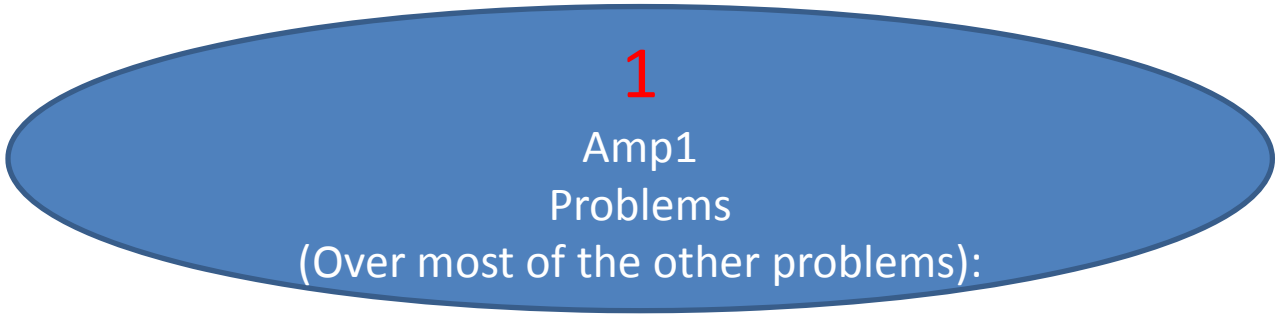
Phto-injector laser chain NEWS

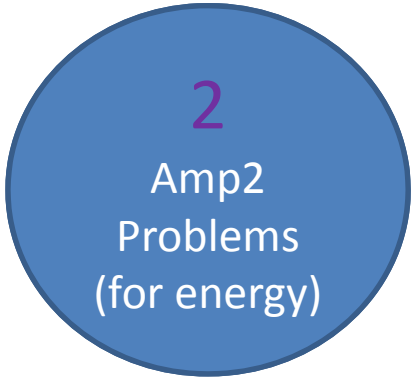
Massimo Petrarca & Marta Divall

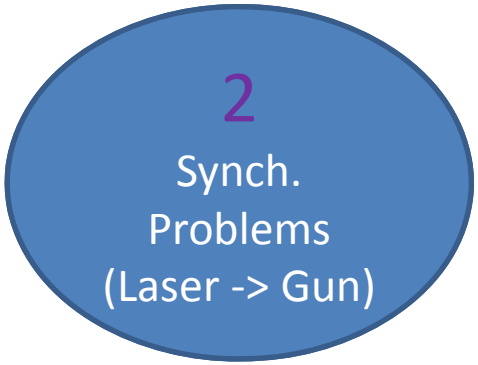
History:

