Nino de Tollis

(1930-2018)

Allievi: W. Alles di Bologna, A. Astbury di Liverpool, A. Barbaro di Roma, B. Barsella di Pisa, G. Bellettini di Roma, L. Bertanza di Pisa, M. Bloch di Paris, V. Borelli di Bologna, B. Brisson Fouché di Paris, A. Byfield di New York City, N. Burgoyne di Kopenhagen, N. Cabibbo di Roma, A. Citron di Genève, G. Culligan di Liverpool, B. De Tollis di Roma E. Eberle di Catania, G. Eder di Wien, E. Ferrari di Roma, H. Filthuth di Genève, G. Finocchiaro di Roma, E. Fiorini di Milano, P. Franzini di Pisa, B. Frisken di Birmingham, R. Gessaroli di Bologna, M. Grilli di Padova, L. Halpern di Wien, R. Hanna di Genève, P. Hillman di Genève, W. Hogg di Glasow, D. Holthuizen di Amsterdam, M. Huybrecht di Bruxelles, B. Jongjeans di Amsterdam, M. Kemp di Liverpool, D. Kleitman di Kopenhagen, J. Knight di Maryland, W. Koch di Bern, G. Leotta di Bologna, L. Lovitch di Cambridge, J. Major di Durham, I. Mannelli di Pisa, T. Massam di Liverpool, W. Menhardt di Göttingen, W. Middelkoop di Geneve, G. Moneti di Roma, H. Paul di Genève, E. Perez Ferreira di Durham, J. Reuss di Leiden, R. Santangelo di Padova, V. Silvestrini di Pisa, R. Stora di Saclay, B. Ugdaonkar di Bombay, S. Vitale di Genova, P. Waloschek di Bologna, A. Zichichi di Genève.

Scuola di Varenna del 1958

Interference in the Double Compton Effect.

B. DE TOLLIS and R. S. LIOTTA

Istituto di Fisica dell'Università - Roma
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

(ricevuto il 28 Dicembre 1956)

Summary. — The differential cross-section by double Compton effect is calculated in the case of identity of the two emitted photons. It results a factor of interference $1/(4\pi)^2$ besides the factor 1/137 due to the perturbative development.

We wish to express our gratitude to Prof. B. FERRETTI for useful discussions and helpful advice.

Anomalous Moment of the μ-Meson for Different Models of Breakdown of quantum Electrodynamics.

B. DE TOLLIS

Istituto di Fisica dell'Università - Roma
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

(ricevuto il 2 Marzo 1960)

In a paper published some time ago, BERESTETSKIJ *et al.* (1), calculated the correction of the μ-meson anomalous magnetic moment due to a possible modification of the photon propagator in case of a break-down of quantum electrodynamics at small distances. Numerically, for the μ-meson, the correction is of the order of α ($\alpha = 1/137$) and therefore it adds directly to Schwinger's $\alpha/2\pi$ anomalous contribution (for the electron, because of its small mass, the deviation would be much smaller and unobservable).

The model that has been used consists in substituting to the photonic propagator $1/k^2$ the modified propagator

Thanks are due to Prof. R. GATTO for having suggested the problem and for helpful discussion.

The Influence of a Possible Pion-Pion Interaction on the Photoproduction of Charged Pions.

B. De Tollis, E. Ferrari and H. Munczek (*)

Istituto di Fisica dell'Università - Roma
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

(ricevuto il 16 Agosto 1960)

As is well known, the experimental evidence for photoproduction of charged pions is not in very good agreement with the prediction of the theory. The formulae derived on the basis of the dispersion relation approach by Chew, Goldberger, Low and Nambu ( ), and subsequently slightly modified and calculated numerically by Robinson (2) give the right order of magnitude of the cross section for positive pions, at 90° in the c.m.s., but not the correct behaviour as a function of energy. The disagreement is stronger at energies near the resonance (300 MeV); at low energies, recent experimental results (3) seem to show a better agreement with the theory. The most serious discrepancy between theory and experiment is given however by the π^-/π^+ ratio at 90°, which is slowly but steadily decreasing with the energy while the theory predicts a nearly constant value.

