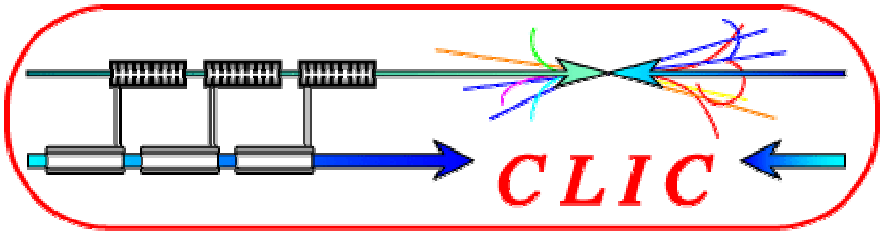
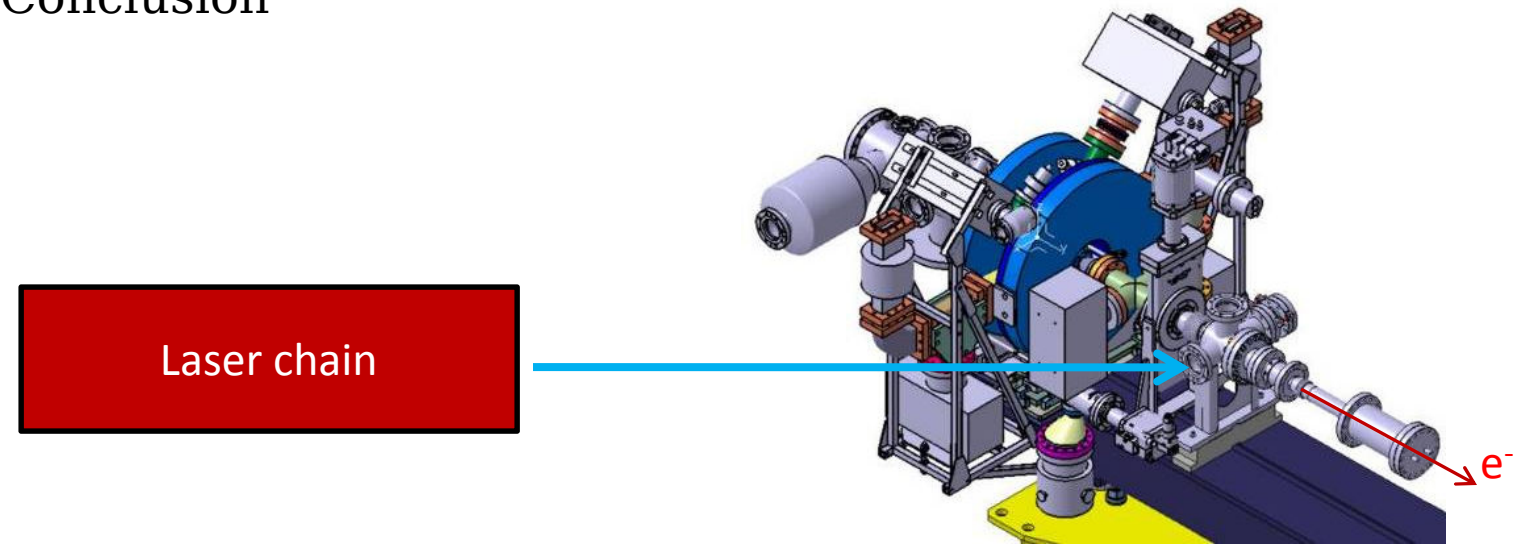
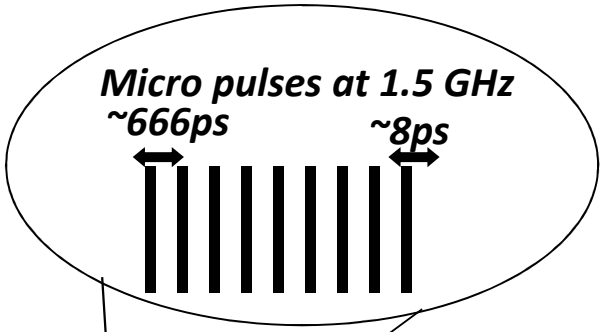


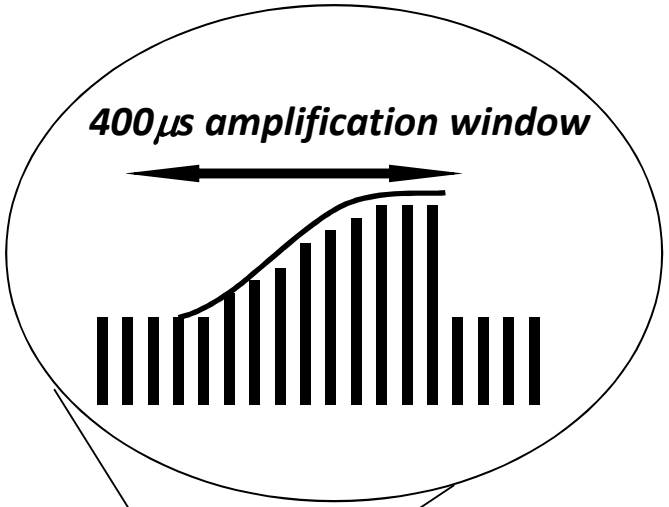
OUTLOOK

1) Present status of the laser for PHIN &CALIFES photo injector
   Achieved vs Target results
1) Preliminary results from the last PHIN photo injector
2) Conclusion



Laser chain overview

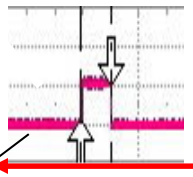




Nd:YLF Oscillator 300mW + Nd:YLF Preamplifier 10W avg 1.5GHz

AMP1 3-pass Nd:YLF amplifier

AMP2 2 pass Nd:YLF amplifier



Optical gate (Pockels cell) Δt

Δt

UV 262nm

4ω

Δt

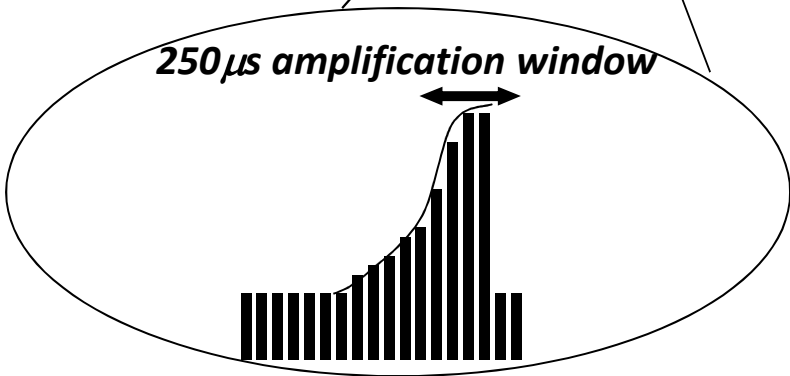
Green 523nm

2ω

Δt

IR 1047 nm

Drive Beam (PHIN) & Main Beam (CALIFES)



