

The Shot Summary System for the Tevatron Collider

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Abstract

Data from numerous devices in the Tevatron Collider are routinely logged and the data stored in files on the Accelerator Division Vax Cluster. The data in these files are necessary for an understanding the performance of the Tevatron Collider and for its improvement. Periodically these files are accessed and the data for a subset of the devices are retrieved. These data are checked, and if warranted by the type of data, averaged and then stored in a relational data base (RIM). The data in the data base can be retrieved by programs written in high level languages i.e. PASCAL and FORTRAN. As an example a SHOT SUMMARY PROGRAM written in PASCAL is used to study performance of a store.

DATA COLLECTION AND RETRIEVAL

In order to monitor and study the performance of the different systems comprising the TEVATRON data from measuring devices located around the ring are periodically logged onto disk files on a VAX Cluster. In addition calculations, using data from the accelerator, performed by different control systems programs are also logged.

The volume of data and the multiplicity of systems monitored usually makes the retrieval of data from these files time consuming. In order to study the behavior of certain specific aspects of machine performance e.g. luminosity as a function of time or emittance growth, it was decided to extract a subset of the data from the data logger files, process it, and store this subset of the original data using a commercial relational data base management program (RTRIM). This data base management program allows the use of keys which can speed up data retrieval. The stored data can be quickly and easily retrieved using programs written in high level languages such as PASCAL and FORTRAN.

The data is retrieved from the data logger files and stored in the data base with a FORTRAN program. The names of the devices for which data is to be retrieved are contained in a file. Also in the file are instructions to the program on the method to handle the data. Several logging options are available which include:

1. Store in a separate record all logged values of the device.
2. Average the data over a specified time interval and store the average and sigma of the data.
3. Store the data when it changes by a specified absolute or relative amount.

The use of options 2 or 3 allows a significant reduction in the amount of data stored in the data base, relative to that stored in the data logger files, without reducing the value of the information. As an example for store 1989, which lasted approximately 30 hours, there were approximately 100,000 individual items stored in the data logger for those devices which are stored in the data base. These data are reduced to fewer than 13,000 records in the data base. In addition to reducing the amount of space needed on the disc to store the data this reduction also speeds up retrieval of the data.

An example of the kind of program which has been developed to access the data in the data base is the SHOT SUMMARY PROGRAM To date this has been the principal program to use the data base. The SHOT SUMMARY PROGRAM is used by the operators to prepare summaries of a store both during after it has ended. The program to prepare the summaries is menu directed.

*Operated by Universities Research Association Inc., under contract with the United States Department of Energy.

```
Shot Summary V0.4
Shot no [ ] Bunch [*] Plotter On [*] Off [ ]
Display On [*] Off [ ]

[ ] Complete Summary
[ ] P Inten. Emit. H V L
[ ] Pbar Inten. Emit. H V L
[ ] Display Life & Growth
[ ] Selective Plot
[ ] Parameter and derivative
[ ] Select X and Y axis
[ ] Add Selective Plot
[ ] Display Shot Directory
[ ] Display Selective Data
[ ] Fetch Shot
[ ] Fetch Options
[ ] Plotter On/Off
[ ] Display On/Off
[ ] Select Bunch
[ ] Set global time limits
[ ] Set Max. and Min Values
[ ] Change Device Name
[ ] Exit
PF2 = Help PF4=Return to top level
```

Figure 1: The options available in the sf SHOT SUMMARY PROGRAM

PROCEDURE FOR RUNNING THE SHOT SUMMARY PROGRAM

1. The operator logs on to the Accelerator Division Vax Cluster into a special turnkey account.
2. The first screen presented to the operators contains the available options and is shown in fig. 1. An operator would normally select, by moving a screen cursor, the full summary.
3. Before beginning the program asks for confirmation of the store number. The operator would usually select the current store number but they can select any store number for analysis.

The normal output corresponding to a full summary is shown in fig 2-4. and is usually available in less than 5min after the program is initiated. The operator can choose to have the plots shown on a graphics terminal and/or printed on a laser printer. The SHOT SUMMARY PROGRAM typically makes use of ~ 20% of the data stored in the data base for a particular shot or ~ 3% of the values originally logged.

Though the SHOT SUMMARY PROGRAM, as its name indicates, is normally used to generate a shot summary it can be used to access the data base and produce a display for any device stored in the data base. To facilitate this the user can select

- The shot number.
- The device name.
- The time interval over which to display the data.

from one or more cursor driven menus.

CONCLUSION

The test of any program such as this is whether it is used by the intended users. The SHOT SUMMARY PROGRAM has proven to be helpful both to the operators, who need to keep records, and to the physicists who consult the records in trying to understand how the collider is performing. It is now a part of the day to day procedure of TEVATRON Collider operation.

