

The HP fiber amplifier for AdVirgo

PSL subsystem

VIR-0190A-16

1/ ALS 50W fiber amplifiers & Alphanov 100W fiber amplifier

- the key-points of these kind of lasers
- long term test of the 100W

2/ Other possible HP amplifiers

3/ Possible steps towards a choice

ALS systems :

- Output power : 43 W

ALS1 tested for 2400 h, ALS2 tested for 3900 h

➔ Power decreasing due to Pump/signal combiner ageing (according to ALS) but not to the fiber photodarkening.

- Has been tested with respect to noise issue and was found to be compliant with the AdV specifications

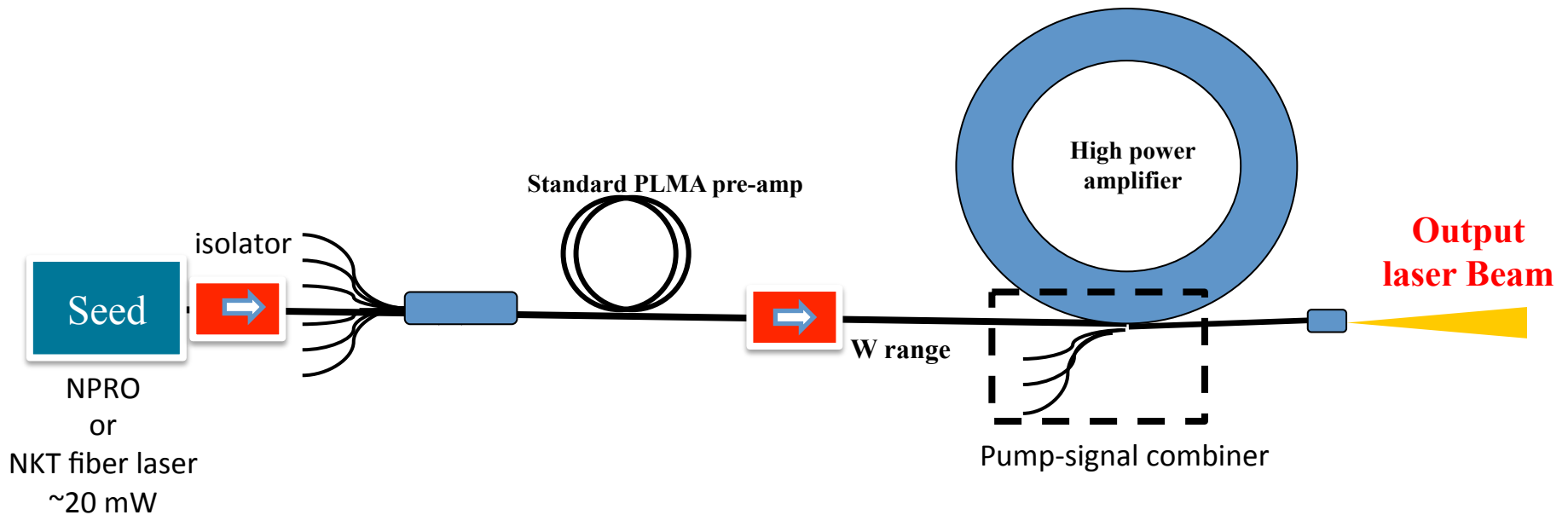
- Not yet received for further long term tests

Start to work on the Alphanov (R&D technological platform) system :

- Output power : 103 W

- Based on the feedback of the ALS experience

- Under an opened collaboration between ARTEMIS and Alphanov



Critical points :



