CARE-PHIN FP6
at Milano

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Summary from Lecce PHIN Collaboration meeting

The task

Title of Milano - JRA2 - CARE scientific task:

"Investigate and test systems for complicated ultra-fast optical waveforms according to user specifications, as those for the new generation of FEL, with benefits for linac photo-injectors."

Two technologies

•LCM-SLM (liquid crystal mask – spatial light modulator)

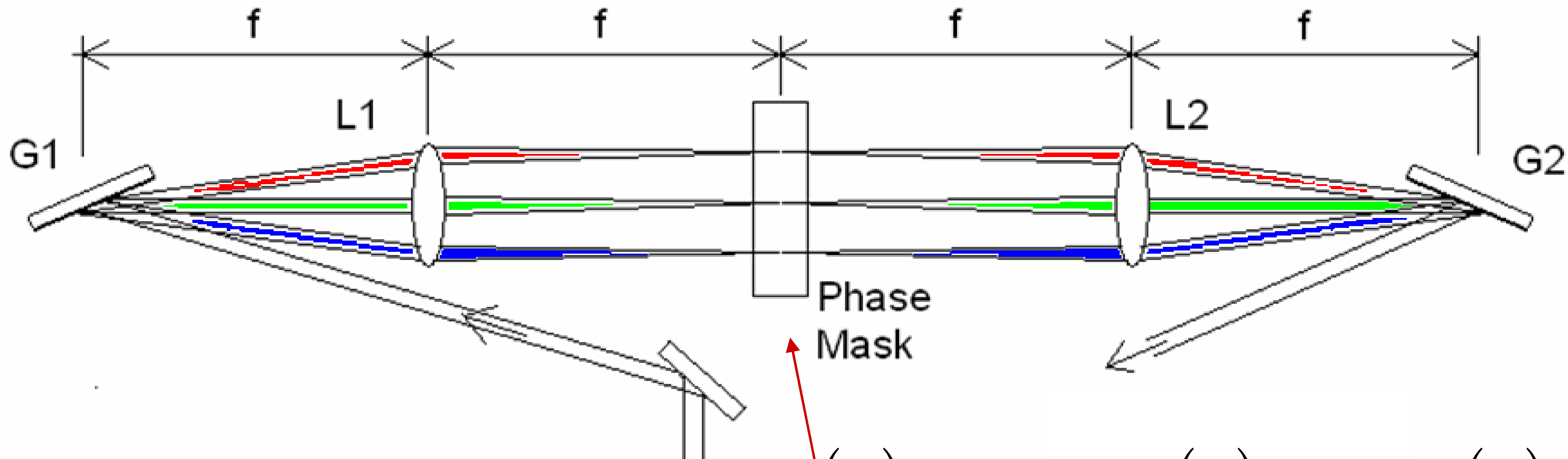
•Dazzler-AOPDF (acousto optic programmable dispersive filter)

the achievements

- ❖ Studied and developed the 4f-system and implemented in the SPARC machine at Frascati
- ❖ Studied and tested the DAZZLER in Frascati
- ❖ Proposed and successfully tested a novel optical system as pulse shaper for rectangular UV laser pulses.
- ❖ A pulse train generation

