



CURRICULUM VITAE – ACADEMIC

Name: THOALFIQAR ALI ZAKER,
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ACADEMIC RECORD

DOCTOR OF PHILOSOPHY (Ph.D.), 2012, Dept. of Physics, Faculty of Natural Sciences , Jamia Millia Islamia, New Delhi, India.

Thesis Title: *Carrier Dynamics in Quantum Well Lasers in Magnetic Field.*
Supervisor: Dr. Aurangzeb Khurram Hafiz. Co-Supervisor: Prof. Zahid Hussain Khan.

M.Sc. Physics, 2000, Department of Physics, College of Education, University of Mosul, Mosul, Iraq.
2th year Thesis Title: *The Effect of Magnetic Field on the Characteristics of AlGaAs lasers.*
Supervisor Mozahim I. Azawe

B.Sc. (Physics Honors), Department of Physics, College of Sciences, University of Mosul, Mosul, Iraq.

Field of Specialization: Semiconductor Laser Physics, Quantum and Nonlinear Optics, Spectroscopy, and Optoelectronic Devices.

EMPLOYMENT PROFILE

Jul 2003 – Jun 2008: Assistant Lecturer in Department of Physics, College of Sciences, University of Mosul, Mosul, Iraq.

Feb. 2008-April 2012: Senior Research Fellow, ICCR. Department of Physics, Faculty of Natural Sciences, Jamia Milla Islamia, New Delhi, India.

Jun 2012 – Till Date: Lecturer in Department of Physics, College of Education, University of Al-Hamdaniyah, Al-Hamdaniyah City, Iraq.

Undergraduate Courses:

- Optics
- Laser Theory
- Electronics
- Laboratories : Electronics and Optics

TECHNICAL EXPERTISE:

- Developing low cost temperature controller, current controller circuits and other laser drive electronics.
- Developing low-noise detection system.
- Building up external as well as extended cavities for diode laser systems to study tenability as well as instabilities.
- Developing GPIB interface programmers for remote operations.
- Working with Diode lasers, Photon Counter, Digital Oscilloscope, Photomultiplier Tubes, Power Meter, Photo-diodes, Monochromators, Programmable Function Generator, Lock-in-Amplifiers and various other electronic and optical components used in optical experiments.

- Good working experience on DOS/Windows environment of PCs and Workstations.
- Developing of Cavity Ring-Down Spectroscopy for detecting gas species and determine the reflectivity of HR mirrors.

RESEARCH GUIDANCE

Work with and advice seven M. Sc. students between 2008-2012 during my phd research work in Dept. of Physics, Faculty of Natural Sciences, Jamia Millia Islamia, New Delhi, India.

BRIEF RESUME OF THE RESEARCH WORK:

▪ Effect of magnetic field on Quantum Well lasers

In comparison with Double Heterojunction (DH) injection lasers, Quantum Well Lasers (QWL) exhibit a higher efficiency as a result of the quasi-two dimensional character of the carriers and their step-like density of states function. In addition, their threshold current is less sensitive to the temperature changes. This makes them very useful for application in optoelectronic devices. The oscillation output power, threshold current and wavelength of laser diodes depend on the injection current, laser temperature and composition. However, it is also known to depend on magnetic field and pressure. To control the oscillating wavelength by injection current or laser temperature alone, it is difficult because of mode jump characteristics of the oscillating wavelength of semiconductor laser. Accordingly, researchers have been interested in the study of changes in laser characteristics influenced by magnetic field. Semiconductor lasers exposed to magnetic fields (both low and high) have been studied and changes in oscillating wavelength, optical output power, threshold current, and modulation bandwidth observed. Earlier studies were performed at very low temperatures ($T < 100\text{K}$) and very high magnetic fields (4T – 20T) taking advantage of the fact that only semiconductor lasers can operate at very low temperatures. Later studies were carried out at room temperature.

