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Citation Classics

Dalgarno A. Atomic polarizabilities and shielding factors.
Advan. Phys. **11**:281-315, 1962.

The author discusses methods of calculating the response of an atomic system to perturbation. Atomic polarizabilities and shielding factors are considered and the relationships between them are demonstrated. A formulation is presented of a self-consistent complex Hartree-Fock approximation in terms of which several other methods can be interpreted. [The *SCI*® indicates that this paper was cited 302 times in the period 1962-1976.]

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"This article was written in response to an invitation from Dr. B.H. Flowers (now Sir Brian Flowers), who had assumed responsibility for the editorship of *Advances in Physics* and who was, I believe, attempting to extend the range of subject matter published in the journal beyond its earlier devotion to solid state physics. The subject was not specified, but I understood that he was seeking a review of some aspect of atomic and molecular physics. I had worked for several years on atomic perturbation theory and I had been impressed by the confusion which attended the development of an accurate description of the response of an atomic or molecular system to the application of a static electric field. The subject was a simple one, and the confusion lay in the propagation of the inevitable inaccuracies in the description of the unperturbed system, into the effects of the perturbation. There were two obvious ways of proceeding: in one, the unperturbed and perturbed systems could be treated simultaneously at the same level of approximation; and in the other, the error in the description of the unperturbed system could be ascribed to an additional perturbation and double perturbation theory used to identify the sources of uncertainty in the calculation of the response. It was not difficult to organize the two viewpoints into a unified presentation and I thought that a review with this end would clarify my understanding and perhaps be more generally useful. Perturbation theory can also be expressed usefully in variational terms, and a review of some aspect of perturbation theory would allow me to emphasize the close relationship between the two apparently disparate approaches. The history of atomic polarizabilities had been a long one in quantum mechanics and the theory had retained its earlier lack of mathematical sophistication. The introduction of more recent angular momentum techniques scarcely merited an original paper but could be conveniently incorporated into a review.

"That my article is often cited is due largely, I believe, to the fact that in further extensions of the topic it was no longer necessary to seek out the appropriate reference in an early extensive but contradictory literature. The article was useful also in that its essential theme, a self-consistent theory of atomic and molecular perturbation, was later to be readily generalized to the description of frequency-dependent response functions, to the calculations of long range intermolecular interactions and to multiphoton processes. It is not without interest to note that the article was a review which had no original content."