Some work on CLIC Phase-Coding system + a PHD collaboration Malka

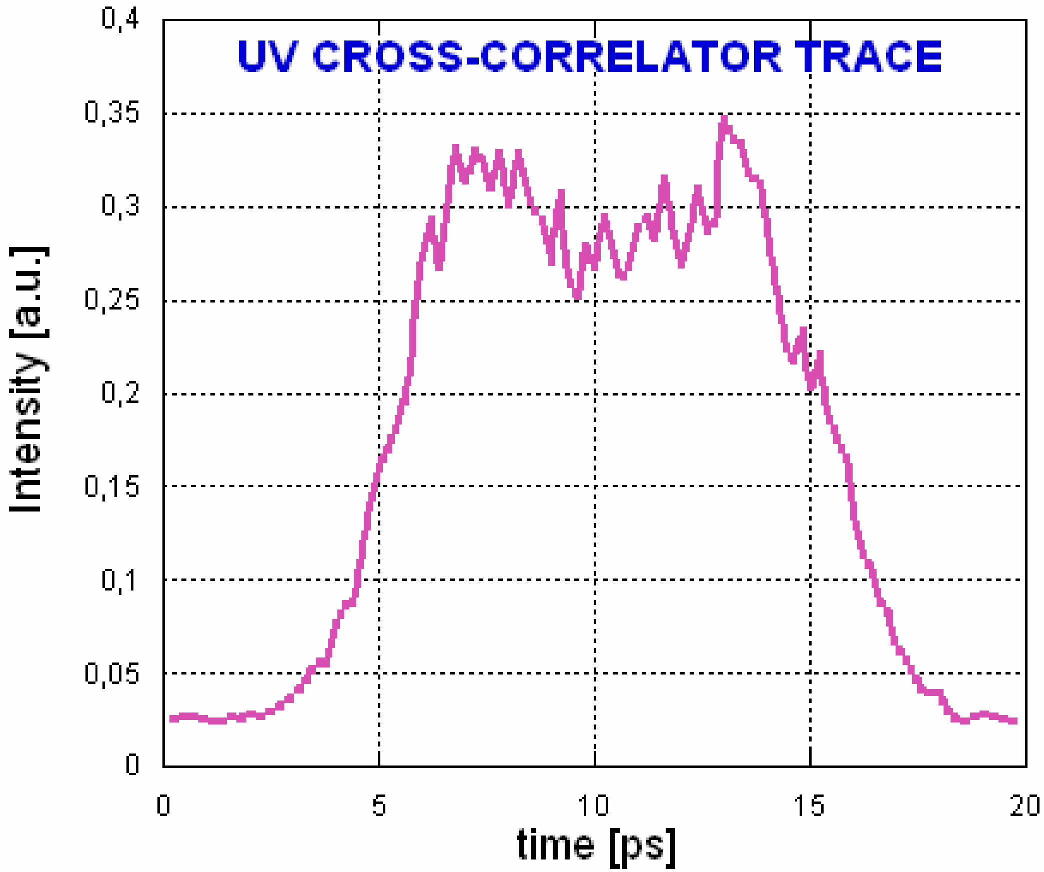
The 4f-system LCM-SLM



$$\Phi_{mask}(\omega) = \Phi_{compression}(\omega) + \Phi_{shaping}(\omega)$$

1. Developed in Milano Lab a Nd;YAG laser system for studing and testing

2. Studied and set the 4f-system driven by an adaptive algorithm
3. Studied and solved the general pulse shaping problem with harmonic generation, tetsted in SPARC machine



UV pulse in SPARC with DAZZLER
2.6 ps rise time 6 ps wide

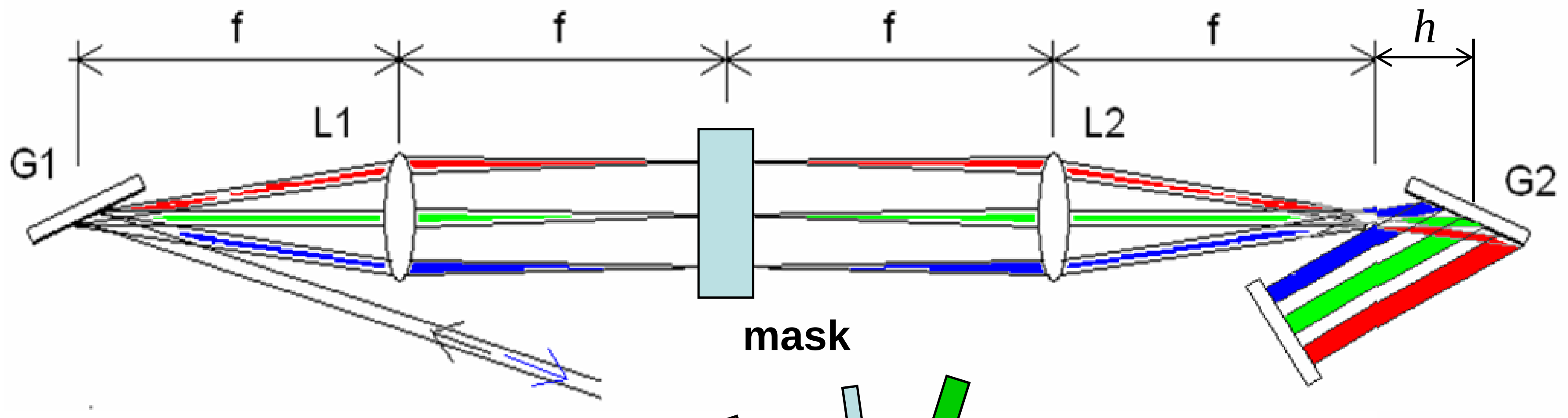
The final result resulted un-satisfactory:

