

## A Graphical Program That Eliminates the Out Dated 3.5" Disk Technology Used By the Stanford Research Multi-Channel Scaler/Averager

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### ABSTRACT

A graphical program was created, to simplify the acquisition of data and data conversion from bin to ASCII, for data obtained by a Stanford Research Multichannel Scaler/Averager (SR430). The SR430 receives the data in the form of pulses from a photomultiplier tube (PMT). The PMT serves as the detector in a pulsed laser spectroscopy experiment. The program was created in LabVIEW™ which was developed by National Instruments. LabVIEW™ allows the user to code programming ideas by selecting and patterning graphical icons. The program presented in this paper eliminates the outdated and clumsy steps of saving the data in DOS format, on a 720K disk, using the 3.5" drive of the SR430, and then converting the data from bin to ASCII, using a DOS program. With this graphical program the user can save the data obtained by the SR430 in a spreadsheet ready format on a computer.

**Keywords** – LabVIEW™, ASCII, PMT, SR430, Laser Spectroscopy

### I. INTRODUCTION

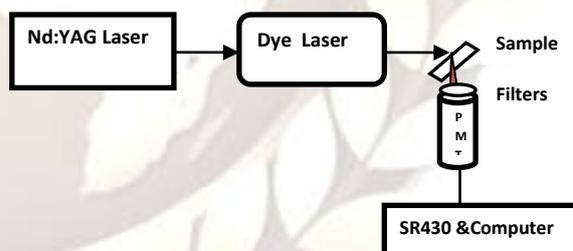
The SR430 is a versatile machine that provides an efficient means of collecting time-dependent photon data in laser spectroscopy experiments. It allows the experimentalist to count incoming photon pulses in successive time bins sent from a PMT. The duration of the time bins is programmable on the SR430 from 5 nanoseconds to 10 microseconds. A trigger starts a record of up to 32,704 time bins. The number of records collected is also programmable from 1 to 65,535 (or free run). Each trigger starts a new record and the data is added to the bin by bin accumulation of all the previous records [1]. In addition the SR430 offers advanced functions such as Smoothing, Curve Fitting and Autoscale. Yet as useful as the SR430 is for collecting time-resolved photon data, the method for saving the data on the machine is an outdated 3.5" disk drive which saves the data in DOS format. After the data is saved it has to be converted from bin to ASCII using a DOS program. Fortunately the SR430 does offer a GPIB interface. The goal of this project was to use the GPIB interface and LabVIEW™ to create a program that would

eliminate the need for the 3.5" disk drive and to save the data in ASCII format. Saving the data in this format simplifies the process of transferring it to a spreadsheet for graphing and analysis purposes.

In section II general information on the laser spectroscopy experiment in which the SR430 was used will be discussed. Section III will describe the timing of the electronics required to operate the SR430 as a photon counter in the experiment, as well as, some of the features available on the SR430. In section IV details of the LabVIEW™ program will be presented. Lastly section V will provide concluding remarks and future works.

### II. THE LASER SPECTROSCOPY EXPERIMENT

The desire to create an interfacing program for the SR430 was prompted by its role in a laser spectroscopy experiment. The experiment was designed to investigate the energy transfer process between gadolinium and chromium in chromium doped gadolinium garnets. The experimental arrangement for the spectroscopy experiment is displayed as Fig. 1.



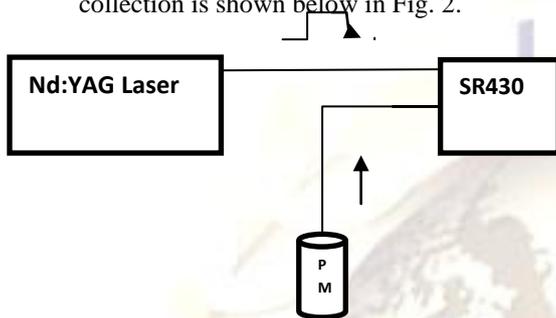
**Figure 1** Experimental arrangement for the time dependent measurements of the sample fluorescence using the SR430.

