

MV/cm longitudinal terahertz fields from relativistic laser-overdense plasma interactions

A. Woldegeorgis^{1,2}, T. Kurihara³, M. Almassarani^{1,2}, R. Große², B. Beleites², F. Ronneberger²,
G. G. Paulus^{1,2}, A. Gopal^{1,2}

¹*Helmholtz-Institut Jena, Jena, Germany*

²*Friedrich-Schiller-Universität Jena, IOQ, Jena, Germany*

³*University of Konstanz, Konstanz, Germany*

High-power broadband terahertz (THz) radiation can be generated when intense laser pulses interact with matter. When the intensity of the laser pulse is higher than the ionization potential, plasma is generated. The charged particle dynamics and the resultant quasi-static fields and currents generated inside the plasma can give rise to broadband electromagnetic radiation ranging from x-rays to THz radiation. In our work we focus on the generation of THz radiation from such an interaction, in particular from the rear surface of a metal foil when its front surface is shined with a TW laser pulse. Here radially polarized THz radiation is generated by the transient dynamics of charged particles exiting the rear surface. Focusing a radially polarized beam, compared to a beam with linear polarization, creates a strong and tightly focused longitudinal field. It has been shown that longitudinal THz fields have a promising potential in particle acceleration¹. To date, few groups have reported on longitudinally polarized THz wave generation with field strengths in the order of a few kV/cm². Here we report on the generation and detection of longitudinally polarized THz pulses with field strength in excess of 1.5 MV/cm from the rear surface of a thin foil irradiated by TW laser pulses. A transverse component with field amplitude of 3 MV/cm was also measured. Noncollinear pump-probe electrooptic technique was deployed to estimate the peak electric field strength, and study the temporal and spectral properties. We employed two crystal geometries to detect the polarization of the propagating THz pulses at the focus.

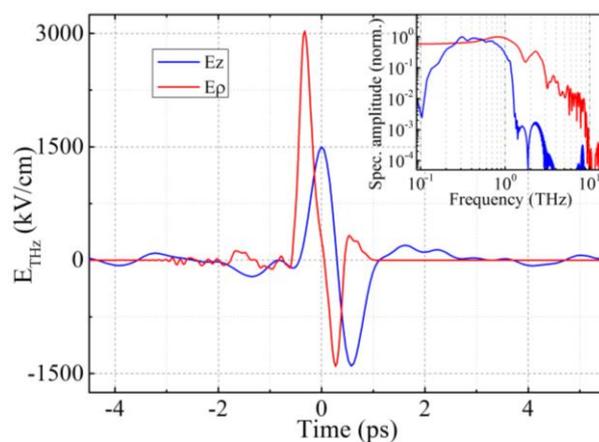


Fig 1. Temporal waveform of the transverse (E_p) and longitudinal (E_z) field components measured using gallium phosphide (GaP) 110- and 100-cut crystal respectively; inset shows the corresponding normalized spectral amplitudes.

References

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