

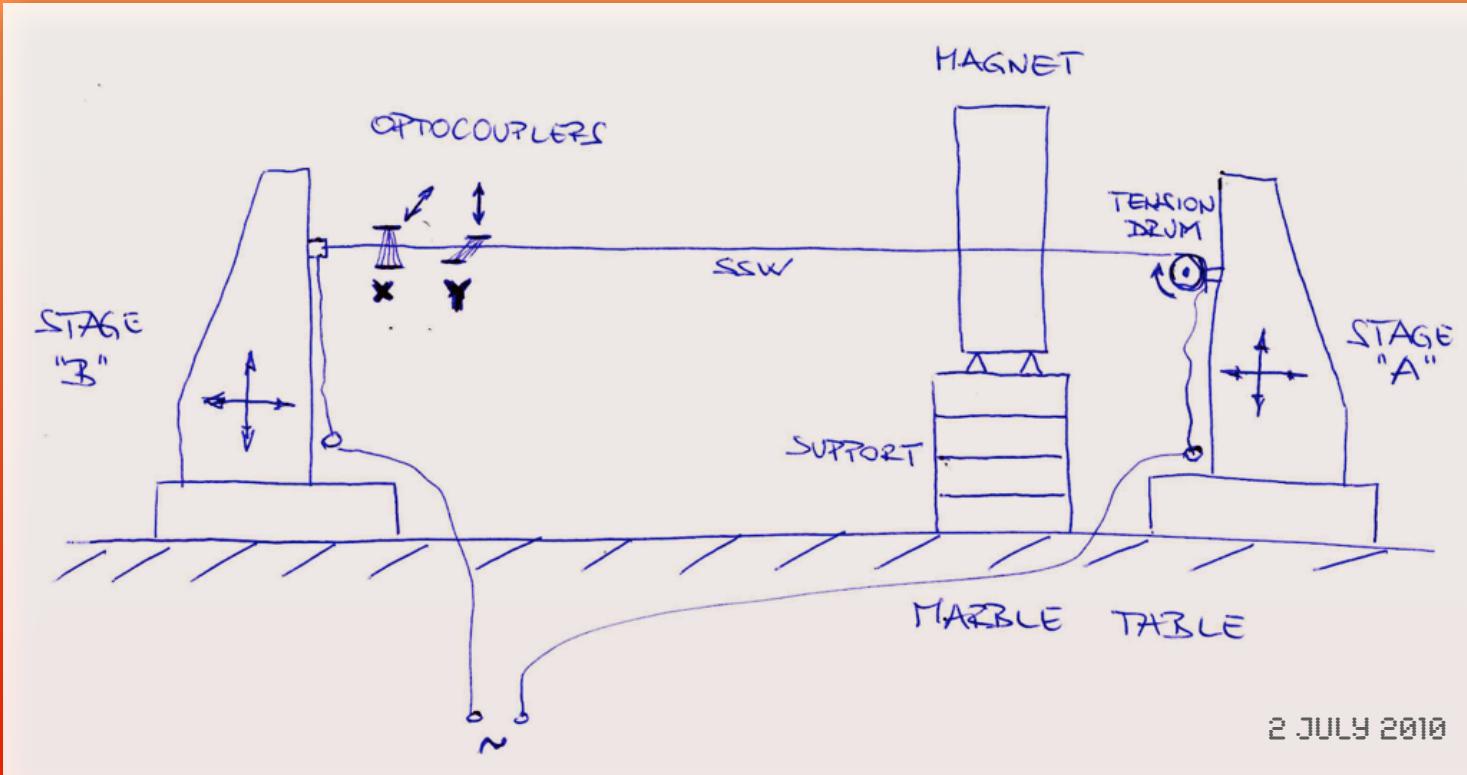
EXPERIENCES WITH THE SINGLE STRETCHED VIBRATING WIRE TEST-STAND AT PSI

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R. Widmer³, M. Calvi⁴, A. Gabard¹, S. Sanfilippo¹

All except of C. Wouters are at the Paul Scherrer Institute:

¹ Magnet Section

² Common Applications Group ³ Versuchsmechanik ⁴ Insertion Device Group



Highlights



IMMW-17, 19-23 September 2011, ALBA, La Mola, Terrassa/Barcelona, Catalonia (Spain)

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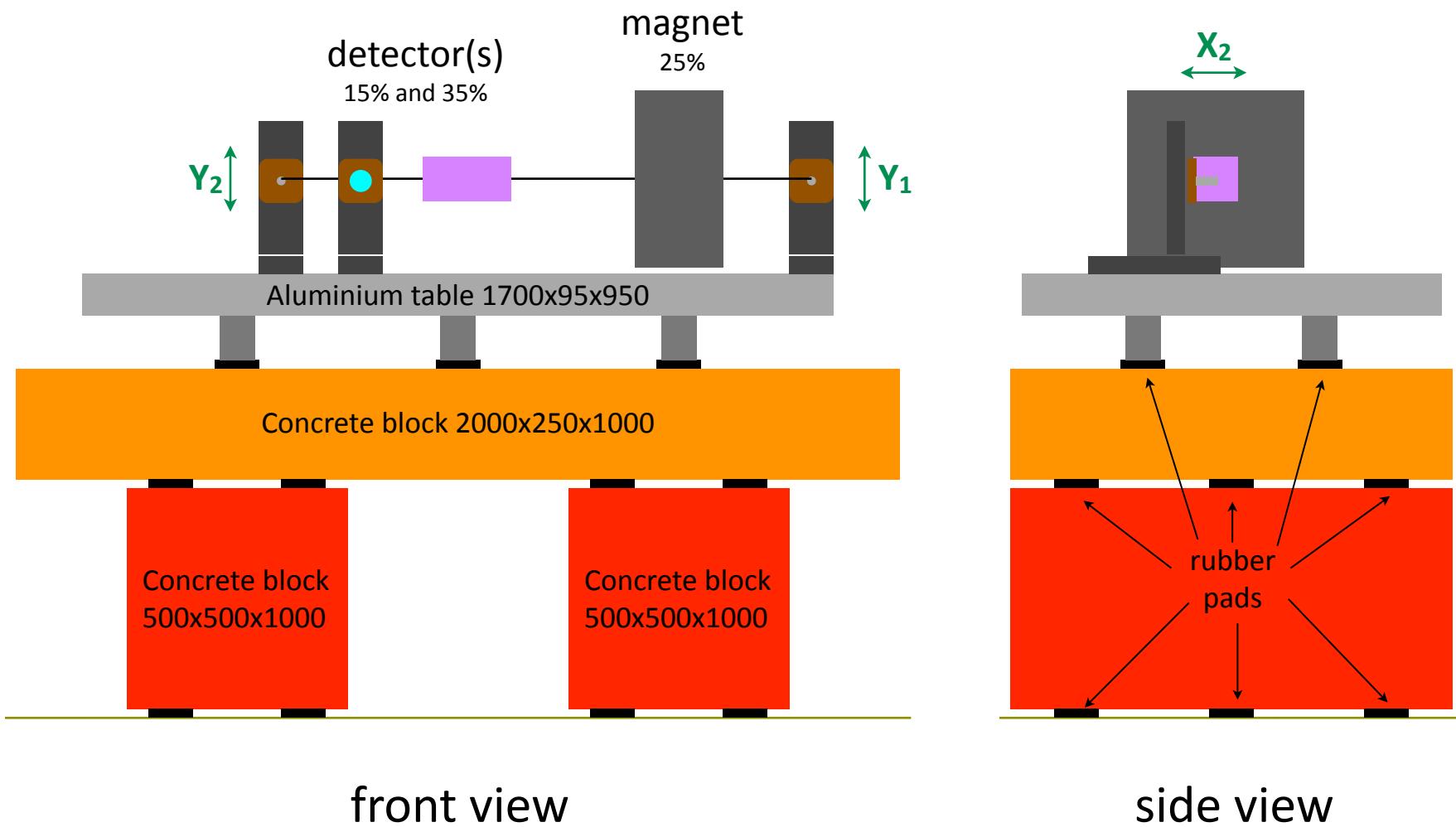
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- ... IMMW17

