V.E. Zuev Institute of Atmospheric Optics

Formation of signals with an adjusted contrast using optical systems

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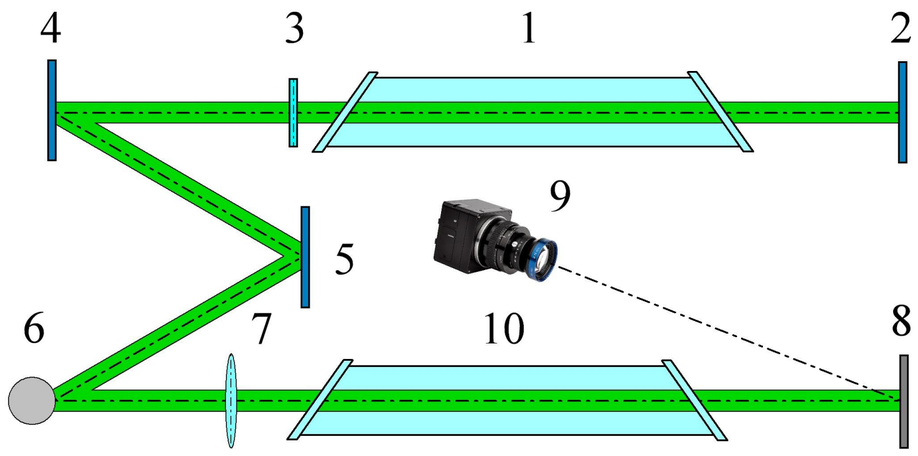


Experimental setup: 1 – illumination source;
2, 3 – plane-parallel cavity; 4, 5 – mirrors;
6 – object under observation; 7 – objective; 8 – projection screen;
9 – machine vision camera; 10 – brightness amplifier.

Imaging of object under observation was performed in the bistatic laser monitor. The non-typical configuration of copper bromide active elements was used: active volume of brightness amplifier was larger than the active volume of the illumination source. It allows to form the powerful beams with given contrast.

	L, cm	D, cm	V, cm^3
Illumination source	50	3.2	402
Brightness amplifier	90	5	1766

Copper bromide was used as the active substance. The radiation was formed simultaneously at two wavelengths: λ1=510.6 nm, λ1=578.2 nm.

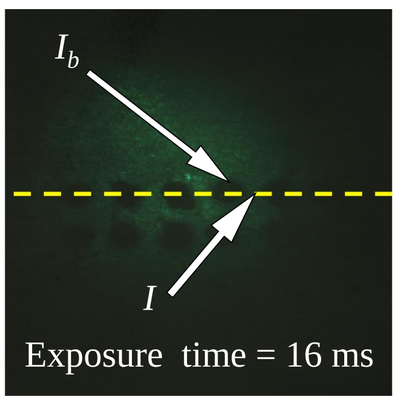
Imaging of object under observation was performed by means of laser illumination, monostatic laser monitor and bistatic laser monitor. Images were recorded by machine vision camera Baumer VLG-20C. Pulse repetition frequency was 16 kHz. The dependencies of pixel brightness distribution are shown.

Veber contrast was determined in the pixel range of (450÷520) by the formula:

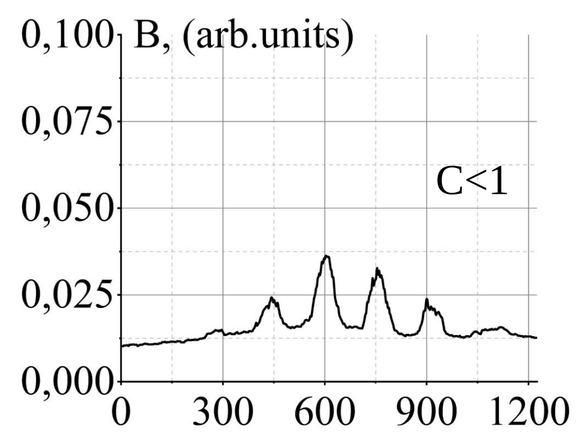
$$C_{veb} = \frac{I - I_b}{I_b}$$

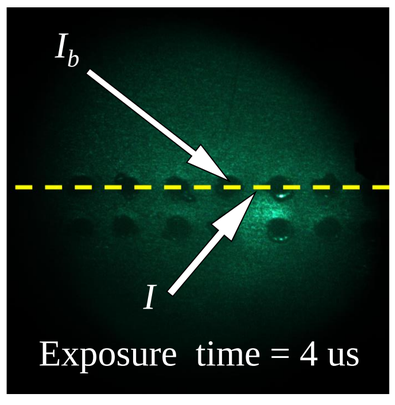
Imaging in the bistatic laser monitor was performed at different time shifts between the radiation pulse of the amplifier and the radiation pulse of the illumination source. The maximal contrast is achieved with a time shift of tsh=-7 ns – in this case the maximum of illumination pulse falls on the amplified spontaneous emission front of the amplifier. In the range of the time shift (-12; 0) ns, the contrast (C) varies from 64 to 83 arb. units. A further change in the time shift leads to a significant drop in contrast. Nevertheless, even with a mismatch of pulse-repetition modes of active elements by 15 ns in any direction relative to the optimal value, the image contrast exceeds the contrast in the monostatic scheme of the laser monitor by at least 8 times.