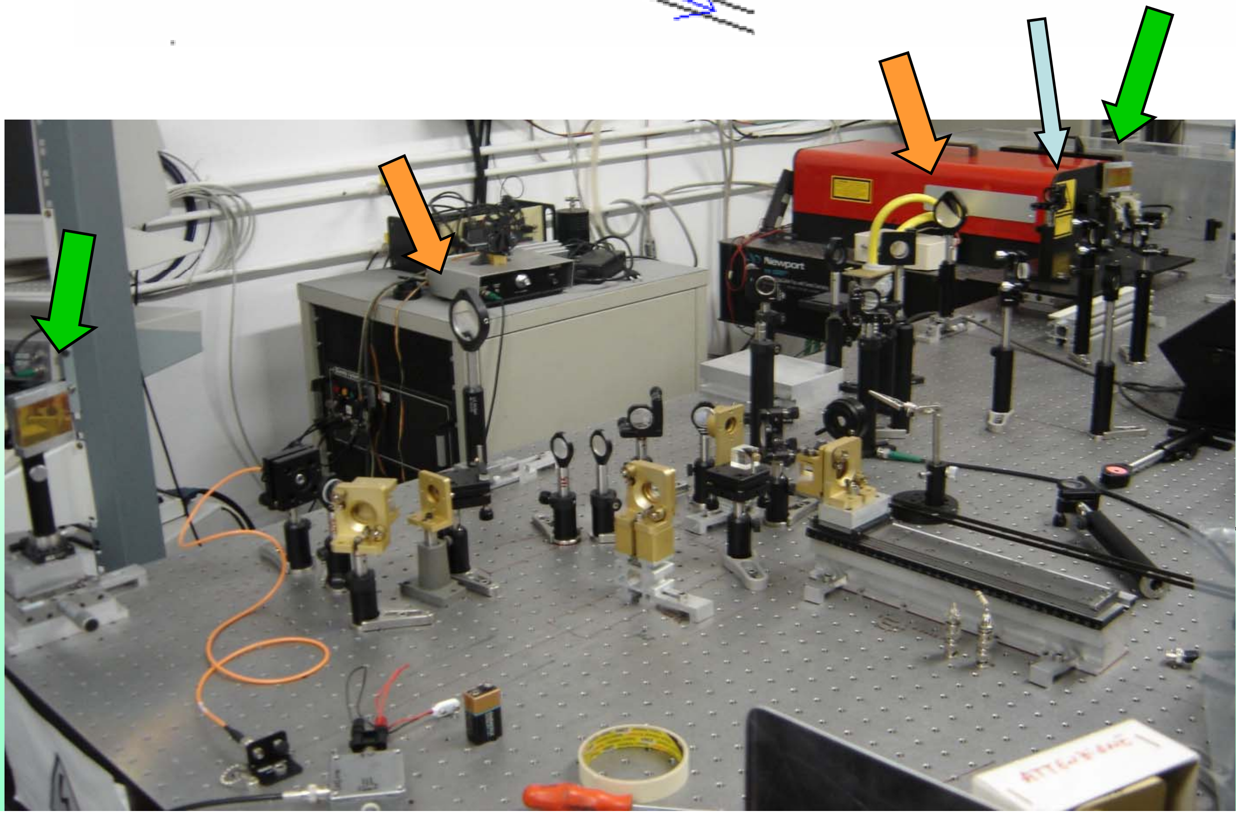
too long rise time

New idea:

A new design stretcher at the UV

New 4f-shaping scheme

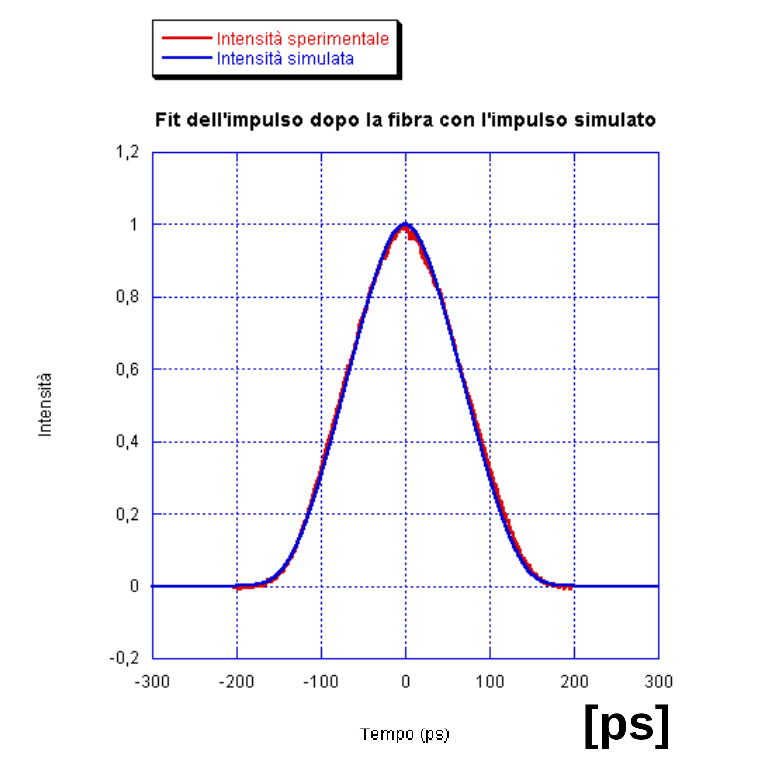




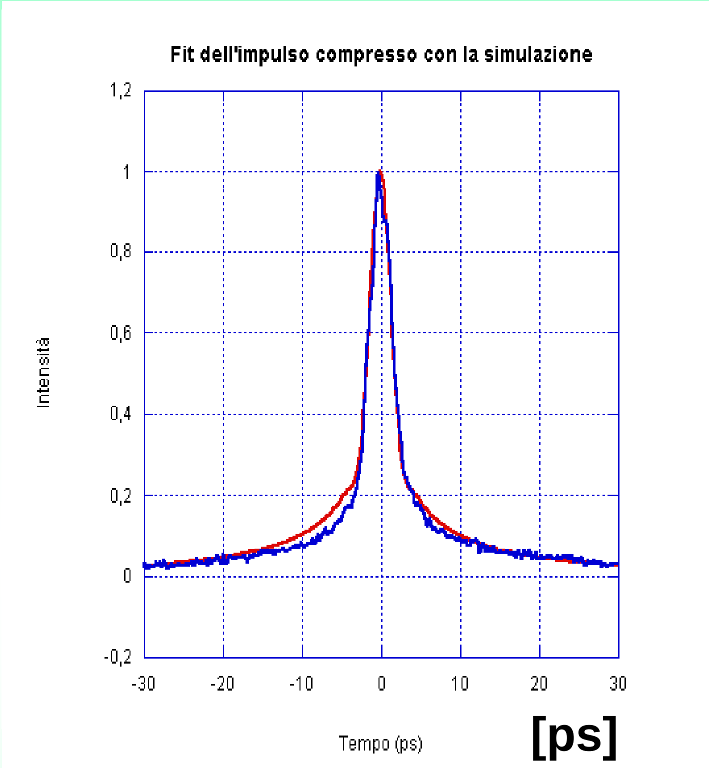
$$\begin{cases} \tau(\delta\omega) = \beta \cdot \delta\omega \\ \beta = \dfrac{\lambda_o^3 h}{\pi c^2 d^2} \dfrac{1}{\left(1 - \left(\dfrac{\lambda_o}{d} - \sin(\theta_i)\right)^2\right)} \end{cases}$$

