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0521675693 - Quantum Electrodynamics: Gribov Lectures on Theoretical Physics

V. N. Gribov and J. Nyiri

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## Quantum Electrodynamics

This book provides an accessible introduction to quantum electrodynamics. Based on lectures on quantum electrodynamics given by the highly original and distinguished physicist V. N. Gribov, the aim of the book is to present the theory of quantum electrodynamics in the shortest and clearest way for applied use. A distinctive feature of Gribov's approach is the systematic use of the Green function method which allows a straightforward generalization to the cases of strong and weak interactions. The book starts with an introduction that uses the basics of quantum mechanics to introduce the reader gently into the world of propagation functions and particle interactions. The following chapter then focuses on spin  $\frac{1}{2}$  particles. The text goes on to discuss symmetries, the *CPT* theorem, causality, and unitarity followed by a detailed presentation of renormalization theory. A final chapter looks at difficulties with the theory and possible routes to their resolution.

VLADIMIR NAUMOVICH GRIBOV received his Ph.D. in theoretical physics in 1957 from the Physico-Technical Institute in Leningrad where he had worked since 1954. From 1962 to 1980 he was the head of the Theory Division of the particle physics department of that institute, which in 1971 had become the Leningrad Institute for Nuclear Physics. In 1980 he moved to Moscow where he became the head of the particle physics section of the Landau Institute for Theoretical Physics. From 1981 he regularly visited the Research Institute for Particle and Nuclear Physics in Budapest where he was a scientific adviser until his death in 1997. Vladimir Gribov was one of the leading theoretical physicists of his time, who made seminal contributions to many fields, including quantum electrodynamics, neutrino physics, non-Abelian field theory, and especially to the physics of hadron interactions at high energies.

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## Contents

<i>Foreword</i>	xi
<b>1 Particles and their interactions in relativistic quantum mechanics</b>	<b>1</b>
1.1 The propagator	1
1.2 The Green function	5
1.2.1 The Green function for a system of particles	7
1.2.2 The momentum representation	8
1.2.3 Virtual particles	12
1.3 The scattering amplitude	13
1.3.1 How to calculate physical observables	13
1.3.2 Poles in the scattering amplitude and the bound states	16
1.4 The electromagnetic field	17
1.5 Photons in an ‘external field’	25
1.5.1 Relativistic propagator	25
1.5.2 Relativistic interaction	27
1.5.3 Relativistic Green function	30
1.5.4 Propagation of vector photons	33
1.6 Free massive relativistic particles	36
1.7 Interactions of spinless particles	38
1.8 Interaction of spinless particles with the electromagnetic field	46
1.9 Examples of the simplest electromagnetic processes	51
1.9.1 Scattering of charged particles	52
1.9.2 The Compton effect (photon– $\pi$ -meson scattering)	54
1.10 Diagrams and amplitudes in momentum representation	56
1.10.1 Photon emission amplitude in momentum space	56
1.10.2 Meson–meson scattering via photon exchange	57
1.10.3 Feynman rules	58

