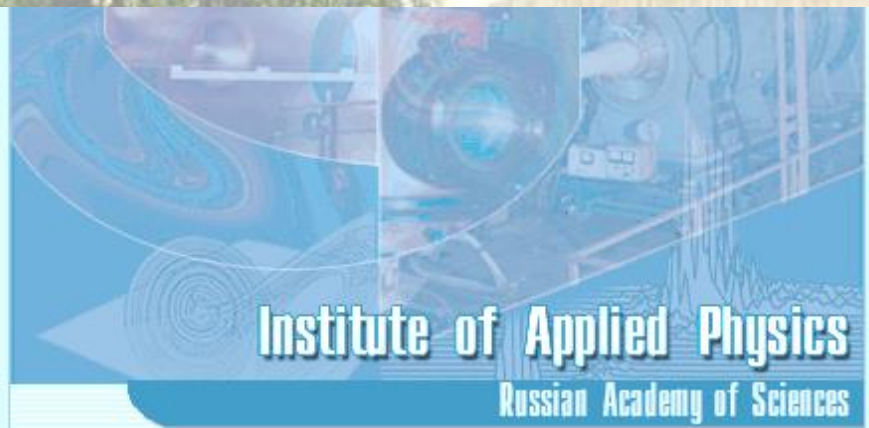
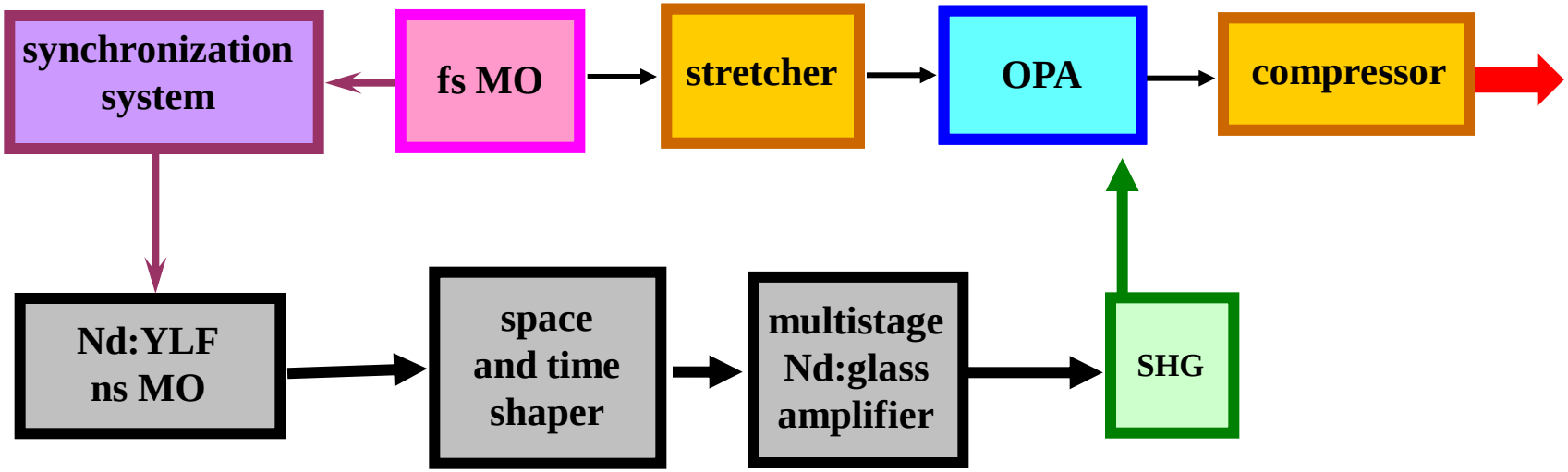
Increasing the efficiency of the multistage laser amplifier