- Large mode area single mode fiber
- High power pump-signal combiner

Output power > 100W : photodarkening + SBS

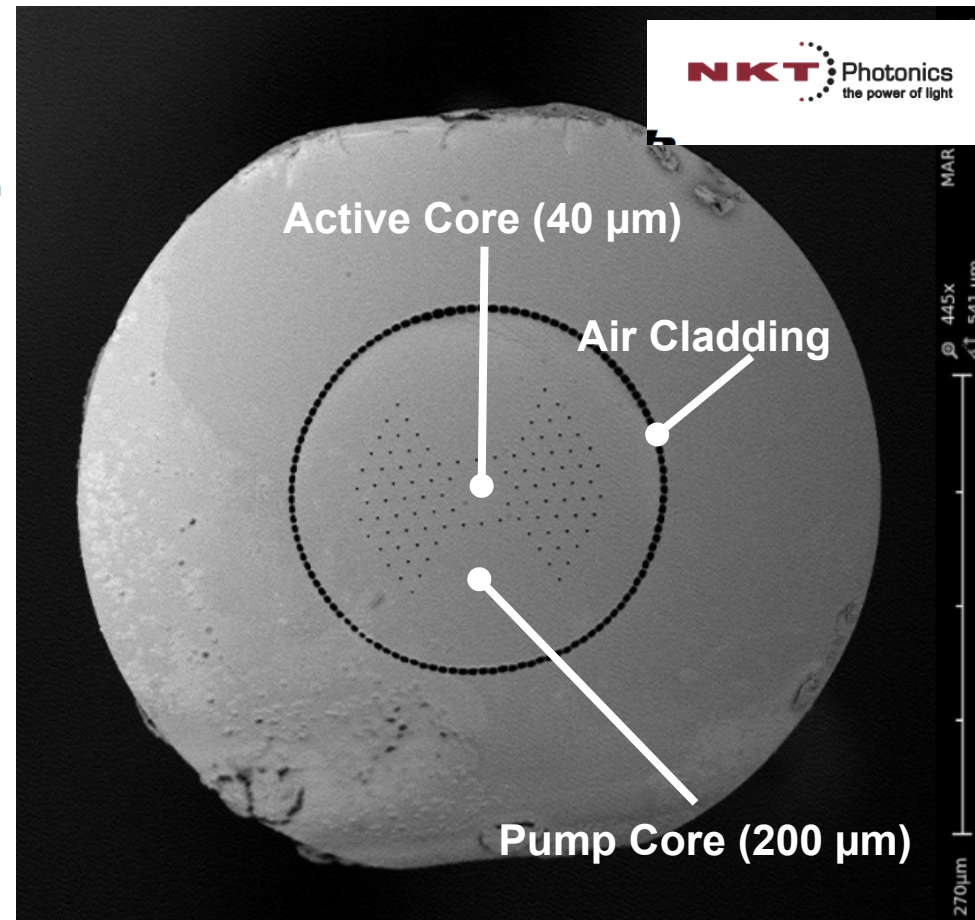
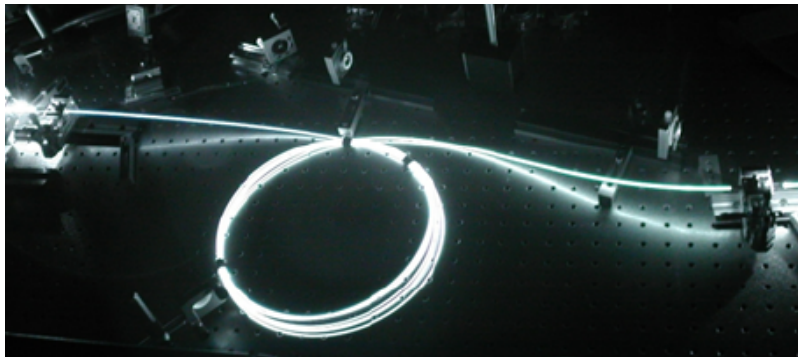
- ➔ - Increase the mode area in order to keep an acceptable intensity
- Shorten the fiber length

