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VISUAL APPLICATION FOR BEAM ASSOCIATED SYSTEMS OF GAS-FILLED SEPARATOR

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Цыганов Ю.С., Поляков А.Н., Сухов А.М. E10-99-36
Визуальное приложение для систем диагностики пучка
газонаполненного сепаратора

Описывается программа для работы с системами диагностики пучка на дубненском газонаполненном сепараторе. Программа написана на языке C++ (Borland Builder v 3.0) и используется для работы на пучке тяжелых ионов циклотрона У-400 в Лаборатории ядерных реакций.

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Tsyganov Yu.S., Polyakov A.N., Sukhov A.M. E10-99-36
Visual Application for Beam Associated Systems
of Gas-Filled Separator

PC based code for Windows 98 operating together with the beam associated systems of the Dubna Gas-filled Recoil Separator is described. It is coded in C++ (Borland Builder v. 3.0). This code was tested in heavy ion-induced nuclear reactions at U-400 main FLNR cyclotron.

The investigation has been performed at the Flerov Laboratory of Nuclear Reactions, JINR.

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1. Introduction

The Dubna Gas-filled Recoil Separator (GFRS) [1], operated at the U400 cyclotron at Flerov Laboratory of Nuclear Reactions, is among the most efficient systems for separation of heavy evaporation residues (EVRs). The separation of reaction products traversing dilute gas media results from differences in their average equilibrium charge and corresponding magnetic rigidity. The identification of EVRs implanted in a position sensitive semiconductor detector is accomplished by detecting a sequence of genetically correlated alpha particles and/or fission fragments if fission terminates the decay chain. In [2] the PC-based monitoring system of GFRS has been described. This system is employed, at most, for acquisition of spectroscopy information obtained from the detecting module of GFRS [3,4]. Since experiments aimed at synthesizing heavy elements are quite lengthy, measurement and visualization of non-spectroscopy parameters from data acquisition system, as well as from beam associated systems, is desirable. The paper presents a computer code created to reach this aim, in addition to the one reported in [2].

2. Program description

The application is coded in C++ Builder v.3.0 under Windows98. For graphic spectra presentation **TeeChar** component is used. Application contains three forms, namely: a main form with main menus, a form for control of radioactive target state and a form to visualize the basic experimental parameters numerically (via virtual device). Information from CAMAC electronics (one crate) is available through CC-012 crate controller [5] and program units for these modules are written as separate **Thread** objects. The time-period of non-spectral information refreshment is defined by the property **Interval** of **Timer** object. The observed parameters are:

cyclotron beam energy measured with silicon surface-barrier detector and with TOF Pick-Up detectors [6];

beam shape as given by rotating wire scanner system, 39 points per 60 mm, in two projections, beam current measured at the separator entrance and downstream the target, and integral beam doze;

alpha-particle spectrum and counting rate as measured with silicon detector in the target control module;

total event counting rate,

pentane vapor pressure in the working volume of the detecting module and hydrogen pressure in the separator volume,

indication of electronic noise from focal and back detectors arrays, temperature in the vicinity of the detecting module, temperature in the spectrometer room, and some extra parameters.

The above information is simultaneously recorded in text mode to the protocol file in 5-minute intervals. One position in protocol line is available via Ethernet to a separate control system in 1-bit form. Bit state indicates alarm/no alarm status for operating the systems related with the separator itself.

The main application form is composed of main menus at the top, three graphic windows for energy or TOF spectrum in the center, and two smaller windows in the right-hand part for beam scanner spectra (X,Y[1]).

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[1] The X,Y axes are tilted by 45 deg with respect to actual horizontal and vertical directions

Each window provides an opportunity to change its ***Align*** property to ***alClient*** and back. A form for target control contains its own submenus. User chooses parameters of interest in virtual multimeter form by pressing appropriate buttons. (***onMouseClick*** at the button position).