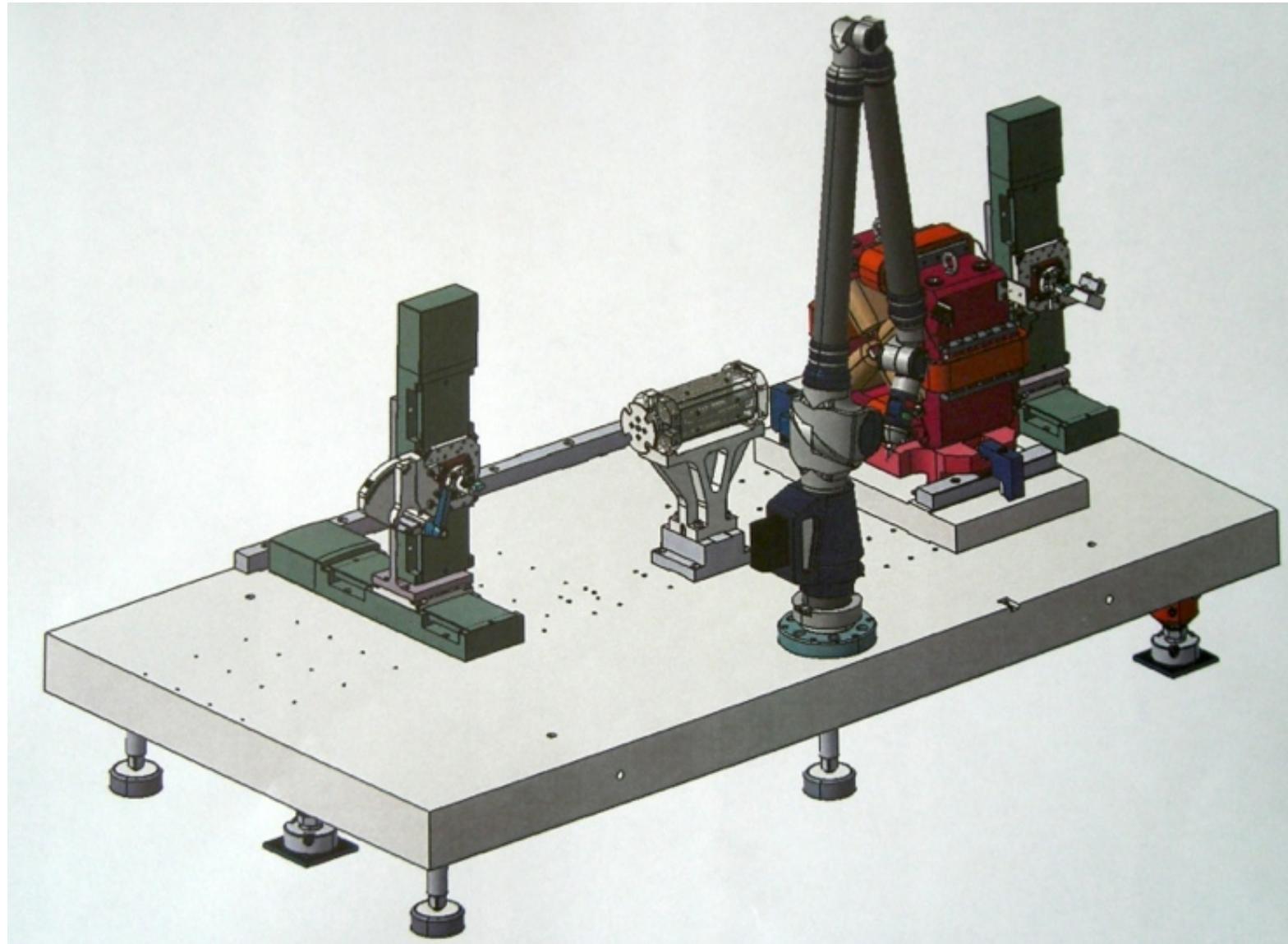
General setup



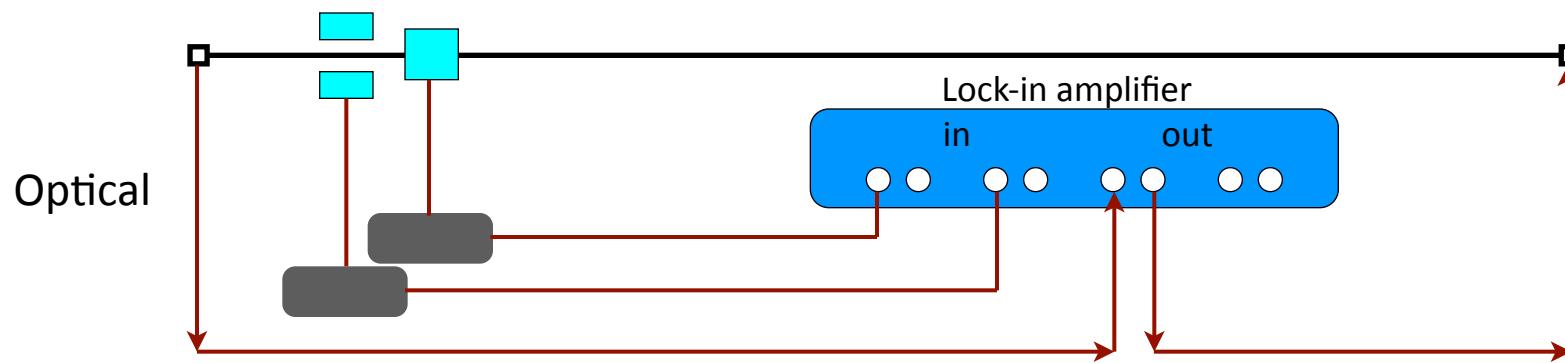
front view

side view

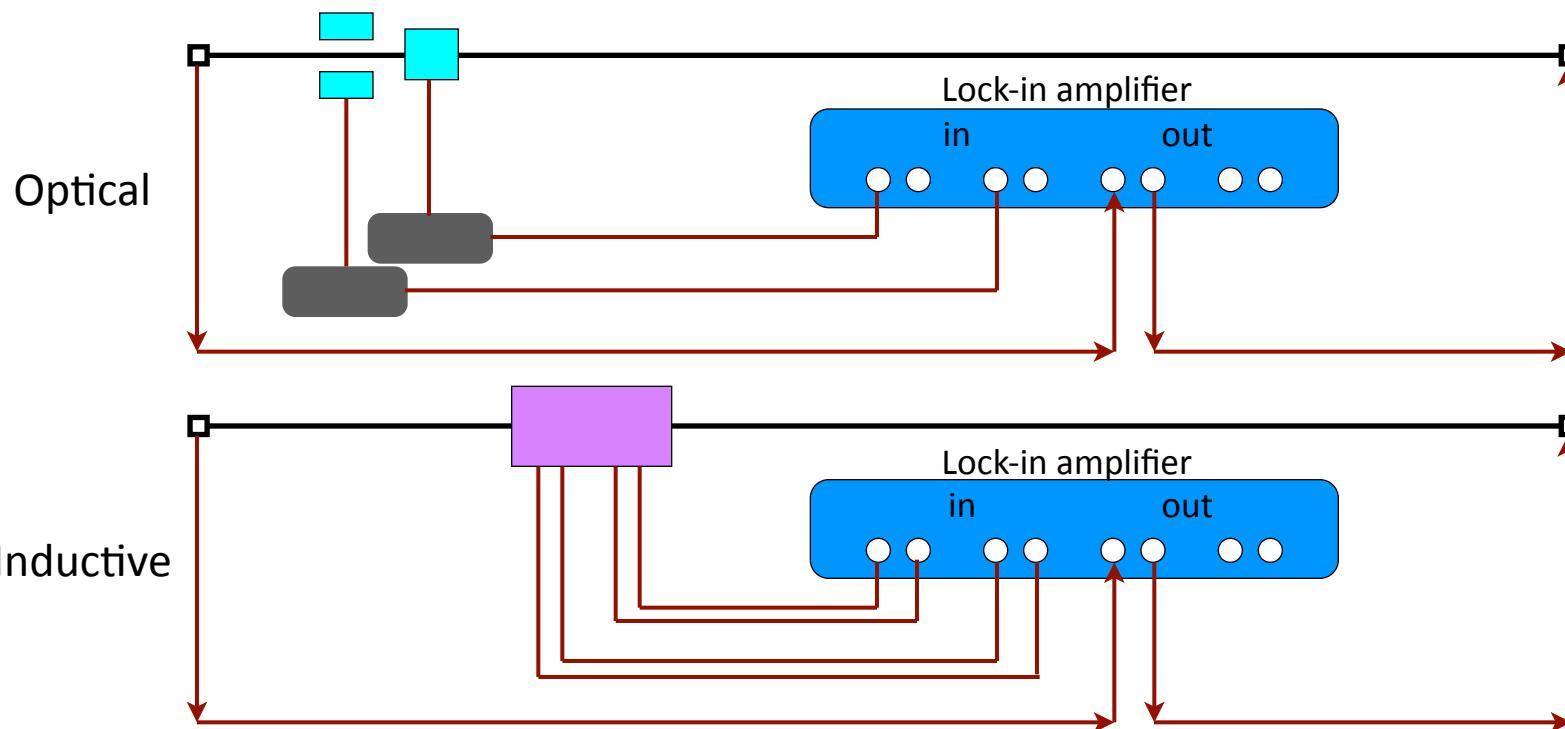
The support table



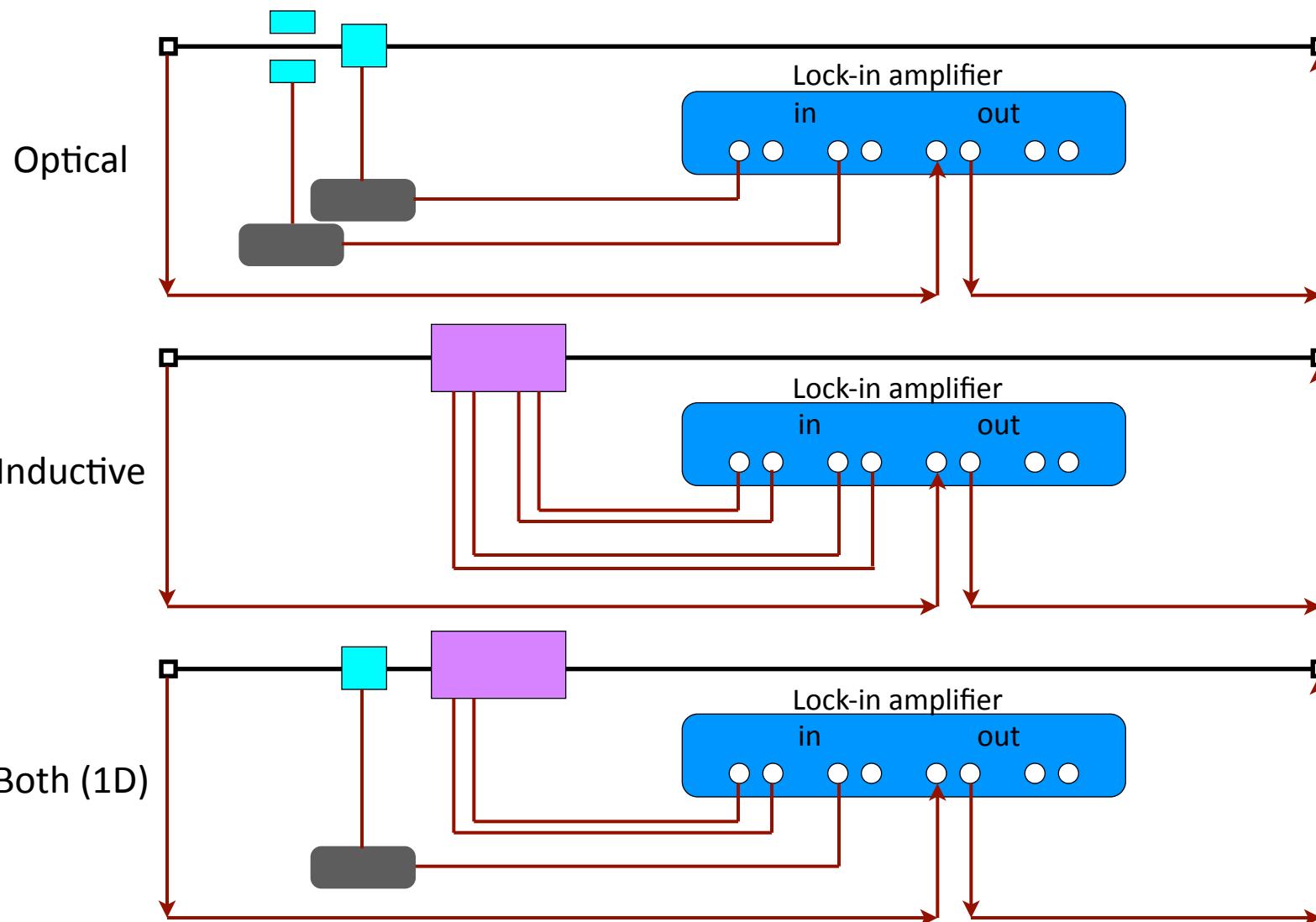
Detector(s) connection options



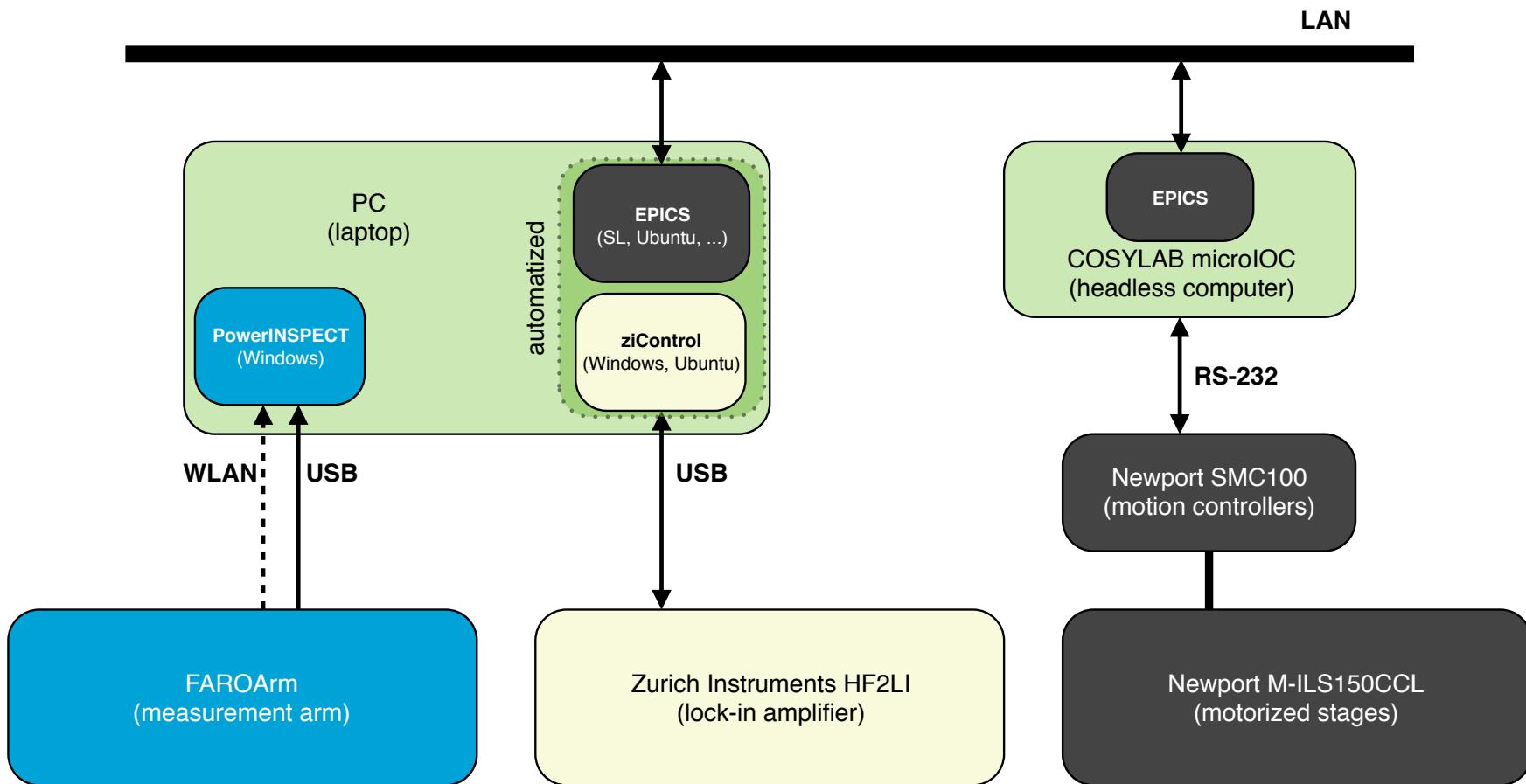
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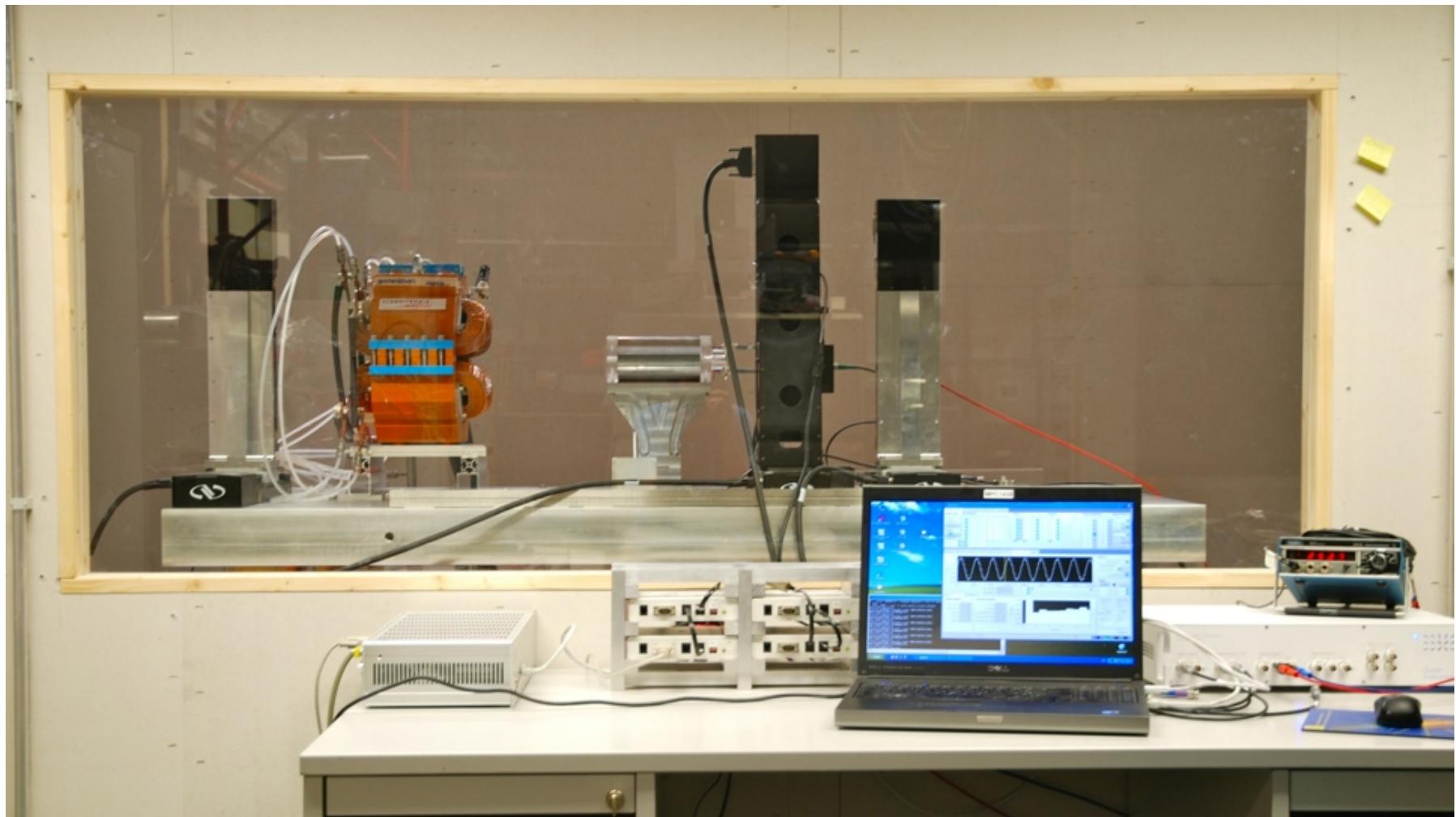
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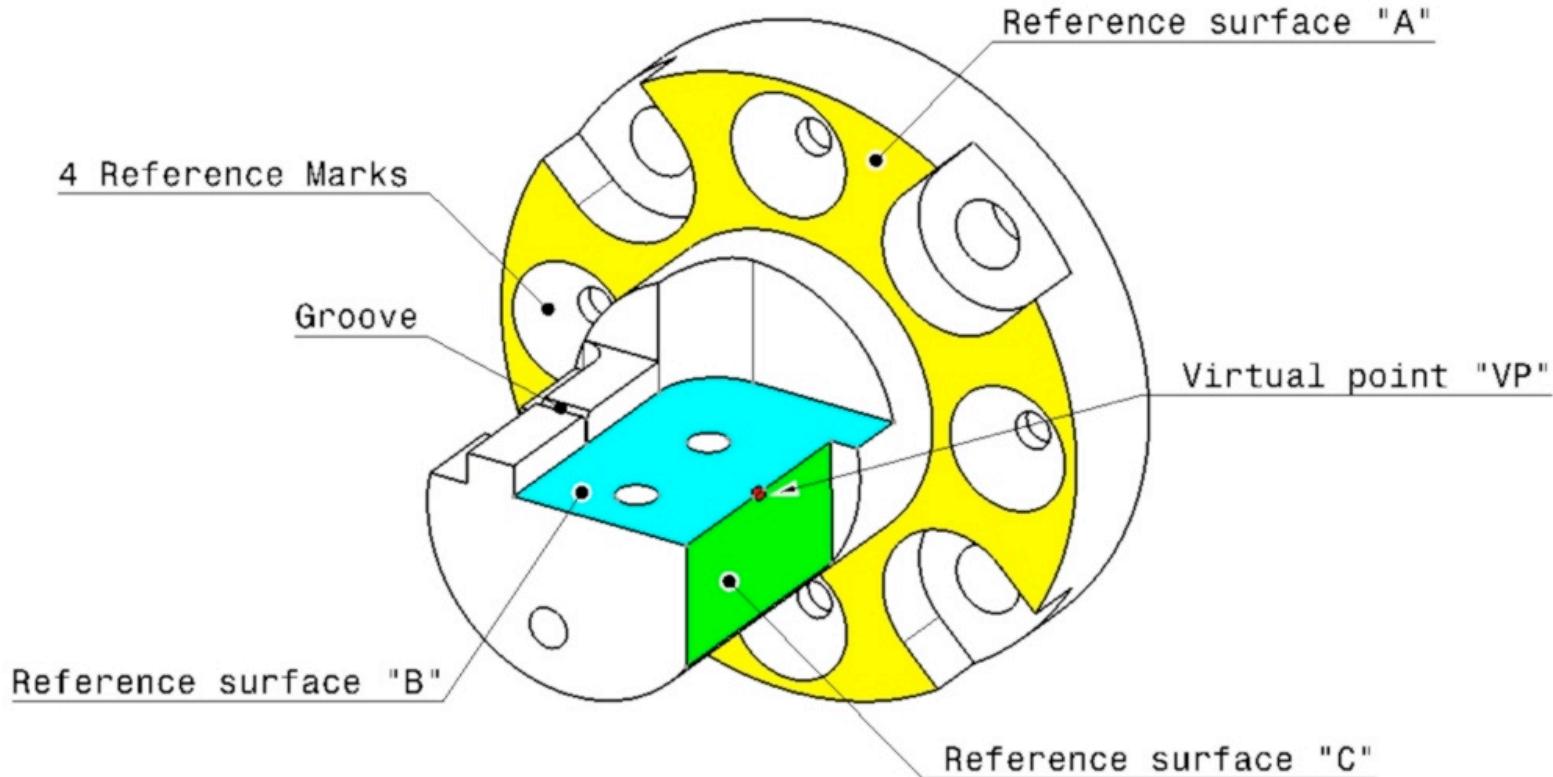
Equipment control and communication



