LAMPS DAQ Software for new CAMAC Controllers

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Introduction

In the field of experimental nuclear physics and high energy physics Data Acquisition Systems are used to acquire raw data at highest possible event rates. Although digital systems and VME are now prevalent, the older CAMAC systems are still in use at IUAC and other laboratories to utilize existing hardware. The IUAC experimental and accelerator facilities GPSC, LINAC, HIRA and test laboratories make use of CAMAC. In view of ageing and obsolete CAMAC controllers it has become necessary to provide new commercially available crate controllers in many setups.

The software system LAMPS [1] (BARC-TIFR), developed for CAMAC and VME is used extensively in several laboratories in India. In this paper we report setting up LAMPS data acquisition for two new crate controllers: C111C, an Ethernet CAMAC controller available from CAEN and CCUSB a USB based CAMAC Crate Controller from WIENER.

LAMPS DAQ GUI Software

LAMPS is a graphical data acquisition package. It allows for online spectra building and can also be used for offline data analysis. It provides, inter-alia, tools for performing calibration, peak fit, peak search, quick fit and obtaining the area and centroid of a spectrum region. It has tools such as rectangular gates, polygonal gates, projections and volume calculation for two-dimensional spectra. The acquired data can be written in various formats: zls, candle, root, csv.

LAMPS for the most part is written in C and employs the GTK2 graphics library for GUI. It can be compiled in any flavor of Linux such as Scientific Linux, Ubuntu, Fedora Core etc. It is designed for large scale experiments.

LAMPS was originally written to support the BARC made CAMAC controllers CC2000/CC2002. A version supporting Cheescote Mountain CAMAC CMC100 is also available. However, support for the controllers C111C (CAEN) and CCUSB (Weiner) was lacking so far.

C111C CAMAC Crate Controller

The C111C CAMAC Crate Controller [3] manufactured by CAEN (Fig 1) offers full CAMAC bus control and has some useful additional features such as NIM I/O, event counters, pulse generators and trigger/busy modules. Its interface to PC is over Ethernet 10/100 using socket connections. Two different ports at the same TCP/IP address are used for exchanging commands and data between C111C and the host computer.

CC-USB CAMAC Crate Controller

CC-USB manufactured by Weiner [4] is a full-featured CAMAC Crate controller with integrated high-speed USB-2 interface and full CAMAC data-way display (Fig 1). It also has additional useful NIM functions.
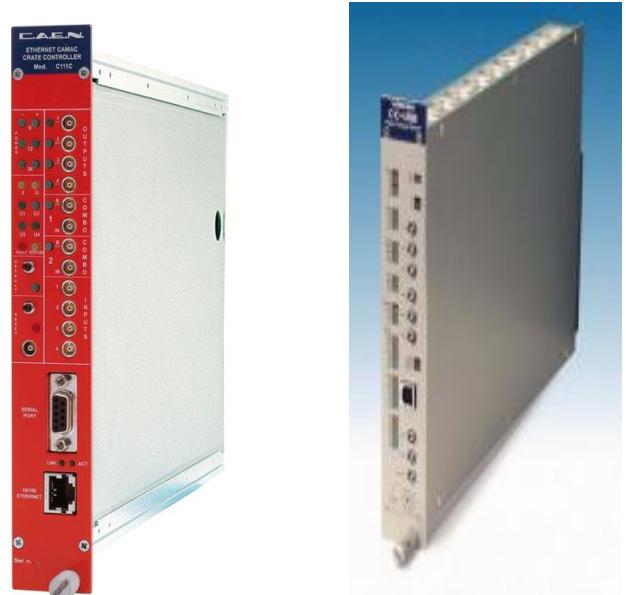
Fig 1
C111C (CAEN) and CCUSB (WEINER)
CAMAC Controllers

Integration with LAMPS program

The downloadable open source LAMPS program variant lamps_cc2002 [1] was used as the starting point. The overall structure of the program, such as threads, INI-CLR mechanism for crate initialization/clearing and encapsulation of hardware related functions were left intact. First the module camactest.c was modified and debugged separately for the two controllers and finally the basic calls were connected to FillBuf thread in control.c which acquires list data alternately in two buffers of user specified size. In both cases, no driver is

required for communication and software libraries are provided by the manufacturers.

