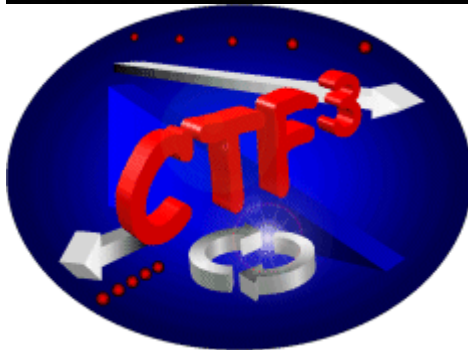


Photo-injector laser chain

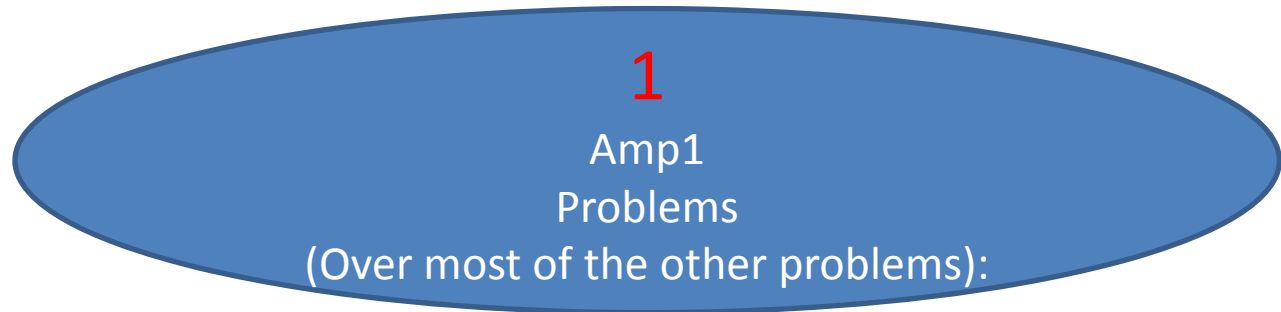
NEWS



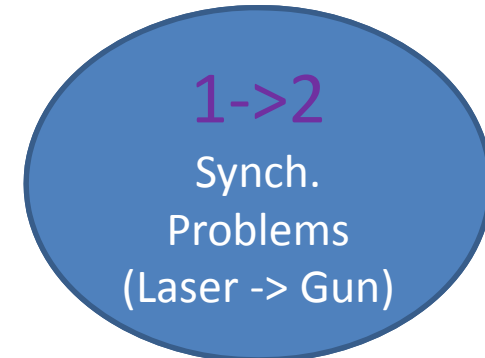
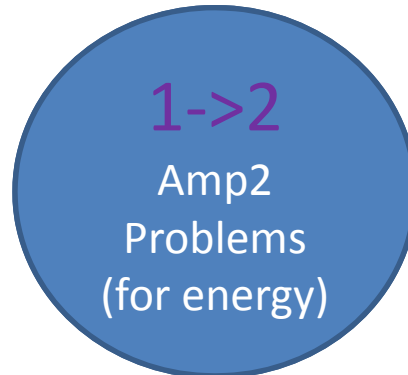
Massimo Petrarca & Marta Divall
V. Fedosseev, K. Elsener, E. Chevallay,

History:

June July 2008
Amp1 problems
(pulses train instability ,
ASE,
parasitic lasing)