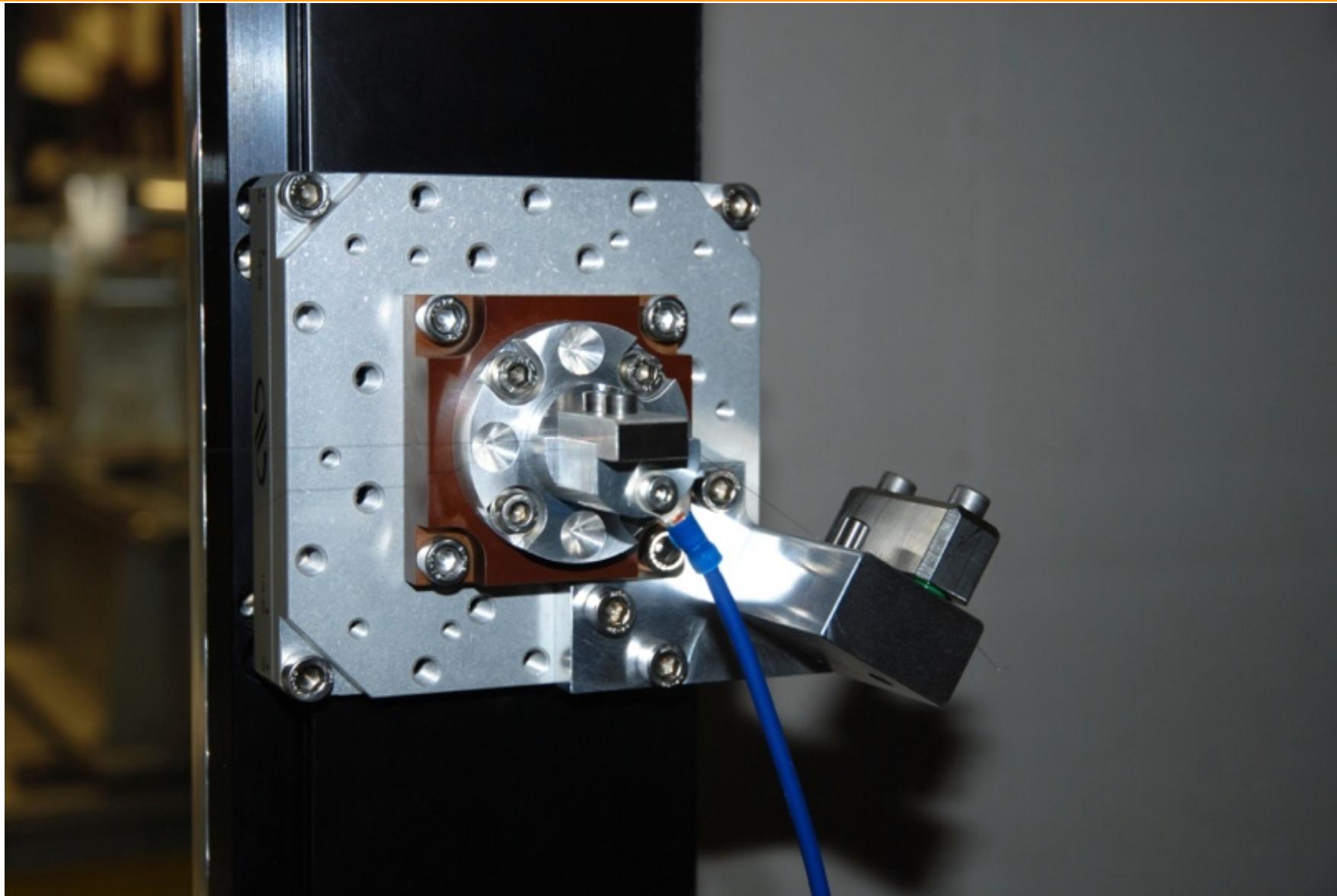
The VW measurement bench room



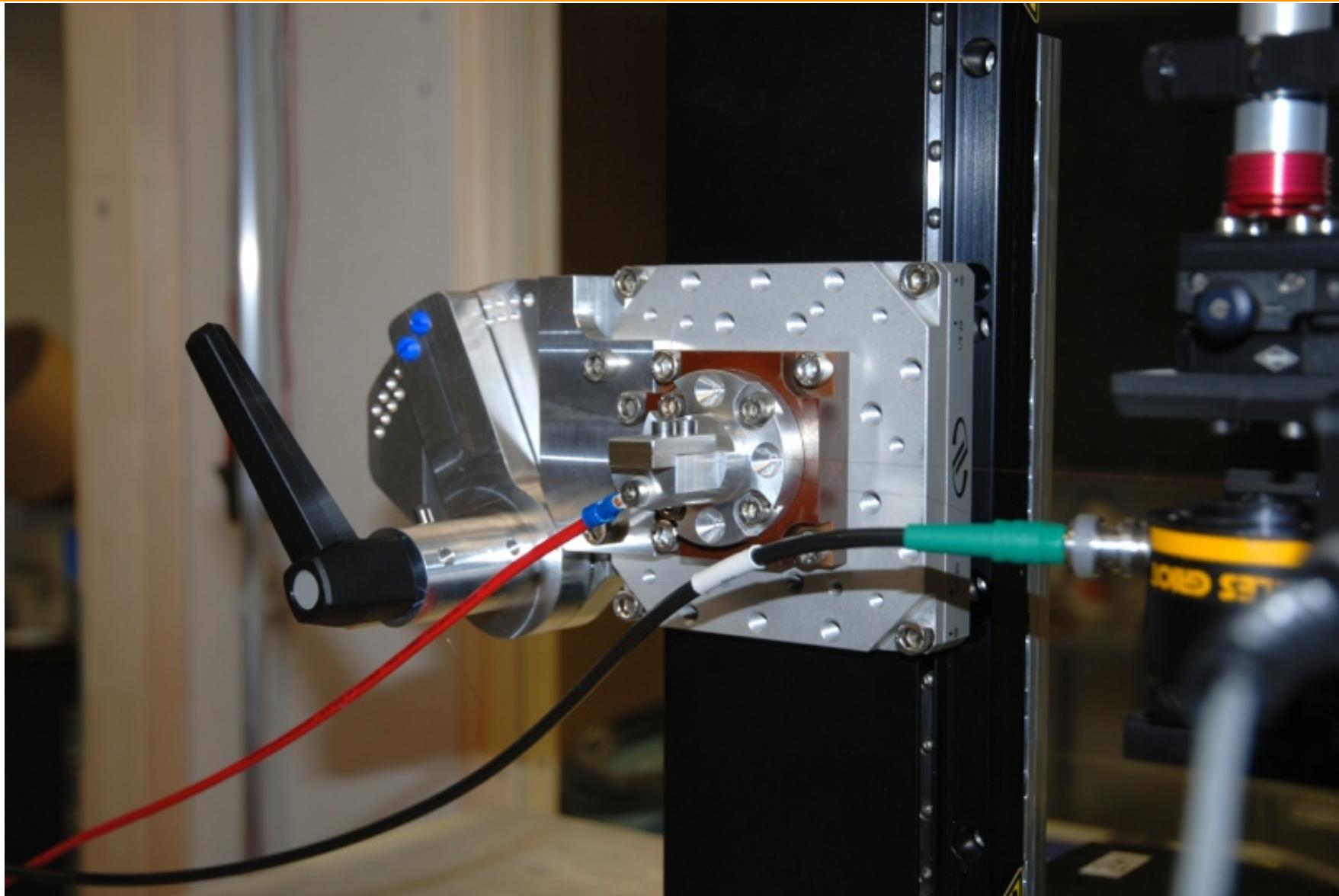
Pins for holding the stretched wire



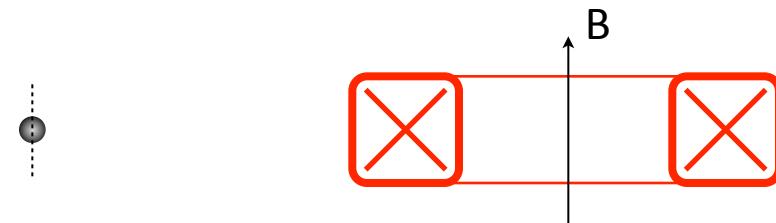
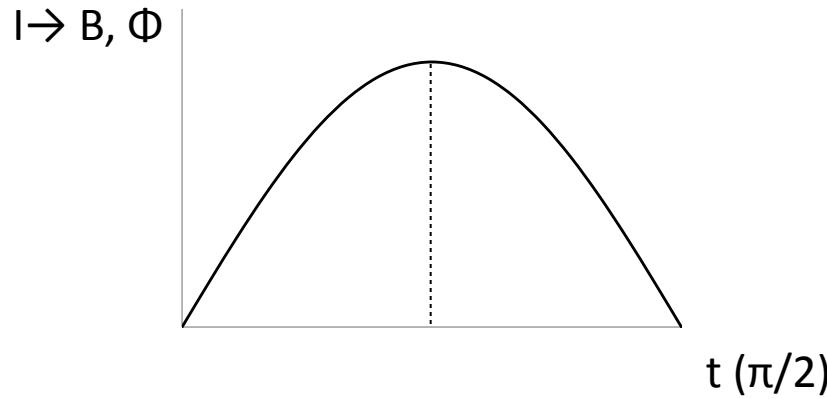
Stage 1 (fixed)



