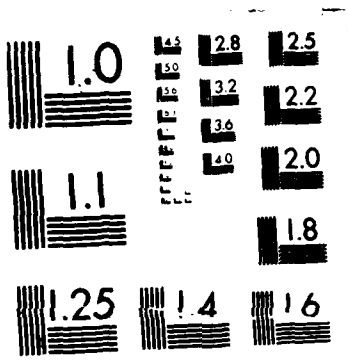
AD-A180 025 A THEORETICAL INVESTIGATION OF ATOMIC STRUCTURE AND SCATTERING PROCESSES(U) NEW YORK UNIV N Y L ROSENBERG ET AL 01 APR 87 N00014-85-K-0376 1/1

UNCLASSIFIED F/G 20/5 NL



Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

12

REPORT DOCUMENTA

AD-A180 025

1a REPORT SECURITY CLASSIFICATION Unclassified	1b REST
2a SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION / AVAILABILITY OF REPORT
2b DECLASSIFICATION / DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION L. Rosenberg, L. Spruch N.Y.U. 6b OFFICE SYMBOL (If applicable)	7a NAME OF MONITORING ORGANIZATION ONR
6c ADDRESS (City, State, and ZIP Code) 4 Washington P. New York, NY 10003	7b ADDRESS (City, State, and ZIP Code) Arlington, VA 2217
8a NAME OF FUNDING / SPONSORING ORGANIZATION ONR 8b OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c ADDRESS (City, State, and ZIP Code) Dept. of the Navy Office of Naval Research Arlington, VA 22217	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. N00014-85 / TASK NO. K-0376 / WORK UNIT ACCESSION NO.

11 TITLE (Include Security Classification)

A Theoretical Investigation of Atomic Structure and Scattering Processes

12 PERSONAL AUTHOR(S)

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13a TYPE OF REPORT	13b TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
	FROM 3/1/85 TO 6/30/85	April 1, 1987	6

16 SUPPLEMENTARY NOTATION

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP

18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

Lasers, atomic scattering, long-range interactions

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

see report attached

20 DISTRIBUTION / AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS	21 ABSTRACT SECURITY CLASSIFICATION unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL L. Rosenberg, L. Spruch	22b TELEPHONE (Include Area Code) (212) 598-7635, 7636 22c OFFICE SYMBOL

Recent research results

(References preceded by R or S refer to bibliographic references of Rosenberg or Spruch, respectively)

Relativistic scattering in an external quasistatic electric field. (R85)

We studied the problem of the relativistic scattering of a charged particle in an external electric field. By imposing certain restrictions on the nature of the field we were able to derive an approximation for the transition amplitude of a particularly simple form, involving as input the physical scattering amplitude in the absence of the field. The basic assumption is that the field is a slowly varying function of time, falling to zero in the remote past and distant future. An additional assumption, which in practice represents a mild restriction on the applicability of the method, is that the energy of the particle is not appreciably affected by the field during the collision. The derivation was similar to earlier treatments of scattering in a low-frequency laser field.

Gauge-invariant approximations for scattering in a strong external field (R87)

While the exact amplitude for scattering in the presence of an external electromagnetic field is gauge invariant the invariance property will not necessarily be preserved in approximations. This observation was the starting point for a reformulation of the scattering problem. In the new version the gauge-dependent vector and scalar potentials are replaced by gauge-independent effective potentials and this allows for the introduction of gauge-invariant approximations in a systematic way.

Extremum principle for relativistic bound-state energies (R88 or S 142)

Due to the existence of negative-energy solutions of the Dirac equation the usual form of the Rayleigh-Ritz minimum principle for the ground-state energy fails to hold for a Dirac particle in a potential. Nevertheless, the calculational problem can be formulated in terms of extremum principles, as we have shown.

Modified perturbation theory for scattering in a laser field (R89)

A variational formulation of the problem of nonrelativistic scattering in a laser field (R72) provides approximations to the transition amplitude correct to first order in the error in the trial function. We showed recently how to estimate the second-order error under the assumption that the interaction of the charged projectile with the laser field in virtual intermediate states is sufficiently weak to justify the use of perturbation theory. The effectively strong projectile-field interaction in initial and final states is treated nonperturbatively through suitable choice of trial functions.

Three papers (R81 or S138; R 83 or S 139; and R86 or S 140) were published on applications of Sturm-Liouville (SL) theory to a new derivation of Levinson's theorem, to a derivation of that theorem in a new domain- when repulsive Coulomb potentials are present-and to a study of the nodal structure of some simple many-body problems. The idea is to avoid the usual approach, based on analyticity, for the extension on that basis from potential scattering to many body scattering would be very difficult. On the other hand, there is an abundance of literature on SL theory as applied to potential and many-body problems.