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



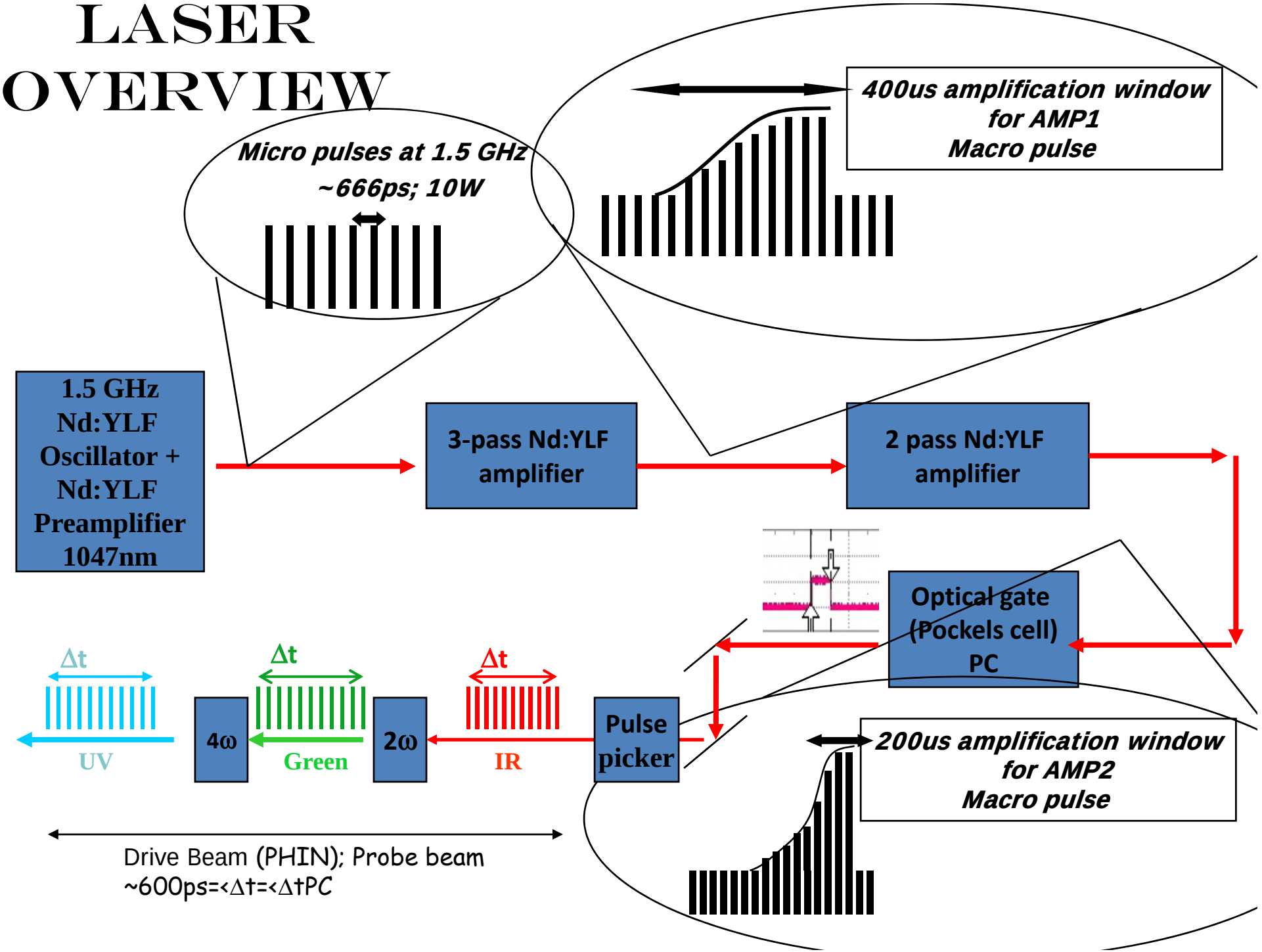
Major issues in
January 2008
When NO
Harmonic generation
was performed!



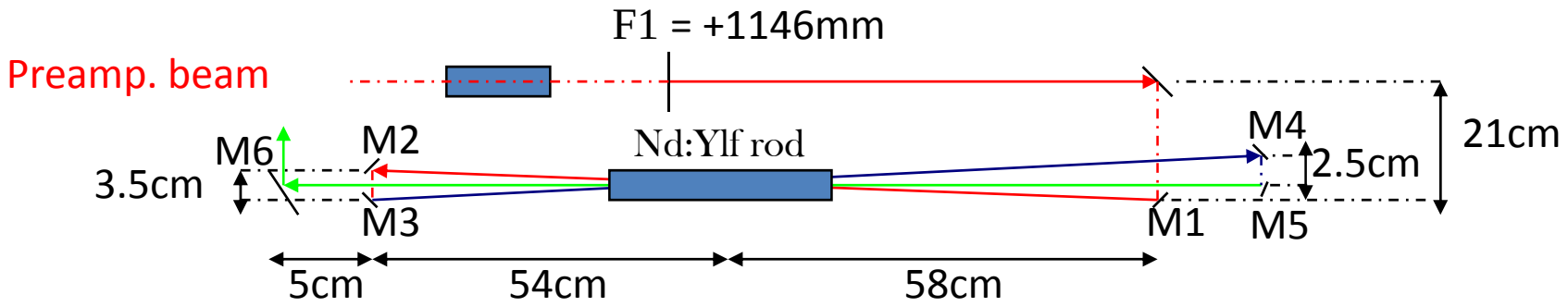


May June 2008
Harmonic generation
Performed with Amp1 only:
New Problems discovered!

