CTF3
Laser Status

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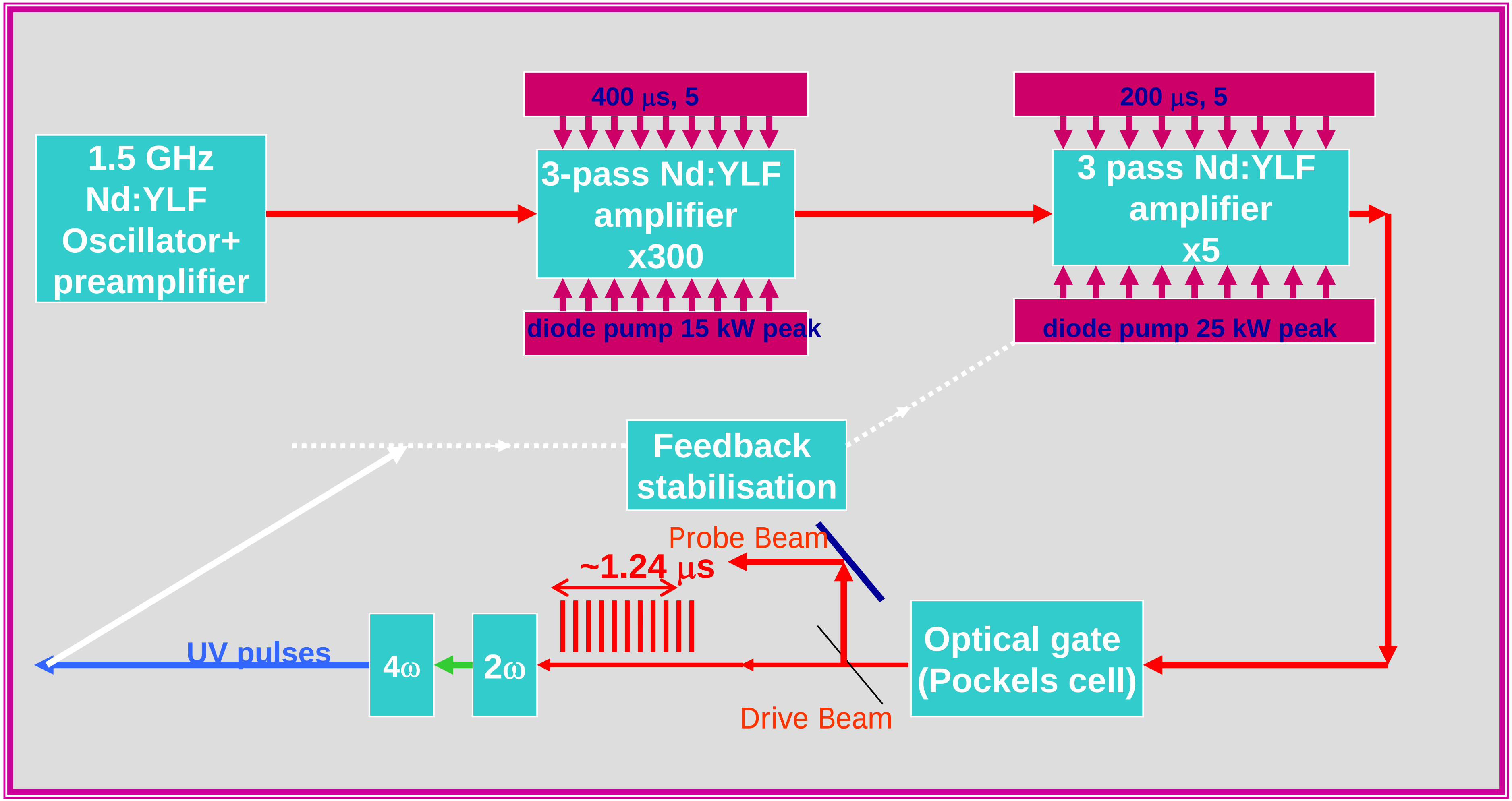
GENERAL

