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MATLAB IN EDUCATIONAL ACTIVITIES ON PHYSICS

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ABSTRACT: *This article suggest a computer integration method in the didactic activities on physics by realization a dedicated interactive graphical interface for processing of the experimental data resulted by measurement in our laboratory. This data processing application created for help student to use computer in laboratory. Like programming medium we chosen the scientific language Matlab at 5.3 versions to up. These techniques have been used to successfully from Laboratory Course in our University.*
KEYWORDS: *computing educational method, interactive graphical interface, physics laboratory works experimental data processing*

INTRODUCTION AND MOTIVATION

Teaching the physics course has never been an easy task. Although it is universally accepted that a laboratory or demonstration is the best way to convey the more complex concepts. The present the problem for the physics educators is how to communicate the content, impart the knowledge, and, all the while, keep the fascination of physics alive. It is almost universally accepted that the way to convey these ideas is through a laboratory or a demonstration, where students can see physics in action and truly appreciate the natural world around them [1], [2]. The computer used by interactive graphical interface in data processing [3], [4] is an easy operation for all people, so that, an interface can be used in the didactic process for students with minimum computer abilities. For graphical interface, we work with Matlab. Matlab is a programming language with high performance, dedicated for a numerical calculation and graphical representation. We motivate this choice by: good performances and reduced instruction time, an easy modification of the source codes, for adapting this interface at any laboratory work and the using of this programming language in the university mediums and the research domains for simulation and experimental data processing.

GENERAL DESCRIPTION OF THE LABORATORY WORK

In this article we present in detail the graphical interface for laboratory work "Verification of the Balmer law". In this laboratory work we determinate the experimental wavelength of the spectral lines from a hydrogen series. This experimental wavelength is compared with the calculated wavelength by mathematical expression of the Balmer law [4]– eq.1.

$$\lambda = \frac{4n^2}{R_H(n^2-4)} \quad (1)$$

where: n is the principal quantum number, R_H is the Rydberg constant for hydrogen with value equal to 109677,58 cm^{-1}.

The experimental installation is an optic side (spectroscope and spectral lamp) and an electric side (the impulses generator) [4]. The tension impulses are applied of the (Ar, Hg, H) discharged tubes electrodes fixed on a support.

The stages of the laboratory work are [4]:

1. *To read the spectroscope division scale of the Hg and Ar discharged tubes, for know wavelength (in Å).*
2. *To raise the standard diagram for spectroscope, $n = f(\lambda)$.*
3. *To read the division scale of the hydrogen lines.*
4. *To determine from standard diagram the experimental wavelength (in Å) for hydrogen lines.*
5. *To calculate the wavelength for the hydrogen lines using the mathematical expression of the Balmer law (eq.1).*
6. *To compare the theoretic values with experimental value of the wave length of the hydrogen lines from Balmer series.*

THE GRAPHICAL INTERACTIVE INTERFACE "LBALMER"

"lbalmer" is the graphical interface application for processing of the experimental data resulted from the laboratory work "Verification of the Balmer law". This application has the six files – figure1.

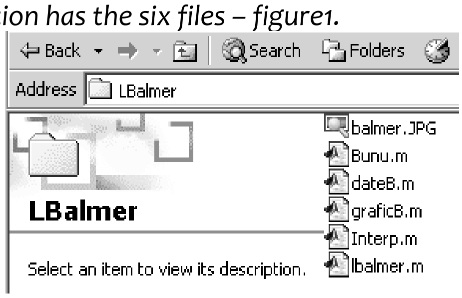

Figure 1. The lbalmer folder

For running the "lbalmer" application we type the name of the application by commanding window of the Matlab program [5], [6]- figure 2.

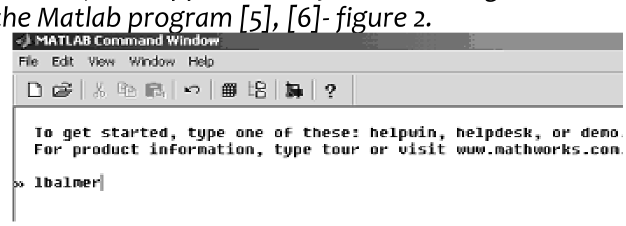

Figure 2. For running the "lbalmer" application

The action of the Enter key opens the principal frame – figure 3.