The main application menu contains 10 positions (see Fig.1). These are:

1. *Spectrum* – group of items for spectra processing
2. *Scanner* – commands for beam scanner, involving test procedures
3. *TOF(U400)* – activates TOF spectrum measured with Pick-Up electrodes
4. *Params* – contains submenu items:
    - *a)* Multimeter – form is open
    - *b)* Reset all alarms – after activation no parameters are under active control, no sound alarm will be given if any value is out of preset range, except for pentane pressure in the proportional chamber and hydrogen pressure in separator volume
    - *c)* To set all alarms – setting all values under control
    - *d)* To set E (meas) – setting the desired value of beam energy to be measured with silicon detector
    - *e)* Contr. Panel++ – opens a panel with additional information (next press- close)
5. Help – help information on application
6. File – write/read spectral files (binary/text)
7. Timer – to set time interval for refreshing spectra or disable this action

8. Target – opening form with spectrum from target control detector
9. Screen – setting screen options (with/without color gradients, **Buffered Display** property equals to **true** or **false**).

   Note that in case an error is detected when protocol line is written the **End gradient Color** property will be changed, and a sound multimedia file will be started in a short time
10. PA-01K – CAMAC test routine for ADC is activated

In addition to the main menu items, some buttons and radio-buttons appear at the bottom panel of the main form. Pressing "*green*" button activates CAMAC associated threads, while activating the scanner-related part of code needs pressing the black-pointed button. Pressing the radio-button *Faraday* activates control of the separator Faraday cup. Alarm sound is generated if beam current value goes out of preset limits. Digits 2,3,4,5 in the panel – give powers of 10 as maximum Y-scale value for given spectrum, whereas L+ means turning on/off logarithmic scaling.

Pressing a button with "?" symbol switches to a more compact presentation of main values at the top of the application in the form of ***HeaderControl*** (11 items).

Application provides simultaneous data visualization at the cyclotron control room. A command panel switching this remote visualization is opened by pressing a button with monitor image. For this purpose, a similar application is booted at the computer of cyclotron control room. The following commands are user-available from this remote computer:

- *No vision* – application at U400 control room will be not visible
- *Visible* – reverse action (in about 2 sec)

- *Scaling* – scaling of spectra at remote computer will follow that at the main one, otherwise cyclotron operator should make the choice manually, by pressing mouse button at the position of the main menus of his computer. After switching Scaling option at the main computer, any attempt to provide rescaling from the remote one will be ignored.
- *Panel On* – some parameters of the experiment available for cyclotron staff
- *Panel Off* – the above panel will be not visible at conin U400 room
- *Scn. Only* - scanner window align will be ***alClient*** at cyclotron control room
- *Not only* – all three windows are available at the cyclotron room
- *Terminate* – terminates application at cyclotron room; after this operation it necessary to press any other listed button to deactivate termination demand for operating it further.

Information on command execution is given in a label at the left of bottom panel.

The button with zoom symbol generates the same action as the main menu item related to target control. Pressing <*measured*> button provides choice in presenting the cyclotron energy as measured with silicon detector or corrected by pulse-height defect, scattering angle, energy loss for a given projectile, etc.

3. Examples

The possibilities of the described system were demonstrated in the experiments with ^{48}Ca beam at the intensities up to $4\cdot10^{12}$ pps. These experiments were performed in 1998 and were aimed to the synthesis of heavy elements. Continuous control of both beam intensity, beam shape and position at the entrance of the separator is of great importance. Fig.2 shows the calibration dependence of the scanner output on the beam current measured with corresponding Faraday cup and Fig.3 - the typical geometric characteristics of the beam. The dependence $Y=-0.29025 + 6.07416e-4\,X - 1.05369\,e-9\,X^2$ has been used to obtain beam intensity value (Fig.1). Under real conditions, due to device noises of up to +/- 0.2 μA in output equivalent, it is preferable to use this dependence for beam current more than 1μA. Note the effective beam size (i.e. $<r>=(fwhmX\ fwhmY)^{1/2}$) of about 5 mm in Fig.3. Fig.4 presents the values related to the detecting module performance: time dependences of pentane pressure in the time-of-flight module, temperature and equivalent noise for focal-plane Canberra PIPS detectors. The time of pressure correction is shown by an arrow. Note, that we had good long-term stability of the pentane pressure without any feed-back.

4. Summary

A PC-based supplement to the main monitoring system of the Dubna gas-filled recoil separator has been designed and tested in the long-term experiments on U400 cyclotron beam. It provides beam profile, beam current, beam position, beam energy and energy spread measurements. This system provided not only the measurement itself, but also simplified the cyclotron tuning during the long-term experiments.