LASER CHAIN LAYOUT



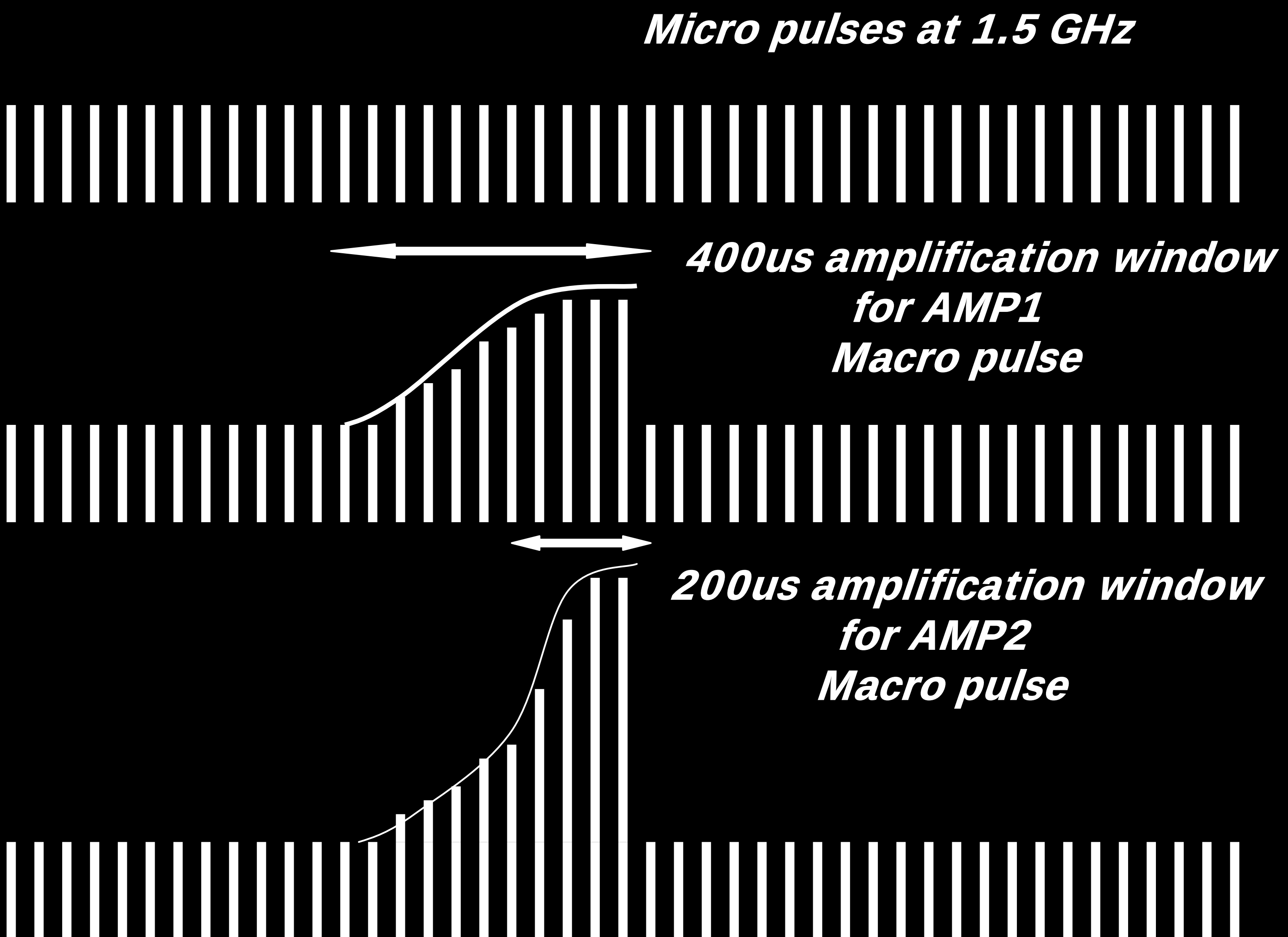
General pulse structure layout

not in scale

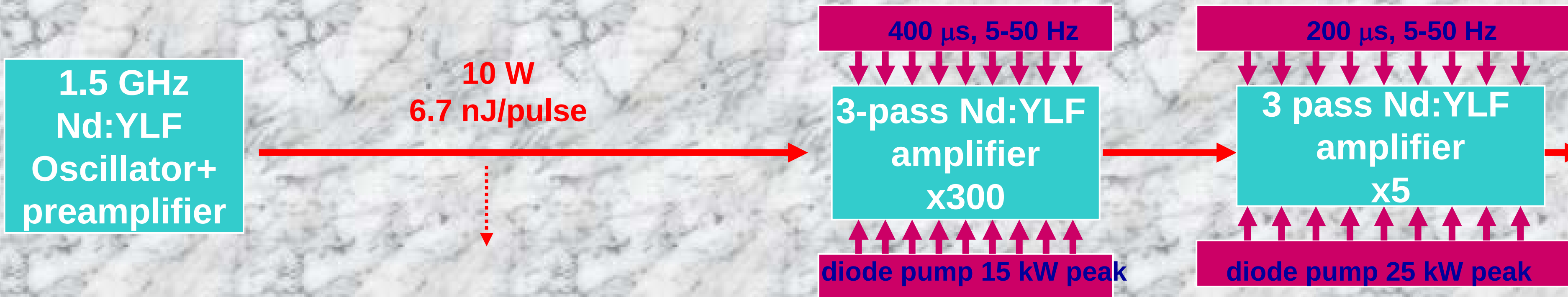
Oscillator
&
Preamplifier
1.5 GHz;
10W AVG
Power

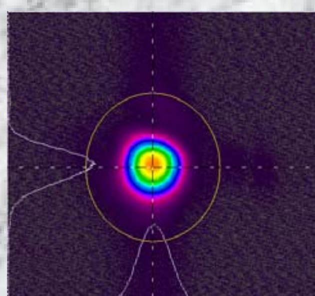
AMP1 @ 90A
400 us;
5Hz
3KW Peak
Power

AMP1 + AMP2
@90 A
400 us;200us
5Hz
14 KW Peak
Power

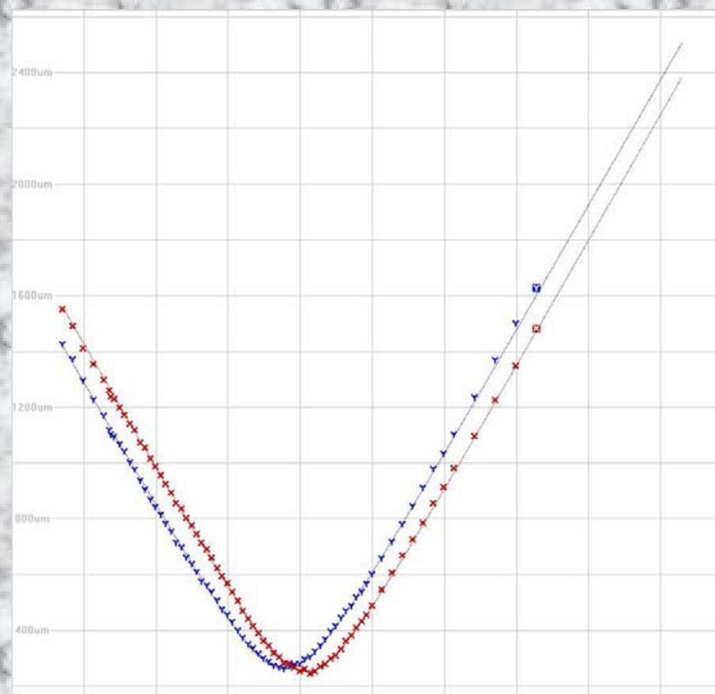


STEP BY STEP CHARACTERIZATION





Preamp beam spot profile



Preamp beam spot size

During M^2 measurements

M^2 results:

Laser		
Waist Width X	5.942e+02	um
Waist Width Y	6.891e+02	um
Divergence X	2.766e+00	mrad
Divergence Y	2.460e+00	mrad
Waist Loc X	1491.72	mm
Waist Loc Y	1608.35	mm
M² X	1.23	
M² Y	1.27	

STEP BY STEP CHARACTERIZATION

1.5 GHz Nd:YLF Oscillator+ preamplifier → **3-pass Nd:YLF amplifier x300** → **3 pass Nd:YLF amplifier x5** →

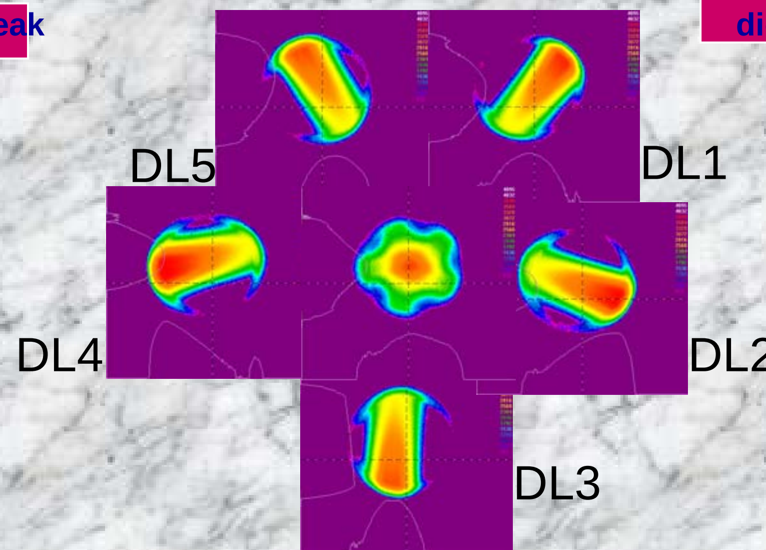
400 μs, 5-50 Hz

diode pump 15 kW peak

~3 kW
2 μJ/pulse

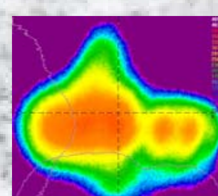
200 μs, 5-50 Hz

diode pump 25 kW peak

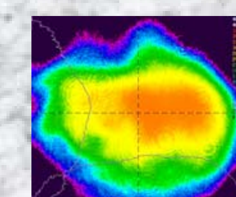


Spontaneous emission from AMP1 rod.
Cylindrical lenses are present to focus the pump diode into the rod