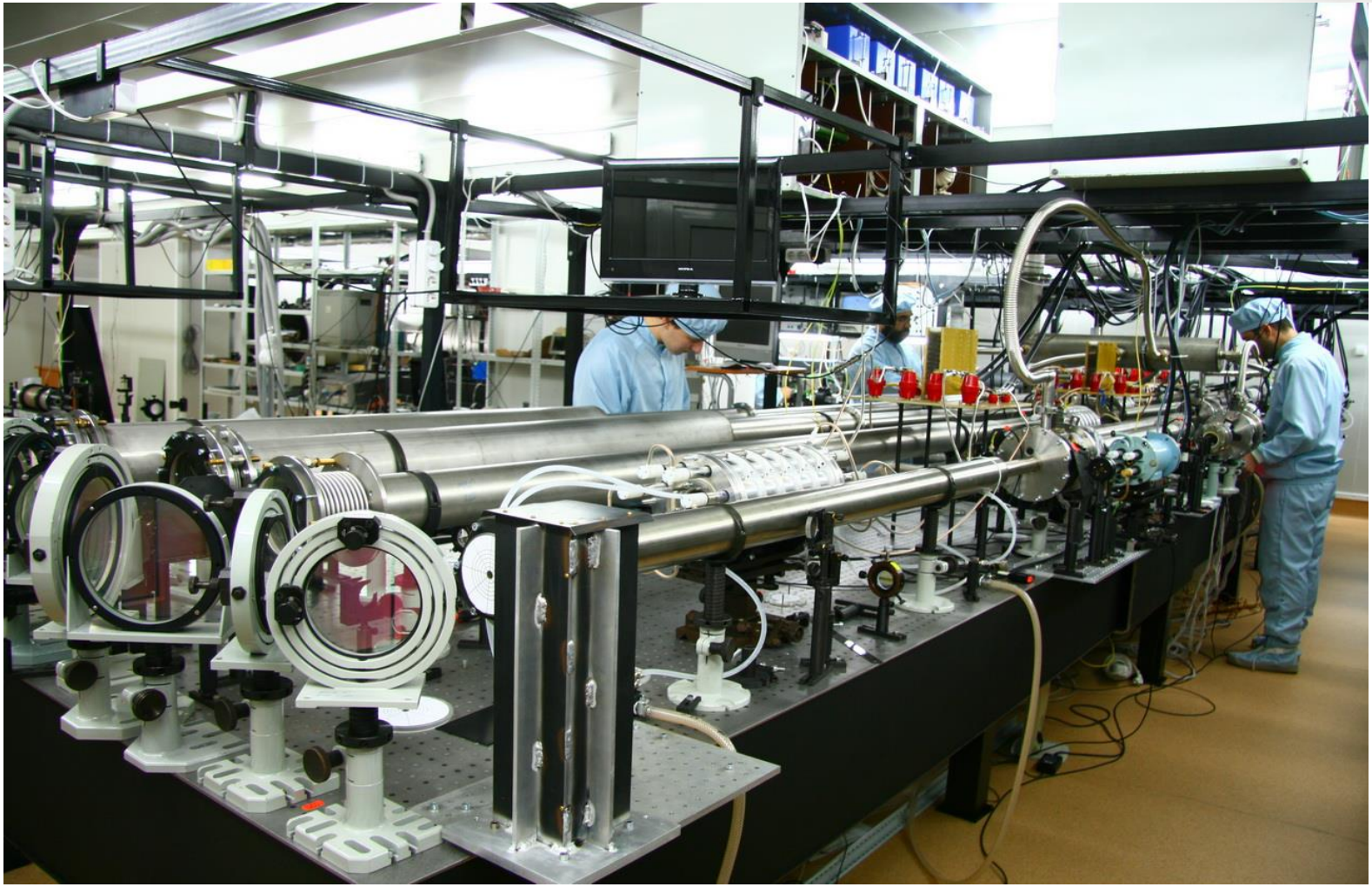


Alexey Kuzmin

Petawatt class PEARL facility
The principal scheme



PEARL facility
Nd:glass pumping laser



Quantum Electronics **46** (4) 371–374 (2016)

