NASA/NSCL SINGLE EVENT EFFECTS TEST FACILITY USER'S MANUAL

N. Anantaraman
National Superconducting Cyclotron Laboratory
Michigan State University
1 Cyclotron Laboratory
East Lansing, MI 48824-1321

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TABLE OF CONTENTS

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1. INTRODUCTION

The Single Event Effects (SEE) Test Facility at NSCL is a dedicated in-air irradiation station with complete diagnostic equipment and controls, located in the S2 experimental vault. It was commissioned at the end of 2003. While it has been tailored to measure the response of electronic components to energetic heavy ions available at the Coupled Cyclotron Facility (CCF) at NSCL (to simulate the environment in space), it can be adapted for doing other in-air irradiation measurements. At the conclusion of an experiment, the experimenters will have all the information they need on operation conditions (beam energy, current, spot size, etc.) in an easily interpreted form. The SEE Test Facility (SEETF) is available to all NSCL users. A report on the performance of the facility during its inaugural runs has been published in IEEE Trans. Nucl. Sci. **51** (2004) 3664.

II. BEAM CHARACTERISTICS

Table 1 lists the first beams that have been delivered with the SEETF setup. The full list of beams presently available from the Coupled Cyclotron Facility is given at www.nscl.msu.edu/exp/propexp/beamlist. The maximum beam energies achievable with the SEE Test Facility are set by the requirement that beams must be degraded by approximately 15% in energy (including the effect of SEETF detectors and degraders) to get adequate spatial uniformity. A limit on the minimum beam energies is the requirement that beam from the A1900 fragment separator (located upstream of SEETF) must have a rigidity of at least 1.5 Tm; beams at the SEETF target position with energies lower than this limit are possible by using degraders in the SEETF setup, but come at the expense of a lower beam purity and a wider energy distribution. Beams outside these limits are possible, but the intensity and energy specifications will be impacted; significant development may be required to evaluate this. High-Z beams from the CCF beam list produced for the SEETF setup by degrading them at the A1900 target position may also require additional development and may have consequences for the intensity and energy distribution. Contact Raman Anantaraman (phone: 517-333-6337, e-mail: raman@nscl.msu.edu) for questions about the feasibility of a desired beam.

The maximum spot size for illumination without rastering is approximately 5 cm in diameter. If rastering capability (computer-controlled periodic motion of the target in horizontal and vertical directions, with beam spot fixed) is developed, illumination of sizes up to 8 cm in diameter may be possible.

The maximum intensity for SEETF beams in the present setup is limited to 4x10^6 particles/second by the 4-quadrant scintillator. The rate limit when the PPAC is also in use is 10^4 particles/second. These detectors, which are part of the SEE Test Facility, are described in Sect. III.

TABLE 1: EXAMPLES OF BEAMS DELIVERED AT THE NSCL SEE TEST FACILITY

Beam Isotope	Cyclotron Beam Energy (MeV/A)	A1900 Be Target Thickness (a) (mg/cm^2)	SEE Degrader (b) Thickness (mm)	SEE Degrader (b) Angle (˚)	SEE Zr Exit Window Thickness (mm)	Air Gap Between SEE Scintillator and Target (mm)	Beam Energy at SEE target (c) (MeV/A)	(GeV)
Kr-78	140	Stripper	--	--	0.25	358	122	9.54
		94	--	--	0.25	358	115	8.98
		681	--	--	0.25	358	50	3.86
		681	0.5	0	0.25	358	26	2.03
		681	0.5	45	0.25	358	11	0.85
Kr-86	140	Stripper	--	--	0.25	358	125	10.75
		517	--	--	0.25	358	79	6.80
		517	0.75	0	0.25	358	57	4.92
		517	1	0	0.25	358	48	4.18
Bi-206	80	--	--	--	0.075	64	63	13.1

(a) "Stripper" indicates that a thin foil was used after the cyclotron to strip all electrons from the beam ions.
(b) The degrader material is aluminum.
(c) Energy values are estimated assuming the beam passes through both the SEETF PPAC and the SEETF scintillator.

Other characteristics of these beams:

- Beam spot shape: square (5 cm x 5 cm)
- Beam spot inhomogeneity < 50%
- Isotopic purity: >99%

These characteristics are illustrated in Figure 16 (at the end of this document), which shows beam profile spectra measured during an actual experiment.

Note about uniformity in energy: The energy spread is up to 5% for a beam that has been degraded in the A1900 fragment separator and transported through the separator without momentum selection slits. With the use of momentum slits, the energy uniformity on target will be higher (to within 0.5% depending on slit setting). If the beam is degraded using the local degrader in the SEETF vacuum chamber, the additional energy straggling will have to be estimated by the experimenter.

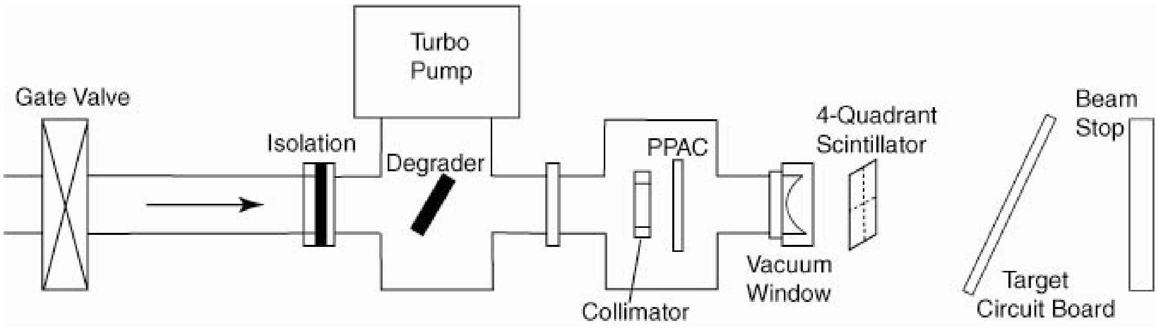


Fig. 1. Schematic layout of the SEE Test Facility.

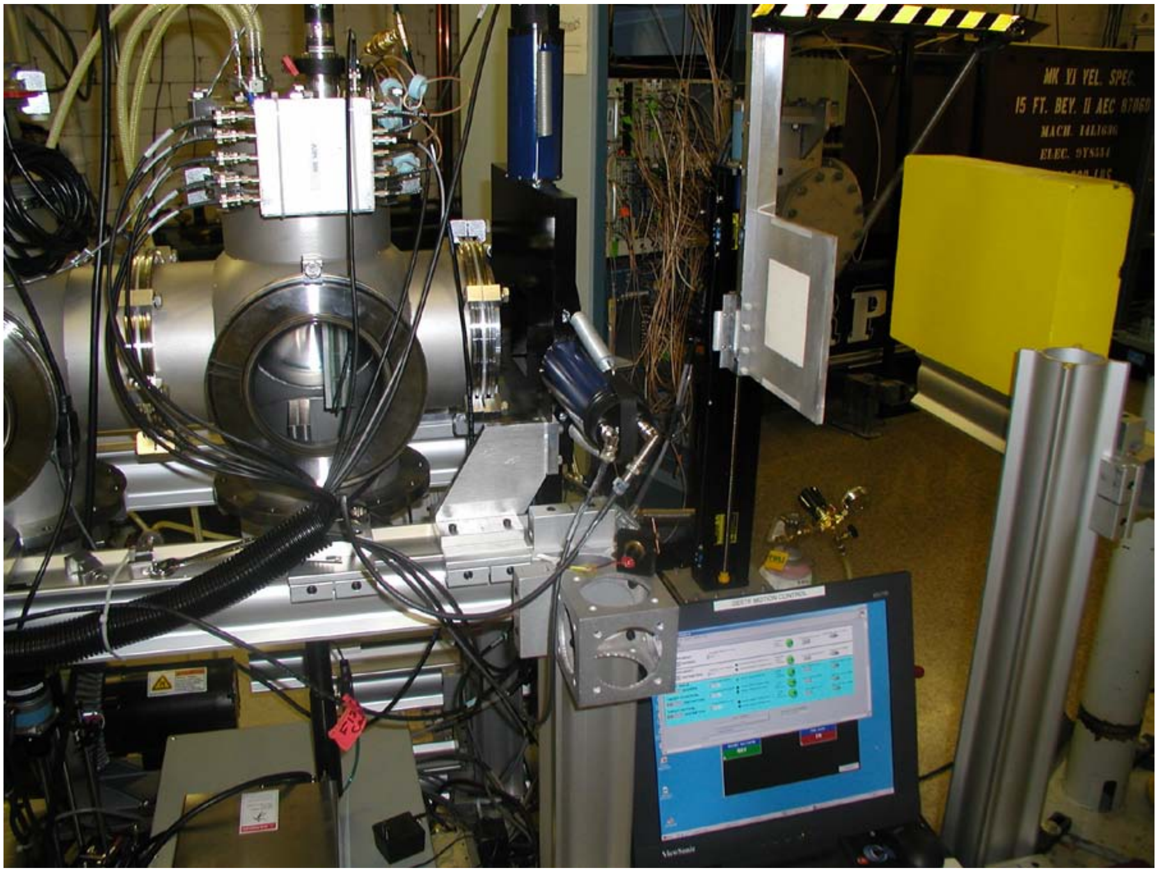


Fig. 2. Photograph of the SEE Test Facility. The cylindrical object with the circular port is the six-way cross which forms the second half of the vacuum chamber. The collimator drive projects below the cross and the PPAC drive projects above it. Just to the right of the cross is the 4-quadrant scintillator, located in air. Further to the right is the target positioning system, with the Viewer plate mounted on it. At extreme right is the graphite block forming the beamstop, painted yellow. Below the Viewer is a monitor displaying the SEETF motion control panel.

III. LAYOUT

A schematic layout of the SEE Test Facility in the S2 vault is shown in Fig. 1 and a photograph of the same in Fig. 2. The apparatus consists of hardware to degrade the energy of the beam, collimate the beam, determine the uniformity of the beam spot, measure the total dosage, position the target, and stop the beam. The elements shown in Fig. 1 will now be described.

Isolation: This provides electrical isolation between the upstream beam pipe and the downstream vacuum chamber, which consists of two six-way crosses connected by a flange. There is also electrical isolation between the vacuum chamber and the turbo pump.

Degrader: This local degrader in the vacuum chamber is used by the experimenter to quickly make small changes in the energy of the beam incident on the target. (Bigger changes in beam energy, e.g. by 30% or more of the starting value, are best done at the A1900 location near the beginning of the high-energy beam line by the NSCL beam delivery group. The beam line will then have to be retuned — an operation that takes up to 2 hours.) The local degrader consists of a 4"x4" aluminum plate or foil, rotatable about a vertical axis for fine control, and mounted on a 3-position drive. Thus, any one of three thicknesses (no degrader, degrader d_1, or degrader d_2) can be inserted in the path of the beam. NSCL will prepare and install degraders of agreed-upon thicknesses appropriate for the needs of the experiment.

Collimator: This is a 2"x2" hevimet collimator with rounded edges. Its main purpose is to prevent the beam from hitting the edges of the PPAC detector.

PPAC: A Parallel Plate Avalanche Counter (PPAC) with an active area of 10 cm by 10 cm is used to measure the (x,y) position of each beam particle that passes through it. As the performance of the PPAC deteriorates at count rates in excess of about 10^4 particles/sec, the PPAC is retracted from the path of the beam prior to starting an irradiation.