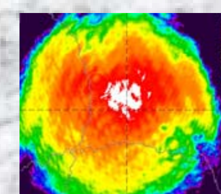
Improvements on the beam spot quality



I=70A



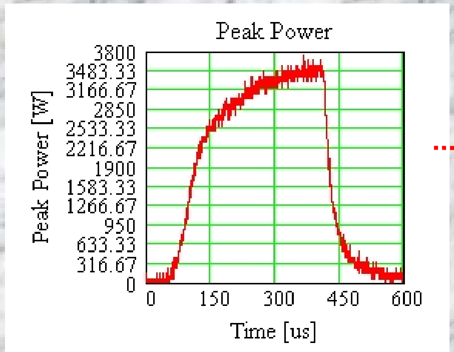
I=90A
P=13.2W



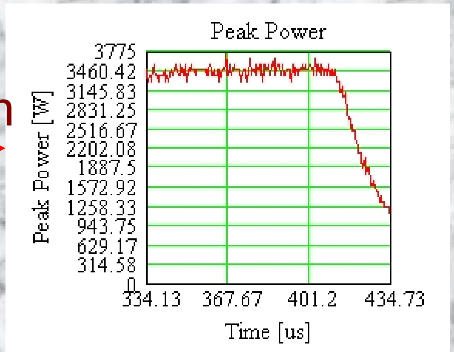
I=90A
P=12.9W

STEP BY STEP CHARACTERIZATION

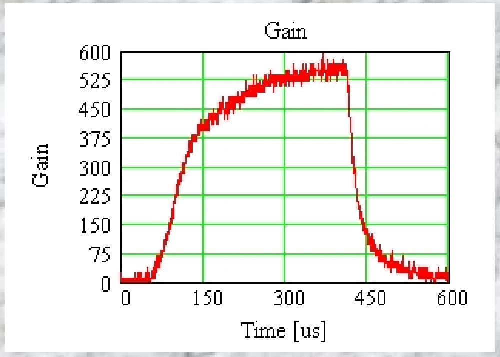
Time structure of the
macro pulse coming out of AMP1
Peak Power, Gain and Energy
Measured @ 90A

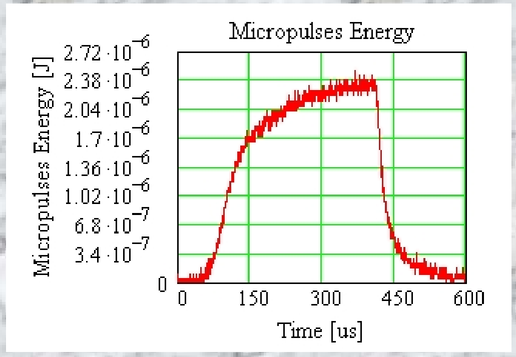


Zoom in



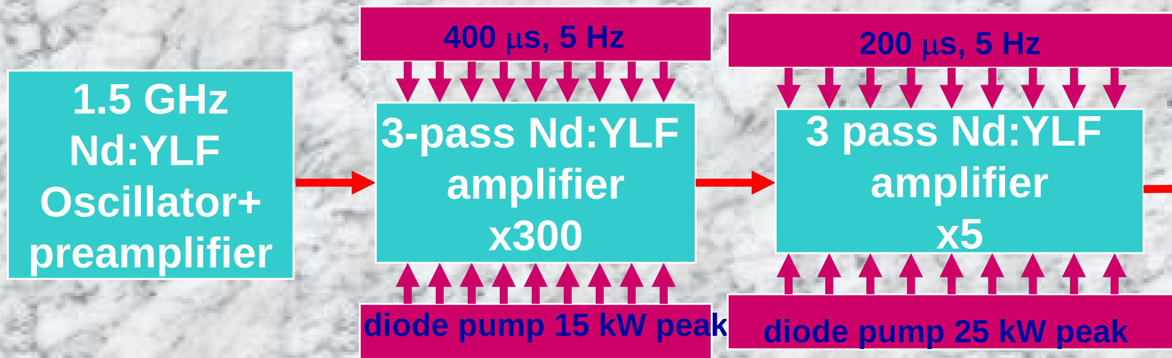
The peak power of the macro pulse
thus the
the gain and micro pulse energy
are well above the specs



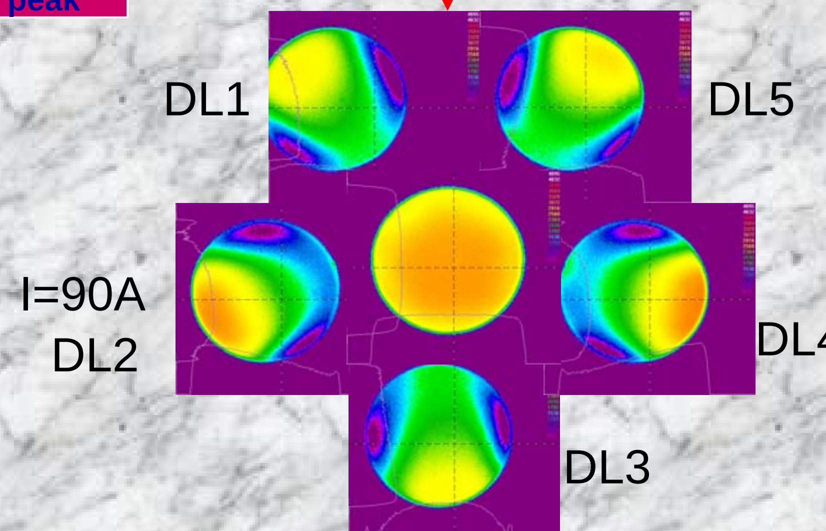


STEP BY STEP CHARACTERIZATION

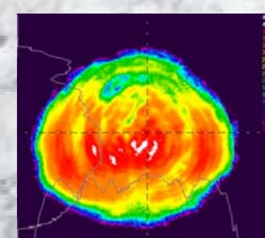
In order to obtain more free space on the optical table the second amp. has been disassembled and assembled again. Now the other devices can be mounted on the table.