DOI: 10.1070/QEL16052

Nd:glass rod laser with an output energy of 500 J

A.A. Shaykin, A.A. Kuzmin, I.A. Shaikin, K.F. Burdonov, E.A. Khazanov

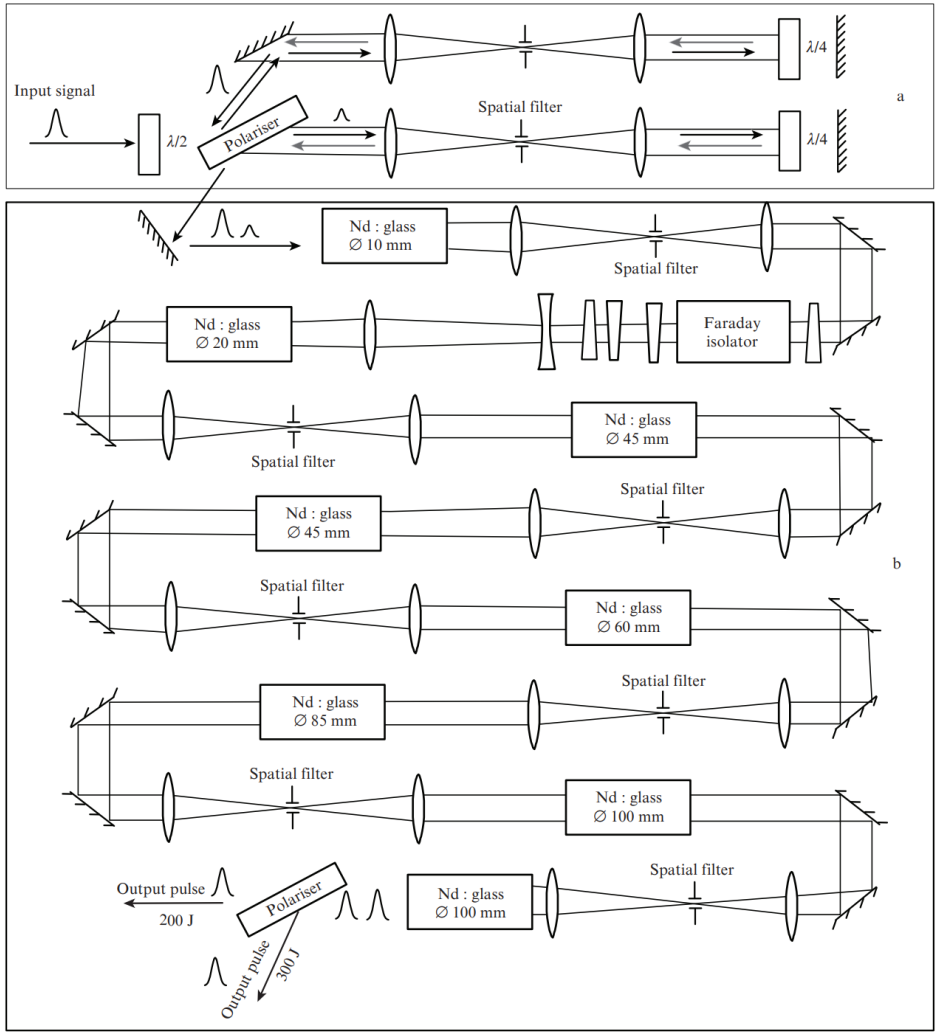


Figure 1. Scheme of the setup: (a) system generating two replicas of the input signal and (b) multistage laser amplifier.