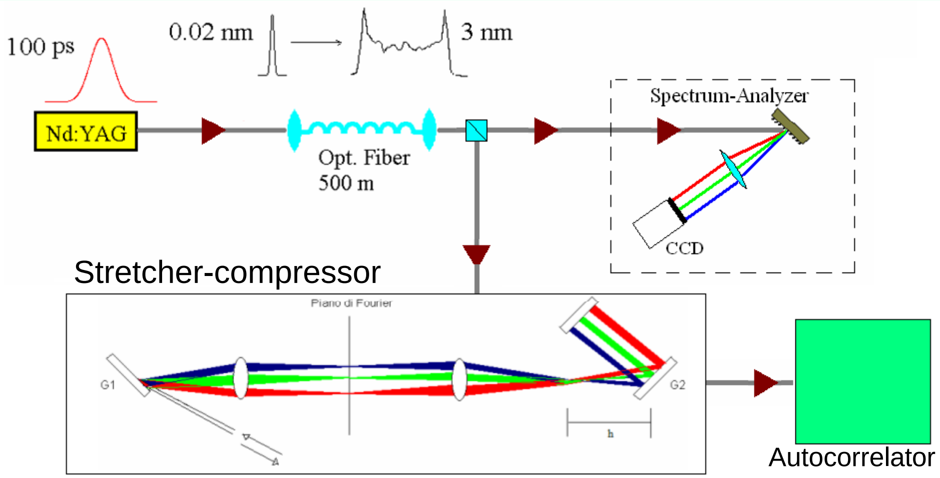
From thesis of Valeria Brizzolara

Entering pulse



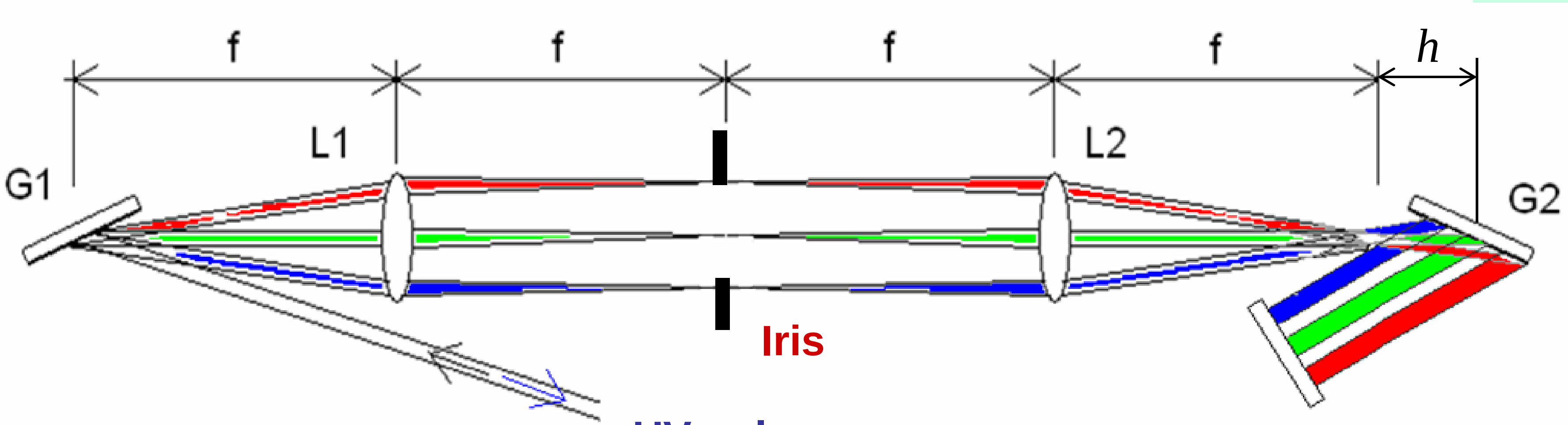
Output pulse



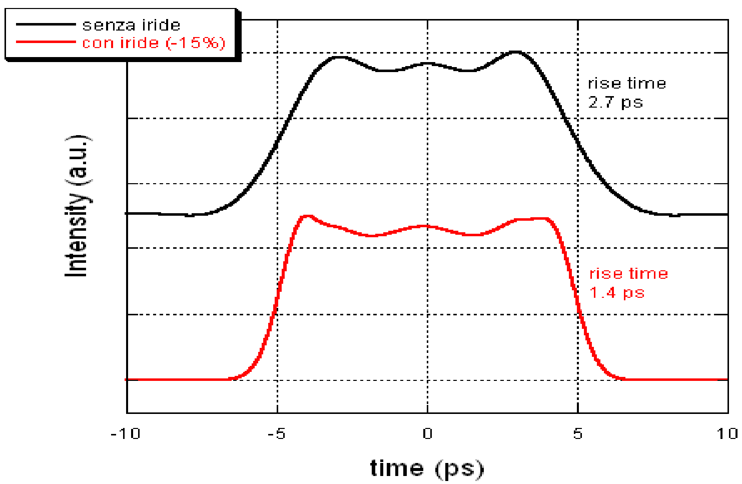


Scheme of the experimental setup

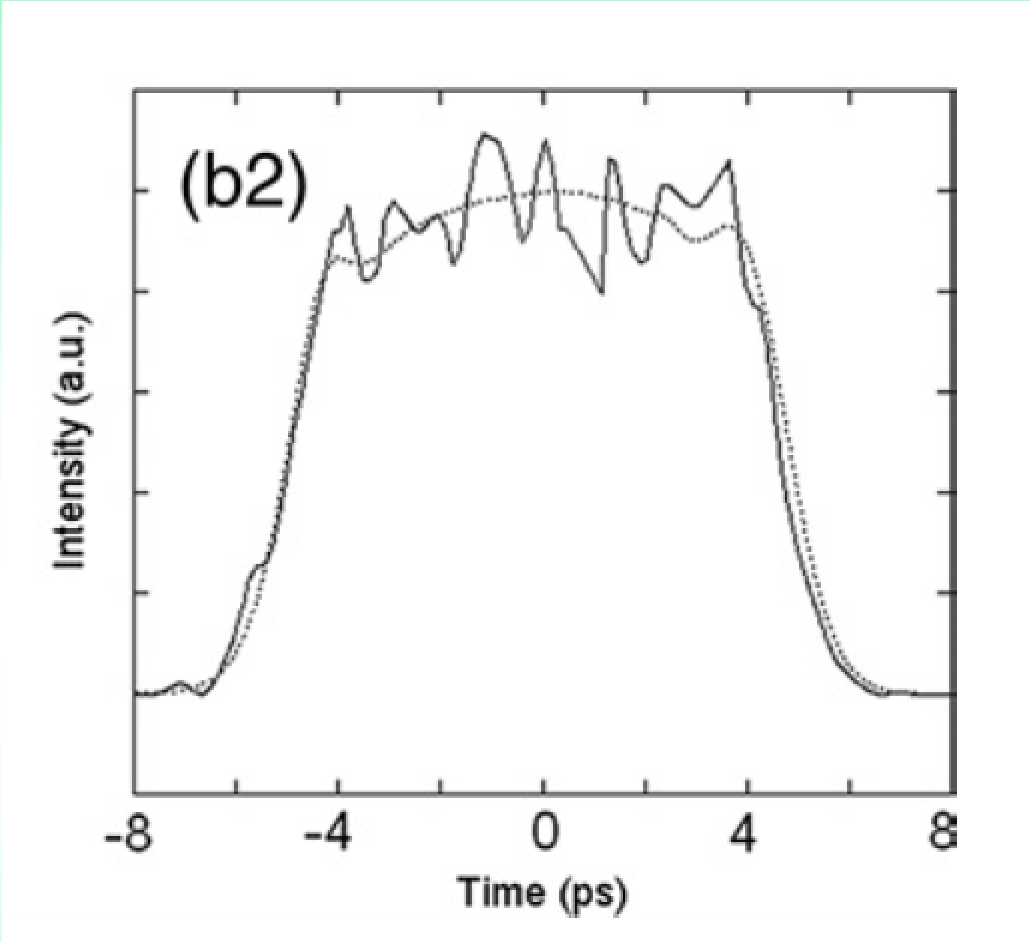
