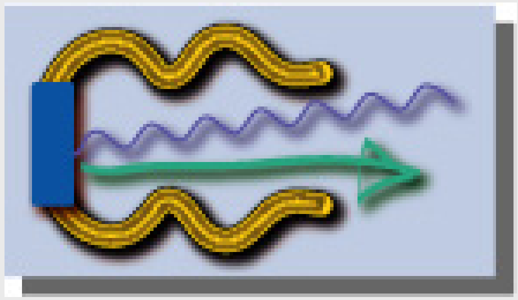
JRA2 - PHIN
Charge production with Photo-injectors



Andrea Ghigo on behalf of PHIN Collaboration

CARE Collaboration Meeting CERN 23-25 November 2005

Institute	Acronym	Country	Coordinator	PHIN Scientific Contact	Associated to
CCLRC Rutheford Appletone Lab. (22)	**CCLRC-RAL**	**UK**	P. Norton	I.N. Ross	
CERN Geneva (19)	**CERN**	**CH**	H. Haseroth	G. Suberlucq	
CNRS-IN2P3 Orsay (3)	**CNRS-LAL**	**F**	T. Garvey	G. Bienvenu	CNRS
CNRS Lab. Optique Appl. Palaiseau (3)	**CNRS-LOA**	**F**	T. Garvey	V. Malka	CNRS
ForschungsZentrum ELBE (10)	**FZR-ELBE**	**D**	J. Teichert	J. Teichert	
INFN-Lab. Nazionali di Frascati (11)	**INFN-LNF**	**I**	S. Guiducci	A. Ghigo	INFN
INFN- Milan (11)	**INFN-MI**	**I**	C. Pagani	I. Boscolo	INFN
Twente University- Enschede (13)	**TEU**	**NL**	J.W.J. Verschuur	J.W.J. Verschuur	

PHIN addressed to

- Development of the high charge e^- beam (drive beam) for the RF power source of the two-beam linear collider CLIC (CERN) implementing the CLIC Test facility at CERN.
- Realisation of the first high power photoinjector that uses a photocathode, laser driven, in a superconducting RF gun for application in ELBE (Rossendorf) and possible use in TESLA Test Facility (Desy).
- Realisation of an high brightness electron source based on new concept: Plasma Photoinjector
- Realisation of new electron source for NEPAL (Orsay) test stand.
- Realisation of the new injector for TEU-FEL (Twente).
- Realisation of the laser temporal pulse shaping system to produce high brightness e- beam for FEL application

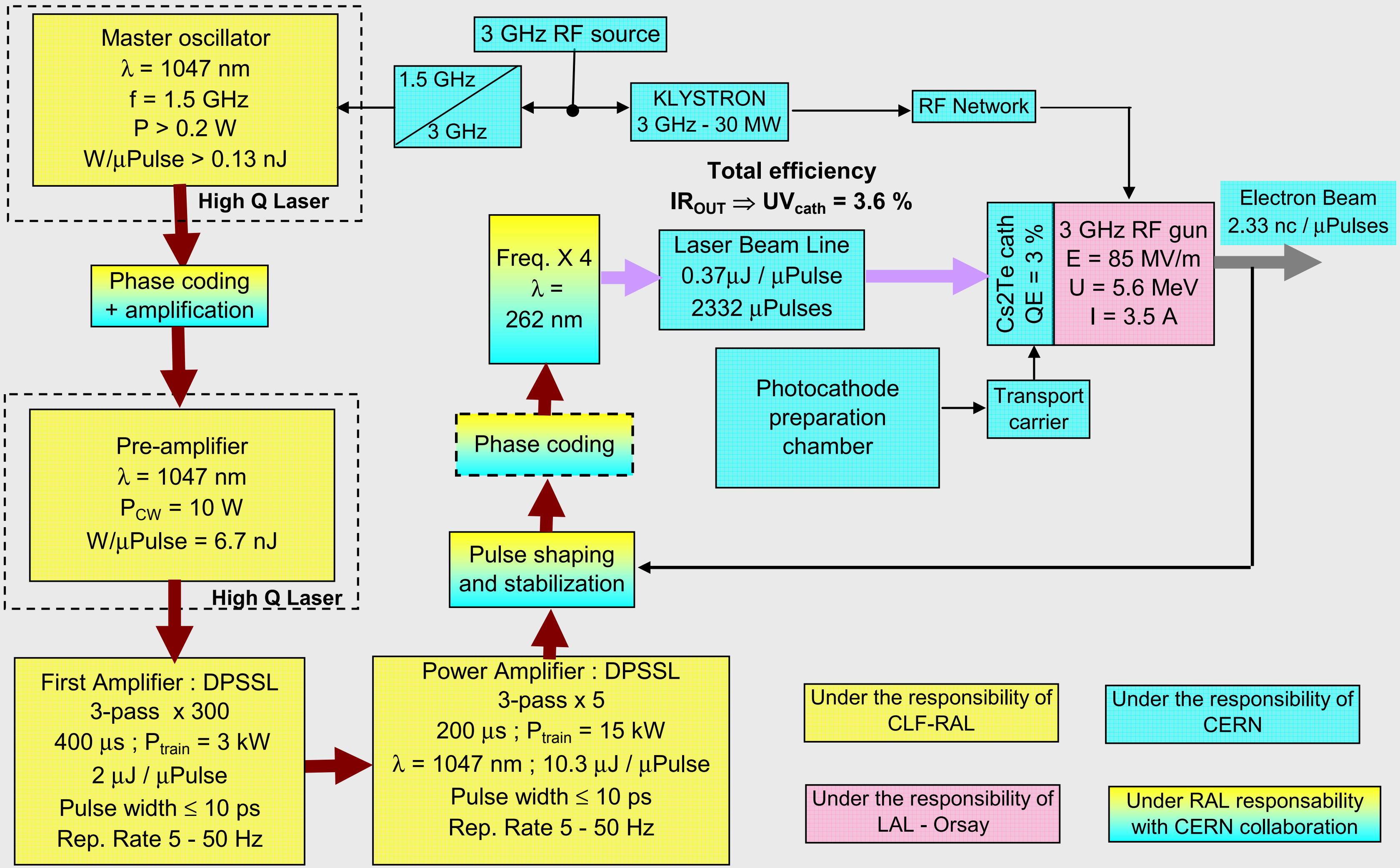
The PHIN Photoinjector for CTF3

- **CERN, CCLRC – RAL, IN2P3 - LAL**

CTF3 photoinjector parameters

- Current in the train: 3.5 Amps
- Pulse train length: 1.5 μs
- Charge in each pulse: 2.33 nC
- Pulse frequency: 1.5 GHz
- Rep rate: 1÷50 Hz (nominal: 5 Hz)

CTF3 Photoinjector



Photocathodes

- Improvement of Cs-Te cathode production (standard cathodes for CTF3)
- Co-evaporation : thickness calibration ➔ evaporation rate control ➔ stochïometric ratio control
  - New evaporators : CEA’s oven
  - New control system: VME based
  - Improved vacuum pressure measurement and new rest gas analysis
  - New transfer arm for XPS analysis

Photocathodes

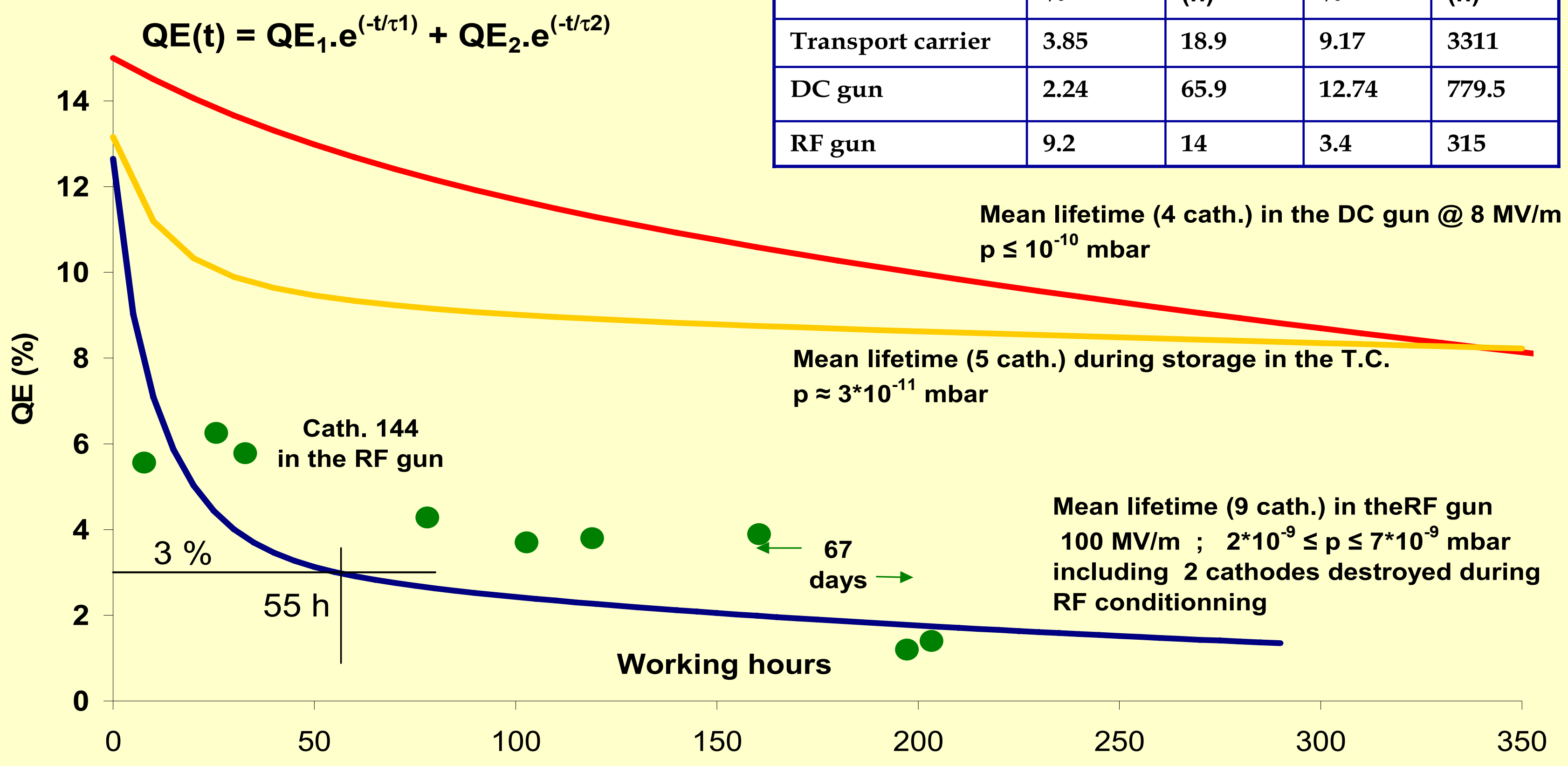
- CERN photocathode Lab was working without interruption since 15 years.
- The whole line (preparation chamber, DC Gun, transport carrier) has been inspected and repaired.
- We started again few days ago with the first calibration coatings.

- We will start very soon with production of $CsTe_2$ by co-evaporation

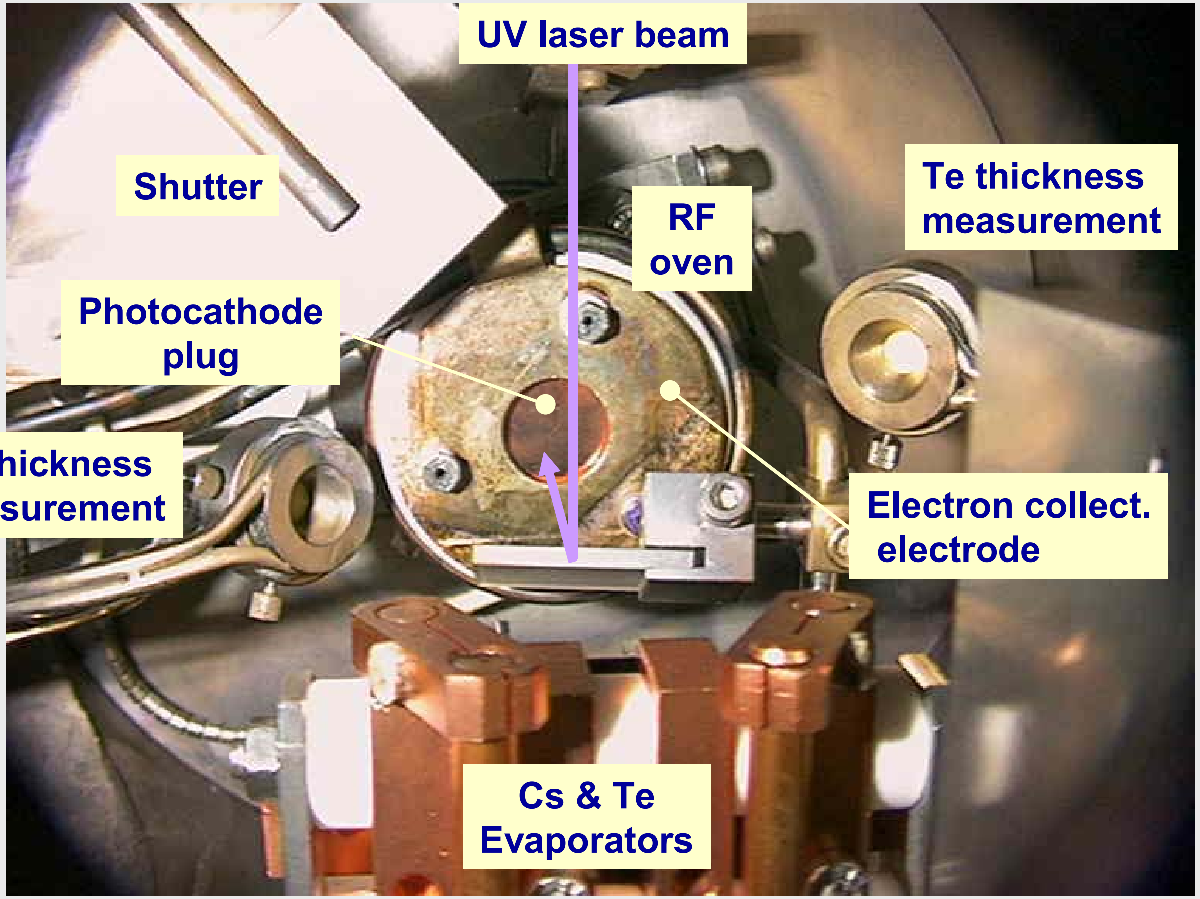
Photocathodes

- Photocathodes produced by co-evaporation seem to be very sensitive to the vacuum quality

QE = f (t)	QE1 %	τ1 (h)	QE2 %	τ2 (h)
Transport carrier	3.85	18.9	9.17	3311
DC gun	2.24	65.9	12.74	779.5
RF gun	9.2	14	3.4	315



Photocathodes preparation chamber



20 cath.	QE(%)
Min	8.2
Average	14.9
Max	22.5

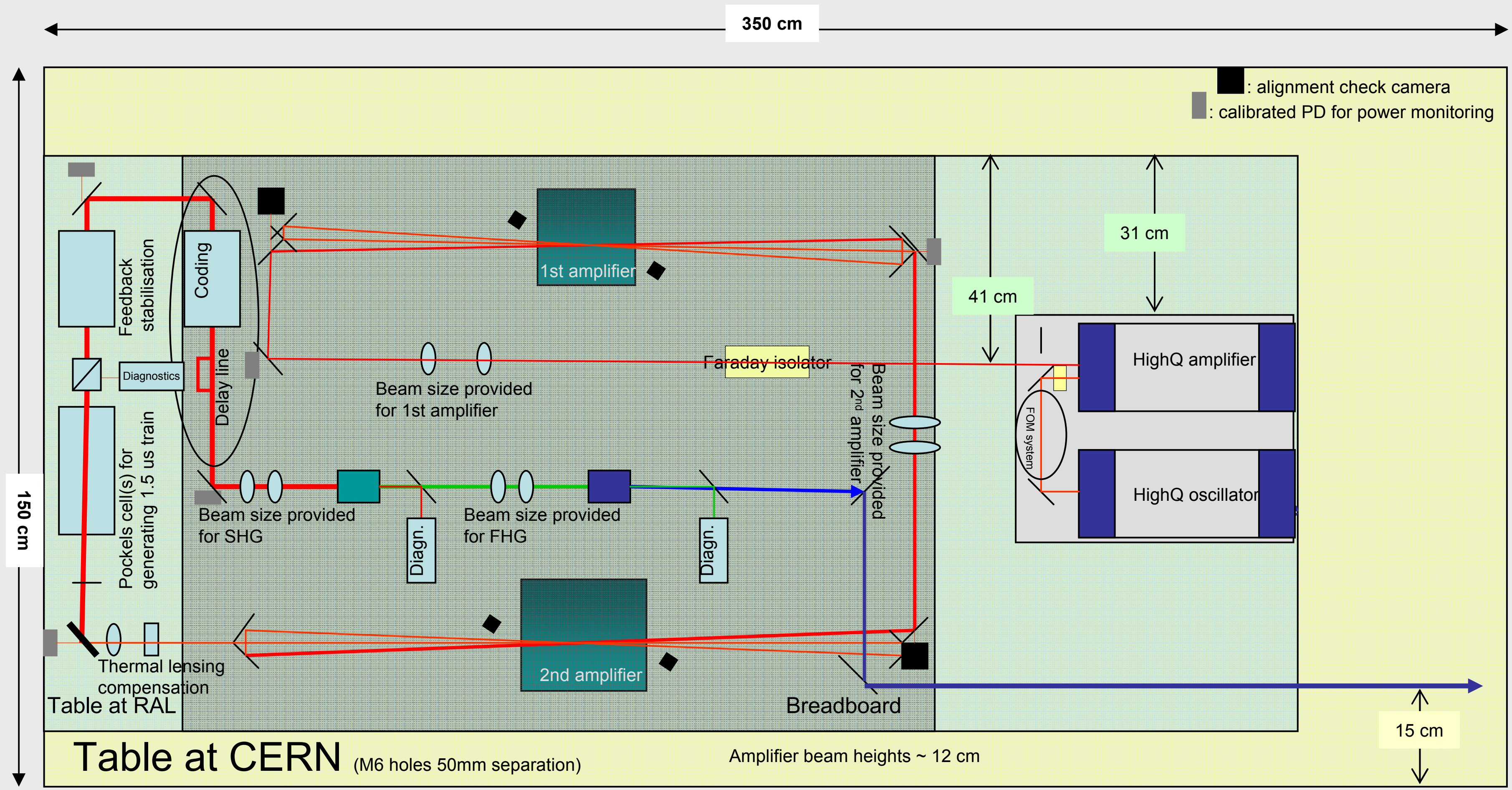
Status of the CTF3 Photoinjector Laser at CCLRC Central Laser Facility

Laser requirements

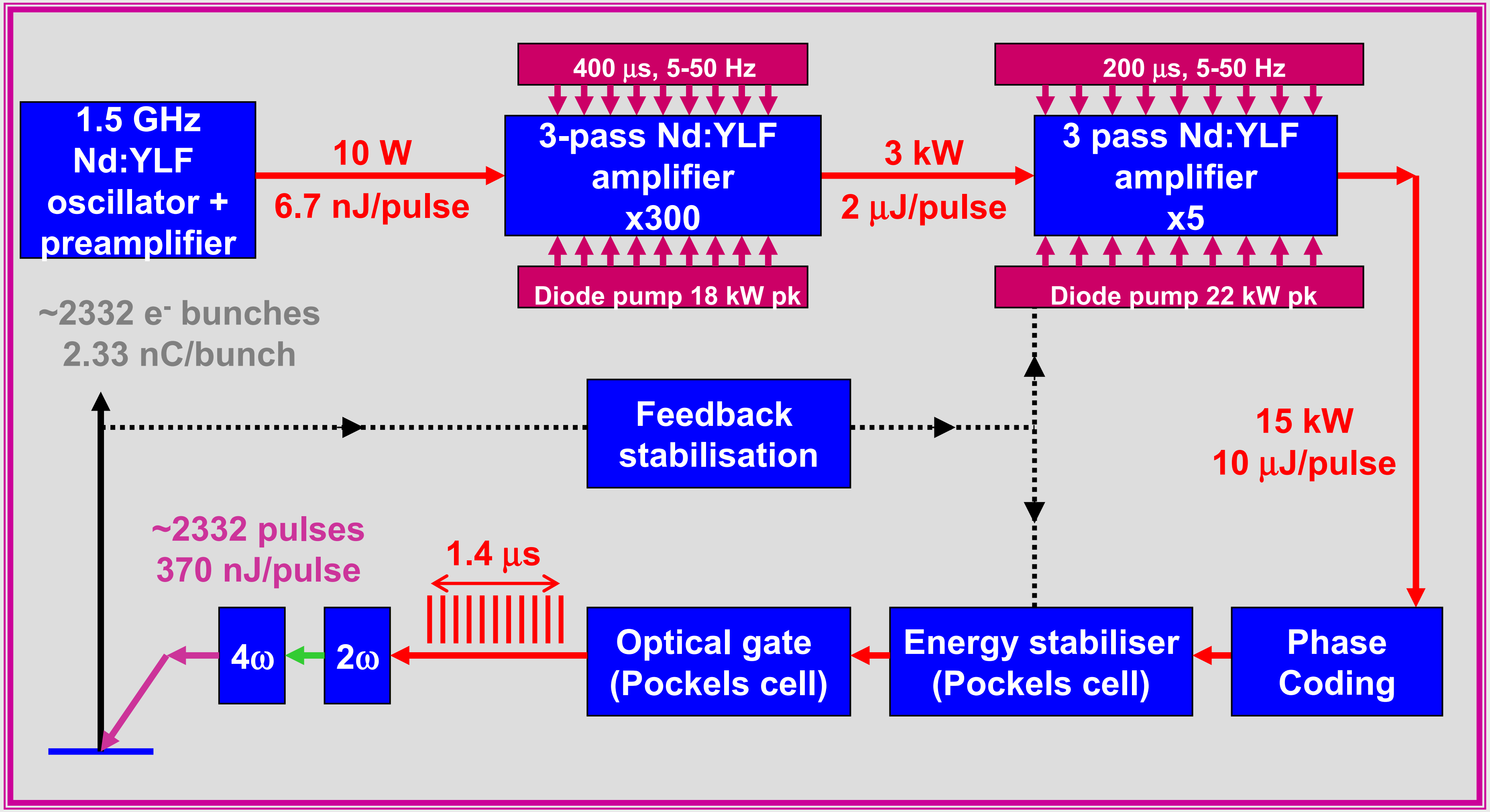
Photocathode material	Cesium Telluride
Laser output wavelength (UV)	262 nm
Laser fundamental wavelength (IR)	1047 nm
Laser material	Nd:YLF
Electron bunch charge	2.33 nC
Laser pulse energy (UV at cathode)	0.37 μJ
Laser pulse energy (IR from final amp)	10 μJ
Average IR laser power in macropulse	15 kW
Laser macropulse rate	5 Hz – 50 Hz

