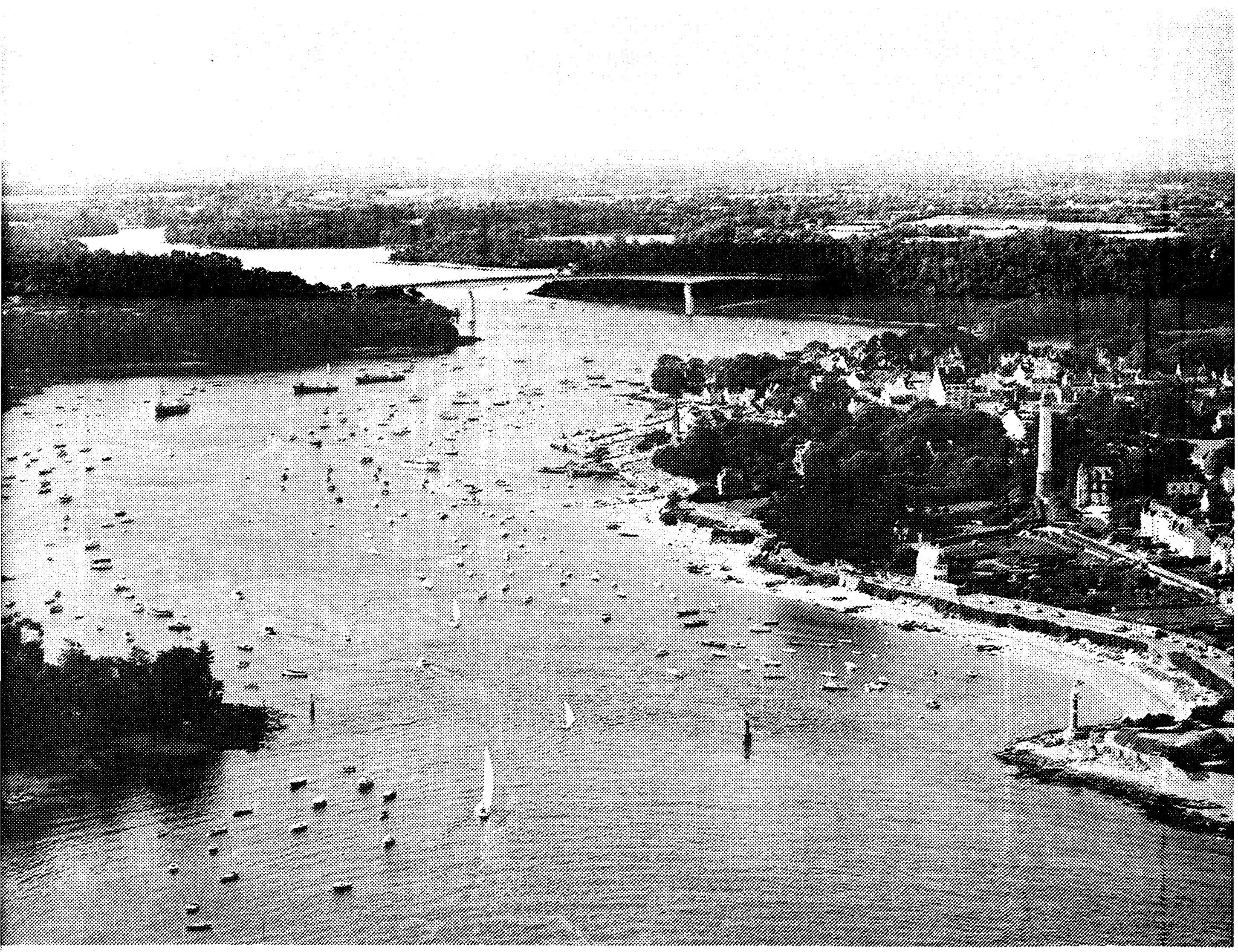
Europhysics Study Conference

on Multiphoton Processes



Bénodet June 18 - 22 1979

INVITED PAPERS

N. DELONE (P.N. Lebedev Physical Institute, Moscow, U.S.S.R.)

Multiphoton Ionization of atoms.

L. ARMSTRONG (Johns Hopkins University, Baltimore, U.S.A.)

Temporal behavior in resonant multiphoton ionization of atoms.

P. KNIGHT (Royal Holloway College, University of London, England)

Quantum beat interference effects in resonant multiphoton ionization.

P. LAMBROPOULOS (University of Southern California, Los Angeles, U.S.A.)

Field statistics and bandwidth effects in resonant multiphoton ionization of atoms.

Y. GONTIER (C.E.A. Saclay, France)

Resonant multiphoton ionization of atoms.

S. HARRIS and J.F. YOUNG (Stanford University,Stanford, USA)

Laser induced inelastic collision and radiative energy transfer from metastable states.

S. FENEUILLE (Laboratoire Aimé Cotton, Orsay, France)

Theory of radiative - collisional reactions in the two-level approximation.