Theory based on the formation of Landau levels was used to successfully explain the behavior of laser diodes at very low temperatures and in strong magnetic fields. The magnetic field confines the movement of charged particles into a plane perpendicular to it. This results in the quantization of

the cyclotron orbits of charged particles. The necessary condition for the formation of Landau levels is $kT \ll \hbar\omega_c$ where ω_c is the angular frequency of the cyclotron orbit. This condition is only achieved at very low temperatures ($T < 100\text{K}$) and strong magnetic fields. Around the room temperature, the thermal agitation is high enough to wash out Landau splitting. Also, contrary to the observed higher frequency side shifts of the oscillating wavelength of semiconductor lasers at low temperatures and high magnetic fields, at room temperature and relatively low magnetic fields (up to 1.4T), researchers have obtained shifts in the oscillating wavelength towards the lower frequency side indicating device heating effects. In order to explain the observed effects at room temperature and low magnetic fields, researchers have propounded theory based on the heating of the active region of the device as the magnetic field is switched on and longitudinal magneto-resistance effects. This theory lacks consistency and cannot explain the simultaneous changes in optical output power and oscillating wavelength.

In our study we examine the output power, threshold current, temperature characteristics of AlGaInP MQW laser at different temperatures (10-40°C) in relatively weak magnetic field (up to 2T). The range of temperature is important as maximum diode laser based applications are performed in this range including telecommunication applications. We have observed changes in the optical output power, threshold current and temperature characteristics influenced by the magnetic field. We have attempted to explain these changes in low magnetic fields based on the dynamics of charge carrier recombination together with the carrier confinement effect.

▪ **Ultrafast dynamics**

Presently I work in cooperation with research team (at Dept. of Physics, College of Education Mosul University, Nineveh, Iraq) uses ultra-short laser pulses to investigate ultrafast dynamics on surfaces and in nanoscale systems. In particular we are interested in the processes of excitation relaxation in such systems. The advantage of ultrashort laser pulses is that they provide a tool to measure directly the dynamics of the charge carriers and lattice following photoexcitation. Knowledge about these processes is very important in the development of modern electronic and optoelectronic devices intended to operate at ultrahigh speed.

▪ Cavity Ring Down Spectroscopy(CRDS)

Resently I also work in cooperation with research team (at dept. of Physics, Faculty of Natural sciences, Jamia Millia Islamia, New Delhi, India) CRDS is a simple, highly sensitive direct absorption technique based on the rate of absorption of light circulating in an optical cavity. CRDS can be used to study atoms and molecules in the gas and condensed phase, and is especially powerful for measuring strong absorptions of species present in trace amounts or weak absorptions of abundant species. The technique can be applied in physical, atmospheric, environmental and analytical chemistry, also combustion science, physics, medical diagnostics and biology. CRDS Techniques and Applications provides a practical overview of this valuable analytical tool, explaining the fundamental concepts and experimental methods, and illustrating important applications.

PUBLICATIONS:

Papers Published in International Journals:

- **Tho-Alfiqar A. Zaker**, Firas S. Mohammed, and Aurangzeb Khurram Hafiz, “Construction of a Stabilized Diode Laser System”, International Journal of Innovative Advances in Science and Technological Research. Vol.1 p. 6-14, ISSN: 2076-3301, E-ISSN: 2076-331X (2011).
- **Tho-Alfiqar A. Zaker** and Aurangzeb Khurram Hafiz,” Influence of Magnetic Field on the Threshold Current, Temperature Characteristics, and on the Output Power in AlGaInP Multiple Quantum Well Laser” Applied Physics Research. Vol. 3 No. 2 (November 2011).
- Santosh Chackrabarti , Rayees A. Zargar, Jyoti Bansal, **Tho-alfiqar A. Zaker**, A.K. Hafiz "Realization of band gap shrinkage to the spectral characteristics of high-luminous-efficiency 658 nm AlGaInP/GaInP multiple quantum well lasers at room temperatures" ELSEVIER, Optical Materials 58(2016) 426-431.
- Santosh Chackrabarti, Dhruv Sharma, Shereena Joseph, **Tho-alfiqar A. Zaker**, A. K. Hafiz and Ram Kafle "Experimental study on the mechanism governing spectral shifts in low power 670 nm AlGaInP multiple quantum well (MQW) laser diodes over temperature range 5–45 °C" Canadian Journal of Physics 2016 94(7) 640-644 10.1139/cjp-2015-0588.