Vacuum Window: The vacuum window at the end of the chamber is a zirconium foil of thickness t, where t may be 0.075 mm, 0.1 mm, or 0.25 mm. The exact choice of t is made depending on the needs of the experiment: generally, t = 0.25 mm is used for Kr beams and t = 0.075 mm for very heavy beams like Bi. The beam passes through this vacuum window into air.

Four-Quadrant Scintillator: Mounted immediately downstream of the foil window is a 4"x4", 0.010" thick, plastic scintillator, divided into four quadrants. The four quadrants are optically isolated from each other, and the counts on each quadrant are read out. The sum of the counts measures the total dosage, while any change in the distribution of the counts in the four segments is a good indicator that the beam has changed position. During irradiations, the ratios of the counts in the different quadrants are used to monitor any drift of the beam spot on target. The scintillator can safely handle count rates of up to 10^6 particles/sec in each quadrant. A 0.125"-thick aluminum plate is used to cover the scintillator when it is not being used; this plate must be removed before beam is tuned down the beam line.

Target: After passing through the scintillator, the beam reaches the target, typically a computer circuit board, mounted on a positioning system. The component of interest, otherwise known as the Device Under Test (DUT), is positioned in the path of the beam using linear and rotary stepping motor drives. A laser system consisting of two line lasers has been set up in such a way that the point of intersection of the light rays at the target location corresponds to the position of the beam axis, to a precision of perhaps 0.5 cm. (If better precision is desired, a telescope can be set up downstream of the target.) A program is run continuously in the board; the effect of the beam is seen as mistakes in the execution of the program. Distance from Vacuum Window to target position is ~17".

The in-air target positioning system has the following features:

- Accurate positioning in x and y, with an accuracy of 0.003" over the entire travel distance (x and y are the horizontal and the vertical axis in the target plane, respectively)
- 10" travel in x direction, 20" in y direction
- Clockwise and counter-clockwise rotations of up to 45 degrees
- Computer controlled.

The positioning system can hold two 10"x10" targets, one below the other. One of these two positions is usually taken up by a Viewer, consisting of a 10"x10" aluminum plate with a 5"x5" square of scintillating material painted in the center. The other position is for the target brought by the experimenter. Specifications for a typical circuit board to be attached can be found in Fig. 3.

Beamstop: A 4"-thick graphite block is located about 12" downstream of the target. This block will stop the beam if the target itself is not thick enough to do so.

Note: In October 2005, a fast-acting gate valve was installed upstream of the SEETF station. Its controller (a metal box 17” long, 5” high) is mounted on the SEETF cart at its upstream end. Please do not turn off, or change the settings on, the controller. Operating instructions for the fast-acting gate valve are given in Appendix A (page 24).

Since the experimental vault has limited space, the SEETF chamber and target drives are mounted on a movable cart. Kinematic mounts reposition the cart in the same location every time it is returned to the vault. The PPAC and scintillator detectors are operated using electronics in the vault. All of the diagnostic drives and target motions are remotely controllable from the data taking area via the laboratory Ethernet. Clean power (120 V.A.C.) is available in the S2 vault and in the SEEFT Data Station (room 183B) via two electrical boxes in each area; each box has four orange-colored receptacles.

The SEETF data acquisition system can be run from either the SEETF Data Station in room 183B or from a designated Data-U in room 144. At each location, there is currently a Windows 2000 personal computer (with two monitors) intended for motion control, beam-line elements control, running energy-loss programs chosen by the experimenters, etc. and a Linux computer (with one monitor) for data acquisition. The functions of the Windows computer are described in Sect. V and those of the Linux computer in Sect. VI. Because the Windows computers (unlike the Linux computers) do not share files, a process, program, or shortcut (desktop icon) available on one Windows computer will not necessarily be available on other Windows computers. As presently only the Windows computer in the SEETF Data Station has installed on it all the features described in this manual, we will assume in what follows that the data acquisition is run from the SEETF Data Station. Note that users may not install their own software on any NSCL computer; but they can request NSCL staff to do so. Such requests will be reviewed and, if approved, will be implemented. Note also that the computers may be re-imaged, removing such extra software, without notification in the interval between experiments.

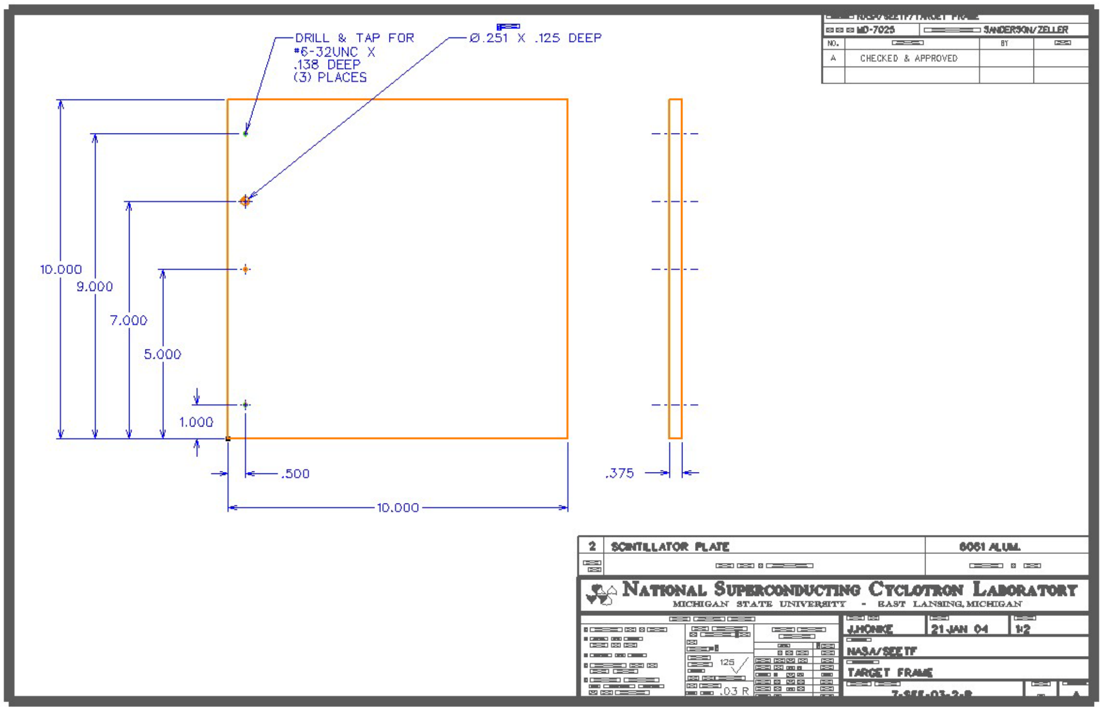
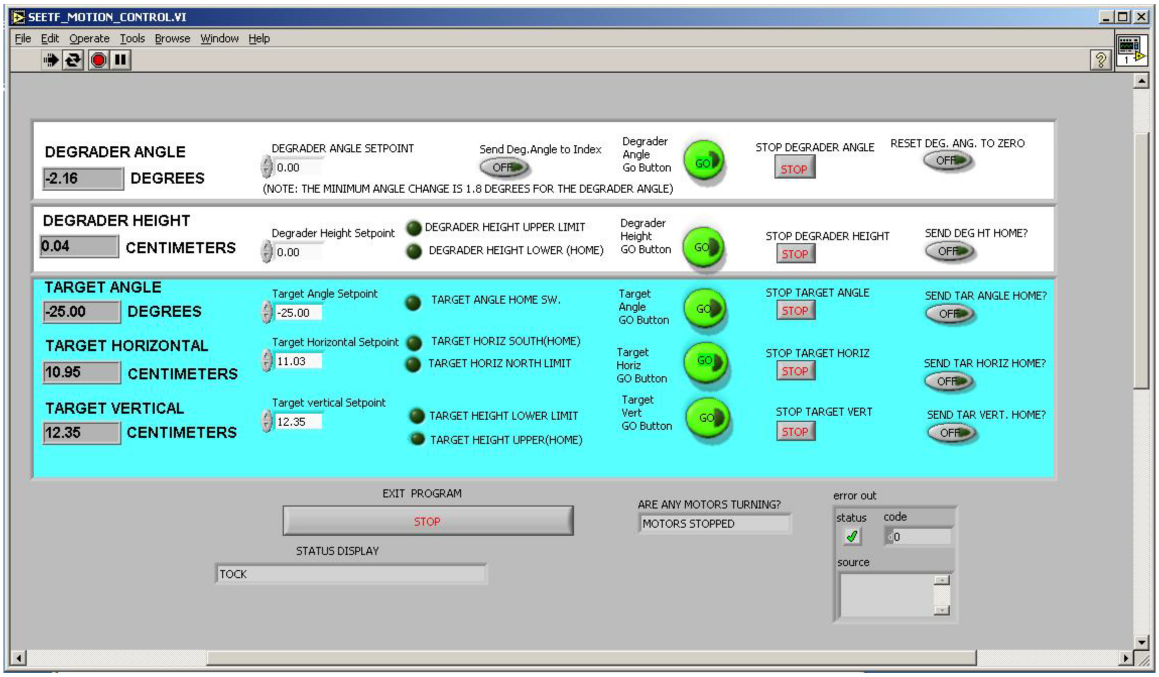


Fig. 3 Specifications for a typical target. It has three 6-32 threaded holes for attaching it to the positioning system and one 0.25" diameter locating pin to insure reproducible positioning. Targets of other sizes can be attached using adapters.



DEGRADER ANGLE: -2.16 DEGREES
DEGRADER ANGLE SETPOINT: 0.00
Send Deg.Angle to Index: OFF
Degrader Angle Go Button
STOP DEGRADER ANGLE
RESET DEG. ANG. TO ZERO: OFF
(NOTE: THE MINIMUM ANGLE CHANGE IS 1.8 DEGREES FOR THE DEGRADER ANGLE)

DEGRADER HEIGHT: 0.04 CENTIMETERS
Degrader Height Setpoint: 0.00
DEGRADER HEIGHT UPPER LIMIT
DEGRADER HEIGHT LOWER (HOME)
Degrader Height GO Button
STOP DEGRADER HEIGHT
SEND DEG HT HOME?: OFF

TARGET ANGLE: -25.00 DEGREES
Target Angle Setpoint: -25.00
TARGET ANGLE HOME SW.
Target Angle GO Button
STOP TARGET ANGLE
SEND TAR ANGLE HOME?: OFF

TARGET HORIZONTAL: 10.95 CENTIMETERS
Target Horizontal Setpoint: 11.03
TARGET HORIZ SOUTH(HOME)
TARGET HORIZ NORTH LIMIT
Target Horiz GO Button
STOP TARGET HORIZ
SEND TAR HORIZ HOME?: OFF

TARGET VERTICAL: 12.35 CENTIMETERS
Target vertical Setpoint: 12.35
TARGET HEIGHT LOWER LIMIT
TARGET HEIGHT UPPER(HOME)
Target Vert GO Button
STOP TARGET VERT
SEND TAR VERT. HOME?: OFF

STATUS DISPLAY: TOCK
ARE ANY MOTORS TURNING?: MOTORS STOPPED
error out
status: ✓
code: 0
source:

Fig. 4. The SEETF motion control panel, used to position the target and the local degrader. The "home" position, where all the five numbers read 0.00, corresponds to the top edge of the degrader being 2" below beam height and the bottom left corner of the target being on the beam axis, with both degrader and target oriented perpendicular to the beam axis.

