THE GANIL CONTROL SYSTEM AS SEEN FROM THE CONTROL ROOM

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Abstract.- In a first part, the control system hardware is described. It is explained how microprocessors
are used to perform local tasks and how they are seen from the operator. The nature of signals sent to the
control room is discussed, as well as the reason why they are sent.In a second part, the consoles design
philosophy is given. It is explained how the operator can use these consoles either at an elementary level
or at a more sophisticated one.

1. Introduction.- Since the beginning of the GANIL project, it was decided that the accelerator would be fully computer controlled. The reason for that choice stems from the fact that GANIL is a variable energy machine designed to accelerate a wide range of ions. Changing the energy requires to modify a large number of parameters ;this cannot be easily achieved without the help of a computer.

The purpose of this paper is to explain how the operator will interact with the accelerator via consoles in the control room or elsewhere.

Traditional control rooms are equipped with a large number of meters and knobs (one per equipment to be controlled). Using a computer allows to replace those dedicated meters and knobs by a very small amount of general purpose displays and knobs that can be assigned to any equipment the operator wishes to control. In this elementary level of operation one knob interacts with a single equipment, the computer behaving as a large multiplexer. At a higher level of operation the operator can run dedicated programs especially written for global procedures.

The way of using the consoles has been chosen as simple as possible. Most of the time the operator has just to show what he wants by pressing either a classical knob or a touch panel. It means that there is no keyboard in the consoles, except very small ones for entering numerical values. When possible the parameters the programs need are entered as YES or NO anwers to questions like : "do you want this or not?"

Informations on the accelerator behaviour available to the computer fall in one of the two classes : alarms and warnings, or general informations. Alarms and warnings interrupt the computer ; each of them results in editing a message on a color screen and a line on a printer ; a bell is rung to draw attention. Such an alarm is generally a consequence of a security action taken by a local automat to prevent equipment damages. General informations are displayed only if the operator asks for them, and only the ones which have been asked for. Usually the operator will require informations either when tuning the accelerator or after an alarm message has been displayed. Doing it this way, the operator is not drawn in a flow of informations only a few percent of which are relevant to him.

2. The Control system hardware.- An overall view of the computer control system for the GANIL has been described elsewhere ([2]).

2.1. Brief description

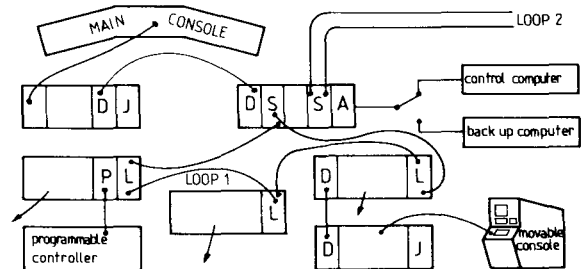The schematic layout is shown in Figure 1.

Fig. 1 : A: Type A crate controller
L: Type L crate controller
J: Autonomous controller (JCAM 10)
S: Serial Driver
D: Data link between CAMAC systems
P: Data link with programmable controller
Arrows : links to the accelerator

The control system has been essentially designed around 3 kinds of processors : computers, microprocessors and programmable controllers. CAMAC is the digital transmission system used to interface the processors to the GANIL facilities.

The control computer is a MITRA 125 equipped with 128K 16 bits words of memory, 2 disks of 5 Mbytes, a line printer and a parallel CAMAC coupler. In case of breakdown, the activities of the control computer will be taken over by an other MITRA 125 which is more powerfully sized with 192 Kwords of memory and equipped with 4 disks of 5 Mbytes,2 magnetic tapes, a line printer and CAMAC parallel couplers. This back up computer is normally devoted to on-line measurements, batch jobs and software developments. The control computer drives a parallel CAMAC branch handling- two serial CAMAC loops operating in bit serial mode at 2.5 MHz frequency and the main operator console.

Four movable consoles that can be plugged on the serial loops allow the operator to be on line with the computer at the place of the equipment for local information flow checkings and diagnostics.

Every console unit linked to the control system is under the command of an autonomous crate controller named JCAM 10.

2.2. The console JCAM 10

A careful analysis of the console operations has poin-
ted out that the most part of its tasks need not to be
performed by the control computer itself.

Therefore, introducing some local intelligence to run
these tasks and consequently to save the main computer
time is an interesting and beneficial way to control
the console unit. So was it decided through the JCAM10.

Every JCAM 10 is equipped with an INTEL 8080 micropro-
cessor and is linked to the control computer via spe-
cial data links which have been made to fulfil our de-
sign specifications. The dialogue between the MITRA 125
and the JCAM 10 is message oriented.

The leading parts of a console JCAM 10 are :
1) to interpret the operator request.
As a simple request generally results from several
actions by the operator, it is the duty of the JCAM 10
to check that all these actions are pertinent, parti-
cularly with regard to any misuse of the console faci-
lities. The JCAM 10 will interrupt the control compu-
ter only when the operator request is fully stated in
the correct manner.

