Efficient Pair Production in Laser Plasma for Measuring Super-High Laser Intensities

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Rapid developments in laser technologies has been excited a great interest in both theoretical and experimental studies of various QED phenomena in strong fields. An intensity of about 1023 W/cm2 was already achieved, and one can expect that the laser intensity in real experiments will soon exceed 1024 W/cm^2. Nevertheless, an accurate determination of the laser intensity represents a challenging task. In strong laser fields, charged particles can emit high energy photons which may then decay producing electron positron pairs via different mechanisms. In our previous investigation [1], we proposed to employ the pair production process to determine the intensity of laser pulses. By measuring the number of positrons created, one can recover the laser intensity by means of one-to-one correspondences deduced in [2]. This kind of laser diagnostics can be quite accurate due to the threshold behavior of the pair production process as a function of the field strength. In the present study, we report more accurate predictions and considerably widen the laser intensity domain where one can use the diagnostics technique by taking into account the QED cascade [3] and strong magnetic field effects.

It is shown that the laser intensity can be determined in different setups in a wide range from recent values up to super-intense fields.

References

[1] Zs Lécz and A A Andreev, Laser Phys. Lett. **17**, 056101 (2020)

[2] I A Aleksandrov and A A Andreev, Phys. Rev. A **104**, 052801 (2021)

[3] I A Aleksandrov and A A Andreev, Phys. Rev. A **110**, 013111 (2024)