IV. DIVISION OF RESPONSIBILITIES DURING EXPERIMENT

NSCL staff will do the following operations for a SEE-type experiment, and the experimenters do not have to learn about their details:

a) Prior to the experiment, mount up to two degraders of the agreed-upon thicknesses on the degrader ladder and pump down the vacuum system. Normally, the degrader thicknesses will be determined by NSCL staff based upon the on-target energies requested in the SEETF Questionnaire, which is to be submitted three months in advance of the run date - see Sect. IX. Otherwise, we require at least three week's notice about the required energies.
b) Prior to the experiment, mount the PPAC and the 4-quadrant scintillator, set up the PPAC's gas-handling system, and measure the PPAC's position calibration.
c) Prior to the experiment, set up a computer account and data collection space on disk and copy ("roll out") from a reference account all the files (programs, desktop icons, etc.) needed for the experiment. A new account will be set up for each experiment, that is, for each visit by the experimenters to NSCL.
d) At the start of the experiment, deliver a beam of the agreed-upon species, energy, size, and uniformity at the target location.
e) By operating the PPAC at the beginning of the run, provide a measurement of the beam profile to the experimenters; this profile will be provided for each tune performed during the experiment.
f) Develop and store appropriate high voltages for the PPAC and the scintillator for each type of beam species and energy that will be used. These high voltages can be recalled by the experimenters as needed, using the SEETF data acquisition system (Linux computer).
g) Set up, operate, and maintain the electronics needed for processing the PPAC and scintillator signals.

The experimenters are responsible for the following operations during the experiment, most of which are done using the SEETF Data Acquisition System. (Experimenters have several other responsibilities prior to the experiment; these are described in Sect. IX.)

a) Mount their target on the positioning system and position it as desired.
b) Fine-tune the energy of the beam on target by changing the local degrader thickness (e.g. by changing its angle). In determining the beam energy at the beginning of the device charge collection region, the energy losses in the degrader, the 0.010"-thick plastic scintillator, the zirconium window of thickness t (= 0.25, 0.1, or 0.075 mm), and the 17" of air must be taken into account. If the experimenters desire to use any particular energy-loss program to calculate this, a request should be made for the program to be installed by NSCL personnel.
c) Start and stop the run by retracting/inserting a beamstop (specifically, the F143VP viewer/beamstop) operated from the Windows computer. It is important to note that the data acquisition (DAQ) for the run should be started at the Linux computer <u>before</u> the beamstop is retracted and stopped <u>after</u> the beamstop is inserted. Details of this procedure are given in Sect. VII.
d) Call the Operator in Charge at extension 305 to change the attenuator setting if a different level of beam intensity is desired. (Note: The attenuators change the beam intensity in increments of roughly factors of 3. Please take care that the

count rate in each quadrant of the 4-quadrant scintillator does not exceed 10^6 particles/sec.)

e) During the run, monitor the ratios of the counts in the four quadrants of the 4-quadrant scintillator; and if the ratios start to change significantly (indicating possibly a shift of the beam spot on target), inform the Operator so that the problem can be corrected. Likewise, monitor the absolute rates; and if they change appreciably (indicating a possible change in the beam intensity), inform the Operator.

f) At the end of the experiment, transfer the data from disk to (one or more) DVDs, for taking to the home institution of the experimenters. Experimenters can bring their own DVDs or purchase them from the NSCL Computer Department during business hours. The DVDs can be burned from the LINUX computer.

V. WINDOWS COMPUTER FUNCTIONS

As stated in Sect. III, SEETF experimenters will have at their disposal a Windows computer in the SEETF Data Station in room 183B during their experiment. This computer is used for motion control, beam-line elements control, possibly running an energy-loss program chosen by the experimenters, etc. There is also a Windows computer in the S2 vault, called Pcout3, mounted below the target positioning system, that can be used for motion control and beam-line elements control; it is labeled "CONTROL MOTION SYSTEM." You can log on to either of these two computers using the Username and Password assigned by the NSCL Computer Department for your experiment. The use of these computers for motion control is described in Sect. V(a) and their use for other functions in Sect. V(b).

a) Target and Degrader Positioning

Positioning of the target and degrader are carried out by computer control using the LABVIEW control program, and can be done from the S2 vault or from the SEETF Data Station in room 183B.

(i) In the S2 vault, after logging on to Pcout 3,

- Click on the "Shortcut to SEETF MOTION CONTROL" icon to start the LABVIEW control program (if it is not already running). This will bring up the SEETF Motion Control Panel (Fig. 4). If the arrow near the top left corner of the panel is white, click on it to start the application; it will turn black.
- Make sure Laplink is running. If it is not already running, click on the Laplink icon on Pcout3 and then shrink the panel that opens up. Now go to step (iii).

(ii) In the SEETF Data Station after logging on to the Windows PC computer, to get remote control of Pcout 3, do the following:
At the SEETF Data Station Windows PC computer:
Click on the Laplink icon;
choose "Connect Over Network" option;
choose "Pcout3";
choose "Remote Control" option in the "Services" subpanel;
On the window that opens up, type:

Username: *vaultuser*
Password: *uservault*
Click on “Shortcut to SEETF MOTION CONTROL” icon to start the LABVIEW control program (if it is not already running). This will bring up the SEETF Motion Control Panel. If the arrow near the top left corner of the panel is white, click on it to start the application; it will turn black. Now go to step (iii).

(iii) At the SEETF Motion Control Panel, there are five motions that need to be specified:
Target angle
Target horizontal position
Target vertical height
Degrader angle
Degrader vertical height

Note that the positions have been calibrated in cm and the angles in degrees. The “home” position, where all the five numbers read 0.00, corresponds to the top edge of the degrader being 2" below beam height and the bottom left corner of the target being on the beam axis, with both degrader and target oriented perpendicular to the beam axis.

Note also that the minimum angle change for the degrader angle is 1.8 degrees. Given this lack of fine control, the following procedure is suggested to set the degrader angle more precisely. At the “home” position, the degrader ladder should be visually inspected to see that it is perpendicular to the beam. If it is not, use the Degrader Angle motion control to appropriately rotate the ladder. Then, reset the angle readout to 0.0 by pressing the “Reset Deg. Ang. To Zero” button, located near the top-right corner of the display.

For putting the target on the beam axis, type in the following values and hit the “go” buttons:
Target angle = 0 degrees;
Target horizontal = 11.03 cm;
Target vertical = 12.35 cm.
These are the settings the NSCL beam delivery group will use when tuning to center the beam spot on the Viewer.

To move to any other position, type in the numbers in the “Setpoint” boxes and click on the “Go” buttons. For the degrader height, the values to use are:
No Degrader: 0.00 cm
Degrader d_1: 10.16 cm
Degrader d_2: 20.32 cm

Note: Only one remote user at a time is allowed to control a PC remotely. Since we wish SEE users to be always informed about the status of the experimental setup, we have adopted the approach that SEE users will have control of the S2 vault PC at all times. The beam physicist will be able to read but not control the position of the target and the degrader and therefore will rely on SEE users to set the target and degrader positioning for beam tuning.

b) Other Functions of the Windows Computer

The Windows computer in the SEETF Data Room has the following desktop icons set up (in addition to the <u>Laplink</u> icon described in V(a)):

- Accelerator Status displays the current status of cyclotron operations, and the names of the Operations staff personnel on shift. Along with other information, you will find the name and photograph of the Operator in Charge and the Beam Physicist on Call for the current shift.
- S2 Panelmate, which calls up the S2 Vault page (see Fig. 5) of the Panelmate application, which is connected to the lab's Allen Bradley PLC system. You should use this page for starting and stopping the irradiations of your target and for some other purposes (described in the next paragraph). Irradiation start/stop can be done in one of two ways. (a) "Retracting" the "F143VP Viewer S2 Beamstop" control button when it is in the "Inserted" position will retract the F143VP beamstop and allow beam to strike your target (provided all other beam line devices have also been retracted). This beamstop, which is actually a scintillator-cum-beamstop, is located on the SEETF beam line in the Transfer Hall, which is immediately upstream of the S2 vault. When you want to stop the irradiation, hit this button again. (b) To have timed irradiations, activate the "F143VP Beamstop Retraction Timer" button by hitting it; hit the "Seconds of Exposure" button; type in the desired number of seconds in the dialog box that will then show up; and hit the "Start Beam Timer" button. The irradiation will continue for the preset duration, and then the F143VP beamstop will be automatically inserted. If for any reason you wish to stop the irradiation while it is going on, hit the "Stop Beam Timer" button. Generally, option (b) is the option of choice for SEE-type experiments. Irradiation Time: The panel "F143VP Beamstop Retracted Elapsed Time" displays the irradiation time. When the F143VP beamstop is retracted, by any means, it starts counting. When the beamstop is inserted, it stops. The next time it is retracted, the value is reset to zero before starting counting in seconds. The units are seconds and the number is an integer.

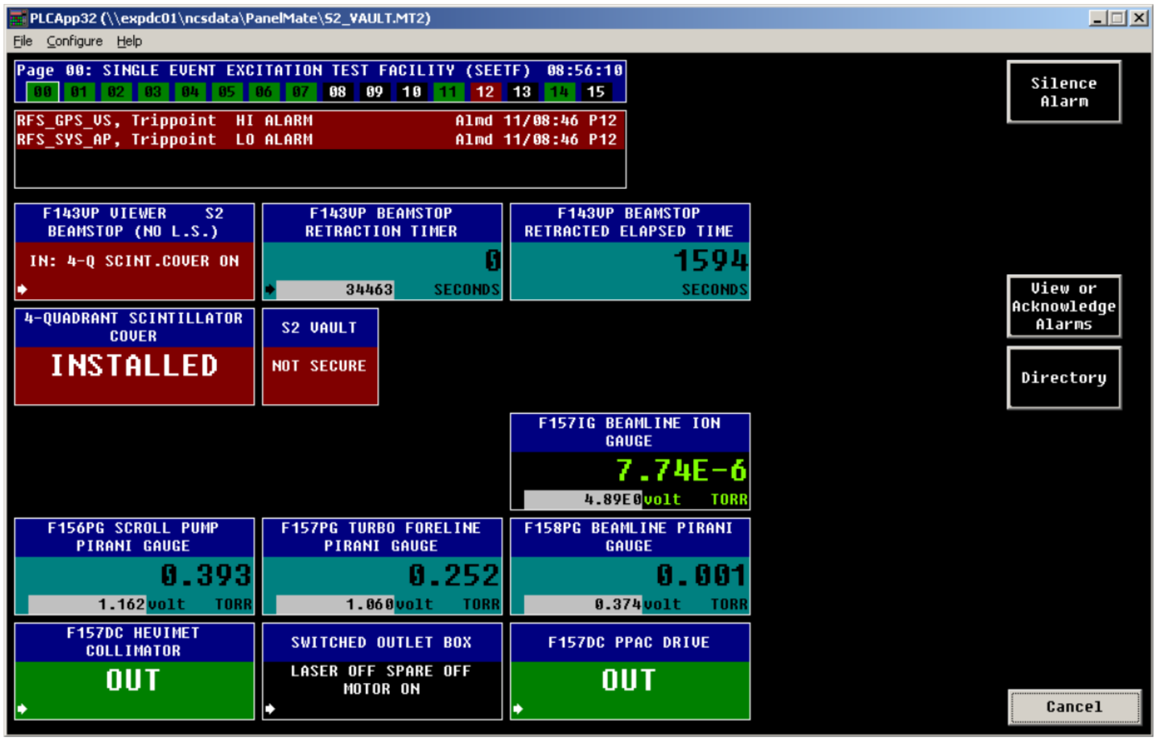
In addition, the S2 panelmate has these other useful indicator displays and controls:

- "S2 Vault Not Secure," if that is the case. (You must not retract the F143VP beamstop when the vault is not secure.)
- "4-Q Scint. Cover Installed" or "4-Q Scint. Cover Removed". (The cover must be removed prior to beam being tuned to the vault and during the irradiations.)
- "Switched Outlet Box," which lets you remotely control (i.e. turn on and off) three devices:
    - the lasers that shine on the Viewer (target); the lasers must be switched off during beam tuning, as otherwise the laser light would obscure the beam spot on the Viewer.
    - the motors that control the of the target and local degrader. To be enabled, the motors must be turned on from both this panelmate control and the switch on the Motor Controller box in the S2 vault. If either of the two is off, the motors will have no power.

