

Thesis format for Departments of Faculties of Natural and Applied Sciences, Social Sciences and Humanities and MUST Business School (approved in 13<sup>th</sup> Meeting of AS&RB)

**EFFECT OF STATIC ELECTRIC FIELD ON LASER INDUCED  
BREAKDOWN SPECTROSCOPY  
(16, bold all letters capital, TNR)**



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**Session 2019-2021  
(14, bold, TNR)**

**Department of Physics  
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(AJK) Pakistan (14 bold, First letter capital, TNR)**

**EFFECT OF STATIC ELECTRIC FIELD ON LASER INDUCED BREAK  
DOWN SPECTROSCOPY  
(16, bold all letters capital, TNR)**

By  
(14, TNR, Normal)

**Muhammad Akram  
(14, bold, First letter capital, TNR)**

**(MUST/FA16-RPH-015/AJK)  
(14, bold all letters capital, TNR)**

A thesis is submitted in partial fulfillment of  
the requirement for the degree of (14, Normal, TR)

**MASTER OF PHILOSOPHY**

In

**PHYSICS  
(14, bold all letters capital, TNR)**

**Session 2019-2021  
(14, Normal, TR)**

**Department of Physics  
Faculty of Natural and Applied Sciences  
Mirpur University of Science and Technology (MUST), Mirpur-10250 (AJK)  
Pakistan**

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Certified that the contents and form of thesis entitled "**Effect of Static Electric Field on Laser Induced Breakdown Spectroscopy of *Calotropis Procera* Plant**" submitted by "**Muhammad Akram** have been found satisfactory for the requirement of the degree-----(MPhil/Ph.D).

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**ACKNOWLEDGMENTS**  
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**Muhammad Akram**

## ABSTRACT

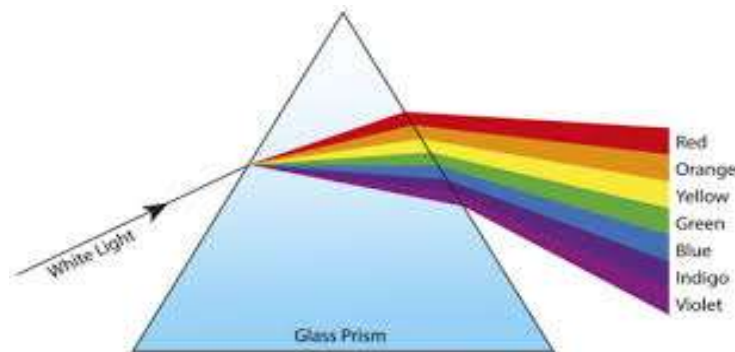
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The technique of laser-induced breakdown spectroscopy (LIBS) for quantitative elemental analysis of materials, has applied to leaves, stem and root of *Calotropis procera* plant collected from Mirpur Azad Kashmir. LIBS plasma is generated by a 1064 nm pulsed Nd: YAG laser. With and without effect of the electric field the time-resolved neutral and ionic spectral lines of aluminium (Al), barium (Ba), copper (Cu), calcium (Ca), cobalt (Co), ferrous (Fe), hydrogen (H), potassium (K), magnesium (Mg), manganese (Mn), sodium (Na), nitrogen (N), oxygen (O) and silicon (Si) from the LIBS spectra has recorded. It has detected using aventus detection system. Using a Nd: YAG laser with a 10 ns pulse duration, LIBS is performed by using electric field on a plant sample shows several LIBS spectra, focusing primarily on Ca and Mg lines. A gradual increase in LIBS intensity is observed when electric field 300V/3mm is used. Without using electric field gives different intensities of elements but resulted in a significant decrease in LIBS emission intensity and significant decrease in spectral intensity of ionic species without using electric field, suggesting a rapid decrease in electron density. The electron number densities are calculated by using standard equations of Stark Broadening for the spectral line of calcium at 422.67 nm wavelength and plasma temperature by using Boltzmann plot method. The Boltzmann distribution and experimentally measured lines intensities support that the plasma is in local thermal equilibrium. The comparison of root, leave and stem sample expose the presence of (Ca, Mg, K, Si, Al, Sr and Na) in all samples by using LIBS. Using electric field, advantages are higher spectral resolution, greater S/N, and increased spectral intensity.

**INTRODUCTION (ALL CAPITAL, 14 BOLD', TR)**

**1.1.HISTORY OF SPECTROSCOPY**

Spectroscopy and spectrograph are terms used to refer the estimation of produced radiations as an element of wavelength (Ali, 2001). In 1666, Isaac Newton depicted entry of white light through crystal in his trial discourse and found that white light could be partitioned into its segment wavelengths (Ali and Naseem, 2010). ( **TNR, 12,Normal, line spacing 1.5**)



**Figure 1.1:** Splitting of sunlight into seven colors

Amid mid 1800's Wollaston watched that dark lines were available amid the examination of sun's solar spectrum. In 1814 Fraunhofer additionally examined these dark lines in the sun's spectrum and saw more than 700 of them (Ali, *et al.*, 2013).

