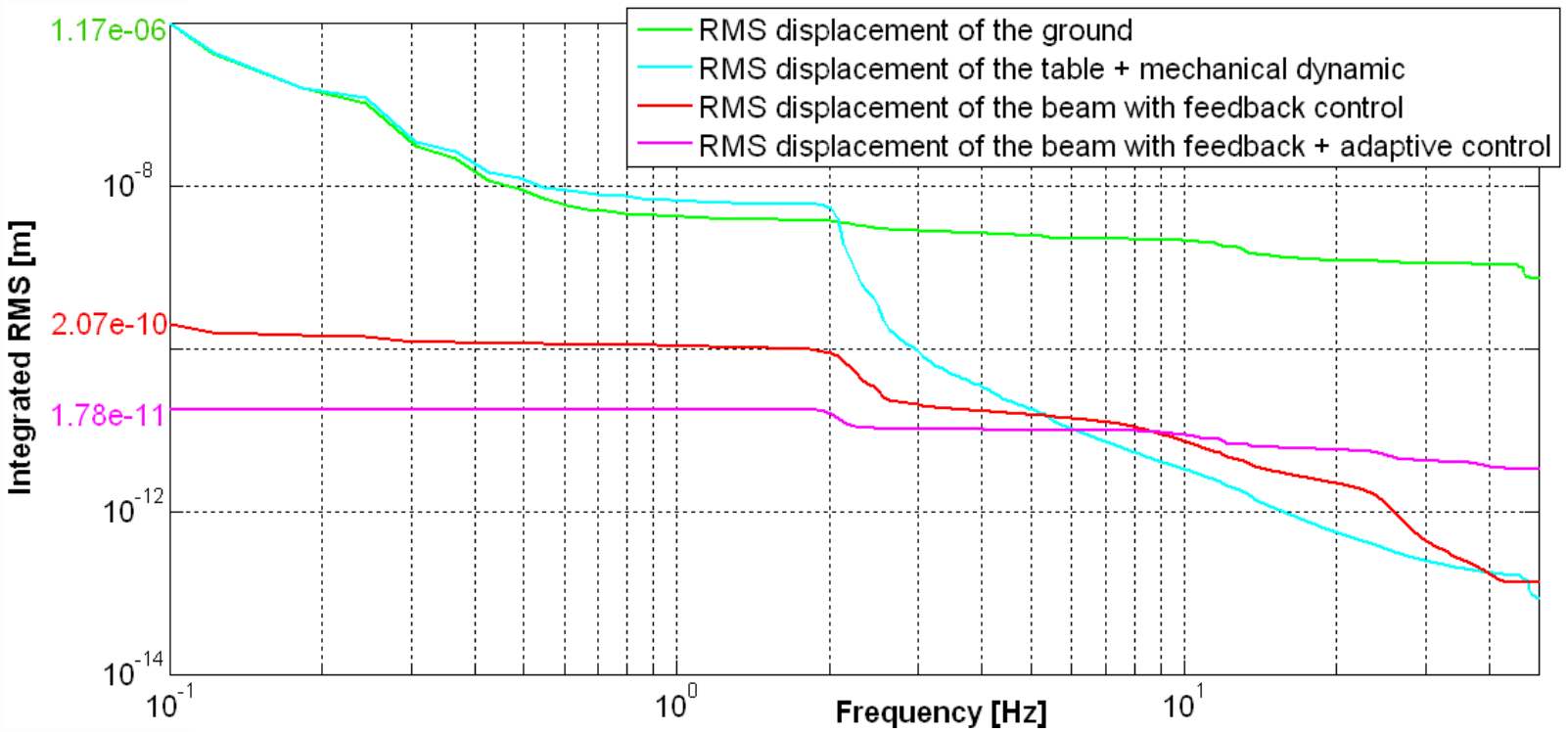
- *Integrated RMS displacement of the beam (TMC table = Mechanical support + Feedback)*
  0.02 nm @ 5 Hz
- *Integrated RMS displacement of the beam (TMC table = Mechanical support + Feedback)*
  0.2 nm @ 0.1 Hz

→ ***Non linear control needed***

TMC table + Mechanical support + Feedback + adaptive control



TMC table + Mechanical support + Feedback + adaptive control



- *Integrated RMS displacement of the beam (TMC table = Mechanical support + Feedback)*
  0.018 nm @ 0.1 Hz

→ ***Robustness***

Robustness of the system {TMC table + Mechanical support + Feedback + adaptive control}