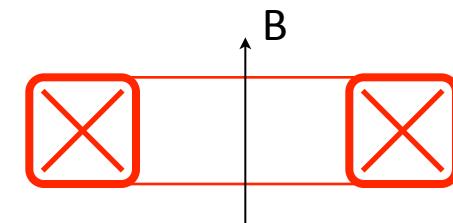
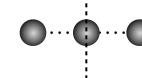
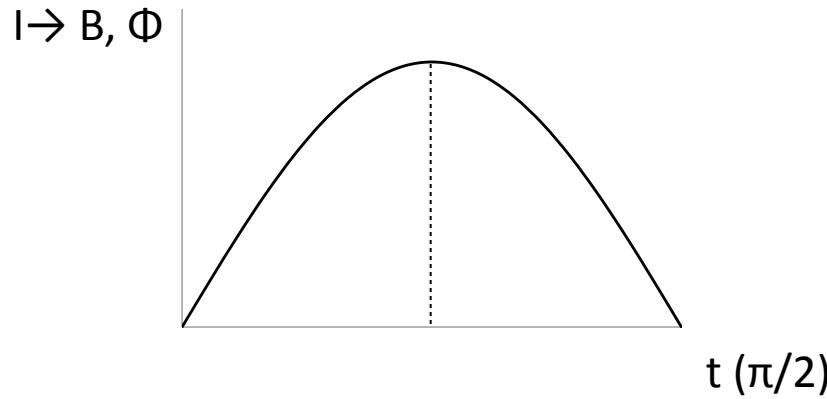
Stage 2 (4 positions, wire tension system)



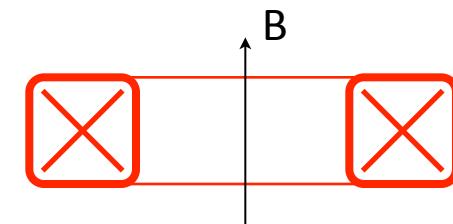
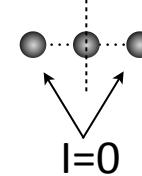
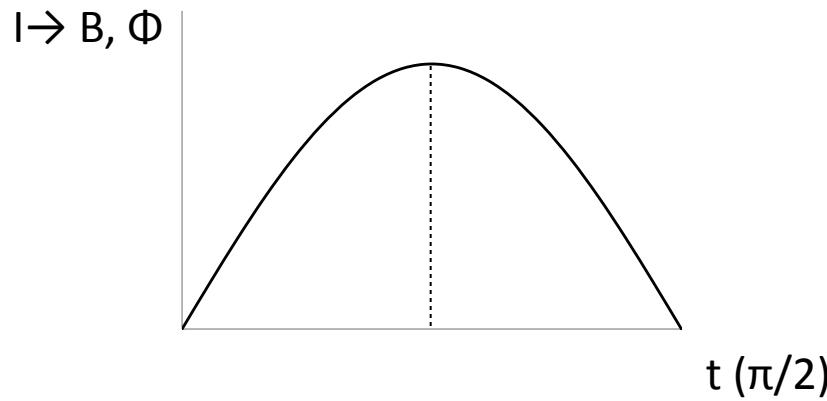
Pickup coil detector principle



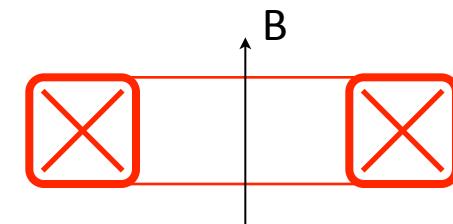
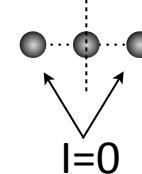
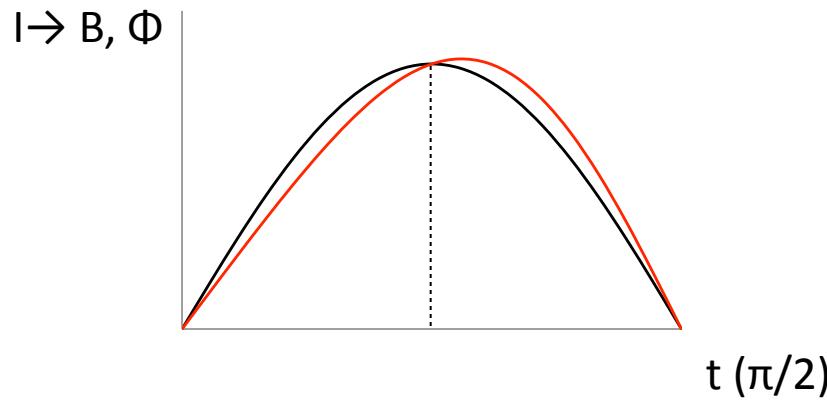
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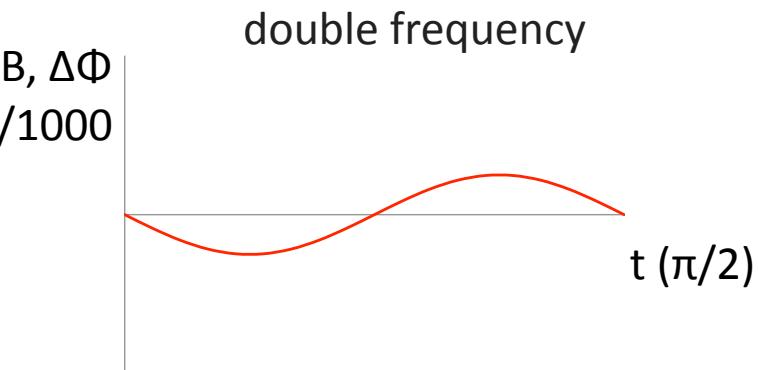
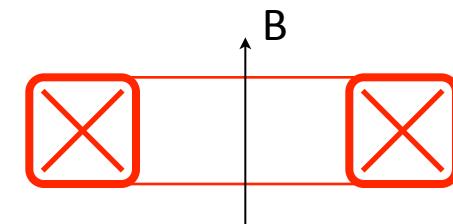
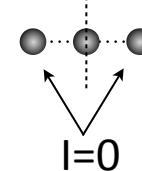
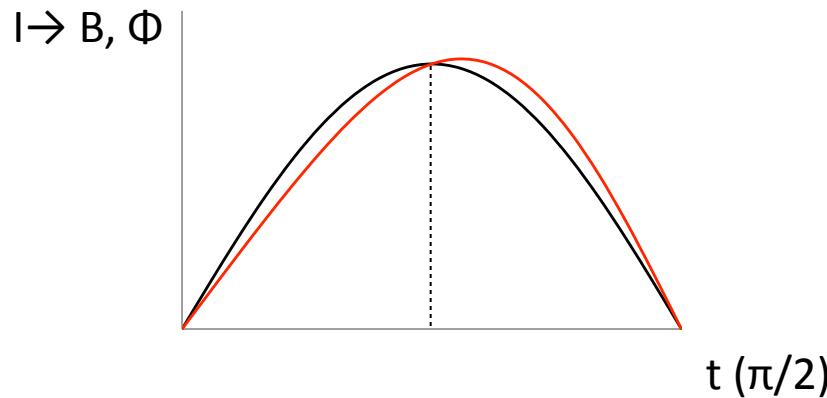
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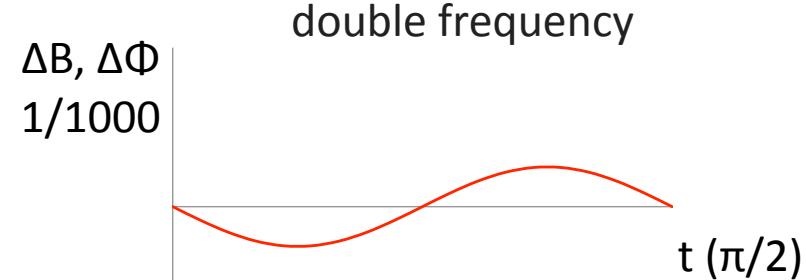
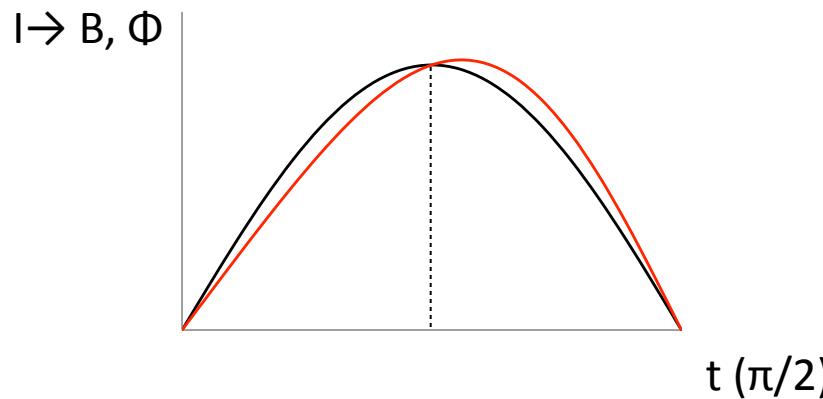
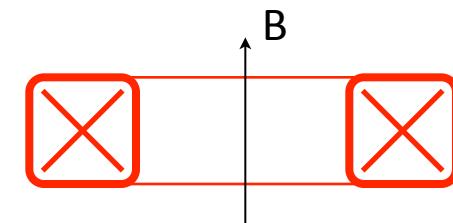
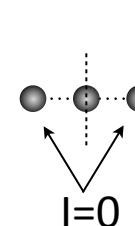
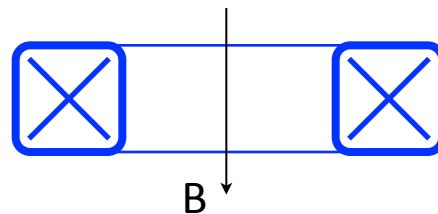
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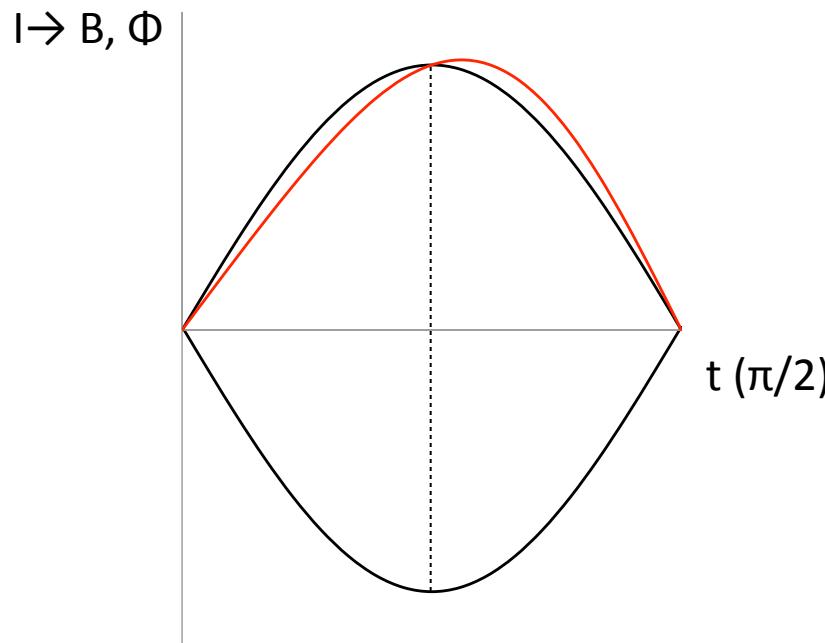
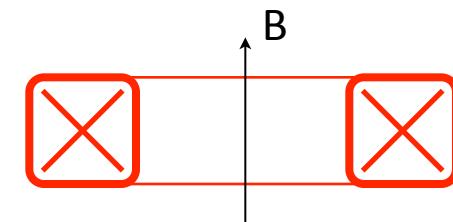
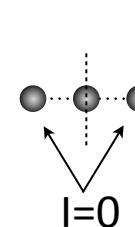
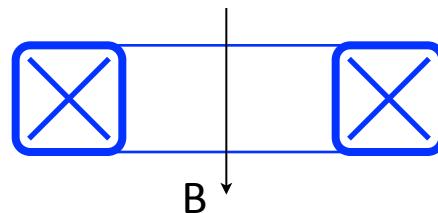
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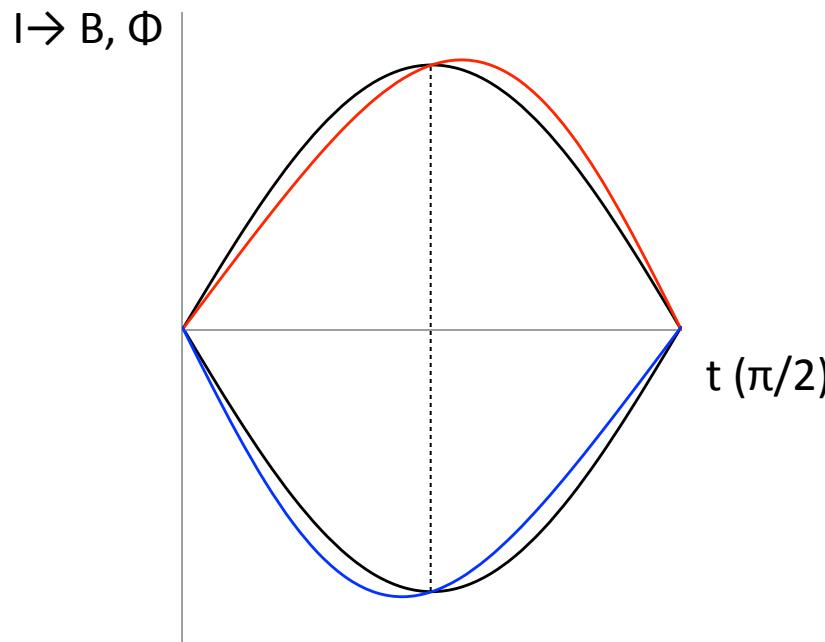
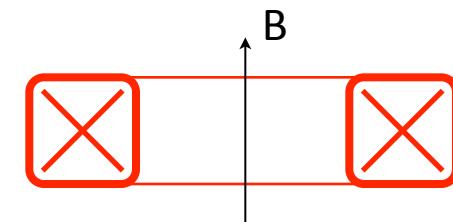
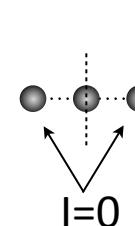
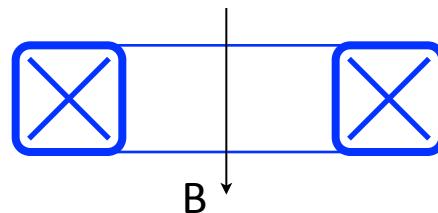