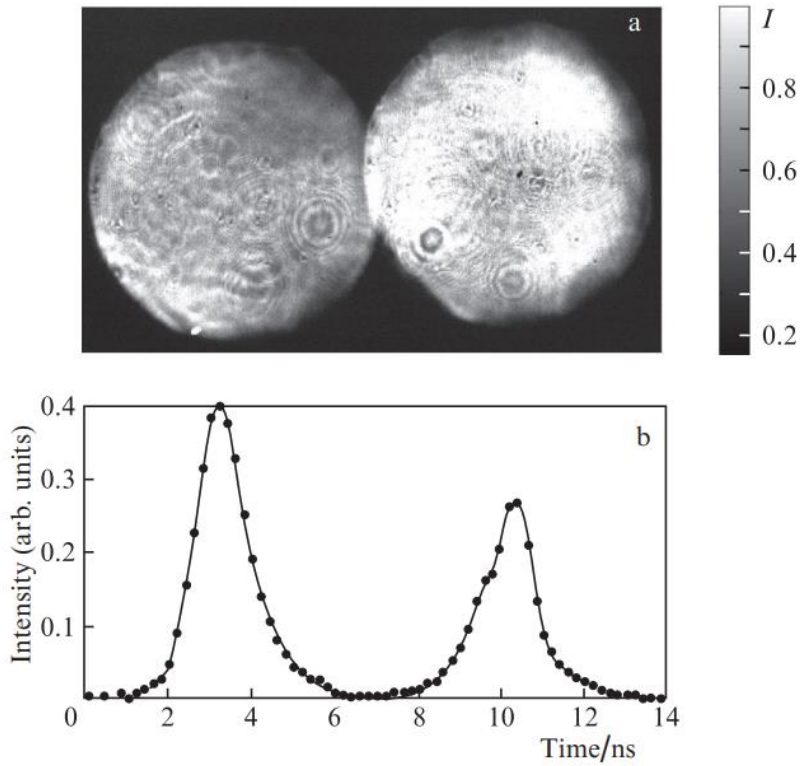
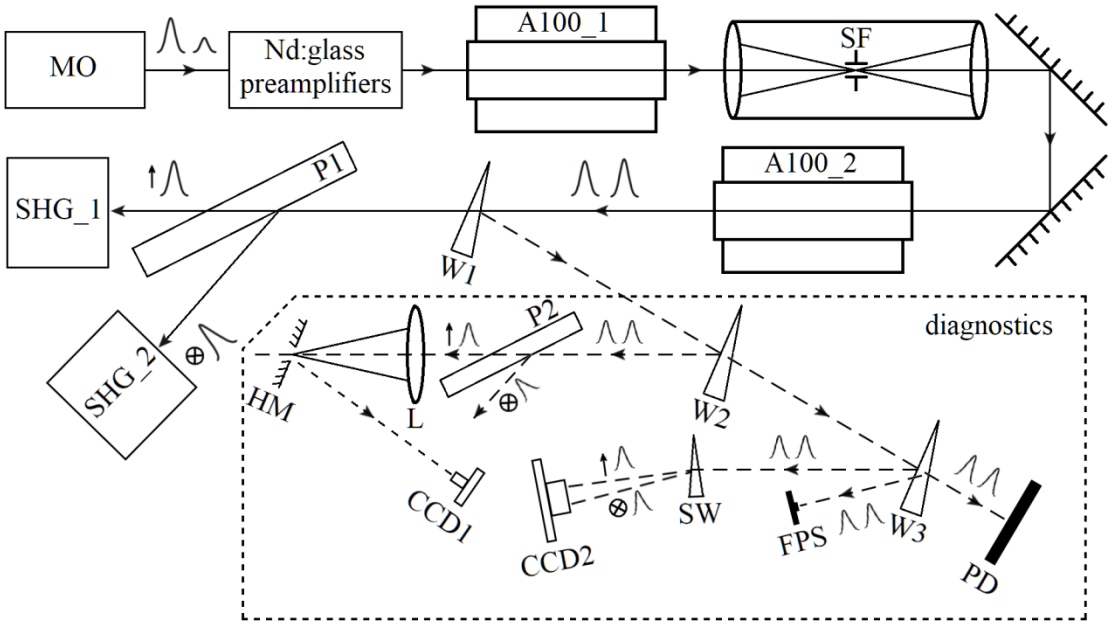
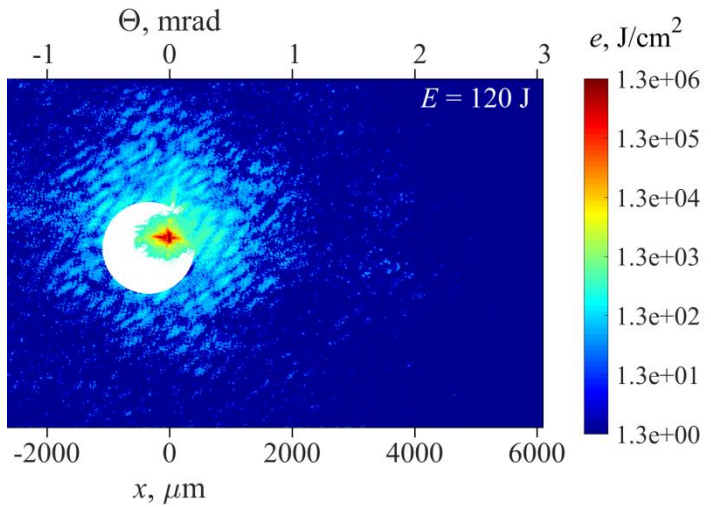
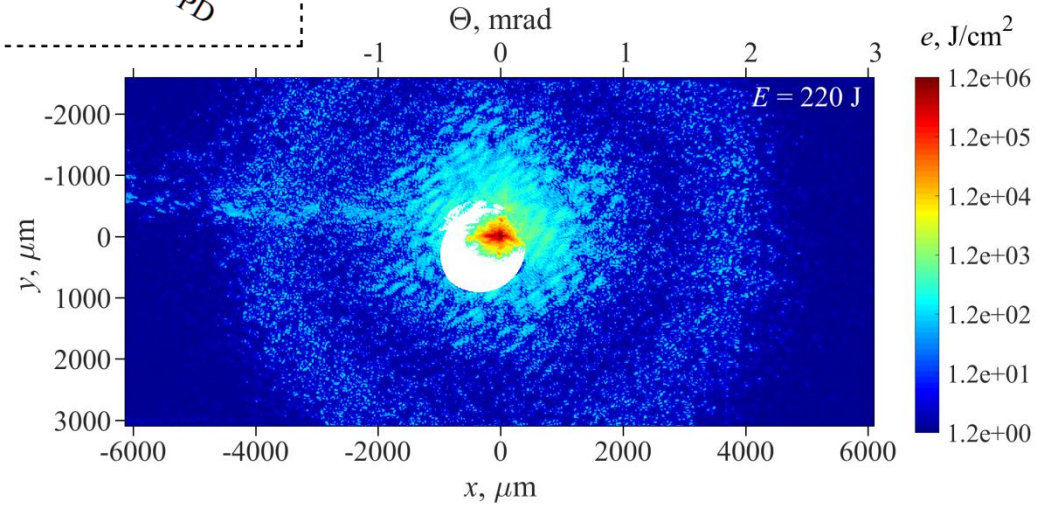


Figure 3. Output intensity distributions (a) in the near-field zone and (b) in time. The energies of pulses are 300 and 200 J; the beam diameter is 100 mm.