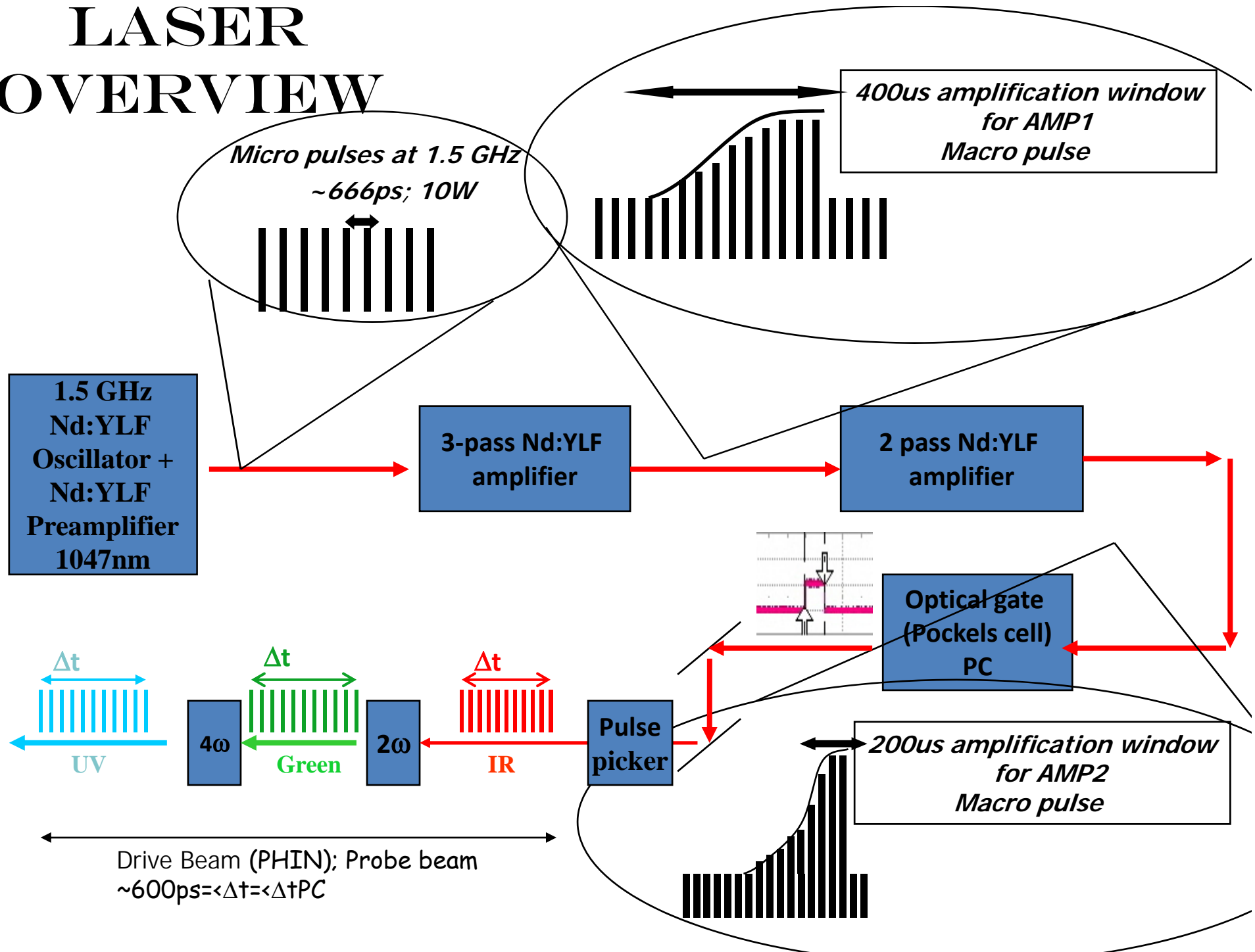
Major issues in
January 2008
When NO
Harmonic generation
was performed!



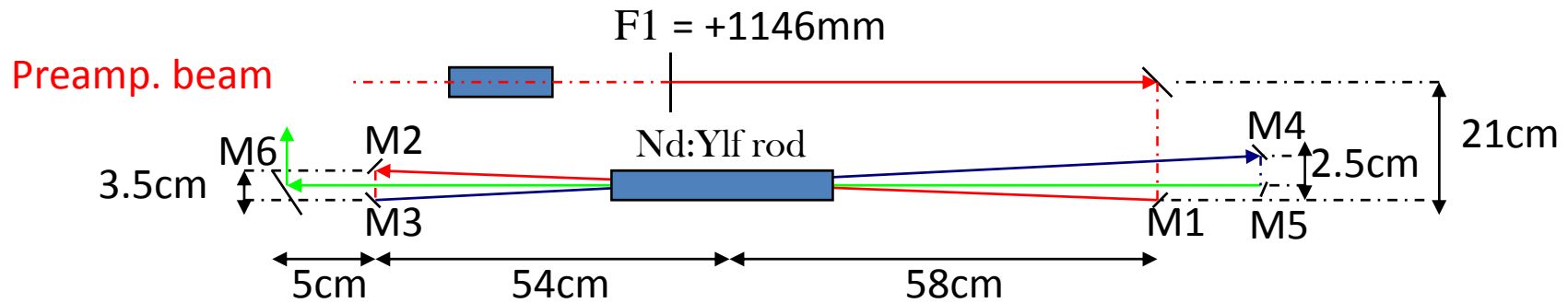
May June 2008
Harmonic generation
Performed with Amp1 only:
New Problems discovered!



