Development of High Energy USP Laser

Keming Du – EdgeWave

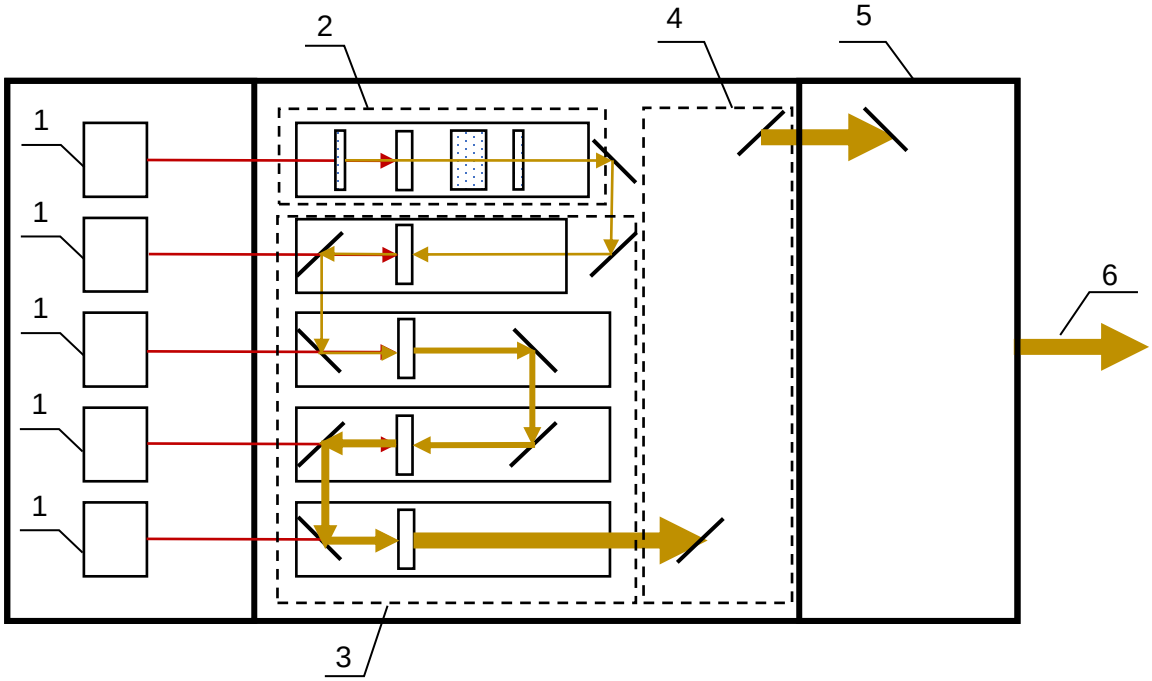
Public Day

Objectives

- Research on the design architecture of short pulse oscillator of high coherence and beam quality
- Building of short-pulse oscillator and experimental investigation
- Research on design of high average power amplifier stage and matching of oscillator and amplifier
- Building of a high average power amplifier stage
- Integration oscillator and power amplifier
- Experimental study of fiber coupling, like handleable pulse energy/power, tolerance, influences on beam quality, coherence, pulse length, polarization, etc.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825503 – PROMETHEUS and from the "Photonics Public Private Partnership" www.photonics21.org

WP2.6 Implementation of high average power short pulse industrial laser source



1: Diode laser stacks
2. q-switched oscillator
3: Multistage amplifier
4: Beam shaping area
5: Fiber coupling unit
6. Fiber