The combination of the Nd:YAG laser and the dye laser served as the excitation source for the sample. An appropriate wavelength was selected to excite the gadolinium in the sample [2]. Upon excitation of the gadolinium, energy was transferred to the chromium and the resulting chromium fluorescence signal emitted was collected with a Hamamatsu R928 red enhanced side-window PMT. The sample was positioned at an angle of approximately 45 degrees to the excitation source and the resulting emission was collected at an angle of 90 degrees to the excitation source. The voltage supply to the PMT was maintained at 1000 volts. A combination of neutral density filters and glass color

filters were taped directly on the PMT window to select the appropriate wavelength and signal strength needed to collect the fluorescence emitted by the sample. In addition, black cloth was used to cover the entire region between the sample and the detector to eliminate unwanted photons from entering the PMT. The photons emitted by the sample were detected by the PMT and sent to the SR430.

### III. ELECTRONIC CONFIGURATION FOR THE DATA COLLECTION

The electronic configuration for the data collection is shown below in Fig. 2.



**Figure 2 Schematic of the electronics for the time dependent fluorescence measurements.**

The Nd:YAG Q-switch sync-pulse was used to initiate the timing of the data acquisition electronics. This was accomplished by connecting the Q-switch sync out from the laser to the trigger input on the SR430. The PMT output was connected to the signal input of the SR430 which enabled the SR430 to collect the data. Each input trigger pulse from the laser started a record whose data was added to the bin by bin accumulation of all the previous records on the SR430. The final result of the data collection was a sum of all the counts in each time bin. Careful attention was paid, in the quest, to set the bin widths and the records per scan, to achieve meaningful data [3]. The resulting data was displayed, in real time, on the screen of the SR430 as depicted in Fig. 3.



**Figure 3 A photograph of the SR430 [1] showing the front panel with example data displayed.**

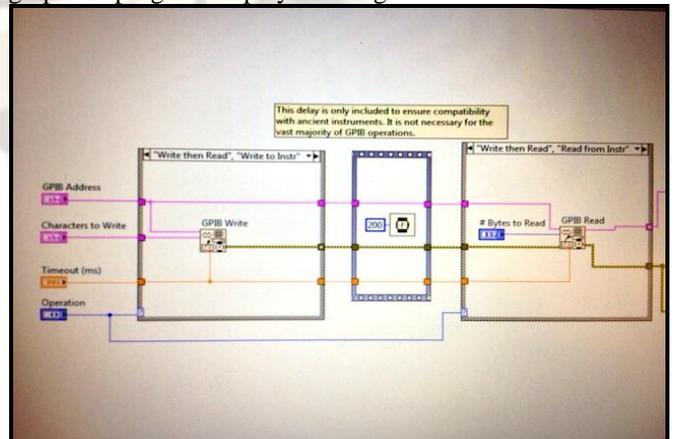
The data was easily optimized on the display screen using the auto-scale feature. The fitting functions on the SR430 math menu were used to perform quick fits to find rise times, which were indicative of the gadolinium to chromium energy transfer time, and chromium decay times. In order to do a detailed analysis of the data, it had to be saved

on a DOS formatted 720K disk using the 3.5" disk drive shown on the far right of Fig. 3. Once saved, the data had to be read by computers with a 3.5" drive and DOS 3.0 or higher. Although the majority of the SR430 features are user friendly, this method of saving data in DOS format is rather archaic. Even more cumbersome, was the process of opening the data in DOS format on a computer and then converting the data from bin to ASCII. Hence the goal of this project was to find a more efficient and up to date method for saving the data in a spreadsheet ready format.