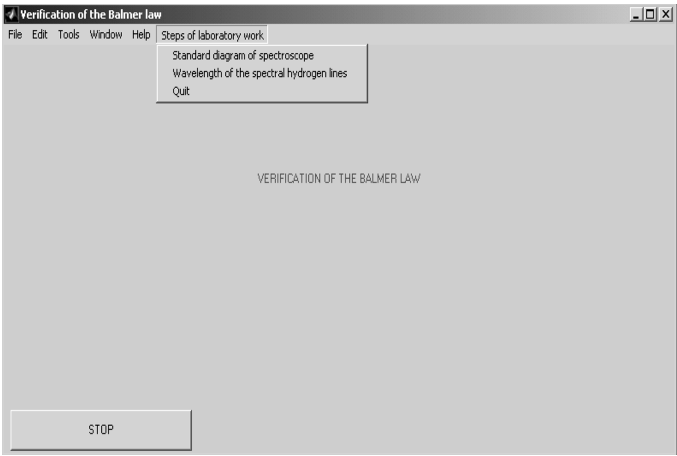

Figure 3. The principal frame of the application

Beside the standard menus of the graphical Matlab window [5], [6]: File, Edit, Window and Help, we create the menu "Steps of laboratory work" which has three commands: "Standard diagram of spectroscope", "Wavelength of the spectral hydrogen lines" and "Quit".

The closing of the application can be possible by commanding "Quit" from "Steps of laboratory work" menu, or operating the "Stop" button from the principal frame.

The "Standard diagram of spectroscope" command to open the intermediary frame which admits the introduction of the experimental data and the presentation of the standard diagram n = f (λ) – figure 4.

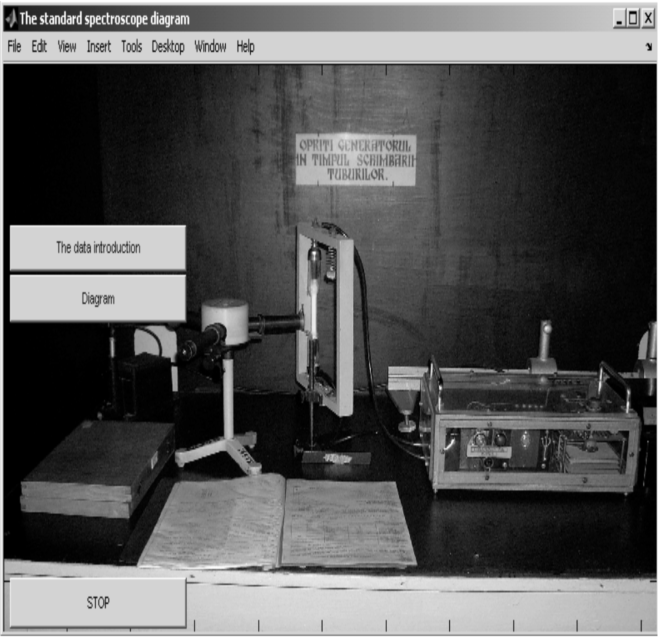

Figure 4. Intermediary frame

The "Wavelength of the spectral hydrogen lines" opens a frame, which asks, from the text box, to read experimental division scale for the hydrogen spectral lines and to display the experimental wavelength (in Å) and the theoretical wavelength witch are calculated with the Balmer law.

By activating of the "The data introduction" button, we have, in the text box: the division scale for the argon and mercury lines and the wavelength (in Å) for these lines – pursuant to figures 5 and 6.

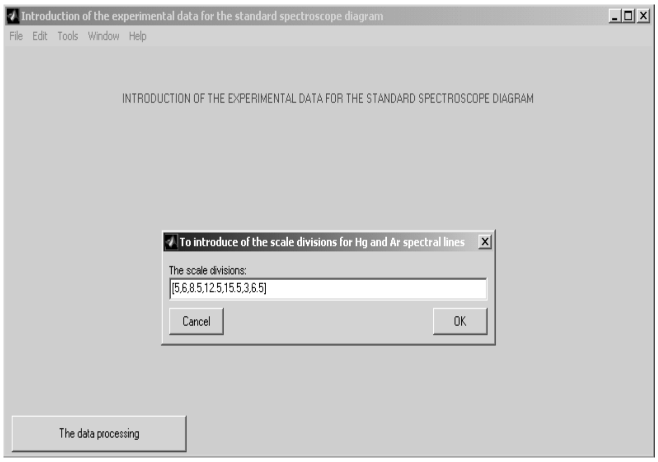

Figure 5. The frame for introducing the division scale

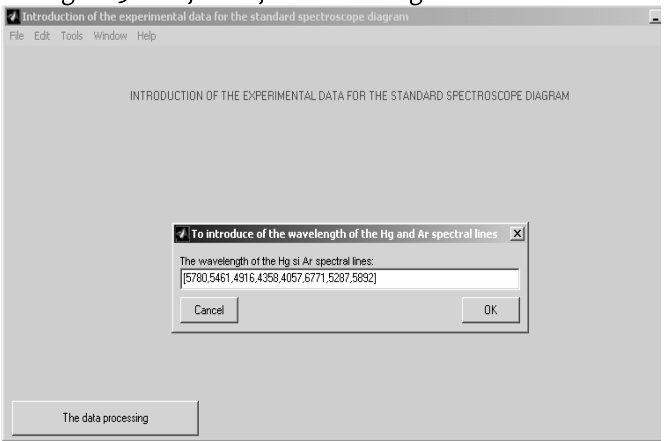

Figure 6. The frame for introducing of the wavelength in Å

If we make a wrong introducing data, we shall get an error message – figure 7.