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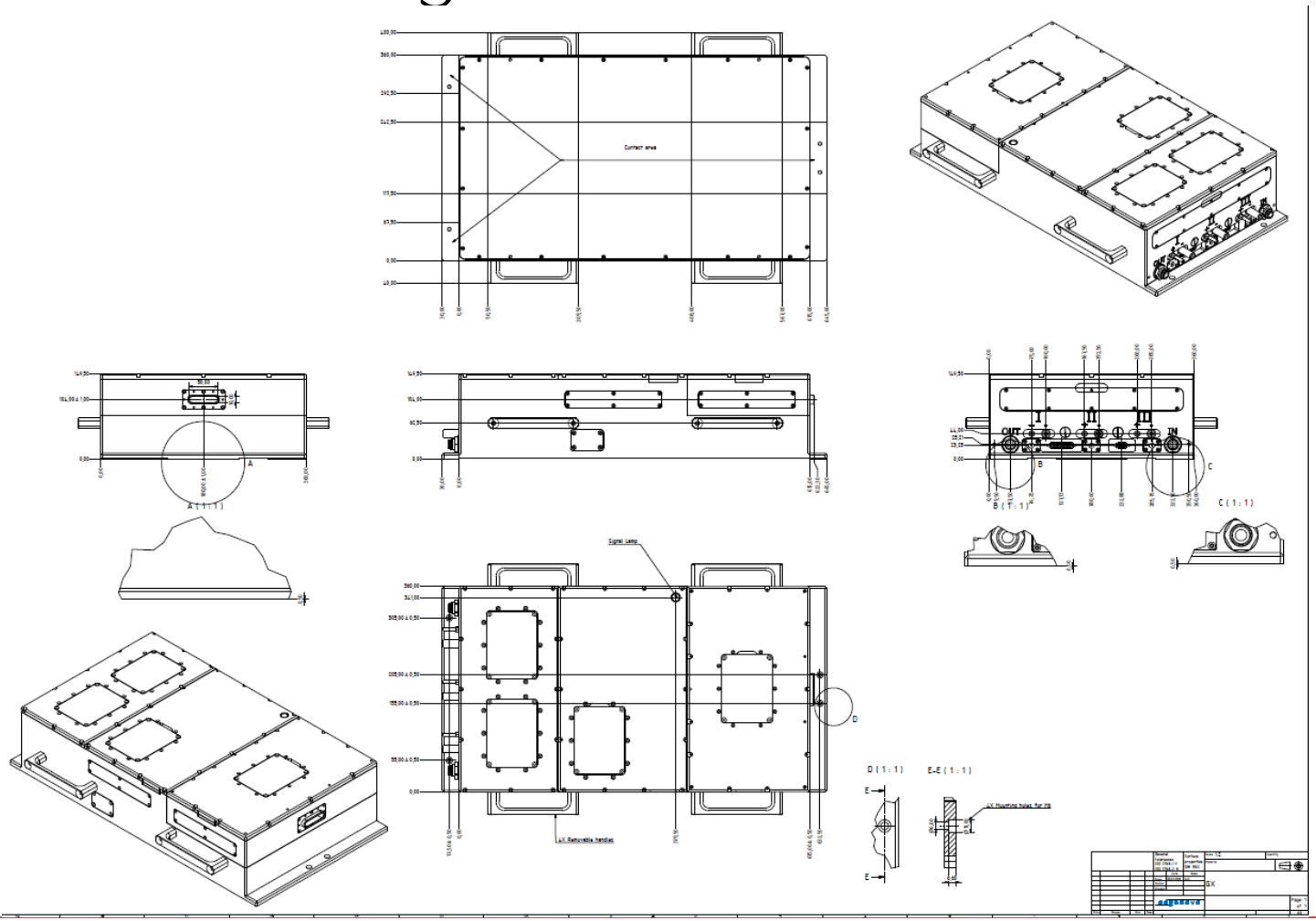
Possible drawing of the laser head