Focal spot in final spatial filter



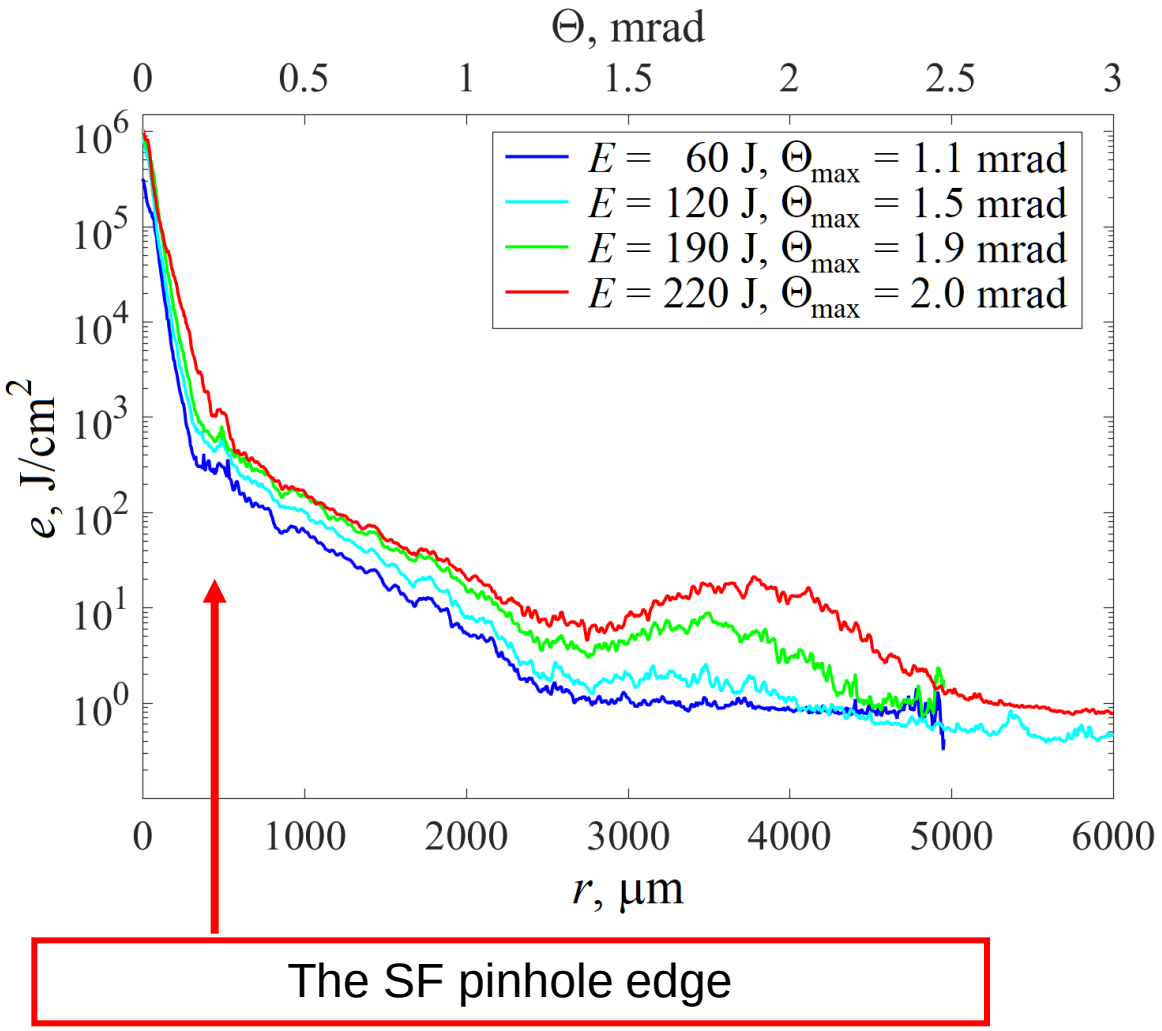




MO – Nd:YLF master oscillator, A100_1, A100_2 – Nd:glass rod amplifiers 100 mm in diameter, SF – final vacuum spatial filter,

W – optical wedges, HM – holey mirror, P – polarizers, SW – spar wedge, FPS – fast photo sensor, PD – pyroelectric detector

