1974 I

The American Physical Society

Division of Electron and Atomic Physics

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TO MEMBERS OF THE DEAP from Francis Pichanick

Arrangements for the APS Washington Meeting (April 22-25, 1974)

(i) Symposia Sponsored by the Division

(a) Topics of General Interest (organized by Ben Bederson and Rolf Sinclair)

1. "Intense Electromagnetic Fields and Multiphoton Processes."
P. LAMBROPOULOS, Texas A and M University.
The interaction of intense electromagnetic fields with electrons gives rise to a plethora of new phenomena. These phenomena are of interest in the study of the interaction of lasers with matter; they also provide a sensitive probe of atomic and molecular structure. Moreover, they have relevance to astrophysical problems arising, for example, from strong magnetic fields or multiphoton and stimulated processes. Intense fields cause severe distortions of atomic structures and induce transitions of order higher than the usual single-photon absorption and emission. Such multiphoton transitions can be described by higher order terms of the usual radiation perturbation theory as long as the incident power is less than approximately 10^{14} Watts/cm^2. A number of interesting effects have been observed and others predicted in this intensity regime. Examples are polarization phenomena, shift and broadening effects due to resonances with intermediate atomic states and unusual dependence of the transition rate on radiation intensity. Experimental results and their theoretical interpretations are reviewed and possible applications are pointed out. For yet higher intensities, the conventional perturbation expansion becomes invalid. Alternative approaches and their predictions are reviewed and discussed. The status of the field is summarized and directions for further research are indicated.

2. "Hidden Variables."
S. J. FREEDMAN, Princeton University
It has often been suggested that the statistical features of quantum mechanical predictions might be described by an underlying deterministic structure. Specific models of this sort take the form of hidden variable theories in which the specification of the fundamental state of a system includes parameters in addition to the quantum mechanical wave function. The possibility that a hidden-variable theory could ever reproduce the experimentally verified properties of quantum mechanics has been a much debated issue. Recent progress in understanding this problem will be discussed with particular attention to recent experiments designed to test local hidden-variable theories.

3. "Analysis of Atomic Collision Processes
H. KLEINPOPPEN, University of Sterling, Scotland
New methods for analyzing atomic collision processes have been used to study spin effects, resonance phenomena and electron-photon correlations, for example. Spin effects in atomic collisions allow separating the

"direct" and "exchange" interaction occurring during the collision process. Resonance phenomena in electron-atom collisions studied by means of high resolution electron energy devices play an important role in elastic and inelastic processes over large energy ranges. Electron-photon coincidences from electron-atom excitation permits extracting new types of observables like excitation amplitudes and their phase differences. A complete analysis of the angular momentum dynamics and of the Fano-Macek orientation and alignment parameters will be derived from a given example of electron-photon coincidences in electron helium impact excitation. Similar problems in heavy particle atom collisions will also be discussed.

(b) Photoionization (organized by Laird Schearer)

1. "Laser Studies of Photoionization Processes."
W.C. LINEBERGER, University of Colorado,
Recent advances in laser technology have made possible investigations of negative ion photodetachment which were not feasible with conventional light sources. Two such types of experiments will be discussed -- tunable laser photodetachment and laser photoelectron spectroscopy. In the former, a tunable dye laser is used to obtain the energy dependence of photodetachment cross sections near threshold with resolution approximately 1Å, enabling the direct determination of electron affinities to better than 1 meV accuracy. Such studies in the alkali negative ions have revealed the presence of autoionizing negative ion states which lie just below the first excited state of the neutral atom. In the second experiment a negative ion beam is crossed by a fixed wavelength argon ion laser beam and the energy and angular distributions of the ejected electrons are measured. A number of electron affinities with accuracy approximately 10 meV have been obtained and several atomic and molecular negative ions have been shown to possess bound electronically excited states. Recent results obtained from these two complementary techniques will be reviewed and current "best" values for electron affinities of the elements will be presented. Some very recent experimental results concerning polarized electrons produced by multi-photon ionization will be discussed.

2. "Photoionization of Rare Gas Atoms in Excited States."
R.F. STEBBINS, Rice University
A molecular beam apparatus has been used in conjunction with a pulsed tunable UV laser to investigate photoionization of He, Ar and Kr atoms in excited states. For He(1s2s:2^1S,2^3S) metastable atoms absolute cross sections have been determined in the range from threshold to 2400Å. In addition the photoionization cross sections at selected wavelengths have been measured for He(1snp:n^1P,n^3P) with n-3,4,5. These results will be discussed in the light of available theory. Photoionization of argon and krypton $mp^5(^2P_{1/2})(m+1)s'$. ($^3P_0$) and $mp^5(^2P_{3/2})(m+1)s$. ($^3P_2$) metastable atoms has been observed in the wavelength range 3230-2690Å. Major contributions to the ionization arise from discrete excitation to $p^5(^2P_{1/2})nf'$ and $p^5(^2P_{1/2})np'$ levels which autoionize into the underlying $P_{3/2}$ continuum. The oscillator strengths for these transitions will be discussed as will the autoionizing lifetimes and term values of the upper levels.