A. LAU (Exxon research and engineering Co, Linden, USA)

Laser-controlled unimolecular and bimolecular processes : Fields dependent rate constants.

S. ANISIMOV (Landau Institute, Moscow, USSR)

Laser induced multiphoton photoelectron emission from metals.

N. BLOEMBERGEN (Harvard University, Cambridge, USA)

A survey of multiphoton excitation processes.

M. VAN DER WIEL (F.O.M. Institute, Amsterdam, The Netherlands)

Multiphoton ionization of molecules.

Y. LEE (University of California, Berkeley, USA)

Infrared multiphoton excitation and dissociation of molecules.

R. HOCHSTRASSER (University of Pennsylvania, Philadelphia, USA)

Two-photon spectroscopy of molecules.

N.V. KARLOV, A.M. PROKHOROV (P.N. Lebedev Physical Institute, Moscow, USSR)

Multiphoton processes in laser-induced chemical reactions.

K.L. KOMPA, W. FUB, K. HOHLA, D. PROCH, J.REILLY, S.D. ROCKWOOD, H. SCHRODER
(Max-Planck Institute, Garching, Germany)

Multiphoton processes and laser-induced chemical changes.

M. FEDOROV (P.N. Lebedev Physical Institute, Moscow, USSR)

Multiphoton stimulated Bremsstrahlung.

S. GELTMAN (JILA, Boulder, USA)

Multiphoton free-free transitions and ejected electron energy distributions.

G. LEUCHS, E. RIEDLE, S.J. SMITH, H. WALTHER
(Universität München, Garching, All.Fédérale)

Angular distribution of photoelectrons in three photon ionization of sodium.

ANGULAR DISTRIBUTION OF PHOTOELECTRONS IN THREE PHOTON IONIZATION OF SODIUM

G. Leuchs, E. Riedle, S.J. Smith[+], H. Walther[++]

Sektion Physik der Universität München
8046 Garching, Federal Republic of Germany

The angular distribution of photoelectrons produced by multiphoton ionization of atoms is a sensitive test for the ionization process since the distribution is determined by the intermediate states. In this paper we report measurements of the angular distribution which have been obtained for resonant three-photon ionization. The results also demonstrate that the angular distribution can be changed by mixing the intermediate states by microwave transitions. This can be used for optical microwave experiments to determine the energy splitting of Rydberg states.

In the experiment two nitrogen laser pumped dye lasers were used to excite the atoms of a sodium atomic beam. The sodium atoms were ionized in the resonant three-photon process $3^2S_{1/2} \rightarrow 3^2P_{1/2}, 3^2P_{3/2} \rightarrow n^2D \rightarrow |1,\vec{k}\rangle$. The electrons emitted in the plane perpendicular to the direction of the laser beams were detected with an angular resolution of 0.35 rad. The angular distribution was probed by rotating the direction of the linear polarization of the laser light.

In the case of single-photon ionization of atoms with an equal population of the m-sublevels the photoelectron angular distribution can be described by the general formula

$$I(\theta) = 1 + \beta P_2(\cos\theta)$$

θ is the angle between the direction of emission of the photoelectron and the laser polarization. β is the anisotropy parameter and P_2 the second Legendre polynomial. In the case where m-sublevels are selectively populated in a n-photon ionization process, higher powers of $\cos^2\theta$ have to be included:

$$I_n(\theta) = \sum_{v=0}^{n} a_v \cos^{2v}\theta .$$

Thus, for a resonant multi-photon ionization process sharp maxima appear in the angular distribution of photoelectrons which critically depend on the quantum numbers of the intermediate states /1/. Experiments on sodium demonstrating this behaviour are reported.

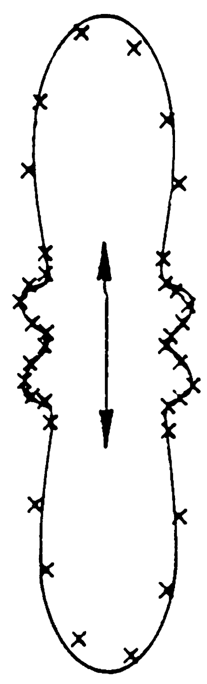


Fig.: The angular distribution of photoelectrons produced by resonant three-photon ionization $3^2S_{1/2} \rightarrow 3^2P_{3/2} \rightarrow n^2D \rightarrow |1,\vec{k}\rangle$ is shown in a polar diagram. The solid line was obtained in a least squares fit of the theoretical function $I_6(\theta)$ to the experimental data, giving $I_6(\theta)=0.03+0.32\cos^2\theta-\cos^4\theta+0.87\cos^6\theta$. The arrow indicates the direction of laser polarization.

+ On sabbatical leave from JILA, Boulder, Colorado

++ also Projektgruppe für Laserforschung der Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V. 8046 Garching, Federal Republic of Germany

/1/ P. Lambropoulos, private communication