$\Delta B, \Delta \Phi$
1/1000

double frequency



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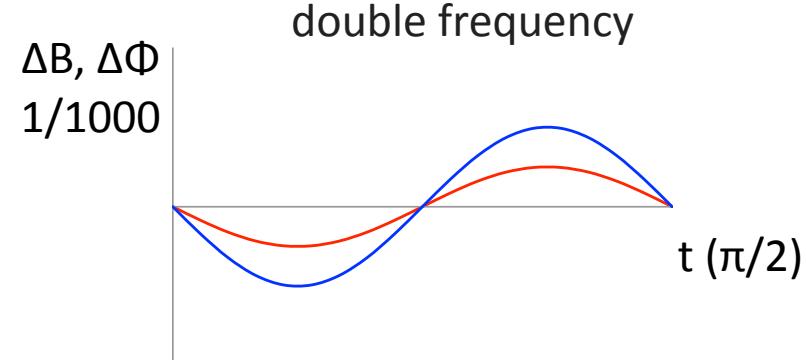
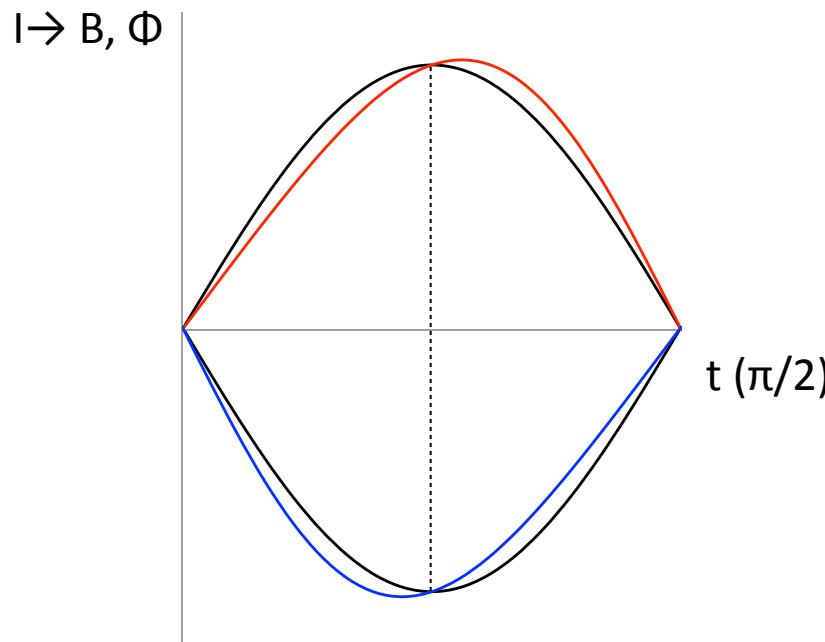
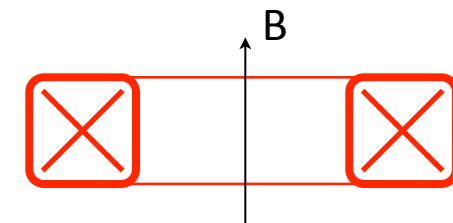
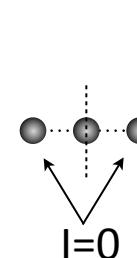
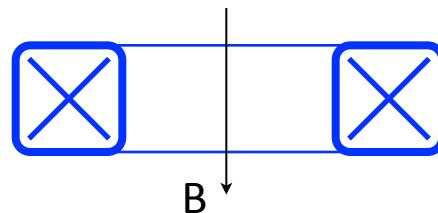


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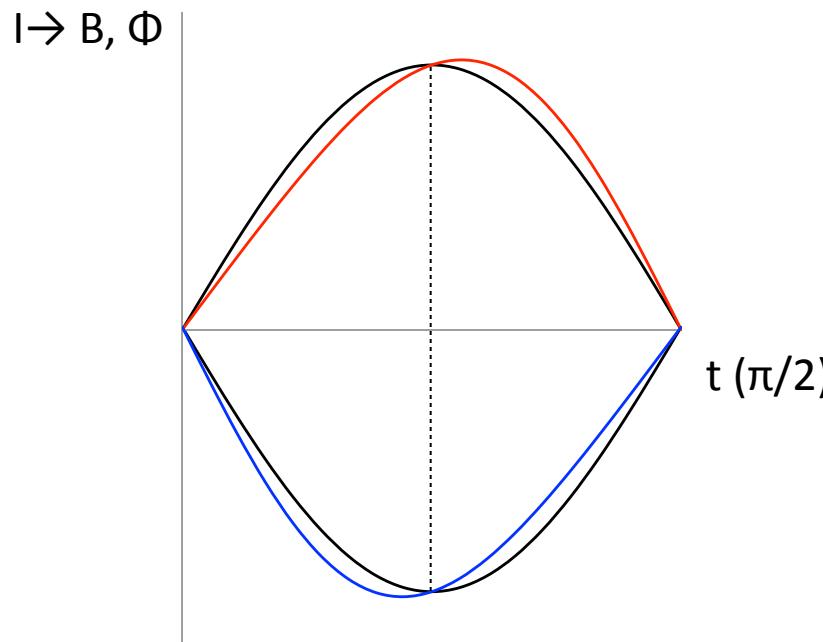
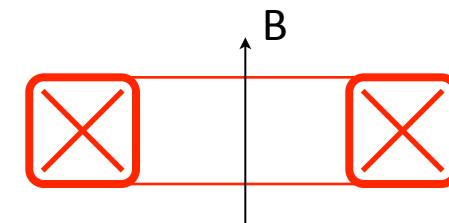
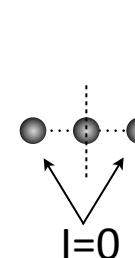
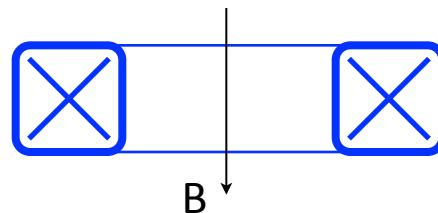
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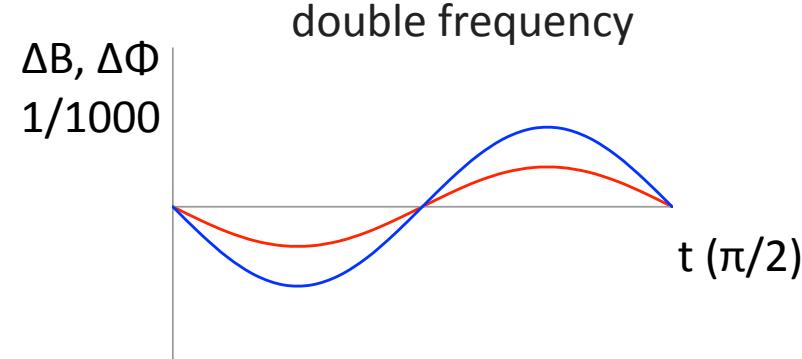
Pickup coil detector principle



Pickup coil detector principle



wire POSITION signal at f



wire VIBRATION signal at $2f$

Pickup coil detector versions

PUC

- 1 coil pair (X-vibration)
- 314 turns/coil
- $\varnothing 90 \mu\text{m}$

PUC-2

- unibody of plexiglas
- 2 coil pairs (X and Y-vibration)
- 3000 turns/coil
- $\varnothing 90 \mu\text{m}$
- coil cross section 5x8 mm
- aperture 10 mm

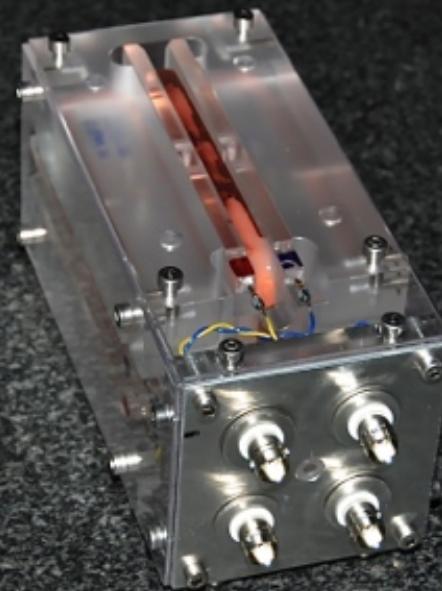
CROC-3

- unibody of plexiglas
- tighter tolerances
- reference plane
- integrated spirit level
- 2 coil pairs (X and Y-vibration)
- 14000 turns/coil
- $\varnothing 70 \mu\text{m}$
- coil cross section 10x5 mm
- aperture 7 mm
- mumetal shield