3. "Multiphoton Spectroscopy of Cesium with a Tunable Dye Laser."
C. B. COLLINS, The University of Texas at Dallas.
Space charge amplification of the direct and indirect ionization resulting from photoabsorption in alkali metal vapor offers to the conventional techniques of absorption spectroscopy a useful complement of highest sensitivity. Even with classical illumination sources, this system has provided for the sensitivity necessary to resolve the pole at n=19 in the doublet line strength ratio for the principal series of atomic cesium. When used with a tunable dye laser of high spectral density multiphoton absorption spectra become as readily obtainable as conventional single-photon spectra. In the 6550-6590-A wavelength region transitions from n=9 to 13 have been recorded for the $6^2S_{1/2}$ $-n^2D_{5/2,3/2}$ series and from n=11 to 14 for the $6^2S_{1/2}$-$n^2S_{1/2}$ series of atomic cesium. At shorter wavelengths two-photon ionization spectra of Cs_2 have been obtained and show clearly the structure of the resonant intermediate states, both bound and continuum. In the latter case single and double photon resonances have been observed for the same wavelength and have given spectra with maxima corresponding to the absorption line spectrum of the dissociation product modulated in amplitude as a function of wavelength by the more slowly carying absorption resonance to the initial continuum state of the molecule. What appears to be dissociation of resonant $d\pi_g$ ($^3\Pi$) terms has been observed with the strong development of features corresponding to newly identified components of the fundamental series in absorption to levels as high at 50^2F. Collectively these results attest to both the importance and the feasibility of further measurements in this rapidly expanding domain of multiphoton spectroscopy.

4. "Angular Distribution of Atomic Photoelectrons."
S. T. MANSON, Georgia State University
Recent theoretical and experimental progress on the angular distribution of atomic photoelectrons is reviewed. On the theoretical side, extensive calculations have given an overview of the combined energy and Z-dependence of the asymmetry parameter β and have predicted rapid variations of β in certain energy ranges. In addition, a general theoretical treatment has been formulated which spotlights the effects of the non-spherical interactions which can be quite significant. On the experimental side, synchrotron radiation and high energy electrons have been employed with noble gases and the results compare well with theory. Measurements in the vicinity of auto-ionizing resonances have also been made and these too agree well with theory. The prospectus for further work shall be discussed.

(c) <u>Positrons at Solid Surfaces and in Defects</u> (organized by J.William McGowan)

1. "Positron Dynamics in Solids."
WERNER BRANDT, New York University
2. "Spectroscopy of Low Energy Positrons Diffusing from Transition Metals."
S. PENDYALA, F.E. GIROUARD, D. BARTELL, J.Wm.MCGOWAN, Univ. of Western Ontario
3. "Slow Positron Interactions with Solid Targets."
K.R. CANTER, A.P. MILLS, S. BERKO, Brandeis University
4. "Time and Energy Spectra of Positron Annihilation in Metal Defects."
I.K. MACKENZIE, University of Guelph
5. "Positrons in Radiation Induced Voids in Aluminum."
J. D. MCGERVEY, Case Western Reserve University
R.W. HENDRICKS, Oak Ridge National Laboratory
W. TRIFTSHAEUSER, Kernforschungsanlage, Juelich, W.Ger.

(ii) The DEAP Executive Committee will meet at 8 p.m. on Monday April 22. The committee consists of Arthur Schawlow (chairman), Benjamin Bederson (vice-chairman), Roy Garstang, Ronald Geballe, Keith Jefferts, Eugen Merzbacher, Ralph Nicholls, Francis Pichanick, Thor Rhodin and King Walters. Members should feel free to contact any of the above should they wish to bring some topic to the attention of the committee.

(iii) The Program Committee meets at noon on April 22. Symposia and invited speakers for our Annual Meeting at Chicago in December, as well as for general APS meetings through March 1975, will be discussed. Please send suggestions for topics and speakers to Ben Bederson, Physics Dept., New York University, 4 Washington Place, New York, N.Y. 10003.

(iv) The Nominating Committee will probably convene at Washington in April. This committee consists of Steve Smith (chairman), Ronald Geballe, Harold Metcalf, and King Walters. They will select a slate of candidates to present to the DEAP membership later in the year. Offices to be filled are vice-chairman, divisional councillor, secretary-treasurer and one committeeman. The chairman of this committee will be happy to receive suggestions from the DEAP membership.

NEWS OF THE DIVISION

1974 Davisson-Germer Prize

This prize has been awarded to Norman Ramsey of Harvard and will be presented at the Washington Meeting. The citation is "for his pioneering work in the imaginative design and performance of molecular beams experiments, for his classic studies on magnetic interactions in molecules and on fundamental properties of nucleons, and for his contributions to the art of high-precision radiofrequency spectroscopy."

DEAP Annual Meetings

The Fifth Annual Meeting was held at Yale on December 10-12, 1973. The superb efforts by the local committee, headed by Vernon Hughes, Jim Bayfield and Bill Wing, made it a great success. It was by far the largest meeting in our history with nearly four hundred attendees and 150 contributed papers. A capacity crowd attended a cocktail party generously provided by Yale, followed by the banquet where the principal speaker was Lewis Branscomb. "Monday Night at the Laboratories" was a great success, with the laboratories in several departments open to visitors. The DEAP is particularly indebted to Allan Bromley, chairman of the host Physics Department, who took an active interest in all aspects of the meeting.

The Sixth Annual Meeting will take place in Chicago on the 2-4 December, 1974. The headquarters for both the sessions and accommodations will be the Center for Continuing Education at the University of Chicago. A detailed announcement will appear soon in the APS Bulletin and in my next mailing. Although the deadline for contributed papers has been previously advertized as Sept. 20 on the back page of the Bulletin, I have been advised by the APS office that this will have to be brought forward to Sept. 13. Remember that this date comes when many of you have just returned from a summer expedition, and it might be wise to plan your contributions during the spring. Abstracts may be sent at any time to Ben Bederson at the address given above under program committee.

The Seventh Annual Meeting will be held in Tucson, Arizona on the 3-5 December 1975.

1975 Gordon Conference

In the summer of 1975 there will be a Gordon Conference of interest to DEAP members. It is tentatively scheduled to be held at Andover Academy a week before the ICPEAC meeting in Seattle, Contact Ben Bederson for details.