ELECTRONS EXCITATION
IN
THE BERYLLIUM- ISOELECTRONIC SEQUENCE
AND
X-RAY LASER

Thesis Advisors | Approval

Prof. Tharwat Mahmoud El- Sharbini ( )

Prof. Ali Helmy Moussa ( )

Prof. Latifa I. Al- Houty ( )

Prof. Dr. M. A. El- Sharkawy ( )

Head of Physics Department
Faculty Of Science
Ain Shams University

بسم الله الرحمن الرحيم

CONTENTS

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CHAPTER I

INTRODUCTION

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The study of the excitation of electrons in atomic isoelectronic sequences is essential not only for a better understanding of atomic structure and ionizing phenomena, but also it provides new laser lines that can be extended into the x-ray spectral region [1,2]. This in turn will help in the development of x-ray laser devices. Once x-ray lasers become reliable, efficient and economical, they will have several important applications [3]. First, their short wavelengths, coherence and extreme brightness should allow the exploration of living structures much smaller than one can see with optical methods. They will also have important applications in high resolution atomic spectroscopy, diagnostics of high density plasmas, radiation chemistry, photolithography, metallurgy, crystallography, medical radiology and holographic imaging.

Shortly after the demonstration of the first soft x-ray amplification in neon-isoelectronic selenium by Mathews et al [4], extensive work was done both theoretically and experimentally on other systems. Progress towards the development of soft x-ray lasers with several plasma-ion media of different isoelectronic sequences was achieved at many laboratories. Hagelstein et al. [5] observed stimulated emission in the soft x-ray spectral region in Ni-sequence by the collisional excitation scheme of elements of low atomic numbers. An extensive series of experiments for developing a soft x-ray laser using Li-sequence was done by Jeagle et al [6,7]

programme CIV3 described by Hibbert [13]. The radial parts of the wave functions are expressed as sums of Slater-type orbitals [14], where the expansion coefficients are treated as variational parameters and the radial integrals are performed analytically. The angular integrals of the wavefunctions are performed using Racah and Fano technique [15].

The study is done for the following singlet states of the Be-isoelectronic sequence:

$1s^2$	$2s^2$	^1S
$1s^2$	$2p^2$	^1S
$1s^2$	$2s3s$	^1S
$1s^2$	$2p3p$	^1S
$1s^2$	$2s4s$	^1S
$1s^2$	$2p4p$	^1S
$1s^2$	$2s5s$	^1S
$1s^2$	$2p5p$	^1S
$1s^2$	$3p^2$	^1S
$1s^2$	$4d^2$	^1S
$1s^2$	$2s2p$	$^1P^o$
$1s^2$	$2s3p$	$^1P^o$
$1s^2$	$2p3s$	$^1P^o$
$1s^2$	$2p3d$	$^1P^o$
$1s^2$	$2s4p$	$^1P^o$
$1s^2$	$2p4d$	$^1P^o$
$1s^2$	$2s5p$	$^1P^o$
$1s^2$	$2p5d$	$^1P^o$