Extention for SPARC



Simulation



Tool to reduce the rise time of the UV rectangular pulse



Pulse output with the new stretcher after UV-HG
1.4 rise time

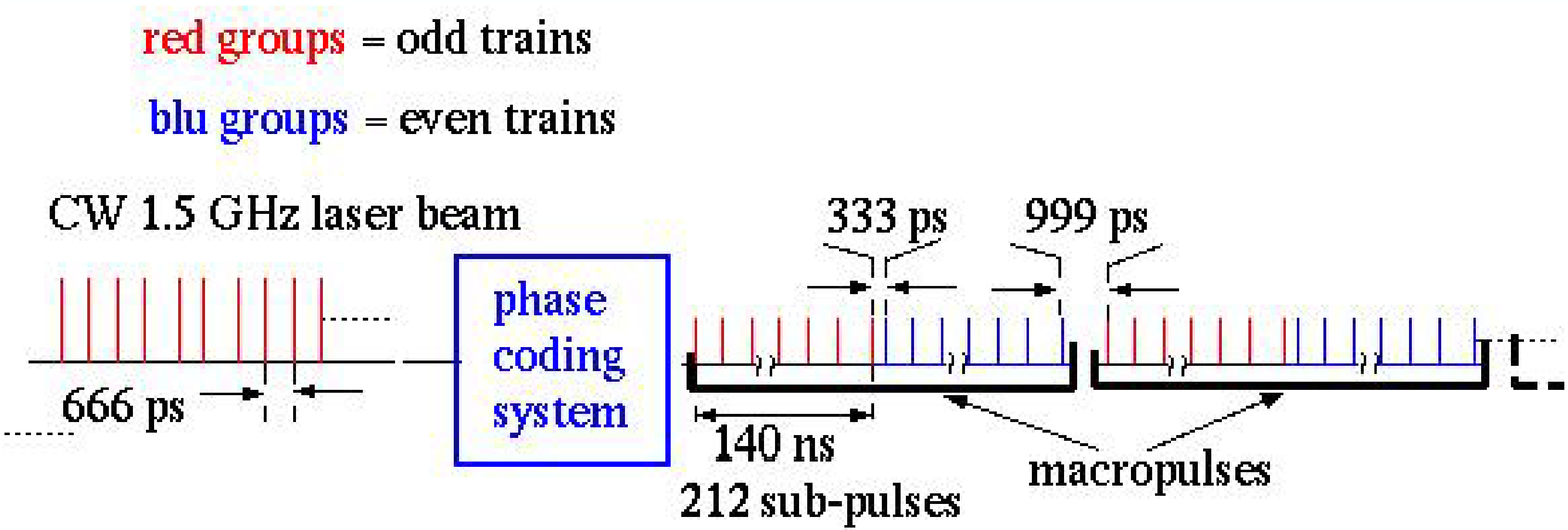
Published articles about laser pulse shaping