- any device that the user wishes to control remotely, by connecting it to the outlet marked “spare.”

During irradiations that use either the PPAC detector or 4-quadrant scintillator, the motors should be off since they can create electrical noise in the detector signal. If it is desired to change the position or angle of the target or local degrader in between irradiations, the motors must be turned on and, after the change is completed, turned off.

Do not operate the other control buttons on the S2 Vault page. They are for operation by NSCL staff; and you will find them useful for monitoring purposes, e.g. “PPAC drive” should show “out” during your irradiations and the various vacuum gauges should show good vacuum.


PLCApp32 (\\expdc01\ncsdata\PanelMate\S2_VAULT.MT2)

Page 00: SINGLE EVENT EXCITATION TEST FACILITY (SEETF) 08:56:10

RFS_GPS_VS, Trippoint HI ALARM Almd 11/08:46 P12
RFS_SYS_AP, Trippoint LO ALARM Almd 11/08:46 P12

F143VP VIEWER S2 BEAMSTOP (NO L.S.): IN: 4-Q SCINT.COVER ON

F143VP BEAMSTOP RETRACTION TIMER: 0 — 34463 SECONDS

F143VP BEAMSTOP RETRACTED ELAPSED TIME: 1594 SECONDS

4-QUADRANT SCINTILLATOR COVER: INSTALLED

S2 VAULT: NOT SECURE

F157IG BEAMLINE ION GAUGE: 7.74E-6 — 4.89E0 volt TORR

F156PG SCROLL PUMP PIRANI GAUGE: 0.393 — 1.162 volt TORR

F157PG TURBO FORELINE PIRANI GAUGE: 0.252 — 1.060 volt TORR

F158PG BEAMLINE PIRANI GAUGE: 0.001 — 0.374 volt TORR

F157DC HEVIMET COLLIMATOR: OUT

SWITCHED OUTLET BOX: LASER OFF SPARE OFF MOTOR ON

F157DC PPAC DRIVE: OUT

Fig. 5. S2 Vault Panelmate page. One or the other of the control buttons “F143VP Viewer S2 Beamstop” and “F143VP Beamstop Retraction Timer” is used for starting and stopping the irradiation of the Device Under Test (target). For timed irradiation, the “F143VP Beamstop Retraction Timer” control button is to be used. No matter which option is used, the elapsed time (in seconds) is shown in the panel “F143VP Beamstop Retracted Elapsed Time”. In addition, this page has these other useful indicator displays and controls, as described in the text.

VI. SEETF DATA ACQUISITION SYSTEM

The SEETF Data Acquisition System (SEETFDAQ) is an automated version of the standard NSCL data acquisition system. Full details of the SEETFDAQ system are available in the SEETFDAQ User's Guide, which is posted at:
http://docs.nscl.msu.edu/daq/see/seeuser.pdf (pdf version, best for making good printed copies);
http://docs.nscl.msu.edu/daq/see/seeuser.html (hyperlatex version, best for convenient on-line navigability).
Here, we give a simplified description of the SEETF data acquisition system.

SEETFDAQ is run from the Linux computer in the SEETF Data Station (room 183B). Log on to the Linux computer using the same Computer-Department-assigned Username and Password as for the Windows computer.

On the Linux computer monitor, you will see various desktop icons (shortcuts). The ones that you will be using are five: the icons labeled User Controls, Readout, Scalers, SpecTcl, and Save Data. To run the process or program associated with any of these icons, click *once* on the icon. User Controls allows you to set the parameters for the electronics, Readout allows you to start/stop the data acquisition for the run, Scalers allows you to monitor the readings from the four-quadrant scintillator, SpecTcl allows you to do on-line analysis of your data, and Save Data allows you to transfer the data accumulated during your experiment from disk onto DVD (one or more).

When you click on the User Controls icon, you will see the panel display shown in Fig. 6. Use the "Select Beam" button to select the beam species and energy. Then hit the "Scint HV On" button. The program thereupon recalls the stored high voltage for the selected beam species/energy, ramps up the high voltages for the 4-quadrant scintillator at the preset rate, and sets the shaping amplifier and constant fraction discriminator values. If you change the beam/energy or need to enter the vault, hit the "Scint HV Off" button (which thereupon turns off the high voltage), and repeat the steps listed above. Note: Do not turn off this control panel while you are collecting data; the program needs to be running for the scintillator high voltage (as also the PPAC voltage) to be on.

When you click on the Readout icon, you will see a panel display similar to that shown in Fig. 7. The Scaler menu in segment (1) of the panel allows you to select readout parameters for the periodic scalers, such as the interval between periodic scaler readout. The boxes in segment (3) allow you to type in the run title and the run number.

The "Record Events" button in this segment needs to be clicked on for the run to be recorded on disk. Note that when the run is being recorded, the control panel background turns green to indicate that. The "Begin" button in segment (4) allows you to start the data acquisition (DAQ) for the run (however, for the actual data collection to start, the beamstop F143VP must be retracted); and when the run is on, this button becomes the "End" button. When the DAQ for the run is ended, the "Record Events" button remains on, and the run number automatically increments by one. Do not use the other buttons in segments (4) and (5), such as the "Pause" button and the "timed" button.

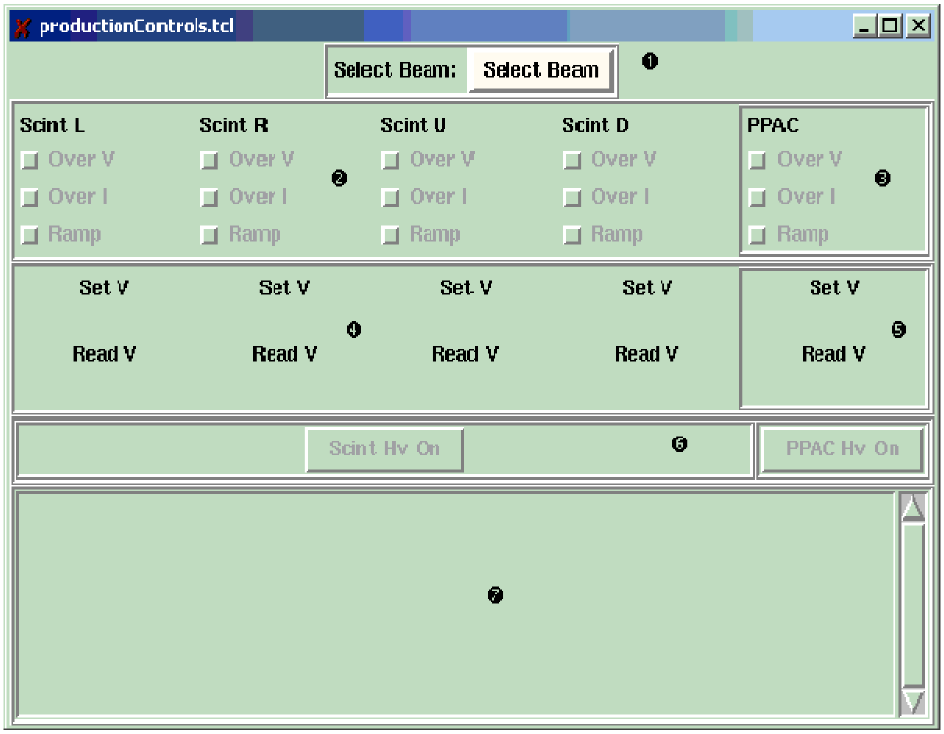
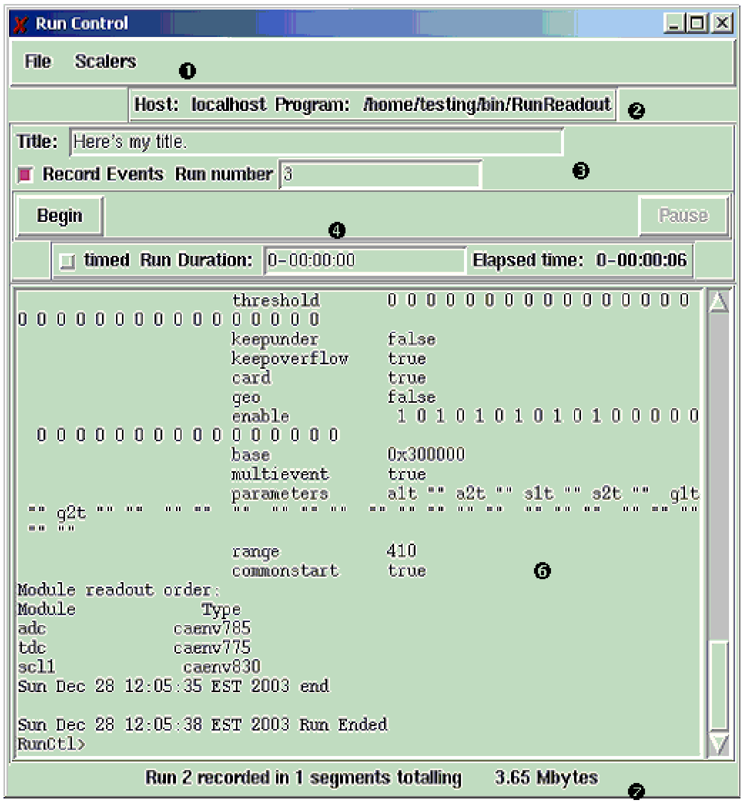


Fig. 6. The SEETF electronics settings control panel.



Host: localhost Program: /home/testing/bin/RunReadout

Title: Here's my title.