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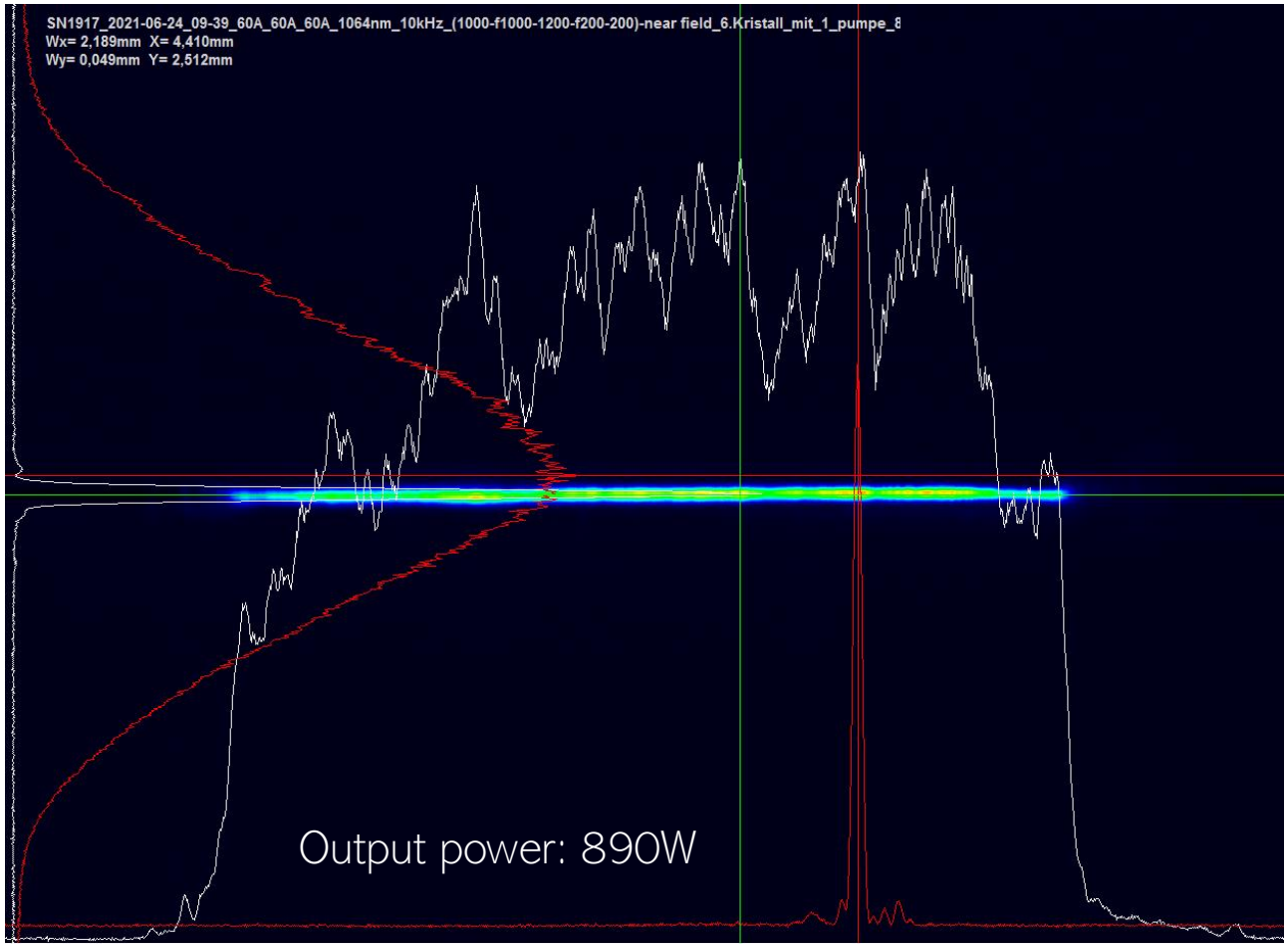

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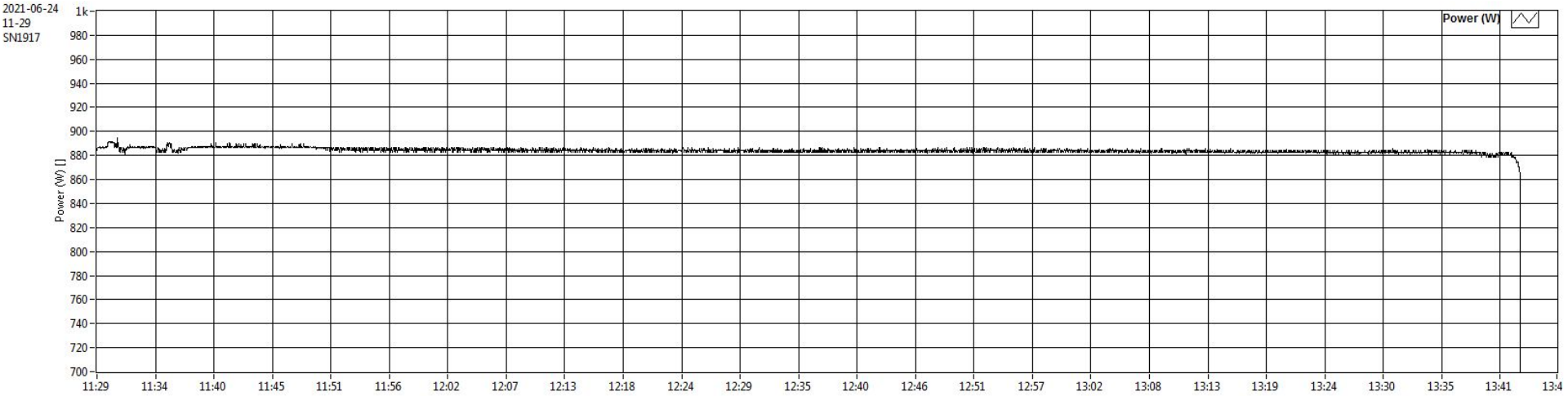

