SELF-CONSISTENT STIMULATED BRILLOUIN SCATTERING MODEL WITHOUT EMPIRICAL FACTORS FOR MULTI-BEAM IRRADIATION OF A SPHERICAL LASER TARGET [[1]](#footnote-1)\*)

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One of the varieties of stimulated Brillouin scattering (SBS) is scattering in counter propagating electromagnetic waves [1]. In case of an oblique incidence, the counter wave is a wave of radiation refracted in the plasma, including radiation from other laser beams during multi-beam irradiation of a spherical target. This type of SBS was named CBET (crossed-beam energy transfer) [2]. In [2],
a CBET calculation model is proposed where radiation intensities are summed up instead of fields and an empirical factor is introduced. Such factors do not have universality. This creates a problem for using the model under various experimental conditions.

In this work, a CBET model without empirical factors is considered. The main thing in the model is the selection of regions in the plasma and laser beam that lead to an effective three-wave interaction. The acoustic wave in this case should be close to a plane wave, i.e. the size of the density perturbation in the direction transverse to the acoustic wave vector ***k****a* should significantly exceed the length of the acoustic wave. In multi-beam irradiation of a spherically symmetric plasma, the only type of plasma perturbations satisfying this requirement are perturbations with *kar*>>*kan* (*kar* is the radial component of the vector ***k****a*, *kan* is the component in the direction perpendicular to the radius). This type of perturbations is caused by the sum of fields from parts of beams located near the optical axis: 0<*p*<*pk*, where *p* is the impact parameter of the ray, *pk* is found from the equation *drt*/*rdt*=1, where *rt(p)* and *t(p)* are spherical coordinates of the turning point of the ray with the impact parameter *p*, the angle *t* is calculated from the optical axis of the beam. At *kar*>>*kan*, the main contribution to scattering is given by a small neighborhood of the point *M*=1, where *M=(u-drc*/*dt)/cs* is the Mach number, *u* is the plasma velocity, *r*c*(t)* is the time dependence of the radius of the critical surface, *cs* is the sound velocity. There is a second restriction on the scope of the impact parameters: 0<*p*<*pM*, where *pM*, is the impact parameter of the ray, which has the turning point at *M*=1. In the rest of the plasma region, density perturbations will take the form of

cells with a size of about half the wavelength of the electromagnetic wave. Due to the phase shifts between the waves, the level of perturbations will be significantly less than when summing the intensities. We can only talk about a weak diffuse scattering of radiation on such a structure. The model was used in the RAPID code [3]. The calculation of the energy balance for the conditions of the OMEGA experiment [2] (the target is a spherical shell of CH with a thickness of 25 m with an external radius of 430 m, the pulse *QL(t)* is shown in the figure) gave results close to the experimental values. In the figure out** is the total fraction of the radiation released from the plasma, CB is the fraction of CBET scattering, out and CB are similar values integrated over the pulse.

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References

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3. Yu.V. Afanas’ev, E.G. Gamalii, N.N. Demchenko, et al. Sov. Phys. JETP, v. 52, p. 425 (1980).
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/It/ru/DB-Demchenko.docx) [↑](#footnote-ref-1)