Figure 7. The error message

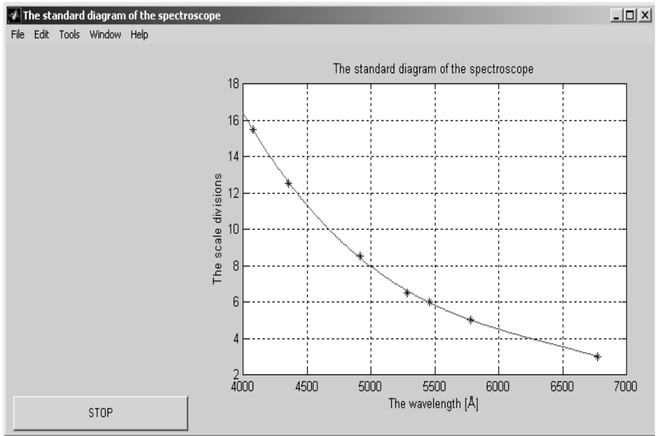

Figure 8. Standard curve of the spectroscope

We turn down in an intermediary frame, the action of "The data processing" (figures 5 and 6), and then, we prepare designing the curve by interpolation.

The action of the "Diagram" button leads to the standard curve of the spectroscope (figure 8).

This standard spectroscope diagram is rise by a regression method [7] with polyfit function from Matlab:

```
x=4000:10:6800;
y=polyfit(landa,n,3);
yt=polyval(y,x);
plot(landa,n,'*b',x,yt,'-r');grid;
xlabel('The wavelength [Å]');
ylabel('The scale divisions');
title('The standard diagram of the spectroscope');
```

Points represent the experimental data. The action of the "Stop" button leads to the principal frame.

By winnowing the command "Wavelength of the spectral hydrogen lines", we shall get the measured values in the division scale frame (figure 9).

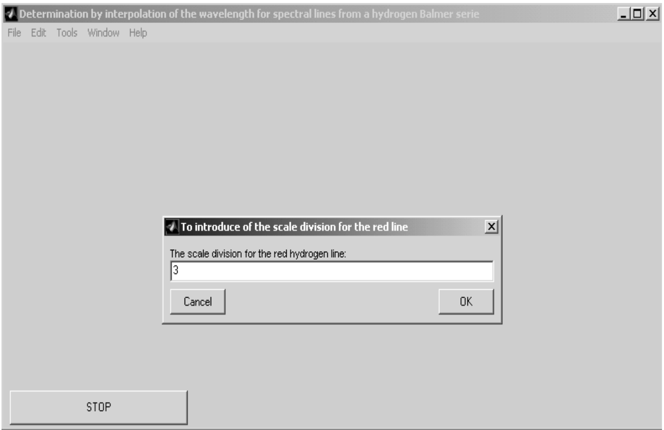

Figure 9. The introduction of the division scale for the hydrogen lines

After introducing the data for hydrogen lines on the active window, we shall have the theoretical and experimental data – figure 10. We turn down in the principal frame by action the "Stop" button.

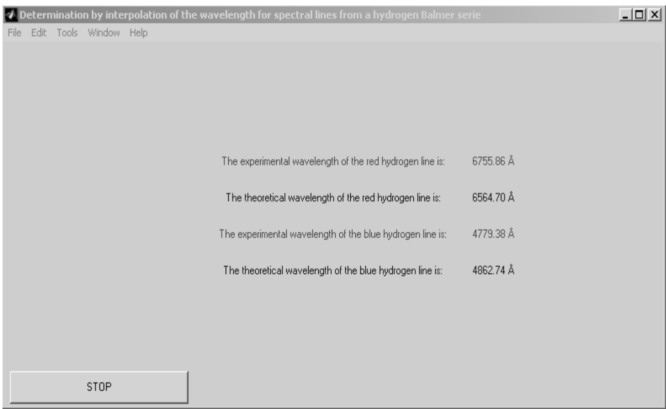

Figure 10. The frame for obtaining data by interpolation

We close the application by action the "Stop" button from the principal frame.

CONCLUSIONS

This work represents a modality for using the computer on data processing in laboratory work. The presented application use an existing software in our faculty (Matlab), no cost and trains the students in the computer utilization in data processing. Pursuant to this utilization methods to the hours of laboratory, the students with informatics skills are emphasize, they will be interested for the programming interfaces for next laboratory themes. Thus, the source code for this application can be used by other laboratory work with minimal modifications. Thus we are realized a collection of these applications for our Physics Laboratory, very interested for students, which represent an education computer support for learning physics.

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