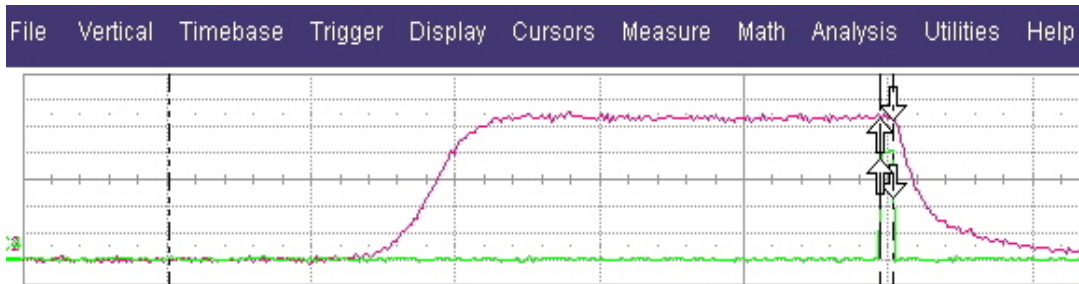
LASER OVERVIEW



First Amplifier layout



1st pass ——— (red line)
 2nd pass ——— (blue line)
 3rd pass ——— (green line)

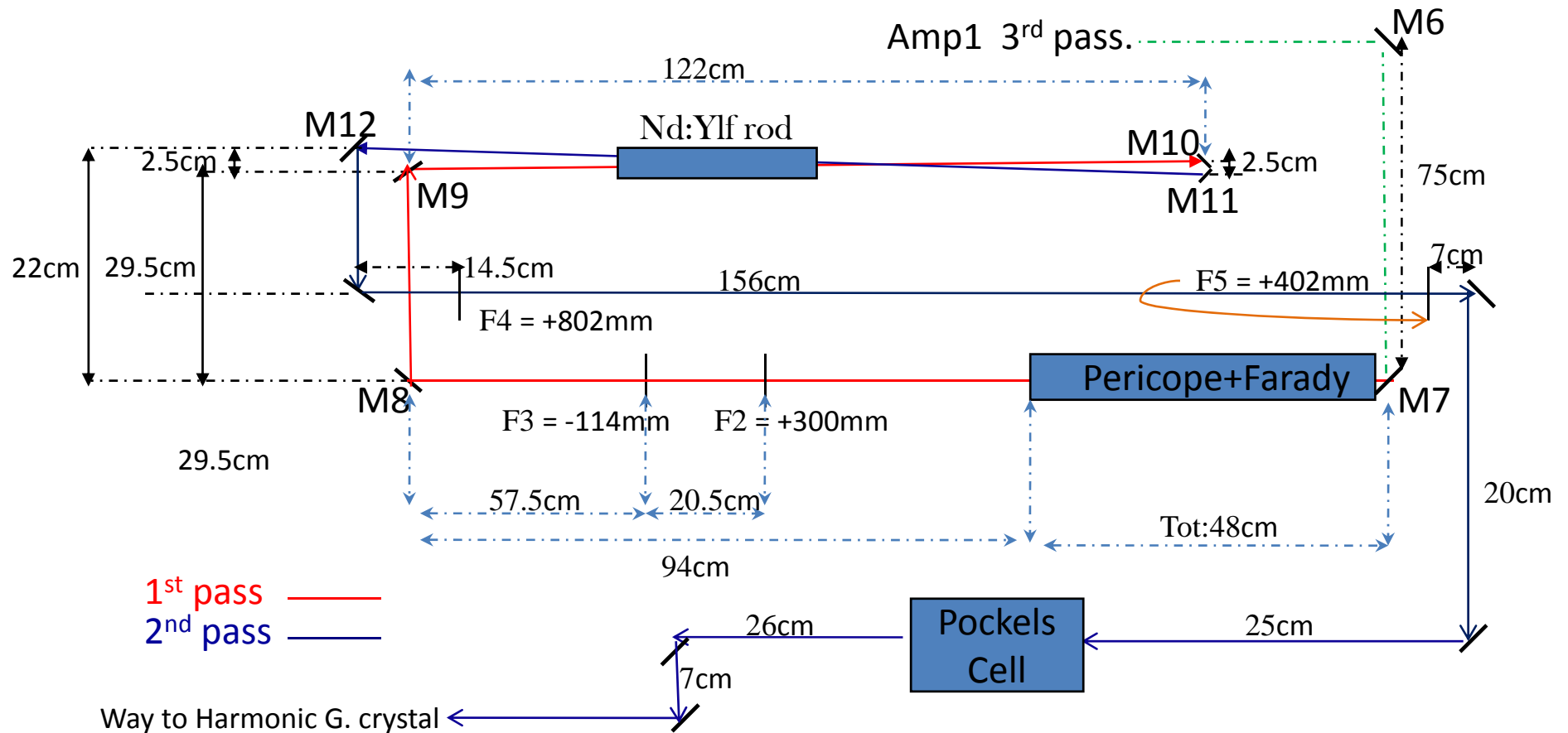


Power Measurements Amp1:

Unamplified → ~ 5.6 W
 @ 50 amps → ~ 6.7 W
 @ 60 amps → ~ 7.4 W
 @ 70 amps → ~ 8.1 W
 @ 80 amps → ~ 8.8 W
 @ 90 amps → ~ 9.7 W →→ ~3.0 KW

-Final configuration: 3 passages through the rod with F1 to ~ compensate for the beam divergence: $X(3^{\text{rd}} \text{ pass}) - X(1^{\text{st}} \text{ pass}) \sim 1.2 \text{ mm}$; $Y(3^{\text{rd}} \text{ pass}) - Y(1^{\text{st}} \text{ pass}) \sim 1 \text{ mm}$.
 Nominal power ~3KW has been reached
 Satisfactory trace pulse stability has been reached
 Transverse beam parameters: $M_x^2 \sim 2.38$; $M_y^2 \sim 1.94$

