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13. ABSTRACT *(Maximum 200 words)*

Over the course of the contract Dr Moses published 12 papers with one still pending. His work on novel electromagnetic wave propagation, together with insights regarding possible transmitters, is nothing short of terminal. Dr Moses was the first to rigorously characterize the universal character of far field patterns produced by a source that operated over a finite time frame. Such patterns could be "requested" and then the design/operating procedure of the source would be the fundamental unknown. Such possibilities were communicated to government lab researchers at AL (Brooks AFB) and subsequent work will be pursued by them and Dr Moses.

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H.E. Moses, Ph.D.
President and Chief Scientist
April 15, 1993

FINAL REPORT

CONTRACT F 49620-88-C-0070
AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

1. **Period of Performance:** April 1, 1988-March 31 1993

2. **Papers Published:**

1. *Exact Matrix Elements for One-Photon Emission from Hydrogenic Bound States.* (with R.T. Prosser). Nuclear Physics B. (Proc. Suppl.), 6, 265 (1989).

2. *A Refinment of the Radon Transform and its Inverse.* (with R.T. Prosser). Proc. Roy. Soc. Lond. A, 422, 343 (1989).

3. *Exact Solutions of the Three-Dimensional Scalar Wave Equation and Maxwell's Equations from the Approximate Solutions in the Wave Zone through the Use of the Radon Transform.* (with R.T. Prosser). Proc. Roy. Soc. Lond. A, 422,351 (1989).

4. *Acoustic and Electromagnetic Bullets.* (with R. T. Prosser). SPIE Vol. 161,403 (1989).

5. *Pulsed Sources and Currents for Acoustic and Electromagnetic Bullets.* (with R. . Prosser). SPIE Vol.1226, 352 (1990).

6. *Acoustic and Electromagnetic Bullets: Derivation of New Exact Solutions of the Acoustic and Maxwell's Equations.* (with R.T. Prosser). SIAM Jour. App. Math.,50, 1325 (1990).

7. *The General Solution of the Time-Dependent Maxwell's Equations in an Infinite Medium with Constant Conductivity.* (with R.T. Prosser). Proc. Roy. Soc. Lond. A,431, 493 (1990).

8. *(1) Time Development of Acoustic Bullets. (2) The Wave Zone Form of Focus Wave Modes and other Solutions of the Acoustic Equation.* (with R.T. Prosser). SPIE, Vol. 1407, 354 (1991).

9. *The "Onion Vortex": An Adiabtatic, Steady-State Flow of a Perfect Gas in the Infinite Domain.* (with G. v.H. Sandri). Phys. of Fluids A,4, 195 (1992).

10. *The General Solution of the Three-Dimensional Acoustic Equation and Maxwell's Equations in the Ingfinite Domain in Terms of the Asymptotic Solution in the Wave Zone.* (with R.J. Nagem and G. v.H. Sandri). J. Math. Phys., 33, 86 (1992).

11. *Bounds for Exact Matrix Elements for Radiation Processes in Hydrogenic Atoms.* (with R.T. Prosser). J. Math. Phys., **33**, 1878 (1992).

3. Paper in Press.

The General and Asymptotic Solution of the Elastic Wave Equation in an Unbounded Medium. (with R.J. Nagem and G. v.H. Sandri). To be published in Proc Roy Soc. Lond. A (1993).

4. Submitted Paper.

Quantum Electric Forces on Charges when there are No Photons. (with G. v.H. Sandri). Submitted to Proc. Roy. Soc. Lond. A.

5. Reports Written.

Two reports were written without intending immediate publication. They were for the use of Dr. R. A. Albanese. One report was to evaluate the electrostrictive effect of an electromagnetic pulse travelling through a dielectric medium. The second concerned the propagation of a pulse in a *moving* dilectric medium.

6. Current Research.

During the 6 month period immediately before March 31, 1993, the effect of t ime-dependent propagation through a chiral-like medium was studied. This is probably the first *time-dependent* study. Results will be used for the Doctoral thesis of S.B. Bronson, who is on the contract as a consultant. Ultimately, it is expected that some of the results will be published. Some research is also going on in which light is considered to consist of photons. We seek to see how the wave and particle picture of light leads to overlapping and (in some cases) constrasting results in terms of propagation.

7. Total Funding.

The total authorized funding under the contract was $582,061. The actual funding, however, was $554,812. The difference of $27,249 is to be paid to the Harry E. Moses-Applimath Co. on receipt and acceptance of this final report.

8. Consultants Supported.

1. Mr. J.W. Penn of the Special Projects Division, Armstrong Laboratories, Brooks AFB.

2. Prof. P.R. Kotiuga and Prof. G. v.H. Sandri of Boston University.

3. Prof. R. T. Prosser of Dartmouth College

3. Graduate Students S.D. Bronson and C. Konstantopoulos of Boston University.

10. Talks.

H.E. Moses and R.T. Prosser have given talks on the material of the published papers at: SPIE meetings at Los Angeles in January 1989-1991, at Boston University, Harvard University, Dartmouth College, University of Lowell, Armstrong Laboratories at Brooks AFB, and Geophysics Laboratories at Hanscom AFB.

11. Compliance with Contract Provisions.

Yearly reports have been sent to the monoitor, Dr. Arje Nachman. They have also been sent to Dr. R.A. Albanese of Armstrong Laboratories. Preprints and reprints of all papers have been sent to Dr. Nachman and Dr. Albanese. The Harry E. Moses-Applimath Company has also complied with all other provisions of the contract.

Sincerely yours,

Harry E. Moses