A paper on the semiclassical evaluation of sums of squares of hydrogenic bound state functions: The sums are of interest in their own right and serve as a check on some extensions of Thomas-Fermi theory by Schwinger and co-workers. (See item S137.)

A paper on the interaction of an electromagnetic wave and an electron image bound to a conducting wall was published. (See item S 136.)

Leonard Rosenberg (continued)

71. Low-frequency Approximation for High-intensity Compton Scattering, J. Phys. A 15, 2547 (1982).

72. Variational Formulation and Low-frequency Approximation for Coulomb Scattering in a Laser Field, Phys. Rev. A 26, 132 (1982).

73. Effect of Infrared Radiation on Nonrelativistic Coulomb Scattering, Phys. Rev. A 26, 1326 (1982).

74. Long-range Interactions in Free-free Transitions, Phys. Rev. A 27, 1879 (1983).

75. Resonant Scattering in the Presence of an Electromagnetic Field, Phys. Rev. A 28, 2727 (1983).

76. Low-energy Approximation for Inner-shell Ionization During Nuclear Resonance Scattering, Phys. Rev. A 28, 3238 (1983).

77. Radiative Capture Estimates Via Analytic Continuation of Elastic Scattering Data, and The Solar Neutrino Problem (with Z.R. Iwinski and L. Spruch), Phys. Rev. C 29, 349 (1984).

78. Final-state Interactions in Multiphoton Ionization Theory, Phys. Rev. A 30, 245 (1984).

79. Electron Scattering in the Presence of Laser Radiation, in Proceedings of the Third International Conference on Multiphoton Processes, Iraklion, September 1984, edited by P. Lambropoulos and S.J. Smith (Springer, New York, 1984), p. 82.

80. Effect of Atomic Electrons on Resonant Nuclear Scatteirng, J. Phys. B 5, 887 (1985).

81. Nodal Structure of Zero-energy Wave Functions: New Approach to Levinson's Theorem (with Z.R. Iwinski and L. Spruch), Phys. Rev. A 31, 1229 (1985).

82. Relativistic Coulomb Bremsstrahlung in Soft-photon Approximation, Phys. Rev. A 31, 2180 (1985).

83. Levinson's Theorem and the Nodes of Zero-energy Wave Functions for Potentials with Repulsive Coulomb Tails (with Z.R. Iwinski and L. Spruch) Phys. Rev. Lett. 54, 1602 (1985).

84. Extension of the Bloch-Nordsieck Model, Phys. Rev. A 32, 1395 (1985).

85. Relativistic Scattering in the Presence of a Quasistatic Electric Field, Phys. Rev. A 33, 164 (1986).

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86. Nodal Structure and Phase Shifts of Zero-incident-energy Wave Functions: Multiparticle Single-channel Scattering (with Z.R. Iwinski and L. Spruch) Phys. Rev. A 33, 946 (1986).

87. Gauge-invariant Approximations for Scattering in a Strong External Field, Phys. Rev. A 34, 978 (1986).

88. Extremum Principles for the Determination of Relativistic Bound-state Energies (with L. Spruch) Phys. Rev. A 34, 1720 (1986).

89. Modified Perturbation Theory for Scattering in a Laser Field, Phys. Rev. A 34, 4567 (1986).

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136. Photoexcitation and photoejection of an electron bound to a wall by the image potential (with R. Shakeshaft), Phys. Rev. A 31, 1535 (1985).

137. Semiclassical evaluation of sums of squares of hydrogenic bound state wave functions (with R. Shakeshaft), J. Phys. B: At. Mol. Phys. 18, 1919 (1985).

138. Nodal structure of zero-energy wave functions: New approach to Levinson's theorem (with Z.R. Iwinski and L. Rosenberg), Phys. Rev. A 31, 1229 (1985).

139. Levinson's theorem and the nodes of zero energy wave functions for potentials with repulsive Coulomb tails (with Z.R. Iwinski and L. Rosenberg), Phys. Rev. Lett. 54, 1602 (1985).

140. Nodal structure and phase shifts of zero-incident-energy wave functions: Multiparticle single-channel scattering (with Z.R. Iwinski and L. Rosenberg) Phys. Rev. A 33, 946 (1986).

141. Relativistic, or Casimir, long-range potentials. Physics Today 39, 37 (1986).

142. Extremum principles for the determination of the energies of relativistic bound states (with L. Rosenberg), Phys. Rev. A 34, 1720 (1986).

END

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