January 2008:

no UV beam

commissioning of the laser to be done

(… laser chain to be debugged)

December 2008:

UV beam produced (not yet nominal energy)

1st run CALIFES & PHIN

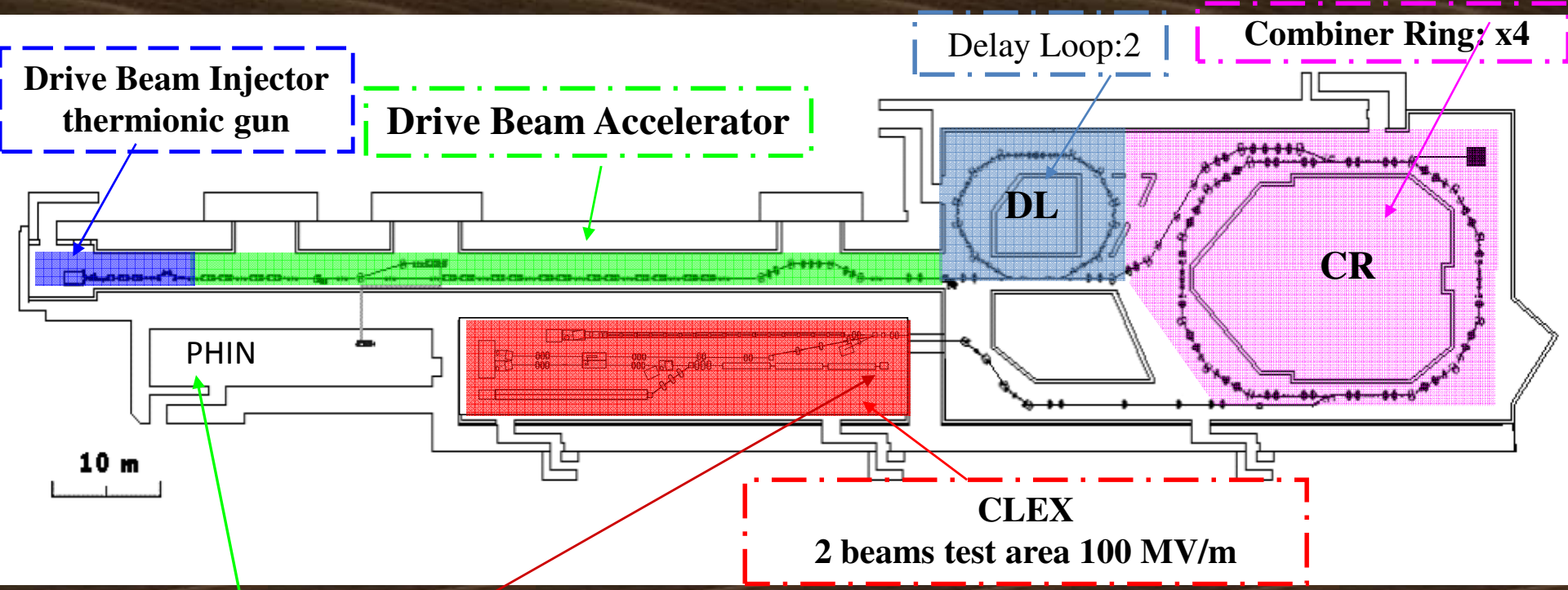
September 2009:

all laser main target parameters fulfilled !!!

stable laser beam @ nominal energy sent to cathode

3rd CALIFES & PHIN run

CTF3 electron sources:



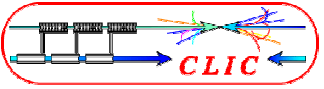
The same laser is used to drive two photo injectors:

CALIFES for the generation of the "main beam"

PHIN for feasibility study of the "drive beam" generation

From January 2008 in less than 1.5 year the laser has been settled up to a satisfactory condition for the commissioning of both the two photo injectors;

During 2009, 30% of the time has been devoted to laser development



Laser

LASER target parameters for PHIN photo injector			
distance between micro bunches	ns	0.667	✓ ok
synch to external rf @ 1.5GHz	ps	<1	✓ ok
micro bunch width (FWHH)	ps	<10	✓ ok
micro bunch energy (@ cathode)	nJ	370	✓ ok
laser pointing stability std	mm	0.5	.....

March 2009

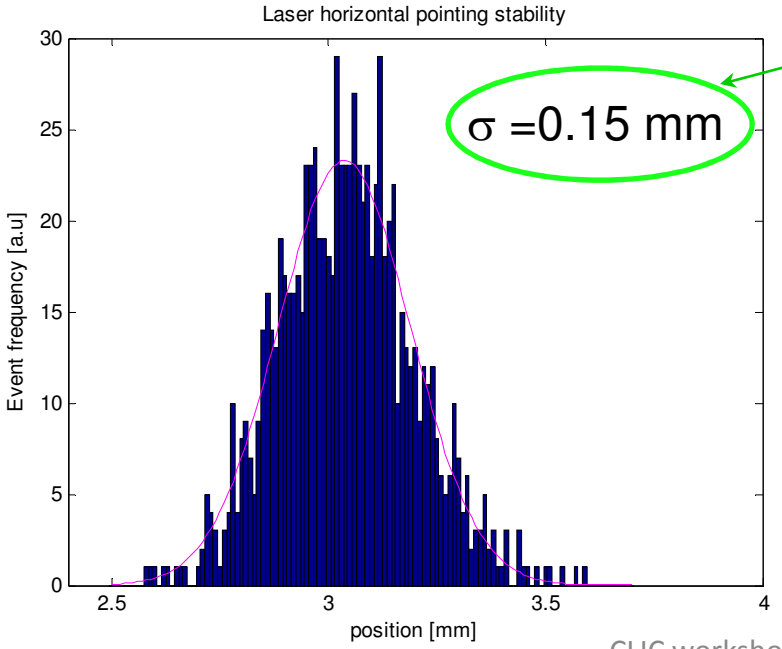
Even though the target UV energy has been reached in March 2009 the available UV energy before was 2/3 of the nominal : enough for commissioning of the photo injectors

