Concept for a novel THz-driven narrow energy spread relativistic electron source

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Numerical simulation of a novel hybrid THz-source based electron accelerator scheme is presented here. Numerous applications demand high energy, high brightness and short electron bunches, furthermore many of them require a narrow energy spread. Recent theoretical studies have demonstrated the possibility of such application-oriented electron sources, which are based on THz-driven electron gun and bunch compression stages [1].

In our proposed setup we combine the unique advantages of Optical Rectification (OR) in lithium-niobate and Large Aperture Photoconductive Antennas (LAPCA). OR based THz radiation provides GV/m accelerating fields while the low-frequency LAPCA source used for the compression, thus different parts of the THz spectrum can be utilized.

For the latter purpose, recent advances in the research of LAPCAs provide a new opportunity. Nowadays, high electric field strength and >10 μJ pulse energies can be routinely achieved by wide band-gap semiconductor antennas at extremely low (0.05 THz) frequencies [2].

Single and quasi-half-cycle compression pulses are compared for electron bunch-shaping. Assessment on the feasibility of a short pulse KrF amplifier chain as an optical driver for both electron and THz pulse generation is also considered.

References

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