Pickup coil detectors



version 3
CROC-3

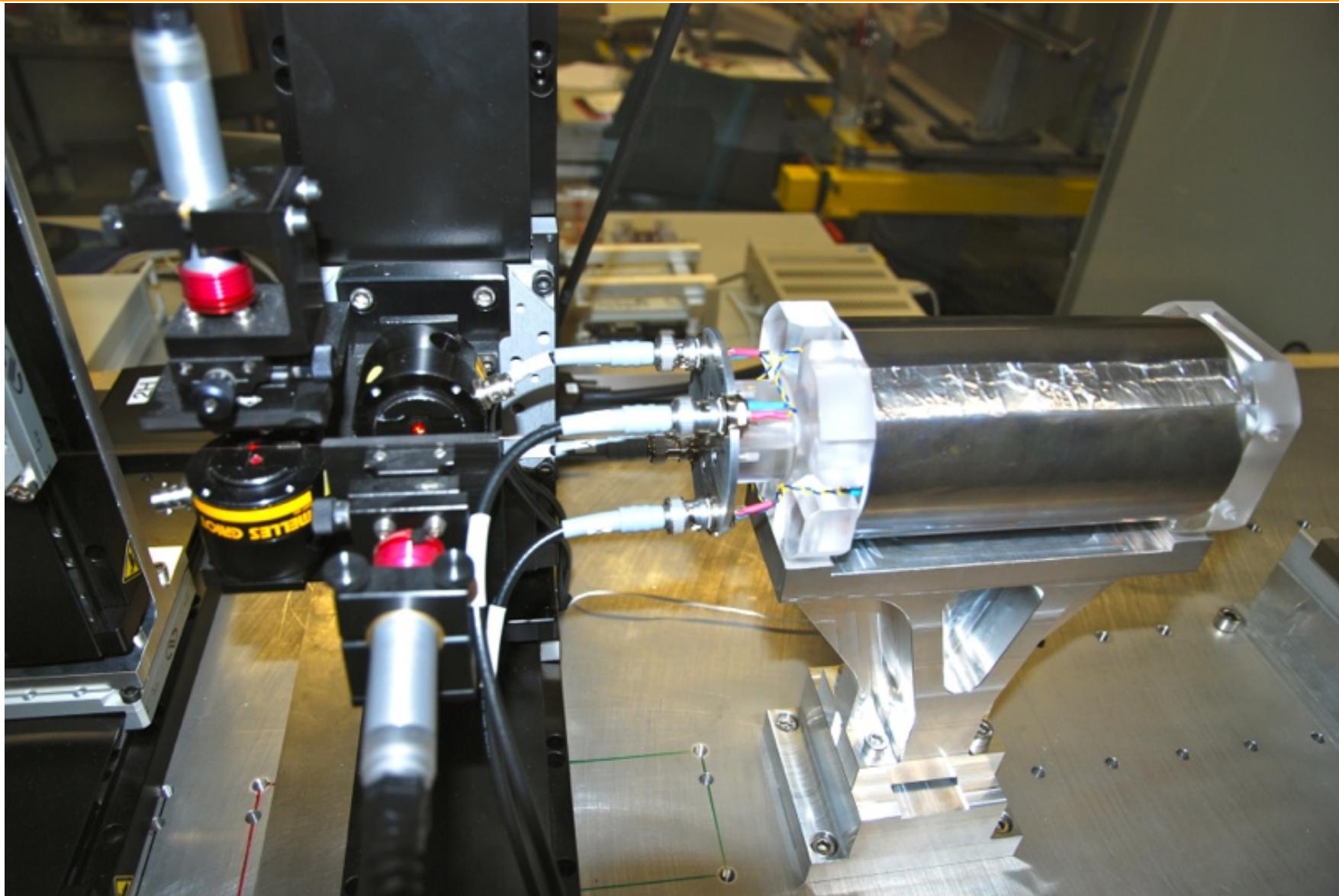


version 2
PUC-2

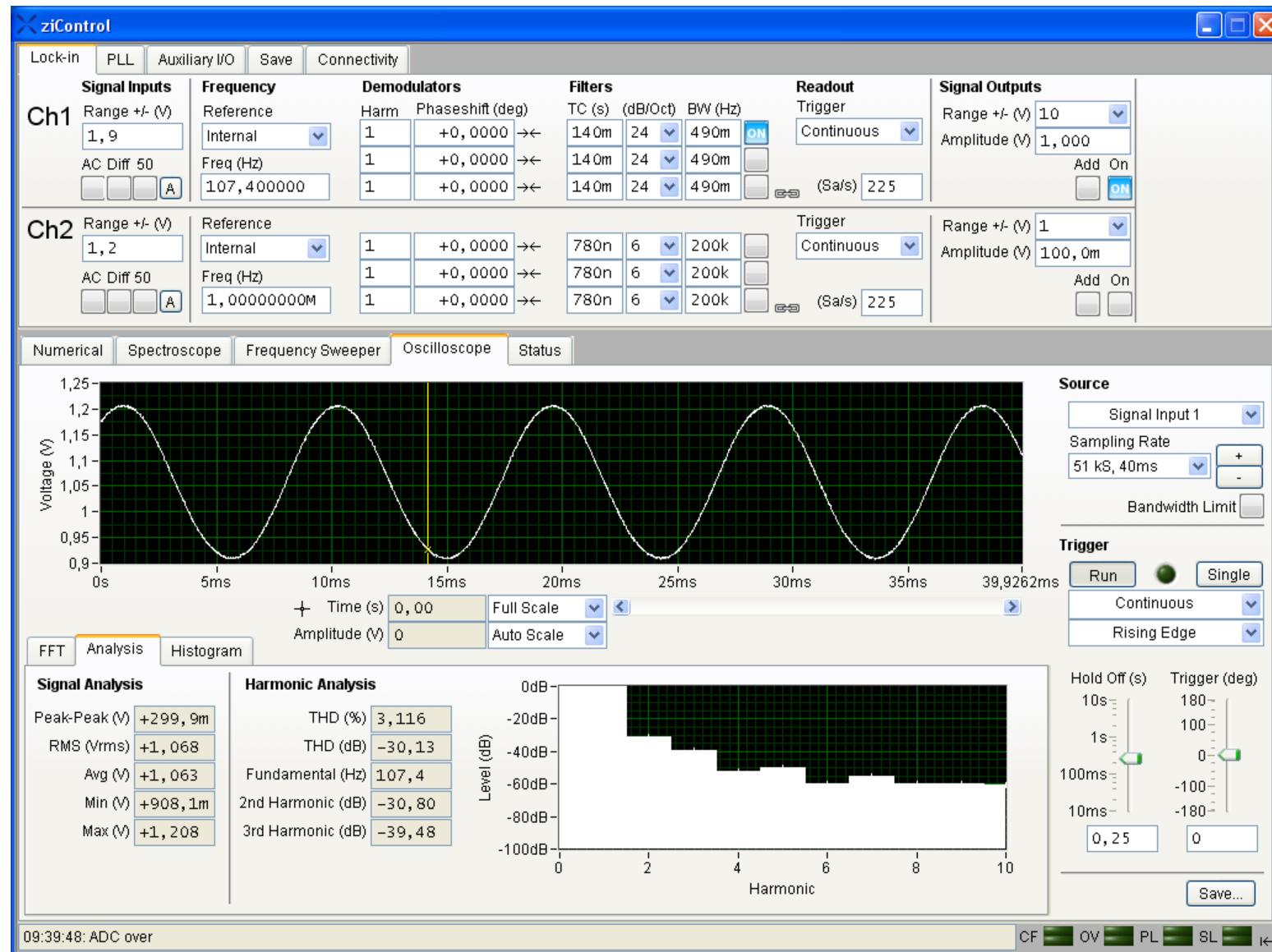


version 1
PUC

Detectors on the bench



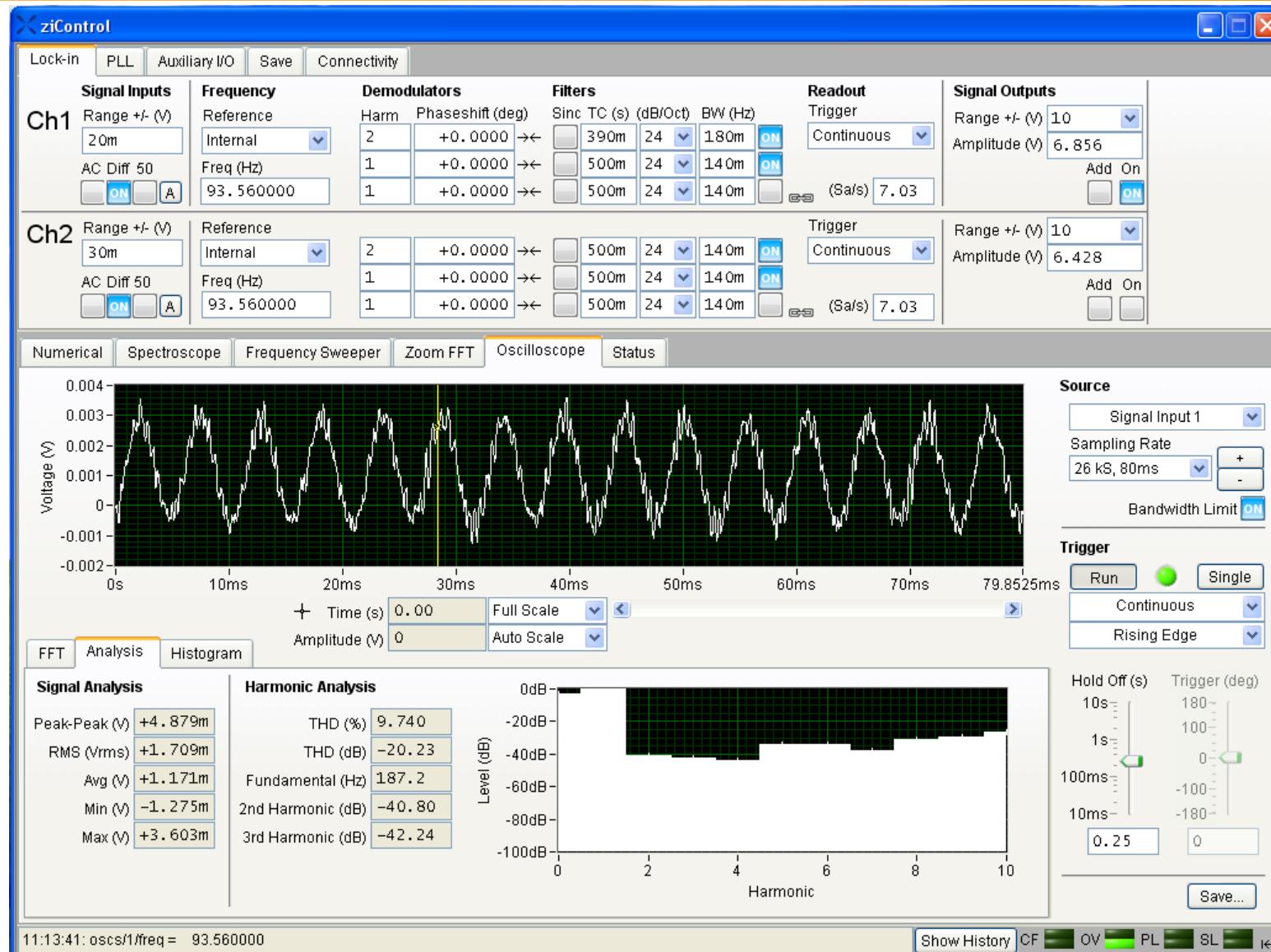
Raw signal from the laser/photodiode



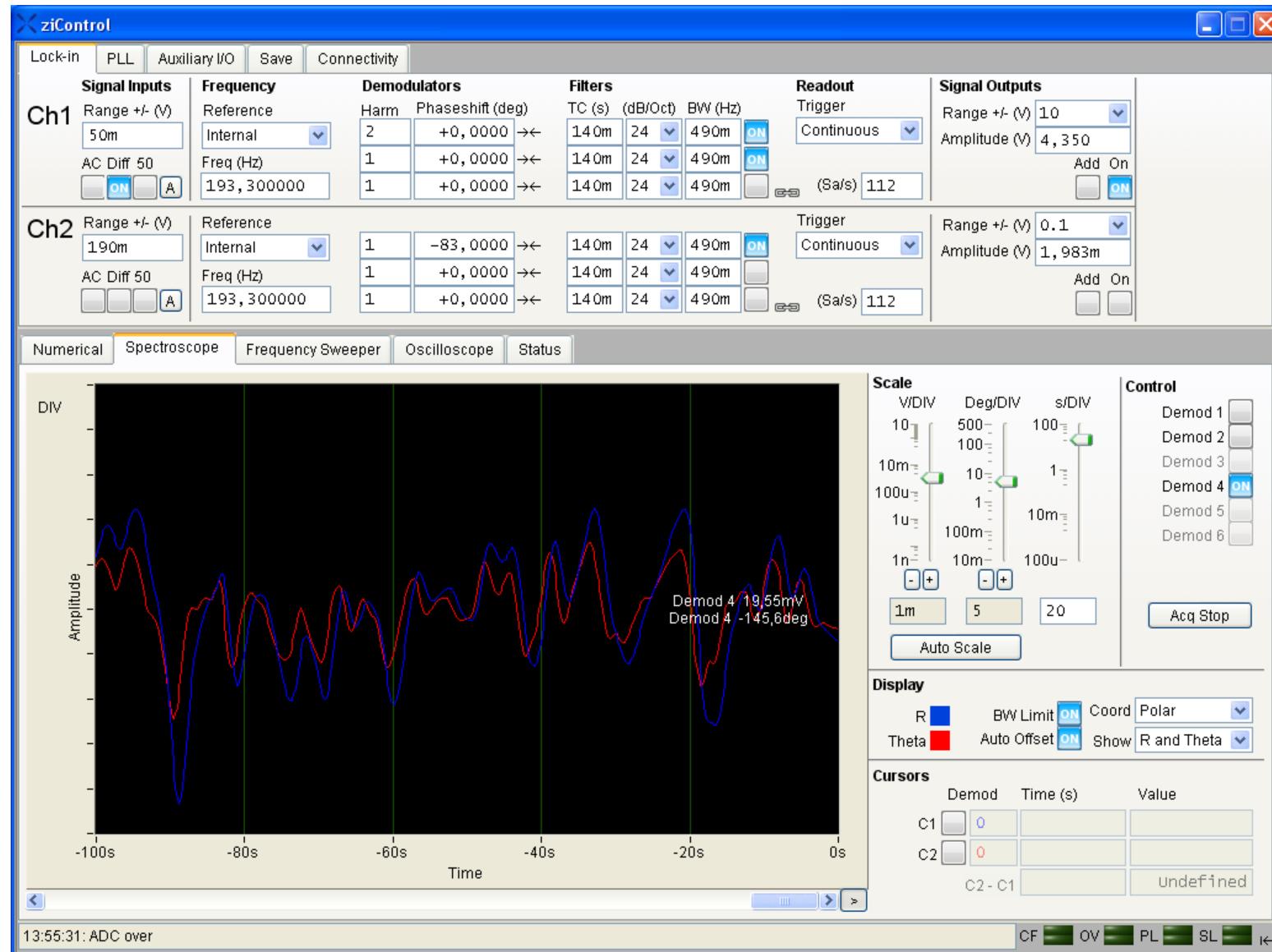
Raw signal from the PUC-2



Raw signal from the CROC-3



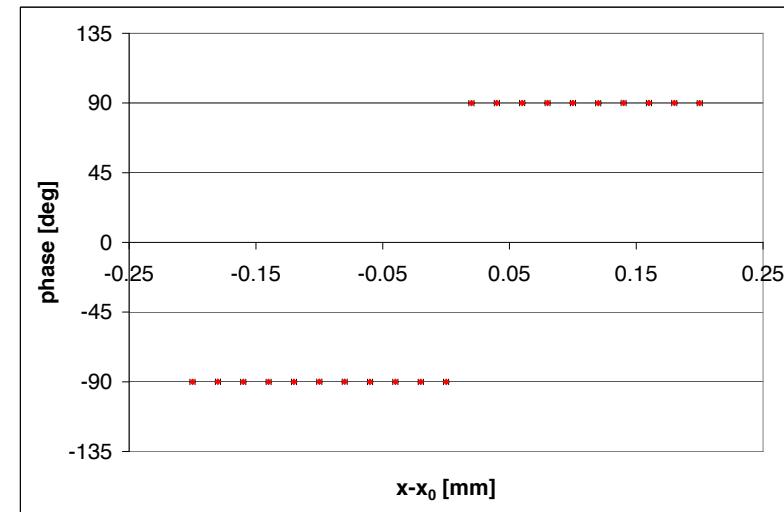
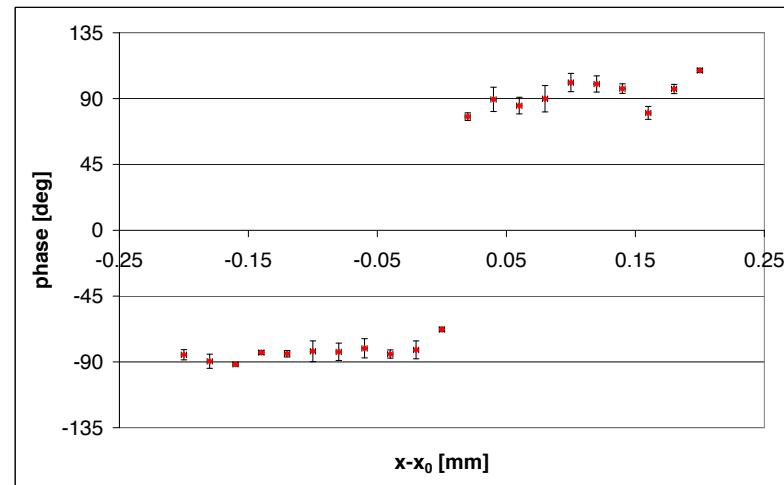
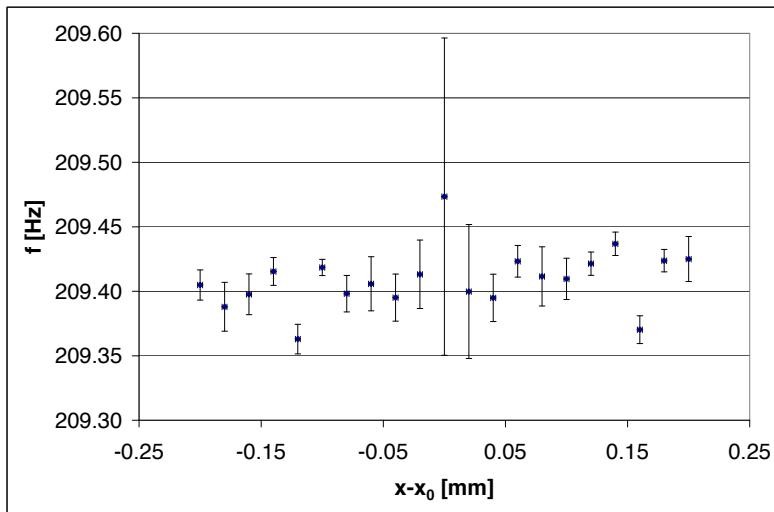
Necessity for demodulated signal averaging