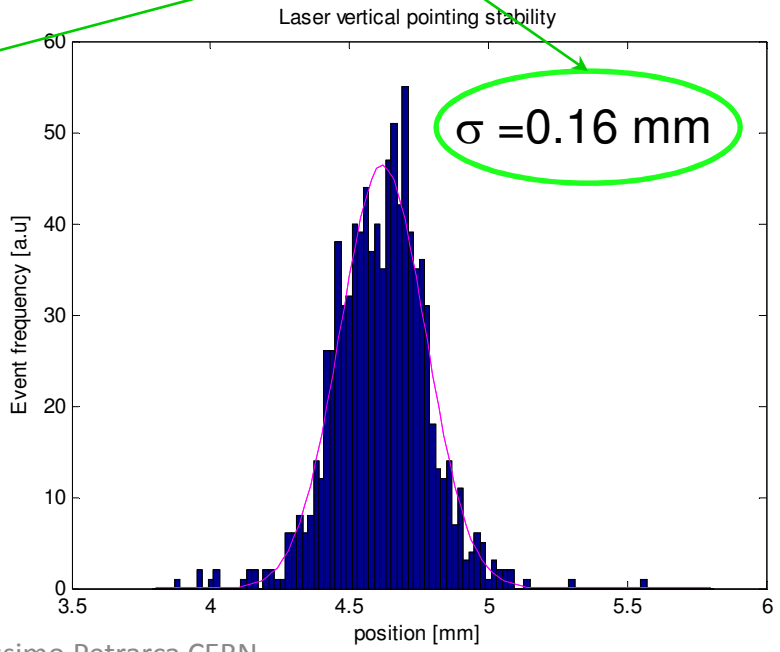
Laser

LASER target parameters for PHIN photo injector

distance between micro bunches	ns	0.667	✓ ok
Synch to external rf @ 1.5GHz	ps	<1	✓ ok
micro bunch width (FWHH)	ps	<10	✓ ok
micro bunch energy (@ cathode)	nJ	370	✓ ok
laser pointing stability std	mm	0.5	✓ok

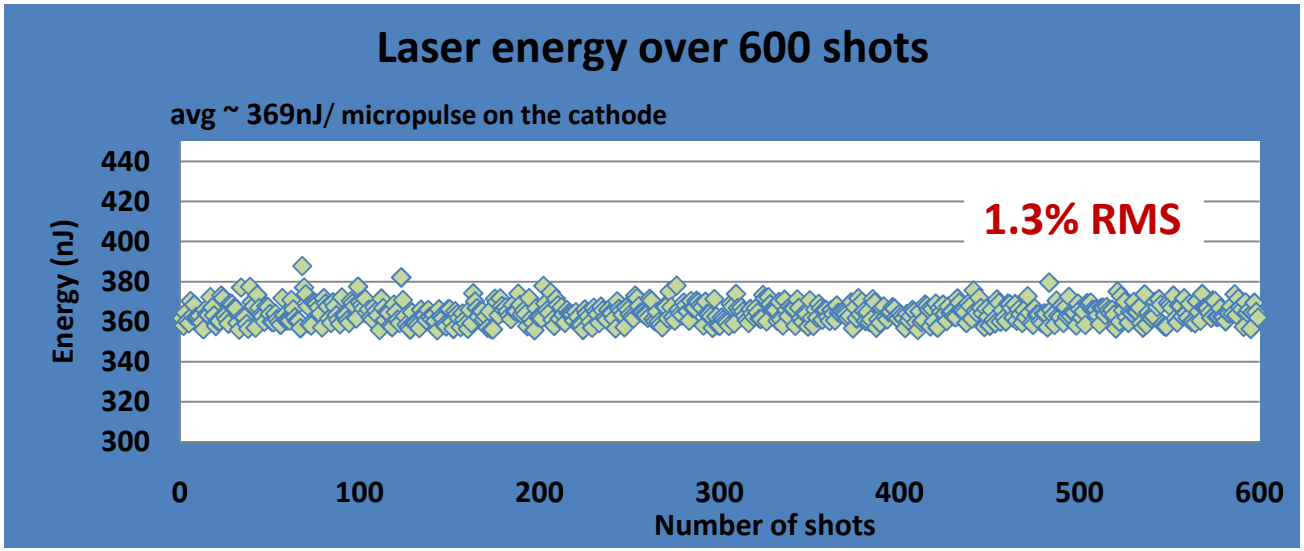
October 2009



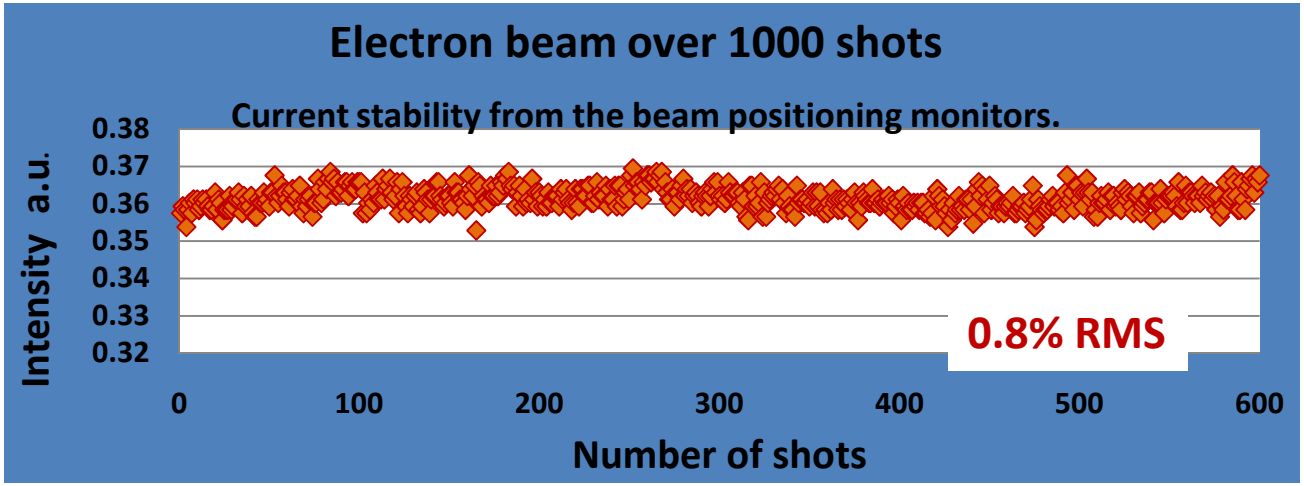


Stability

laser effects on electron beam



Retrieved energy measurement from integrated area of the laser beam profile picture @ virtual cathode; values are calibrated to the energy measurements by the Joule meter.