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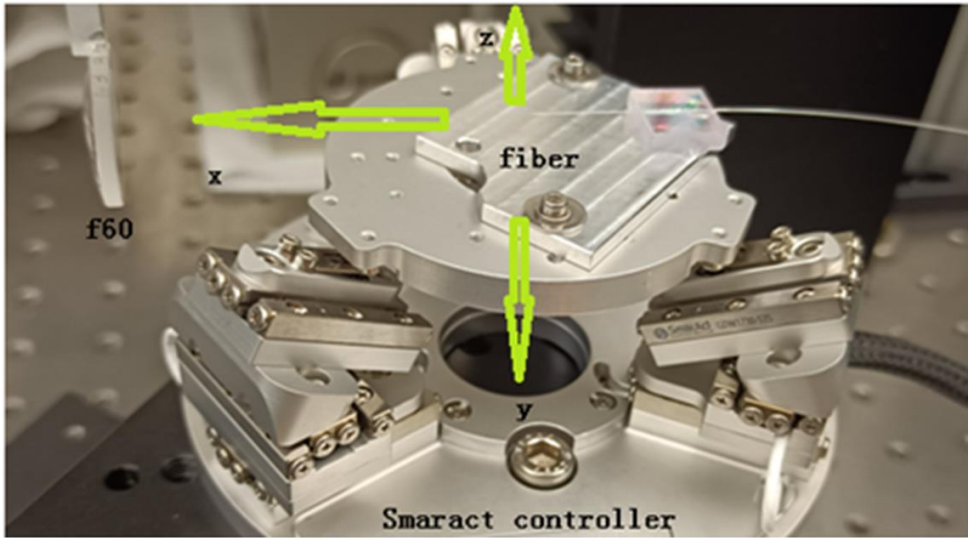
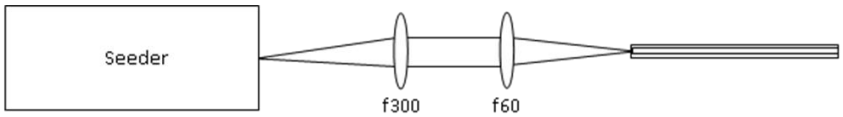
WP2.4 Scheme and experimental setup of fiber coupling