viii	<i>Contents</i>	
1.11	Amplitudes of physical processes	59
1.11.1	The unitarity condition	61
1.11.2	$S$ -matrix	61
1.11.3	Invariant scattering amplitude	65
1.11.4	Cross section	65
1.11.5	$2 \rightarrow 2$ scattering	67
1.11.6	$\pi^- \pi^-$ scattering	68
1.11.7	$\pi^+ \pi^-$ scattering	71
1.12	The Mandelstam plane	75
1.13	The Compton effect (for $\pi$ -mesons)	80
<b>2</b>	<b>Particles with spin <math>\frac{1}{2}</math>. Basic quantum electrodynamic processes</b>	<b>85</b>
2.1	Free particles with spin $\frac{1}{2}$	85
2.2	The Green function of the electron	98
2.3	Matrix elements of electron scattering amplitudes	100
2.4	Electron–photon interaction	102
2.5	Electron–electron scattering	105
2.5.1	Connection between spin and statistics	106
2.5.2	Electron charge	111
2.6	The Compton effect	112
2.6.1	Compton scattering at small energies	121
2.6.2	Compton scattering at high energies	123
2.7	Electron–positron annihilation into two photons	125
2.7.1	Annihilation near threshold	128
2.7.2	$e^+e^-$ annihilation at very high energies	128
2.8	Electron scattering in an external field	130
2.9	Electron bremsstrahlung in an external field	132
2.9.1	Emission of a soft photon by a low energy electron	133
2.9.2	Soft radiation off a high energy electron	135
2.10	The Weizsäcker–Williams formula	137
<b>3</b>	<b>General properties of the scattering amplitude</b>	<b>144</b>
3.1	Symmetries in quantum electrodynamics	144
3.1.1	$P$ -conservation	144
3.1.2	$T$ -invariance	147
3.1.3	$C$ -invariance	150
3.2	The $CPT$ theorem	153
3.2.1	$PT$ -invariant amplitudes	155
3.3	Causality and unitarity	156
3.3.1	Causality	156
3.3.2	Analytic properties of the Born amplitudes	160
3.3.3	Scattering amplitude as an analytic function	162

<i>Contents</i>		ix
3.3.4	Unitarity	164
3.3.5	Born amplitudes and unitarity	167
3.3.6	How to restore perturbation theory on the basis of unitarity and analyticity, or perturbation theory without Feynman graphs	170
<b>4</b>	<b>Radiative corrections. Renormalization</b>	<b>174</b>
4.1	Higher order corrections to the electron and photon Green functions	174
4.1.1	Multiloop contributions to the electron Green function	174
4.1.2	Multiloop contributions to the photon Green function	179
4.2	Renormalization of the electron mass and wave function	182
4.3	Renormalization of the photon Green function	187
4.4	Feynman rules for multiloop scattering amplitudes	192
4.5	Renormalization of the vertex part	193
4.6	The generalized Ward identity	199
4.7	Radiative corrections to electron scattering in an external field	202
4.7.1	One-loop polarization operator	204
4.7.2	One-loop vertex part	213
4.8	The Dirac equation in an external field	221
4.8.1	Electron in the field of a supercharged nucleus	230
4.9	Radiative corrections to the energy levels of hydrogen-like atoms. The Lamb shift	234
<b>5</b>	<b>Difficulties of quantum electrodynamics</b>	<b>241</b>
5.1	Renormalization and divergences	241
5.1.1	Divergences of Feynman diagrams	242
5.1.2	Renormalization	249
5.2	The zero charge problem in quantum electrodynamics	258
	<i>References</i>	267
	<i>Index</i>	268

## Foreword

The idea of this book is to present the theory of quantum electrodynamics in the shortest and clearest way for applied use. At the same time it may serve as a general introduction to relativistic quantum field theory within the approach based on Green functions and the Feynman diagram technique.

The book is largely based on V. N. Gribov's lectures given in Leningrad (St Petersburg) in the early 1970s. The original lecture notes were collected and prepared by V. Fyodorov in 1974.

We were planning several modifications to the work. In particular, Gribov intended to include discussion of his new ideas about the structure of the theory at short distances, the problem he had been working on during his last few years. His death on 13 August 1997 prevented this, and I decided to stay as close as possible to the version completed by early 1997 and already checked by him.

In preparing the book, I got invaluable help from many of our friends and colleagues. I would like to express my gratitude to those who read, commented on, and provided suggestions for improving the manuscript, especially to A. Frenkel. I would also like to thank C. Ewerz and especially Gy. Kluge for their help in preparing the figures.

I am deeply indebted to I. Khriplovich and, most of all, to Gribov's former students, Yu. Dokshitzer, M. Eides and M. Strikman. They performed the enormous work of checking the manuscript by going meticulously through the whole book several times. They compared the text to their own notes taken at Gribov's university courses and restored the Gribov lectures as fully as possible. They found and corrected inconsistencies and errors. It was more than mere scientific editing. Among their objectives was to preserve in the English text the unique style of Gribov the lecturer, a style that is remembered by his disciples and colleagues with admiration.

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