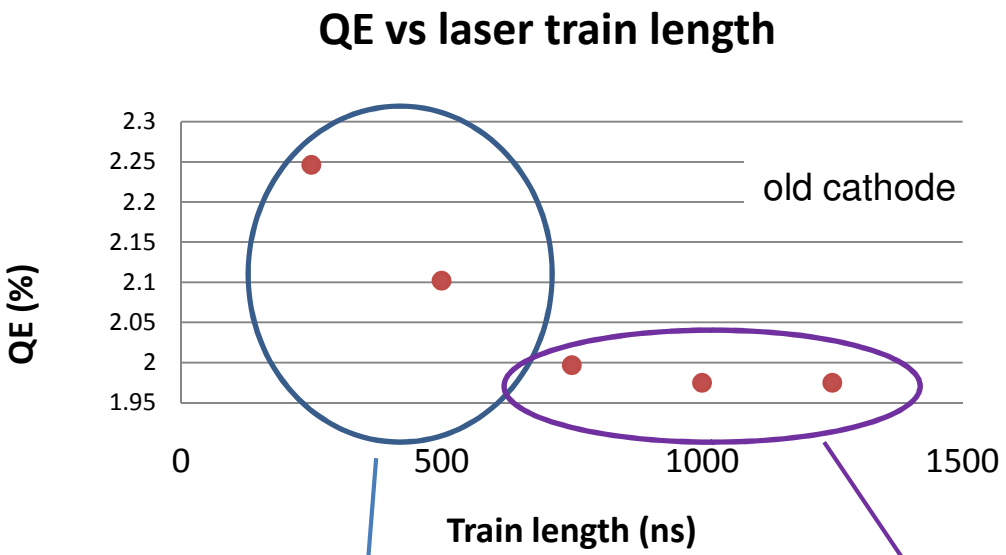


PRELIMINARY

October 2009

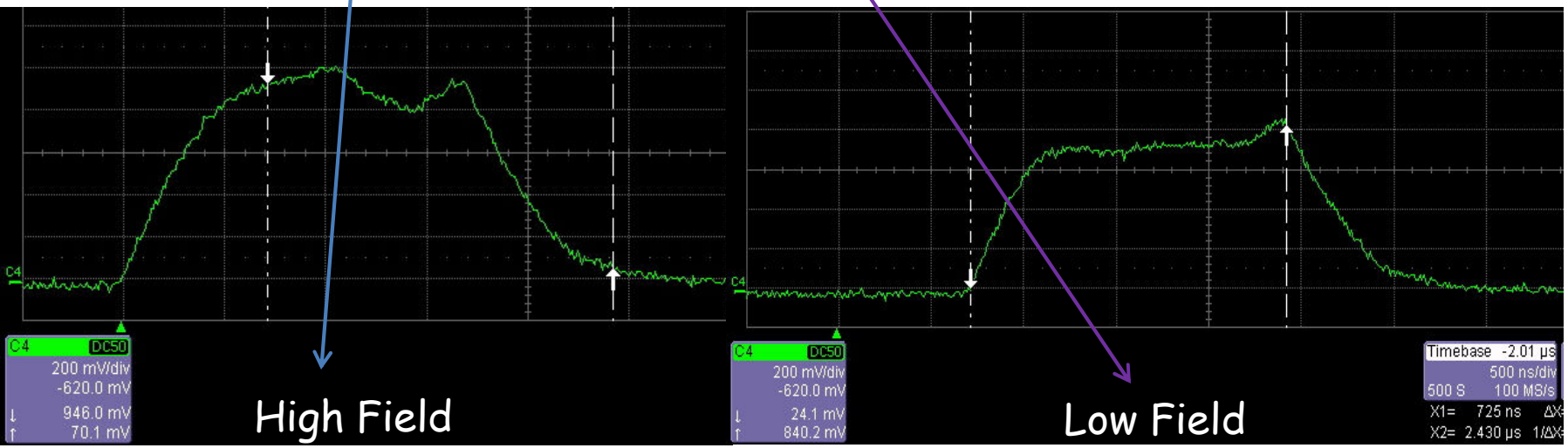
Target: 0.25% rms (1%rms optional)

Quantum efficiency

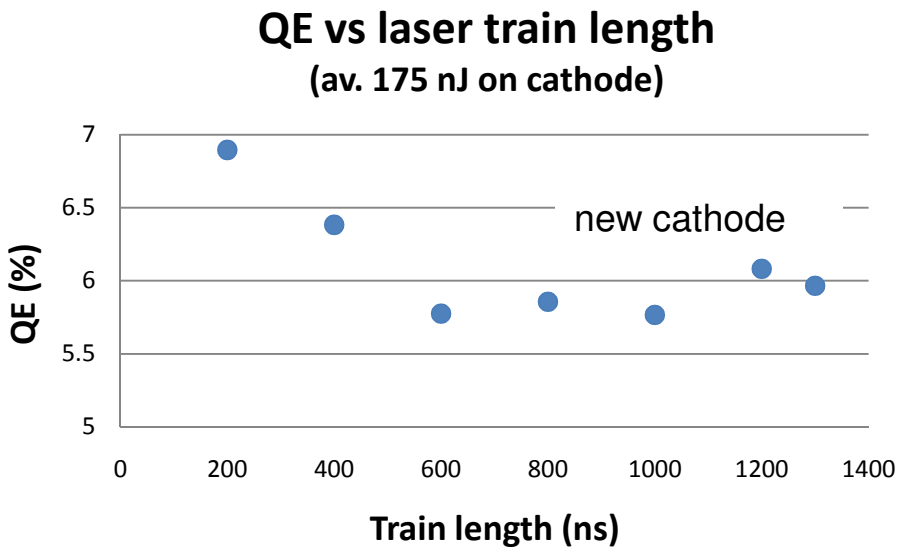


PRELIMINARY

October 2009



Quantum efficiency



PRELIMINARY

October 2009

Summary for the LASER

PHIN: All the main LASER target parameters for PHIN photo injector has been fulfilled

Measured Intensity Stability: <1.3% rms
can be lowered but it is already satisfactory for a laser without stabilization feedback

CALIFES: the laser has not been designed to produce the UV energy (~1μJ) required to obtain 0.6nC by 0.3% cathode QE. Nevertheless the amplification scheme can still be improved to get UV energy close to the nominal.

Future work

Phase coding →required for e-beam frequency multiplication

Stabilization system → to reduce the intensity fluctuation

Amplification scheme → higher ir energy

Harmonic generation →more UV energy

September 2009: +1 person on EN/STI/LP section to work on the laser

welcome Marta Csatari !

Sur la route pour CLIC

		DRIVE BEAM			MAIN BEAM
	Unit	CTF3 / PHIN [17]	CLIC 3 TeV	CLIC Compton ring	CLIC 3 TeV
μ pulse charge	nC	2.33	8.6	9.3	0.96
μ pulse width (FWHH)	ps	10	12	100	100
peak current	A	233	716	93	9.6
number of μ pulses	-	1908	92664	312	312
distance between μ pulses	ns	0.667	1.49	0.5	0.5
Macro pulse duration	ns	1272	140000	156	156
Macro pulse charge	nC	4446	796900	3120	300

More powerful amplifiers can be added at this laser so that it can be used as a source for **CLIC 3TeV "Drive Beam"** if CeTe cathode with a QE of 3% is maintained.

For **CLIC Compton ring:** 2GHz laser oscillator is feasible but more powerful amplifiers have to be designed if QE ~3% is maintained. Robustness of the cathode must investigated

For the CLIC 3 TeV "Main Beam"

The CTF3 laser scheme has to be reviewed in order to use cathode for polarized electron generation like GaAs that work in range of wavelength different from the one offered by this laser ; other factors like the peak current @ the cathode and its lifetime have to be investigated !!