LASER

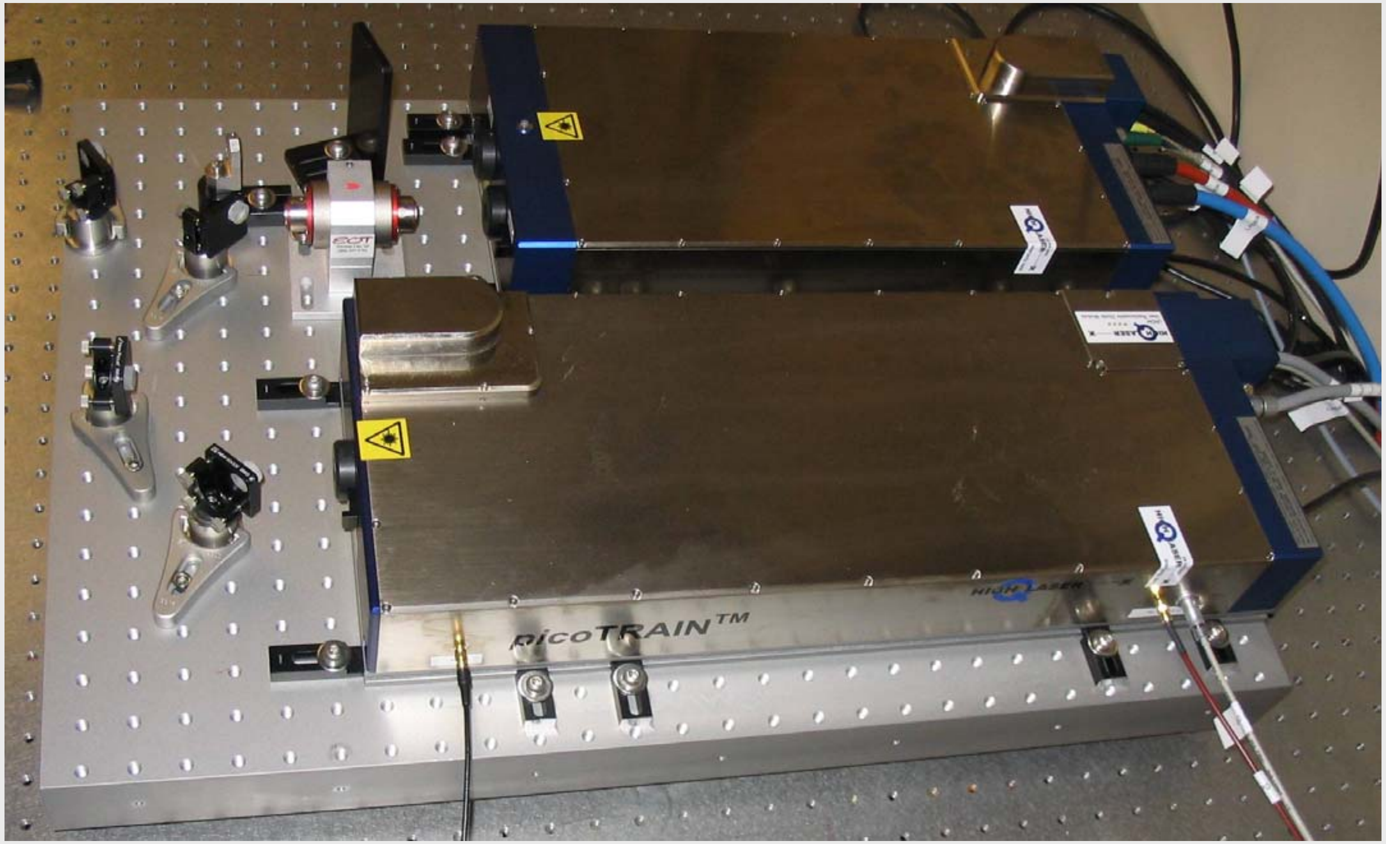
- How it will look like



CTF3 Photoinjector LASER

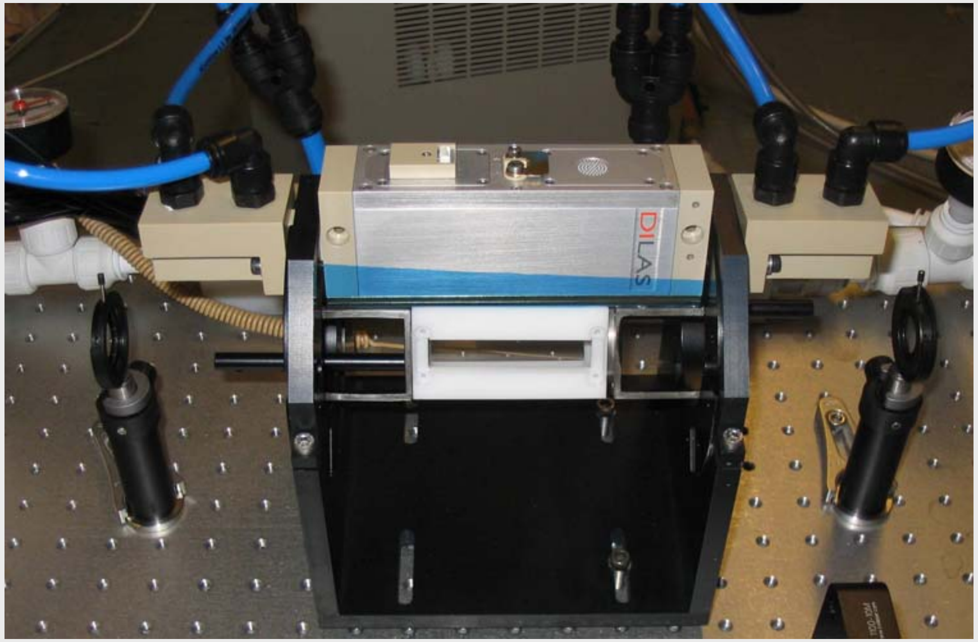


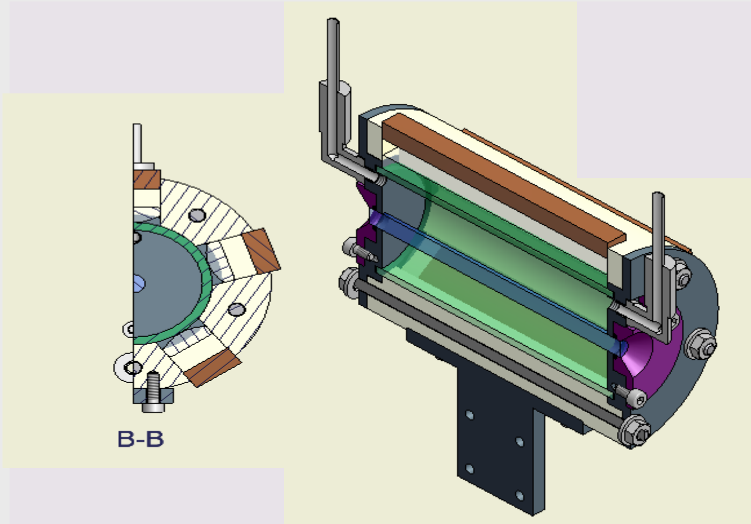
Status – Oscillator/Preamplifier



- Delivered, installed and commissioned in Q2 2005
- Has met all specifications
- Seems capable of accommodating coding hardware

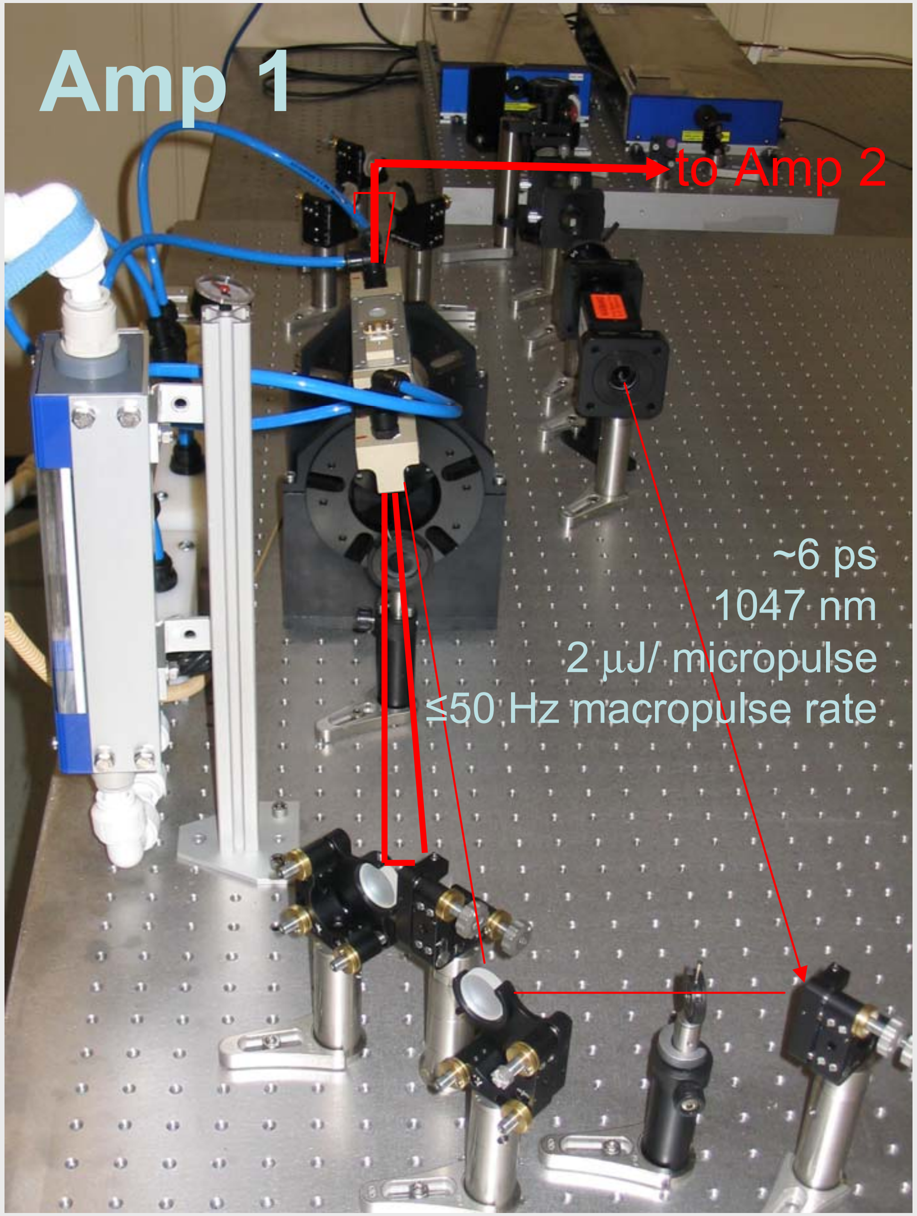
Status - Diodes





- Amp 1 and Amp 2 diodes delivered
- Amp 1 diode chiller delivered and installed
- Water connected and tested to one Amp 1 diode stack
- Diode wiring designed with shielding to satisfy Low Voltage Directive
- Amp 1 drivers delivered and tests under way

Status – Amplifiers



- Designs complete
- All Amp 1 components delivered
- Amp 2 components in procurement or delivered (diode chiller outstanding)
- Amp 1 mechanical assembly tested
- Amp 1 diode plumbing, wiring and interlocking under way

LASER

Measured from error signal

$$Jitter_{pk-pk} = 733\,fs$$

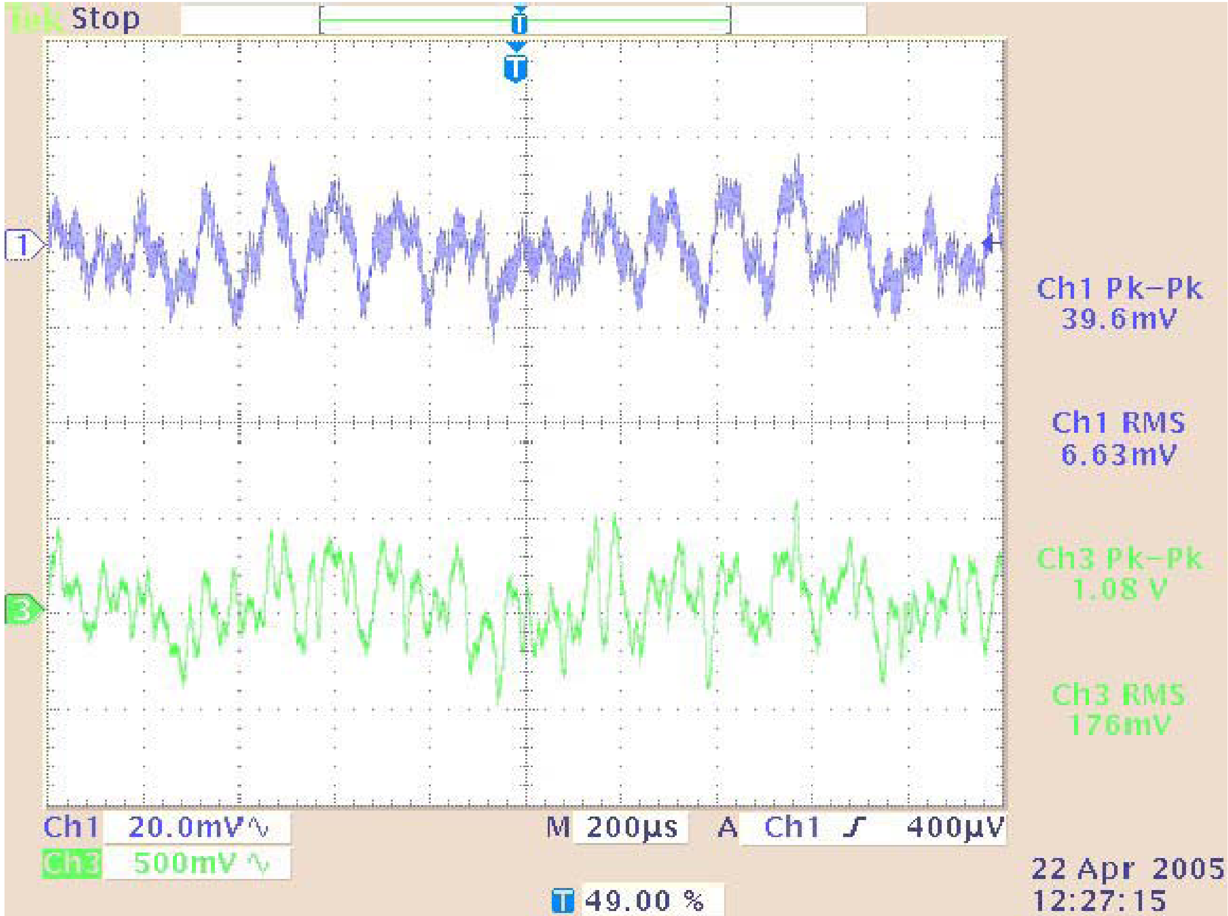
$$Jitter_{rms} = 122.8\,fs$$

Measured with Xcorrelation

$$Jitter_{pk-pk} = 771\,fs$$

$$Jitter_{rms} = 125.7\,fs$$

Optical and electronic phase stability measurements



Summary and Issues

SUMMARY

- Oscillator and preamplifier commissioned
- Power Amplifier 1 under test and most Amplifier 2 components either delivered or in procurement
- Gating, coding and stabilisation subsystems planned and in pre-procurement or procurement
- HG crystals ordered and thermal lensing compensation begun
- Control and interfacing under development

ISSUES

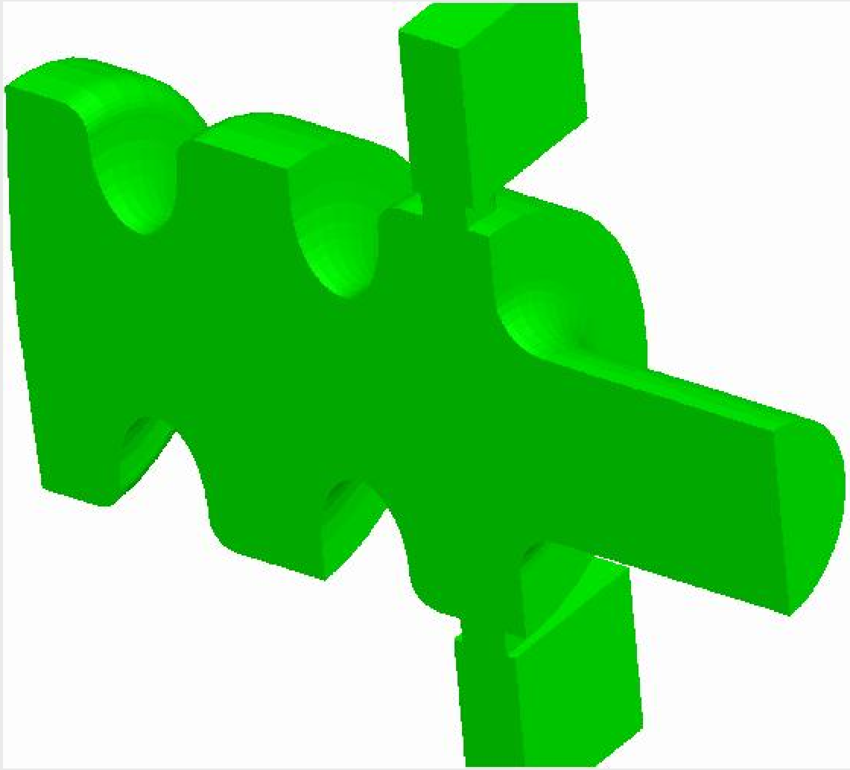
- Stabilisation control architecture to be decided
- Stabilisation system may need optimising in final environment
- Tight procurement will be needed to maintain delivery date
- Recovery of coding system losses

RF Gun

- **Design inspired to CTF2 Gun type IV, but ended on a completely new gun.**
- **Optimization for higher charge, lower emittance, lowest possible vacuum level ($2 \cdot 10^{-10}$ mbar)**

RF Gun

- Next step: 3D Simulations with HFSS

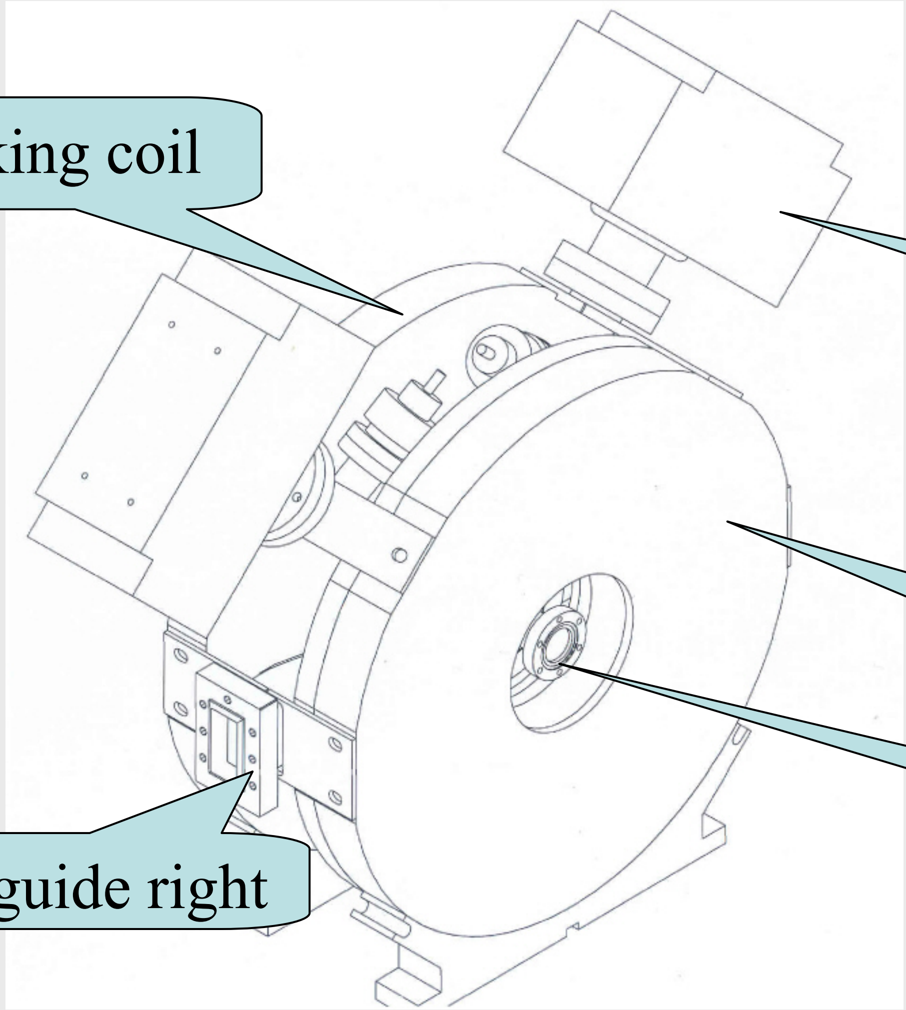


- Two symmetric couplers to reduce transverse kick
- Overcoupled (β=2.9) to match the beam.
- 30 MW are needed to compensate beam loading

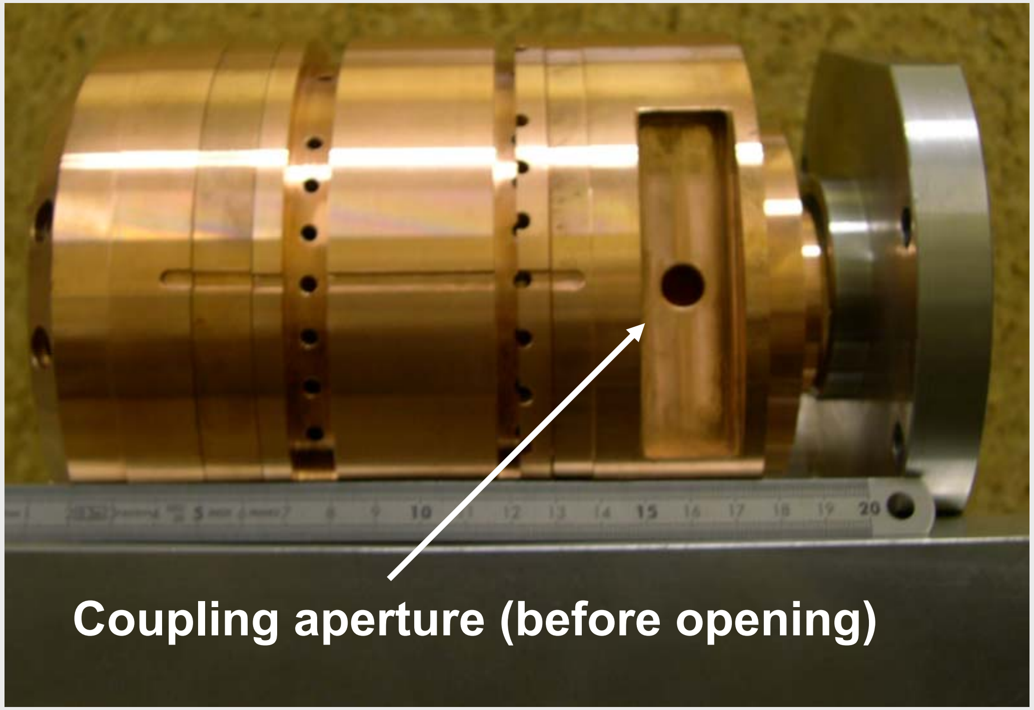
Fabrication of a photo-injector for the CTF3 accelerator and for the NEPAL test stand

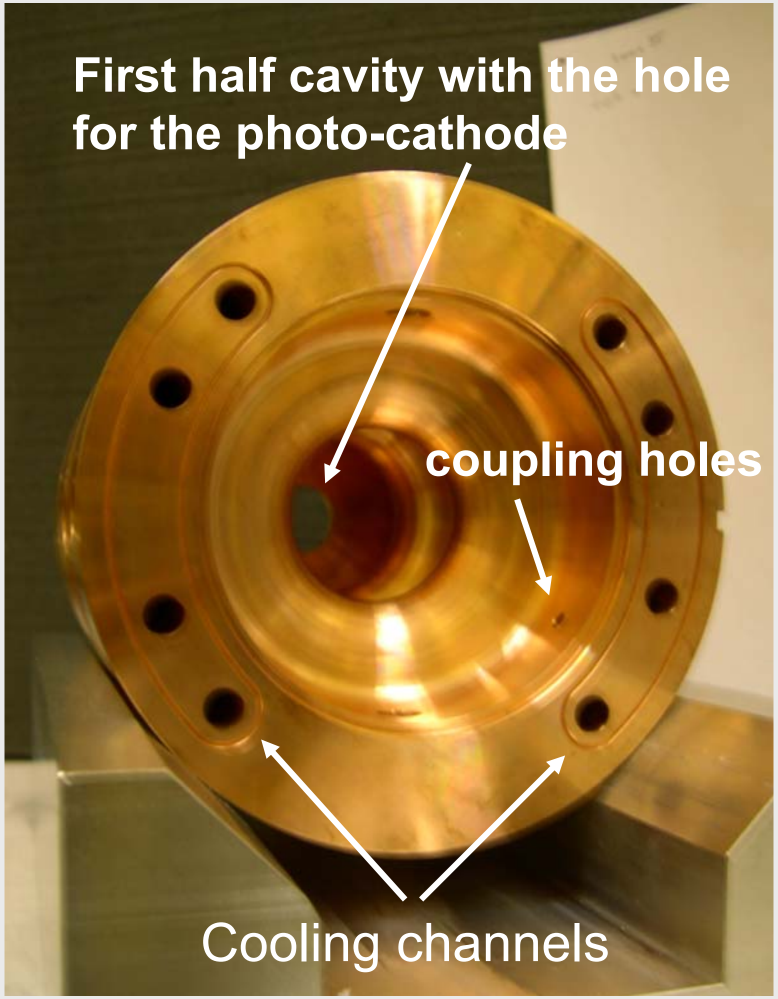
SERA

PHIN



3 GHz RF Gun prototype





SERA

Construction of a cold model to valid RF simulations

PHIN

Ordered in March a test piece to check :

-iris profile
-roughness
-mechanical accuracy

Test cavity received in April

Iris profile not satisfying, another item O.K.

- **Several tries later, order in beginning of June, foreseen delay: 8 W**

- **Last piece received in November 4** th

(the firm begins (we suspect) the work only in October)

- Checking at LAL:

general accuracy: 5 μm, roughness: < 0,4 μmRa , iris profile O.K.