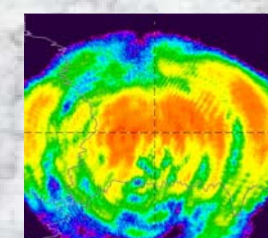
Spontaneous emission from AMP2 rod.
Cylindrical lenses are not present



After straightforward alignment:
Beam spot after AMP1 and AMP2 both @ 90A

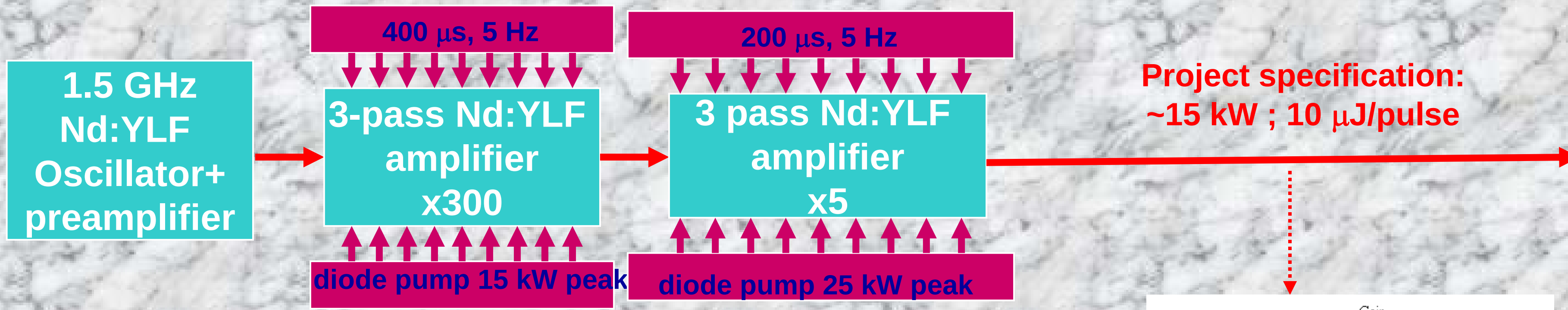


With lens to fit the camera

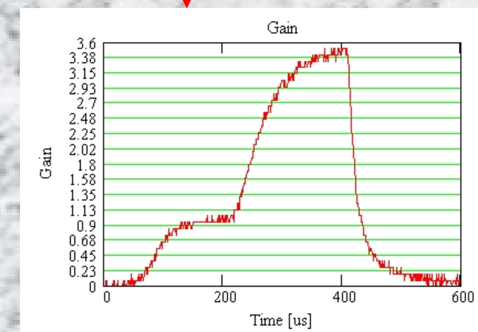


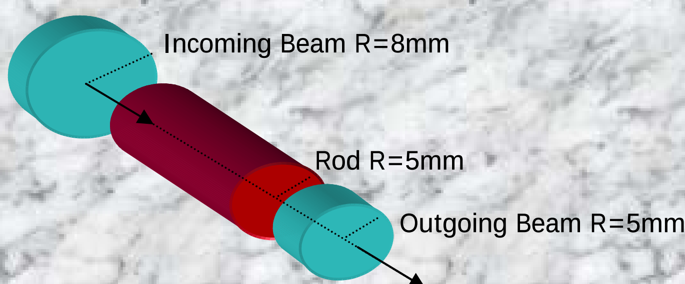
Without lens

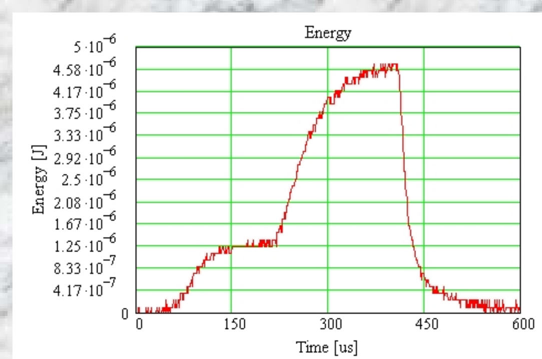
STEP BY STEP CHARACTERIZATION

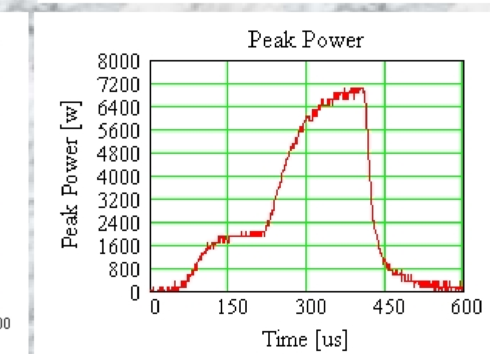


After straightforward alignment:
Time structure
Gain, Peak Power and Energy
when
AMP1 and AMP2 are
both @ 90A