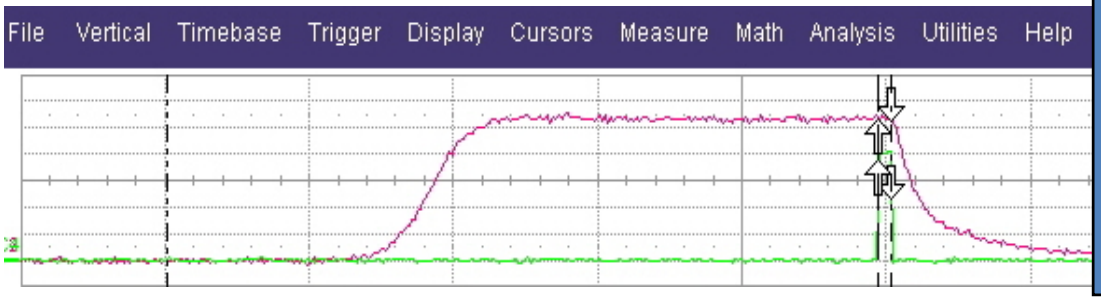
LASER OVERVIEW



First Amplifier layout



1st pass
2nd pass
3rd pass



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

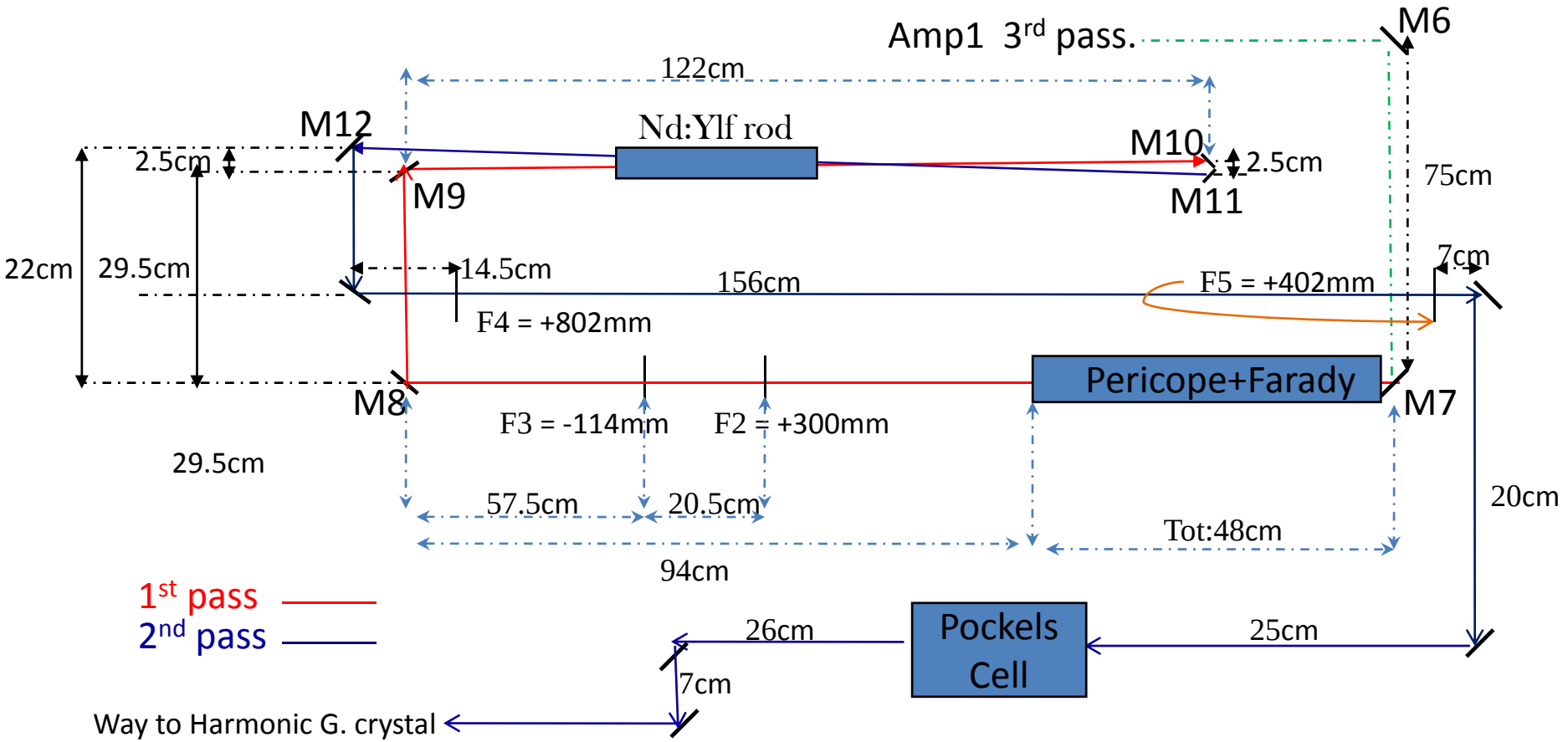
-Final configuration: 3passages trough the rod with F1 to ~ compensate for the beam divergence: X(3rd pass)-X(1st pass)~1.2mm; Y(3rd pass)-Y(1st pass)~1mm .