### IV. GRAPHICAL PROGRAM

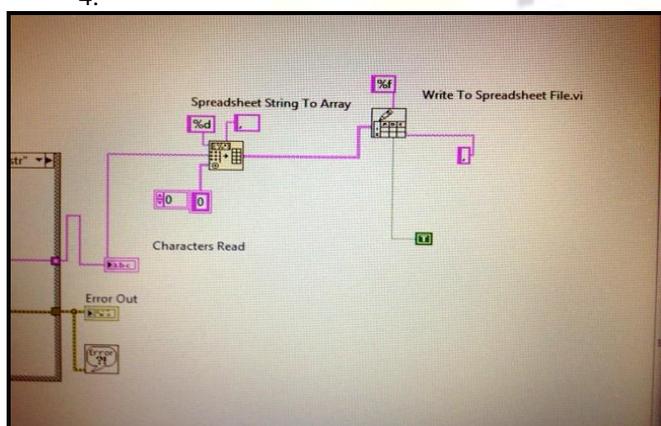
The SR430 is equipped with RS232 and GPIB (IEEE-488) computer interfaces. An initial search for interfacing programs available for the SR430, revealed only one option from National Instruments (NI) which was an instrument driver [4]. Although the driver was available for download on the NI site, it was not supported by NI. Furthermore, when using an instrument driver, all controls are shifted from the instrument to the computer which is not always ideal as was the case in this experiment. The driver was tested but found to be cumbersome and eliminated too many of the unique features available on the SR430. Thus a program was created in LabVIEW™ to save the data once it was collected by the SR430. The end result provided the experimentalist with a way to use all the features on the SR430 but gave alternate means for saving the data instead of using the outdated 3.5" disk drive with DOS formatting.

A NI GPIB controller for Hi-Speed USB interfacing was used to connect the IEEE port of SR430 to a laptop computer [5]. LabVIEW™ software was used to initiate communication between the SR430 and the laptop [6]. On the main page under NI Example Finder there is a section for Hardware Input Output GPIB. The example under GPIB.VI was used to create the first part of the graphical program displayed as Fig.4 below.



**Figure 4 Graphical LabVIEW™ program used to initiate communication between the SR430 and the computer.**

The program in Fig. 4 allowed the data to be sent from the SR430 to the computer. The data was collected, on the SR430, before the GPIB to USB connection was made. Once a data run was complete the GPIB to USB connection was made with the SR430 and the data was sent to the computer. Although this worked smoothly the data was not in a format easily sent to a spreadsheet. The beauty of graphical programming is that it is easy to write and attach additional components to a program. A second program was created using a spreadsheet string to array with a comma as a delimiter [6]. The data was also transposed before it was sent to a spreadsheet file. The second program displayed as Fig 5 was attached the original program shown in Fig 4.



**Figure 5 The LabVIEW™ program added to the one shown in Fig. 4 which allowed that data to be saved in a format that could be easily written to a spreadsheet.**

Once this part was added to the original program, in a single step, the data was saved in a spreadsheet ready format. For further analysis, OriginLab® Data Analysis Software was used to open the data in a spreadsheet. By simply selecting the import ASCII file on the OriginLab® menu the data was opened and ready for analysis.

## V. CONCLUSION

Prior to the creation of the LabVIEW™ program in this project, saving data obtained by the SR430 and opening it in a spreadsheet was a time-consuming and cumbersome multi-step process. In addition, finding the 720K disks required to save the data on the SR430 3.5" drive, was not easy nor was finding a computer equipped with a 3.5" drive to read the data in DOS. The LabVIEW™ program, presented in this paper, rejuvenates the powerful features available on the SR430 by eliminating the need for the old 3.5" disk technology. Because the program is designed to save the data and not to act as a driver for the device, one can continue to use all of the unique modes available on the SR430. Moreover, the program successfully eliminates the need for disks, DOS and the multiple step process of

transferring the data from bin to ASCII. Users of the SR430 or other devices that require a 3.5" drive can simplify their data collection by using the program presented in this paper.

There are additional features that could be added to the program that would assist in the data analysis. OriginLab® offers graphical components that can be implemented into LabVIEW™ programs. An unsuccessful attempt was made to write the data directly to a spreadsheet using the graphical components provided by OriginLab®. Because of time constraints and the desire to move on to the laser spectroscopy experiment, further attempts were not made to edit the program. It is simple enough to open the spreadsheet file created by the LabVIEW™ program using the import ASCII feature in Origin®. However it would eliminate an extra step if this process was incorporated in the program. Currently, the user must keep record of the bin width selected on the SR430 so the data can be modified with correct bin time before performing the analysis. Again it is a simple step, of multiplication, but it could be eliminated by incorporating it into the program. Although enhancements could be made to the program, the current version successfully accomplishes the original goal of the project which was to eliminate the outdated 3.5" disk technology that hindered the usefulness of the SR430 as a photon counting device in the laser spectroscopy experiment.

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