EFFECTS OF THE ANISOTROPIC SCATTERING ON THE DOPPLER SPECTRUM OF WAVES BACKSCATTERED FROM AN EXPANDING CLOUD OF MICROPARTICLES

A. N. Kondratev, A. V. Andriyash, S. E. Kuratov, D. B. Rogozkin

FSUE Dukhov Research Institute of Automatics (VNIIA), Moscow, Russia

The report presents the results of modeling the Doppler spectrum of backscattered radiation applied to laser interferometric probing of ejecta from shock-loaded targets. The calculations are based on the approach that relates the averaged power spectral density of heterodyne beats with the solution of the transport equation for the correlation function of the backscattered field [1].

A numerical solution is used by the discrete ordinate method for the system of Milne-like equations [1], which is derived from the original transport equation. The numerical solution procedure includes accuracy control using the weighting errors factors of the Gauss-Kronrod template. The case of relatively large metallic microparticles, larger than or on the order of the wavelength of the probing radiation (1550 nm), is considered. It is shown that particles of this size make the main contribution to the reflected signal. The calculations are performed for realistic phase scattering functions in a wide range of ejecta areal mass values, taking into account such conditions characteristic of the experiment as the presence of a reflecting boundary (free surface), radiation absorption in the ejecta cloud, and a limited field-of-view of the probing system.

It is shown that due to the contribution of waves scattered at small angles (the so-called snake waves [2]), the peak in the spectrum at the Doppler shift frequency corresponding to the free surface velocity acquires a pronounced asymmetry toward relatively high frequencies. The peak in the spectrum is preserved up to the values of the total thickness of the ejecta cloud equal to several transport mean free paths. The simulation results are compared with calculations in the transport approximation and published results of direct simulation using the Monte Carlo method [3, 4].

References

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