■ Record Events Run number 3

☐ timed Run Duration: 0-00:00:00 Elapsed time: 0-00:00:06

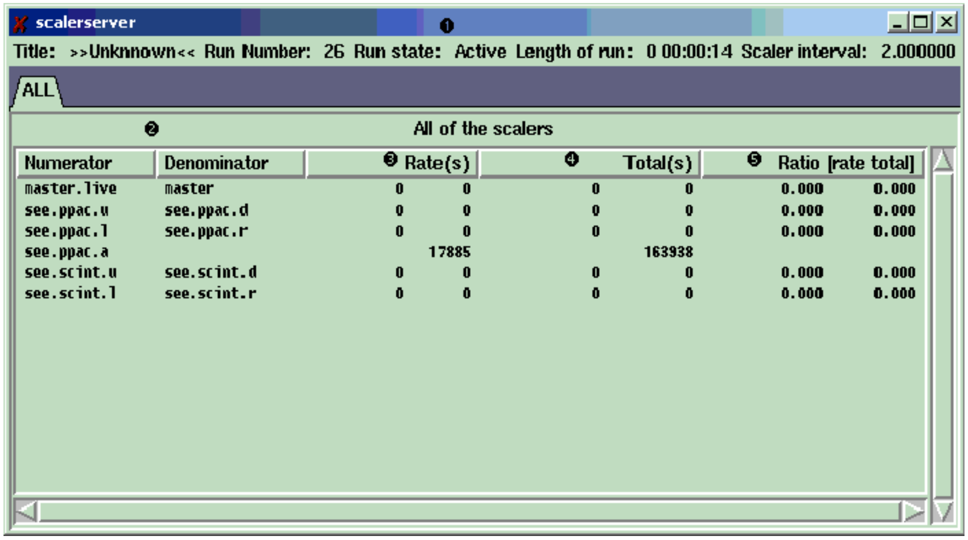
```
                     threshold        0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
                     keepunder        false
                     keepoverflow     true
                     card             true
                     geo              false
                     enable            1 0 1 0 1 0 1 0 1 0 1 0 0 0 0 0
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
                     base             0x300000
                     multievent       true
                     parameters       a1t "" a2t "" s1t "" s2t ""  g1t
 "" g2t "" ""  "" ""  ""  "" "" ""  "" "" "" "" ""  "" "" ""  "" "" ""
 "" ""

                     range            410
                     commonstart      true
Module readout order:
Module            Type
adc             caenv785
tdc             caenv775
scl1             caenv830
Sun Dec 28 12:05:35 EST 2003 end

Sun Dec 28 12:05:38 EST 2003 Run Ended
RunCtl>
```

Run 2 recorded in 1 segments totalling 3.65 Mbytes

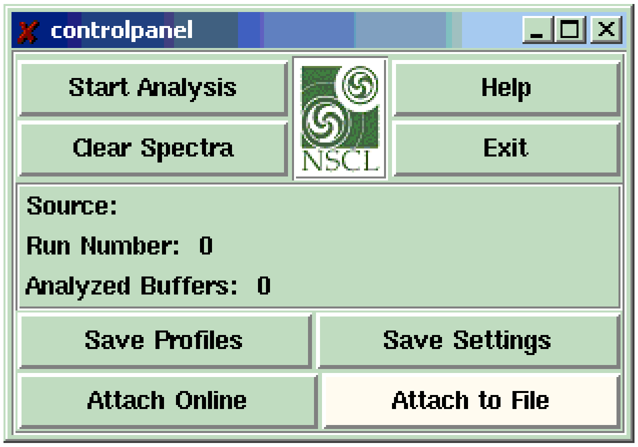
Fig. 7. The Readout control panel.



Title: >>Unknnown<< Run Number: 26 Run state: Active Length of run: 0 00:00:14 Scaler interval: 2.000000

Numerator	Denominator	❸ Rate(s)		❹ Total(s)		❺ Ratio [rate total]	
master.live	master	0	0	0	0	0.000	0.000
see.ppac.u	see.ppac.d	0	0	0	0	0.000	0.000
see.ppac.l	see.ppac.r	0	0	0	0	0.000	0.000
see.ppac.a			17885		163938		
see.scint.u	see.scint.d	0	0	0	0	0.000	0.000
see.scint.l	see.scint.r	0	0	0	0	0.000	0.000

Fig. 8. The scaler display panel.



Source:

Run Number: 0

Analyzed Buffers: 0

Fig. 9. The SpecTcl control panel.

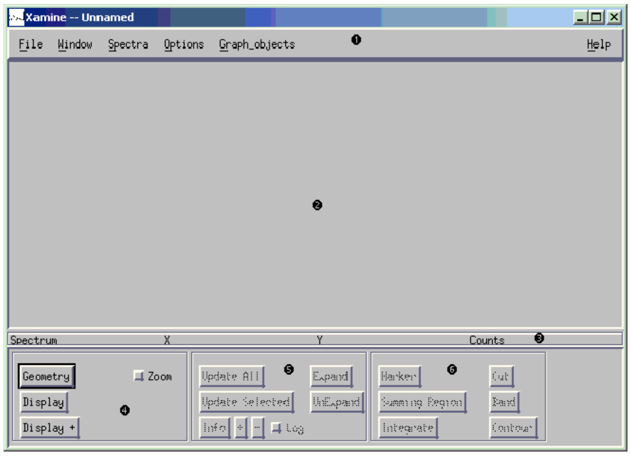


Fig. 10. The Xamine user interface.

When you click on the Scaler icon, you will see a panel display similar to that shown in Fig. 8. The sum of the "Totals" counts in the up, down, left, and right scintillator quadrants gives the total number of ions hitting the target, i.e. the dosage. Dividing this number by the length of run (displayed in the top row of the scaler display panel) and by the area of the beam spot (determined from the PPAC data) gives the average flux during the run (particles/sec/cm^2). For monitoring possible shift of beam spot during the run, the four ratios shown in the lower right corner of the matrix (i.e. the numbers corresponding to the last two rows and the last two columns) are the ones to keep track of. They are the ratios of instantaneous and the run-to-date counts in the up/down and the left/right scintillator quadrants.

When you click on the SpecTcl icon, you will see two panels: the SpecTcl control panel (Fig. 9) and the Xamine user interface for SpecTcl (Fig. 10). Xamine is used to display histograms produced by SpecTcl. Once you have clicked on the "Attach on-line" button shown in Fig. 9 to activate the on-line display of spectra, the Xamine user interface allows you to look at spectra. To select a spectrum, hit the "Display" button in Fig. 10 and select from the Spectrum Choice Dialog the spectrum you want to display. (Note: The trendline spectra, which display the count rates in the scintillator quadrants as a function of time and are important as monitoring tools, will not show up in the Spectrum Choice Dialog box until after the run is begun, i.e. until the "Begin" button of Fig. 7 is clicked on.) To display a set of say 4 spectra in a 2-row, 2-column format, hit the "Geometry" button and "apply" the 2x2 option. Each box in the display area is called a *pane*. One pane will always look like it is pressed in; this pane is called the *selected pane*. Once you have selected a pane geometry, you will want to display spectra in the panes of this geometry. To do this you will:
a) Select the pane you want to "fill."
b) Click on either the Display or Display+ button to bring up the Spectrum Choice dialog.
c) Select a spectrum from that dialog.
d) Click Apply or Ok to accept. Note that double clicking the spectrum name also performs the default action (Ok for Display and Accept for Display+).
These and several other useful and necessary details are described on pages 21-23 of the postscript version of the SEETFDAQ User's Guide that was referenced at the beginning of this section. Please consult that Guide for these details.

For the monitoring of the data by the experimenters during runs as well as for analysis later on, the following spectra are particularly useful:
see.sci.{u,d,l,r} One-dimensional energy spectra from the 4 quadrants of the scintillator;
see.sci.counts A one-dimensional 4-channel spectrum that histograms the total counts in each quadrant (see lower right panel of Figs. 12, 13, 15, and 16);
see.trend{u,d,l,r} Trendlines for the count rates in the four quadrants (see Fig. 14); a trendline is a time trace that shows the history of count rate vs. time, like a strip chart. As mentioned in the previous paragraph, the trendline spectra will not be selectable till after the run is begun, i.e. until the "Begin" button of Fig. 7 is clicked on and has become the "End" button. The spectra will disappear in between runs if the "Begin" button is switched on and off between runs.

For the PPAC profile spectra, to convert the x and y coordinates from channel number to mm, click on the button “Map” near the bottom of Fig. 10.

When a run is ended, a lot of information is automatically written to disk; see page 24 of the SEETFDAQ User’s Guide for a full description of the standard run products. The run products include time-stamped scintillator scaler rate values, the four trendline spectra (time traces) of the count rates in the four scintillator quadrants, a directory that has all the configurational settings for the run, etc.

The Save Data icon allows the transfer of data from disk to DVD, an operation that should be performed at the end of the experiment in order to preserve the accumulation of data from the different runs. When you click on the icon, a parameter entry dialog box such as shown in Fig. 11 will appear. The example shown in Fig. 11 will record all runs to DVD.

● All Runs

○ Select Runs

Fig. 11. Parameter entry dialog box

To select a range of runs, select the “Select Runs” radio button and enter a starting run number and, optionally, an ending run number in the text entries. If you do not enter an ending run number, all runs starting at the selected run will be written to DVD. Once you have selected the set of runs you want to burn, click the Burn button. Before starting to burn each DVD, the program will prompt you to put a blank DVD disk in the burner. If the data size is more than be fitted on one DVD, the program informs you of that and allows you to burn multiple DVDs. (Data for any given run will not span multiple DVDs.) After all of the DVD’s have been burned, the program will turn the output capture window’s “Cancel” button into a “Dismiss” button. Review the output for errors, and dismiss it when you are satisfied or want to retry the burn.

The burnt DVDs would have on them a “config” directory, an “experiment” directory, and a “scalerfiles” directory. The “experiment” directory has under it a directory for each run, and the directory for each run will have a scint.log file in it. For off-line analysis, it will generally be sufficient for you to look at the scint.log file for each run, in conjunction with the irradiation times you have recorded manually. (To display the recorded spectra during analysis, select the option “Attach to File” in the SpecTcl control panel, Fig. 9.)

VII. SEQUENCE OF STEPS FOR DATA COLLECTION

In this section we list the various steps involved in data collection during a SEE-type experiment at NSCL. Details of the steps given here are to be found scattered throughout this manual. In particular, the present section should be read in conjunction with Sect. IV to get a better idea of the whole process.

a) Before the experiment starts, you (the experimenters) should develop a rough run plan in conjunction with the A1900 contact person.

b) Before the experiment starts, Raman Anantaraman will “roll out” the computer account for the experiment. This means copying on to the new account all the files from a (previously used) reference account, including programs and desktop icons.

c) With the fast-acting gate valve activated, the aluminum plate protector of the 4-quadrant scintillator removed (manually), the SEETF degraders out of the way and the Viewer positioned on the beam axis (using the SEETF Motion Control Panel), the S2 vault room lights turned off (manually), the S2 vault secured, and the laser lights in S2 turned off (using the S2 panelmate page), the beam physicist will tune beam(s) of the agreed-upon species, energy, size, and uniformity to the target location. Beam profiles (such as shown in Figs. 12-16, which were measured during the SEETF test run on February 25, 2004 using a primary beam of 140 MeV/nucleon ^{78}Kr) will be measured for these beams. These operations will generally be done from the Data-U2 area in room 144, using a computer account different from the account for the experiment. Printouts containing the beam profile information (such as Fig. 12), as well as a photo of the beam spot at the viewer target position, will be given to you. At the end of the experiment, the beam physicist will burn a DVD containing all data relevant for beam delivery. Note: The characteristics of the beam spot at the PPAC and viewer target positions should be very similar, but there can be a small convergence of the beam from the PPAC position to the target depending on the ion optics properties.

d) At the end of the operations described in (c), the beam physicist will park the beam on the F143VP beamstop (i.e. insert this stop in the path of the beam) and retract all other beam-line elements (including the PPAC in the SEETF vacuum chamber but excluding the SEETF local degrader and the hevimet collimator). This means that the beam will hit the SEETF target as soon as the F143VP beamstop is retracted.