- 9 papers
- Conferences proceeedings
- 5 Physics thesis (MI)

Phase Coding system tests in Milano

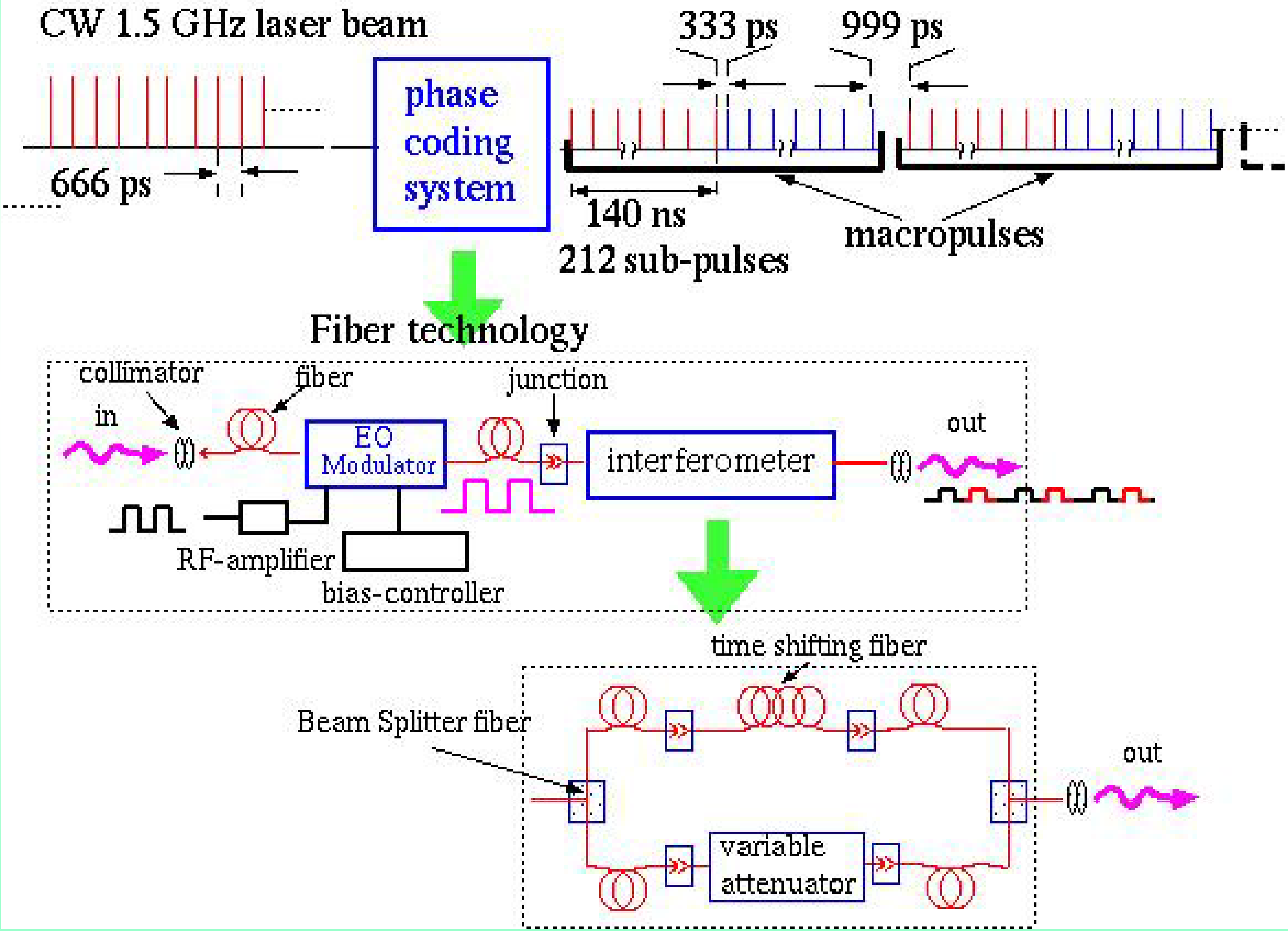
Operation of the Phase Coding System

Re-pattern a CW 1.5 GHz mode-locked laser beam into a laser beam made up of a succession of trains as shown in figure;



red groups = odd trains

blu groups = even trains



THE EXPERIMENTAL TESTS IN MILANO

1. fiber launch losses
2. Modulator losses
3. Fiber-fiber junction losses
4. Fiber beam-splitter losses
5. Entire system losses
6. RF-driver modulus test
7. Full system operation

1- Fiber launch losses

Losses **1 dB**

input and output collimators are lossy about 15 %.