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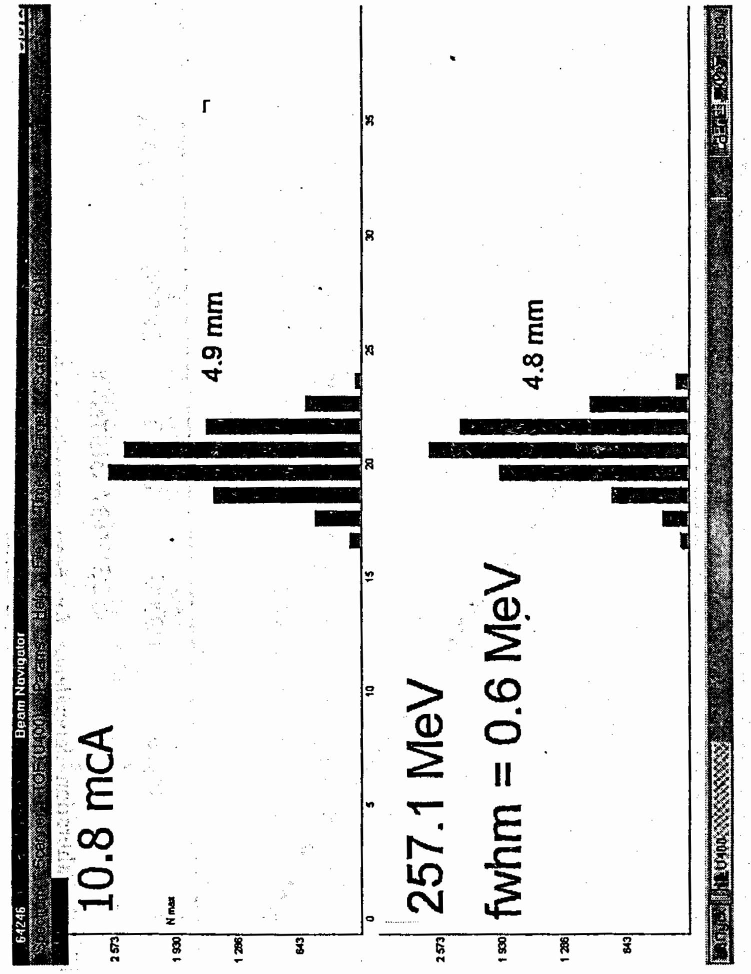

Fig. 1. Beam shapes (X,Y) from scanner and main menus(top).
(The values of heavy ions energy and fwhm are measured with TOF Pick-Up detectors[6])

