



Calibration of the Cedrat / PI piezo-mover systems and new results on the investigation of the stability

Oscar BLANCO^{1,2}, Frédéric BOGARD¹,
Philip BAMBADE¹, Patrick CORNEBISE¹, Sandry WALLON¹

LAL¹, CERN²

July 5, 2013





Table of contents

The system

Vertical displacement

PI without and with feedback

Cedrat without and with feedback

Coupling (effect in y when moving x)

PI without and with feedback

Cedrat without and with feedback

Stability and Minimum Step

PI without and with feedback


Cedrat without and with feedback

Current work/prospects



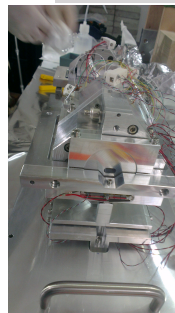
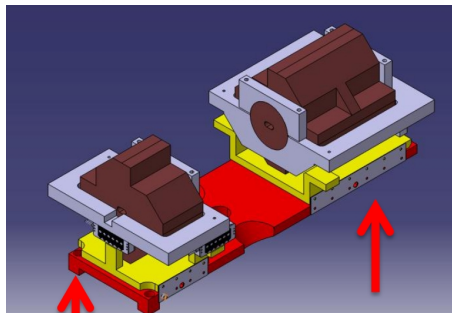
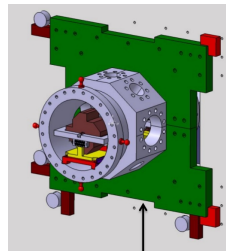
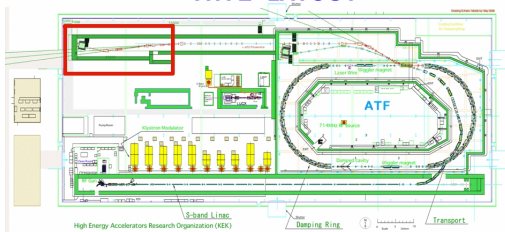
Motivation

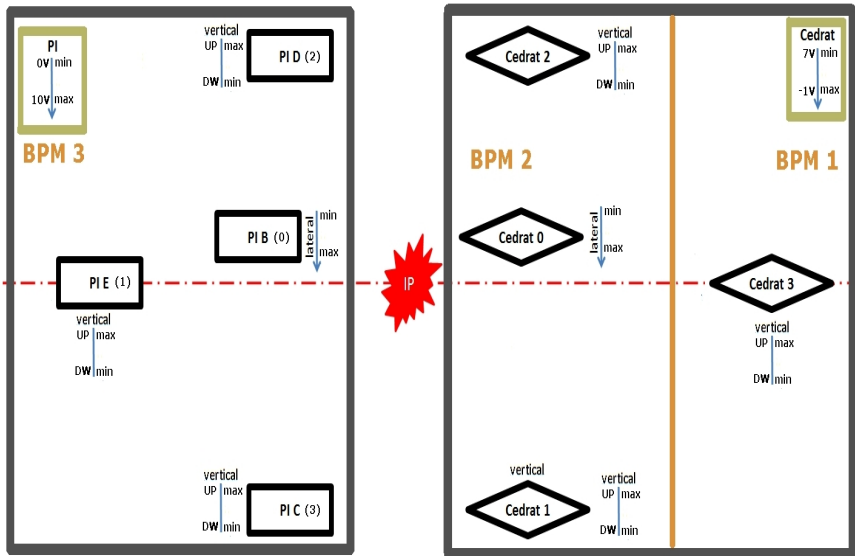
- ▶ Locate BPMs to enable the **maximum possible** beam position resolution
- ▶ Precision $\sim 5\mu\text{m}$
- ▶ Calibration $\sim 10^{-4}$

Displace each BPM block  **independently**



ATF2 LAYOUT



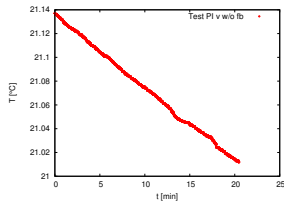
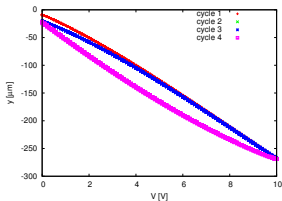
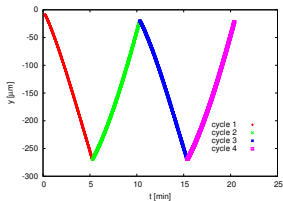