   Before handing over control of the beam to you, the beam physicist will:
   - Have the hevimet collimator inserted (unless you instruct otherwise);
   - Record the beam profile and make a printout for you;
   - Adjust the intensity and attenuator setting for the beam such that the count rate per quadrant of the scintillator will be as close to the limit of 10^6 pps as possible;
   - Transfer to your computer account the high voltage settings for the PPAC and the scintillator appropriate for the beam being used.

e) If you need to enter the S2 vault before starting your irradiations or at any time while the experiment is in progress, first bias off the scintillator and PPAC voltages using the User Controls icon on the Linux computer in room 183B and then follow the procedure described in Sect. VIII(b).

f) Whenever you expect not to use the beam for periods of 30 minutes or longer – either before you start your irradiations or in between irradiations – please turn over control of the beam to the Operator by calling extension 305. The reason for this is mentioned in item 6 of Sect. X(b). When you are ready to use the beam, ask the Operator to return the control to you.

g) When you are ready to have an irradiation of your target, the correct sequence to follow is:
Beam off;
DAQ on;
Beam on;
Irradiation (either for a preset time or for a not-predetermined duration);
Beam off;
DAQ off.
To do this, with the beam parked at the F143VP beamstop, first turn the DAQ on with the "Begin" button on the Readout control panel on the Linux computer. As a check that the 4-quadrant scintillator and its electronics are functioning normally, verify that the scintillator count rates shown in the scaler display panel of the Linux computer are low (below 10 per sec) during this beam-off period. If the rates are high, call the Operator to summon assistance. Next, turn the beam on by retracting the F143VP beamstop from the S2 Vault page on the Windows computer, as described in Sect. V(b)(i). Irradiate your target. If you chose the preset Timer option [option (b) in the S2 Panelmate paragraph of Sect. V(b)], the F143VP beamstop will be inserted automatically at the end of the specified beam-on duration. Wait for 5 seconds and then turn the DAQ off with the "End" button on the Readout control panel. (The reason for this 5-second wait is that the travel time of the beamstop as it gets inserted is about 2 seconds; during those 2 seconds, you will notice the count rate in the scintillator quadrants dropping from a high value to the background value of under 10 per sec.) When each run is ended (DAQ is turned "off"), the run products are automatically saved on disk, as described in the third-from-last paragraph of Sect. VI.

h) During the irradiation, monitor the ratios of the counts in the four quadrants of the 4-quadrant scintillator; and if the ratios start to change significantly, inform the Operator so that the problem can be corrected. Likewise, monitor the absolute rates; and if they change appreciably, inform the Operator. Both the scaler display panel and the trendline spectra are useful for monitoring purposes.

i) Call the Operator at extension 305 to change the attenuator setting if a different level of beam intensity is desired. The attenuators cover the attenuation range from 1 to $3x10^6$, in steps of roughly factors of 3. Please take care that the count rate in each quadrant of the 4-quadrant scintillator does not exceed 10^6 particles/sec.

j) The total dose per unit area for each of the irradiations can obtained by dividing the scintillator scaler data by the known size of the beam spot at the target, measured either based on the PPAC spectrum or, better, by using the viewer images. The average flux during the irradiation can be obtained by dividing the total dose per unit area by the duration of the irradiation.

k) If you go to a different beam energy or beam species, please change the high voltages for the four quadrants of the scintillator by making the appropriate selection at the User Controls panel on the Linux computer.

l) At the end of the experiment, put the protective cover back on the 4-quadrant scintillator.

m) At the end of the experiment, transfer the data from disk to DVD, for taking to your home institution. You can bring your own DVDs or purchase them from the NSCL Computer Department during business hours. The DVDs can be burned from the LINUX computer, using the Save Data icon. We suggest that you make a second copy of the data for leaving behind with Raman Anantaraman, as access to this copy will be useful for NSCL staff attempting to answer any questions you may have at a later date about the experiment.

n) Log off your account at the Linux and Windows PC computers. Note that when you log off at the Linux computer, the scintillator and PPAC voltages are automatically turned off – this is a safety feature. (Likewise, these voltages are turned off when you log off User Controls; therefore, you should have User Controls running during the experiment.)

VIII. SAFETY ISSUES

a) Safety Training

One member of your group must be designated "Safety Representative" for the experiment. The responsibilities of the Safety Representative, as well as of the Spokesperson, are outlined at www.nscl.msu.edu/exp/safety/users. All NSCL users are required to attend a site-specific radiation safety training session, with an annual refresher session, prior to working in the experimental vaults. Please make arrangements through Raman Anantaraman for scheduling a training session for any members of your collaboration who have not yet obtained site-specific training or the refresher. Allow 30 minutes for this, most conveniently during a weekday preceding your experiment.

b) Access to secured experimental vault S2:

Anyone working in experimental vaults must be familiar with the protective CCF interlock system.

1. To gain access to the secured S2 vault:
   a. You (the experimenter) must request the Operator in Charge to insert the proper beam blocker and wall plugs.
   b. After biasing off the scintillator and PPAC voltages using the User Controls icon on the Linux computer in room 183B and after verifying from an indicator light next to the vault door that the wallplug is inserted, open the shield door to the S2 vault.
   c. Enter the S2 vault with any surveying equipment (ion chamber, geiger counter) specified by the health physicist during the dose assessment for the experiment.
   d. If you need to go to the area of the vault beyond the yellow chain, you may do so after breaking the connection between the chain and its switch, but in that case you must follow step 2.b when vacating the vault. Normally, you would have no reason to go beyond the yellow chain.
2. To vacate and secure the S2 vault:

    a. Visually inspect vault and ensure that everyone else is out of the vault before closing.
    b. If you had gone deeper into the vault than the yellow chain, press the arm-box button located on the east wall of the vault, and re-connect the yellow chain to its switch.
    c. Arm the interlock system by pressing the arm-box button located inside the vault on the south wall (adjacent to the SEETF target area).
    d. Turn off the room lights.
    e. Close the shield door. You will see the “Vault Secure” indicator light up on the small yellow wall-mounted box to your left labeled “Vault Security Status.”
    f. Inform the Operator in Charge, who will verify that the vault is secure and then retract the appropriate beamstops except for F143VP. Retraction of F143VP will allow beam to reach the SEE target and is therefore controlled by the experimenters.
3. If you are in a vault and the shield door is closed or closing:
    a. Press any arm-box button or the "Emergency Stop" button located next to the shield door.
    b. Press the fluorescent "Open Door" button next to the shield door.

c) Film badges, etc.

Each experimenter is required to wear a NSCL-supplied film badge at all times during the experiment. The badges should be collected from Raman Anantaraman upon arrival at NSCL, and must be returned to him before departure from NSCL.

Prior to each experiment, the S2 vault is surveyed for radiation level and certified to be safe for all listed beams up to the intensity levels several orders of magnitude greater than needed for typical experiments. The vault has a neutron area monitor system which is part of the radiation safety interlock system. A display of the neutron monitor reading is visible as one enters the vault. Note: Unless there is a good reason, do not disconnect the yellow chain stretched across the vault downstream of the SEE setup (see Sect. VIII(b)1.d above).

IX. STEPS FOR DOING A SEE-TYPE EXPERIMENT AT THE NSCL SEETF

a) Three months in advance of the desired run date, fill and submit on-line the Questionnaire for SEETF experiments and the Safety Review form. These two forms are available at:
groups.nscl.msu.edu/userinfo/questionnaire/see_q.php
and
groups.nscl.msu.edu/userinfo/questionnaire/safety_review.php

Note: The Questionnaire allows you to specify your requirements for beam species, beam energies, spot sizes, degrader thicknesses, etc., and allows us to set these up for your experiment. Please select your beam from the already developed set (posted at www.nscl.msu.edu/exp/propexp/beamlist). As far as possible, your experiment will be scheduled immediately before or after an experiment in our normal nuclear science program which uses the same beam. In such a case, your fee will not include a charge for the time taken for the development of the primary beam. If this is not possible, you will be charged for the primary beam development, which requires approximately 14 hrs. (Changes in the energy of an already-running beam by passing it through a degrader will not involve a charge for the development of the starting beam.)

b) If the beam time request is approved, a document called “NSCL Guidelines for Facility Use by Extramural Users” will be sent to you for your acceptance. Among other things, this document specifies the fee for the use of the Coupled Cyclotrons and associated facilities.

c) Prepare your targets for mounting on the positioning system. The target mounting fixture is designed for a 10"x10" circuit board with three 6-32 threaded holes for attaching to the positioning system and one 0.25" diameter locating pin to insure reproducible positioning. Specifications for such a board are shown in Fig. 3. Other board configurations can be accommodated using adapters; please specify this in your Questionnaire.

d) If you need any programs installed on NSCL computers used for your experiment, please specify this in your Questionnaire.

e) Prior to visiting NSCL for the experiment, contact Raman Anantaraman with the names and itineraries of the experimenters coming for the experiment. Requests for arranging accommodation, if desired, should also be made at this time.

f) When you arrive at NSCL, collect NSCL gate cards, NSCL parking permits, film badges for the members of your group, and computer account information for your experiment from Raman Anantaraman.

g) Report for and undergo the 30-minute NSCL radiation safety training (see Sect. VIII.a).

h) Perform your experiment.

i) Before leaving NSCL, transfer the data you have collected on disk to DVD, and (optionally) leave a copy of the same with Raman Anantaraman.

j) Give your feedback on the experiment to Raman Anantaraman, preferably before leaving NSCL.

k) Reimburse NSCL for the use of the facility when you receive the invoice.

X. CONTACTS AND OTHER USEFUL INFORMATION

a) Contacts

Before the experiment, for all issues connected with performing an experiment at NSCL, please contact Raman Anantaraman, Assistant Director for User Relations, phone: 517-333-6337, e-mail: raman@nscl.msu.edu.

While doing an experiment at NSCL, please contact the Operator in Charge for all your needs for assistance. The name and photograph of the Operator in Charge are displayed by clicking on the Accelerator Status icon on the Windows computer in Room 183B), and the role of the Operator is described in (b). You can visit or call (x 305) the Operator in the control room or page the Operator (x 143). The Operator has one of two 2-way radios with him when performing duties outside the control room (the other radio is charging). These radios can be contacted by dialing 9-2-8090, waiting for the tone, then dialing either 750019 or 750020. The Operator will contact the appropriate support staff to deal with your request. The support staff is responsible for beam delivery, measurement of beam characteristics, control software assistance, and a safe testing environment. In case of unresolved problems, you may call (x 337) or page (x 143) Raman Anantaraman.

b) Role of the Operator in Charge

The Operator in Charge has the authority and responsibility to safely and efficiently operate the Coupled Cyclotron Facility. Decisions of the Operator prevail. Users can request review of Operator decisions through the Assistant Director for User Relations.

1. The Operator routes requests from experimenters for assistance to appropriate lab personnel. Experimenters can request after-hours laboratory resources through the Operator.
2. In the event of facility equipment breakdown, the Operator performs an initial assessment and coordinates the response.
3. The Operator changes the beam attenuator settings at the request of the experimenters.
4. The Operator has the authority to take control of the beam at any time if this is required for the safe and efficient operation of the Coupled Cyclotron Facility.
5. The Operator needs to know the status of the beam at all times.
    a. The Operator releases beam to the experiment by stopping the beam on a beam blocker and informing the experimenter that beam of a specified intensity is available for the experiment on a specified beam blocker. The experimenter can then ask the Operator to remove the beam blocker.
    b. The experimenter relinquishes the beam by requesting the Operator to stop the beam and informing him/her that control of the beam has been returned to the Operator.
6. Prior to entering the experimental vault, the experimenters request that the Operator insert the proper beam blocker and wall plugs for radiation protection. After securing the vault, the wall plug gets retracted, then the beam blocker, so that the wall plug never gets exposed to beam. If experimenters anticipate spending more than 5 minutes in the vault, the beam should be relinquished so that the Operator can use the time to measure beam parameters.