SERA

PHIN

Status of the construction of the NEPAL beam line

Laser :

Ordered in July

Expected at LAL in the end of this year

Preparation chamber :

In progress in the LAL workshop

Beam-line :

A possible design exist

A lot of drawing elements are readies

The final studies are in expectation (lack of manpower)

Present status of the Rossendorf Superconducting RF Photo injector development

Rossendorf SRF Photo Gun Parameters

Normal-conducting cathode inside SC cavity

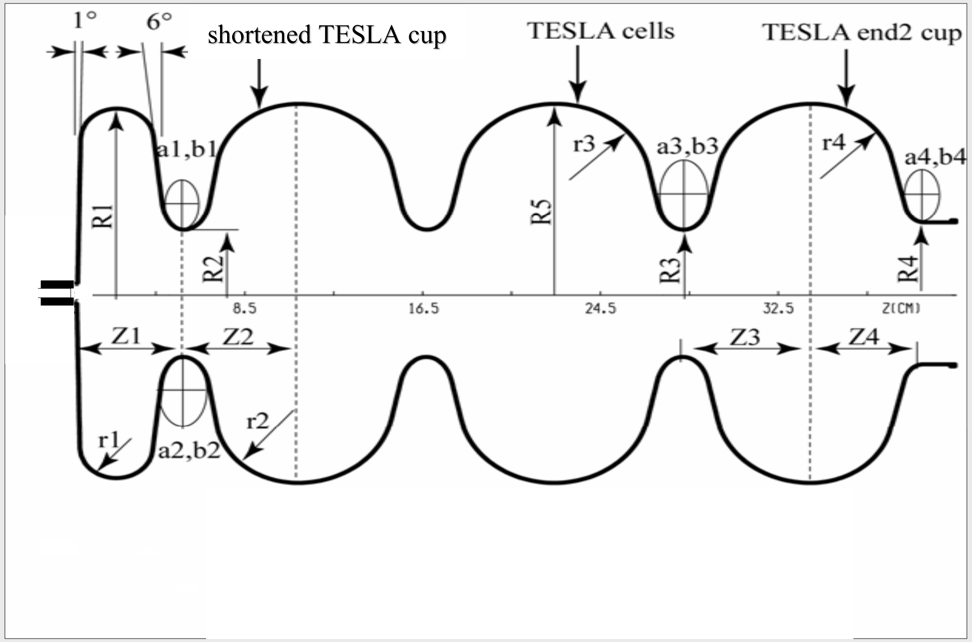
Cavity:	Niobium 3+½ cell (TESLA Geometry)
	Choke filter
Operation:	T = 1.8 K
HF frequency:	1.3 GHz
HF power:	10 kW
Electron energy:	9.5 MeV
Average current:	1 mA
Cathode:	Cs_2Te
	thermally insulated, LN_2 cooled
Laser:	262 nm, 1W

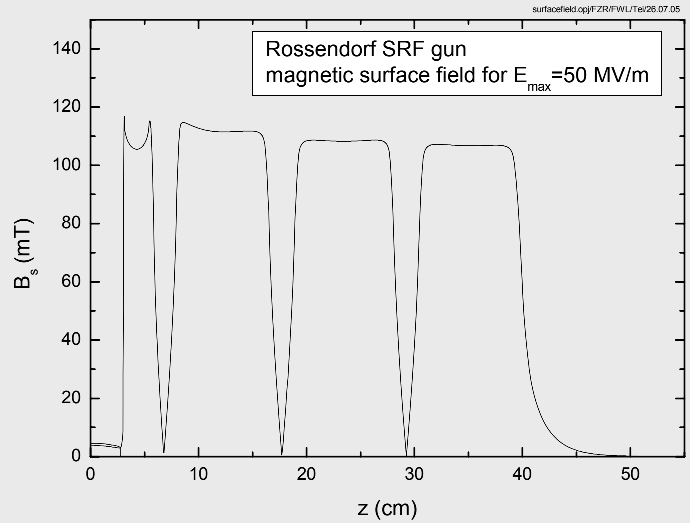
Rossendorf SRF Photo Gun Parameters

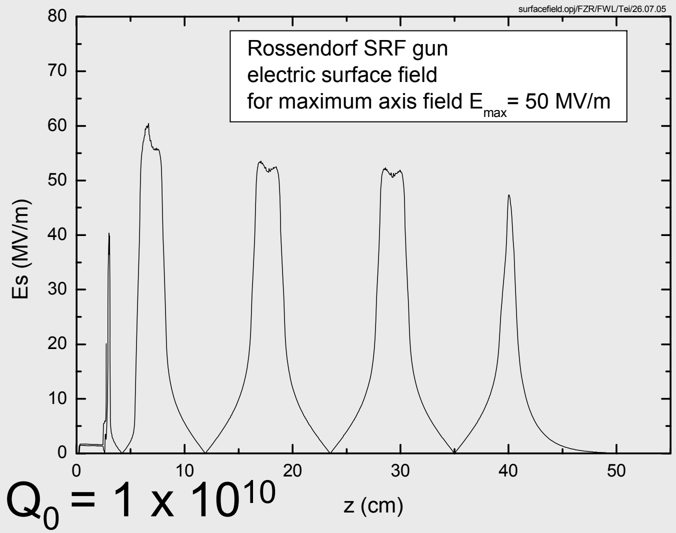
Planned Operation Modes and Beam Parameters

	ELBE	High Charge	BESSY-FEL
Pulse Frequency	13 MHz	≤1 MHz	1 kHz
Bunch Charge	77 pC	1 nC	2.5 nC
Bunch Length (FWHM)	5 ps	20 ps	50 ps
Peak Current	15.4 A	50 A	125 A
Average Current	1.0 mA	≤1 mA	2.5 µA
Norm trans. Emittance_N (rms)	1.5 µm	2.5 µm	3 µm

Rossendorf SRF Photogun
3 ½ Cell Cavity Design







1. 3 GHz, 10 kW
optimized half cell & 3 TESLA cells
$E_{z,max}$= 50 MV/m (TESLA cells)
= 32 MV/m (1/2 cell)

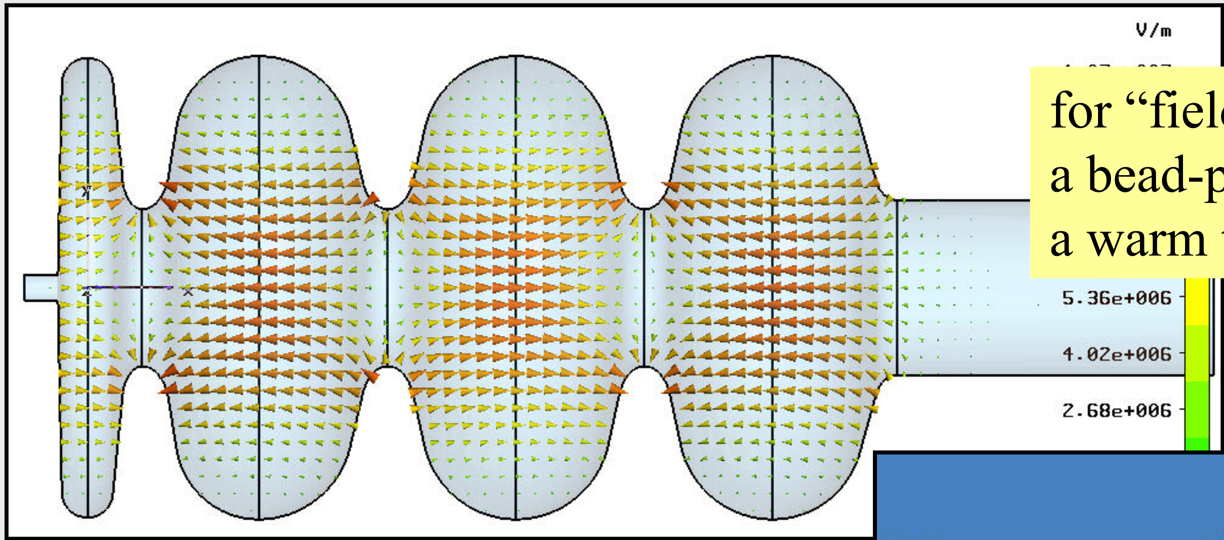
TESLA 500 specification, i.e. E_{acc} = 25 MV/m and Q_0 = 1 x 10^{10}

Rossendorf SRF Gun - 3½ Cell Niobium Cavity

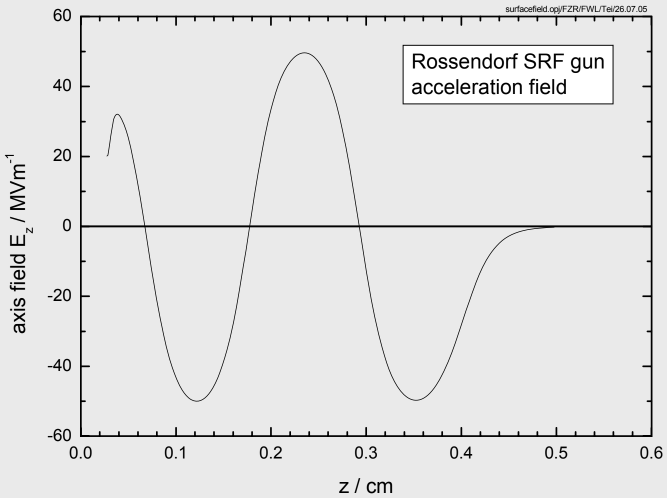
Niobium RRR 300 (RRR 40)
total length:
cell diameter:
NbTi flanges
3 TESLA shape cells
cathode half-cell with 12 mm hole
beam tube:
flange for 10 kW power coupler
2 HOM couplers (TESLA type)
1 pick-up
cathode side:
choke filter with pick-up
two tuners:

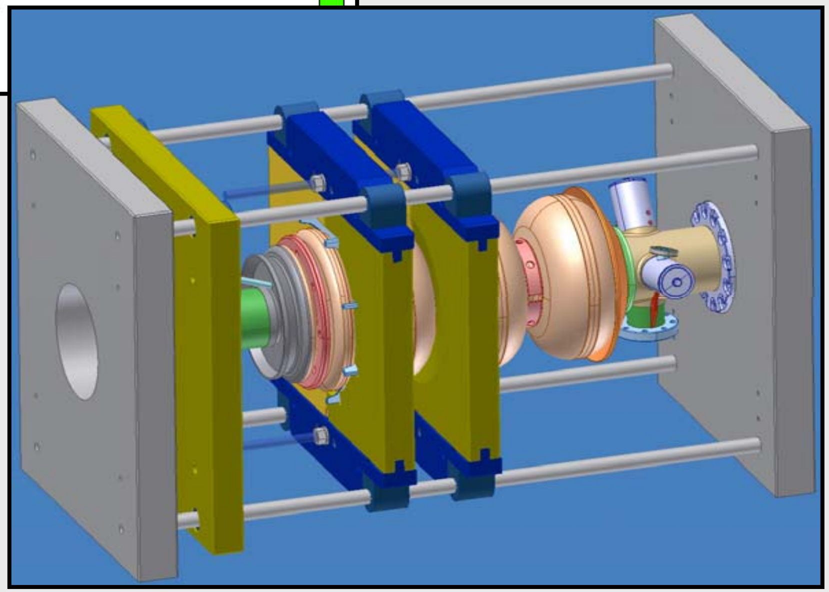
- half-cell tuner
- TESLA cells tuner

Rossendorf SRF Gun – Cavity warm tuning

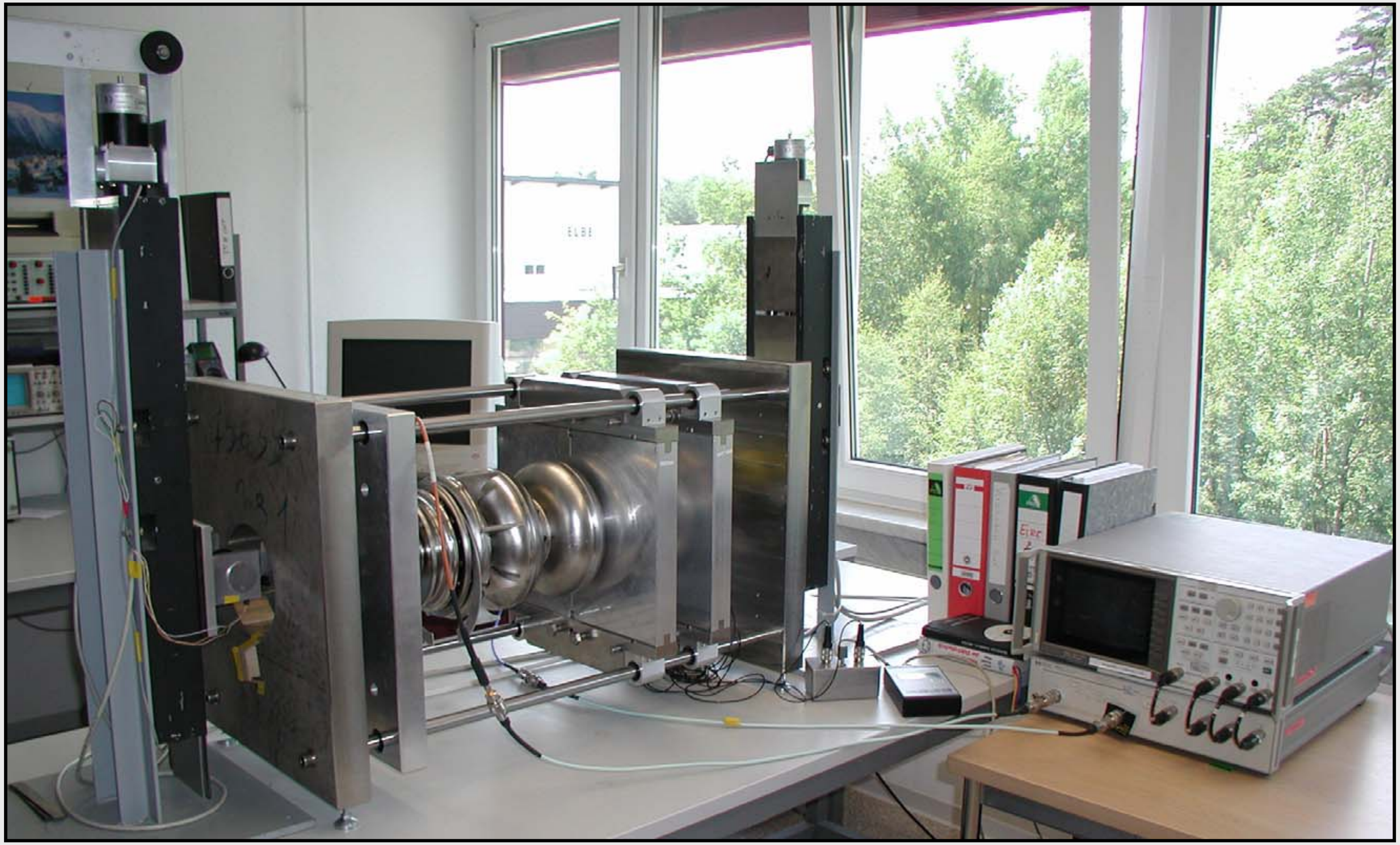


for "field flatness" tuning
a bead-pull machine and
a warm tuning apparatus was built

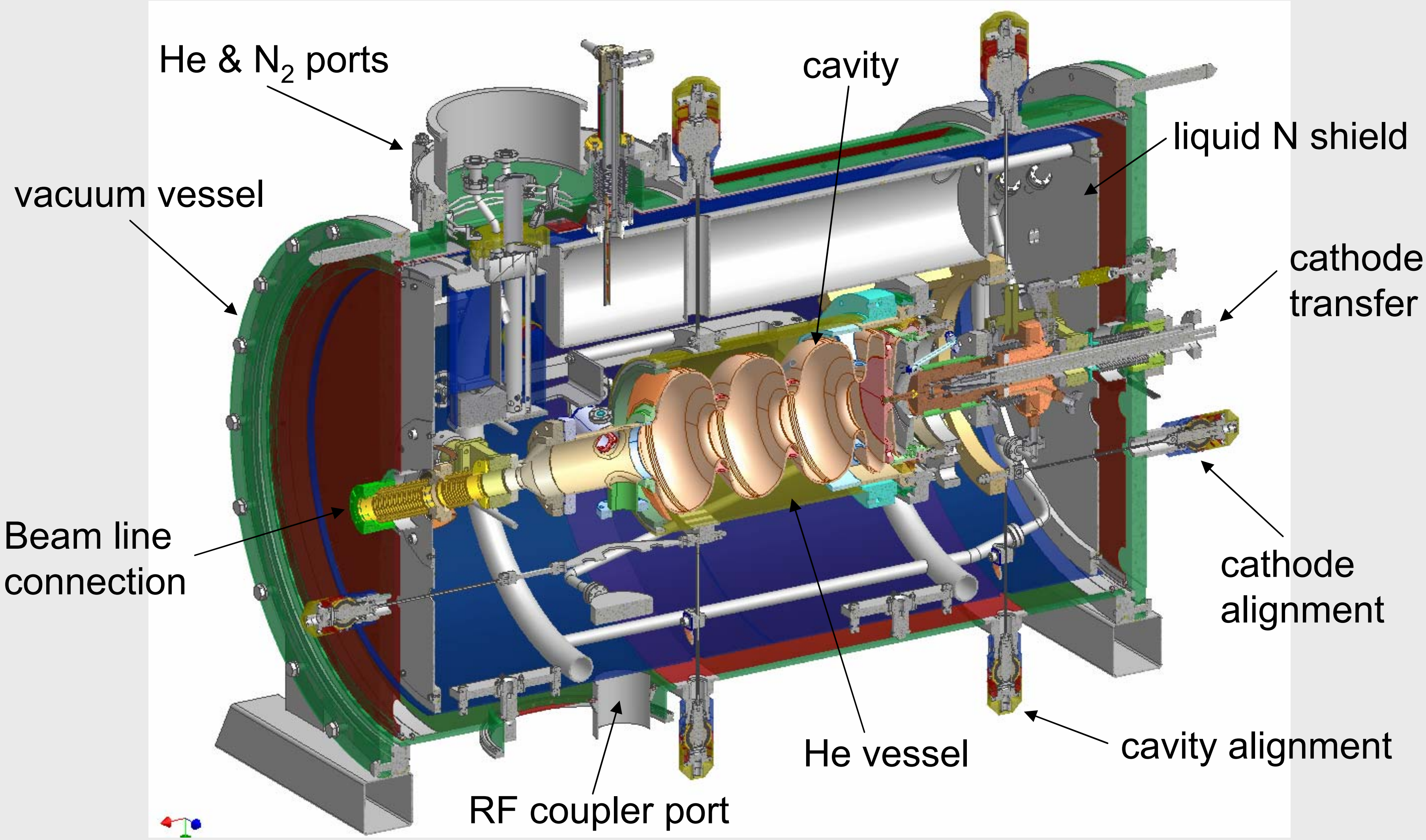




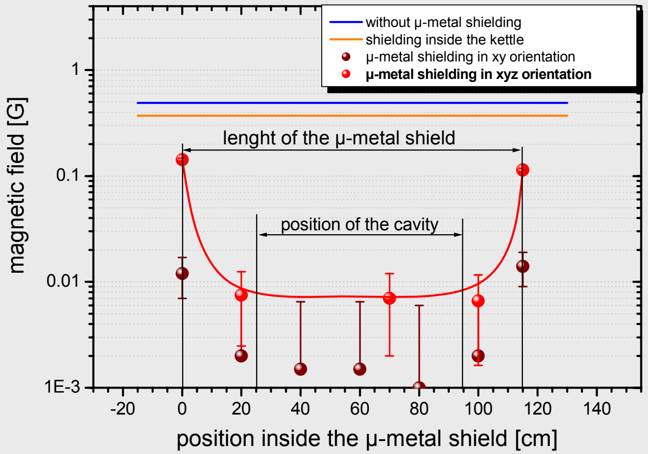
Rossendorf SRF Gun – Cavity warm tuning



Rossendorf 3½ Cell SRF Gun – Cryomodule design

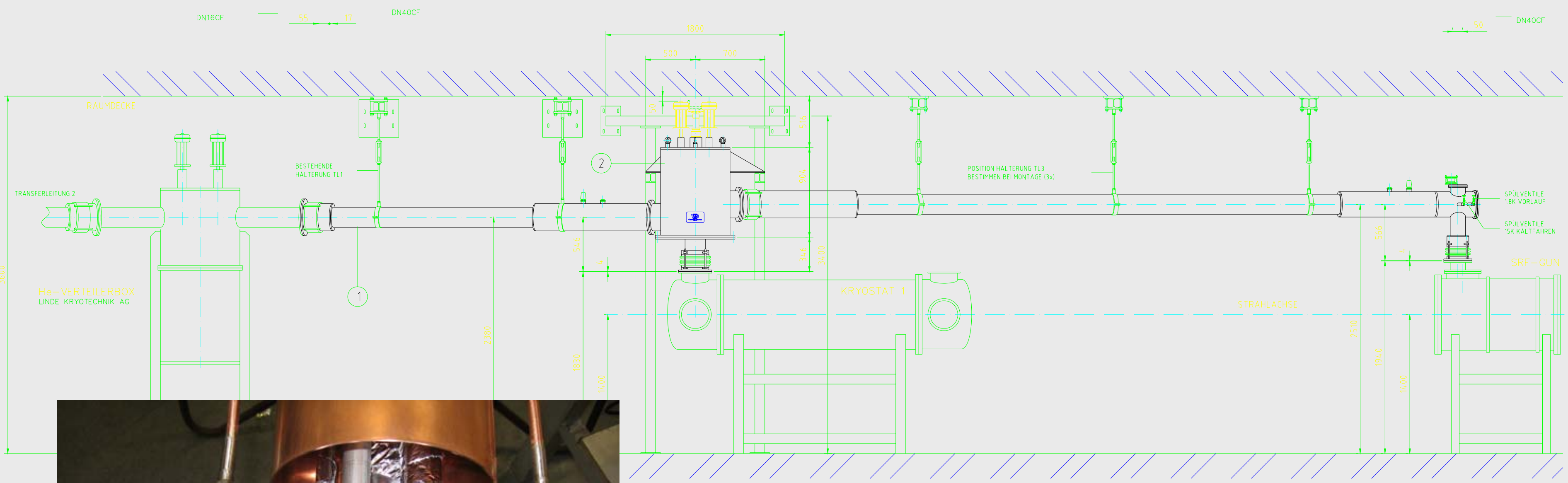


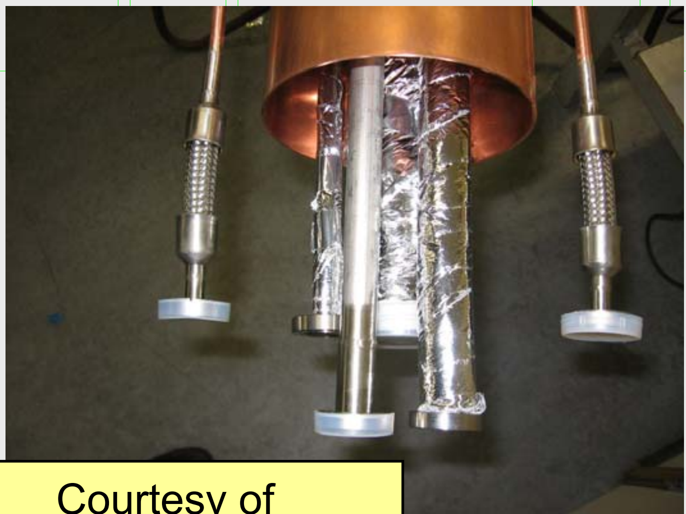
Rossendorf 3½ Cell SRF Gun – Cryomodule



Main parts have been delivered:
- vacuum vessel
- magnetic shield
- liquid N_2 shield

Helium Transfer Line and Distribution Box



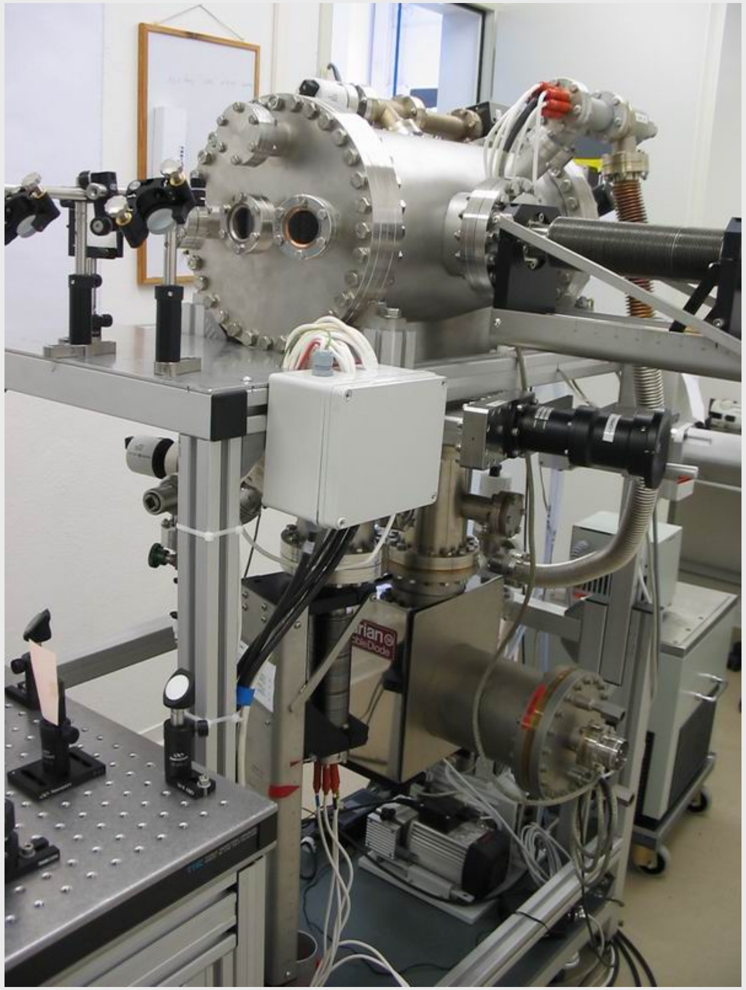


Courtesy of
Vacuüm Specials B.V.

the SRF gun cryostat will be connected
to the ELBE He cryoplant (220 W @ 1.8 K)

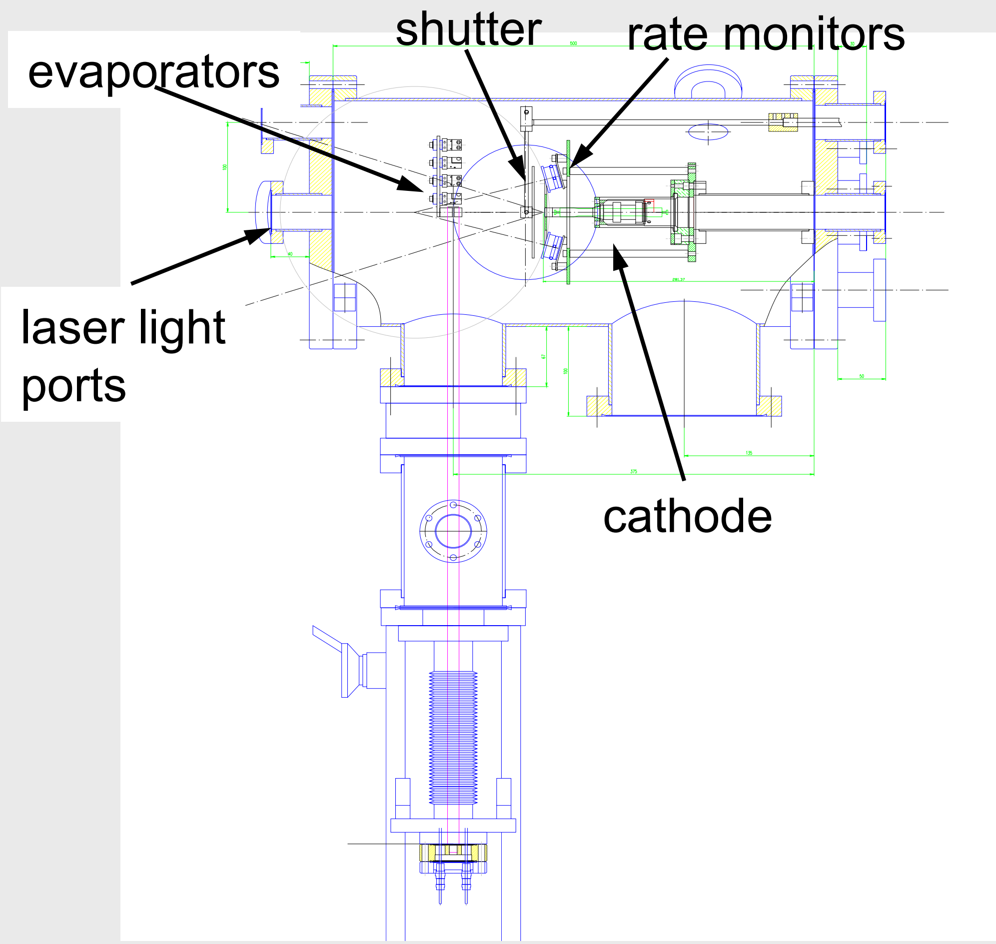
The 13 m long transfer line (1.8 K He & gas return) and the distribution box are ordered, will be installed in Dec./Jan. shut-down.