Amp2: layout



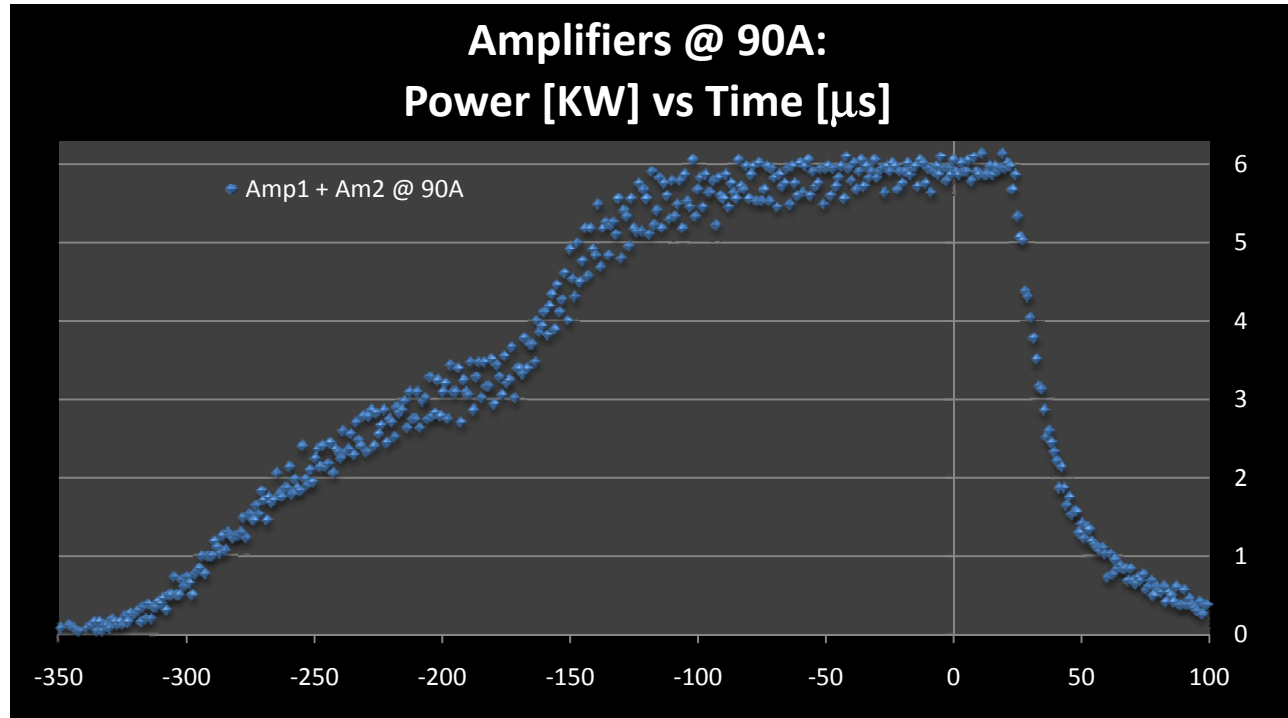
-Present configuration:

2 passages through the rod with F3 and F2 for the matching: "beam size rod size"

Satisfactory trace pulse stability has been achieved

Power ~6.3KW has been reached with 90A (Amp1@90A)

Amp1 + Amp2 @ 90A



Power Measurements Amp1:

Unamplified \rightarrow \sim 5.6 W
@ 50 amps \rightarrow \sim 6.7 W
@ 60 amps \rightarrow \sim 7.4 W
@ 70 amps \rightarrow \sim 8.1 W
@ 80 amps \rightarrow \sim 8.8 W
@ 90 amps \rightarrow \sim 9.7 W $\rightarrow\rightarrow$ \sim 3.0 KW

Power Measurements Amp1 @90A +Amp2 ...:

@ 50 amps \rightarrow \sim 10.0W
@ 60 amps \rightarrow \sim 10.5 W
@ 70 amps \rightarrow \sim 11.2 W
@ 80 amps \rightarrow \sim 11.6 W
@ 90 amps \rightarrow \sim 12.3 W $\rightarrow\rightarrow$ \sim 6.3 KW

Amp1+Amp2 Harmonic Generation

	IR energy within 2 μ s gate	GREEN energy within 2 μ s gate	UV Energy within 2 μ s gate
Amp1 @90amps PC on 2 μ s (Best Result)	(4.15-1.33)mJ std=0.06mJ	~1.2 mJ Std=0.016mJ	0.398 mJ Std=0.012 →133.3 nJ in a micro pulse
		~44 % efficiency	~34 % efficiency
Amp1+Amp2 @90amps PC on 2 μ s	(12.3-4.2)mJ std=0.26mJ	3.23 mJ Std=0.07mJ 40% efficiency	0.692 mJ Std=0.024 →~234 nJ in a micro pulse 22% efficiency

A decrease on the conversion efficiency has been observed when both amplifiers are @90A
Optimization of the beam size onto the conversion crystals has to be done; nevertheless the
conversion efficiency is still acceptable yielding a micropulse energy of ~230nJ (nominal 730nJ)

Collaboration with Guy Cheymol "CEA"