Acknowledgment

Laser :

Nathalie Lebas (CERN, EN/STI/LP)
Marta Csatari (CERN, EN/STI/LP)
Valentine Fedosseev (CERN, EN/STI/LP section leader)
Roberto Losito (CERN, EN/STI group leader)

2 months collaboration:
M. Martyanov (Institute of Applied Physics, Nizhny Novgorod, Russia)
G. Luchinin (Institute of Applied Physics, Nizhny Novgorod, Russia)
V. Lozhkarev (Institute of Applied Physics, Nizhny Novgorod, Russia)

Photo injector:

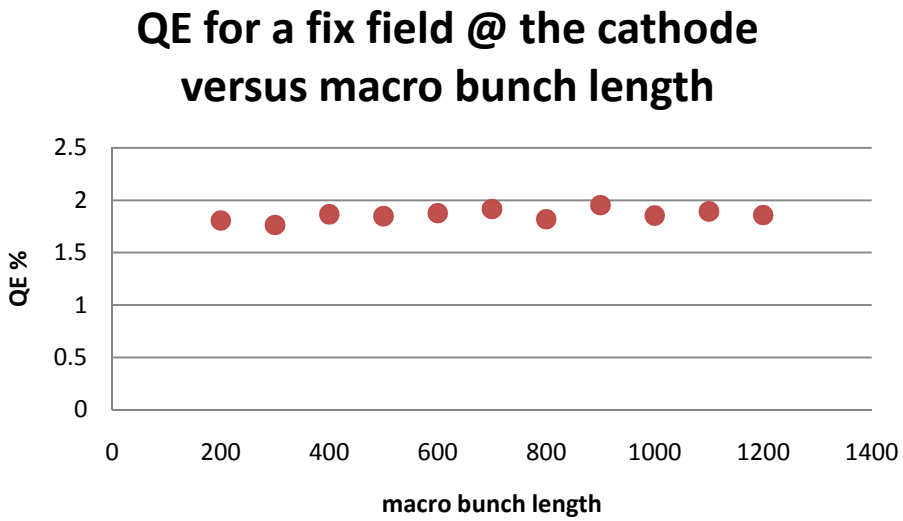
Eric Chevallay (CERN, EN/STI/LP)
Steffen Doebert (CERN, BE)
Thibaut Lefevre (CERN, beam diagnostic group)
Anne Dabrowski (CERN, beam diagnostic group)
R. Roux (LAL; photo injector designer)

Acknowledgements

- We acknowledge the support of the European Community-Research Infrastructure Activity under the FP6 "Structuring the European Research Area" programme (CARE, contract number RII3-CT-2003-506395).

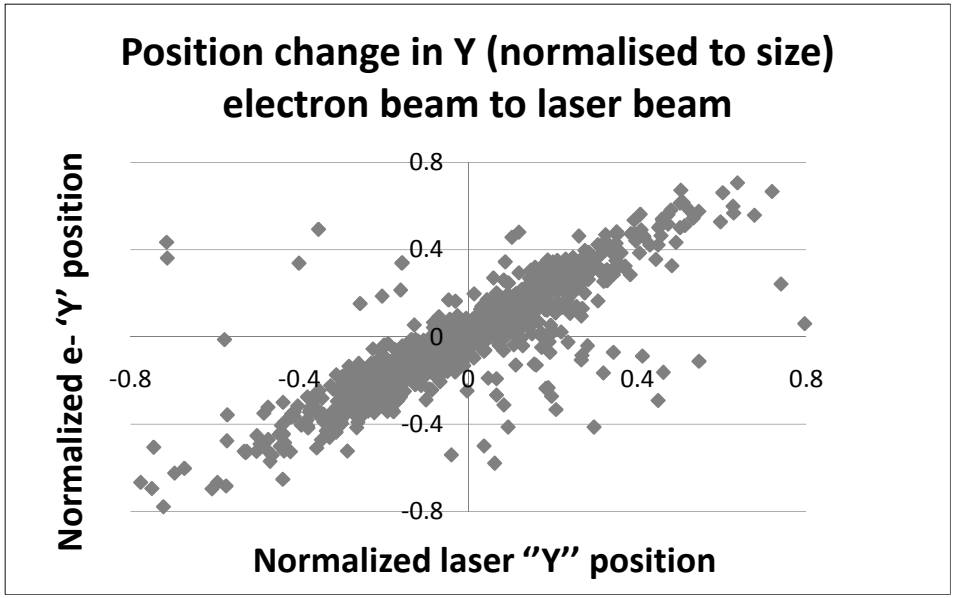
….. Oznur Mete

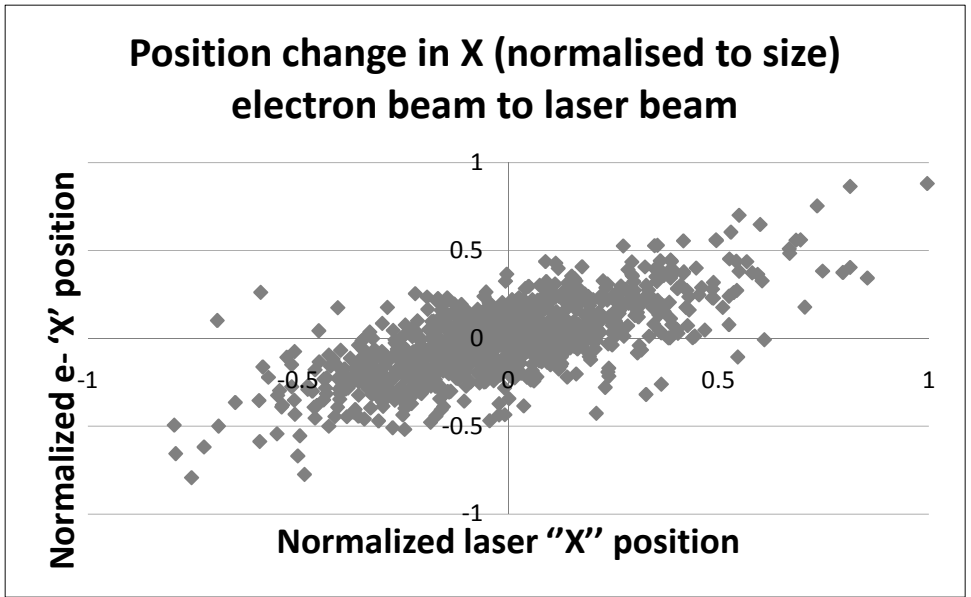
SPARES SLIDES


QE for a fix field @ the cathode versus macro bunch length
QE %
2.5
2
1.5
1
0.5
0
0
200
400
600
800
1000
1200
1400
macro bunch length

