سامية محمد مصطفى



شبكة المعلومات الحامعية

بسم الله الرحمن الرحيم



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سامية محمد مصطفي



شبكة العلومات الحامعية



شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم





سامية محمد مصطفى

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسو

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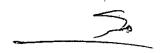
سامية محمد مصطفى

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بالرسالة صفحات لم ترد بالأصل





A STATISTICAL INTERPRETATION FOR ABOVE THRESHOLD IONIZATION USING A SEMICLASSICAL LASER PULSE MODEL

THESIS SUBMITTED TO

THE DEPARTMENT OF ENGINEERING MATHEMATICS AND PHYSICS

FACULTY OF ENGINEERING

CAIRO UNIVERSITY

FOR

DEGREE OF DOCTOR OF PHILOSOPHY

BY

BORHAM MOHAMED TAKER EL-ADAROUSY

UNDER THE SUPERVISION OF

PROF. DR. FAWZIA M. M. TAIEL

HEAD OF PHYSICS DIVISION

ENG. MATH. & PHYS. DEPT.

FACULTY OF ENGINEERING

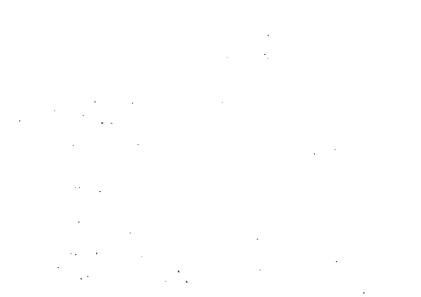
CAIRO UNIVERSITY

DR. AMR M. SHAARAWI
ENG. MATH. & PHYS. DEPT.
FACULTY OF ENGINEERING
CAIRO UNIVERSITY

DR. SALAH M. EL-SHEIKH
ENG. MATH. & PHYS. DEPT.
FACULTY OF ENGINEERING
CAIRO UNIVERSITY

الزواد الدواد

B17-EV



ACKNOWLEDGEMENT

Words are in many situations incapable of expressing what one feels. The author, therefore, wishes to express his deepest thankfulness to all those who participated in completion of this work.

The author would like to express his deepest gratitude to his supervisor Prof. Dr. Fawzia M. M. Taiel Head of Physics Division, Department of Mathematics and Engineering Physics for her sincere supervision and invaluable guidance throughout this work. He feels that without her help, the bringing of this work to light would not have been possible.

A special word of appreciation is due to his supervisor Dr.

A.M. Shaarawi. Department of Mathematics and Engineering Physics,
who generously gave him much of his valuable time. He is
specially obliged to him because of his invaluable help,
encouragement and beneficial advice.

The author is very grateful to his supervisor, Dr. S. M., El-sheikh. Department of Mathematics and Engineering Physics for his excellent supervision and help during the performance of this work.

The author is greatly indebted to Dr. A. F. Ayoub,

Department of Mathematics and Engineering Physics, for his help

and encouragement.

The author would like to thank Dr. H. Elsabbagh, Faculty of Vet. Med., for his continuous help and encouragement.

Moreover, The author would like to express his thankfulness to Prof. Dr. F. I. Ahmed, the Dean of Faculty of Engineering and Prof. Dr. A. A. Mohsen, the Chairman of the Department of Engineering Mathematics and Physics for their cooperation and encouragement.

The author would like to express his gratitude to Mr. K. Rushdy for his help with the computer lab. facilities

Finally, the author feels very grateful to his parents for their continuous support and love.

ABSTRACT

A semiclassical model for highly intense laser pulses is introduced. Such pulses are often used to study Above Threshold Ionization which is a non-perturbative multiphoton process. Pertubation theory as well as other approximate techniques had failed to provide agreement with experiment and had constantly pointed to the importance of the modeling of the laser pulse itself. The model presented here makes use of a semiclassical under photon which has a finite dimension. The pulse consideration can be divided into elementary cells each having the same transverse size of the photon, each cell is with a characteristic interaction length, that shows a dependence on the intensity. The relation between the derived from intensity is characteristic length and the comparisons with experiments. It is shown that the characteristic length varies as the intensity to the power 0.75, independent the experimental setup or the gas under consideration. Along the interaction length, it is shown than an atom absorbes a number of photons that follows a Poisson's distribution, which is characterized by an average number of photons per cell. This average number corresponds to the highest peak of the spectra of the electron. The relative strength of the other peaks is statistically evaluated using the Poisson's formula. The highest peak shifts to higher energies as intensity is increased. In the mean while the model predicts that the lower energy peaks are progressively suppressed. This is a typical behaviour of above threshold ionization. Nonetheless, the peak suppression resulting from the shift of the peaks of the Poisson's distribution is quite weak. To overcome such a short coming, the ponderomotive effects should be incorporated.

In the present model, a symmetric pulse having an intensity profile with slowly rising and decaying times has been utilized to include the effect of the ponderomotive potential. Such an approach produces reasonable peak suppression, especially if compared to the energy constraint relationship derived in the Keldysh-Reiss type of solutions. The resulting spectra provide a reasonable, and to some extent, quantitative agreement with experiment.

NOMENCALTURES

1	Flatick 5 companies
h	h/2π
a)	Temporal angular frequency
I	Intensity
MPI	Multiphoton ionization
ATI	Above threshold ionization
ī	Average intensity
Iett	Effective intensity
Ī	Average maximum intensity
E _p	Pulse energy
T,	Pulse duration
r	Radius of focus of the laser beam
1.	Saturation intensity
ψ(r)	Wave function
H _{5/4}	Hankel function of order 5/4
P	Momentum operator
P	Energy devided by C
χ.	Schrödinger operator
н	Hamiltonian
ş	Generators of S(3,C) group
Ŗ	Position operator

Planck's constant

	Navo leligili
ΔR.	Uncertainty in R
ΔR _b	Uncertainty in R _b
rγ	Radius of the photon
r,	Radius of the electron
α	Fine structure constant
V _P	Pulse volume
٧ _e	Cell volume
η	Characteristic length
c,	Number of cells
N _o	Number of photons
Ñ	Average numer of photons per cell
٧°	Initial velocity
V(t)	Instanenious velocity
E,	Amplitude of the electric field
۵	Amplitude of the ponderomotive potential energy
₿	Magnetic induction
W j	Correction factor at ionization energy E
Δ	The value of the ponderomotive potential energy at any
	position in the pulse

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