Choose collimators tailored to our wavelength

2- Modulator losses

Pin mW	Pout mW	ε %
75	15	20
170	30	18
250	45	18

About 2 times higher than CCLRC estimate

3-Fiber-fiber junction losses

loss of about **0.5 dB**

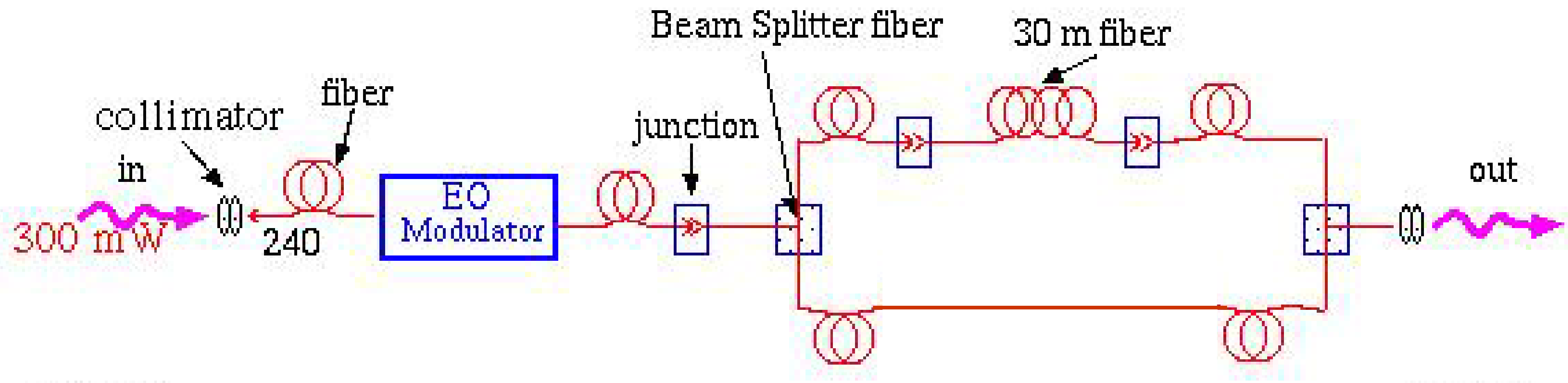
Junction soldered

4- fiber beam splitter losses

Again higher than foreseen

5 F U L L S Y STEM LOSSES

misure con fascio laser in continua (non mode-locked)



CCLRC	1	4.5	0.5	0.5	0.5	0.5	0.5	loss dB
assesments	0.8	0.35	0.9	0.9	0.9	0.9	0.9	P_o / P_i
Milano	ok	7.3	ok	>0..5	ok	ok	>0..5	
measurements		0.18		<0.9			<0.9	