PCF : Photonic Crystal fiber

DC-200/40-PZ-Yb

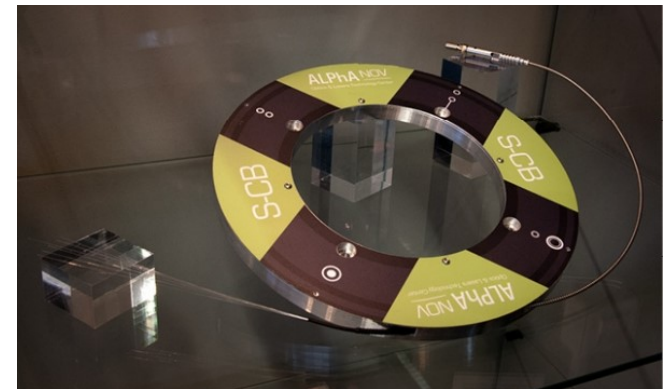
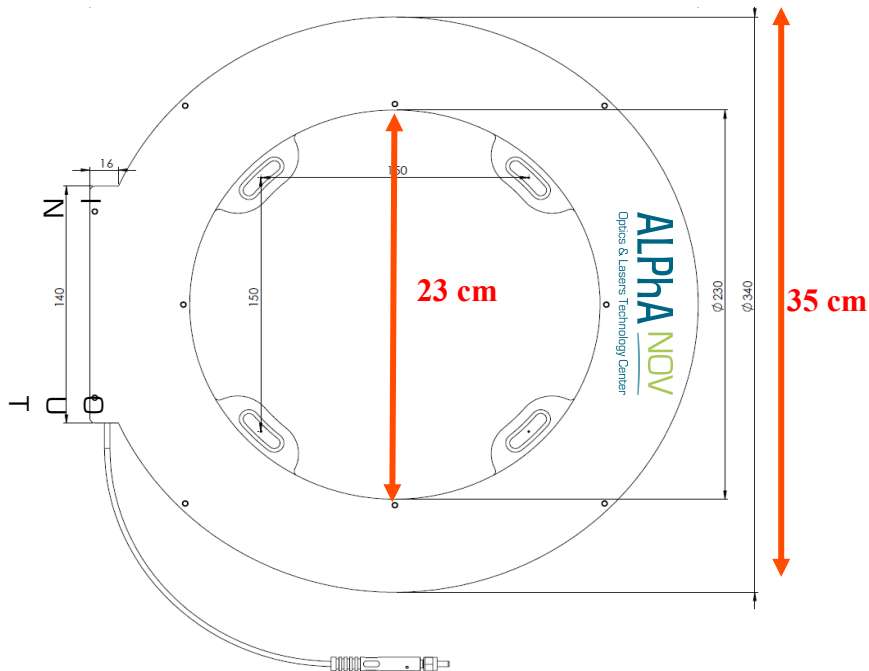
Single-mode, polarizing double-clad Ytterbium-fiber with large mode area

- Single polarization (PZ)
- Can be coiled to 20 cm diameter-ease of integration
- High pump absorption (10 dB/m @976 nm)