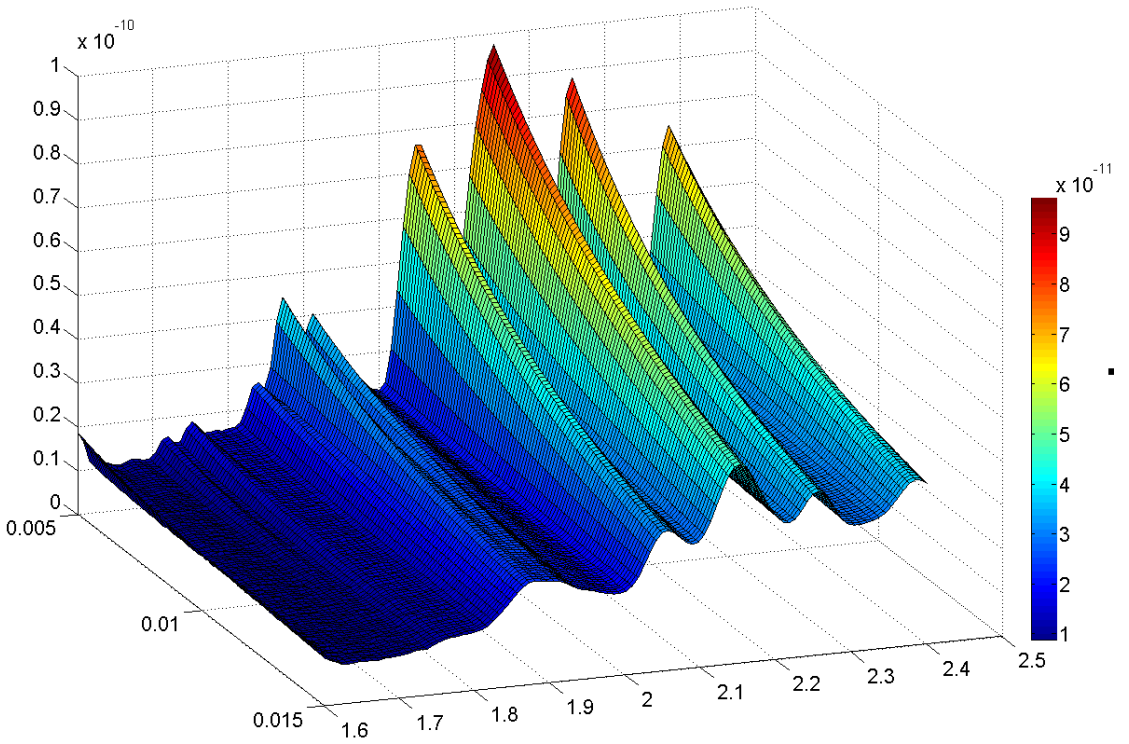
- *Controller optimized for the PSD of the ground motion filtered by the TMC table + Mechanical support K_2*

$$K_2(s) = \frac{1}{1 + \frac{2\xi}{\omega_0} s + \frac{1}{\omega_0^2} s^2}$$

ξ= 0.01
f_0 = 2 Hz

$f_0 = f_0 \pm 10\%$
$\xi = \xi \pm 50\%$

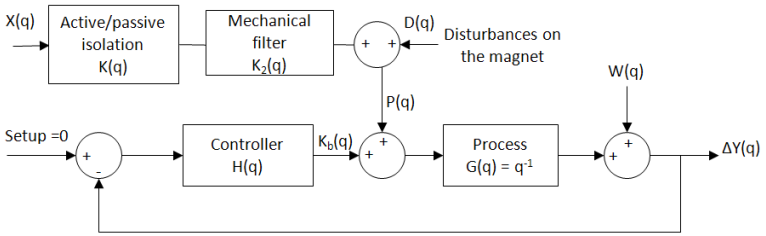
- The worst case:
  f_0 = 2.2 Hz
  ξ = 0.005



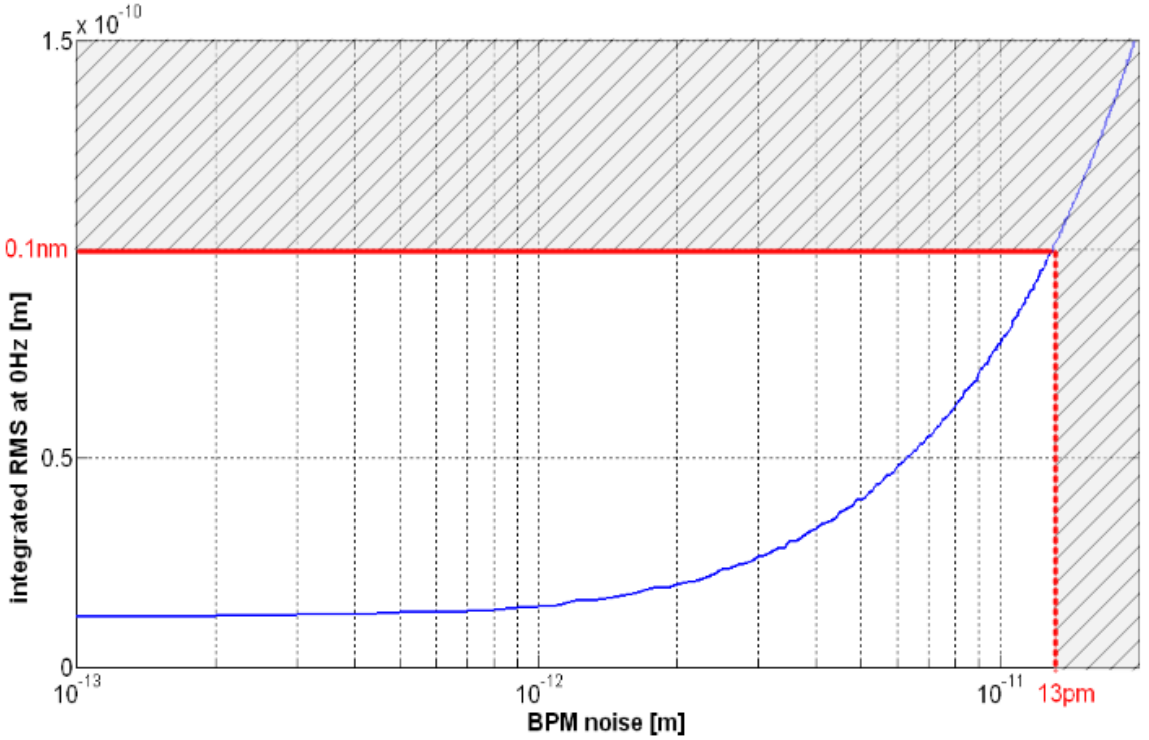
Integrated RMS displacement of the beam
0.1nm @ 0.1 Hz

