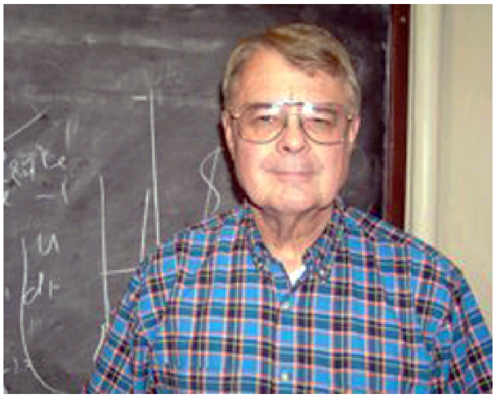
Faculty Profile



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W. Ronald Salzman

Professor Emeritus- Retired

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Education and Appointments

- B.S. 1959, UCLA (Chemistry)
- M.S. 1964, UCLA (Physics)
- Ph.D. 1967, UCLA (Chemistry)

Research Interests

Research Summary

Theoretical Chemistry

My interest is in the interaction of light with atoms and molecules; this includes the behavior of atoms and molecules in intense light beams, and phenomena, such as optical rotation which occurs at lower light intensities. The approach is mainl semiclassical, i.e., the atom or molecule is treated quantum mechanically but the light beam it interacts with is treated as classical electromagnetic field. However, we also use fully quantized models when appropriate. Problems of present activ interest include:

I. Microwave Optical Rotation

We have been able to show that optical activity exists in the microwave region for molecules of appropriat symmetry. Questions remaining are: How large are the effects? Can they be measured? Do the effects provide an new and interesting molecular information?

II. Non-Perturbation Theory Methods

We have been treating the interaction of light with matter in intense fields by numerically integrating Schrödinger' equation in model systems. This technique gives results that are not easily derived by common theoretical methods. Open theoretical questions are: Can we find closed-form theoretical methods which will give us these same results, and can this technique provide useful information regarding the dynamics of internal energy transfer in molecules?

III. Optical Rotation Near Resonance Absorption

We have developed a formulation of the theory of optical activity in which the fundamental parameters do not go to infinity as the driving frequency passes through a resonance absorption. It remains to be seen whether this formulation will provide any new insight or lead to new molecular information. The consequences of this formulation need to be explored further.

IV. The Magnus Expansion in Time-Dependent Perturbation Theory

We have recently developed an alternative to the Magnus expansion in time-dependent perturbation theory. This new form of the expansion is easy to derive and the form of the higher order terms is so simple that they can be written to arbitrary order by inspection. The new expansion removes the principal barrier to the wide-spread use of the Magnus expansion in quantum dynamics, namely the extreme complexity of the conventional forms of the terms above third order. This development permits us to study the detailed properties of the expansion as well as apply it to problems of spectroscopic and dynamic interest. In addition, it is now possible to study carefully the convergence properties of the Magnus expansion. Preliminary work indicates that there may be unsuspected problems with convergence for some simple models of physical interest.

Selected Publications

- "A New Criterion for Convergence of Exponential Perturbation Theory in the Schrödinger Representation," W. R. Salzman, *Phys. Rev. A.*, 36, 5074 (1987).
- "Semiclassical Theory of Microwave Optical Activity Near Resonance in Asymmetric Rotors," W. R. Salzman, *Chem. Phys.*, 138, 25 (1989).
- "Semiclassical Theory of Microwave Optical Activity in Asymmetric Rotors," W. R. Salzman, *Chem. Phys.*, 143, 405 (1990).
- "Circular dichroism at microwave frequencies: Calculated rotational strengths of selected transitions for some oxirane derivatives," W. R. Salzman, *J. Chem. Phys.,* 107, 2175 (1997).

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