**1.2.LASER SPECTROSCOPY**

Laser have a progressive impact in optical spectroscopy since mid-1960's. Laser spectroscopy is a spectroscopic system that uses lasers to evaluate the radiated frequencies of matter.

**1.3.LASER INDUCED BREAKDOWN SPECTROSCOPY (LIBS)**

Laser induced breakdown spectroscopy is a diagnostic method that is utilized to examines the subjective and quantitative essential examination.

**REVIEW OF LITERATURE (ALL CAPITAL, 14 BOLD, TR)**

**1.4.HISTORY OF SPECTROSCOPY**

Ali (2001), described that Spectroscopy and spectrograph was the best technique to analysis phytochemicals and other elemental studies in the plant materials. (TNR, 12,Normal, line spacing 1.5).

**Note:** Review of Literature can be written parawise in chronological order of year , i.e . write data of 2000, then 2001, then 2002, and so on.

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**Chapter No. 03**

**MATERIALS AND METHODS (ALL CAPITAL, 14 BOLD', TR)**

In the past section I have talked about, the history of Spectroscopy along with its types, methods, optical instrumentation and its applications with merits and demerits. Laser Induced Breakdown Spectroscopy is also discussed with its applications, benefits and negative marks (Ali, 2001). The plasma formation and its generation mechanisms, line profile and diverse variables affecting the lines profile have talked about in section first. The detail of medicinal plant which we have utilized for LIBS study has likewise given in first section. . (TNR, 12,Normal, line spacing 1.5).

## **2.1. EXPERIMENTAL DETAIL**

By using LIBS setup we study the emission spectra of Calotropis Procera. The solid samples of the plant i.e. leaves, stem and roots in the form of pellets are used (Nasir and Khan, 2014).

## **2.2.ND-YAG LASER**

Keeping in mind the end goal to create plasma plume on pallets we use Q-switched Nd: YAG laser. We want to use it because it is easy to control and has high irradiance and accuracy. Nd: YAG laser has four level schemes (Khawar *et al.*, 2020).

### **2.2.1. Structure of Laser**

The bars of Nd: YAG laser is mostly of 10cm long and has 12mm diameter. A linear flash lamp and Nd: YAG rod are accommodate in a reflector cavity of elliptical cross-section. The light emitting from the lamp is firmly joined to the laser rod since they are set at the foci of the ellipse.

**RESULTS (ALL CAPITAL, 14 BOLD, TR)**

The fundamental ideas of spectroscopy, spectra and its compose, laser induced breakdown spectroscopy (LIBS) and its applications have talked about in first and second chapter. . (TNR, 12,Normal, line spacing 1.5).

**3.1.ELECTRON DENSITY**

The knowledge of electron density is an important parameter in plasma because the efficiency of the physical phenomena occurring in the plasma and their reaction rates are generally depending directly on density of electrons. Aluminum in a humid air to measure electron density using  $H_{\alpha}$  line. Process was completed using several time delays but fix gate to obtain several values.

**Table 3.1:** Spectroscopic data of Ca use in the Boltzmann plot for leaf with electric field

<b>Energy (<math>\text{cm}^{-1}</math>)</b>	<b>Intensity I(a.u)</b>	<b>Wavelength <math>\lambda(\text{nm})</math></b>	<b>Statistical Weight (gk)</b>	<b>Transition Probability <math>A_{kj}</math></b>
23652.3	26599.75	422.676	3	2.18E+08
38551.56	5038.907	428.273	5	4.34E+07
38464.81	5430.745	428.929	3	6.00E+07
38464.81	3381.023	429.91	3	4.66E+07

**DISCUSSION (ALL CAPITAL, 14 BOLD, TR)**

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## **CONCLUSIONS** (all capital, 14 Bold', TR)

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Laser induced breakdown spectroscopy technique with static electric field effect has used to find elemental composition of leaves, stem and root. With and without effect of the electric field the time-resolved neutral and ionic spectral lines of aluminum (Al), barium (Ba), copper (Cu), calcium (Ca), cobalt (Co), ferrous (Fe), hydrogen (H), potassium (K), magnesium (Mg), manganese (Mn), sodium (Na), nitrogen (N), oxygen (O) and silicon (Si) from the LIBS spectra has been recorded.



**FUTURE PROSPECTS**  
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Ali, M. 2001.... other from scholar google using APA style

Ali, M. and Naseem, A. 2010. other from scholar google using APA style

Ali, M., Naseem, A., Islam, K., Mazhar, I. 2013. other from scholar google using APA style

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