Robustness of the system {TMC table + Mechanical support + Feedback + adaptive control}

- *W:* white noise added to the measured displacement



- *Sensor's noise has to be < 13 pm integrated RMS @ 0.1 Hz*

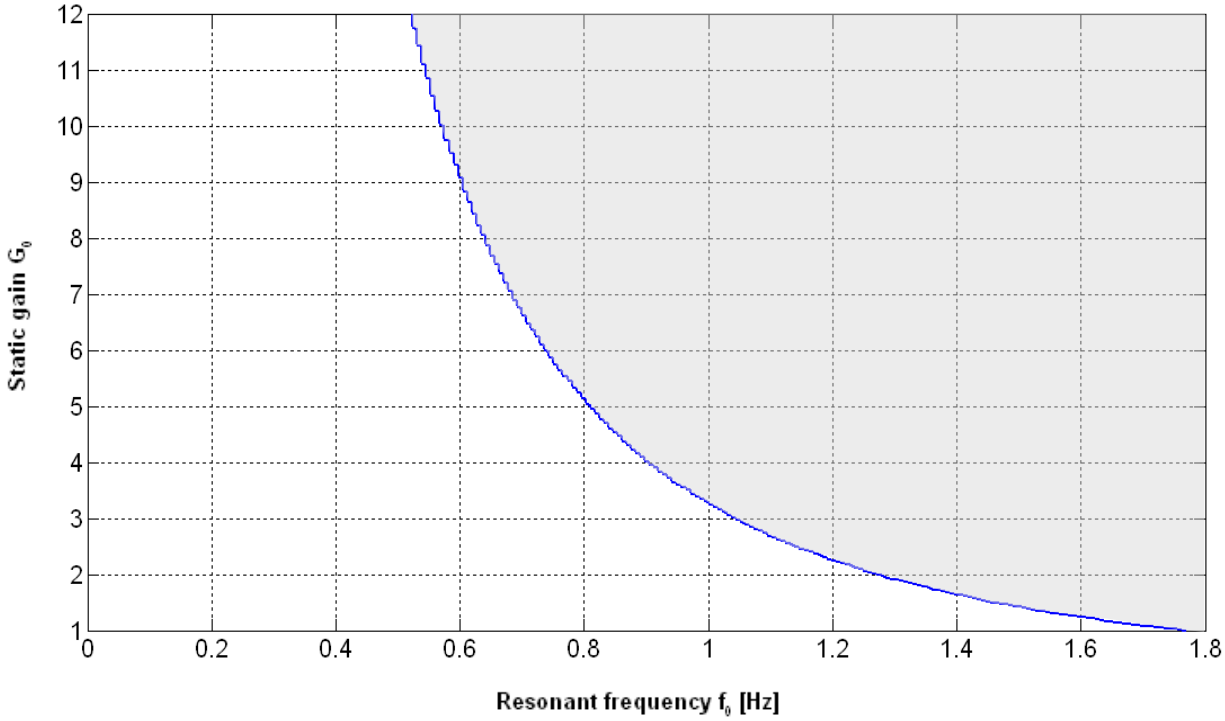


Pattern of an active/passive isolation

TMC table + Mechanical support = Global active/passive isolation

➡ $K_1 K_2 = K_g$

$$K_g(s) = \frac{G_0}{1 + \frac{2\xi}{\omega_0} s + \frac{1}{\omega_0^2} s^2}$$



- *Independent from the variations of the damping ratio ξ in the range [0.005 0.7]*

➡ ***Specification of the future active isolation support***