Preparation Chamber



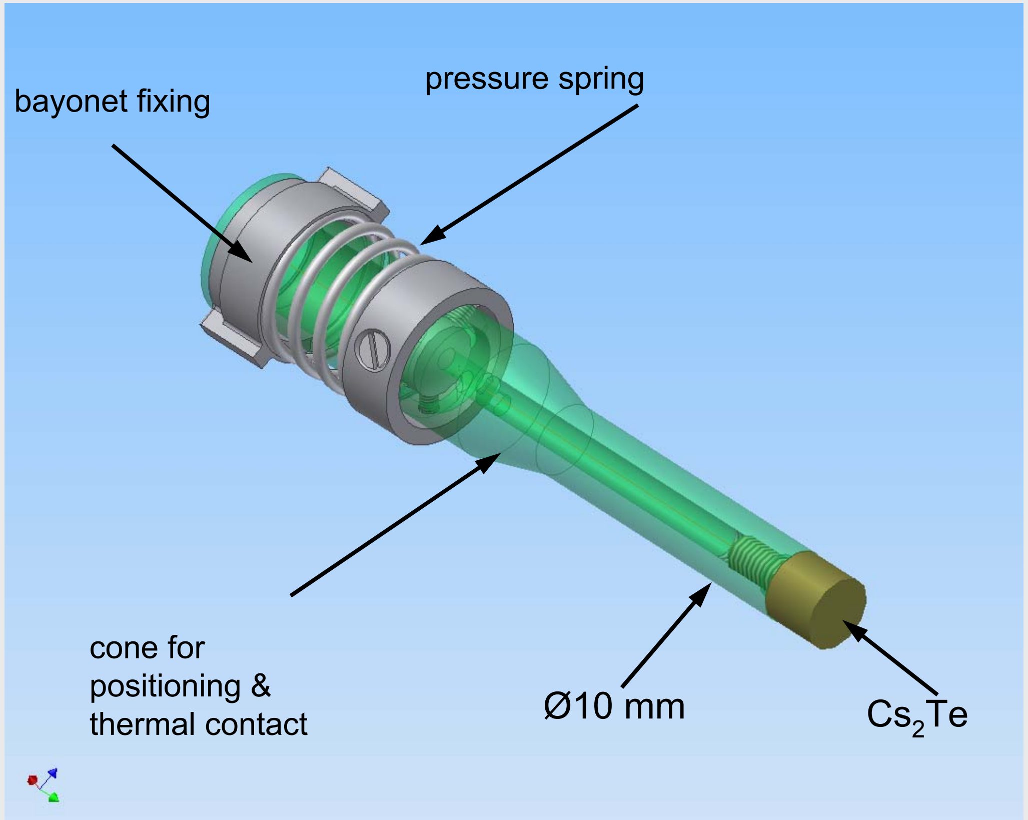
- ✓ Design
- ✓ Manufacture
- ✓ First test, optimize
- ✓ Clean room building
- o Clean
- • Assemble
- • Experiment
- • Production (July 2006)

Preparation System



- Ultra high vacuum ($10^{-11} \sim 10^{-9}$ mbar)
- Cathode holding
  - Halogen-light heating
  - Ion-beam cleaning
- Co-evaporation of Te and Cs
- Measurement of quantum efficiency
  - QE during deposition
  - Life time
  - Distribution scan

Cathode plug



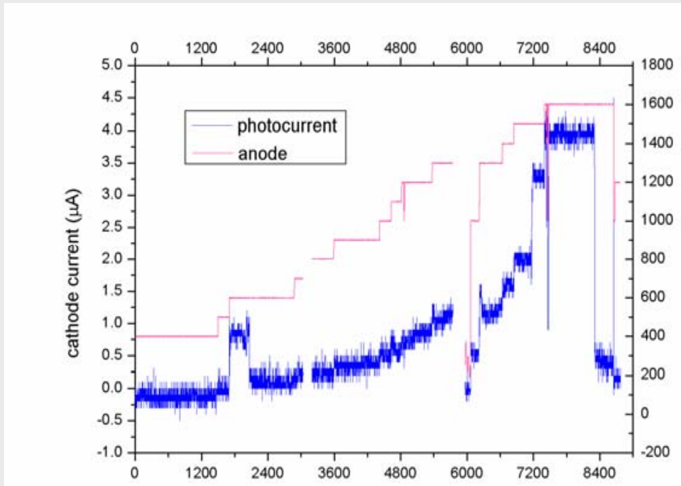
Cathode plugs are made of Cu or Mo

Manual Polishing result:
average roughness: 17.2 nm

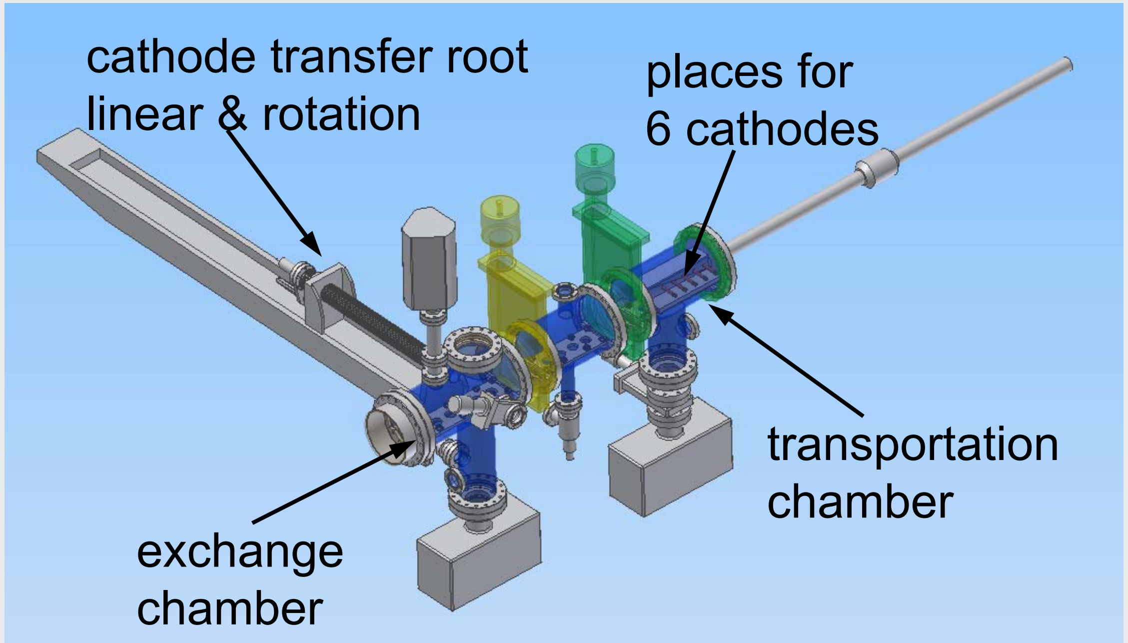
(analyzed by Dektak8 profiler)

First test in new chamber

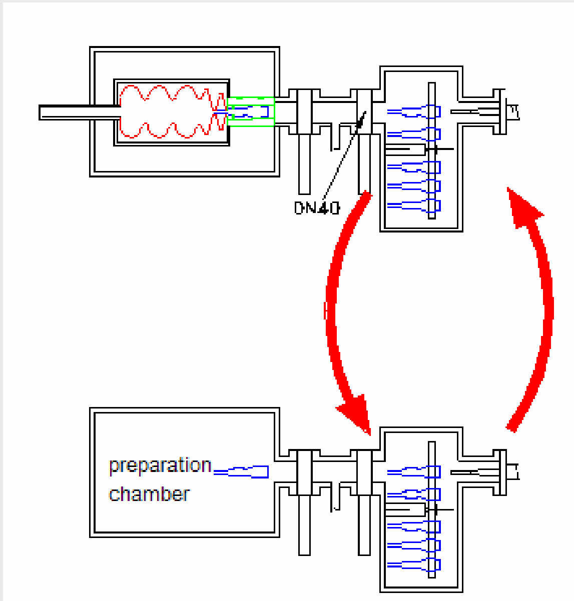
No.	Sub.	Thick. Te	Thick. Cs	Cs/Te	
				PIXE	RBS
#05-05-31	Cu	10 nm	20 nm	0.55	0.44
#05-06-16	Cu	10 nm	68 nm	\	1.9
#05-06-22	Si	10 nm	70 nm	1.6	\
#05-06-23	Si	10 nm	46 nm	0.8	0.8



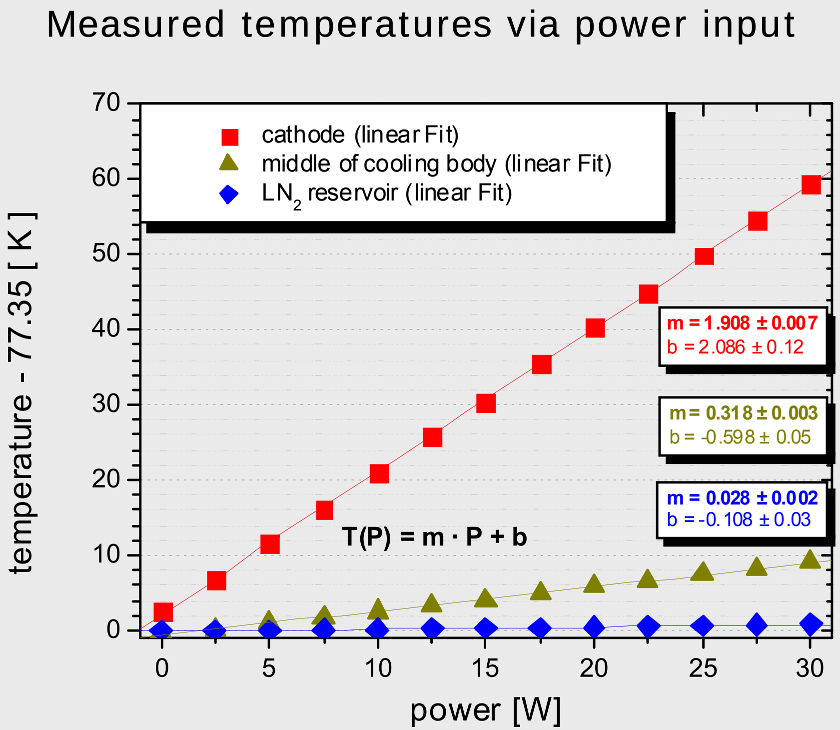
Transport Chamber



- ✓ **Design**
- ✓ **Manufacture**
- o **First test, optimize**
- • **Clean**
- • **Assemble**



Test of the cathode cooling system



30 W power input to the photo cathode burdens the cavity with only 31 mW.

(F. Staufenbiel, et al., SRF2005)

Last year progress in laser pulse shaping at INFN-Milano

Introduction

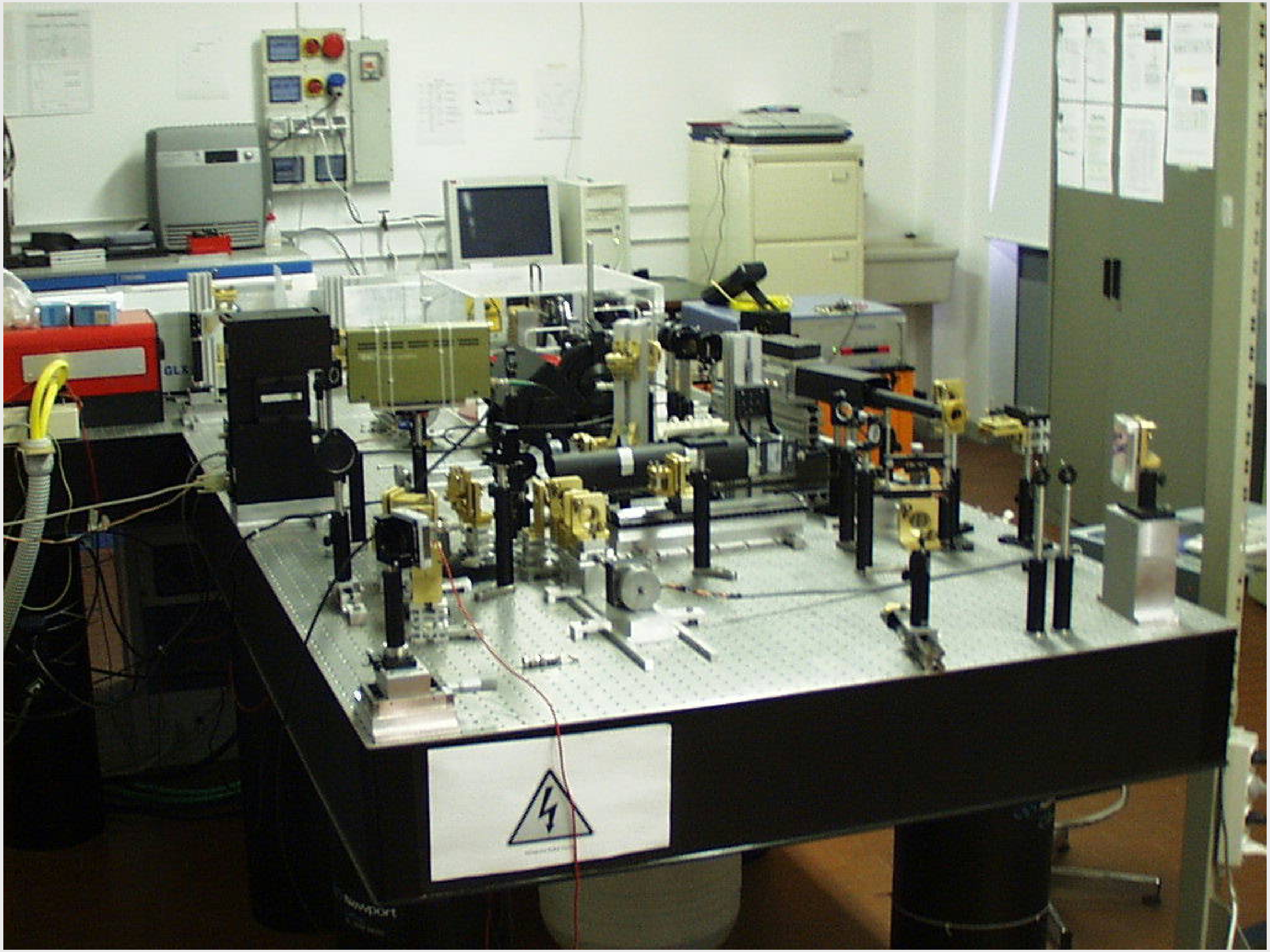
Since the last meeting

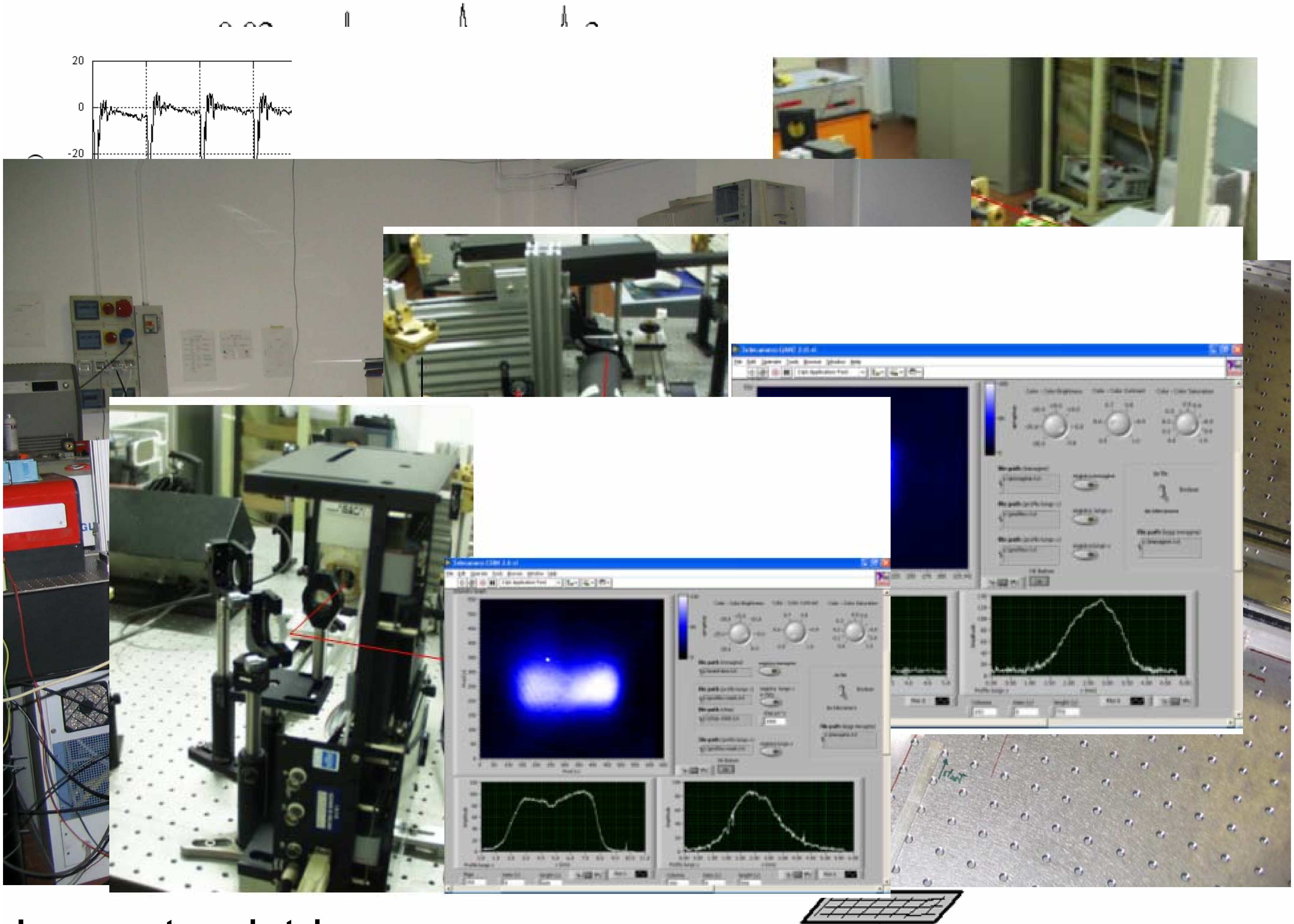
- We built a laser system in Milano for the generation of target pulse waveforms
  - Nd-YAG laser souce
  - Diagnostic tools
  - Feedback loop with LCM-SLM to obtain automatically the target pulse waveforms

- Physics and relevant simulation program of pulse temporal profile modulation in 2° and 3° harmonic generation
  - Positive experimental test in SPARC-frascati lab. of the theoretical work

The Milano laser system

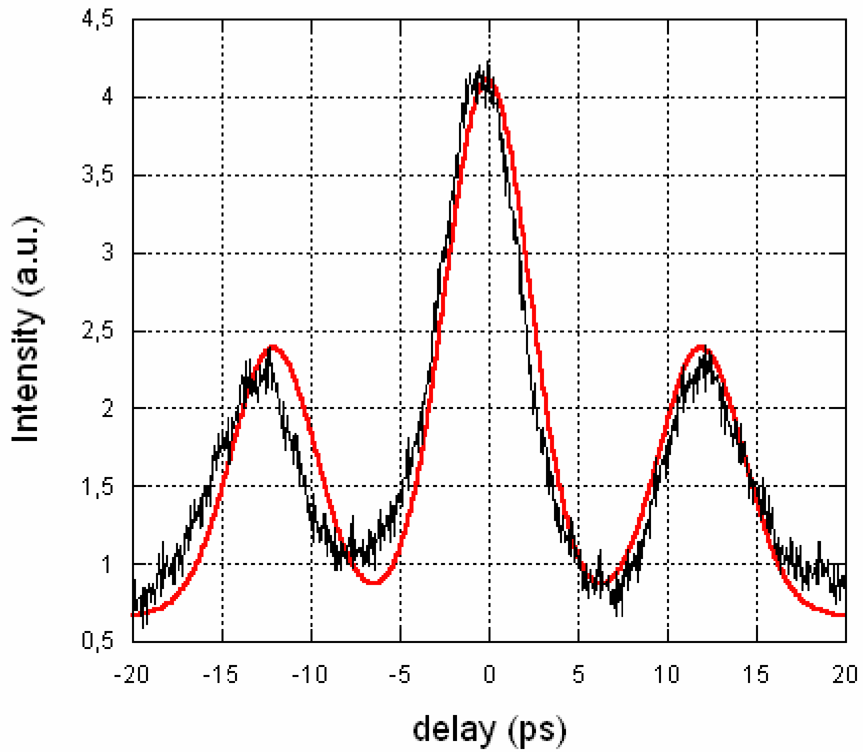
laser diagnostics

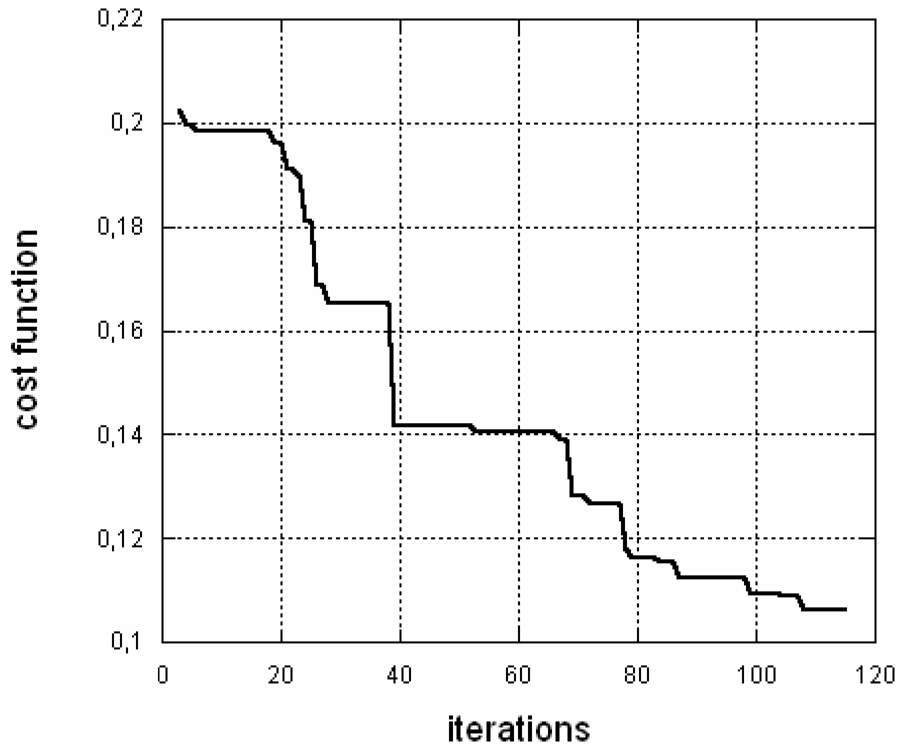




Laser system sketch

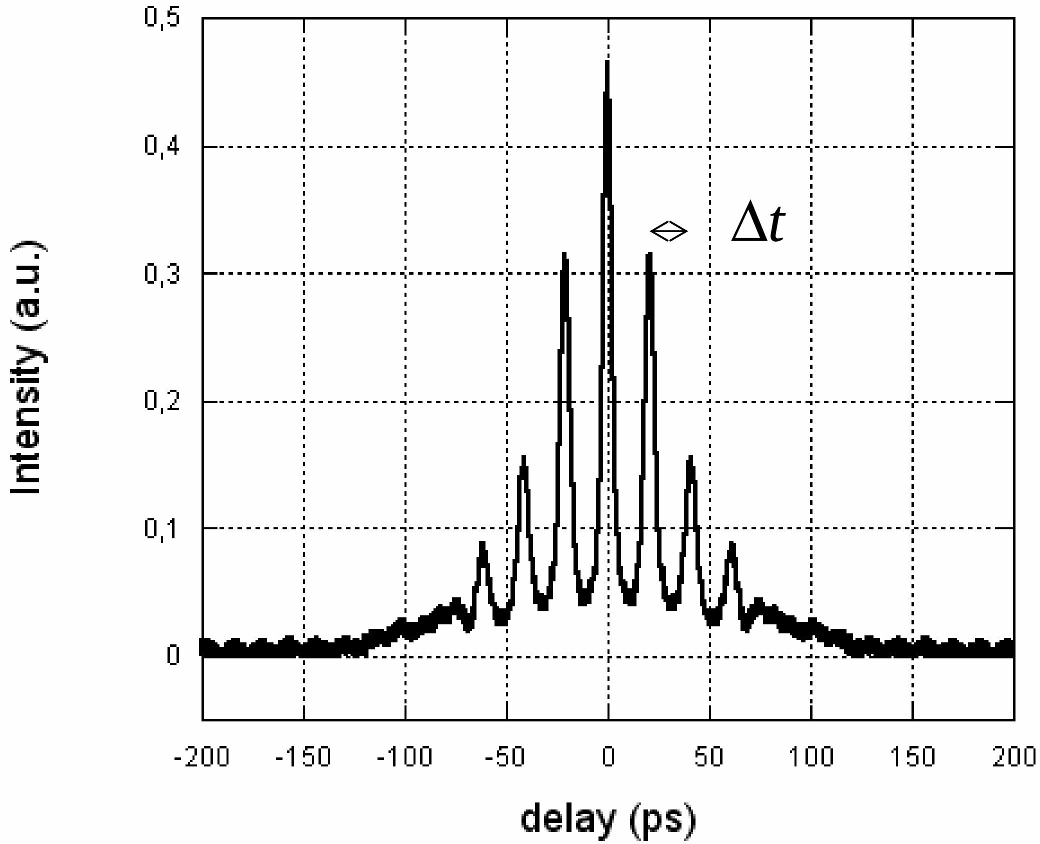
Two pulses

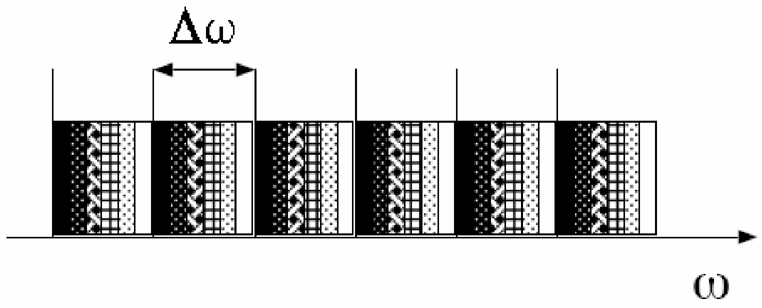




$$\Phi_{RND} = \frac{1}{2}\alpha_{RND}\omega^2 + RND(\omega)$$

Pulse train





$$\Delta t = \frac{2\pi}{\Delta \omega}$$

Pulse shaping with harmonics

- We have developed the theory of pulse shaping within non-linear crystals for the hamonics generation: "Rectangular pulse formation in a laser harmonic generation", S.Cialdi, F. Castelli, I. Boscolo, Report INFN-BE-05-1 (2005) in press on the Appl. Phys. B