Nominal power ~3KW has been reached

Satisfactory trace pulse stability has been reached

Transverse beam parameters: M^2_x~2.38; M^2_x~1.94

Amp2: layout



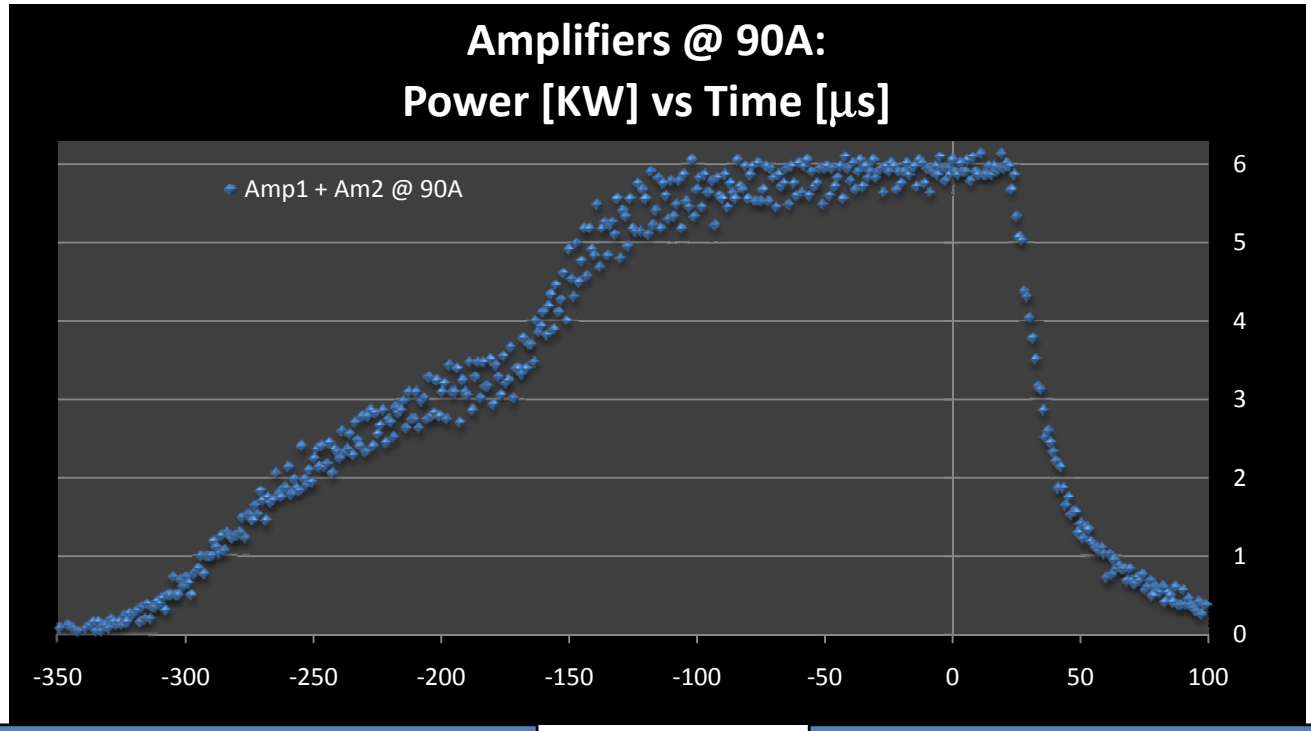
-Present configuration:

2passages trough 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



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@ 90 amps → ~ 9.7 W →→ ~3.0 KW

Power Measurements Amp1 @90A +Amp2 ..:

@ 50 amps → ~ 10.0W
@ 60 amps → ~ 10.5 W
@ 70 amps → ~ 11.2 W
@ 80 amps → ~ 11.6 W
@ 90 amps → ~ 12.3 W →→ ~6.3 KW

Amp1+Amp2 Harmonic Generation

	IR energy within 2μs gate	GREEN energy within 2μs gate	UV Energy within 2μs gate
Amp1 @90amps PC on 2μs (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 2μs	(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"

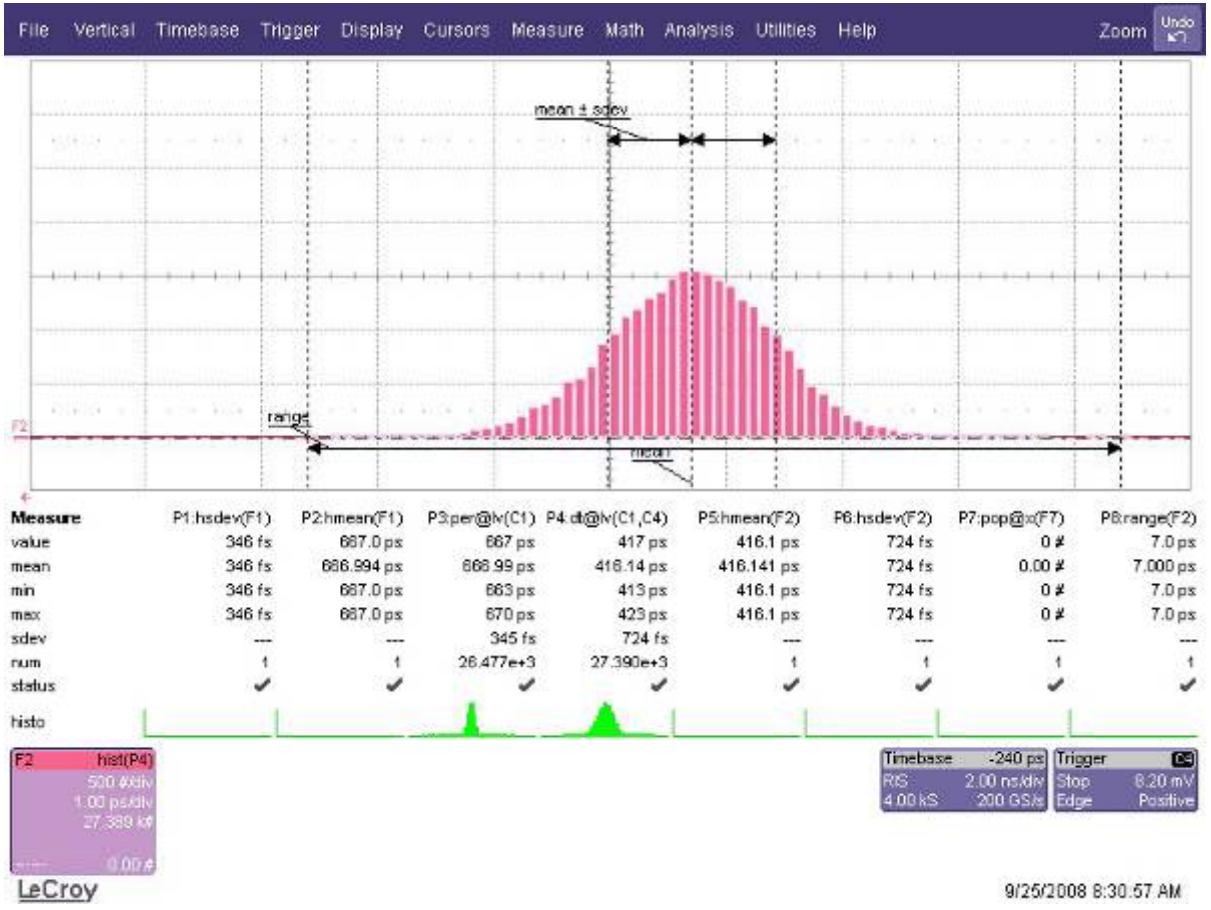
On site synchronization meas.:

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

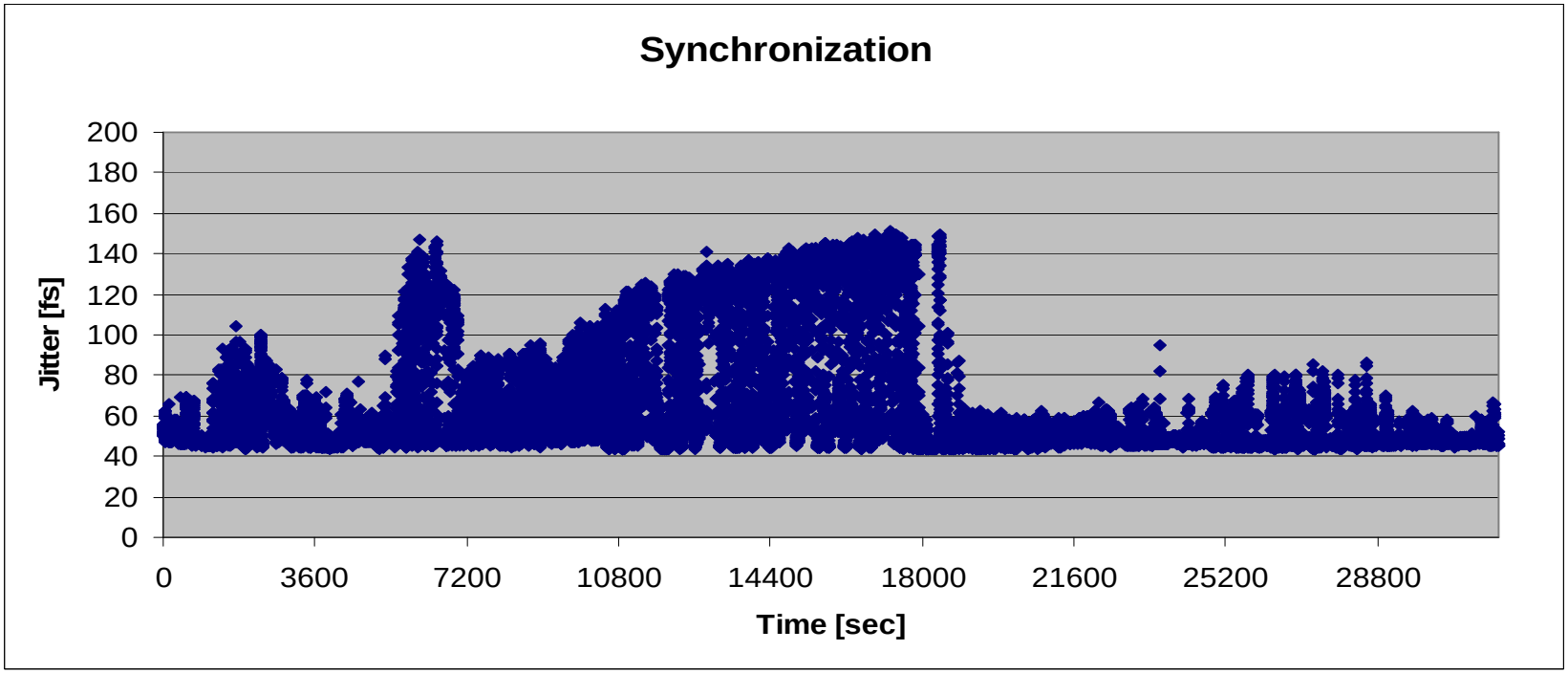


$$J_{real} = \sqrt{(J_{meas})^2 - (JNF)^2}$$

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

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

HighQ Jitter behavior (over a day)