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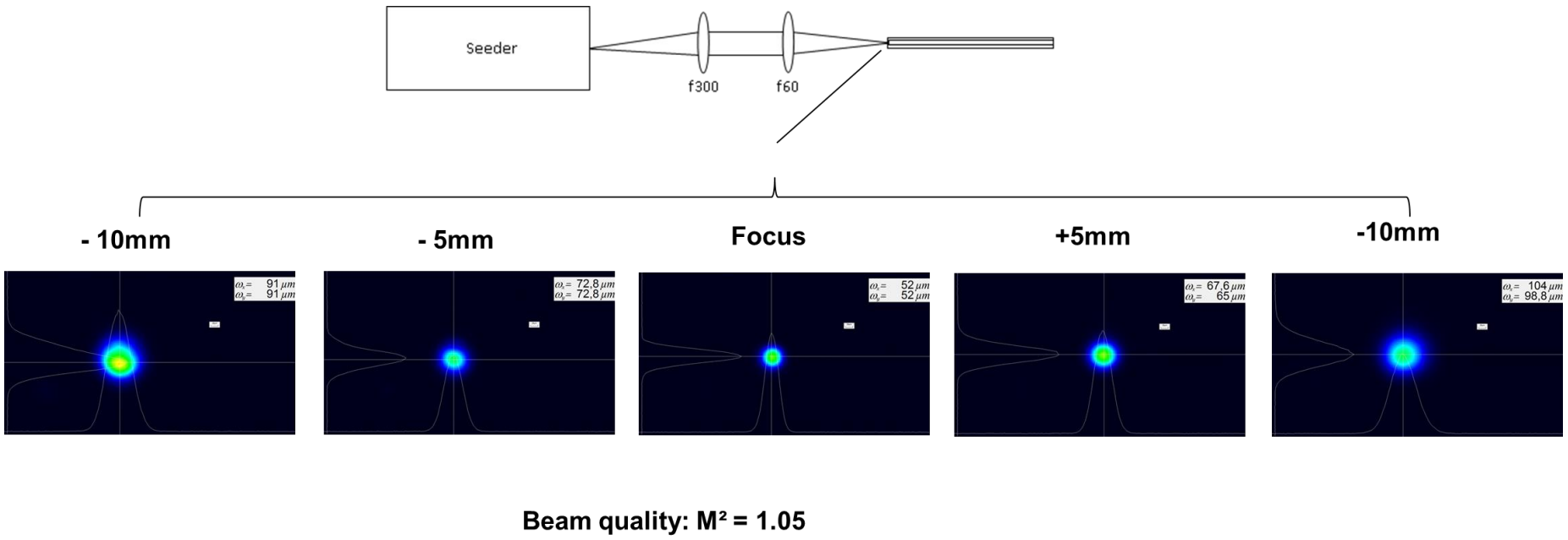
WP2.4 Testing of Fiber Coupling of a ps Laser

Intensity profiles of input beam



Beam quality: $M^2 = 1.05$

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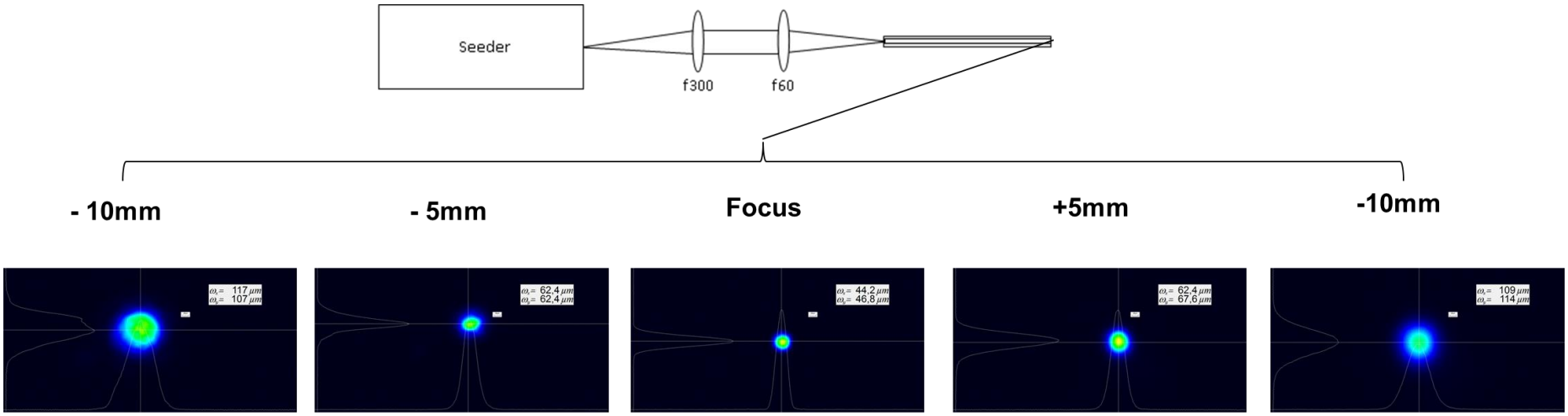
WP2.4 Testing of Fiber Coupling of a ps Laser

Intensity profiles of output beam



Beam quality: $M^2 = 1.09$

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WP2.4 Testing of Fiber Coupling of a ps Laser

