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Calculations of pair-creation probabilities in low-energy heavy-ion collisions

The supercritical effects of QED have not yet been studied in experiments. The supercritical fields cause the instability of the vacuum, which can decay spontaneously via creation of electron-positron pairs [1]. Such strong fields can be achieved in low-energy heavy-ion collisions. At the future FAIR facility it will be possible to produce sufficient amount of heavy ions of required energies [2].

Investigation of supercritical effects requires the proper theoretical methods for treatment of heavy-ion collisions. In this work we present a many-electron method which takes into account the dynamics of occupied negative-energy states. The approach is based on propagation of all initial states via numerical solving of time-dependent Dirac equation using the monopole approximation. The amplitudes of the various processes are obtained with the second quantization technique [1, 3]. Employing the developed method the systematic calculations of pair-creation probabilities have been performed for subcritical and supercritical heavy-ion collisions.

References

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