Focal spot in final spatial filter



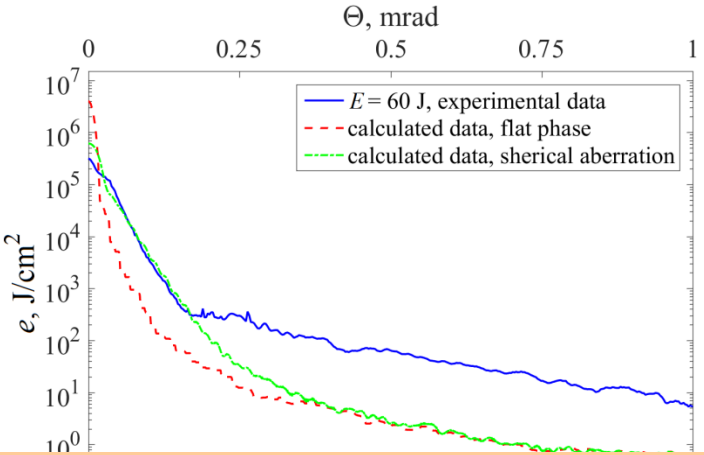
$\Theta_{max} = (2n_0n_2I)^{0.5}$ – the angle of maximal small-scale instability,

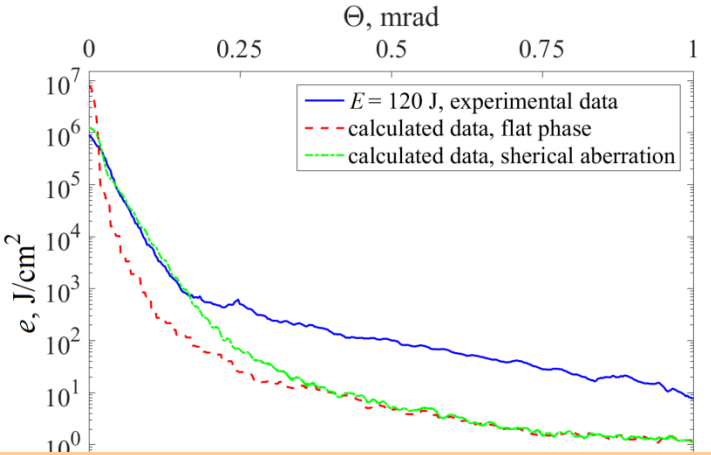
I – the intensity of the laser radiation,

n_0 – the linear refractive index

n_2 – nonlinear refractive index

Focal spot in last spatial filter

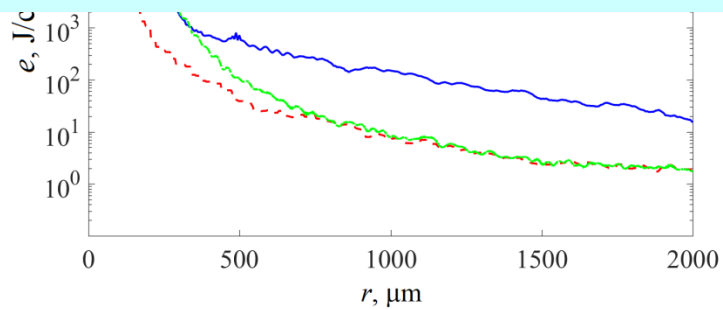


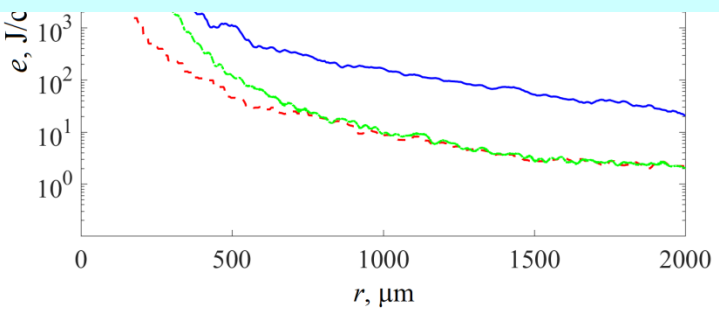


$$U = \alpha\sqrt[3]{e}, \quad \alpha: \ 2.8\times10^{6}\ \mathrm{cm\cdot s^{-1}\cdot\left(J/cm^{2}\right)^{-1}}$$