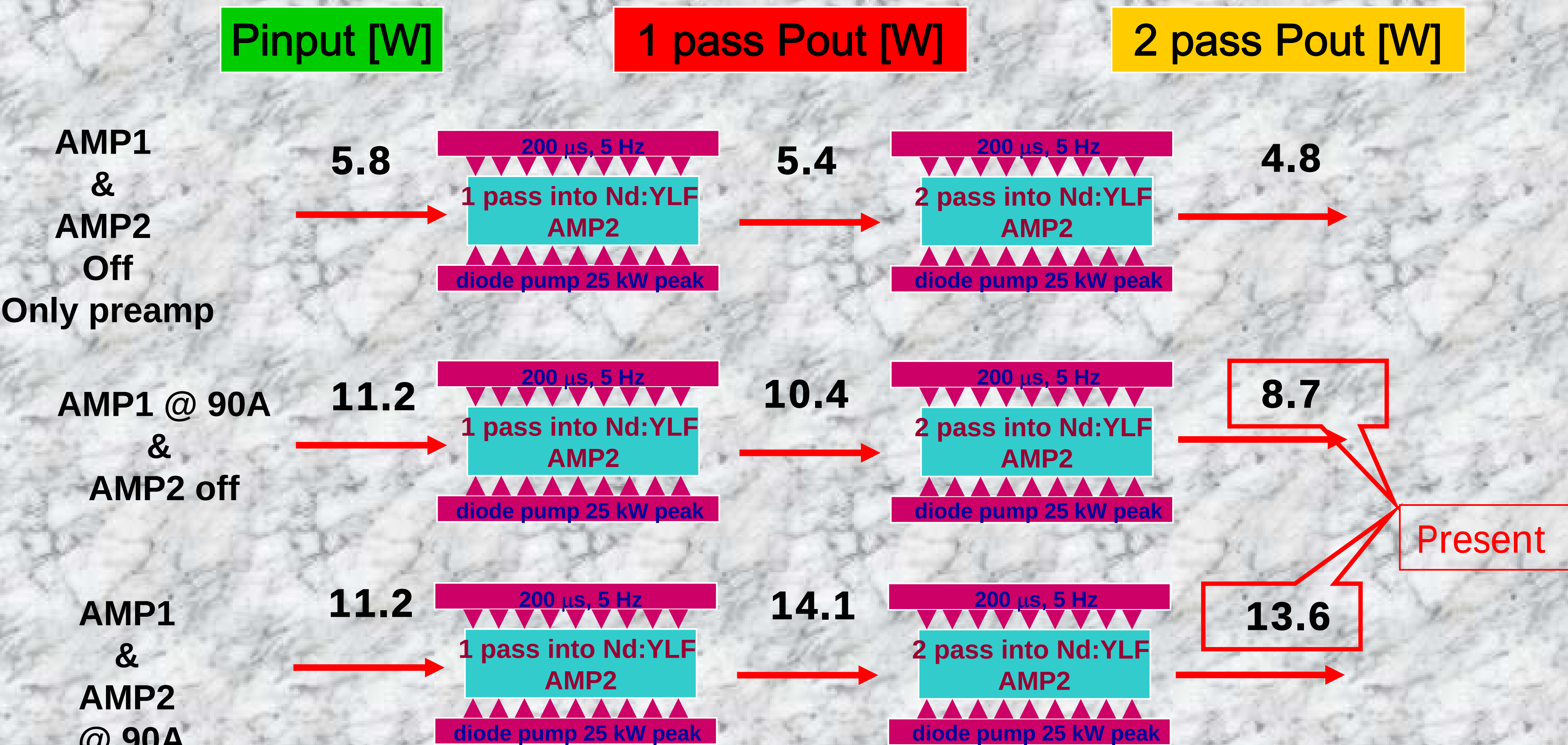






The micro pulse specified in the project is still not achieved
Why? → Losses due to beam cut into AMP2

Gain & Beam cut losses



Comparing with past results (RAL):

14.2-9.7 = 4.5 W past → 13.6-8.7= 4.9 W now

(Note: Gain is important not avg. power)

But we have to compensate for the beam cut losses

Past (RAL)

Reducing Telescope

In order to decrease the beam spot dimension thus the beam cut losses through AMP2, a decreasing telescope has been installed between the two amplifier.

The beam size without telescope is too big for 2 reasons:

1) a non collimating telescope before AMP1 is present

2) The Nd:YLF acts like a diverging lens

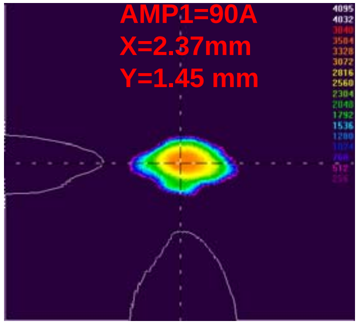
Power measurements to control the beam cut losses :

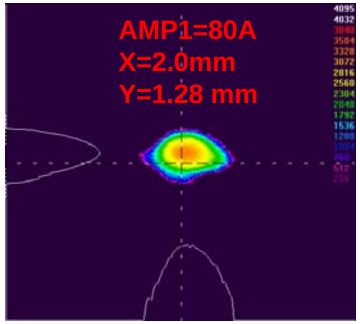
AMP2 is off, the amplified beam from AMP1 @ 90A is sent into AMP2

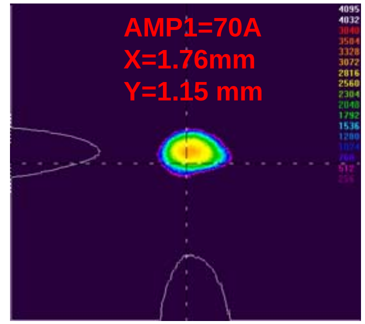
AMP2 is off, the unamplified beam from AMP1 @ 0A is sent into AMP2