Imaging results

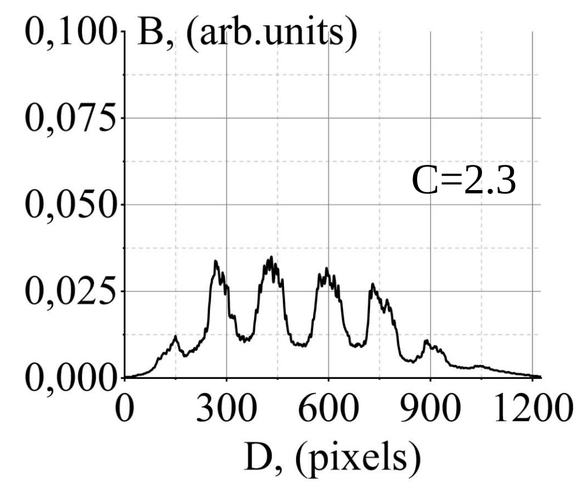


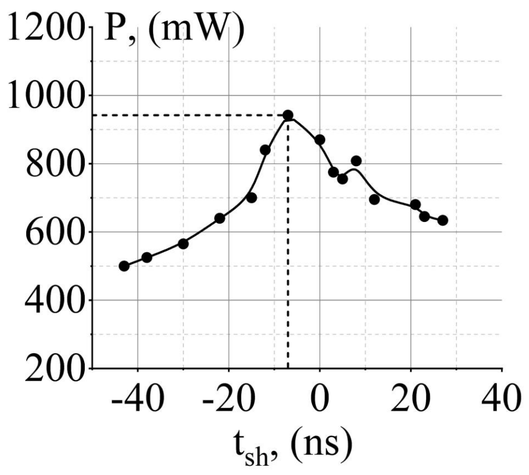
Laser illumination



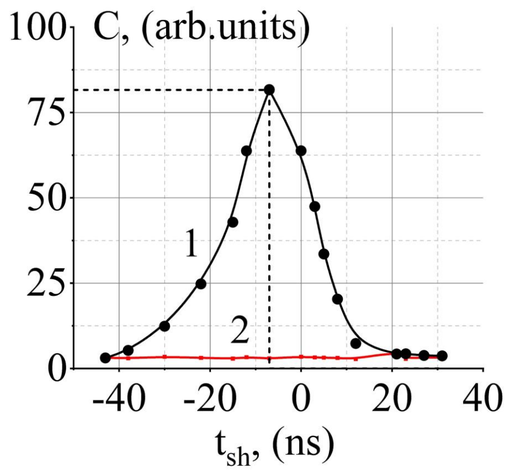


Monostatic laser monitor





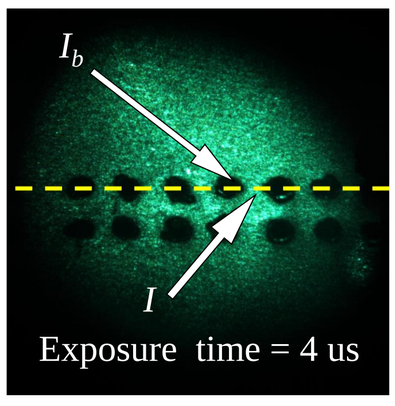
Dependence of output radiation power on time shift t_{sh}



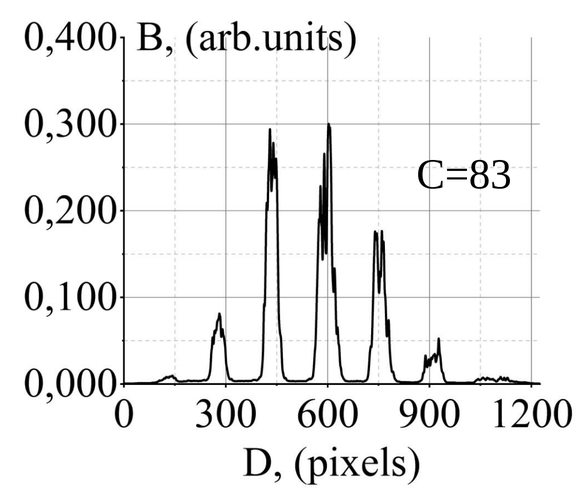
Dependence of image contrast on time shift t_{sh}:

1 – bistatic laser monitor

2 – monostatic laser monitor



Bistatic laser monitor



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