Stability

laser effects on electron beam



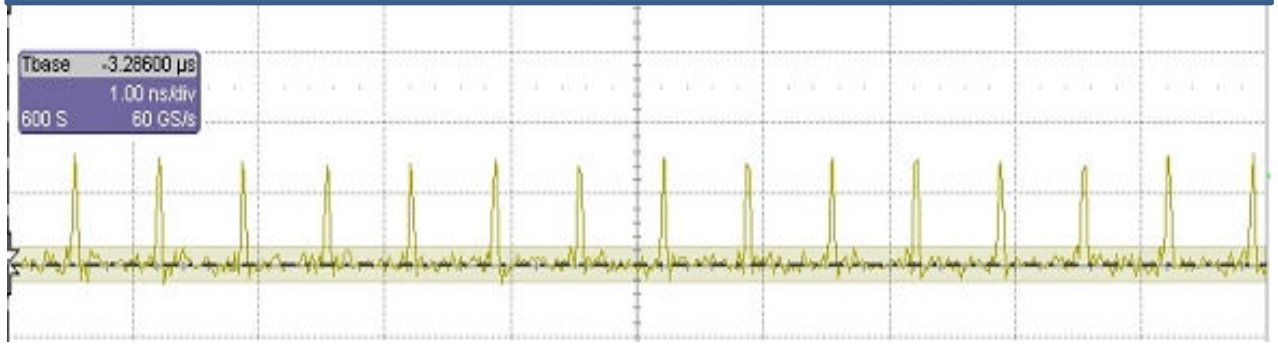


PRELIMINARY

Laser parameters :

…to fulfill PHIN photo injector requirements		
micro bunches repetition rate	ns	0.667
Synch to external rf @ 1.5GHz	ps	<1
micro bunch width (FWHH)	ps	<10
micro bunch energy (@ cathode)	nJ	370
laser pointing stability std	mm	0.5

Micro bunches time structure



Laser parameters :

LASER target parameters to fulfill PHIN photo injector requirements		
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Synch to external rf @ 1.5GHz	ps	<1
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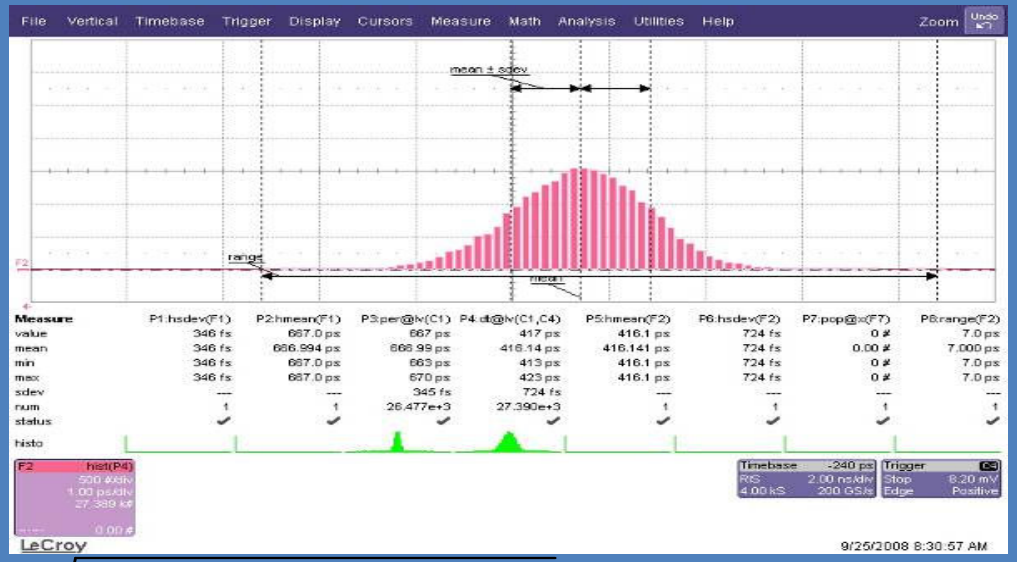
micro bunch energy (@ cathode)	nJ	370
laser pointing stability std	mm	0.5

Lecroy SDA (16GHz, 60GS/s+ NewFocus Photodetector25GHz)



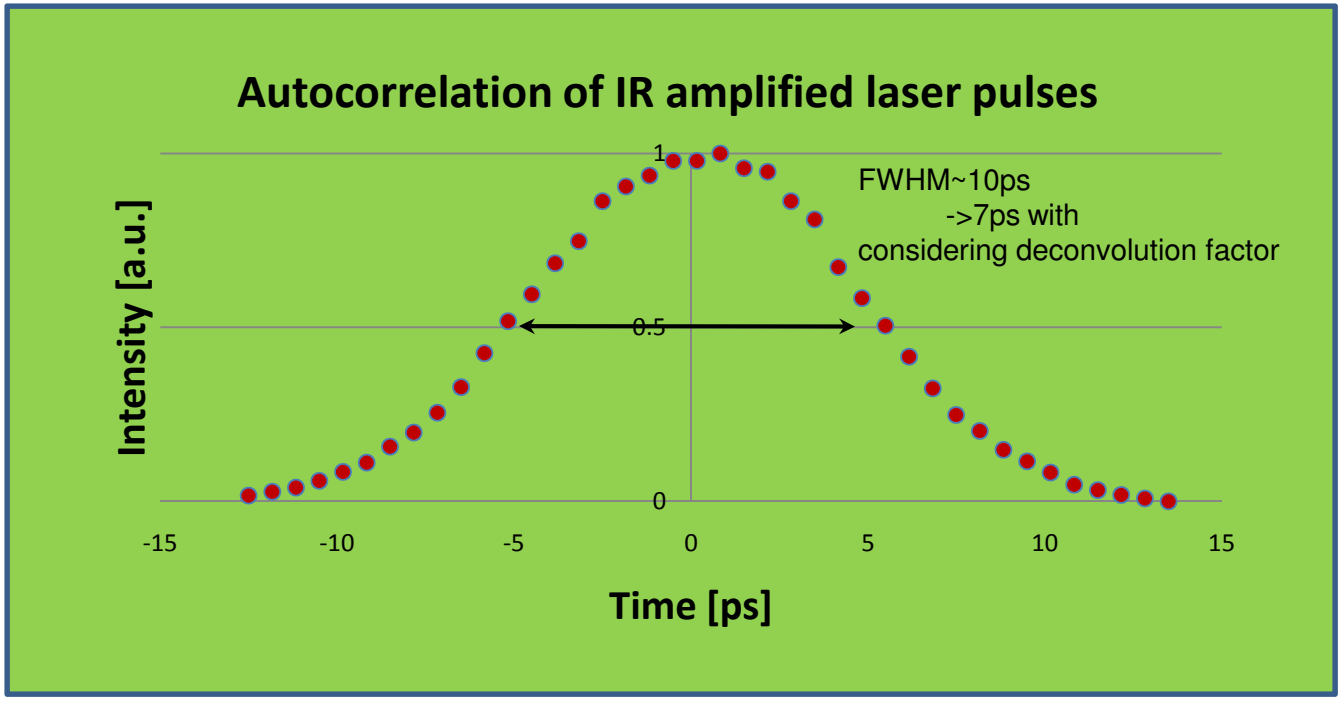
JNF:
Jitter noise floor ~ 350 fs
Jmeas: 724fs

$$J_{real} = \sqrt{(J_{meas})^2 - (JNF)^2}$$

J_{real} ~ 634 fs (rms jitter required <1ps)