In this paper we will show that the theoretical predictions on the π^-/π^+ ratio at 90° can be brought in better agreement with experiment by taking into account the presence of a possible pion-pion interaction, which has been already investigated by several authors (4). This interaction is supposed to take place in a resonant $T=1$, $J=1$ state. Starting from the Mandelstam representation, Cini and Fubini

We thank Prof. M. Cini for constant advice and helpful suggestions. We thank also Proff. M. Beneventano, L. Odian and G. Stoppini for clarifying discussions on the experimental aspect of the problem.

The Effect of a Pion-Pion Interaction on the π^0 Photoproduction.

B. DE TOLLIS

Istituto di Fisica dell'Università - Roma
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

A. VERGANELAKIS (*)

Scuola di Perfezionamento in Fisica Nucleare - Roma

(**ricevuto** il 14 Agosto 1961)

Summary. — It is shown that the results of the Chew, Goldberger, Low and Nambu dispersive theory, taking into account the pion-pion interaction in the resonance states $T=1$, $J=1$ of two pions and $T=0$, $J=1$ of three pions (with a suitable choice of some parameters that appear in the theory), are in good agreement with experimental data for π^0 photoproduction on protons for energies from threshold up to $(400 \div 450)$ MeV.

We wish to thank Professor M. CINI for many fruitful discussions and for his constant helpful advice. We are also grateful to Professor M. AGENO who has permitted the use of the I.B.M. computer of the « Istituto Superiore di Sanità » at Roma, and Dr. A. REALE for his valid help in writing the computer program.

Inelastic Scattering of High Energy Photons in the Coulomb Field of a Nucleus with Production of Electron-Positron Pairs (Radiative Pair Production) (*).

B. DE TOLLIS

Isituto di Fisica dell'Università - Roma
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

G. JONA LASINIO (**)

Enrico Fermi Institute for Nuclear Studies, University of Chicago - Chicago, Ill.

R. S. LIOTTA (**)

Department of Physics, Columbia University - New York, N. Y.

(ricevuto il 22 Luglio 1960)

Summary. — We study the radiative pair production and we give the differential cross-section for two kinematical cases. Pair, electron and positron with the same momentum, forward and scattered photon emitted at an angle θ. Photon emitted in the forward direction and pair, still electron and positron with the same momentum, emitted at an angle θ. The calculations are performed with the standard perturbative theory in Born approximation. For small angle θ and for incident γ energy available from modern synchrotrons the two cross-sections are sufficiently high so that they can be measured.

The authors wish to thank Professor BRUNO FERRETTI for having suggested the problem and the Istituto Nazionale per le Applicazioni del Calcolo for having performed a part of the algebraic calculations.

Dispersive Approach to Photon-Photon Scattering.

B. De Tollis

Istituto di Fisica dell'Università - Roma
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

(ricevuto il 5 Marzo 1964)

Summary. — The scattering of light by light is considered with the aid of double dispersion relations. The spectral functions are easily obtained, in the lowest perturbative order, by means of the Cutkosky rules and a Mandelstam representation is explicitly written. This approach is very suitable for the symmetry properties of this scattering reaction and allows to obtain the differential cross-section in a straightforward way for all the values of the energy and of the angle. In order to give a detailed exposition of the method we consider in this paper only that amplitude which describes the scattering of linearly polarized photons in a direction perpendicular to the scattering plane.

The Scattering of Photons by Photons.

B. DE TOLLIS

Istituto di Fisica dell'Università - Roma
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

(ricevuto il 5 Agosto 1964)

Summary. — The general expressions for the five independent amplitudes of photon-photon scattering are given in a rather compact form. It has been shown in detail, in a previous paper (1), that this result is easily obtained for all the values of the energy and of the angle with the aid of the dispersion relations techniques. In that paper one particular amplitude was calculated using the double-dispersive representation and the Cutkosky rules for the calculation of the spectral functions at the lowest perturbative order. The knowledge of the amplitudes for any value of the angle enables one to make the numerical evaluation of the total cross-section. The curve of the total cross-section as a function of the energy, for unpolarized photons, is given in the last Section. The maximum of the total cross-section, $\sigma_{\text{unp}}^{\max} \approx 1.6\ \mu\text{b}$, is reached when the energy of each photon is about 0.7 MeV in the center-of-mass system. In the last Section angular distributions for unpolarized as well as polarized photons are given.