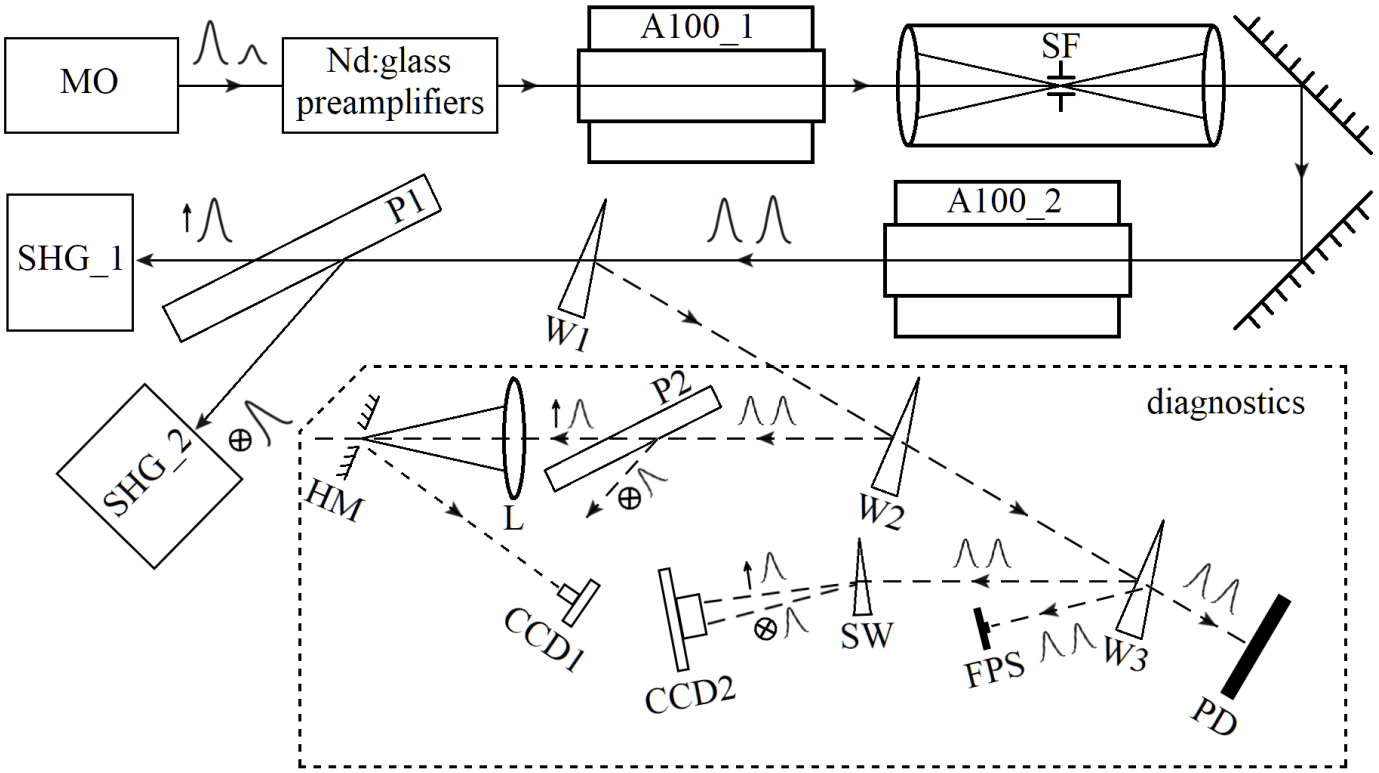
$E = 120$ J, $R = 450$ μm $\Rightarrow$ $U = 2.2\times10^{7}$ cm·s^{-1}, $\Delta t = 2$ ns

$E = 220$ J, $\Delta t = 2$ ns $\Rightarrow$ $R > 600$ μm





Scheme of the experimental setup

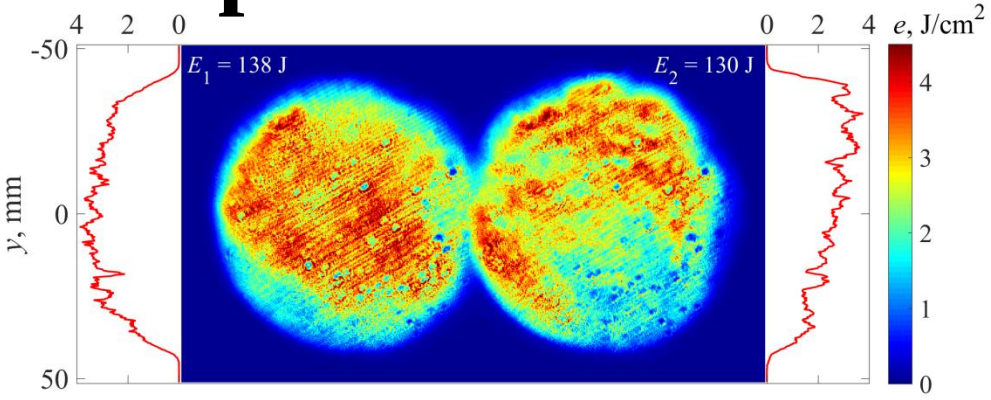


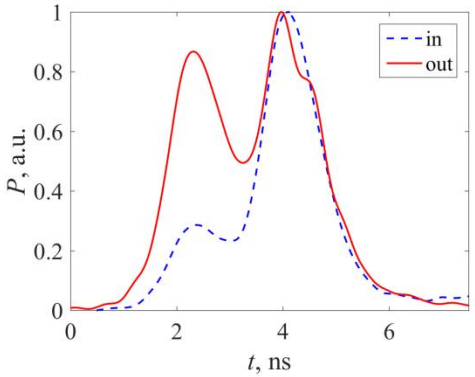
MO – Nd:YLF master oscillator, A100– Nd:glass rod amplifiers 100 mm in diameter, SF – final vacuum spatial filter, SHG – second harmonic generators