7. Operators need to take control of the beam every few hours to measure and record machine parameters and to tune up the beam. While this can often be done efficiently if experimenters make the Operator aware of any time periods where the beam is not used for the experiment, the Operator in Charge must take control of the beam and tune up whenever beam losses increase significantly.
8. The Operator keeps the experimenters aware of the cyclotron status.

c) Some Useful Telephone Numbers

The main telephone number for the laboratory is 517-355-9671. A receptionist will be at this number during normal work hours in the Eastern Time Zone. Other useful numbers are:
S2 vault (west): 535 (for intra-lab calling only);
SEETF Data Station (room 183B): 517-324-8117;
Regular Data-U's (room 144): 517-324-8110;
Outside User Area: 517-324-8122.

To make telephone calls:

PROCEDURE	INSTRUCTIONS
TO CALL SOMEONE IN THE LAB	dial the last three digits of their phone number
TO PAGE SOMEONE IN THE LAB	Dial 143, announce your message, hang up phone
TO PAGE FROM OUTSIDE THE LAB	Dial 355-9672 X 143, announce message, hang up
TO DIAL AN ON-CAMPUS NUMBER	must dial 9, then 5 digit number (EXAMPLE: 9-5-9671)
TO DIAL AN OFF-CAMPUS LOCAL NUMBER	dial 8, then regular phone number (EXAMPLE: 8-655-7203)
TO DIAL AN OFF-CAMPUS LONG-DISTANCE NUMBER	dial 8, 1 or 0, area code, regular phone number (EXAMPLE: 8-1-517-655-7203) (1 for direct dial, 0 for operator assist.)
FAX:	(517) 353-5967

d) Information about NSCL; After-Hours Access

A lot of general information about NSCL is posted at www.nscl.msu.edu. Information for experimenters is posted at www.nscl.msu.edu/exp/.

To get into the NSCL building outside of normal work hours, please inform Raman Anantaraman beforehand about your arrival plans. When you arrive, go to the main (west) entrance of the building on South Shaw Lane (closest to Chemistry), and use the phone located between the outer and inner doors to call the Cyclotron Operator in Charge at extension 305; and, if he is not at that number, page him by dialing 143.

e) SEETF Spare Parts Cabinet

A locked cabinet marked “SEETF SPARE PARTS,” containing various items of spare parts for the SEETF setup, is located at the west end of the corridor outside the S2 vault. SEETF users can get the key to the cabinet from Raman Anantaraman.

APPENDIX A: SEETF FAST-ACTING VALVE OPERATING INSTRUCTIONS

D.P. Sanderson

February 7, 2008

In order to protect the gas detectors in the A1900, a fast-acting gate valve has been installed in the beamline upstream of the SEETF experimental station. The valve is at location A119GV in the Transfer Hall. If the vacuum in the SEETF chamber goes above 10 mTorr unexpectedly (such as during a failure of the foil vacuum window or PPAC), 15 milliseconds later the valve is closed.

The controller for the valve is mounted on the SEETF cart. The sensor for the valve is mounted on one of the ISO200 ports next to the vacuum window. The valve is opened, closed, and armed manually using the pushbuttons on the front of the controller.

The sensor is enabled using the PANELMATE application A1900_Vacuum.mt2 on page 6. The sensor can only be enabled if the vacuum in the SEETF apparatus is good (Setpoint 1 on the beamline Convectron gauge). The valve is enabled on the same page. It can only be enabled if the beamline gate valve just upstream of the SEETF (F152GV) is open.

Once the sensor and the valve are enabled, the “RESET” button, on the front of the controller “CONTROL” module, can be pressed, arming the fast-acting valve. In this state, if it is open and the vacuum goes bad, the valve will close in < 15 msec. If the SEETF vent valve is slowly opened, the vacuum in the convectron gauge will go bad while the fast-acting valve sensor stays good, due to the turbo between the two sensors. In this scenario, the F152GV will close first, disabling the fast-acting valve.

The valve can be manually opened and closed using the two pushbuttons on the “VALVE” module. This is independent of the firing “enable” interlocks mentioned above.

After a window rupture event, the fast-acting valve as well as the gate valves F152GV and A129GV will be closed. There will be poor vacuum in the section 8 beam line between the fast-acting valve and A129GV. In this case, the A1900 group will need to do a normal rough-down of section 8. This operation will open a roughing valve to pump this gas out. Once the beam line is roughed down, the fast-acting valve can be manually opened at the controller to connect the two parts of beam line section 8.

Note added on April 8, 2008: This moth, the controls group has implemented the use of the fast acting valve for the G-beamline. This means that there are two sensors in the vault and two cables going back to the control unit. When the cables are switched, the lab control system needs to know this so that it can interlock the sensor enable based on the vacuum in the SEETF or the experiment on the G beamline. To do this, the A1900 Vacuum Panelmate application has buttons on page 6 in the template labeled A119GV SENSOR ENAB. They are labeled "SENSOR ON SEETF" and "SENSOR ON G205 CHAMBER". It is up to the person moving the cables to make sure everything is configured correctly.

Fig. 12. Beam profile spectra measured measured at the SEETF station during the SEETF test run on February 25, 2004. The beam was ^{78}Kr at 114 MeV/nucleon, obtained by degrading a primary beam at 140 MeV/nucleon. A 2-mm diameter circular aperture was used at the A1900 target position to define the beam spot. The degree of flatness of the projections in the x and y directions is a measure of the uniformity achieved. The lower right panel is a 4-channel spectrum that histograms the total counts in each quadrant of the 4-quadrant scintillator. The fact that the 4 channels show approximately equal counts (to within a factor of 2) means that the beam was approximately (but not exactly) centered with respect to the scintillator.

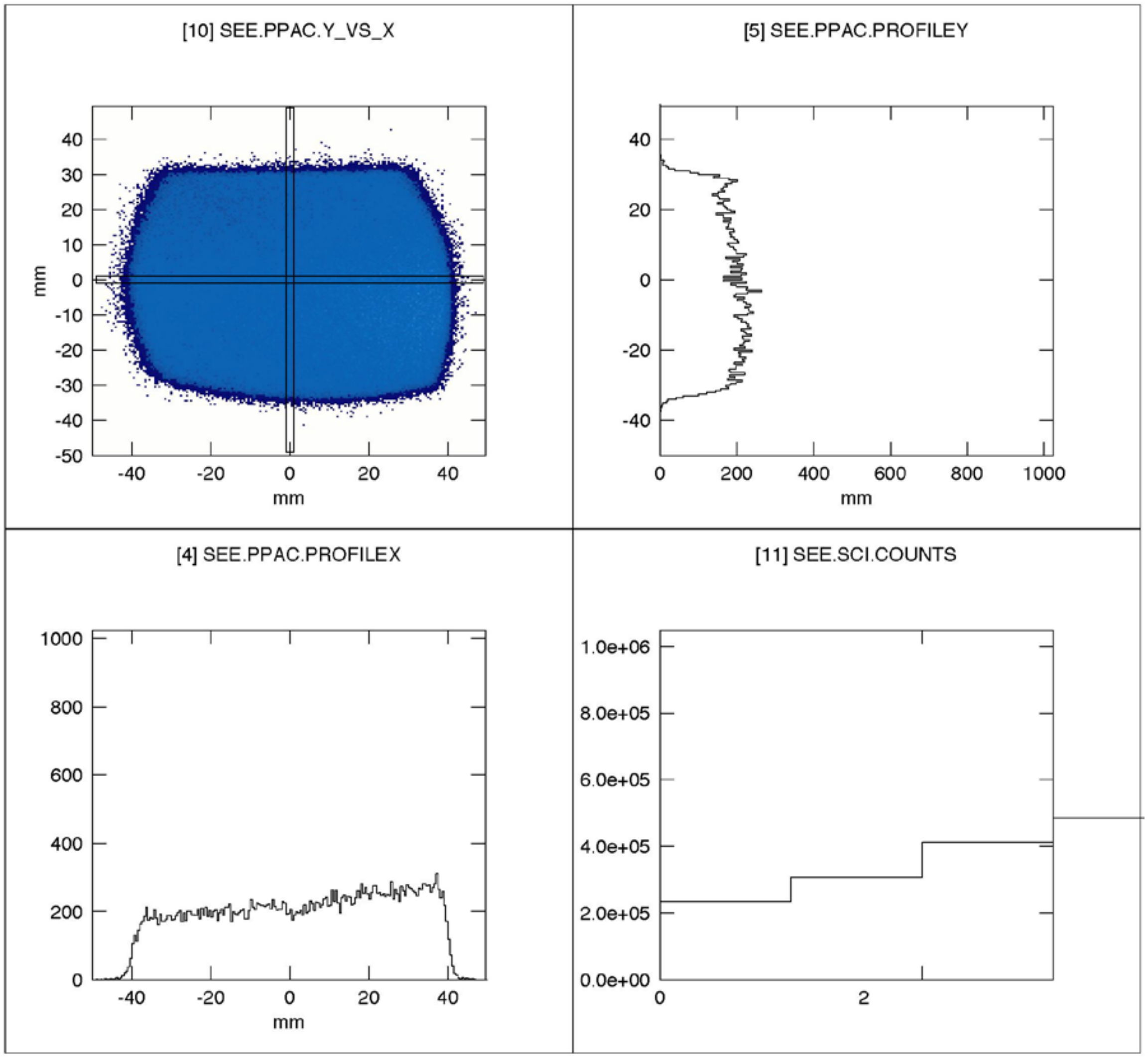


Fig. 13. Beam profile spectra measured at the SEETF station during the SEETF test run on February 25, 2004. The beam was ^{78}Kr at 114 MeV/nucleon, obtained by degrading a primary beam at 140 MeV/nucleon. The tune used a 4-mm diameter circular aperture at the A1900 target position and the largest magnification among the calculated optics files. The top and bottom edges of the beam spot are determined by the vertical gap in one of the beamline dipole magnets (either Z108DS or F133DS). The left and right edges of the beam spot are determined by the shape of the 4"-diameter beam pipe.