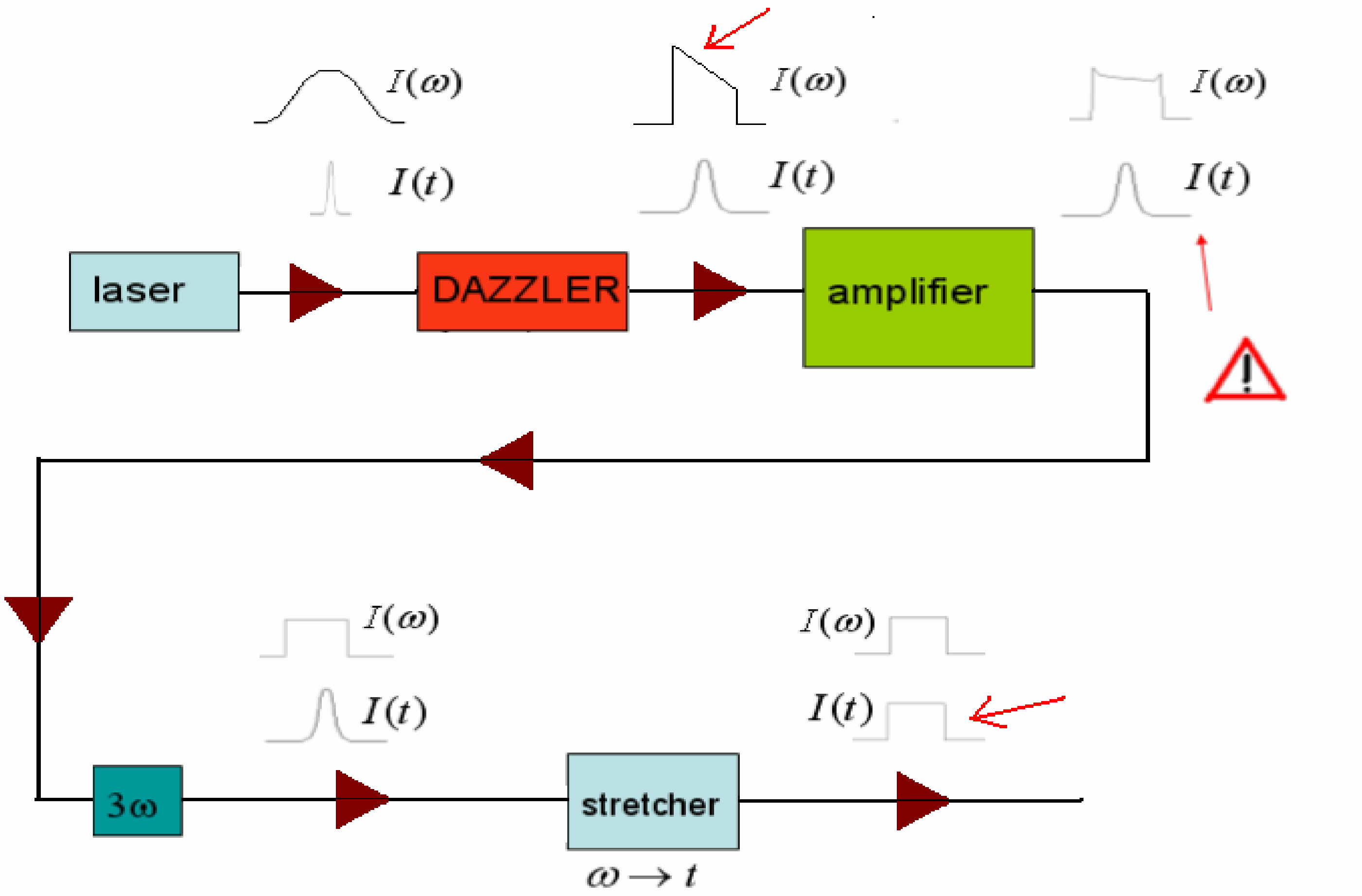
- The theory has been applied and positively tested at the SPARC apparatus in Frascati

- The relative simulation program developed in Milano have shown to be very useful for achieving experimentally the searched pulse waveform

- The high resolution spectrum analyzer developed in Milano has been reproduced in Frascati and has shown to be efficient for our needs

Pulse shaping at harmonics

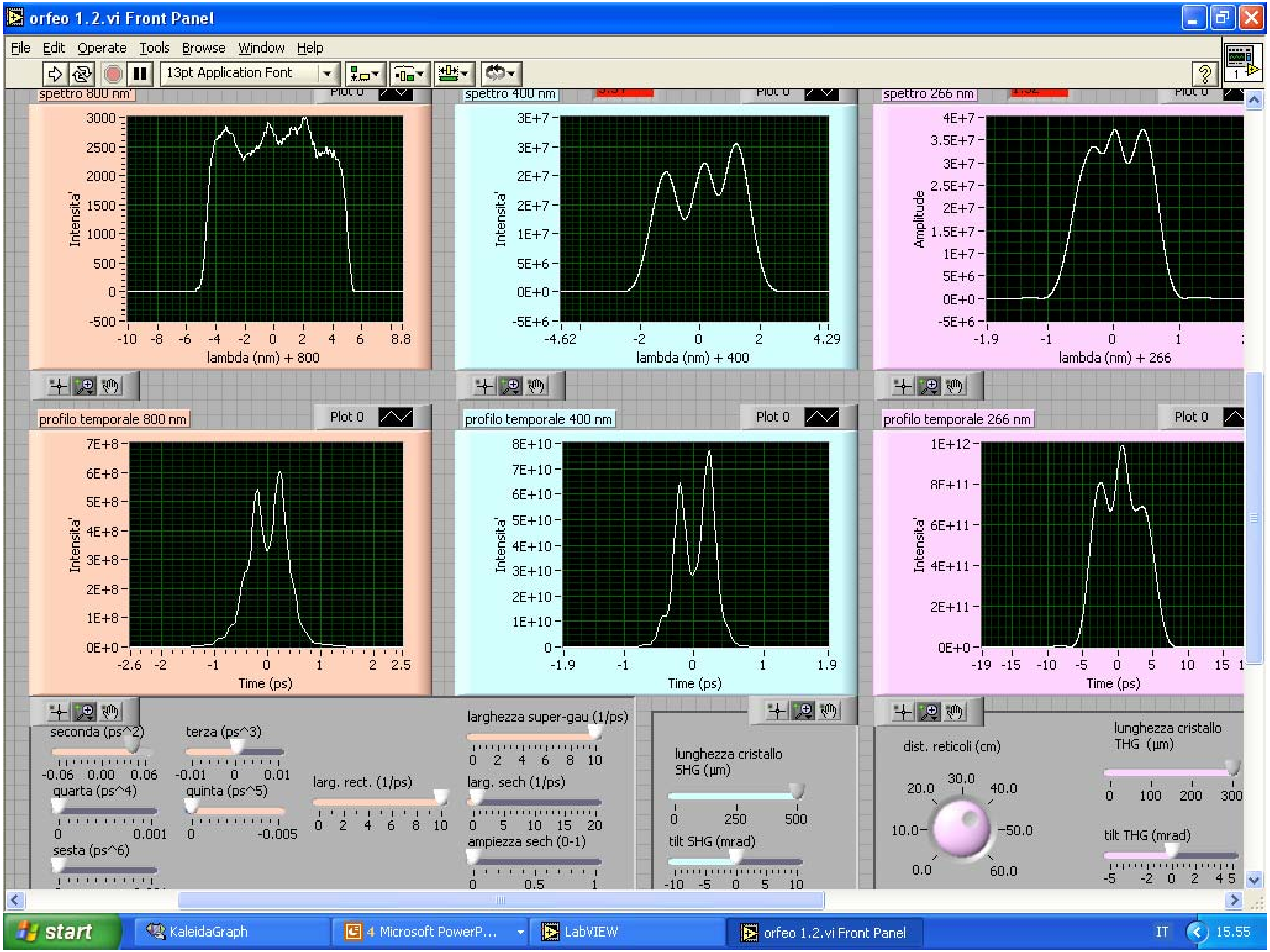
at SPARC laser system with DAZZLER



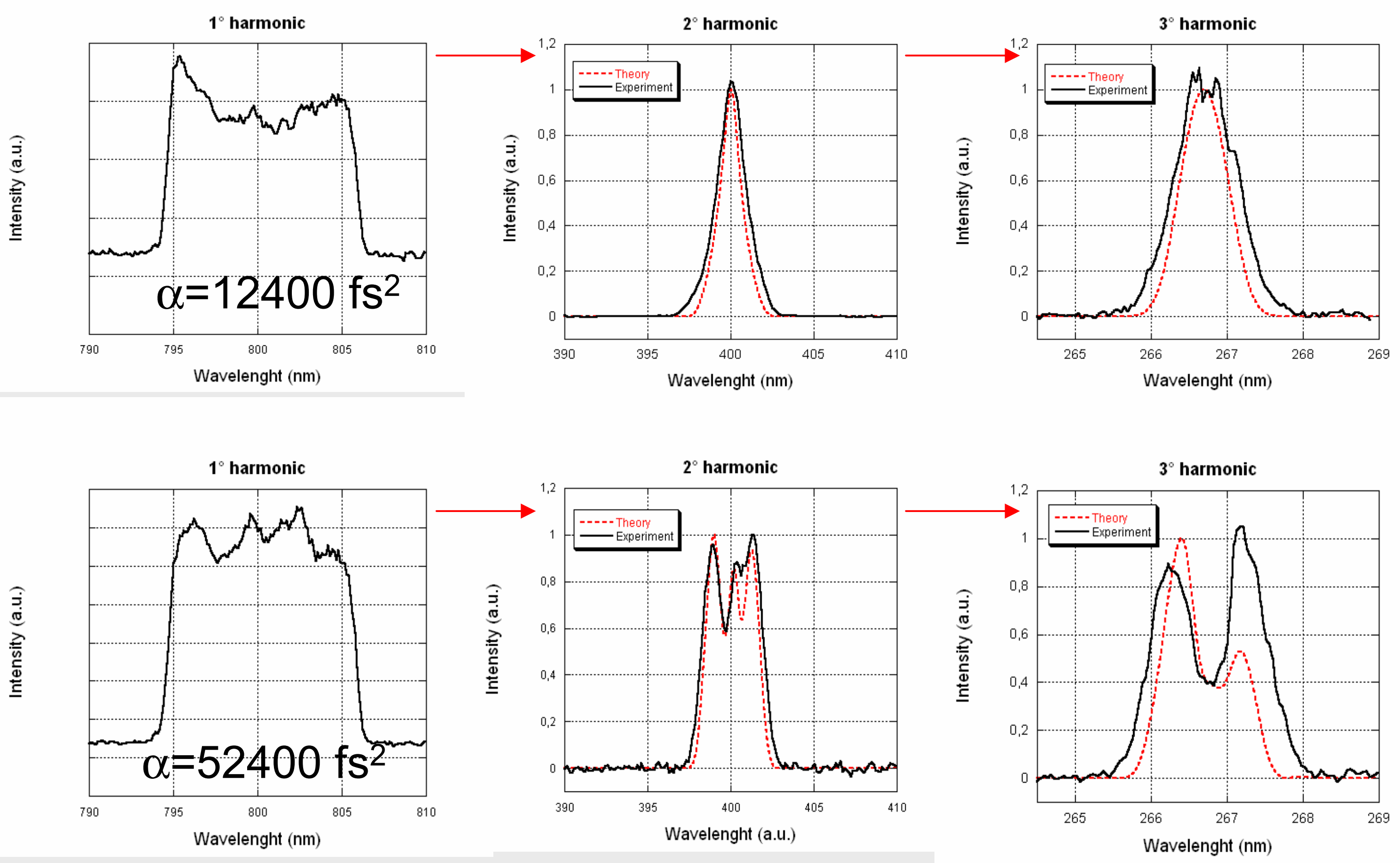
"Rectangular pulse formation in a laser harmonic generation", S.Cialdi, F. Castelli, I. Boscolo, Report INFN-BE-05-1 (2005) in press on the Appl. Phys. B

"A shaper for providing long laser waveforms" S. Cialdi, I. Boscolo, Nuc. Inst. Meth. A 538, 1-3 (2005) 1-7

$$I(t) \propto \left| \int A(\omega) \cdot e^{i\frac{1}{2}\alpha\omega^2} \cdot e^{-i\omega \cdot t} d\omega \right|^2 \approx \left| \int A(\omega) \cdot \delta\left(\omega - \frac{t}{\alpha}\right) d\omega \right|^2 = \tilde{I}(\omega(t))$$


orfeo 1.2.vi Front Panel
File Edit Operate Tools Browse Window Help
13pt Application Font
spettro 800 nm
Intensita'
lambda (nm) + 800
spettro 400 nm
Intensita'
lambda (nm) + 400
spettro 266 nm
Amplitude
lambda (nm) + 266
profilo temporale 800 nm
Plot 0
Intensita'
Time (ps)
profilo temporale 400 nm
Plot 0
Intensita'
Time (ps)
profilo temporale 266 nm
Plot 0
Intensita'
Time (ps)
seconda (ps^2)
terza (ps^3)
quarta (ps^4)
quinta (ps^5)
sesta (ps^6)
larg. rect. (1/ps)
larghezza super-gau (1/ps)
larg. sech (1/ps)
ampiezza sech (0-1)
lunghezza cristallo SHG (µm)
tilt SHG (mrad)
dist. reticoli (cm)
lunghezza cristallo THG (µm)
tilt THG (mrad)
start
KaleidaGraph
4 Microsoft PowerP...
LabVIEW
orfeo 1.2.vi Front Panel
IT
15.55

Comparison between theory and experiment

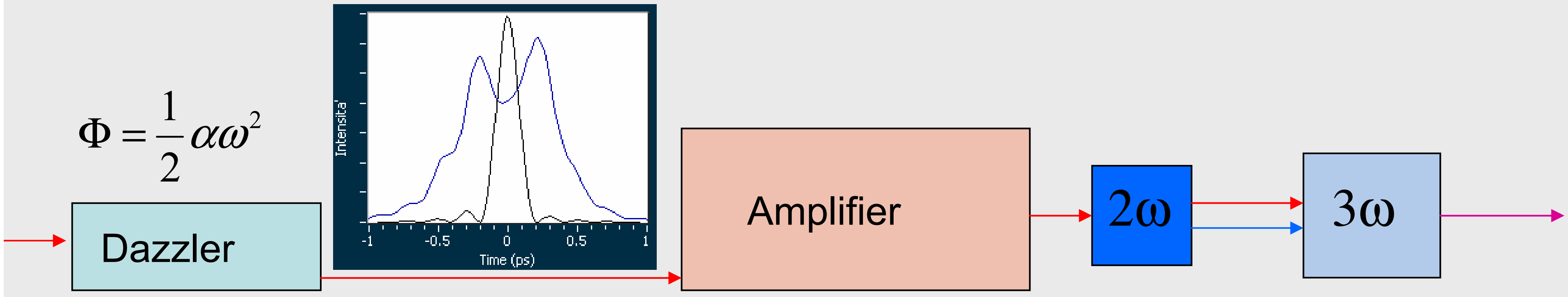


$$A_2(t) \propto A_1(t)^2$$
$$\downarrow$$
$$A_2(\omega) \propto A_1(\omega) \otimes A_1(\omega)$$

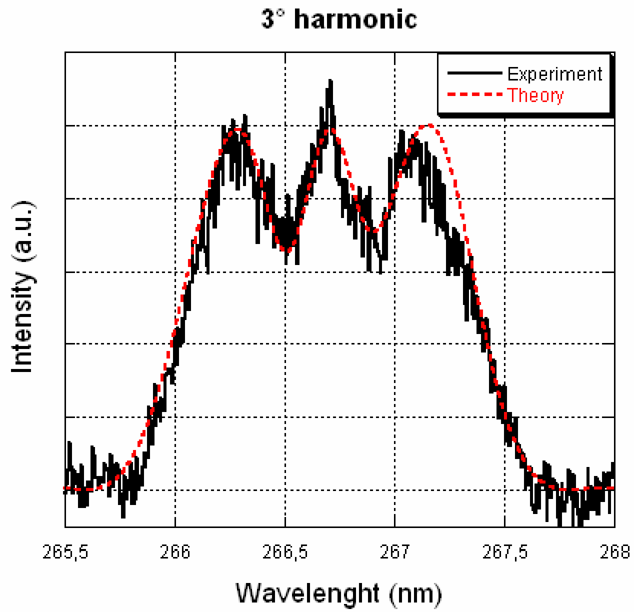
$$\alpha \rightarrow \infty$$

$$I_2(\omega) \approx I_1^{\,2}\left(\frac{\omega}{2}\right)$$

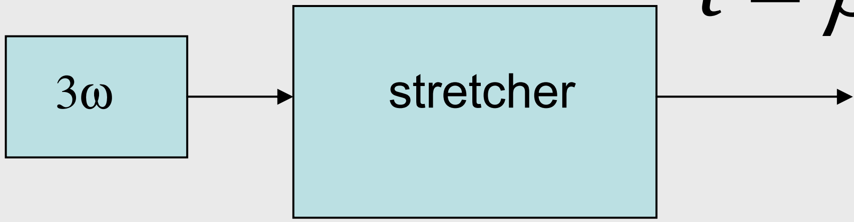
$$\Phi = \frac{1}{2}\alpha\omega^2$$



First rectangular spectrum in 3° harmonic



$$t = \beta \cdot \delta\lambda$$



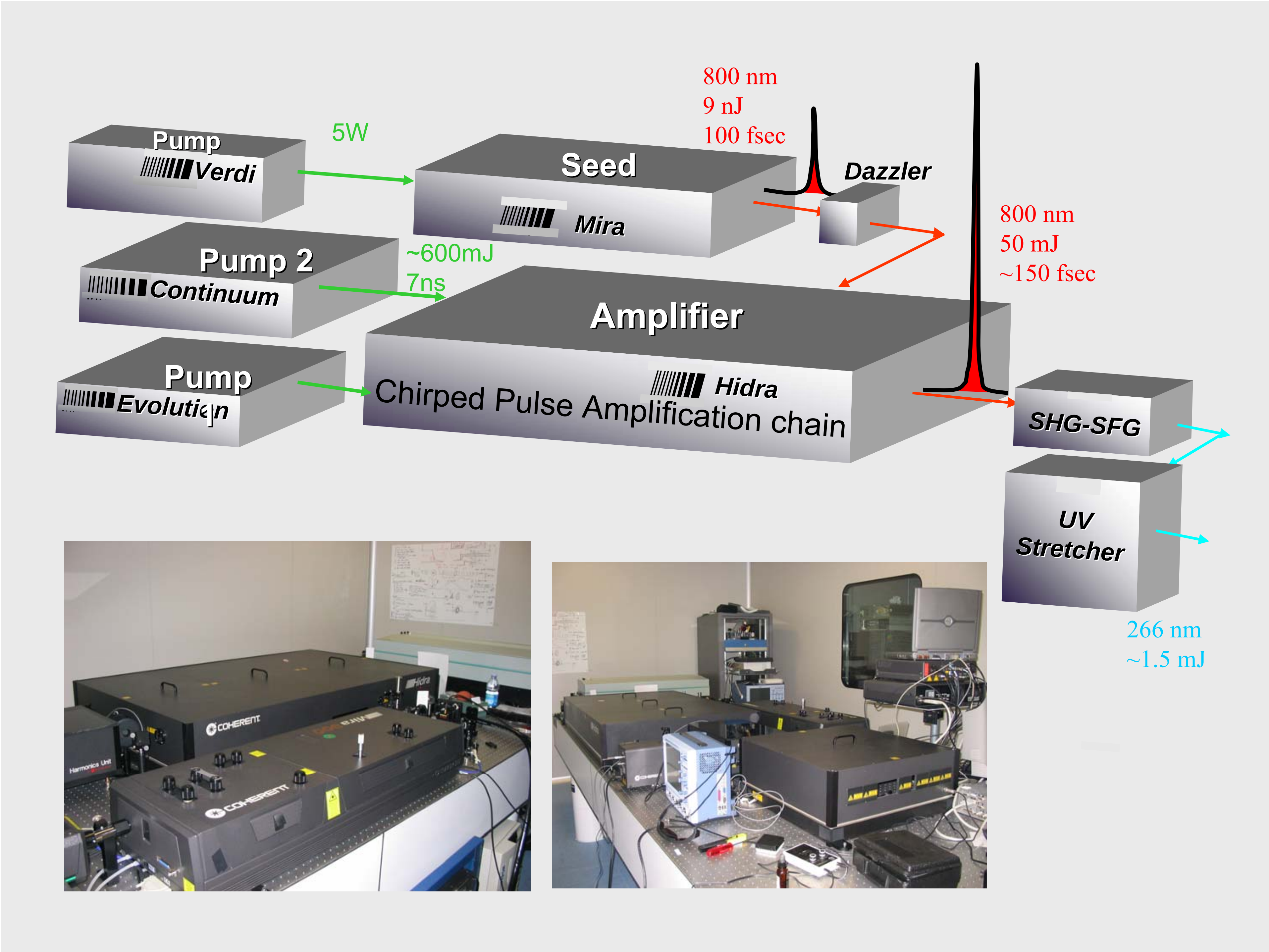
$$\tau_{rise-time} \approx 2.3\ ps$$

$\tau_{\text{rise-time}}$ (2.3 ps ⟶ 1 ps)

$\Delta\Omega_3$ > constant (t_{min} < 1ps) this is not a problem

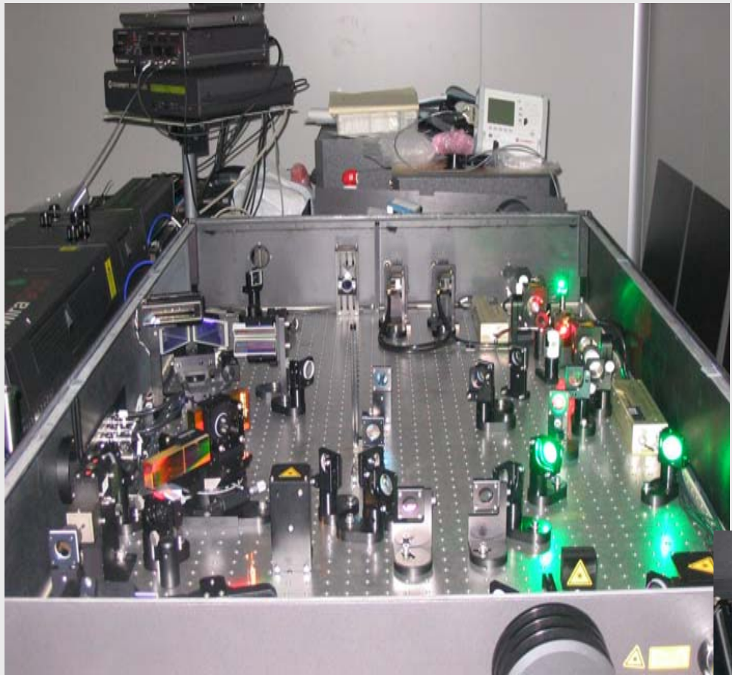
$\Delta\Omega_3 < \Delta\Omega_{crystal}$ (we have to reduce the spectrum width in 1° harmonic)