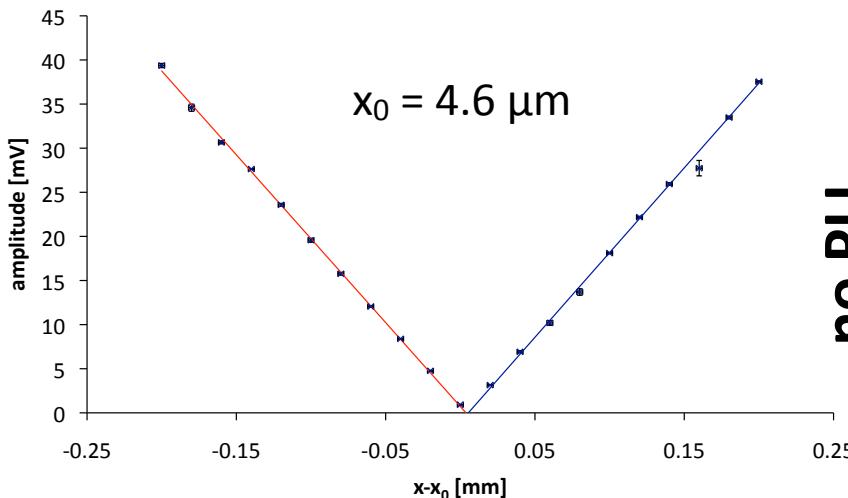
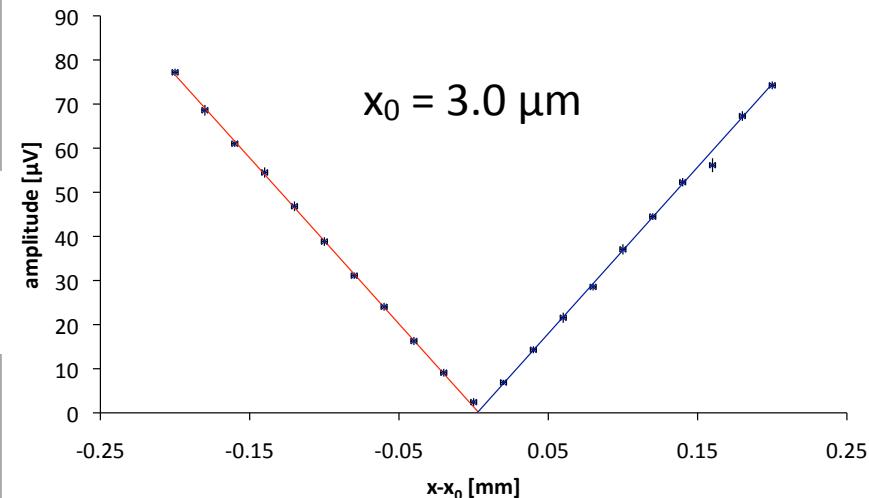
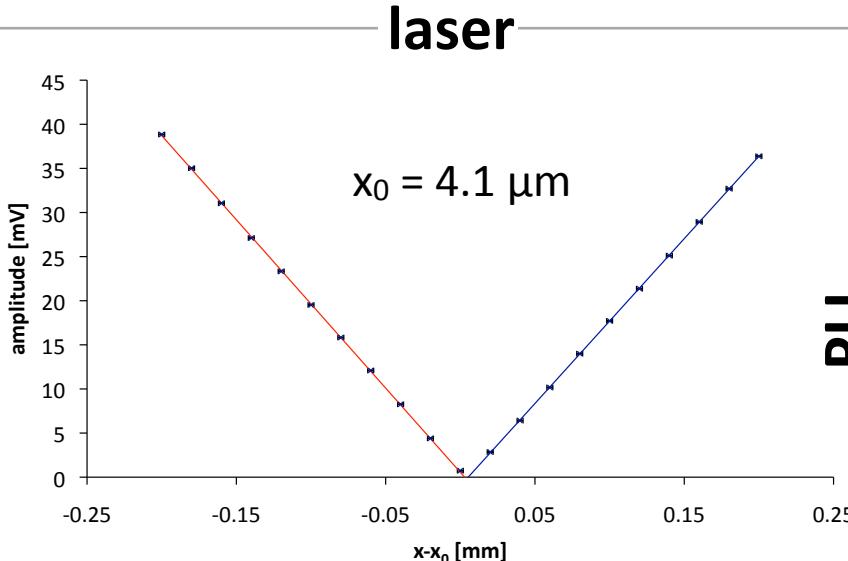
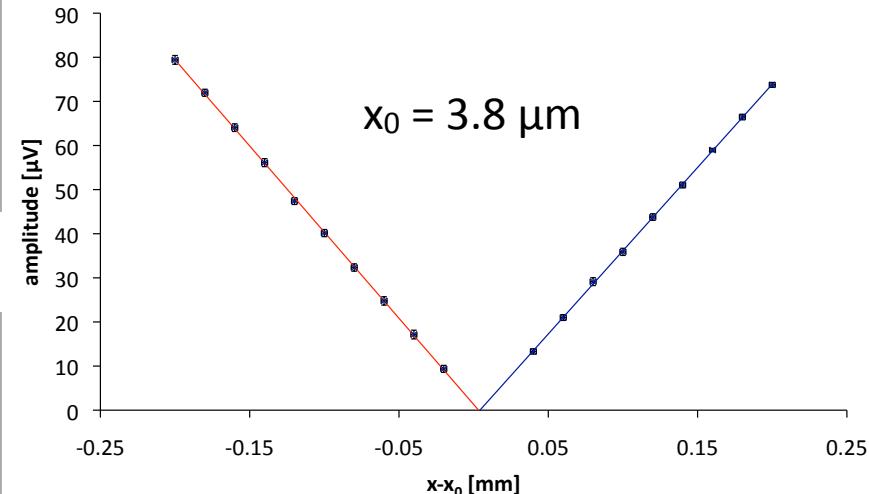
Phase Lock Loop (PLL)

Fixed driving frequency →

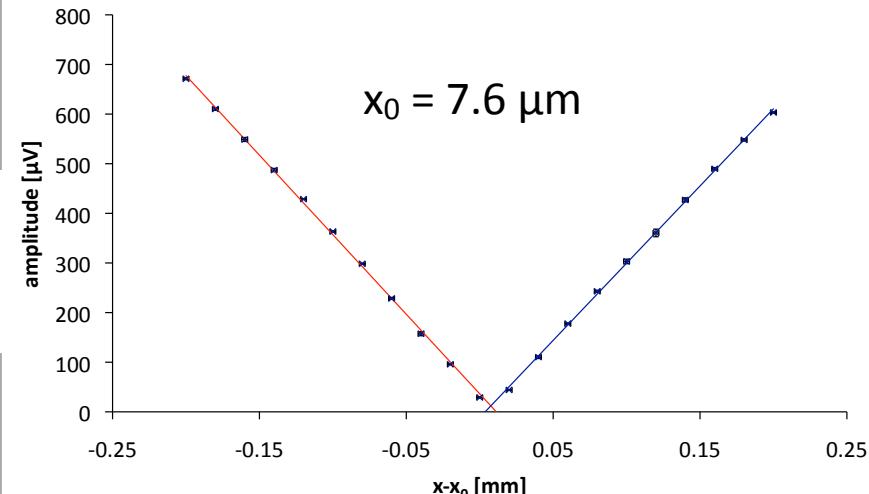
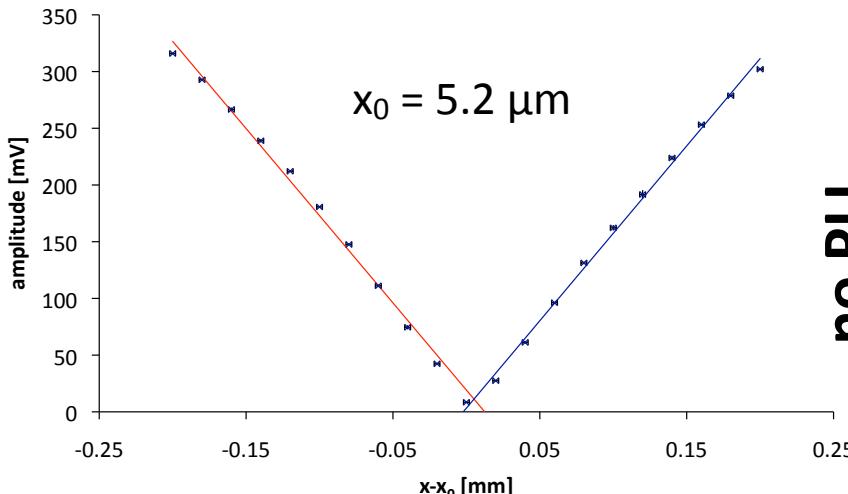
PLL changes the driving frequency to keep the phase shift to $\pm 90^\circ$.



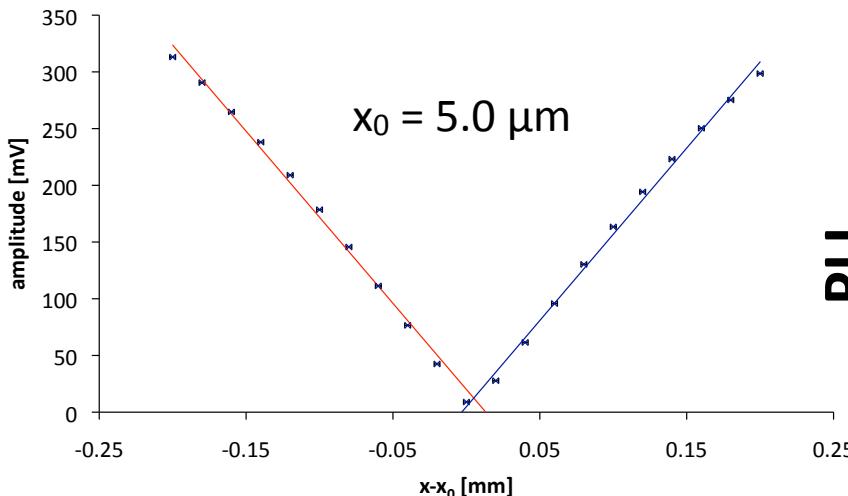
Comparison (X_{off} , weak quadrupole 0.3 T)

**no PLL****croc-3****PLL**

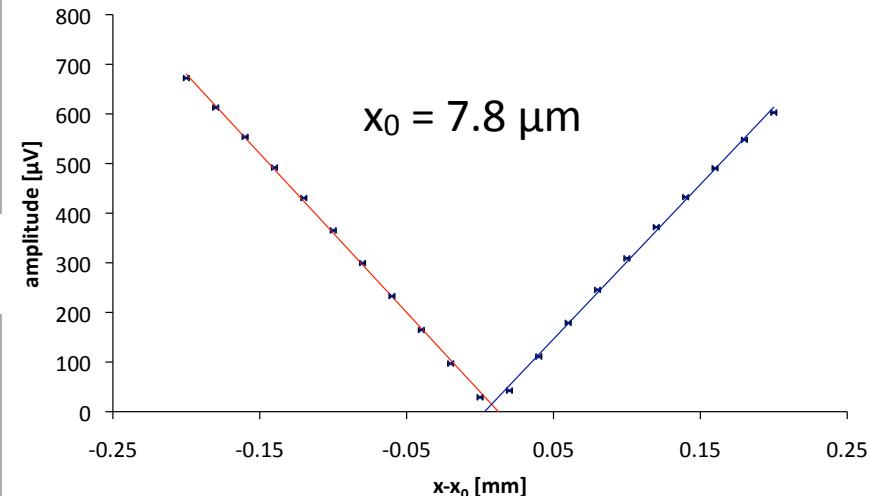
Comparison (X_{off} , strong quadrupole 3 T)



laser



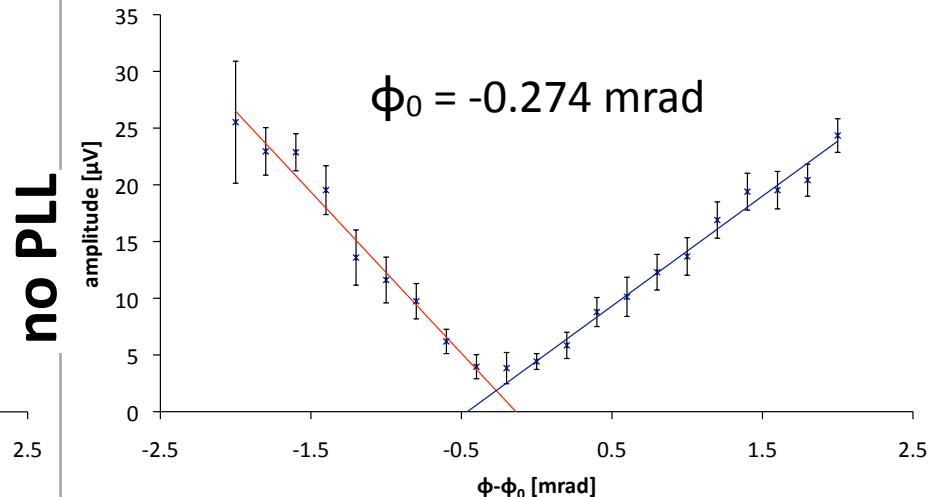
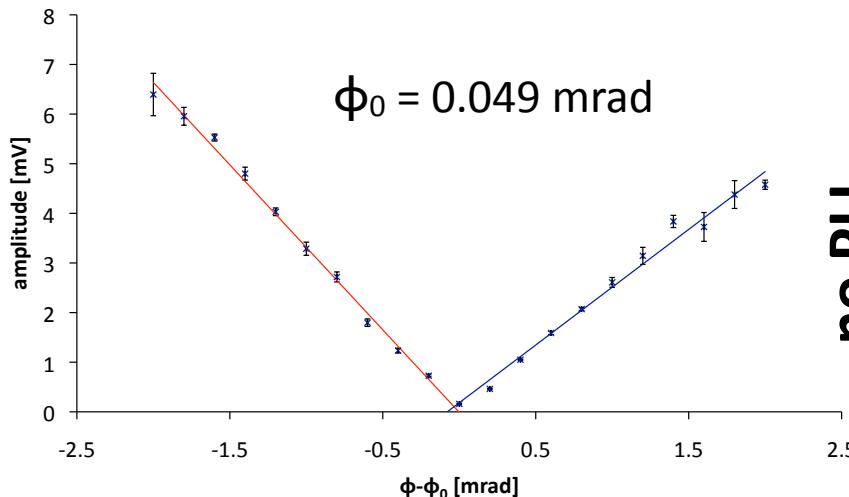
PLL