Combiner + PCF amplifier module developed by Alphanov



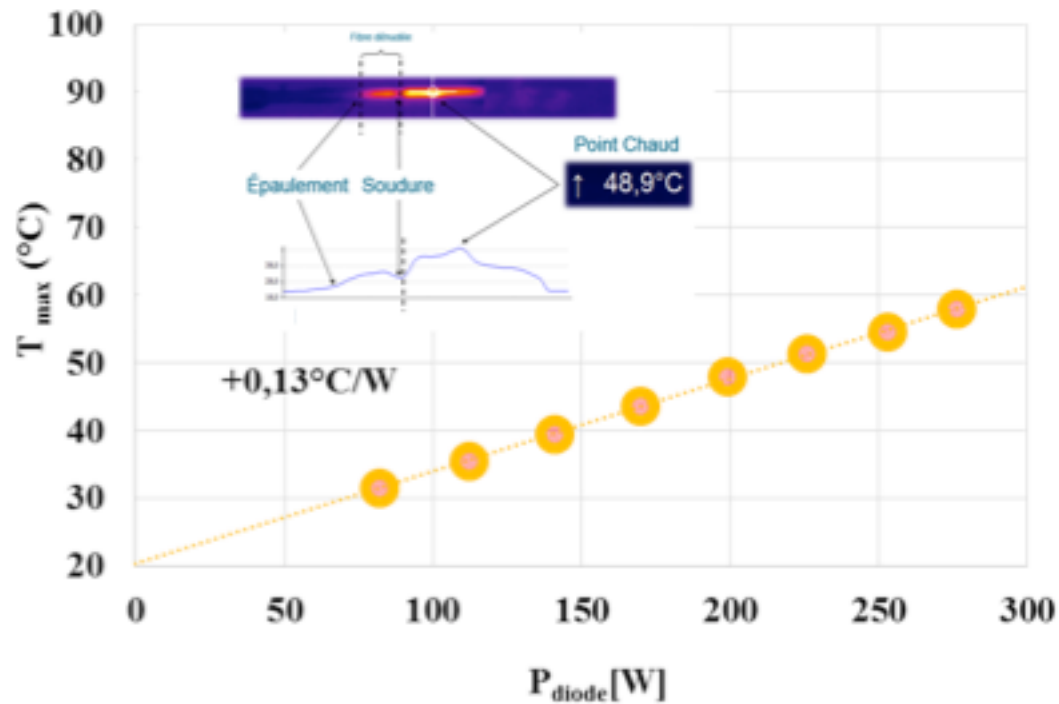
- - Rugged design, operating range tested from 15°C to 50 °C under 300 W pump power.
- - Air cooled up to 100 W of output power, water cooled for higher output powers.