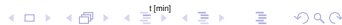
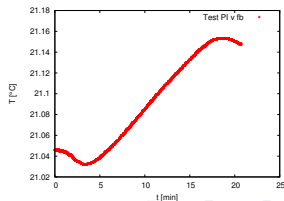
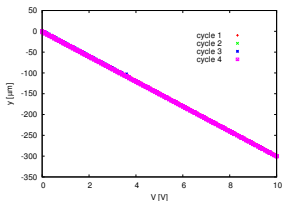
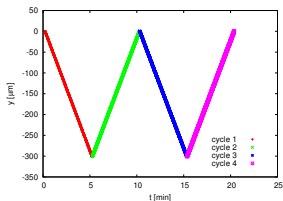
PI without and with feedback

Four cycles, range (0~10V, 0~300 μ m)

PI without fb

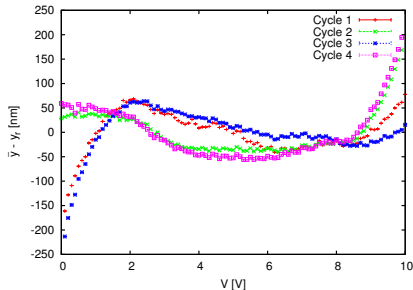


PI with fb





Linearity (with fb)



Cycle	Slope[nm/V]	Offset[nm]
1	-30011 ± 1	-191 ± 9
2	-29997 ± 1	-204 ± 9
3	-29982 ± 2	-502 ± 9
4	-30018 ± 2	84 ± 11

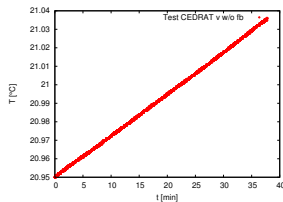
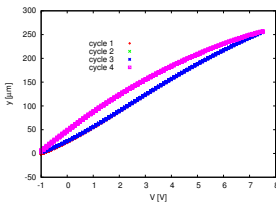
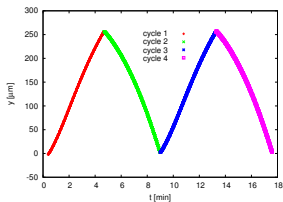
Slope mean = 30002 ± 7

Frédéric Bogard showed $\sim 120\text{nm}/0.1^\circ\text{C}$ from measuring setup (neglecting thermal inertia)

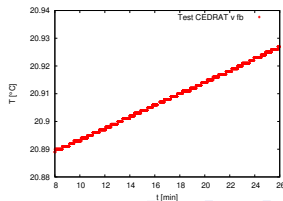
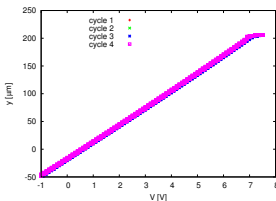
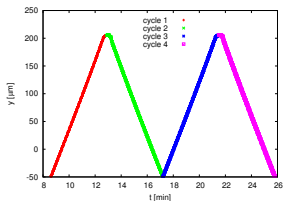


Four cycles, range (-1~7V, 0~250 μ m)

Cedrat without fb

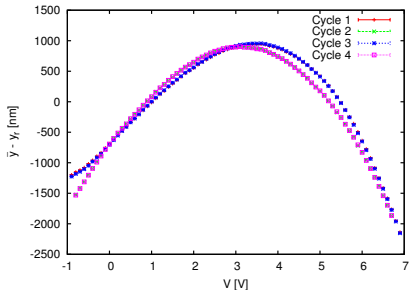


Cedrat with fb





Linearity (with fb)