Laser parameters :

LASER target parameters to fulfill PHIN photo injector requirements		
distance between micro bunches	ns	0.667
Synch to external rf @ 1.5GHz	ps	<1
micro bunch width (FWHH)	ps	10
micro bunch energy (@ cathode)	nJ	370
laser pointing stability std	mm	0.5



Laser parameters :

LASER target parameters to fulfill PHIN photo injector requirements		
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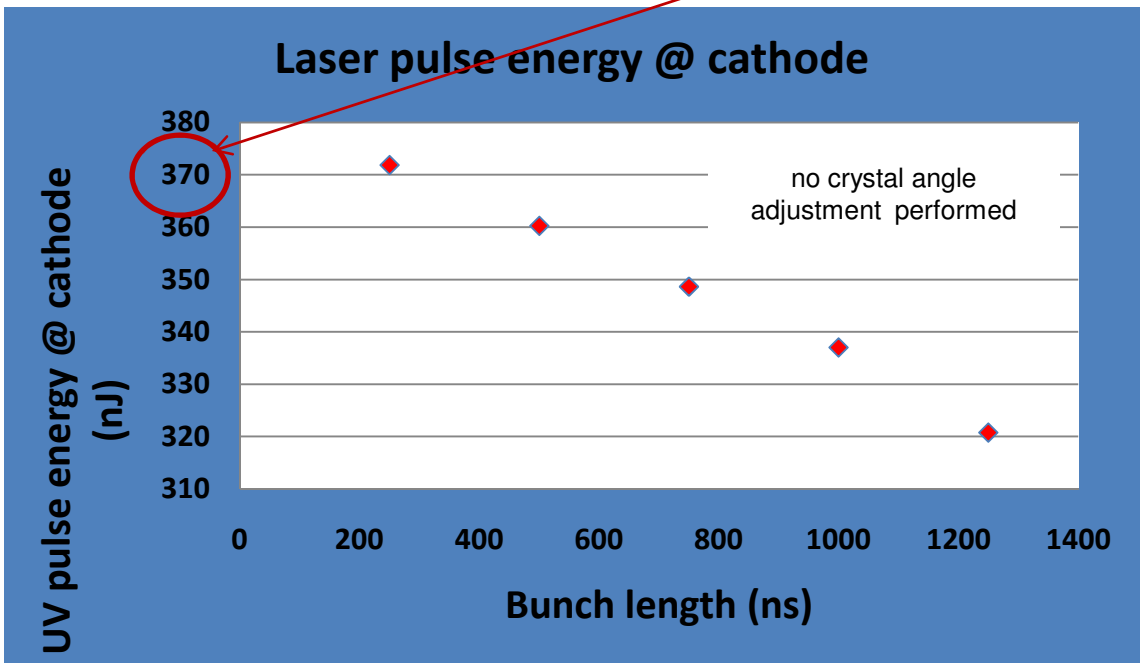

Laser

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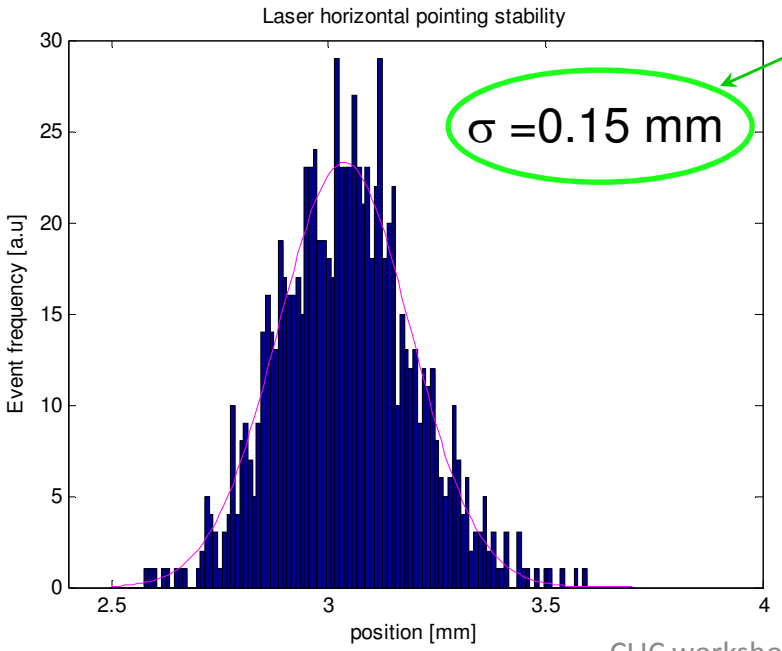

