A SYSTEM FOR ON-LINE CONTROL OF
BUBBLE CHAMBER MEASUREMENTS

G. Blomqvist, S.O. Holmgren,
P.O. Hult and U. Svedin

Institute of Physics,
University of Stockholm,
Stockholm, Sweden.

ABSTRACT

A hardware system that connects a measuring device for bubble
chamber pictures, "Enetra", on-line to a CDC 8090 computer has been con-
structed by the Stockholm group. The software is under development.
The measurements will be performed using a measurement list. Auxiliary
data such as event type and ionization will be entered through a set of
thumbwheel-switches, and demands will be given by the operator through
push-buttons each with a specific function. The operator will be guided
in the measurements by a label display and a set of message lamps. No
typewriter is necessary in the system. The data from the measurements
will be stored on magnetic tape. The on-line system will be used as a
complement to a future Spiral Reader System.

1. SYSTEM CONFIGURATION

The device constructed for on-line measurement of bubble chamber
film is shown in Fig. 1. Components of the CDC 8090 computer system used
are also indicated. Figure 2 shows details of the operator control
system.

In the on-line system, the typewriter of the off-line system has
been replaced by a set of thumbwheel switches, the Databox, and a number
of "Demand" push-buttons. The computer communicates with the operator
via the Label display and the signal lights (the OK, Wait, and Error
signals), which are placed in front of him, and via the specific messages
(Fig. 2).

The counting equipment of the measuring device and the operator's
console are connected via the interface to the 8090 system.
2. MEASUREMENT ON THE ON-LINE SYSTEM

Measurements on the new device will proceed as follows:

To start the measurement of a new event, the operator must load the Databox with information on the event from a measurement list (placed just below the Databox).

The operator initiates the measurement by pushing the **New Event** button. The wait signal (yellow lamp) is immediately turned on. This informs the operator that measurements may not proceed until this signal has been turned off.

If everything is in order, the operator receives the **label** of the first measurement to be made together with an OK signal (green lamp). The wait signal is turned off. It is possible, on the basis of the event type specified in the Databox, to provide the operator successively with labels, at least for those events with standard topologies.

On receiving a positive message, the operator positions the point to be measured on the Enetra's cross-hair, presses the coordinate pedal and waits for the next message. From the operator's point of view this usually arrives almost immediately. If everything is still in order, the operator receives a new positive signal together with a new label (if appropriate), and so on.

If measurement data for some reason should not be accepted -- for example, when an error has occurred in the counting equipment or as a result of an illegal operator action -- the operator receives an error signal (red lamp), which informs him that something is wrong, together with a specific error message informing him of the type of failure and the necessary action to be taken, e.g. "coordinate error, reset counters, and remeasure the view".

When the operator deems the measurements of a track to be complete, he presses the **End-of-Track** button. This command causes the data for the particular track to be examined.

In a similar way, the End-of-View button is pressed when the operator has completed measurement of a view, and the data from the whole view is then checked.
Should the operator find it impossible to measure some particular view, the Unmeasurable button may be used. In this case, the label for the next object to be measured is displayed.

When the topology of an event to be measured has not been anticipated by the event type, e.g. an associated secondary interaction, the label may be changed manually with the aid of the New Label button and the Step controls (Fig. 2). Using these controls, the two characters of the label may be changed to any desired combination of letters and digits. Any such changes are registered by the computer.

By making use of the four Erase buttons, the operator can delete measurements which have already been stored in the computer. These buttons delete last event, last view, last label, or last point, respectively.

When measurement of a complete event has been finished and accepted, the measurement data, which is temporarily stored in the computer, is transmitted to a magnetic tape which is used as input to the bigger computer (CDC 3600) where the events will be reconstructed geometrically by the program THRESH.

3. COMPARISON OF THE ON-LINE AND OFF-LINE SYSTEMS

The system constructed has several advantages over the off-line system. Simplicity has been a primary goal.

a) The typewriter used earlier is replaced by a Databox and Interrupt buttons. A typewriter is often considered more flexible, but here it was found that this greater flexibility was not necessary. The new system is simpler with respect to both the necessary electronics and the operator interface. Most of the information in the Databox is not changed from event to event, and much time spent in typing is saved. In addition, the Databox, being built of thumbwheel-switches, reduces the risk of the operator loading erroneous information.

b) Signals from the control logic of the counting equipment are transmitted to the interface and then on to the computer. The operator is given a message immediately if some error occurs.
c) On completion of each track or view, the data is checked, and the operator is informed whether the measurement was in order, whether it has to be completed, or whether some error has occurred.

d) The on-line system will be particularly useful for "operator training", and many systematic errors that otherwise occur frequently can be detected and corrected almost immediately.

e) Because of the greater reliability of the measurements, expensive computer time otherwise used for reconstruction of erroneous events will be saved.

f) As the measurement data are stored directly on magnetic tape, the conversion from paper tape to magnetic tape is eliminated.

g) Based on the experience of other groups, it seems reasonable to expect that the on-line system will increase the measurement speed by a factor of two.
Fig. 1

The On-line system and its connection to the 8090 system
1. "Enable"
2. "Erase last event"
3. "Erase last view"
4. "Erase last label"
5. "Erase last coordinate"
6. "Not measurable"
7. "New label"
8. "Change of label, left character"
9. "Change of label, right character"
10. "End of view"
11. "End of track"
12. "Read coordinate"
13. "New event"

Fig. 2

The Console