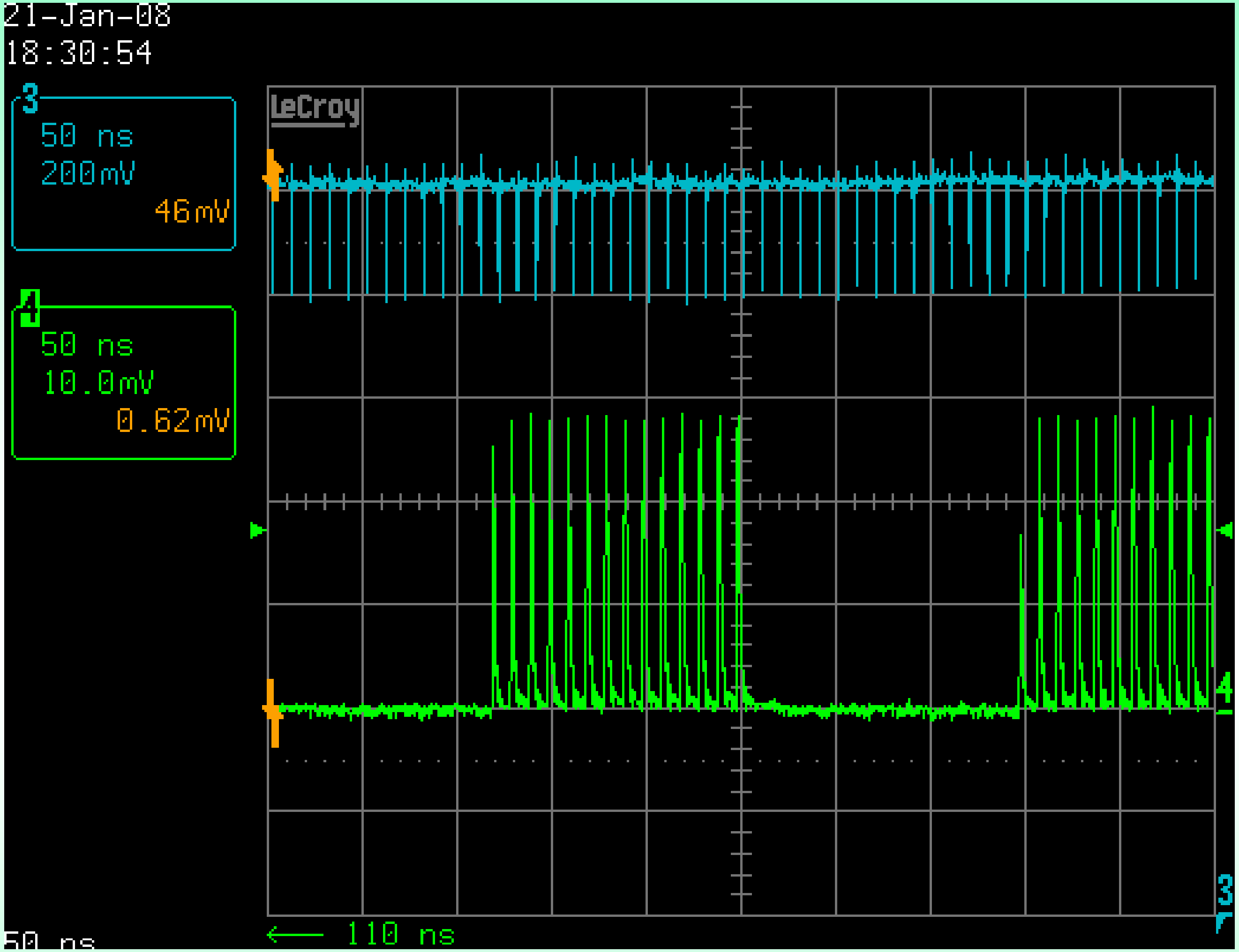
Pin 300 mW expected Pout 10.7 mW

Measured: Pout about 7 mW

Very difficult to set correctly fiber junctions and input fiber launch

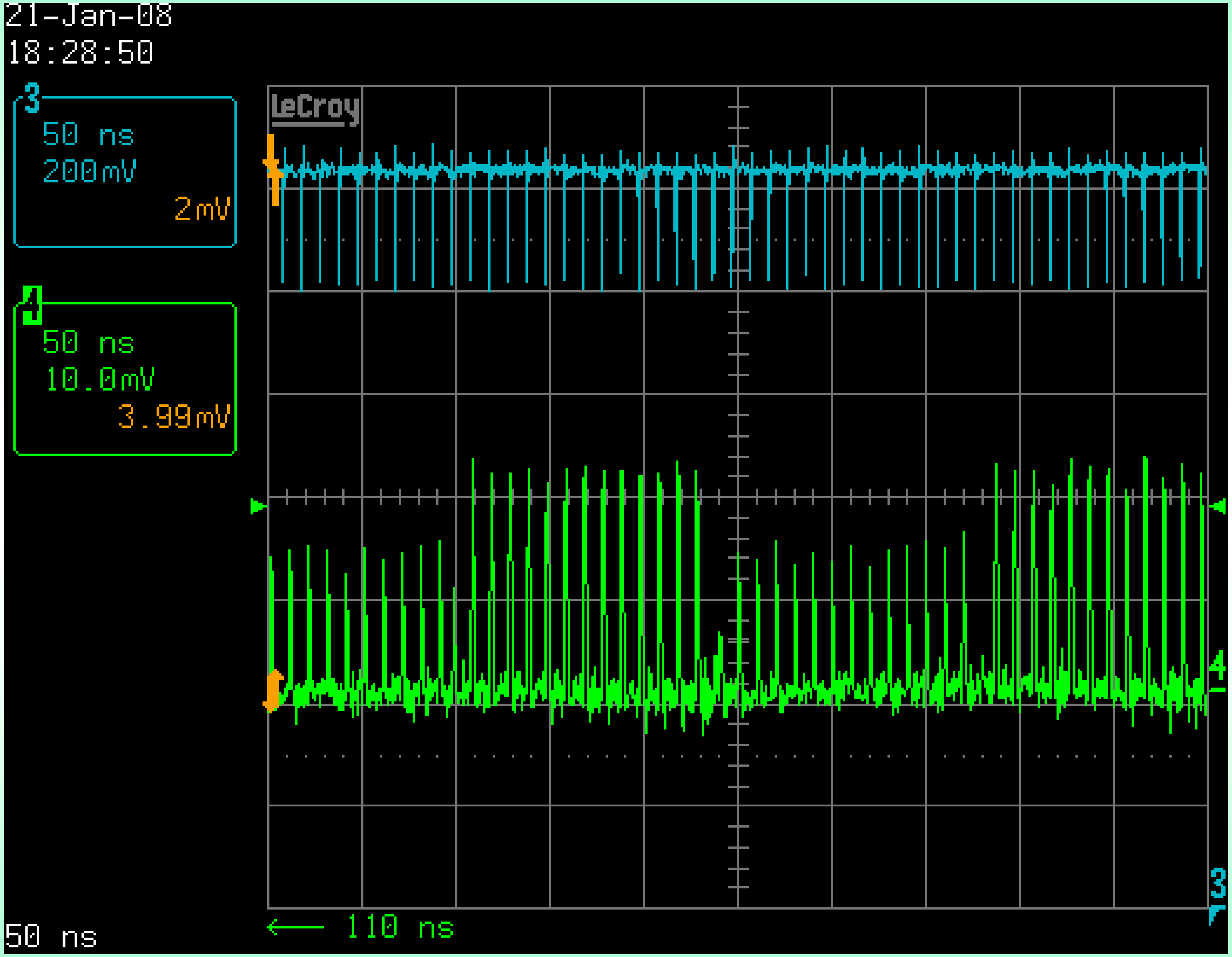
6- test of RF-driver amplifier

The item is now fixed



Trains of the right length are generated

7- full system operation



The interleaving is tested positively

Power test of full system

Pin = 300 mW

Pout = 2 mW measured

Assuming the best launch and junctions

Pout expected 0.017x300 = 5.2 mW

System with soldered junctions and tailored collimators Pout expected 0.045x320= 14.4 mW

Unless we can find a better performace with the modulator