Contributions of Pion Pairs and Unstable Intermediate States to γ-γ Scattering.

B. DE TOLLIS

Istituto di Fisica dell'Università - Roma
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

G. VIOLINI

Istituto di Fisica dell'Università - Roma

(ricevuto il 21 Giugno 1965)

Summary. — The contribution to photon-photon scattering, graphically represented by lowest-order perturbation diagrams containing charged pions in the closed loops, is evaluated. This contribution is found to be not important compared with the one of diagrams with internal electron lines. Moreover the possible effects, partially considered by previous authors, arising from the presence in the intermediate states of an unstable system (such as π^0, η, positronium), are briefly discussed.

Nonlinear Effects in Quantum Electrodynamics.

V. COSTANTINI

Istituto di Fisica dell'Università - Roma

B. DE TOLLIS

Istituto di Fisica dell'Università - Roma
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

G. PISTONI

Istituto di Fisica dell'Università - Roma

(ricevuto il 30 Giugno 1970)

Summary. — The fourth-rank vacuum polarization tensor, which is related to the lowest-order nonlinear interaction between four electromagnetic fields in quantum electrodynamics, is exactly calculated in terms of rational, logarithm and dilogarithm functions when two of the four electromagnetic fields describe photons off the mass shell. This task has been accomplished by a not exceedingly laborious effort with the aid of double dispersion relations which proved to be a very convenient tool for the treatment of these problems (in particular, photon-photon scattering). From the explicit expression of the polarization tensor we have easily obtained the exact amplitudes for photon-photon scattering, photon splitting and photon coalescence into photons on nuclei. Moreover we give the real and imaginary part of Delbrück scattering in the form of threefold integrals over the momentum transferred to the nucleus by one of the two virtual photons. This can be compared with the fivefold and sixfold integrals for the imaginary and real part, respectively, available in the existing literature on Delbrück scattering. Finally we give an explicit expression for the differential cross-section of Delbrück scattering in the limit of low energies.

On Delbrück Scattering (*).

B. De Tollis and M. Lusignoli

Istituto di Fisica dell'Università - Roma
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

G. Pistoni

Istituto di Fisica dell'Università - Roma

(ricevuto il 21 Gennaio 1976)

Summary. — The formulae for the amplitudes of Delbrück scattering given in a previous paper are manipulated and much simpler expressions for them are derived having the form of a sum of twofold and threefold integrals. The integrands are rather compact and contain only rational, irrational and logarithmic functions. In this preliminary work we consider only the amplitude a_{+-} for circularly polarized photons and we give numerical results for photon energy equal to 10.83 MeV and scattering angle in the range from 50° to 150°. For what concerns the real part of the amplitudes, these preliminary results allow one to resolve the discrepancy between the numerical results previously obtained by Ehlotzky and Sheppey and those more recently given by Papatzacos. In fact our results agree with those by Papatzacos and this seems to confirm that the fixed-angle dispersion relation used by Ehlotzky and Sheppey for the calculation of the real parts is incorrect.

On Forward Delbrück Scattering.

B. De Tollis

Istituto di Fisica dell'Università - Perugia
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

(ricevuto il 23 Giugno 1982)

Summary. — Alternative very transparent expressions for the forward complex amplitude for Delbrück scattering, in the form of a single integral representation and in the form of power series expansions in the photon energy are derived. In particular, the series expansions, obtained by using the method of the Mellin transform, are rapidly convergent and are found to be very convenient for numerical calculations. Tables of numerical results are also given.

On Delbrück Scattering: Numerical Results.

B. De Tollis

Dipartimento di Fisica dell'Università - Perugia
Istituto Nazionale di Fisica Nucleare - Sezione di Roma

L. Luminari

Istituto Nazionale di Fisica Nucleare - Sezione di Roma

(ricevuto il 19 Dicembre 1983)

Summary. — The formulae found in a previous paper are used in order to give numerical values of Delbrück amplitudes for photon energies equal to 30, 50 and 70 MeV and scattering angles from 0° to 180°. These numerical results extend those given by other authors to a range of higher energies, where extensive calculations are generally lacking.

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