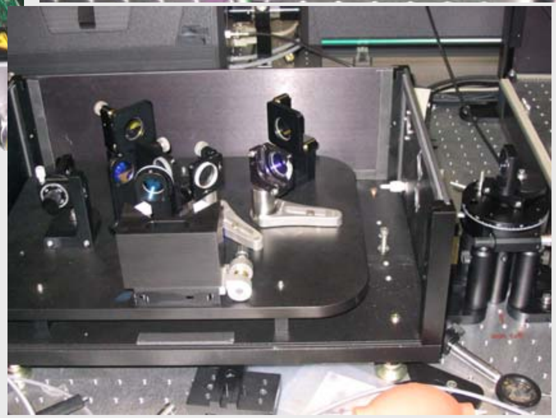
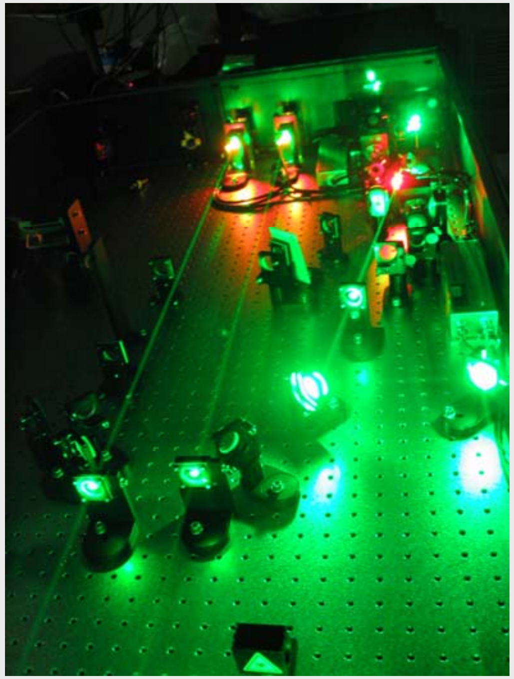
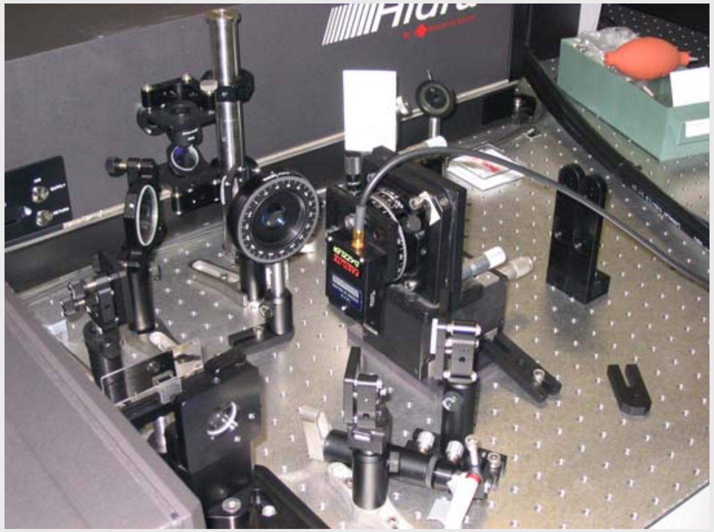
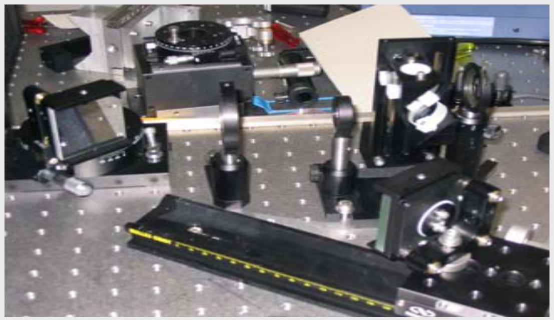
INFN SPARC laser progress


Pump
Verdi
5W
Seed
Mira
800 nm
9 nJ
100 fsec
Dazzler
Pump 2
Continuum
~600mJ
7ns
Amplifier
Hidra
Chirped Pulse Amplification chain
800 nm
50 mJ
~150 fsec
Pump
Evolution
SHG-SFG
UV
Stretcher
266 nm
~1.5 mJ
COHERENT
Harmonics Unit

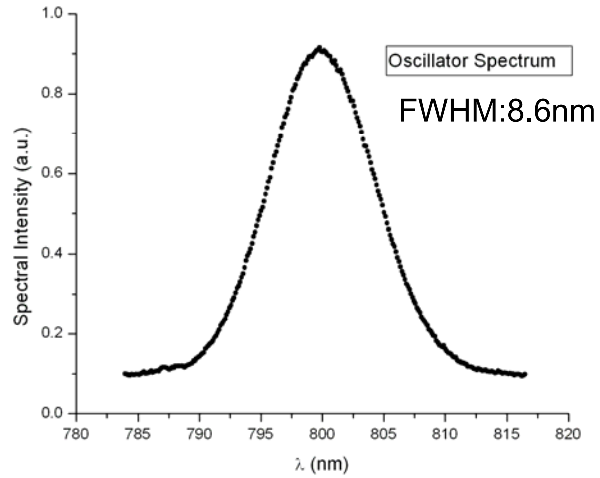
Energy & Power measurements

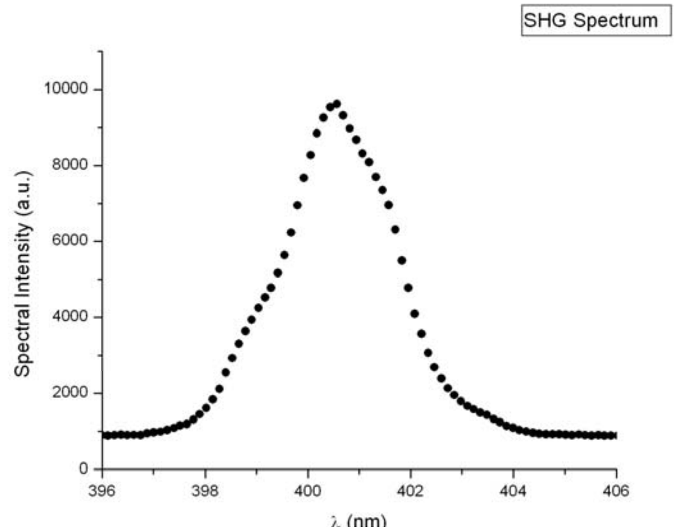
	measured value	unit
Oscillator [79,3 MHz]	>800	mW
Regen amplifier [1kHz]	2	mJ
Regenerative pump @ 532 nm	15	W
First pass amplifier [10 Hz]	10	mJ
Second pass amplifier [10 Hz]	65	mJ
Multipass pump @ 532 nm	720	mJ
Compressed pulse [10 Hz]	>50	mJ
Second harmonic	20	mJ
UV un-stretched	3.5	mJ
UV stretched	1.4	mJ

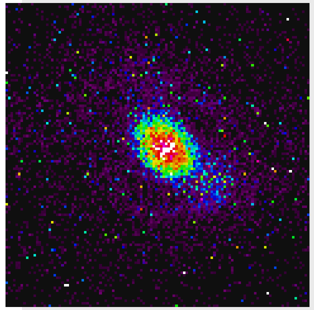


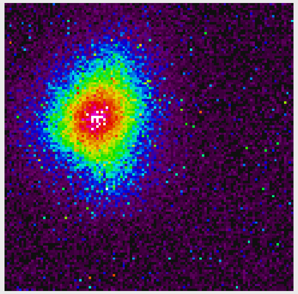
Laser Characteristics



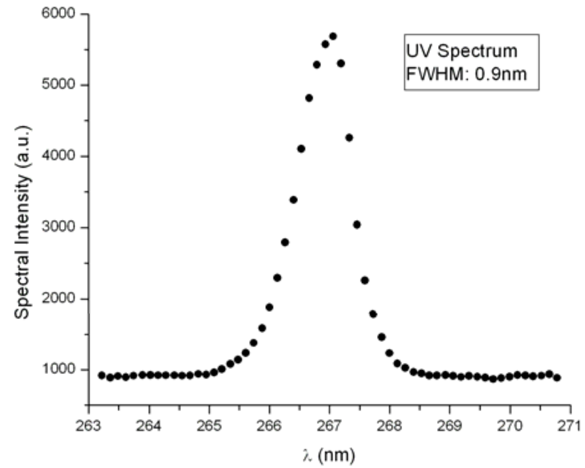


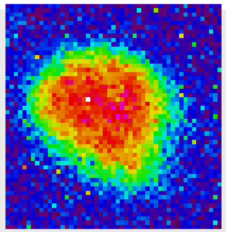


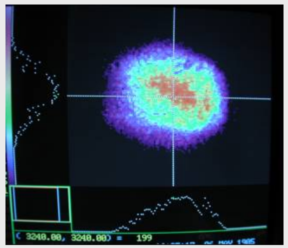
Blue
beam spot
Full Energy
20mJ



IR
beam spot
Full Energy
50mJ



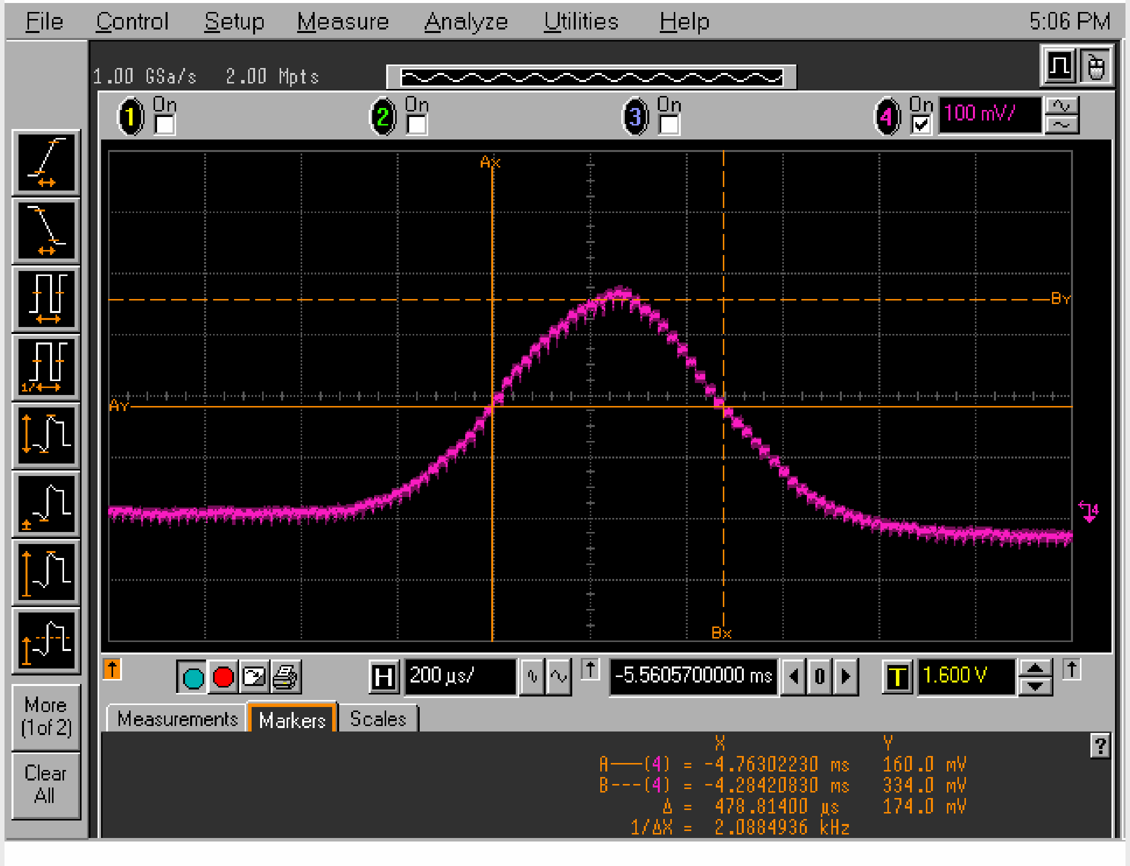




UV
beam spot
Full Energy
3.5mJ

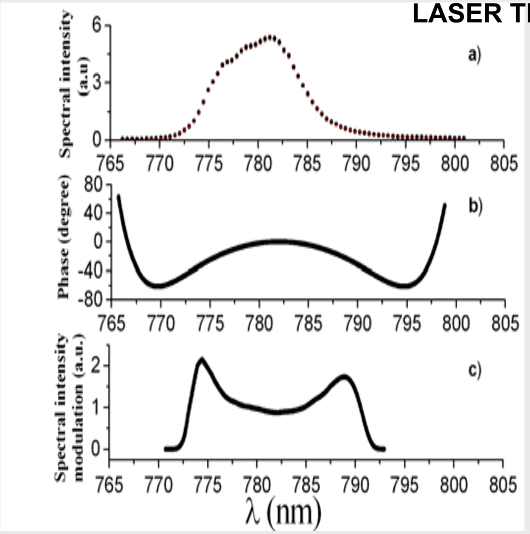
Single Shot Amplifier Autocorrelation Trace

Autocorrelation FWHM T~ 200fs --> Gaussian Shape T ~160 fs

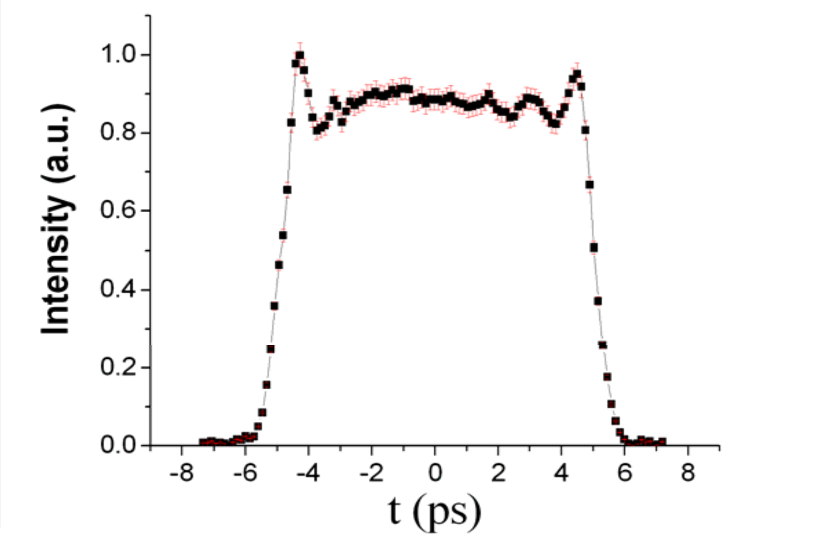


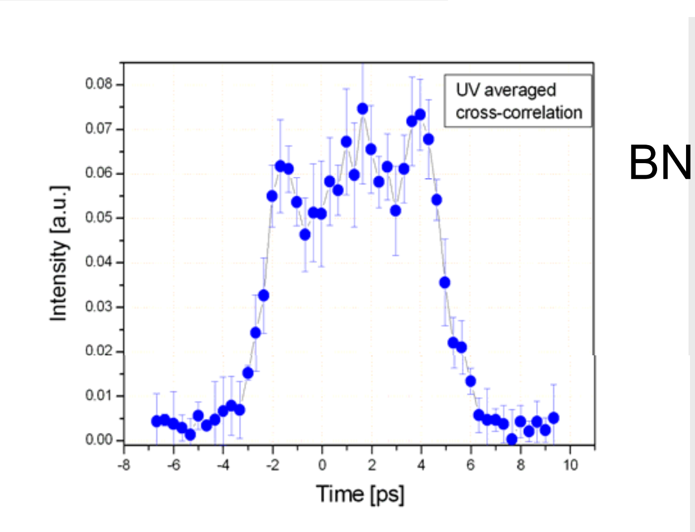
Old IR pulse shaping measures

Proceeding EPAC 2004:
LASER TEMPORAL PULSE SHAPING EXPERIMENT FOR SPARC PHOTOINJECTOR



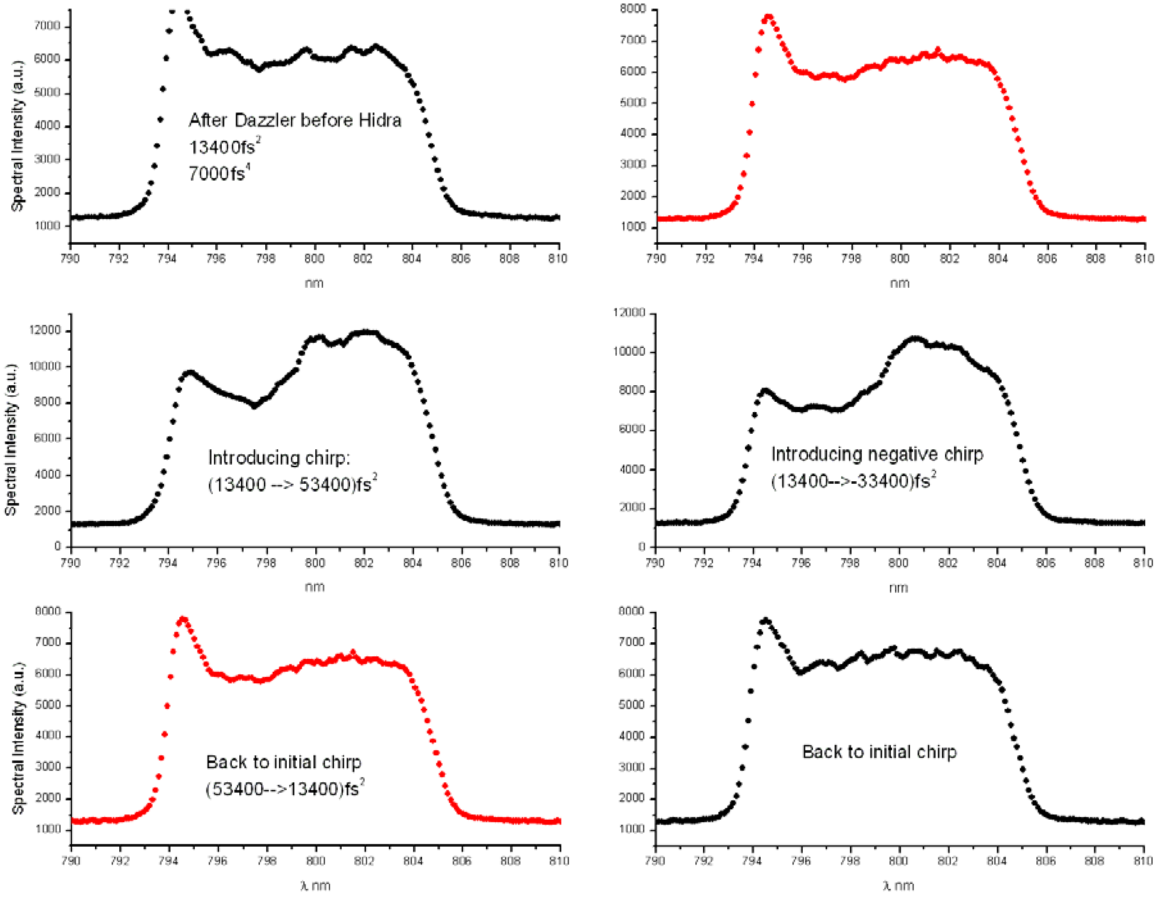
IR





UV:
BNL measure

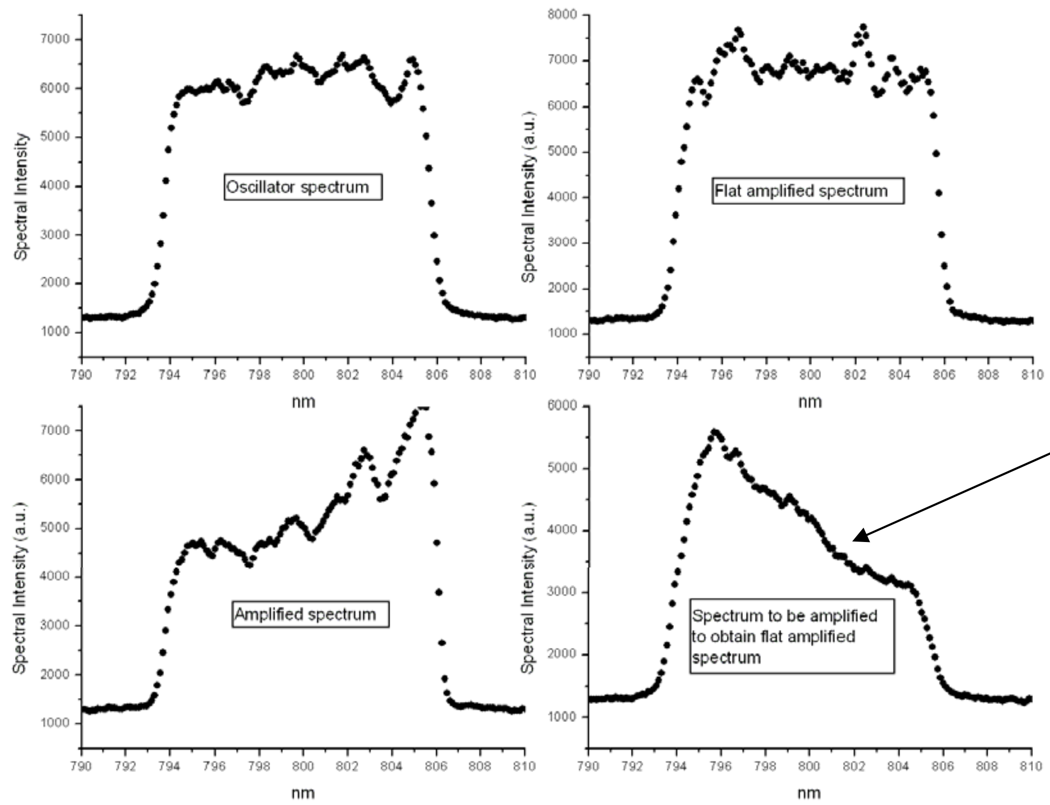
Phase & Amplitude modulation [@LNF]



Phase modulation is coupled to Amplitude modulation in Dazzler

By changing the phase ONLY;
the amplitude
is affected too:
they are coupled

Amplification spectral distortions on a flat spectrum @LNF

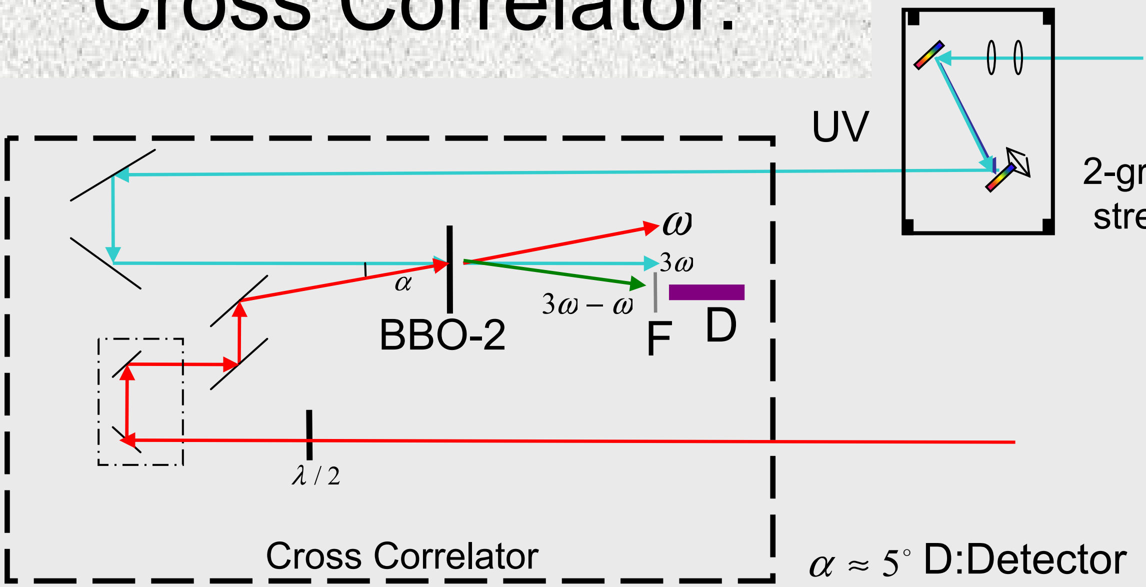


The distortion introduced by the amplifier can be compensated using the DAZZLER: spectrum we need to produce before the amplifier to obtain flat spectrum after

The amplifier introduces distortions in the spectrum so:

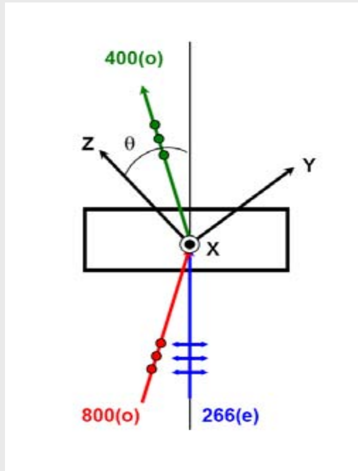
IT is better to look at the amplified spectrum as a reference to start the pulse manipulation for the flat spectrum or other spectral shapes

Cross Correlator:



2-grating UV stretcher

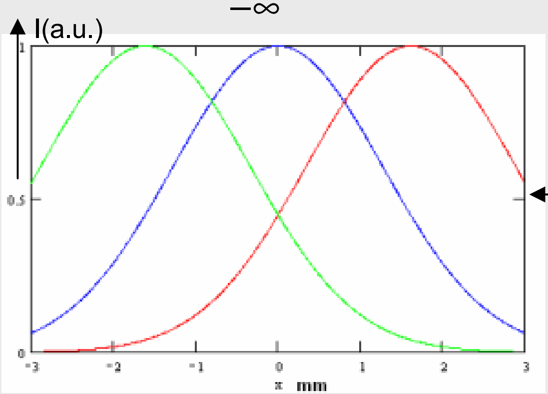
$\alpha \approx 5^\circ$ D:Detector F:Filter



BBO-2 geometry

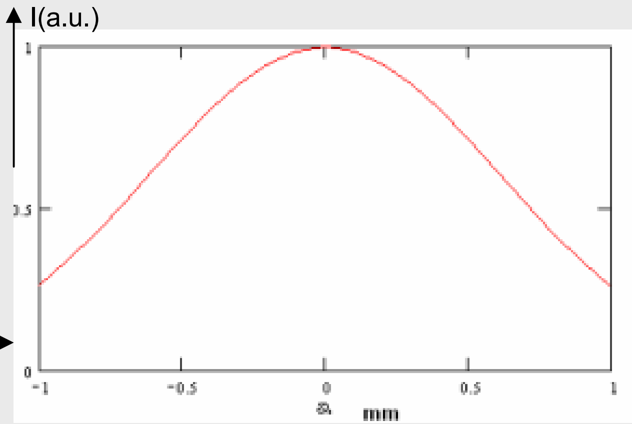
$$A_2(\tau) = \int_{-\infty}^{\infty} I_1(t) I_2(t-\tau)\,dt$$