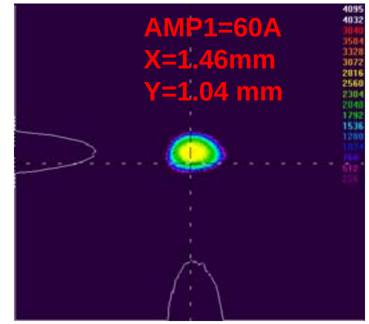
Beam Spot vs AMP1 diodes current

Beam spot Before AMP2

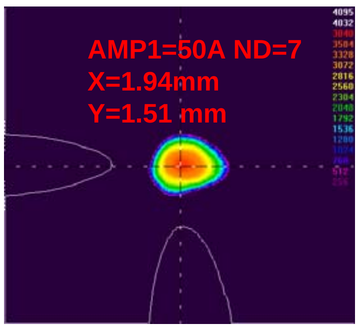


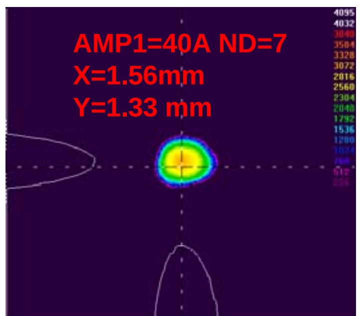


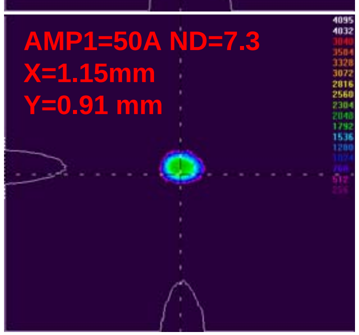


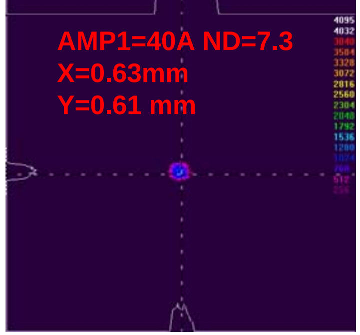


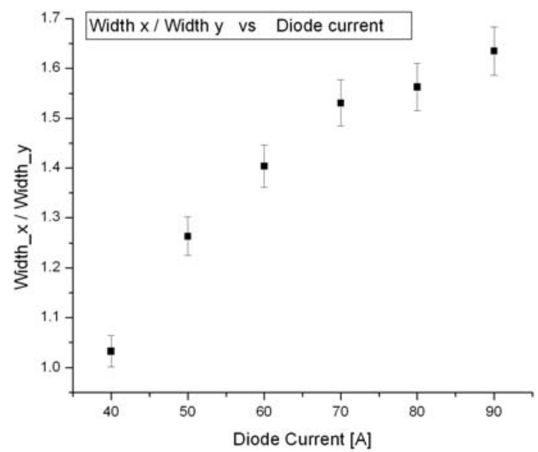
ND=7.3







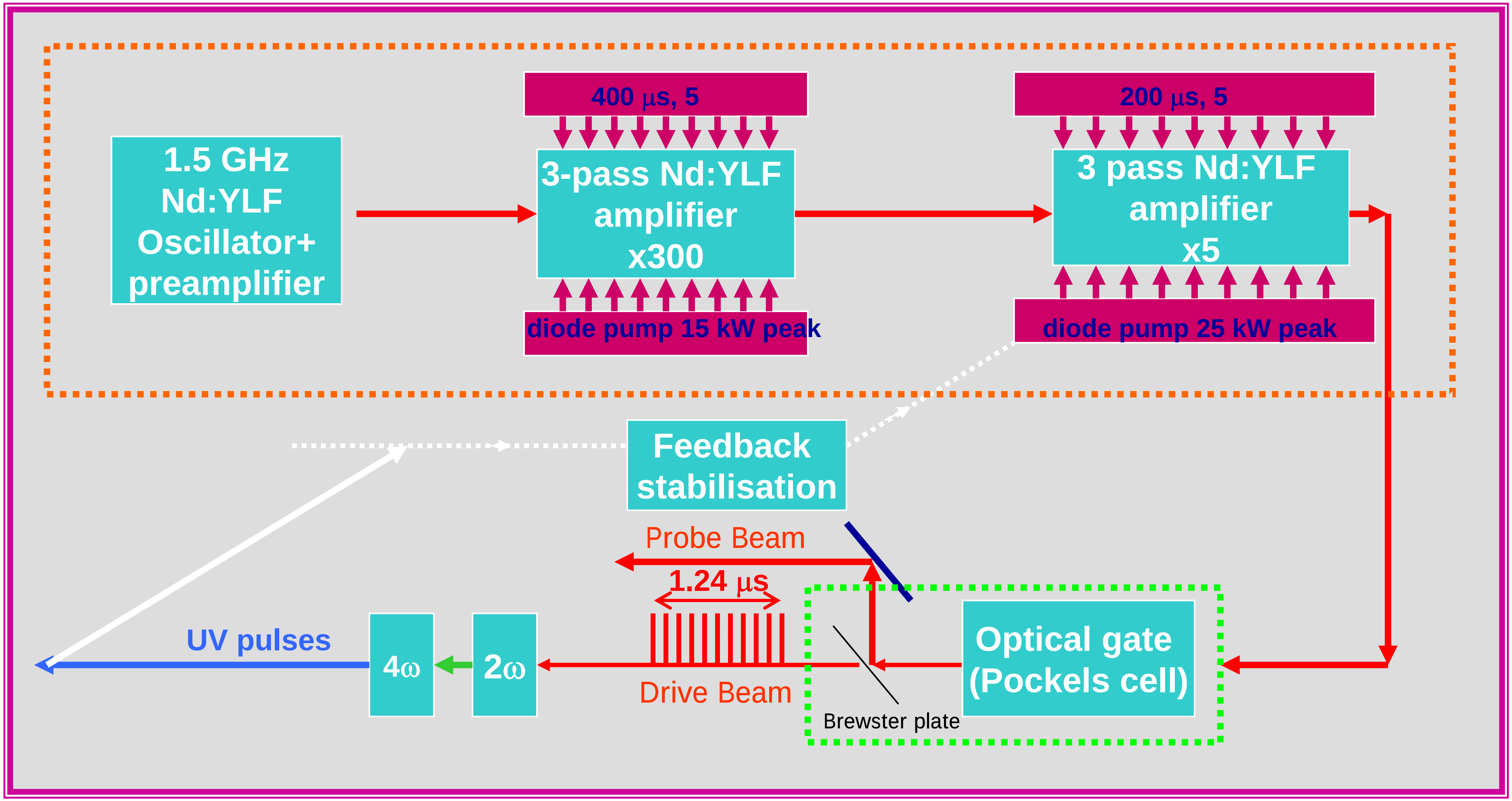




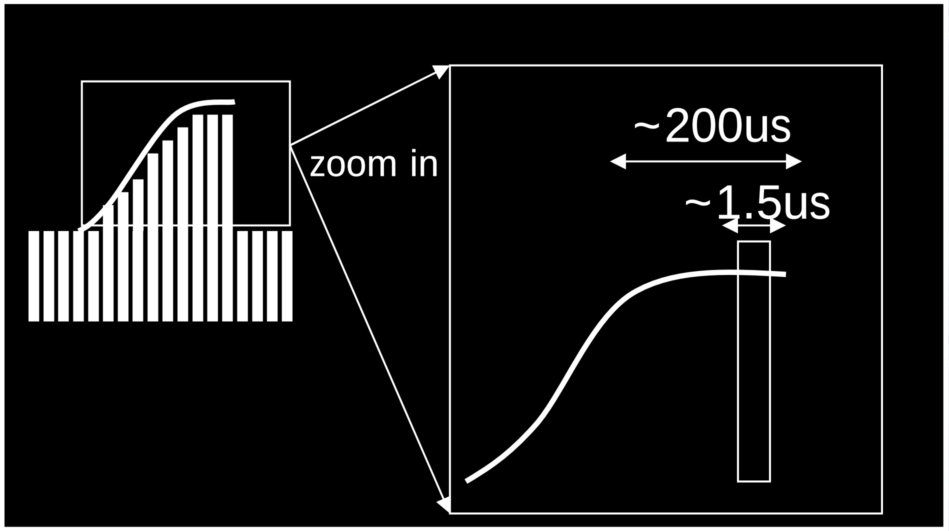
The symmetry in intensity is satisfactory

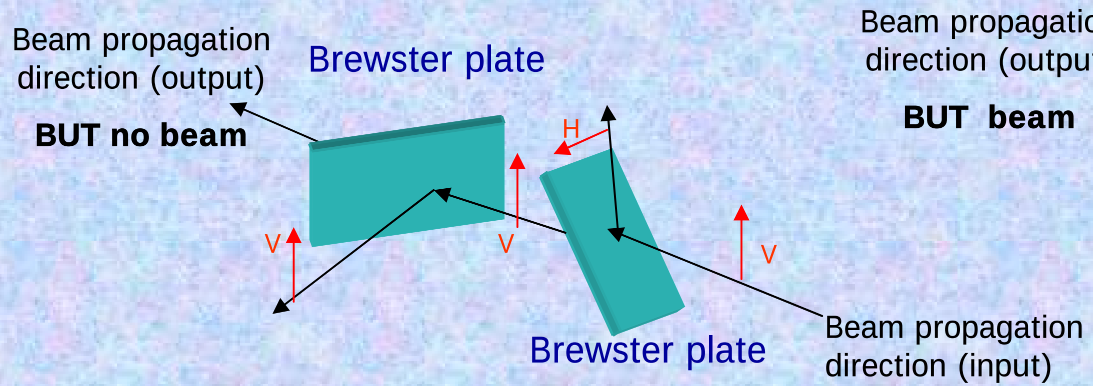
But the shape is elliptical → thermal effect during amplification: Nd:YLF acts like diverging lens→ cylindrical lenses to compensate for have to be put.