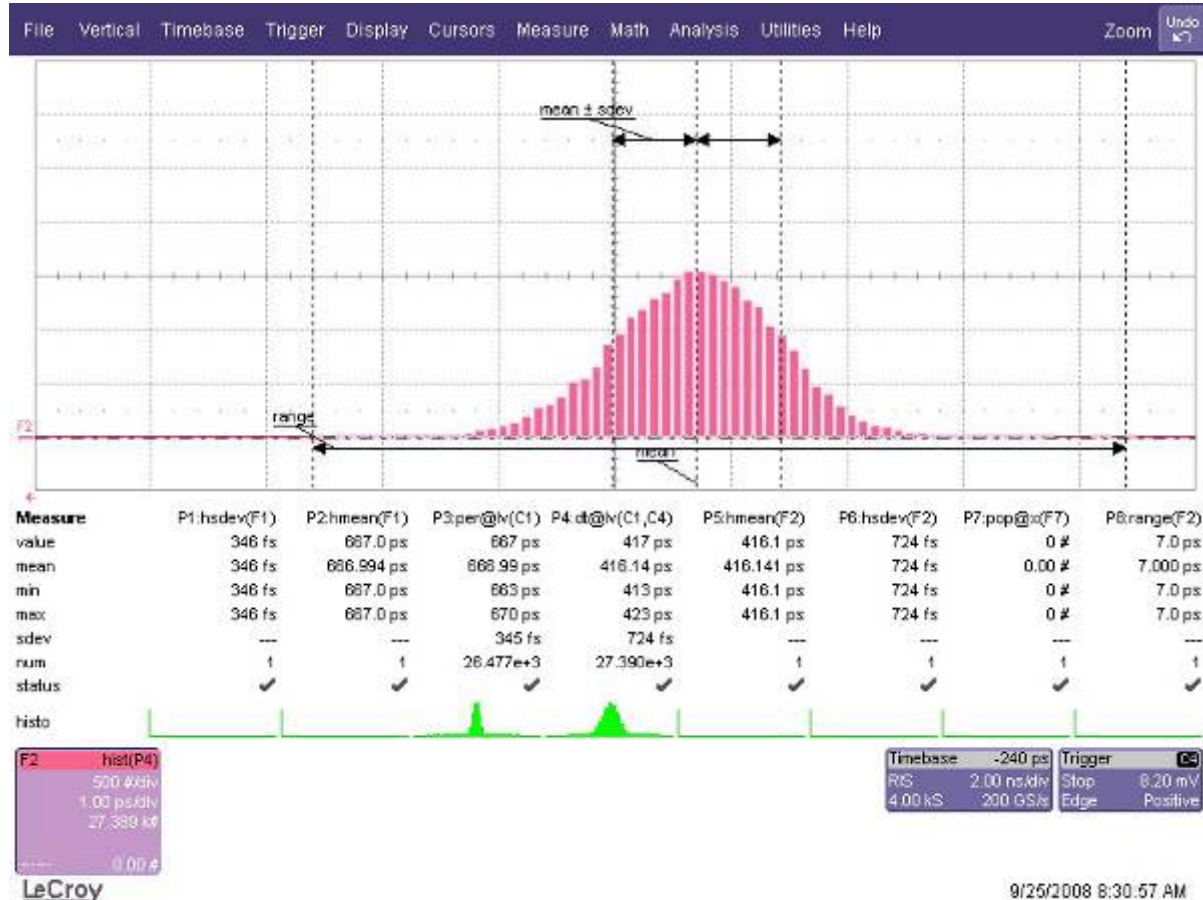
On site synchronization meas.:

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

After on site investigation,
oscillator cavity
perturbations due to
thermal effects were
suspected

HighQ expert came and
fixed the settings of the
oscillator end-cavity mirror
(semiconductor saturable
absorber mirror "SESAM"):
50C
Degree