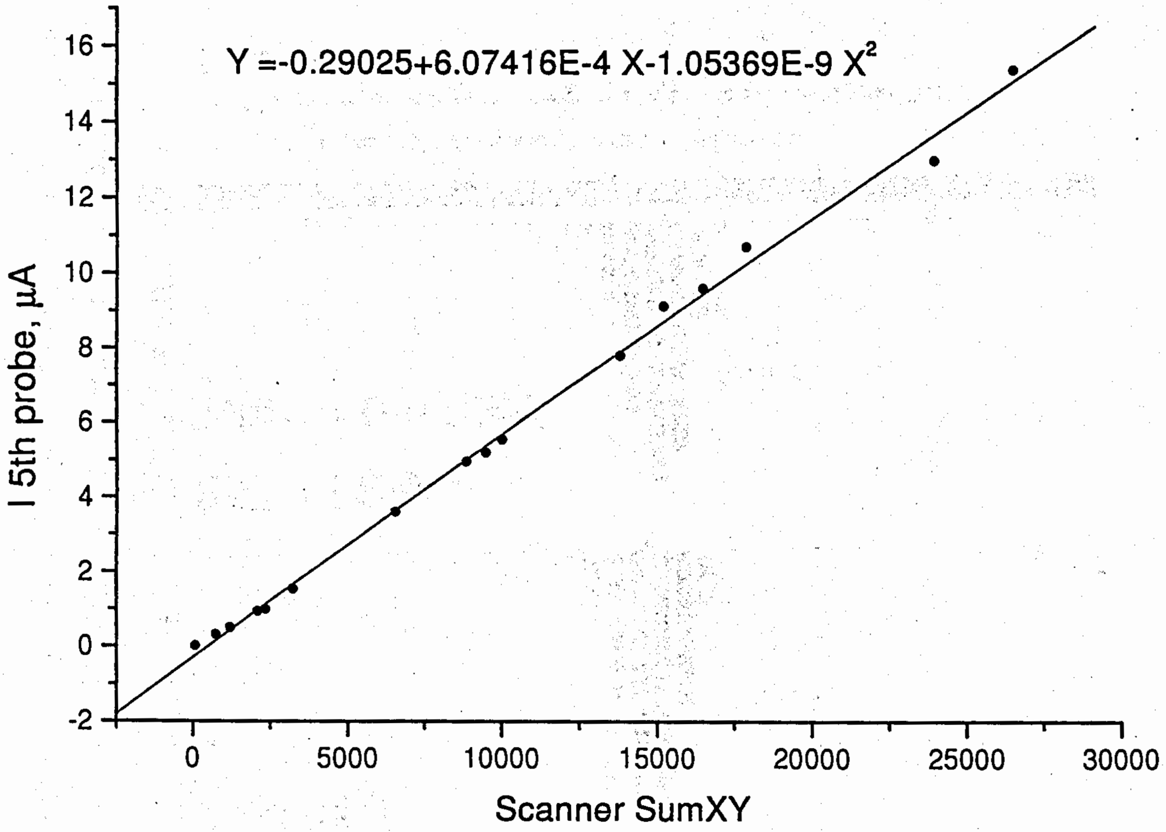

Fig. 2. Calibration dependence for beam intensity against the rotating wire scanner measured output parameter