Average losses measurement

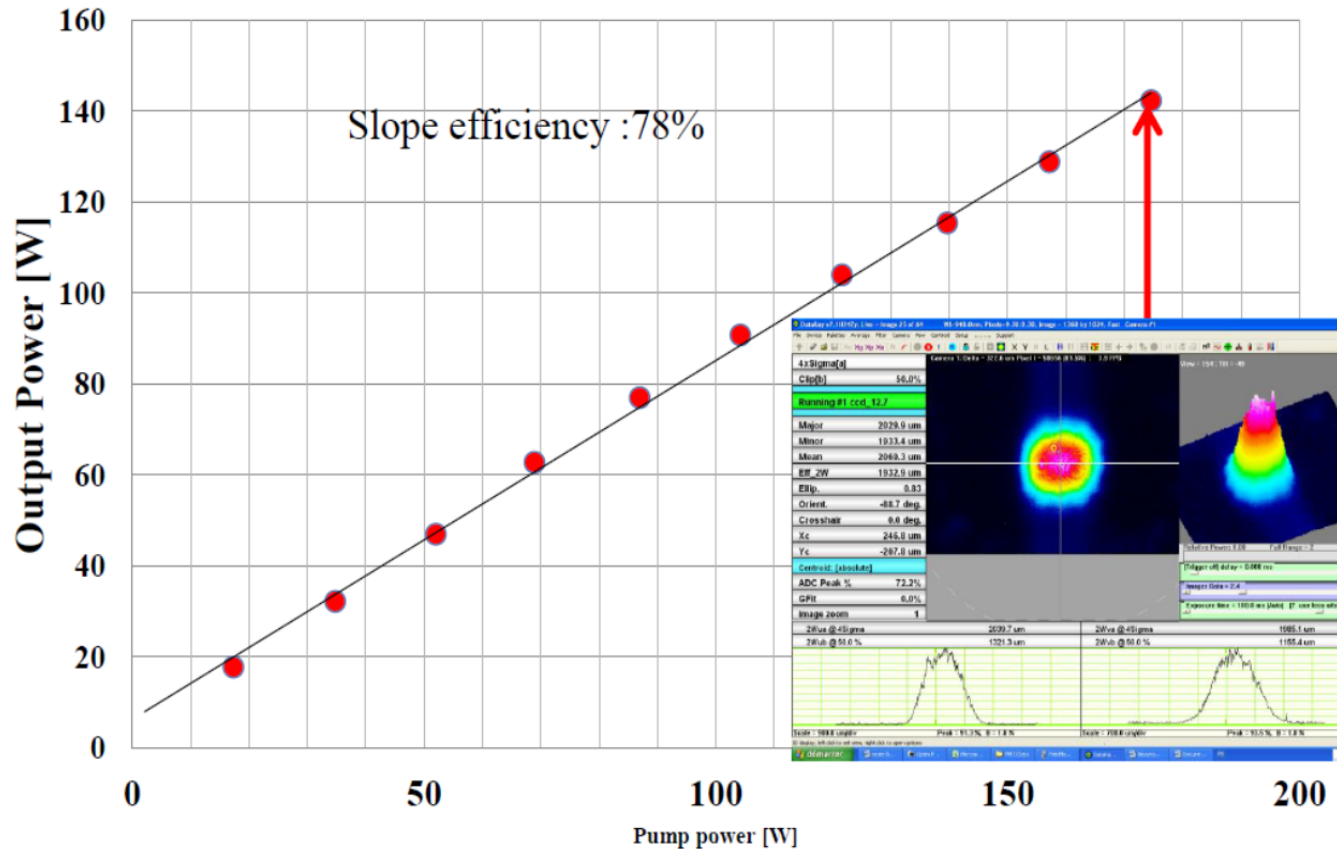


- Pump losses : < 2%
- Signal losses : < 15%

Optimized Thermal management of fused components

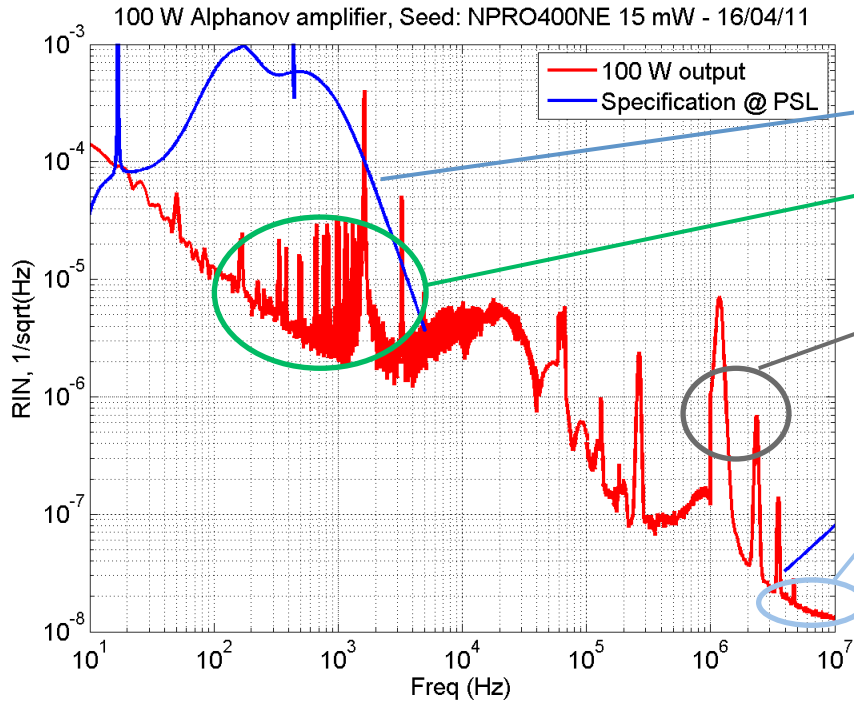


Puissance laser vs puissance de pompe ex-combineur