Software Details for C111C

Communication makes use TCP IP sockets. The manufacturer has provided the files crate_lib.c and crate_lib.h. Here all the basic CAMAC functions are included as per ESONE specifications (European Standards on Nuclear Electronics). First a call to CROPEN is made at the static IP address 192.168.0.98 which gives a Crate Id. This allows subsequent calls such as CSSA (16-bit CAMAC NAF operation), CCCZ (Initialize), CCCC (Clear), CCCI (Inhibit) etc. Although CCLWT (wait for LAM on a specified slot) was provided in crate_lib, we implemented polling in a loop testing for LAM in the acquisition thread.

Software Details for CCUSB

Communication over USB takes place with linux usb library. The compiler flag -lusb is required while building the complete program. The manufacturer provided files w_usb.h and w_usb.c. The functions xxusb_devices_find() and xxusb_device_open() are first needed. Subsequently the basic CAMAC functions CAMAC_read and CAMAC_write (for NAF commands), CAMAC_Z, CAMAC_C and CAMAC_I can operate on the USB device handle. LAM was detected in a polling loop with a CAMAC_read function which provides a Q response when a module generates LAM which then triggers FillBuf in a thread in control.c

CAMAC Scalers

During data acquisition, CAMAC scalers are to be read out periodically for status and dead-time monitoring. This has been achieved by making the required NAF calls periodically, as in the original LAMPS program.

DAQ at Dayalbagh Institute

The Department of Physics at Dayalbagh Educational Institute, Agra was in urgent need of a multi-parameter data acquisition system to carry out their educational programs related to muon telescope, muon paddle efficiency studies and measurement of secondaries with detector station. They had obtained C111C CAMAC controller but had no software setup to acquire the data. In November 2018, we visited DEI and set up LAMPS system on both Ubuntu and Scientific Linux computers, allowing smooth operation of their experiments.

DAQ for HCI at IUAC

For these ion-beam experiments, there are three parameters from each neutron detector, namely, light output, zero-cross timing (PSD) and time-of-flight (TOF)

which are to be recorded on event-by event basis. For these experiments we have installed and tested LAMPS data acquisition on Ubuntu for Wiener CC-USB CAMAC Controller. A test using ^{60}Co source is shown in Fig 2. At present this DAQ will be used to carryout Bremsstrahlung X-Rays from ECR ion source which injects ion beam into upcoming High Current Injector. Plasma diagnostic studies from the ion source will be carried out in order to understand and also to improve the ion source using this DAQ system.
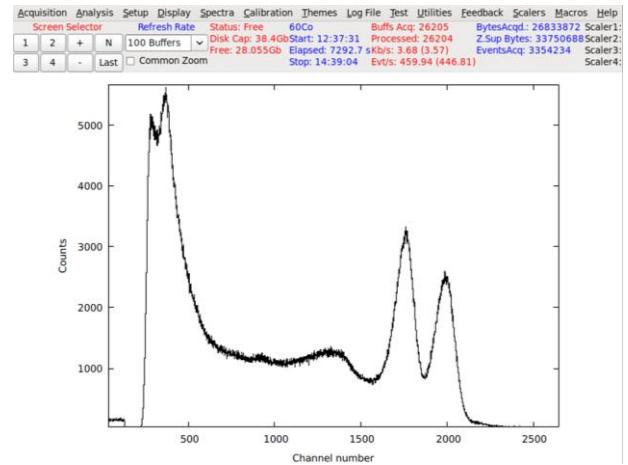

Fig 2: Cobalt -60 Spectrum acquired using CCUSB DAQ through LAMPS

Conclusion

Adapting the LAMPS software to work with the CAMAC controllers from CAEN (Ethernet based) and Wiener (USB based) has given a new lease of life to CAMAC systems in laboratories which would otherwise have to invest in completely new hardware. At present we have implemented only a polling mode for LAM detection which is sufficient for the low data rate in the experiments where it is being used. For the future we can take up the implementation of wait-for-LAM on C111C and Block_read functions in CCUSB.

ACKNOWLEDGMENT

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