Cross correlation signal



Spatial chirp effect

Amplitude modulation
Due to spatial chirp



Synchronization system

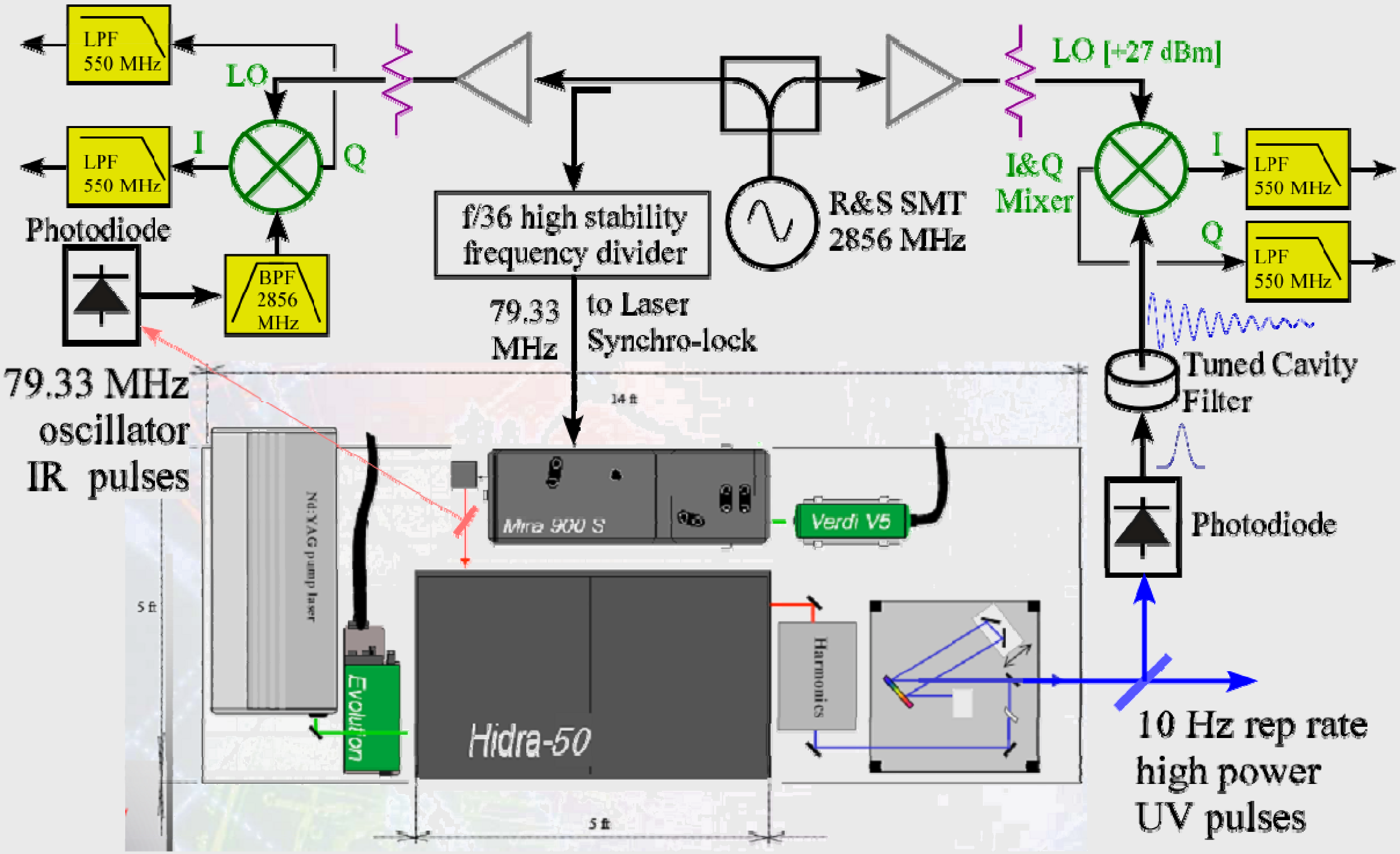
Thanks to

SPARC

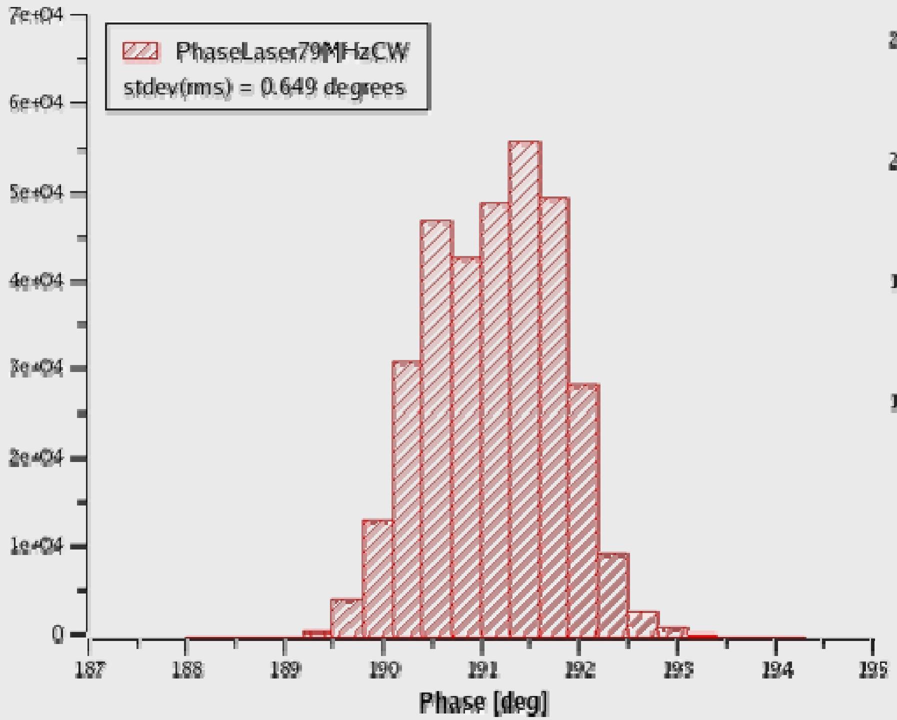
RF Low Level Control

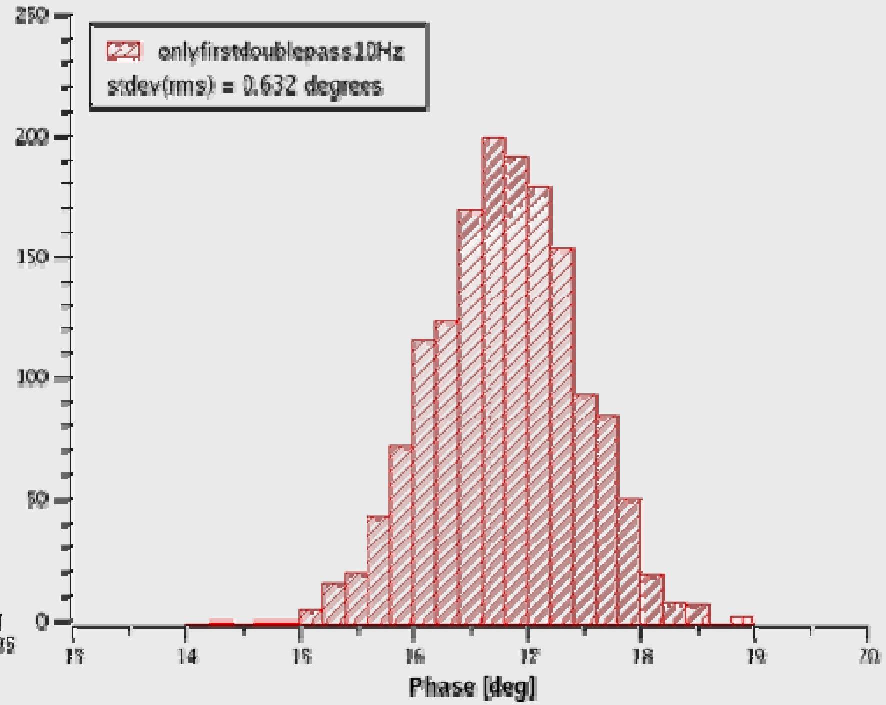
M. Bellaveglia   A. Gallo L. Cacciotti

Laser time jitter measurements set-up



Laser time jitter measurements





Laser oscillator phase noise
IR pulses, 79.33 MHz rep rate
Measured phase noise
650 ÷ 750 fs rms

Laser output phase noise
UV pulses, 10 Hz rep rate
Measured phase noise
630 fs ÷ 1 ps rms

Summary

To perform pulse shaping using the Dazzler
it is not possible to change
the phase without changing
the spectral amplitude too

The Dazzler can compensate for the
distortions introduced by
the amplifiers and the harmonic conversion

The achieve correct information about the pulses
temporal width using
cross correlation technique
it is necessary to eliminate the
spatial chirp.

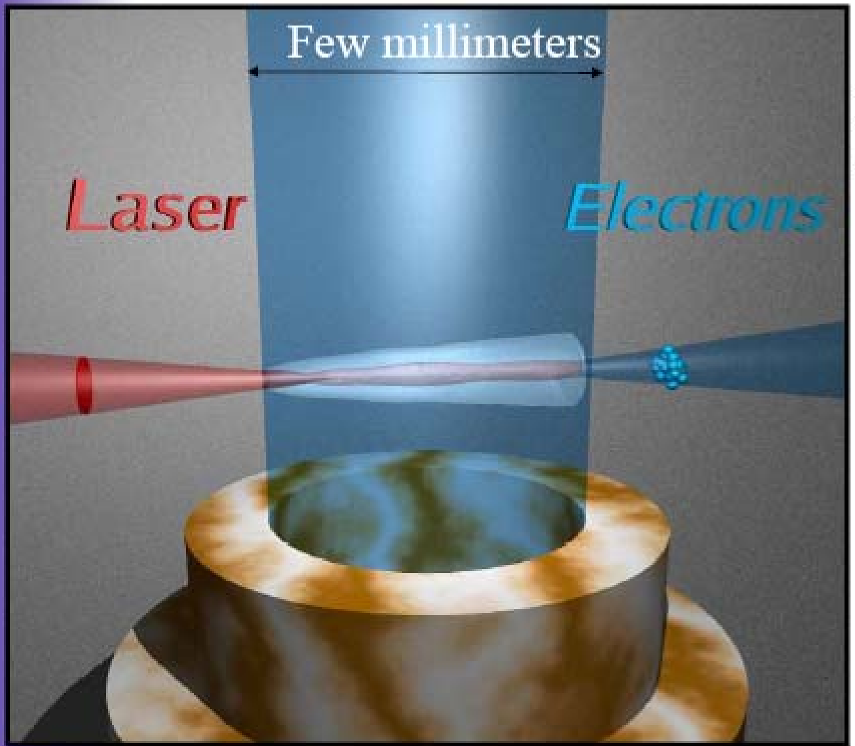
ÉCOLE POLYTECHNIQUE

ENSTA

CNRS CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

Development of a compact single shot electron spectrometer

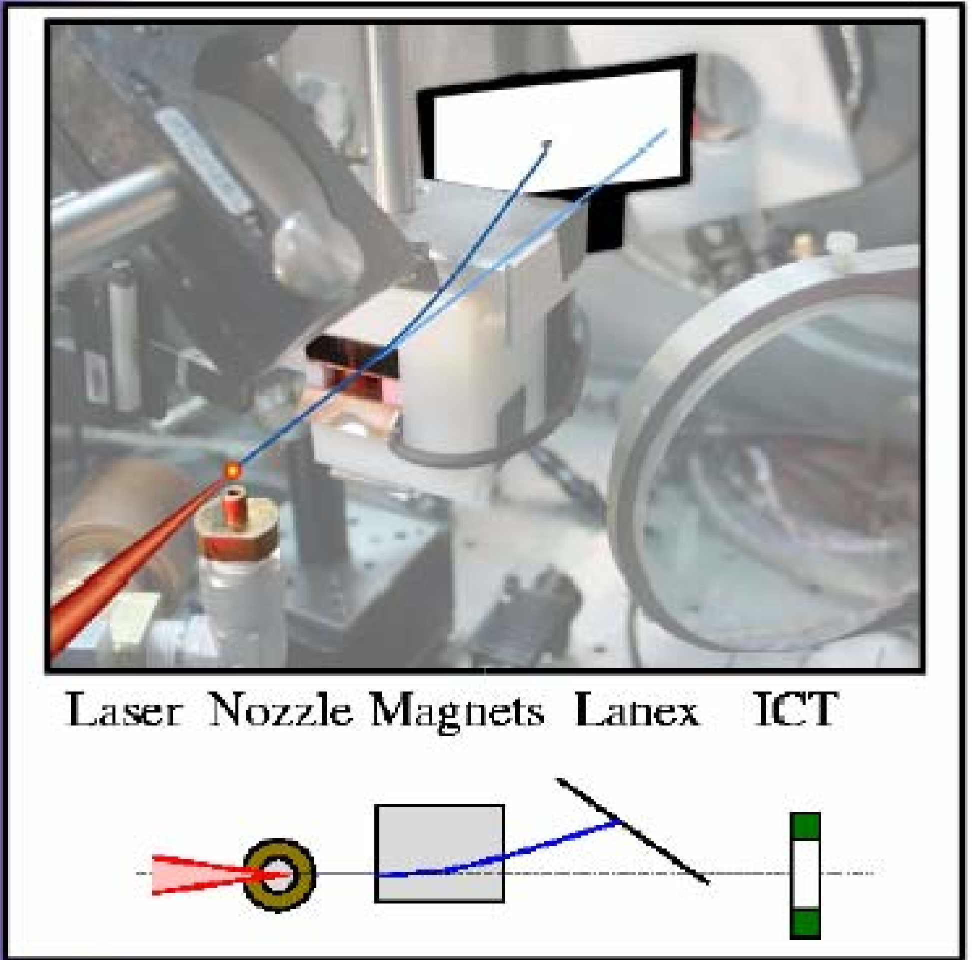
Compact electron accelerator



Major enhancements of the electron beam properties :

- Small source size
- Low divergence
- Quasi-monoenergetic
- Short duration
- High charge

In the interaction chamber

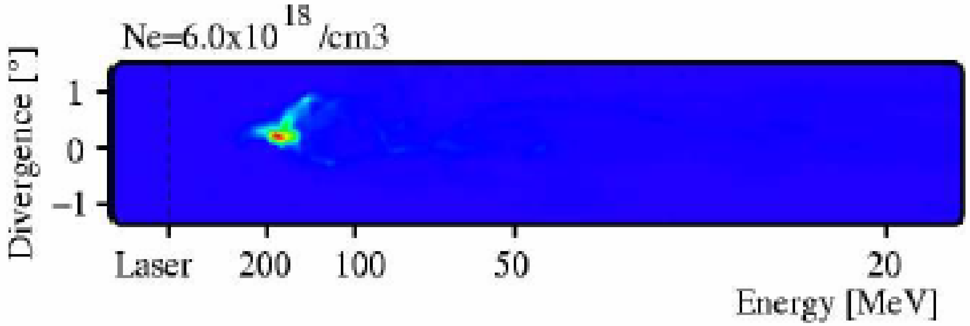


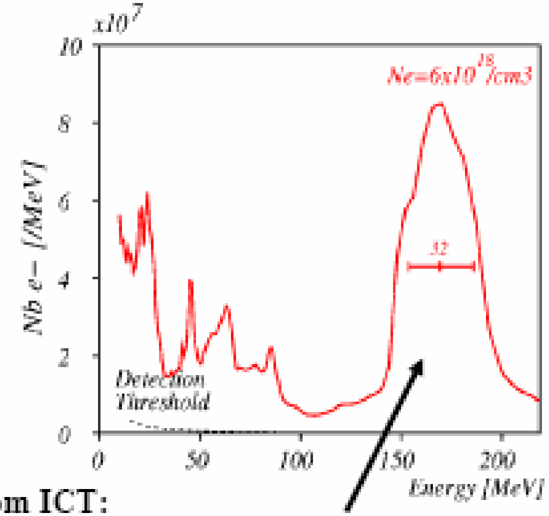
New spectrometer :

- Single shot measurement
- Spectrum and divergence
- Measurement of the charge a high energy

This diagnostic can be used because the electron beam is very collimated.

Measurement of a quasi-monoenergetic electron beam





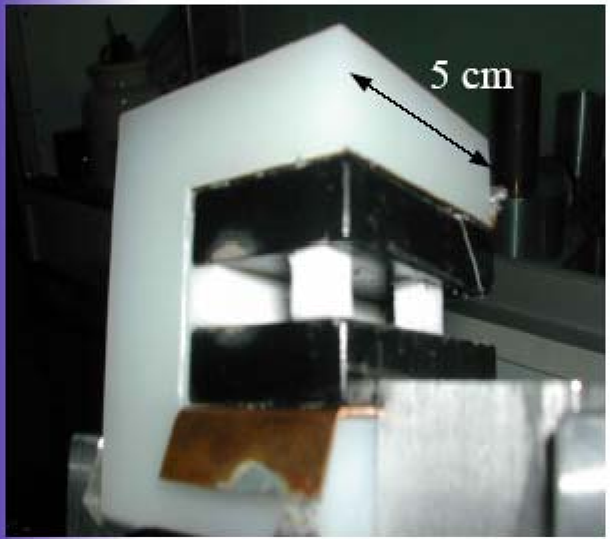
From ICT:
500 pC +/-200 pC in the bump at 170 MeV

Limitation due to the spectrometer resolution

Faure *et al.*, Nature **431**, p541 (2004)

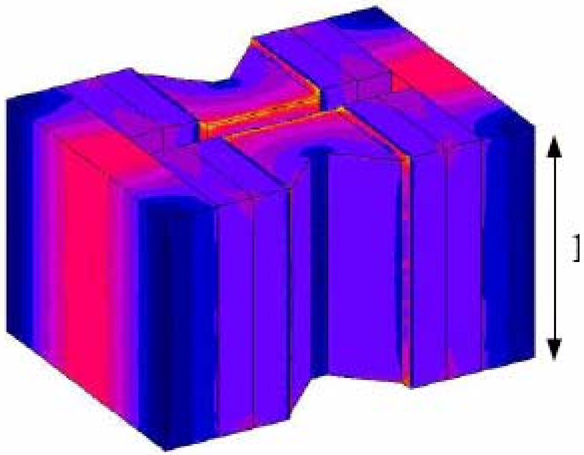
Comparison of the two magnets

B=0.41 T



Previous Magnet
home made, up to 100 MeV

B=1 T



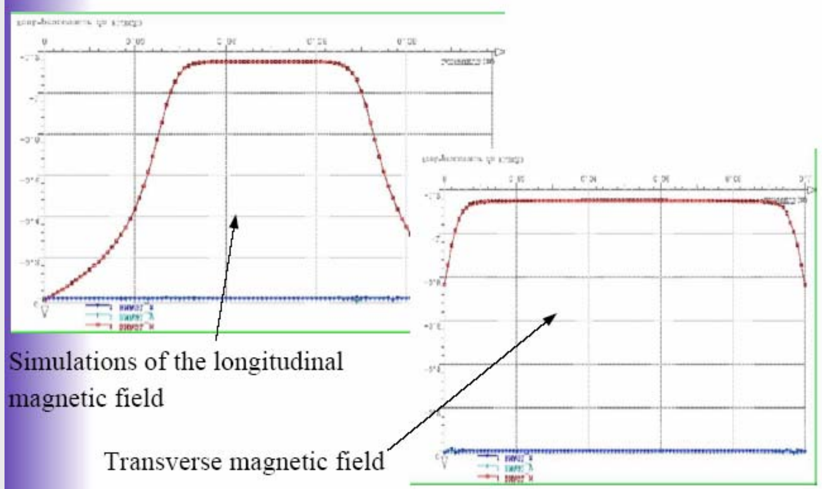
Design of a new magnet
up to 400 MeV

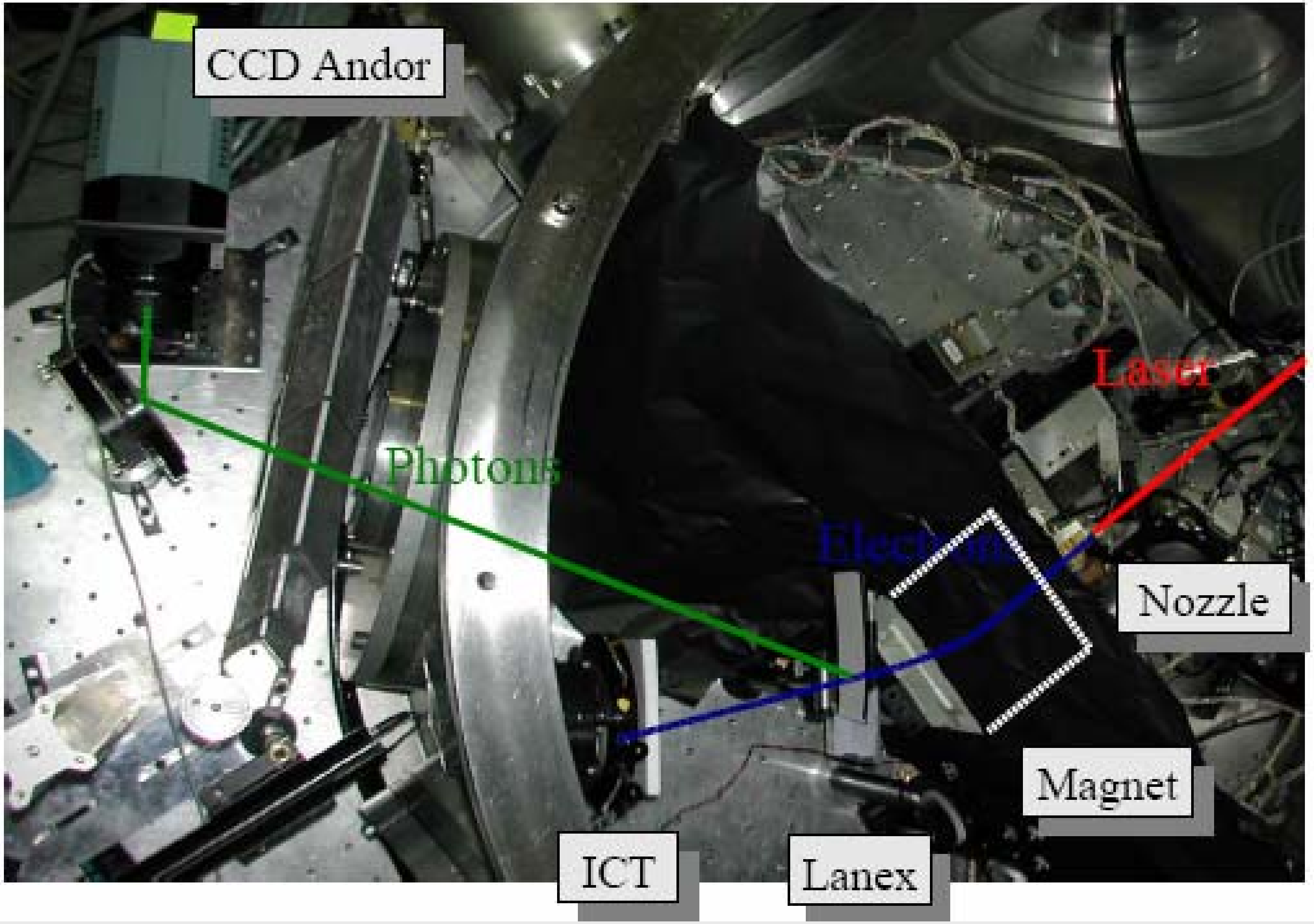
Constraints :

- Gap = 1cm
- Magnetic field ~ 1T
- Length = 10 cm
- Large slit required
- Compact spectrometer

Solution :

- Good homogeneity due to a special arrangement of magnet poles




CCD Andor
Laser
Photons
Electrons
Nozzle
Magnet
ICT
Lanex

Conclusion and Perspectives

I – Needs of a compact single shot spectrometer

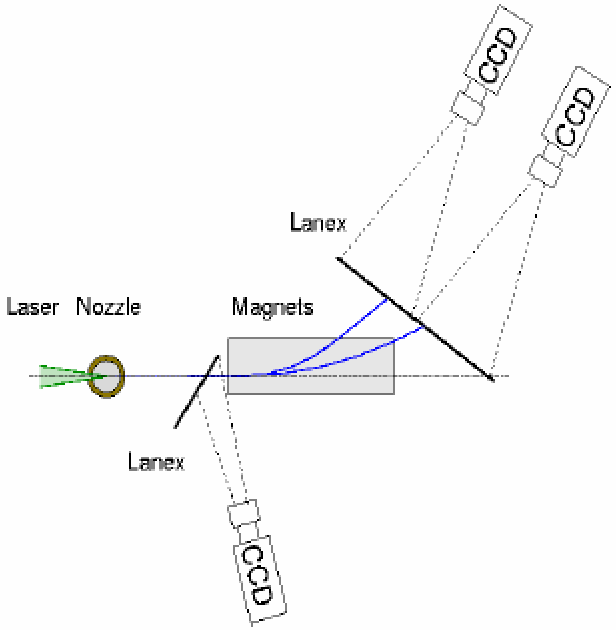
- Requirements
  - Acceleration of electrons up to 200 MeV.
  - Adapted to high repetition rate : no film processing.
- Solution chosen
  - Design and purchase of a strong permanent magnet
  - Purchase of 16 bits Andor CCD cameras.
  - Development of analytical formulaes for spectrum deconvolution
  - Purchase of a hall probe for magnet characterization

II – Further developments

- The present work will help to design a larger magnet for GeV acceleration experiments
- Estimation of the efficiency of the scintillator

Example of possible configuration for a 1 GeV-energy electron spectrometer

- Longer magnet requires larger detector to get the full spectrum
- The electrons may exit the magnetic field by the edges, in order to reduce the deflection angle for low energies
  - Beware that the each pixel on the detector corresponds to a single energy.
- A third camera with less pixel depth to monitor the electron beam axis before the magnets.
  - Valid if the scattering angle is smaller than the natural divergence. Depends on the phosphor thickness. OTR may be required.