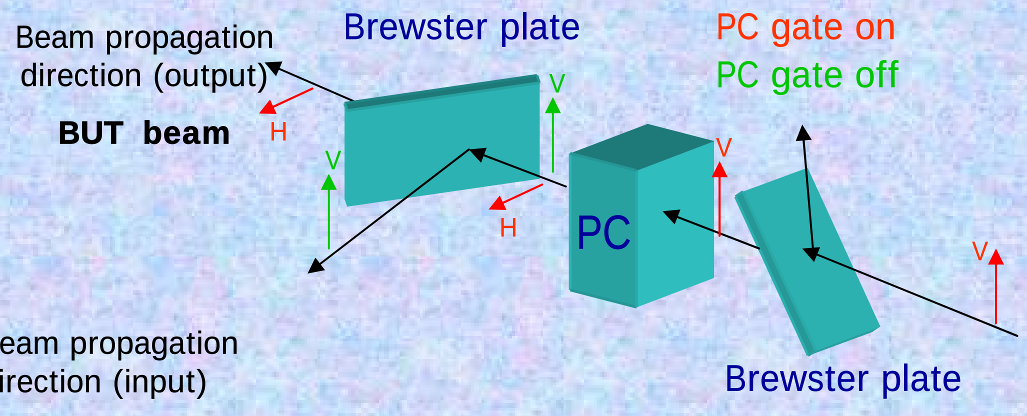
"POCKELS CELL" POSITION



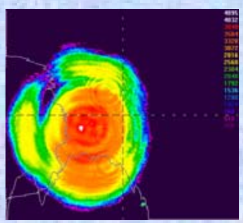
POCKELS CELL (PC) INSTALLATION







Final beam spot after PC, AMP2 off, AMP1 90A

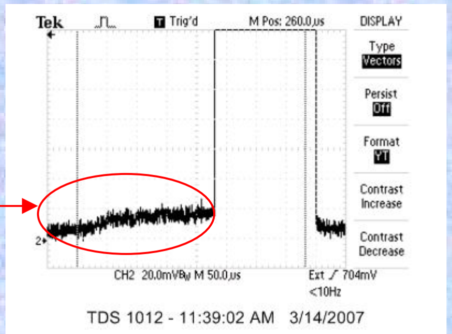


Power:

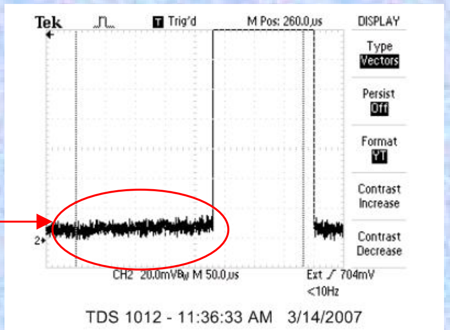
Gate: (390 -> 400)us → 0.14W → ~2.8 KW

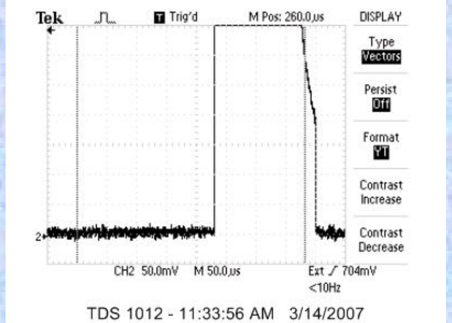
Pockels Cell (PC) Installation
Transmission Efficiency

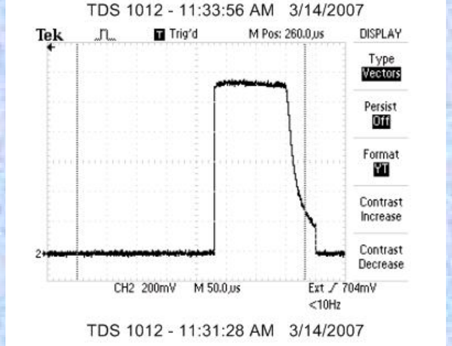
No good transmission:
Brewster plates
slightly misaligned



Improvements:

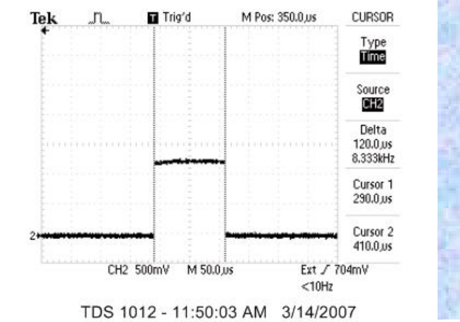




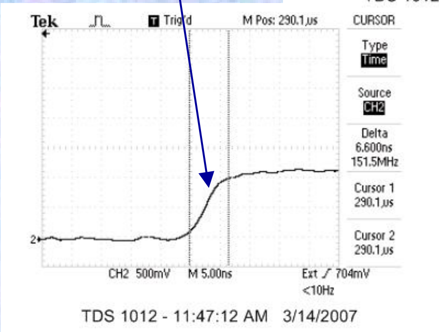


Zooming out direction

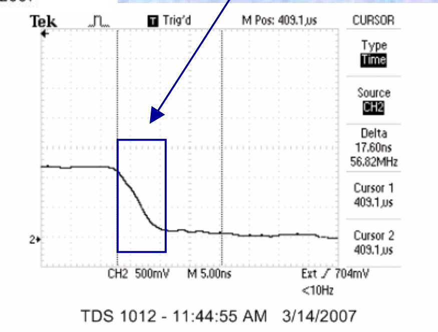
Now selecting a window from (290 → 409)us:



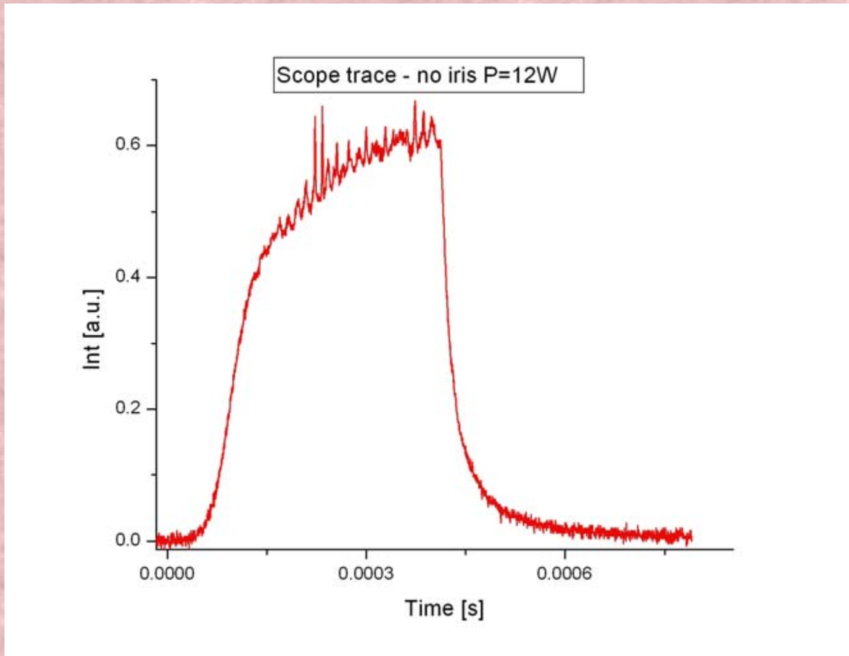
Rise time
~ 6ns
10%,90%

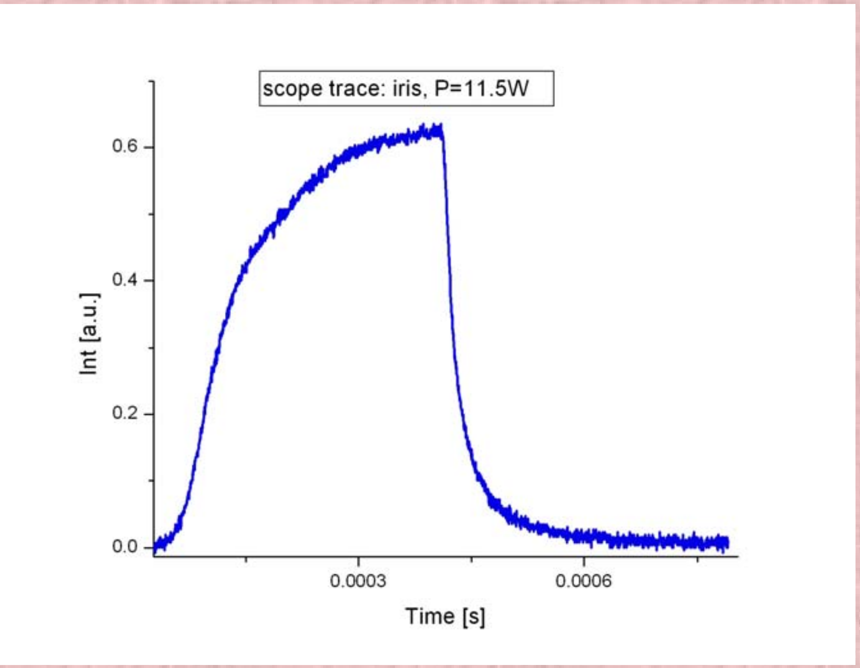


Fall time
~ 6ns
10%,90%



Fluctuations



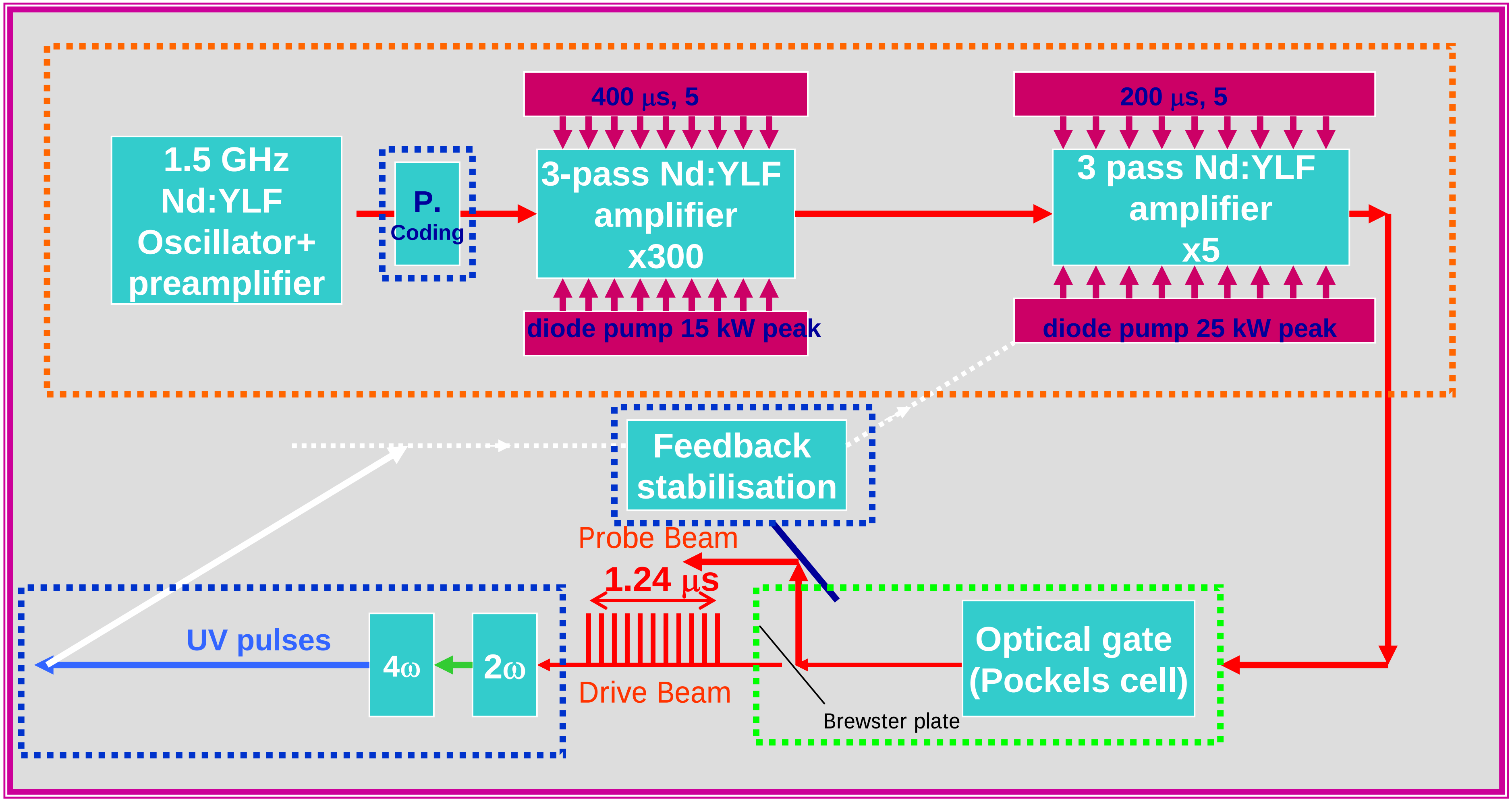


With iris, to slightly cut the beam the noise is reduced

The reason of this fluctuation (noise) has to be investigated:

1) Spot size dimension→ reflection (maybe into the rod) .... ?!
2) Spontaneous emission → noise ... ?!

WHAT IS REMAINING ?



Future work:

1) Need to control the AMP2 performance (peak power, beam spot profile, saturation) when the new driver will work.

2) Need to install the beam deflector in order to remove the background signal that is not going to be used→ less energy density through the optics, less undesired effects.

3) Need to study and look into the intensity instability problem: preamp. beam size problem into the rod? pre lasing noise into AMP1 and AMP2? …??

4) Need to install the harmonic generation crystals, check their efficiency, the beam spot profile after them and final UV micro pulse energy.

5) Need to install the phase coding, actually under study from S. Cialdi and I. Boscolo @ University of Milan – INFN.

Jura :Geneva March 07- From my office window


The
End