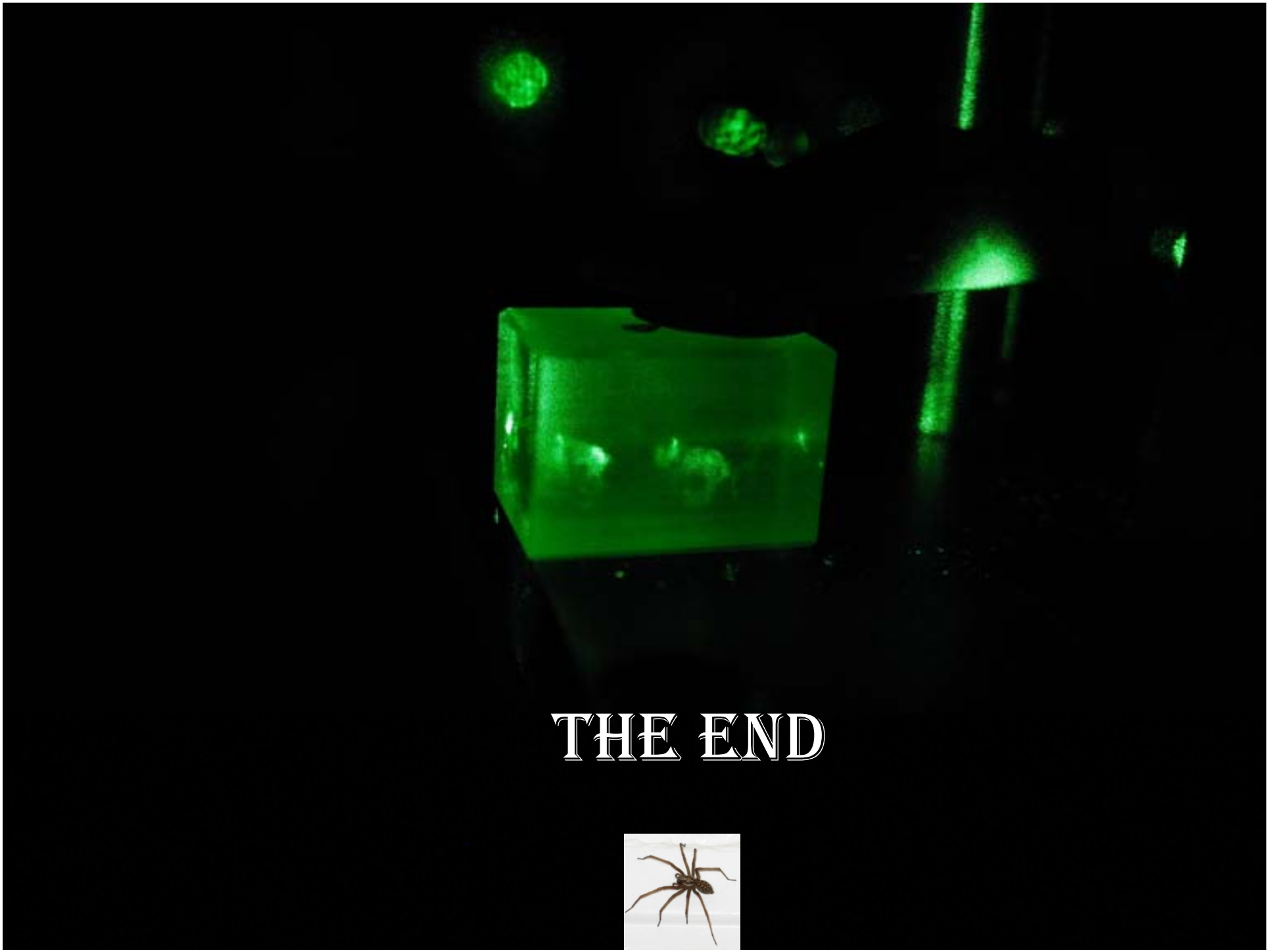


HighQ company provided
the unit to synchronize the laser to the ext. rf master clock (~1.499):“Synch”
From this unit it is possible to monitories the jitter “Laser vs Ext-rf”

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 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….)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