W – optical wedges, HM – holey mirror, L – lens, P – polarizers, SW – spar wedge, FPS – fast photo sensor, PD – pyroelectric detector, CCD – cameras

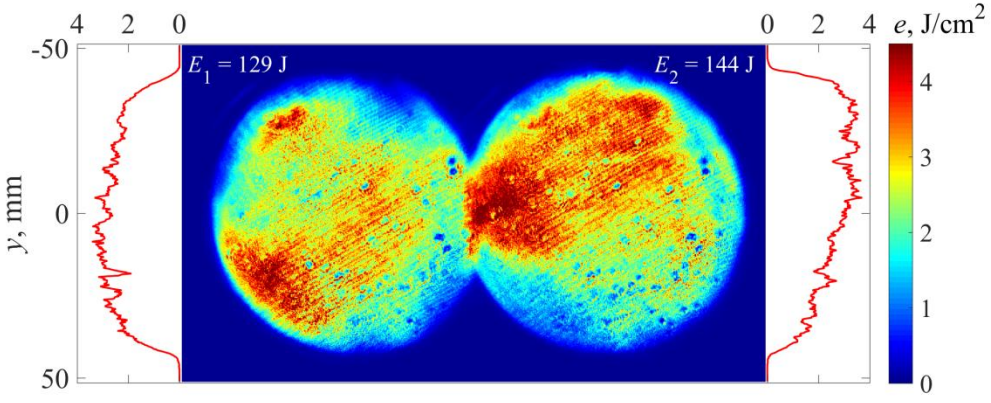
Two pulses after the final SF

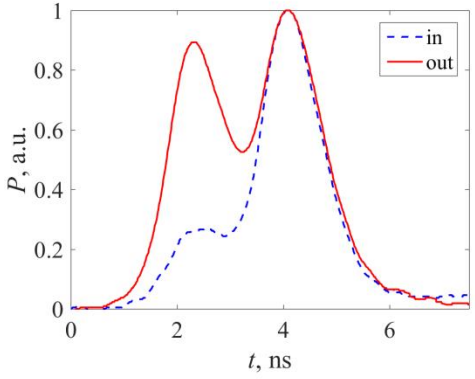
$R = 450$ μm



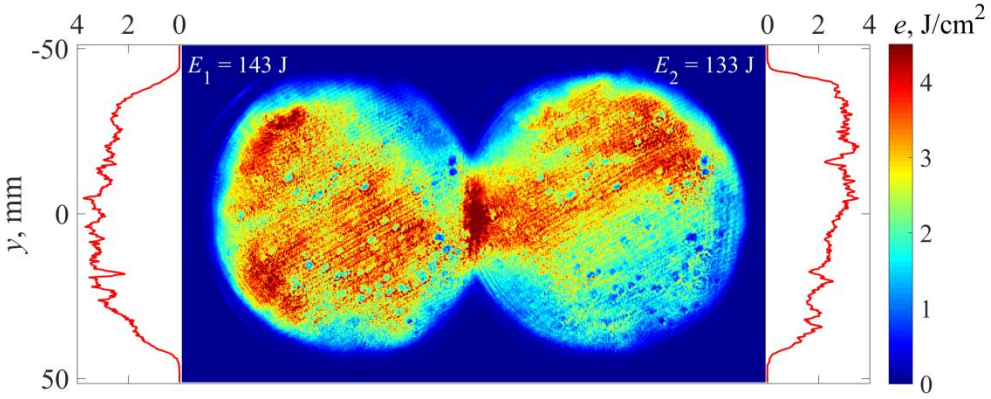


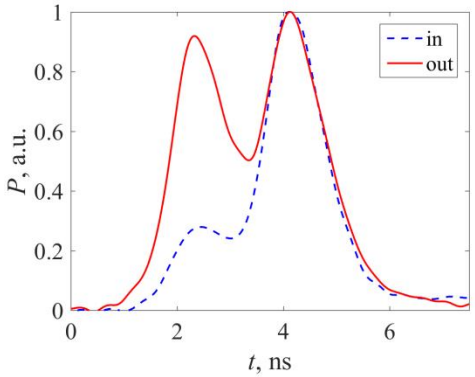
$R = 800$ μm





$R = \infty$





Publication:
Kuzmin A.A., Khazanov E.A. and Shaykin A.A., "**Pulse energy limitation for high-power nanosecond lasers due to plasma formation in spatial filters**", Quantum Electronics, accepted for publishing (2020)
http://iopscience.org/qe, http://www.turpion.org/journal/qe

The Research was carried out within the framework of the EU project CREMLINplus, grant agreement 871072.

Thank you for your attention!