University of Twente

Ellipsometry as a diagnostic tool for monitoring the preparation of photocathodes

University of Twente
The Netherlands

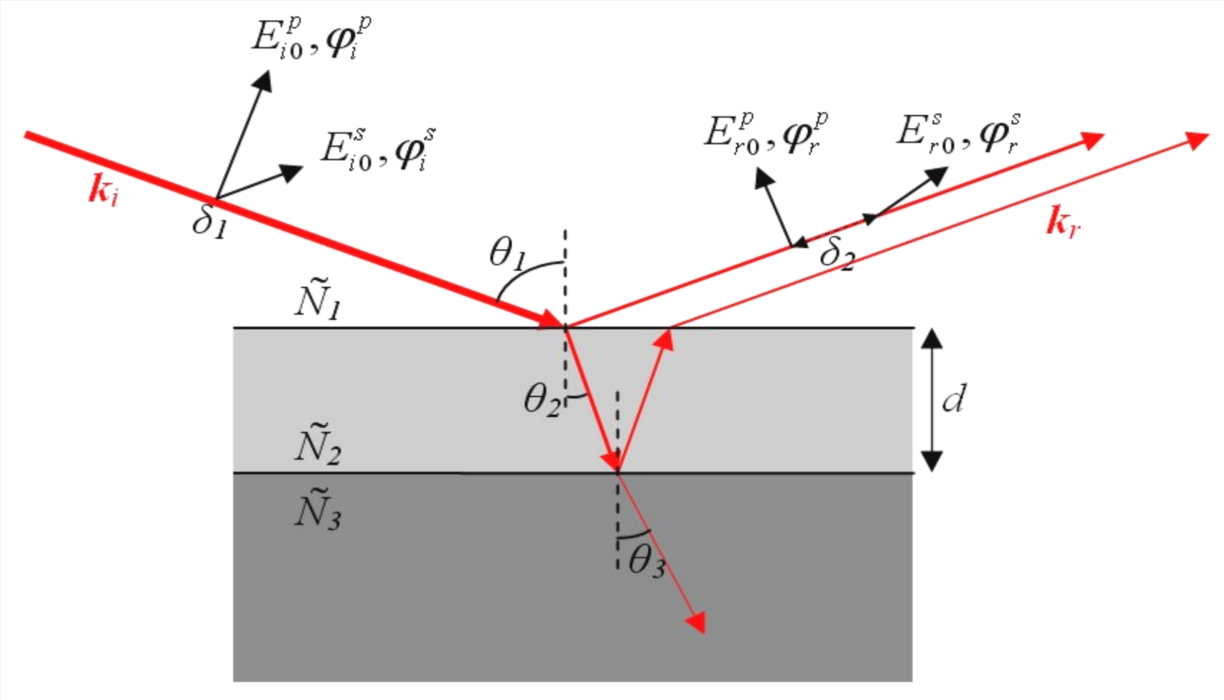
Cs-Te photocathodes

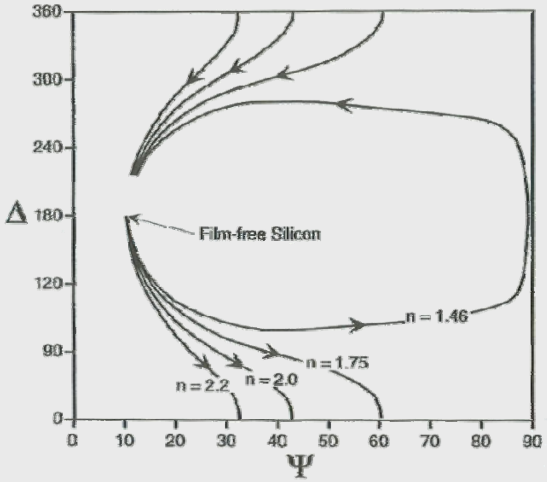
- Cs-Te seems to offer the best compromise between QE and lifetime (>10% and lifetime of months)
- Quantum efficiency and life time are sensitive to exact preparation process
- Unexplained performance variations between several research groups
- Photocurrent monitoring is not exclusive enough to characterize photo cathode
- Basic understanding and inside monitoring of preparation process is necessary

Ellipsometry for monitoring

- Different stoichiometry will have different optical constants
- Ellipsometry can determine layer thickness and optical constants
- Additional advantages:
  - In-situ
  - non-destructive
  - real-time

Ellipsometry basics

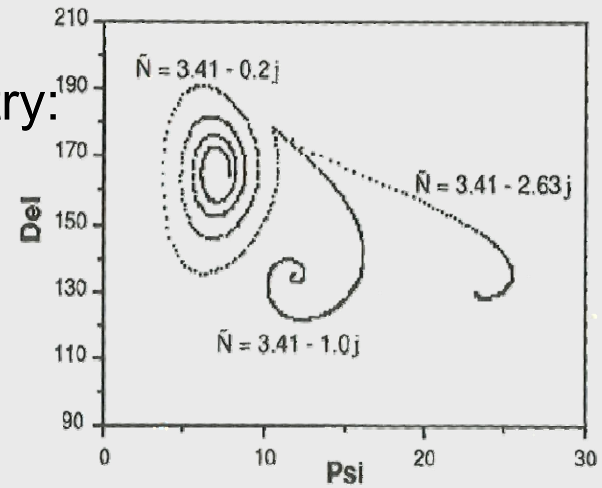




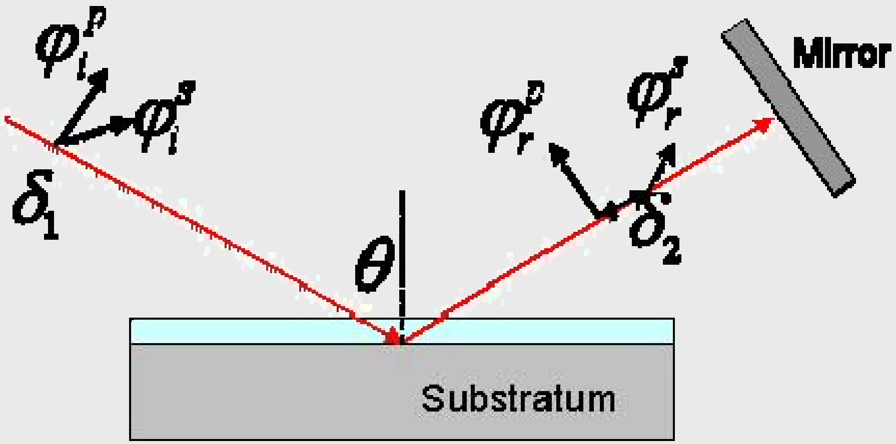
- Basic equation ellipsometry:

$$\rho = \tan \Psi e^{i\Delta} = \frac{R^p}{R^s}$$

- Psi/delta trajectory



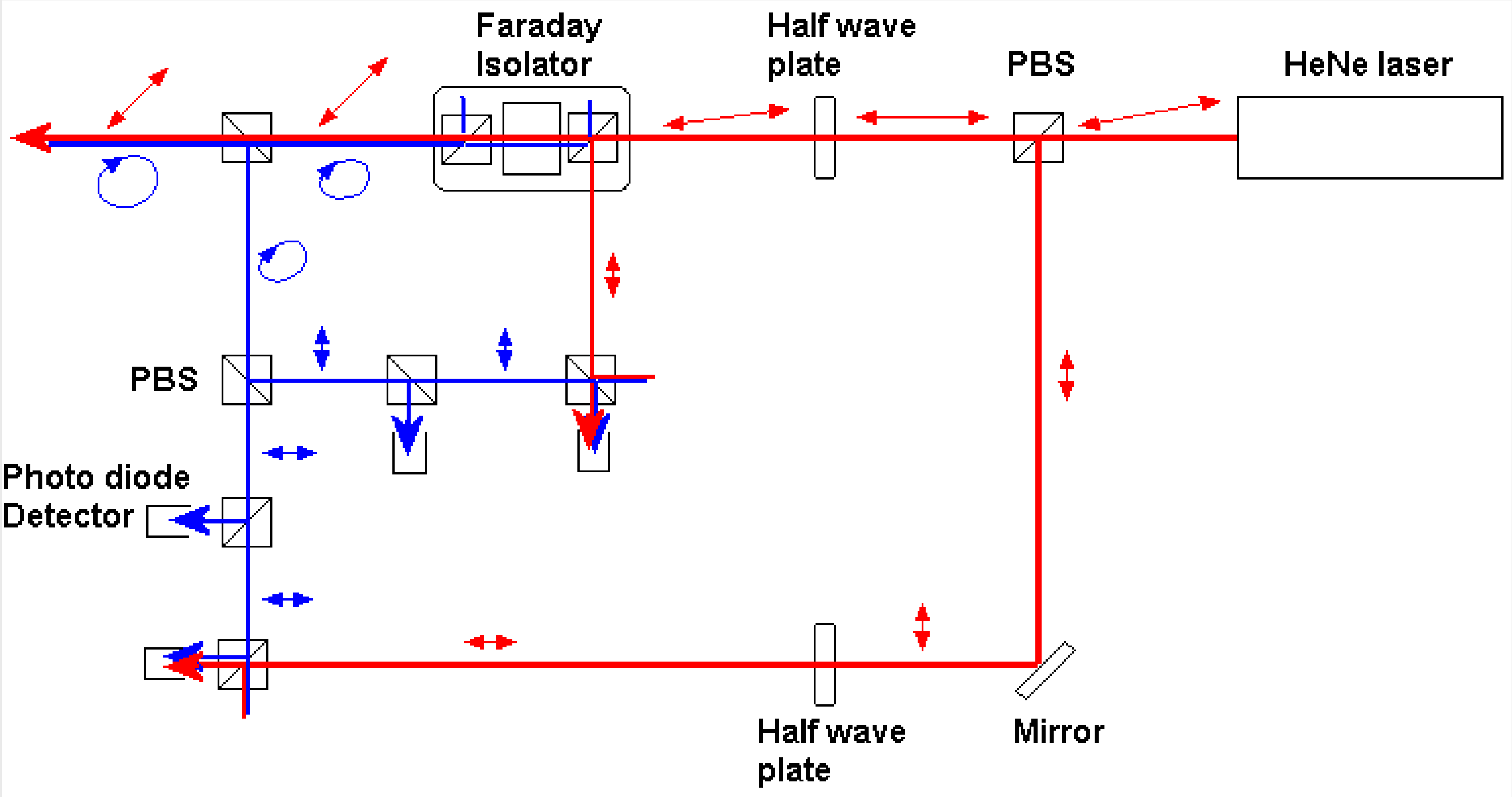
Our modified diagnostic setup



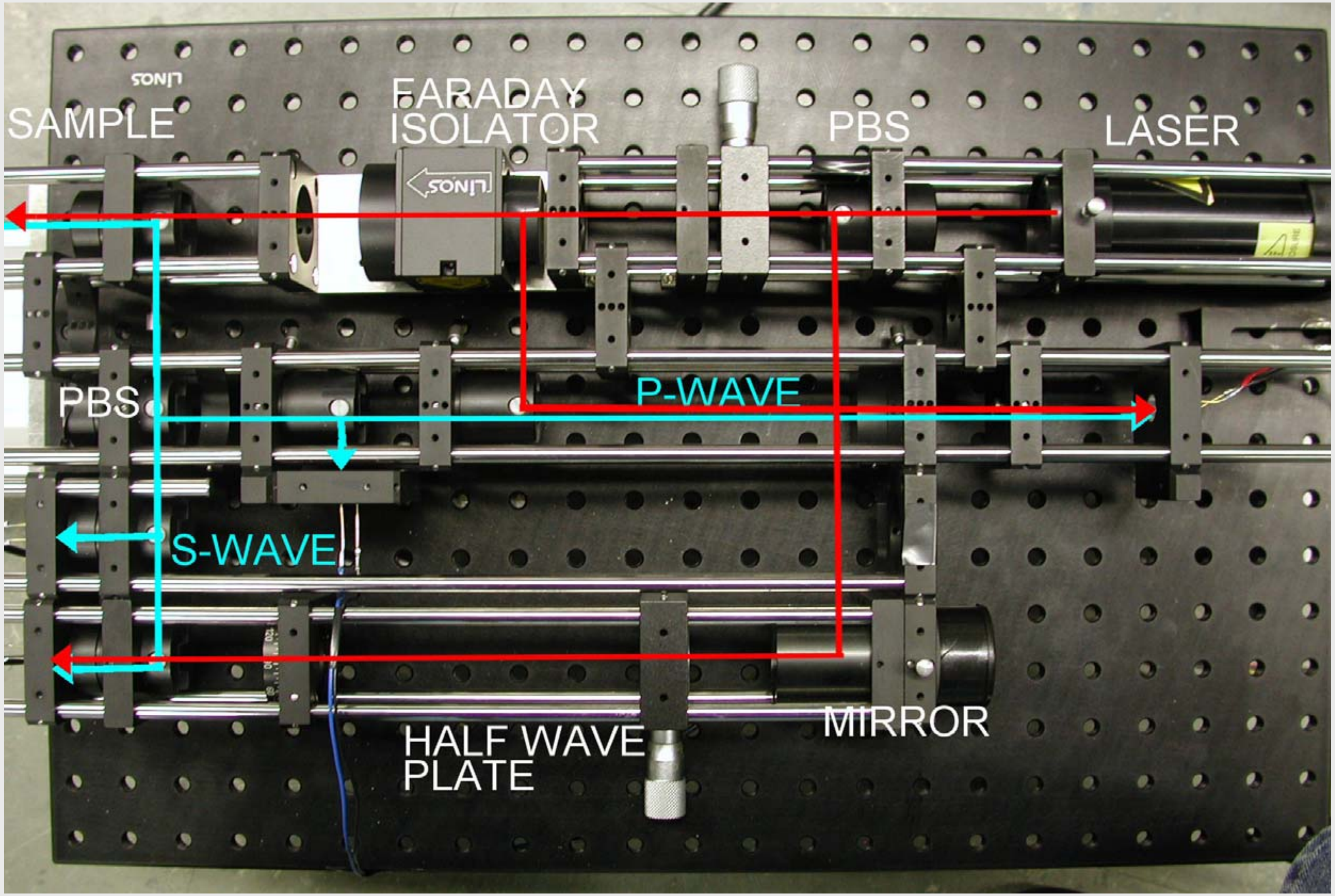
Adjusted setup:

- Measuring separate intensities and phases instead of angles
- Copper mirror
- Need adjusted model to obtain required information

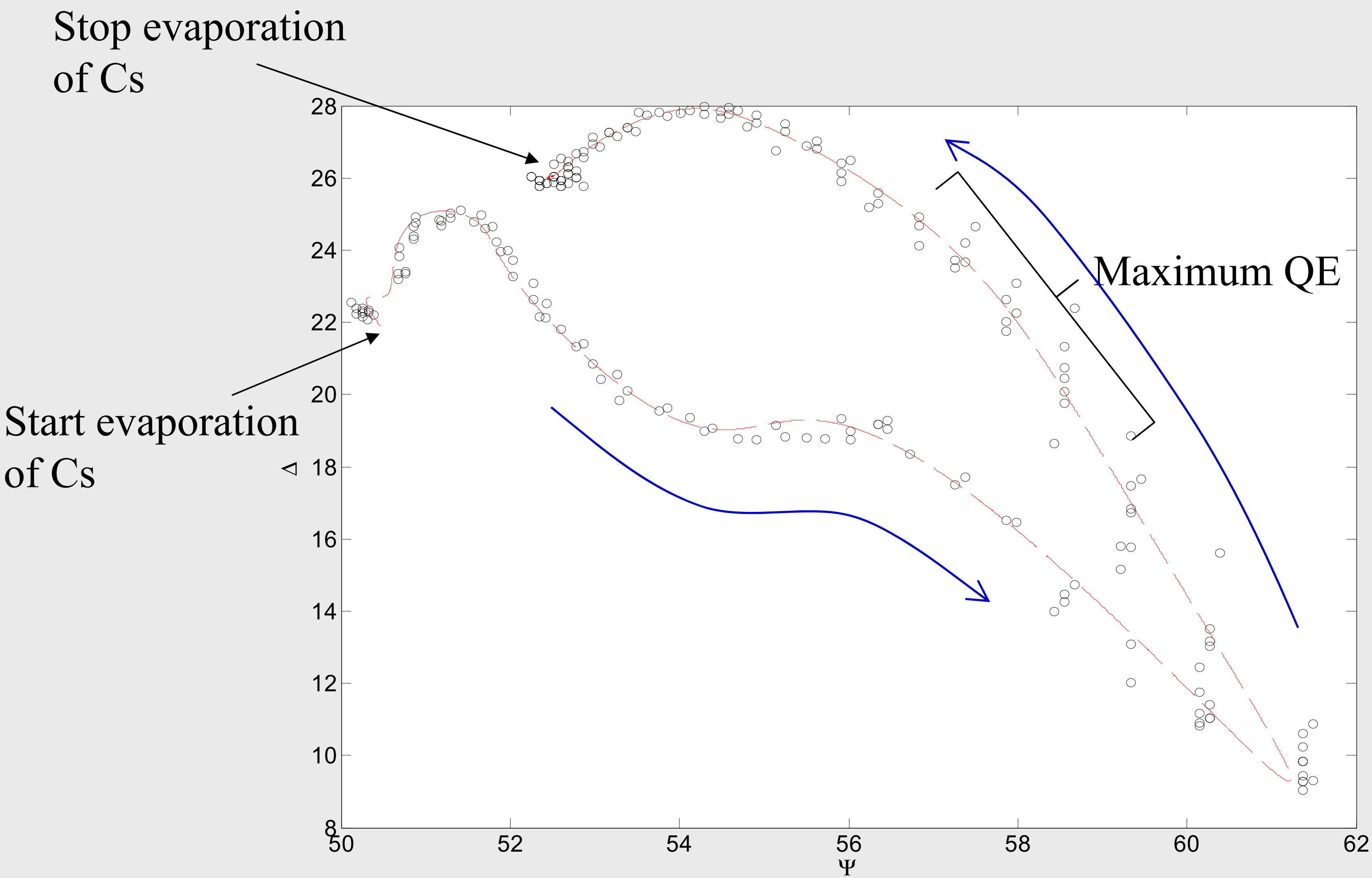
Setup schematic



Setup realized



Delta/Psi trajectory



Conclusions

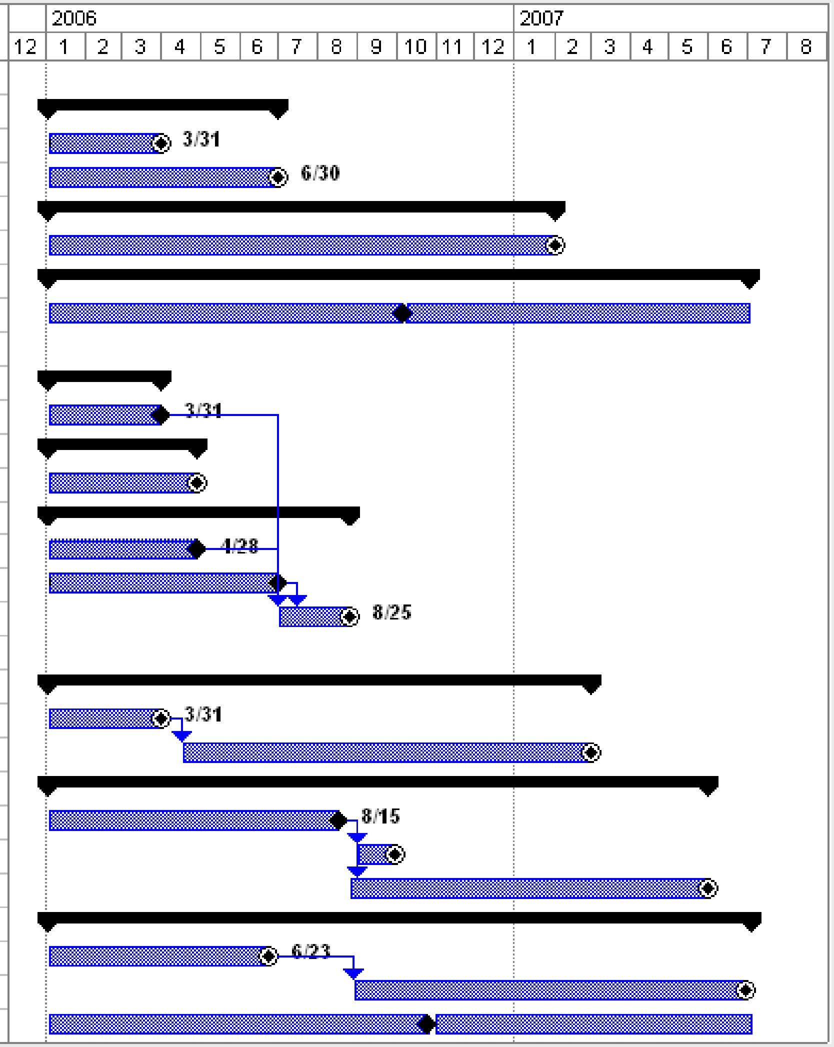
- **Ellipsometry is a very promising diagnostic tool to relate photocathode quantum efficiency and life time to optical parameters and stochiometry.**
- **Dynamic monitoring of the formation of cathode layer based on optical constants reveals the stochiometry**

Deliverables 1/1/2006 – 30/6/2007

PHIN	23	Two 3 GHz RF guns construction	Prototype	WP4	CNRS-Orsay	18
PHIN	22	Laser RF feedback development	Report	WP3	CERN	21
PHIN	10	Photocathode ready for 3 GHz RF guns	Prototype	WP2	CERN	25
PHIN	11	UV generation and feedback: overall system assembly and tests	Prototype	WP3	CCLRC	30
PHIN	12	SC RF gun realisation	Prototype	WP4	FZR	26
PHIN	13	SC RF gun test	Report	WP4	FZR	36
PHIN	20	Pulse shaping comparison	Prototype	WP3	INFN – LNF, MI	22
PHIN	14	CTF3 3 GHz RF gun test at CERN	Report	WP4	CNRS. CERN	33
PHIN	27	Superconducting cavity photocathode tests	Report	WP2	FZR	37
PHIN	28	Final report on 100 MeV laser driven plasma source R&D	Report	WP2	CNRS-LOA	48

JRA2-PHIN schedule for the next 18 months

Task Name	Milestones	Main Deliverables
WP2 Charge Production		
High efficiency photocathode for 3 GHz RF gun		
High efficiency photocathode comparison		Final report
photocathode 3 GHz high field R&D		Photocathode ready
Photocathode for SC cavity		
Photocathodes test		Final Report
Laser driven plasma source		
250 MeV laser driven plasma source R&D	Inter.Report	
WP3 Laser		
Laser System		
Oscillator + amplifier test		Final report
Pulse shaping system		
Pulse shaping comparison		Pulse shaper ready
UV generation and Feedbacks		
UV Harmonic generator test		UV crystals ready
Laser-RF Feedback development		Feedback test
Overall system assembly and tests		Laser System ready
WP4 GUN		
SC RF gun		
SC RF gun realisation		SC RF gun ready
SC RF gun test		Final Report
3 GHz RF gun		
Two 3 GHz RF guns construction		3 GHz RF guns ready
CTF3 3GHz RF gun test at CERN		Final report
NEPAL 3 GHz RF gun testat Orsay		Final report
Spectrometer for e- beam		
1-250 MeV Spectrometer construction		Spectrometer ready
1-250 MeV Spectrometer test		Final report
0.1-1Gev Spectrometer development	Inter. Report	



Budget for the next 18 months [January 1th 2006 to June 30 2007]

JRA2	Participant (cost model)	Permanent Staff direct cost ONLY (Euros)	Additional Staff direct cost ONLY (Euros)	Durable Equipment direct cost ONLY (Euros)	Consumables and Prototyping direct cost ONLY (Euros)	Travel direct cost ONLY (Euros)	All Direct Cost	Subcontract	Indirect cost	Expected costs including indirect cost (Euros)	Requested funding (Euros)
3	*CNRS-Orsay*	*384,375*	*35,000*	*90,000*	*10,000*	*5,000*	*524,375*	*0*	*104,875*	*629,250*	175000
	CNRS-LOA	*120,000*	*60,000*	*0*	*112,000*	*10,000*	*302,000*	*0*	*60,400*	*362,400*	105000
	CNRS(FCF)	504,375	95,000	90,000	122,000	15,000	826,375	0	165,275	991,650	280000
9	FZR(AC)	0	45,917	0	39,858	0	85,775	0	17,155	102,930	102930
10	*INFN-LNF*	*0*	*80,000*	*0*	*33,333*	*10,000*	*123,333*	*0*	24,667	*148,000*	148000
	INFN-Mi	*0*	*80,000*	*0*	*25,000*	*6,667*	*111,667*	*0*	22,333	*134,000*	134000
	INFN(AC)	0	160,000	0	58,333	16,667	235,000	0	47,000	282,000	282000
11	TEU(FC)	35,910	167,580	0	45,000	5,000	253,490	0		253,490	101773
17	CERN (AC)	0	42,500	0	940,000	18,417	1,000,917	0	200,183	1,201,100	779200
20	CCLRC-RAL (FC)	13,719	28,843	0	0	6,620	49,182	0	59582	108,764	11000
	Grand total	**554,004**	**539,840**	**90,000**	**1,205,192**	**61,703**	**2,450,739**	**0**	**489,195**	**2,939,934**	**1,556,903**