

Electron Positron Pair Production in Strong Electric Fields

Dissertation

zur Erlangung des akademischen Grades
doctor rerum naturalium (Dr. rer. nat.)



seit 1558

vorgelegt dem Rat der Physikalisch-Astronomischen
Fakultät der Friedrich-Schiller-Universität Jena

von M. Sc. Alexander Blinne
geboren am 19.10.1987 in Essen

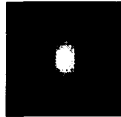


Table of Contents

1. Introduction	3
2. The Wigner Function Formalism	9
2.1. Equation of Motion	11
2.2. Observables	13
2.3. Quantum States	15
3. Homogeneous Electric Fields	21
3.1. The Wigner Method	21
3.1.1. The Modified Quantum Kinetic Equation	23
3.1.2. Numerical Calculations	25
3.2. The Semiclassical Method for Two-Component Electric Fields	27
3.2.1. Solution of the Dirac Equation	28
3.2.2. Momentum Spectrum of Produced Pairs	31
3.3. The Rotating Sauter Pulse	32
3.3.1. The Semiclassical Method for the Rotating Sauter Pulse	33
3.3.2. Phenomenology of the Rotating Sauter Pulse	37
3.3.3. Comparison of the Wigner and Semiclassical Methods	46
3.3.4. Total Particle Yield	53
3.3.5. Typical Spectra	54
3.3.6. Magnetic Moment	63
3.4. Generalized Polarization	66
3.5. Chirped Pulses	71
3.6. Bichromatic Fields	74
3.6.1. Bichromatic Rotating Fields	74
3.6.2. Bichromatic Linear Fields	81
4. Inclusion of Magnetic Fields	87
4.1. Equation of Motion	89
4.2. Numerical Implementation	92
4.3. Preliminary Results	97
5. Conclusion	99

Table of Contents

A. Appendix	I
A.1. Matrices for the Equation of Motion Including Homogeneous Magnetic Fields	I
A.2. Semiclassical Results for the Constant Rotating Pulse	III
A.3. Calculation of the Momentum Spectrum for the Sauter Pulse	IV
B. Bibliography	VII
C. List of Figures	XIX
D. List of Symbols and Abbreviations	XXI
E. Danksagungen	XXV
F. Ehrenwörtliche Erklärung	XXVII