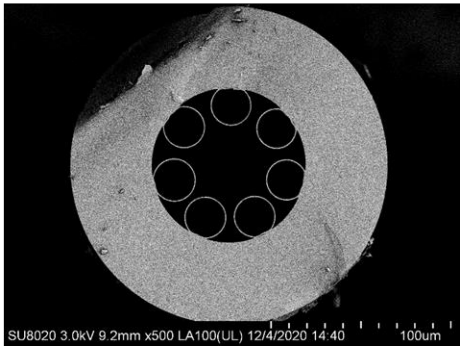
Transmission efficiency

I(A)	5.8	6	6.3	6.5	6.8	7	7.2
Pin(W)	1.02	1.12	1.31	1.39	1.49	1.57	1.64
Pout(W)	0.95	1.06	1.21	1.3	1.41	1.49	1.55
efficieny	0.93	0.946	0.923	0.935	0.946	0.949	0.945

Input Gaussian beam size diameter 34 μm($1/e^2$)Input fiber diameter 41 μm.

Input efficiency due to the fiber aperture effect 0.945,

which means for 0.5m fiber, the transmission loss is trivial.



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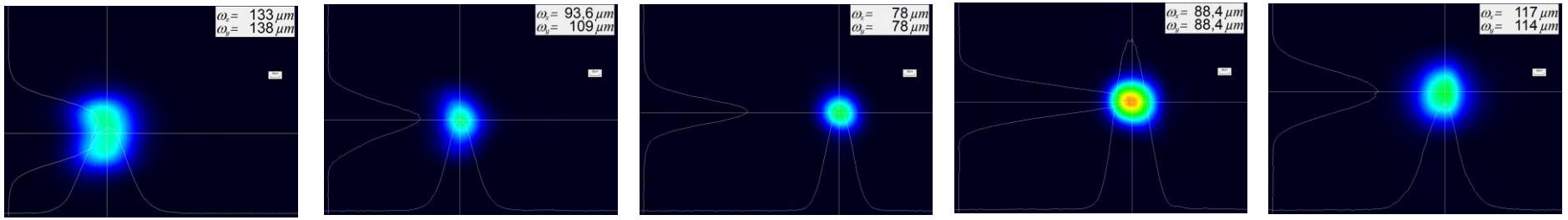
WP2.4 Testing of Fiber Coupling of a ps Laser

Intensity profiles of a ns laser beam

- 20mm | - 10mm | Focus | +10mm | +20mm



Beam quality: $M^2 < 1.25$

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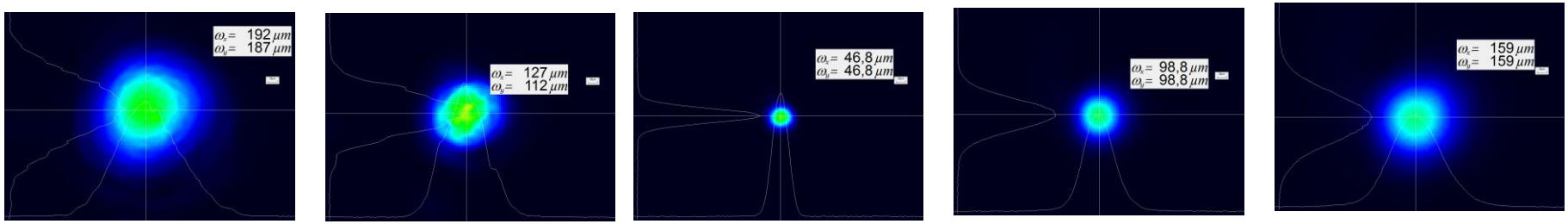
WP2.4 Testing of Fiber Coupling of a ps Laser

Intensity profiles of a ns laser beam after the fiber

- 15mm | - 10mm | Focus | +10mm | +15mm



Beam quality: $M^2 < 1.15$

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WP2.4 Testing of Fiber Coupling of a ps Laser

Transmission efficiency of Photonics Bretagne:

SN10953M1F1 C030K03

input(W)	output(W)	efficient
0.9	0.74	82%
3.4	2.7	79.4%
12.3	10.3	83%

Side lobes: 7/104 = 5%

Damaged at 2.5mJ and 2kHz
Efficiceny 0.42/0.46=91%
Similar to China fiber

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Conclusion

- Oscillator development successful
- Amplifier architecture confirmed
- Test of hole fiber with ns laser done
- Building up the amplifier and integration of amplifier completed
- Demonstrator finished and delivered to Projekt-Partner IWS

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