Slope mean = $31015 \pm 12(\pm 42)$

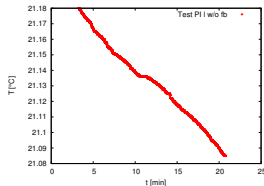
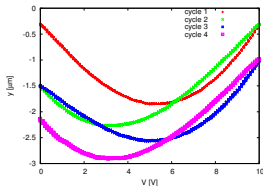
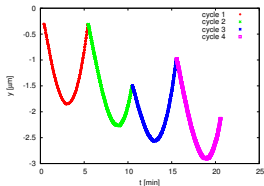
Temperature effect from setup not measured but expected to be similar

Cycle	Slope[nm/V]	Offset[nm]
1	30988 ± 41	-18670 ± 154
2	31039 ± 42	-19092 ± 154
3	30993 ± 41	-18547 ± 156
4	31040 ± 42	-18935 ± 154

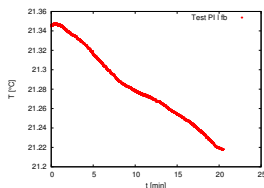
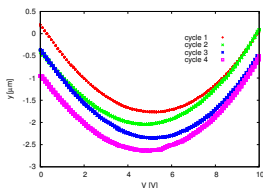
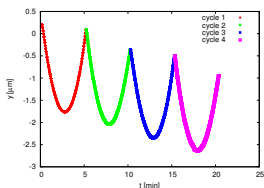


Four cycles, range (0~10V, 0~300 μ m)

PI without fb



PI with fb



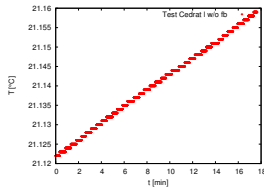
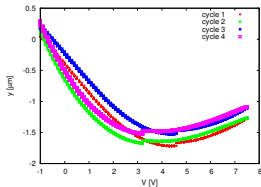
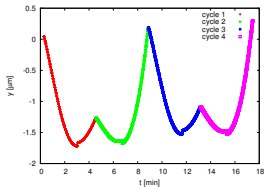
Coupling of 3 μ m over all lateral range, equivalent to (1%)



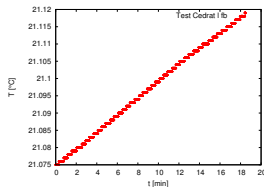
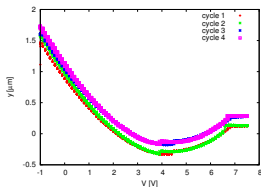
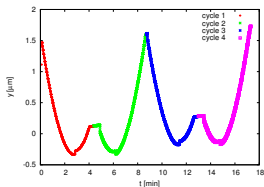


Four cycles, range ($-1 \sim 7.0\text{V}$, $0 \sim 250\mu\text{m}$)

Cedrat without fb



Cedrat with fb

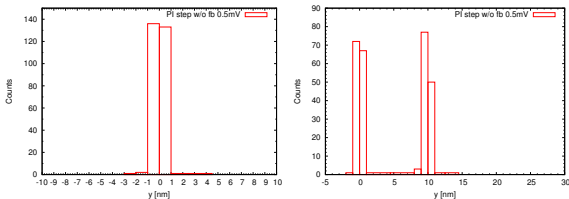


Coupling of $2.5\mu\text{m}$ over all lateral range, equivalent to (1%)