- $M^2 = 1.2$

- ASE suppression = 40 dB



AdV specification

the peak forest is likely due to pump diode power supply

the peaks are likely connected to the control electronics

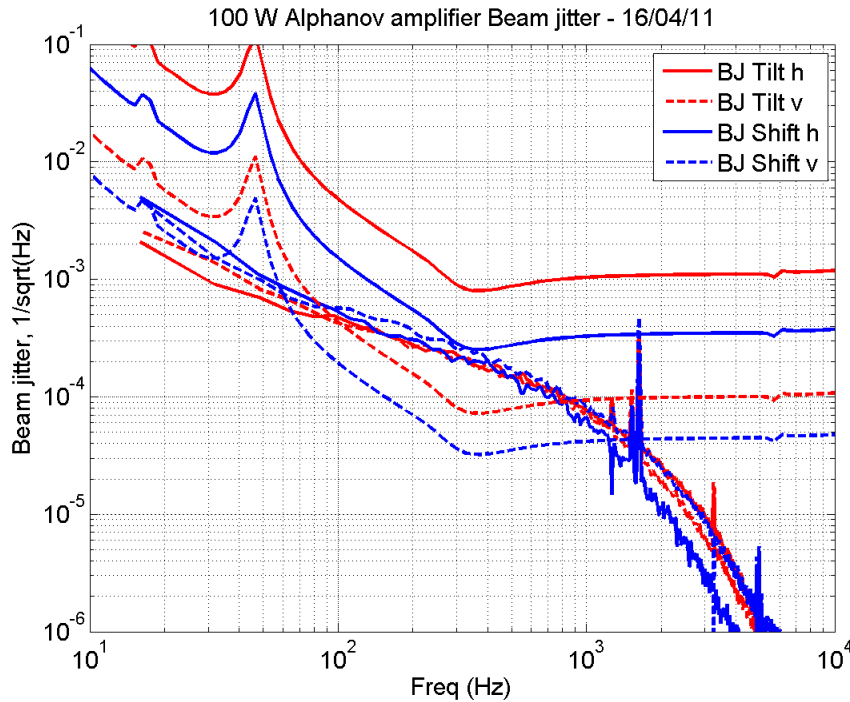
within Specs @ 6 MHz, assuming a V+ like PMC