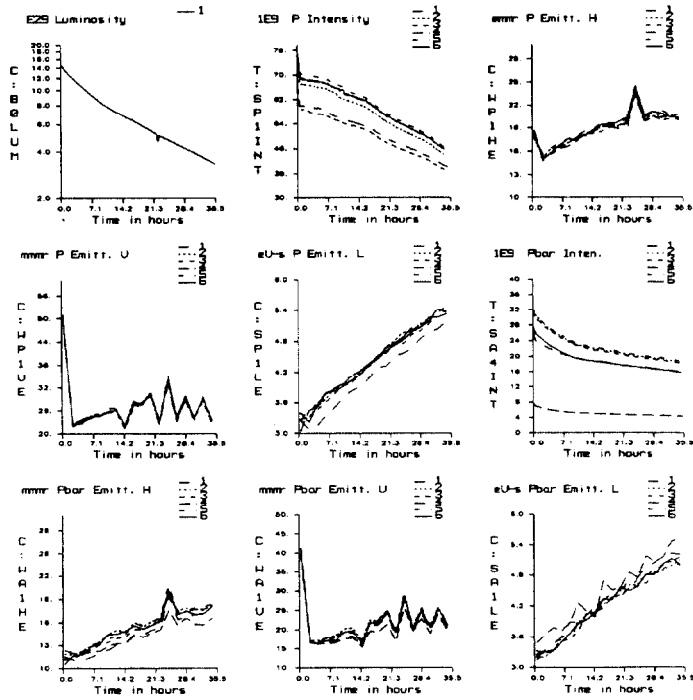


Figure 2: Output from the SHOT SUMMARY PROGRAM showing the Luminosity Bunch Intensities and Emittances as a function of time. Note that a problem with the flying wire that measures the vertical emittance is very obvious.

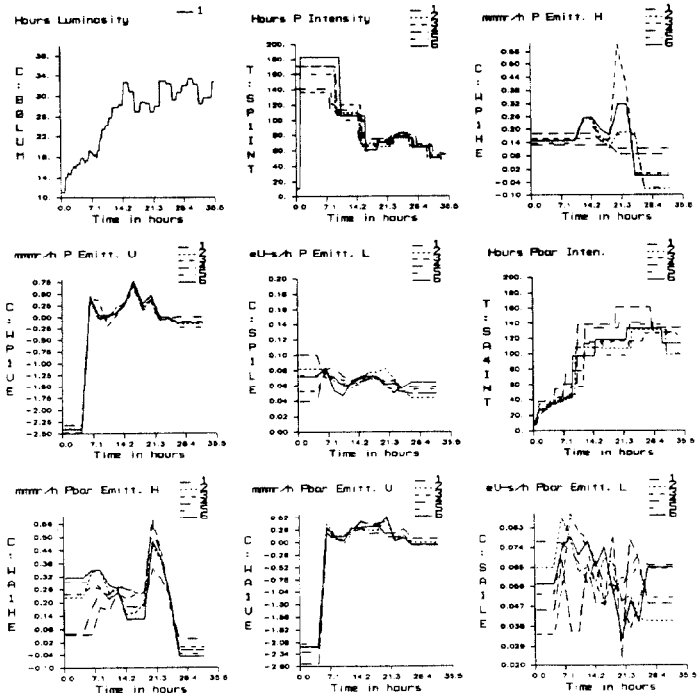


Figure 3: Output from the SHOT SUMMARY PROGRAM showing the Luminosity and Bunch Intensities Lifetimes and Emittance Growth Rate as a function of time.

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Shot : 1989
      Low Beta                               Beam Low Beta
From  : 2/16/89 17:52:08                     2/18/89 17:52:08
To    : 2/18/89  8:02:30                     2/18/89 05:17:20
Duration: 36.17 hours                          35.42 hours

Luminosity,*Integrated : 87.51 nb-1          Initial : 14.53 E29
Lifetime : 22.46 Hours              Final   : 3.35 E29

      Lifetime                               Growth rates for Emittances
      Intensity                               Horizontal Vertical Longitudinal
Proton
83.352 h      0.148 mmmr/h      -0.117 mmmr/h      0.063 eV-s/h
80.533 h      0.160 mmmr/h      -0.120 mmmr/h      0.066 eV-s/h
85.371 h      0.156 mmmr/h      -0.127 mmmr/h      0.062 eV-s/h
83.798 h      0.162 mmmr/h      -0.099 mmmr/h      0.065 eV-s/h
81.969 h      0.150 mmmr/h      -0.129 mmmr/h      0.064 eV-s/h
82.928 h      0.167 mmmr/h      -0.100 mmmr/h      0.062 eV-s/h
Ave. 82.992 h      0.157 mmmr/h      -0.115 mmmr/h      0.064 eV-s/h
Antiproton
97.421 h      0.224 mmmr/h      0.017 mmmr/h      0.062 eV-s/h
79.974 h      0.210 mmmr/h      0.020 mmmr/h      0.058 eV-s/h
80.507 h      0.230 mmmr/h      0.034 mmmr/h      0.058 eV-s/h
92.176 h      0.157 mmmr/h      -0.035 mmmr/h      0.060 eV-s/h
82.740 h      0.232 mmmr/h      0.050 mmmr/h      0.061 eV-s/h
83.413 h      0.212 mmmr/h      0.039 mmmr/h      0.059 eV-s/h
Ave. 86.039 h      0.211 mmmr/h      0.021 mmmr/h      0.060 eV-s/h

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Figure 4: Tabulation of results.