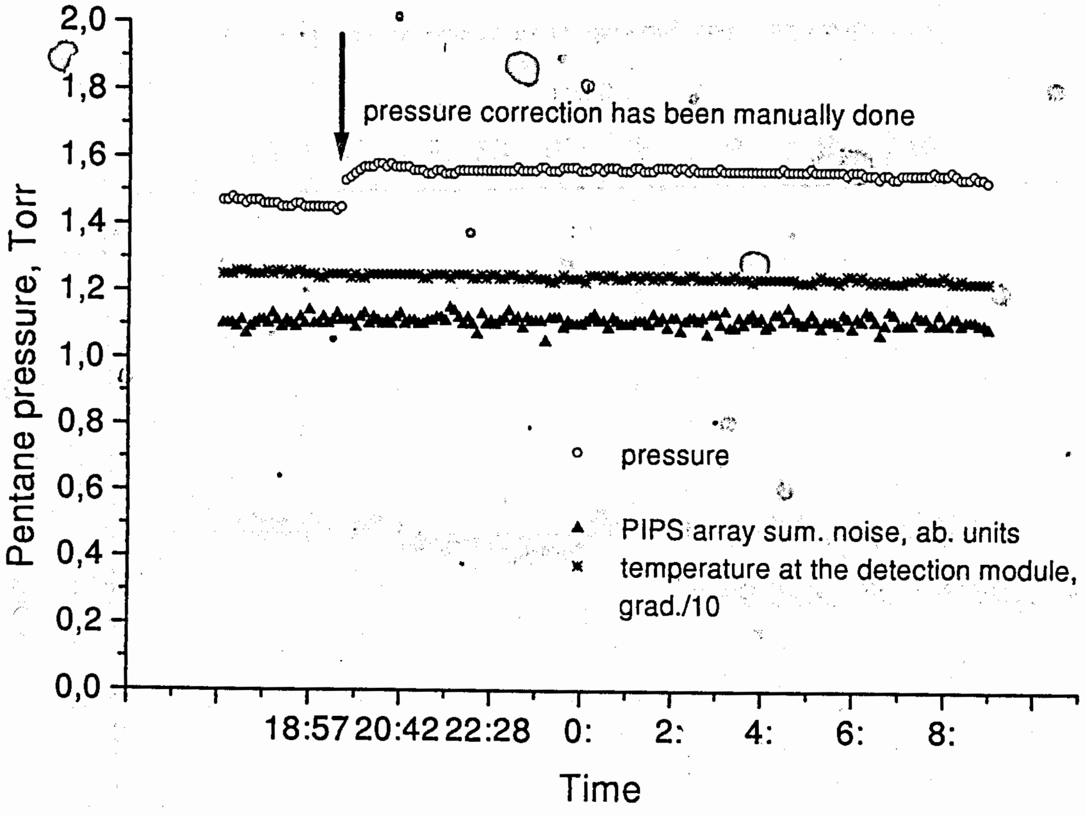

Fig. 3. Geometrical performances of the beam

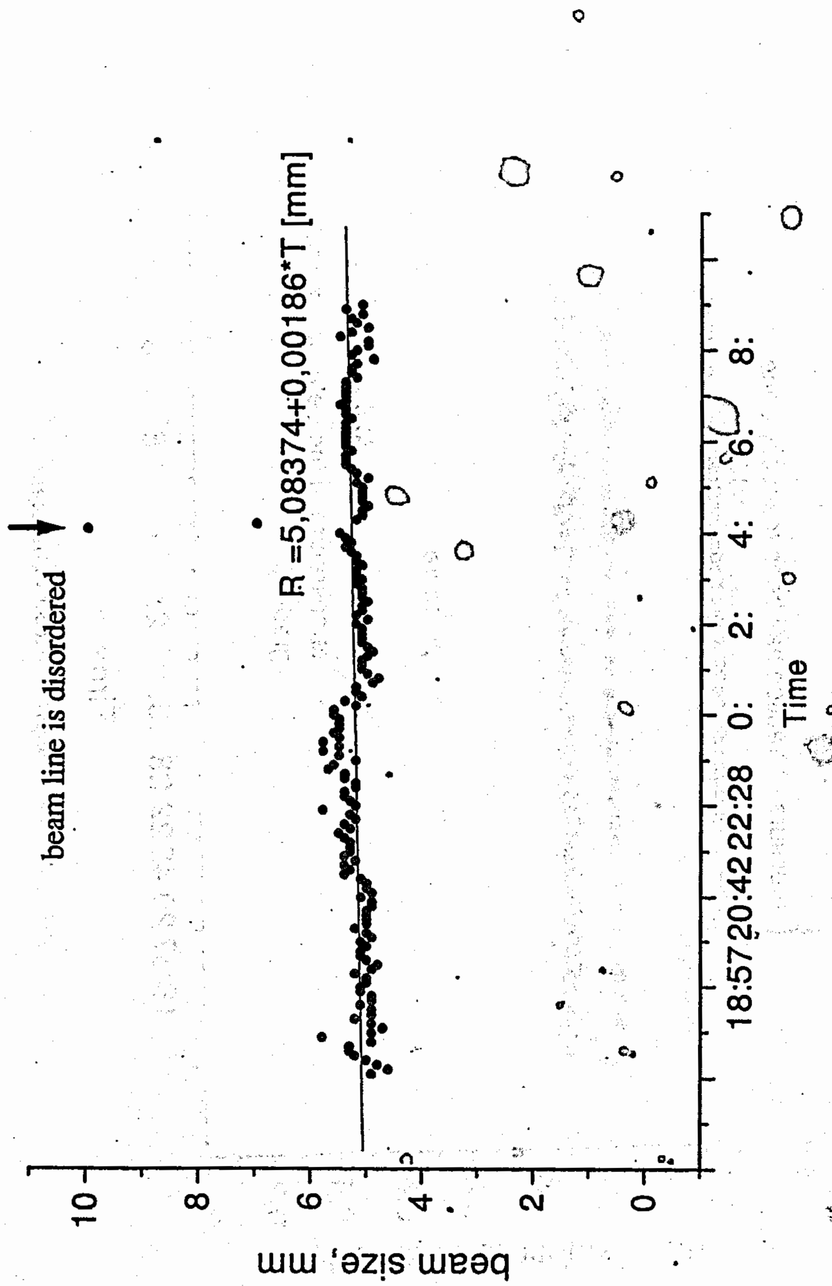

Fig. 4. Time dependencies for the detecting module associated values

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