Summary of X_{off} measurement

Laser-photodiode			σ_{meas} [mV]	σ_{fit} [mV]	S [mV/mm]	Inters. [mm]	R [mm]
No PLL	10A	$x < x_0$	0.155	0.309	-190.140	0.0046	0.0024
		$x > x_0$	0.154	0.287	192.022		0.0023
	100A	$x < x_0$	0.966	6.346	-1537.063	0.0052	0.0048
		$x > x_0$	1.392	4.924	1540.968		0.0041
PLL	10A	$x < x_0$	0.016	0.102	-190.824	0.0041	0.0006
		$x > x_0$	0.014	0.057	186.846		0.0004
	100A	$x < x_0$	0.103	5.831	-1517.640	0.0050	0.0039
		$x > x_0$	0.060	5.762	1519.834		0.0038
CROC-3			σ_{meas} [μ V]	σ_{fit} [μ V]	S [μ V/mm]	Inters. [mm]	R [mm]
No PLL	10A	$x < x_0$	0.944	0.373	-376.386	0.0030	0.0035
		$x > x_0$	0.910	0.333	377.337		0.0033
	100A	$x < x_0$	2.353	5.063	-3206.590	0.0076	0.0023
		$x > x_0$	3.001	4.234	3110.845		0.0023
PLL	10A	$x < x_0$	0.874	0.313	-390.649	0.0038	0.0030
		$x > x_0$	0.661	0.237	377.451		0.0024
	100A	$x < x_0$	0.881	4.805	-3200.389	0.0078	0.0018
		$x > x_0$	0.845	6.514	3115.355		0.0024

Comparison (yaw, weak quadrupole 0.3 T)

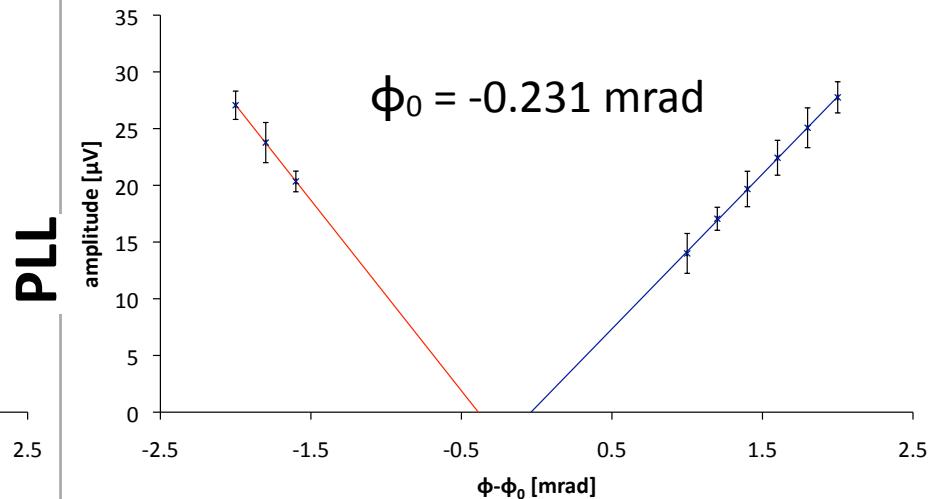
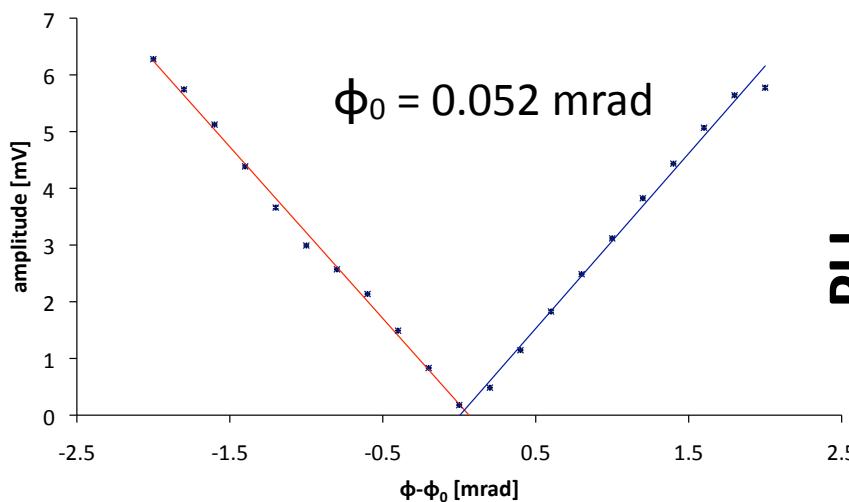


laser

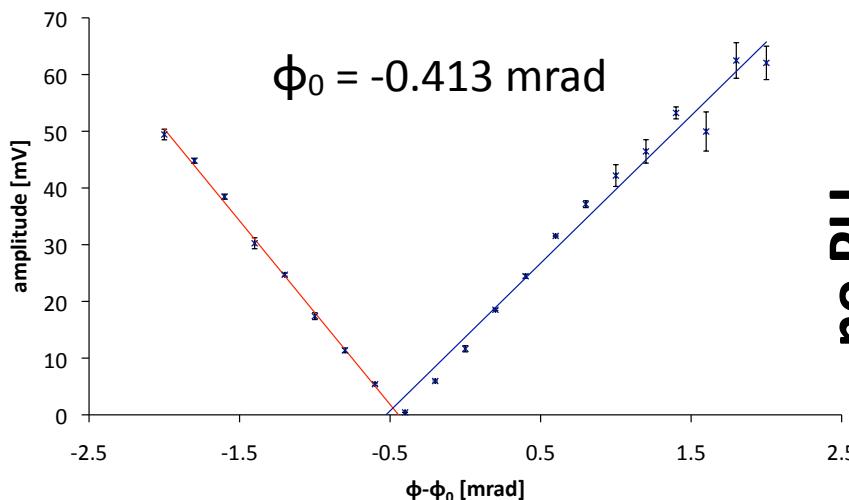
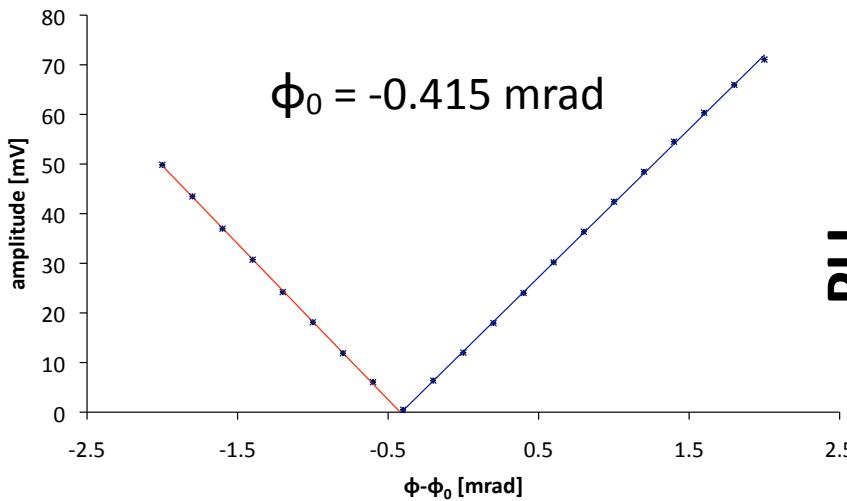
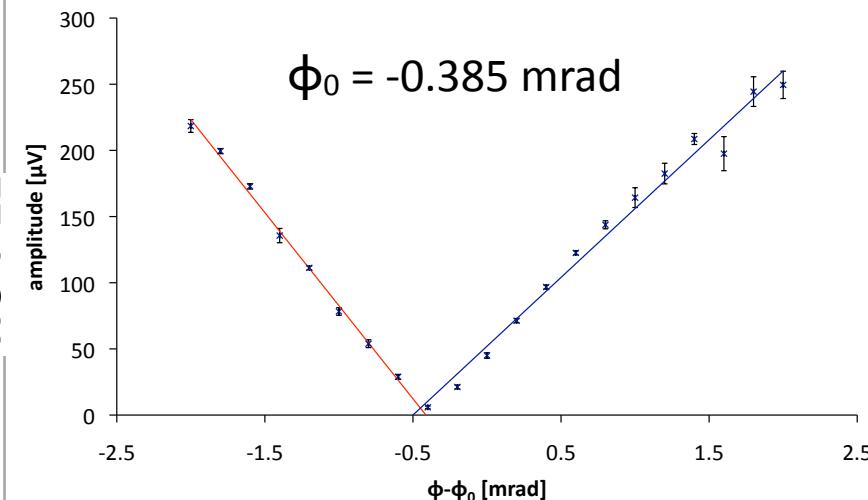
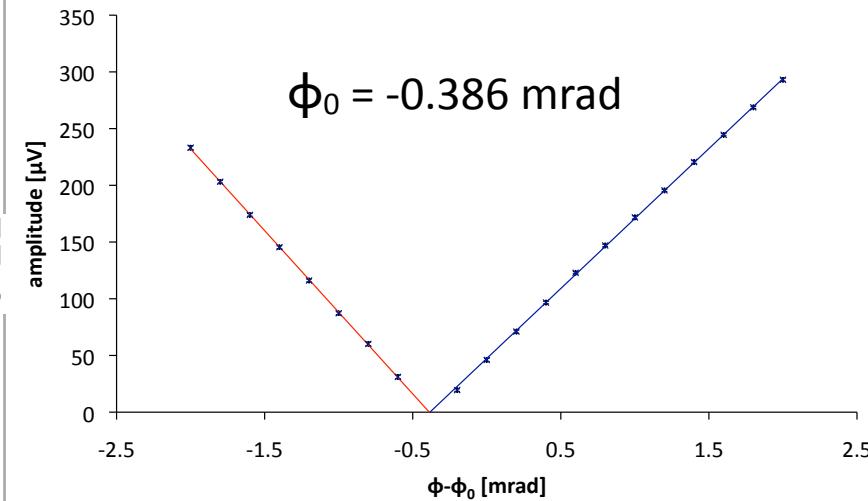
croc-3

no PLL

PLL



Comparison (yaw, strong quadrupole 3 T)

**laser****no PLL****PLL****croc-3**

Summary of yaw measurement

Laser-photodiode			σ_{meas} [mV]	σ_{fit} [mV]	S [mV/mrad]	Inters. [mrad]	R [mrad]
No PLL	10A	$\phi < \phi_0$	0.047	0.129	-2.670	0.0492	0.0658
		$\phi > \phi_0$	0.067	0.141	2.737		0.0759
	100A	$\phi < \phi_0$	0.530	0.694	-32.387	-0.4127	0.0378
		$\phi > \phi_0$	0.335	0.323	31.642		0.0208
PLL	10A	$\phi < \phi_0$	0.012	0.113	-3.025	0.0517	0.0412
		$\phi > \phi_0$	0.011	0.035	3.245		0.0144
	100A	$\phi < \phi_0$	0.037	0.205	-31.413	-0.4153	0.0077
		$\phi > \phi_0$	0.025	0.362	29.847		0.0130
CROC-3			σ_{meas} [μ V]	σ_{fit} [μ V]	S [μ V/mrad]	Inters. [mrad]	R [mrad]
No PLL	10A	$\phi < \phi_0$	1.706	0.096	-15.581	-0.2735	0.1157
		$\phi > \phi_0$	1.415	0.184	10.533		0.1518
	100A	$\phi < \phi_0$	2.272	2.242	-135.721	-0.3851	0.0333
		$\phi > \phi_0$	1.828	1.220	124.407		0.0245
PLL	10A	$\phi < \phi_0$	1.312	0.031	-16.797	-0.2307	0.0800
		$\phi > \phi_0$	1.501	0.105	13.655		0.1176
	100A	$\phi < \phi_0$	1.375	0.718	-143.963	-0.3863	0.0145
		$\phi > \phi_0$	1.155	0.875	123.328		0.0165

Pitfalls



IMMW-17, 19-23 September 2011, ALBA, La Mola, Terrassa/Barcelona, Catalonia (Spain)

Pitfalls

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- all together took about a calendar year of a **great team work AND lots of fun**