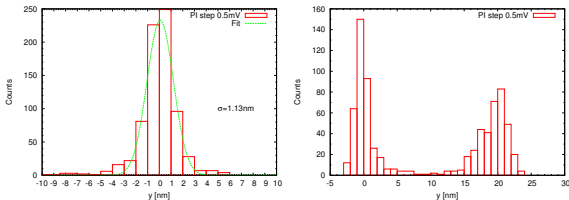


PI without and with feedback

PI without fb



PI with fb

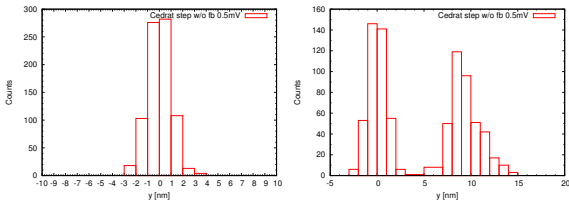


0.5mV → 15nm

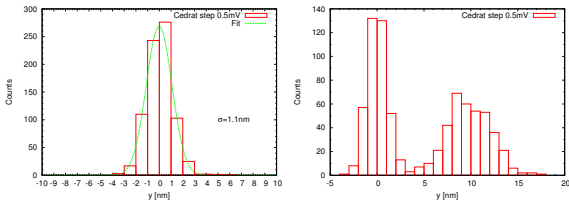




Cedrat without fb



Cedrat with fb



0.5mV \rightarrow 15.625nm



Current work

- ▶ System installation at the IP
- ▶ Test in vacuum

Prospects

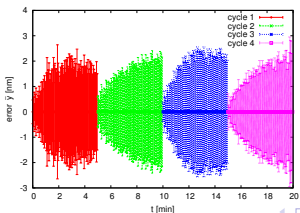
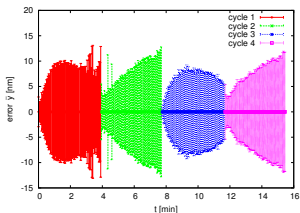
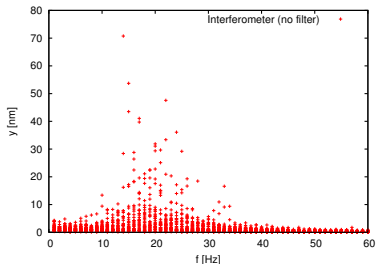
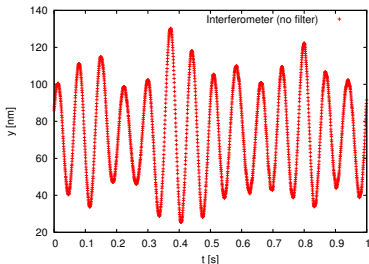
- ▶ Feedback residual curve characterization
- ▶ Investigate own alternative software based feedback
- ▶ Verify/further study strain gauges → In situ interferometer calibration under consideration



Thank you!

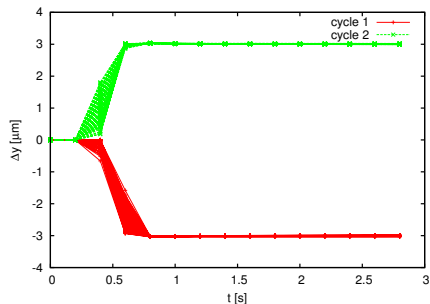
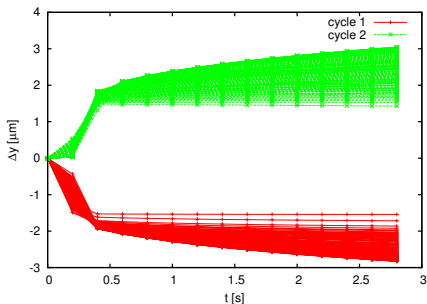


Support





PI

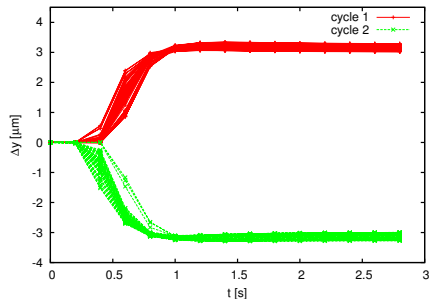
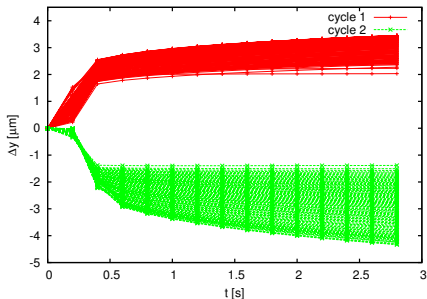


Each step is 0.1V ($3\mu\text{m}$), sampled 15 times (over 3 s).

System can respond at $3\mu\text{m/s}$

Last 10 points were used to calculate the mean on each step, error over the mean of each step: less than 3nm.

Cedrat



Each step is $0.1V$ ($\sim 3.125\mu m$), sampled 15 times (over 3 s).
 System can respond at $3\mu m/s$

Last 10 points were used to calculate the mean on each step, error over the mean of each step: less than 15nm.