- **Thoalfiqar Ali Zaker**, Firas S. Mohammed, and Muntadher J. Khudhair. " Multi-channel Free Space Optical Communication under Frequent Sand and Dust Storms " Journal of Engineering and Applied Sciences, 2018, 13 (22):9725-9729.
- Fias S. Mohammed, **Thoalfiqar Ali Zaker**, Rana Oday Abdaljali, and Mofaq M B Alsaady " Low magnetic field effect of circular conductors on a fiberoptic transmission system" Journal of Physics Conf. Series: Photonics 1371 (2019) 012025.
- Mofaq Alsaady, N A Awang, and **Thoalfiqar A Zaker** " Q-switched in figure of 8 by using graphite flakes as saturable absorber" Journal of Physics Conf. Series: Photonics 1371 (2019) 012010.
- **Thoalfiqar Ali Zaker**, Talib Zeedan Taban, and Firas S. Mohammed " Mitigating The Influence of Dense Oil Fires on Free Space Optical Communication" EUREKA: Physics and Engineering, Number 3, 2020

Papers Published in International Conferences:

- Firas Sabeeh Mohammed, **Tho-Alfiqar A. Zaker** and A. K. Hafiz, "Controlling Laser Diode Characteristics via Novel Temperature Controller", India International Conference on Power Electronics (IICPE)-2010, IEEE Xplore ID 21, NSIT, New Delhi, January 2011.
- **Tho-Alfiqar A. Zaker**, Firas Sabeeh Mohammed and A.K. Hafiz, "Construction and Performance of Current Diver for Diode Lasers", India International Conference on Power Electronics (IICPE)-2010, IEEE Xplore ID 22, NSIT, New Delhi, January 2011.
- **Tho-Alfiqar A. Zaker**, Firas Sabeeh Mohammed, and A. K. Hafiz, "Electrical Characteristics of AlGaInP Index Guided Multiple Quantum Well Laser Exposed to Magnetic Field.", International Conference on Fiber Optics and Photonics, Photonics 2010, PSW-89, Guwahati, India December 2010.

- Makram A. Fakhir, Basam G. Rashid, Najman H. Numan, Ban A. Bader, Farah G. Khalid, **Tho-Alfiqar A. Zaker**, and Evan E. Salim." Synthesis of nano porous silicon heterostructures for optoelectronic applications" Citation: AIP Conference Proceedings 2045, 020016 (2018); doi: 10.1063/1.5080829, Published by the American Institute of Physics.

- Muna Y. Slewa , **Thoalfiqar Ali Zaker**, and Emad Toma Karash " Mechanical and thermal properties of dental resin nanocomposite material polymerized by diode Laser" Virtual Conference IMDC-SDSP 28-30 June 2020.

Papers under publication:

- **Tho-Alfiqar A. Zaker**, Zahid H. Khan and Aurangzeb Khurram Hafiz, "Oscillation Wavelength Shift of AlGaInP MQW Laser in Magnetic Field"

- **Tho-Alfiqar A. Zaker**, Shereena P. Joseph, Zahid H Khan and Aurangzeb Khurram Hafiz, "Effects of Magnetic Field on the Spectral Characteristics of AlGaInP Multiple Quantum Well Laser"

- **Tho-Alfiqar A. Zaker** , Cherry Dhiman, Mohammed S. Khan, and A.K. Hafiz "Determination of reflectivity of the HR mirrors with low cost LED at different temperature using CRDS technique".

- Ammar Zakar, Andrey Kaplan, and **Thoalfiqar Ali Zaker** "Determination of spectral dependence recombination coefficients of porous silicon using optical pump -mid IR probe spectroscopy"

EXTRA-CURRICULAR ACTIVITIES AND HOBBIES

- Member of the Institute of Electrical & Electronics Engineers (IEEE).
- Interesting to Space Exploration, Black Holes and Big Bang Theory.
- Other hobbies include watching scientific movies, listening songs, playing table tennis, badminton, etc.

Date: Julay 2020

Place: Iraq

**sd-
Thoalfiqar Ali Zaker**

A handwritten signature in black ink, reading "Thoalfiqar Ali Zaker", written in a cursive style. The signature is positioned to the right of the typed name.