Problem has been fixed

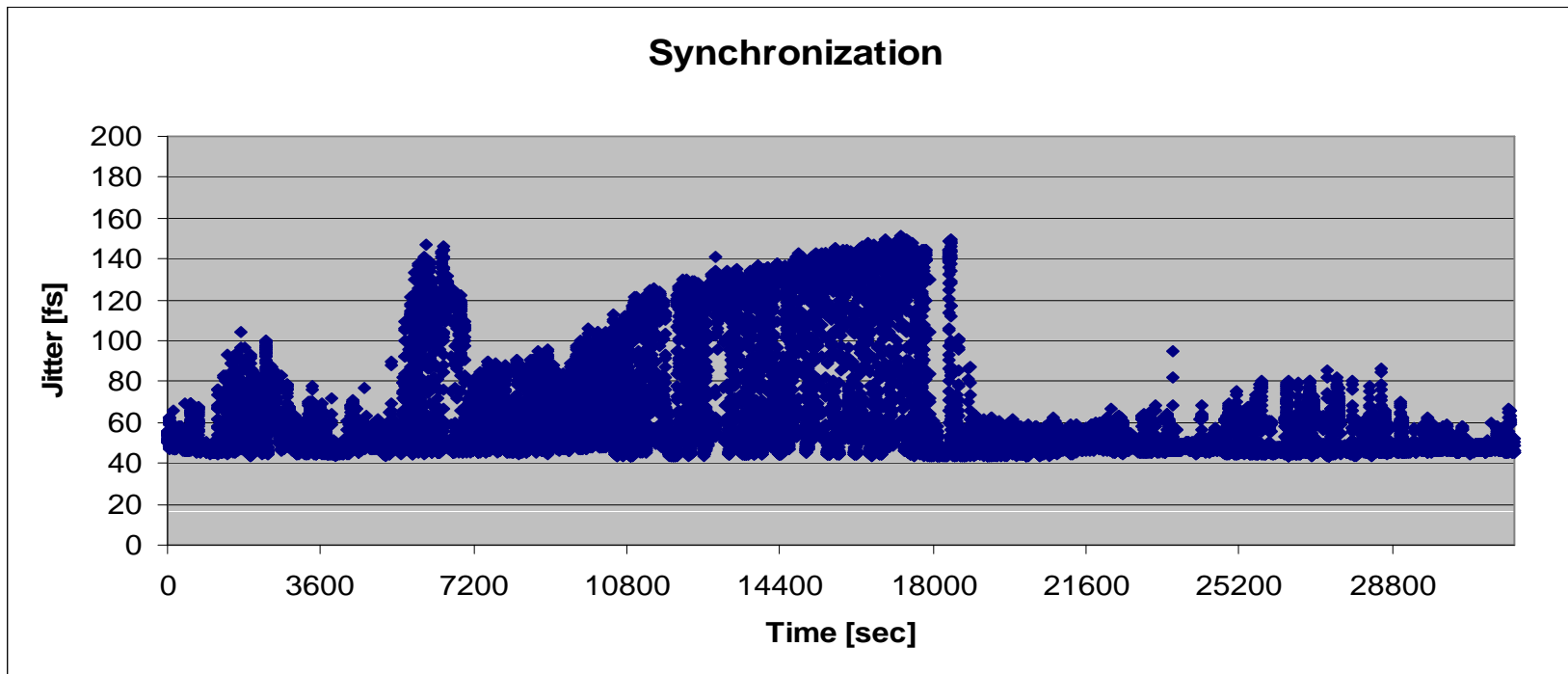


$$J_{real} = \sqrt{(J_{meas})^2 - (JNF)^2}$$

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

→ $J_{real} \sim 634$ fs (rms jitter required <1ps)

HighQ Jitter behavior (over a day)



HighQ company provided
the unit to synchronize the laser to the ext. rf master clock (~1.499): "Synch"
From this unit it is possible to monitor the jitter "Laser vs Ext-rf"

Open Issues:

Even more difficult (it takes time!!):

- The rod probably has to be changed to improve transverse beam profile (poor quality now!).
- Third passage has to be installed to extract more energy and to compensate for thermal effect introduced by Amp1 .
 - Lenses system for the matching “rod -beam” size along the 3 passages has to be installed (optimization of the whole beam line that comes after!!!!)
- Coupling: “Pumping beam vs Nd:Ylf rod” has to be study (no cylindrical lenses installed now; it could be necessary to replaced those lenses to focus pumping beam into the rod.)
- Conversion efficiency studies (saturation, best size onto crystals....)
 - Collaboration (starting) with Russian people from ‘Institute of Applied Physics ’, they will help us performing the changes required to improve the laser performances: Amp2 layout modification + Harmonic Generation scheme modification → Higher IR energy, conversion efficiency & better beam profile

THE END