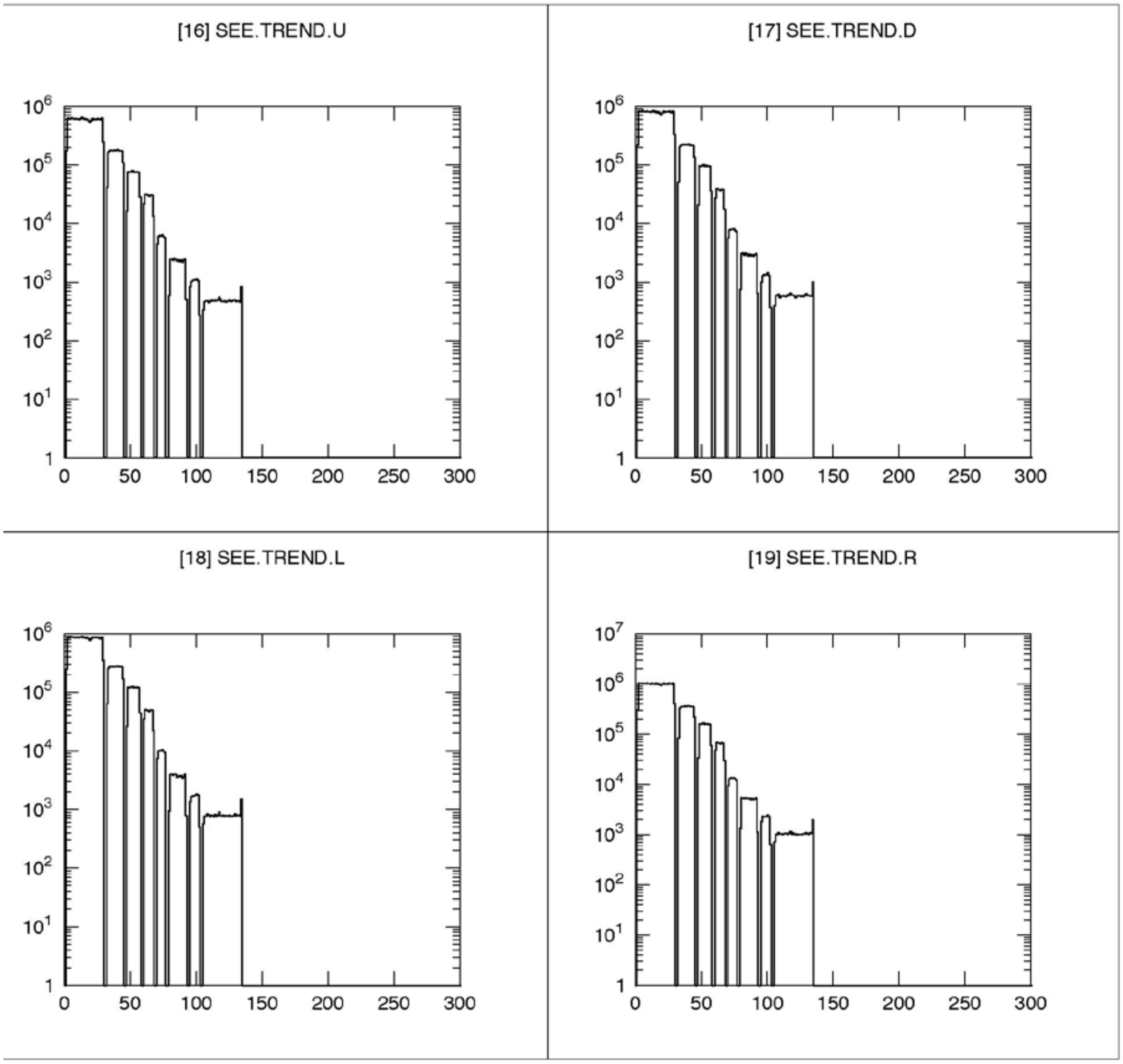


Fig. 14. Trendline spectra, showing the count rates in the four quadrants of the scintillator as a function of time. The beam was ^{78}Kr at 114 MeV/nucleon, obtained by degrading a primary beam at 140 MeV/nucleon. The steps in these spectra were produced by changing the beam attenuator value (which can be varied over a range of 1 to 3x10^6, in steps of roughly factors of 3). The flatness of the spectra in between attenuator changes is a measure of the constancy of the beam current.

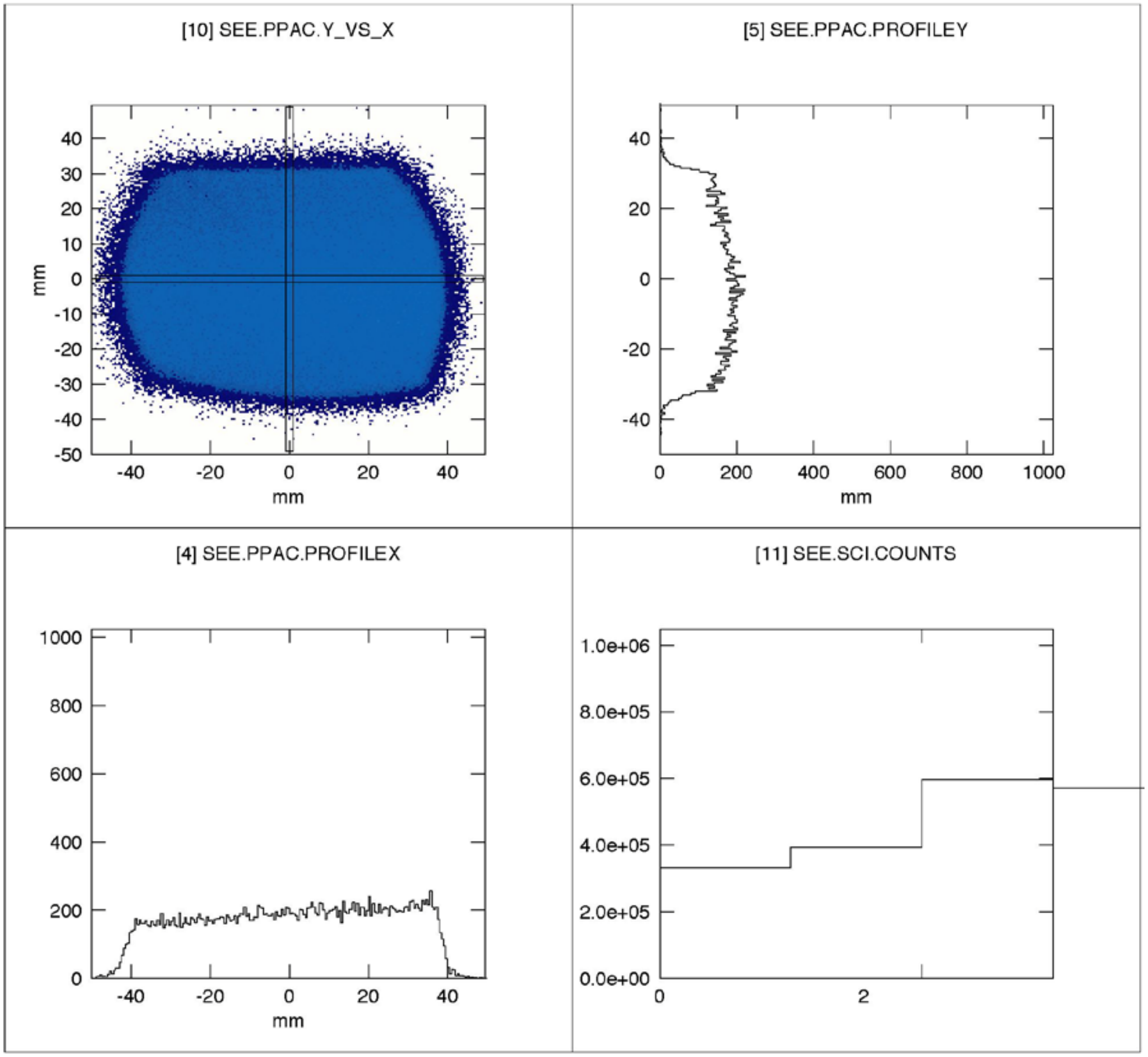


Fig. 15. Beam profile spectra measured at the SEETF station during the SEETF test run on February 25, 2004. The beam was ^{78}Kr at 123 MeV/nucleon, obtained by degrading a primary beam at 140 MeV/nucleon. The features of the spectra are similar to those observed at 114 MeV/nucleon (Fig. 13); this shows that the beam spot characteristics are reproducible for different settings of the A1900 fragment separator and beam line.

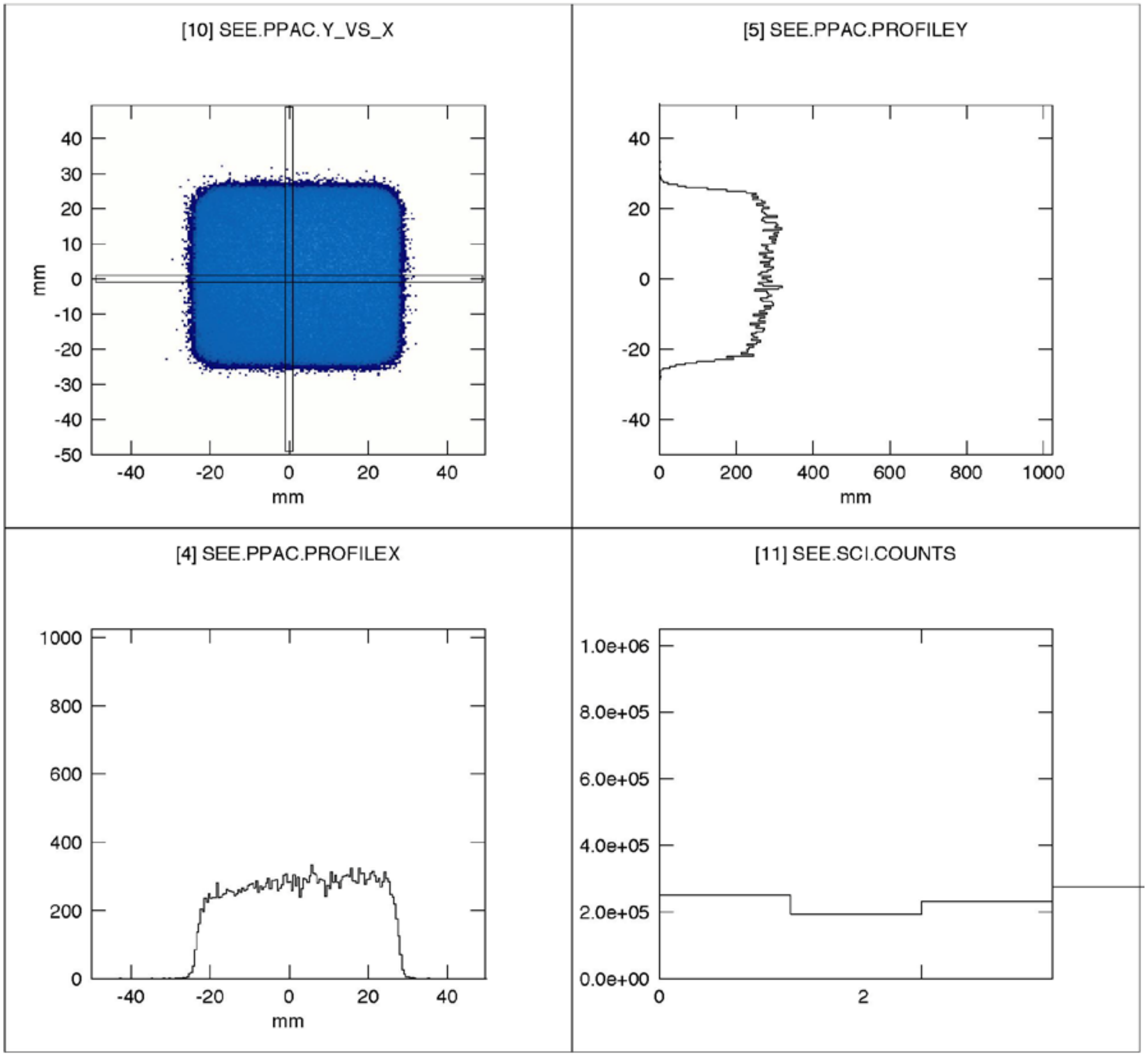


Fig. 16. Beam profile spectra measured at the SEETF station during the SEETF test run on February 25, 2004. The beam was ^{78}Kr at 64 MeV/nucleon, obtained by degrading a primary beam at 140 MeV/nucleon. The 2"x2" SEETF hevimet collimator is in place and defines the beam spot, as shown in the upper left panel.