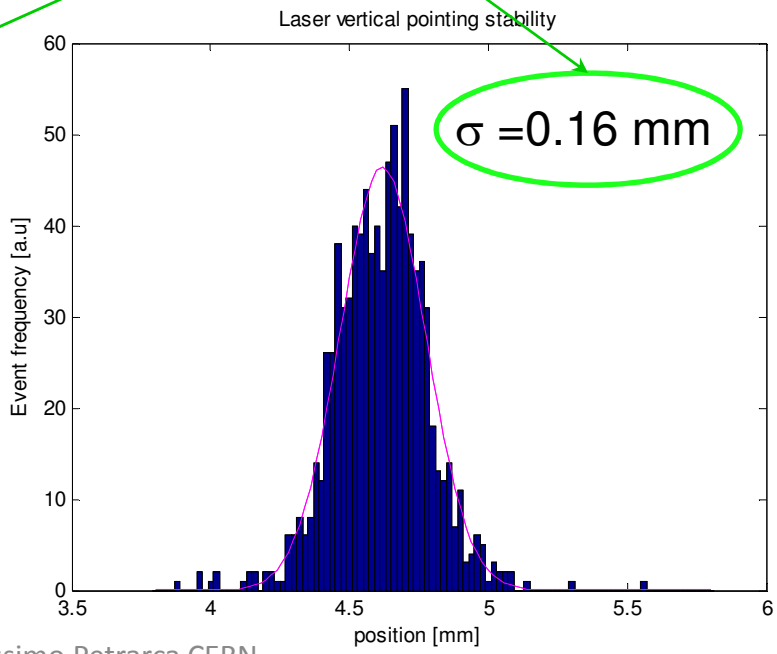

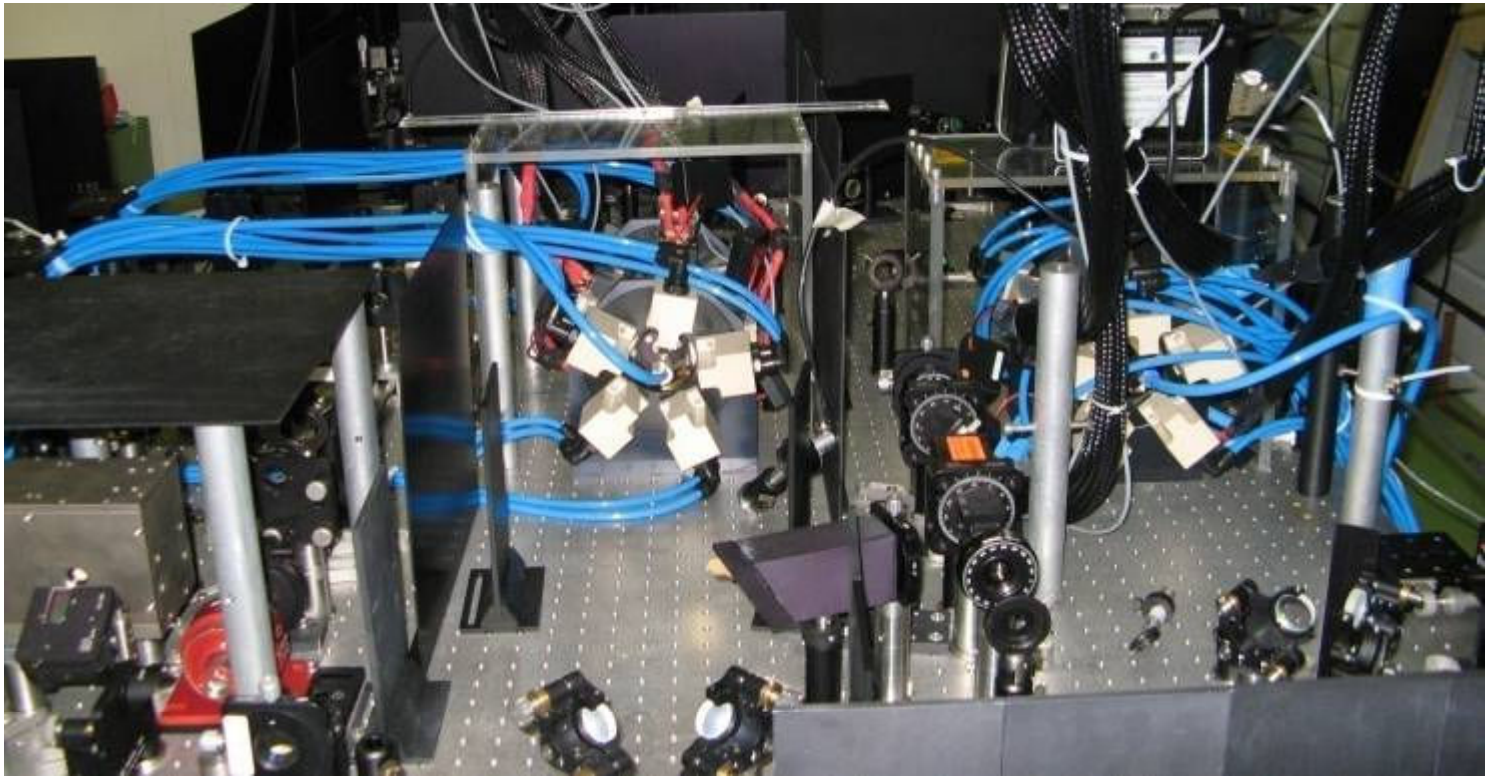

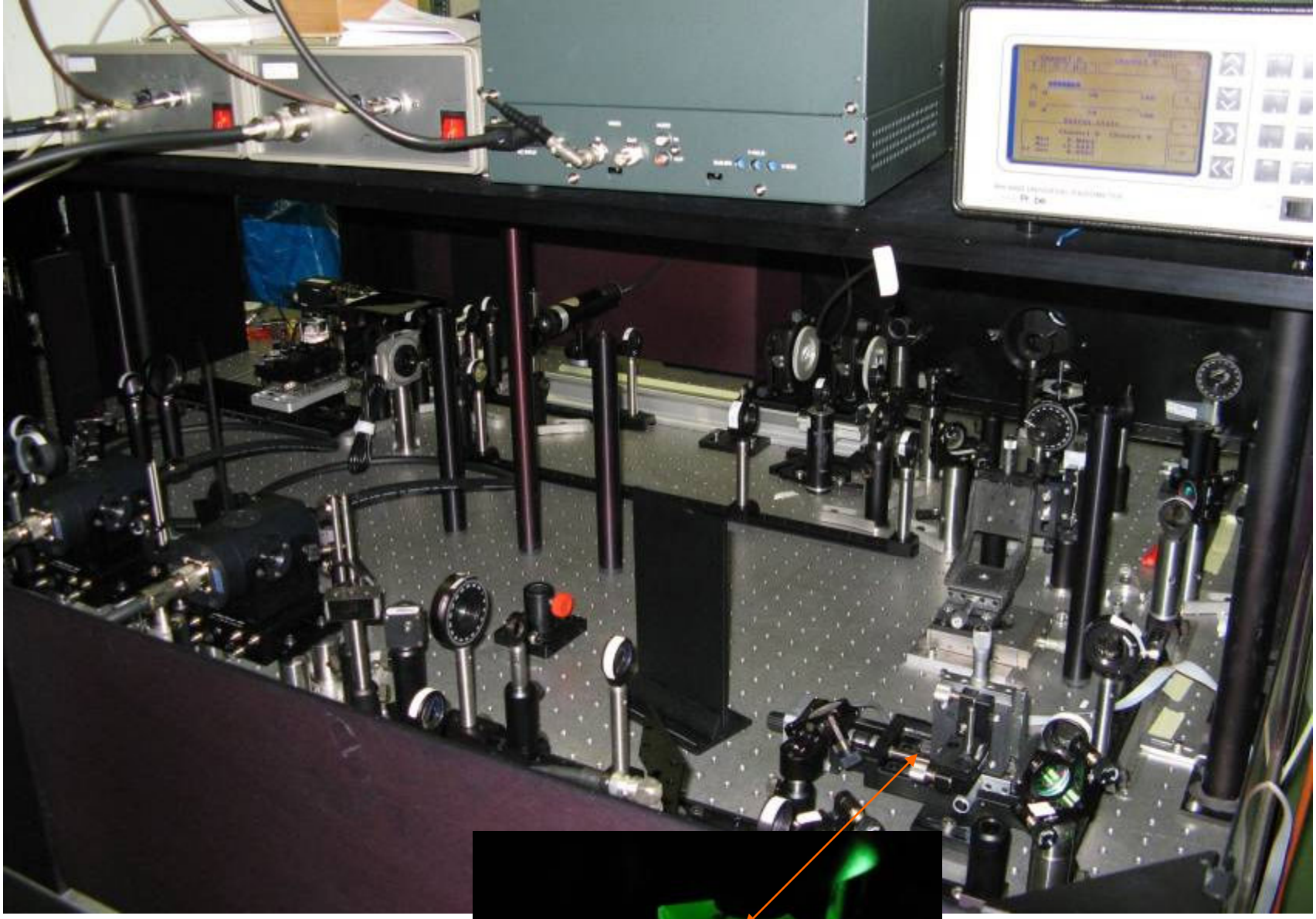
IR 1047 nm