2) to display informations enclosed in messages sent
by the control computer. These informations come as
crude display lists. The JCAM 10 has to transform the-
se lists into sequences of CAMAC orders sent to the
CAMAC display drivers.

Let us give some examples of the console JCAM 10
activities.

✱ Hooking an equipment. Everytime the operator presses
the touch panel selector the JCAM 10 is in action to
turn the corresponding page of the operational names
tree. (Equipments are known by the operator through
their operational names).
Once the operator has pin pointed on the touch panel
the equipment he wants to hook - a leaf of the opera-
tional names tree - and designated the associated
shaft encoder, the JCAM 10 will interrupt the control
computer for a hook request message.
According to the answer of the MITRA 125 the hook re-
quest is accepted or refused. This answer is interpre-
ted by the JCAM 10 which displays corresponding messa-
ges on the TV Screen area assigned to the shaft enco-
der knob (Figure 3).
In case of successful hook attempt, the JCAM 10 will
store, in particular, useful informations for updating
operation.

✱ Watching the on-line shaft encoders. Periodically -
say every 300 ms - the console JCAM 10 looks at the
hooked shaft encoders to check wether they have been
turned or not in the mean time. The JCAM 10 sends if
any the incremental values to the control computer.
The MITRA 125 will return to the JCAM 10 the new re-
quested absolute values or an error code in case of ina-
dequate request (MIN/MAX values reached, or something
else). This error code is translated into error messa-
ge and properly displayed by the JCAM 10.

2.3. Analog signals

Among the numerous signals collected along the accele-
rator, most of them concerning parameters values or
status are digitalized and enter the data flow trans-
mitted by the CAMAC system for processing.
Many signals remain which are to be used in their ana-
log form. This is the case of most beam diagnostics
signals and more generally everytime that waveform
observation is necessary.
A signal observation system (SOS) has been built on
CERN specifications to enable analog waveform to be
observed in the control room.

Up to 200 signals at frequency < 1 MHz can be taken
into account.
These signals can be displayed on autoranged galvanome-
ters or on oscilloscopes.
This system is quite suitable for beam diagnostics de-
vices such as wire chambers. The very high frequency
analog signals (~ 1 GHz) for phase extension diagnos-
tics can also be observed, after a sampling process,
with the SOS.
RF cavity signals are transmitted via a specific system
to the control room and pass through an autonomous mul-
tiplexer before being displayed on a 100 MHz oscillos-
cope screen for observation.

3. The Console system.

3.1. Description.

As said in the introduction, the normal way to control
the GANIL facility is to interact with the control sys-
tem via consoles.
There are - the main console located in the control
room and directly linked to the parallel CAMAC branch-
and four movable consoles which can be connected on the
serial loops for local operations (Figure 1).
The main console, mechanically built with 11 benches,
is divided into 3 operating console units I, II and III
(Figure 2).

Fig. 2 :
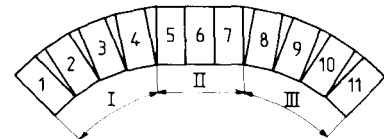
The central console unit II is devoted to equipments
not linked to the computer such as source and RF equip-
ments. Console units I and III are identical.
From a logical point of view, console unit I or III
(Figure 3) is divided into 4 areas α, β, γ, δ :
- Area α and δ are logically identical.
  Area α is exactly the image of a movable console.
- Area β is related to analog signals.
- Area γ is devoted to synoptic diagrams display.
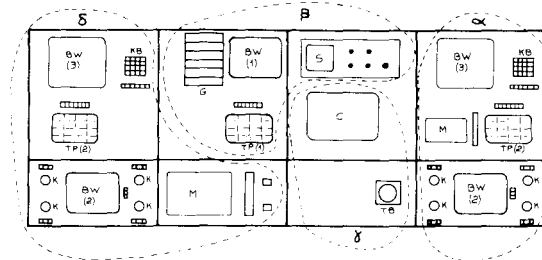

Fig. 3 : BW : Black and white TV Monitor
KB : Keyboard   G : Autoranged Galvanometer
M : Memoscope   K : Shaft encoder Knob
S : Scope   TB : Track ball
C: Color TV Monitor for synoptic diagrams display
TP: Touch panel selector

3.2. Console operating levels.

Controlling the GANIL process with the console system
can be exercised at the elementary level or at a higher
level.

3.2.1. Elementary level operations.

At the elementary level the control system behaves as a
multiplexer. Equipments designated by their operational
names are handled one by one.
The operator uses the touch panel and turns the pages
of the operational names tree to choose the one corres-
ponding to the equipment he wants to control. Then he
can hook a free shaft encoder knob (one of the four lo-
cated at the lowest part of the console unit and asso-

ciated with a TV monitor screen) to the selected equip-
ment by pressing the hook button. If the hook request
is accepted by the control computer, the hook button
will light up and the operator can read on the TV
Screen area assigned to the knob various informations
such as the controlled value of the parameter, its ac-
tual value and a status word. All these informations
are updated every 300 ms. If the equipment to be con-
trolled is already reserved by an other console unit
or by a task, the hook request is refused and a warning
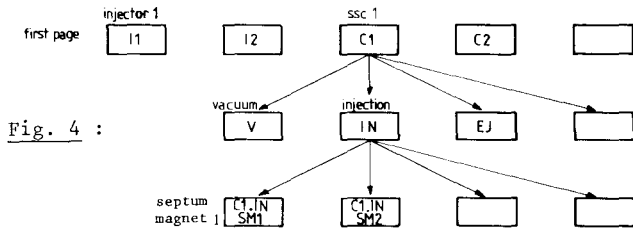message is written on the screen.