Replace power supplies



Confirm the control electronics related noise and filter it



The beam-jitter is evaluated at PMC input, assuming a Virgo+ like PMC

Specifications

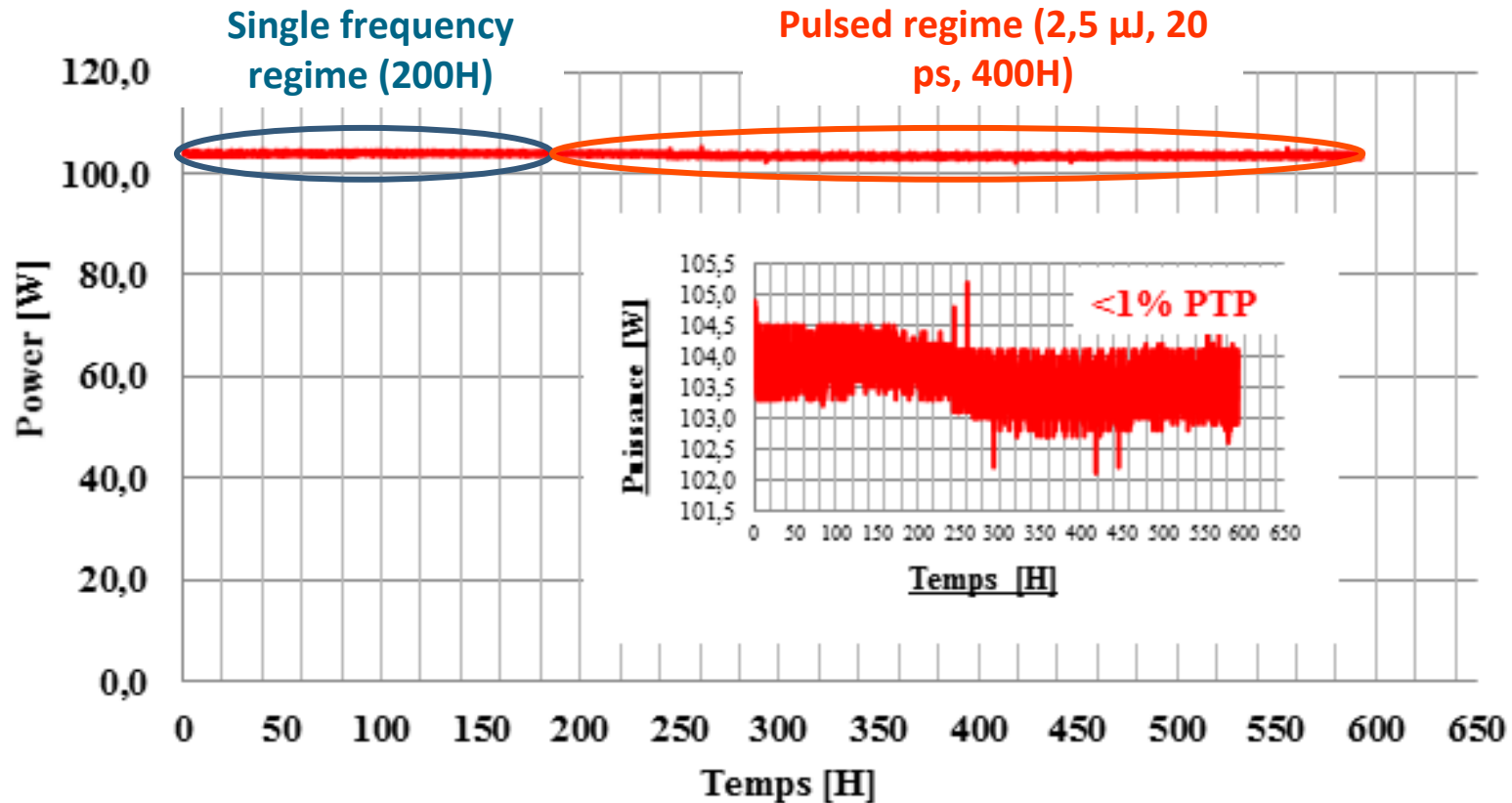
Measurements

The beam jitter is out of specification : due to the fiber maintaining system



To be improved

Peak to peak power fluctuations < 1% on 25 days, at constant pump diode current



- ➔ Still waiting for the ALS system to conduct final tests

- ➔ Alpahanov system back to Bordeaux for upgrade : output fiber maintaining system

- ➔ Replace power supplies

- ➔ Implementation of several diagnostics for long term test

Other vendor or labs R&D of fiber amplifiers:

- **Optical Engines Inc (US)** : claims also a 100W amplifier (cannot be rent, no budget for buying that)
- 100 W amplifier mounted by AEI/LZH: had some failures with a 200W amplifier, some long term test with a 50 to 150W , but no reliable results yet in the last month.

Vendor of SSL:

- **NEO Lase (Germany)** has designed a 100W based on a 4 stages solid Nd-YVO4 rods
Seeded by a 20W
No budget for bying
Wait for AEI results if they succeed to get one for test.

- The 1st, conclusion is:

Whatever the system, we need the coherent combination (as what we have validated in the Liwei thesis)

→ Good compromise to have a 200W output with medium power amplifiers

→ (2x100W would be the best configuration)

- The 2nd question is: as we know a more precise date for the 200W need on site
- 10-12 months before that, we'll make the choice between what has come out from:
 - The ALS/Alphanove amplifiers (we have already bought them)
 - The SSL results shared with our AEI colleagues
 - We don't plan to buy other prototypes for test (not to explode the budget)

THANKS FOR YOUR ATTENTION