Fig. 4 :

. unhook operation is achieved by pressing the corres-
ponding unhook button : the associated screen area is
erased and the hook button goes out.

. Status control actions can be performed with a hook-
ed equipment. There are ON-OFF and RESET. ON and OFF
orders are for instance relevant to power supplies or
vacuum valves whereas RESET is quite suitable to power
supplies. These status control actions are carried out
with very simple specific press-button protocoles.
The Area β of the console unit is assigned to analog
signals to be displayed on galvanometers or oscillos-
cope. The wanted analog signal is obtained by turning
the pages of an analog signal tree with the touch pa-
nel selector. The operator hooks the signal to a galva-
nometer by pressing the associated button which lights
up in case of successful hook attempt.
The same button is used to clear the galvanometer.
Galvanometers can be used in auto-range mode. A TV mo-
nitor BW(1) gives informations concerning the analog
signals appearing on the galvanometers and on the sco-
pes : analog signals names, scales, etc,.....

3.2.2. High level operations.
Full benefit of the Control System can only be taken
with high level operations.
While playing with a touch panel selector of area α or
area δ, the operator has access to the tasks tree and
turns pages to reach the individual task he intends to
run.
Each task has to reserve an area on the TV monitorBW(3)
screen for messages and data display. The operator can
only accept or modify values given by the task. He ans-
wers by enabling the cursor, moving it within the
screen area reserved for the task. Then he modifies,
if necessary, the displayed values with the small nume-
ric keyboard and sends them to the computer. These ope-
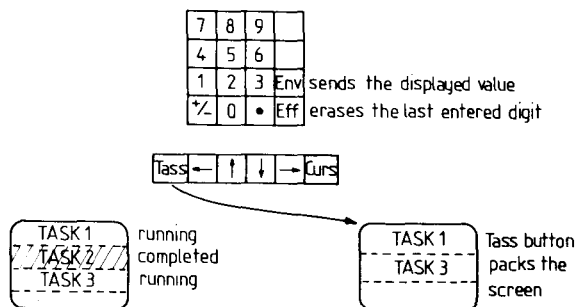rations are illustrated on Figure 5.

Fig. 5 :

It is possible for tasks to reserve one or several
shaft encoders to drive equipments.
When a specific message appears on the TV monitor
BW(2) inviting him to designate a shaft, the operator
presses a free hook button to hook the corresponding
shaft. In that case, unhook can be achieved only by
programmed unhook request or by task's end.
Tasks can also write alphanumeric messages or draw
graphical lines on the memoscope screen.

3.3. On-line synoptic diagrams.

The area γ of the console unit I or III is used to
display synoptic diagrams of subsets of the accelera-
tor. This area comprises a trackball and a color TV
monitor. Color is a leading feature for such an appli-
cation. The shape of the drawing gives the status of
an equipment (ON/OFF, OPENED/CLOSED) while its coded
color indicates if this situation is to be considered
as normal or not. The actual values of different para-
meters can also be read on the synoptic diagram (fre-
quency, intensity, pressure, etc....). All variable
informations, such as status and parameters values,
are updated every 600 milliseconds.
Synoptic diagrams are organized into a tree structure,
so that all synoptic diagrams stem from the general
layout of the GANIL one. The operator uses the track-
ball to choose among a list located on the right of
the displayed synoptic diagram the name of the next
diagram he would like to observe and so forth, down to
the most elementary subset diagram.

3.4. The alarm screen.

A color TV monitor located in the middle of the main
console, i.e., belonging to the console unit II, is
used for alarm messages display.
There are several kinds of alarms ; to each of them
corresponds a color code. For instance, CAMAC alarms
are edited in red upon a yellow background. A buzzer
vibrates to call attention everytime a new alarm mes-
sage appears on the screen.

4. The Present situation. – The GANIL operating soft-
ware called GANICIEL which is written in LTR – a high
level real time language – is almost completed. Pieces
of it are already tested or running.The JCAM 10 soft-
ware written in assembly language is presently under
test.
The main console is installed and partially equipped.
Our major effort is dedicated to the movable consoles
equipment since they are more adequate to fulfil the
users' requirements during the GANIL construction and
tests time. So a movable console assigned to the in-
jector cyclotron control is already completed and the
results of the first operations at the elementary le-
vel as well as at the higher level (running a user's
task to check the beam position) are quite encouraging.

References.

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2. M. PROME "The GANIL Control System"
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