THE OPERATOR-DEVELOPED USEFUL TOOLS AT KEKB ACCELERATOR

K. Yoshii, Y. Satoh, T. Kitabayashi, H. Iida, S. Fuke, M. Tanaka, T. Kawasumi,
T. Aoyama, S. Shimomura, K. Sugino, T. Nakamura, T. Ohkubo,
Mitsubishi Electric System & Service Co. Ltd., 2-8-8 Umezono, Tsukuba, Ibaraki 305-0045, Japan
and
M. Yoshioka,
High Energy Accelerator Research Organization (KEK),
Oho 1-1, Tsukuba, Ibaraki 305-0801, Japan

Abstract

The main tasks of the operators at KEKB accelerator are safety management, beam tuning and operation logging. In KEKB facility, the accelerator scientists are exploring and developing new beam tuning methods to realize high luminosity. To master these new methods quickly and correctly, the operators developed their own tools for day-to-day operation. As a consequence, the stable and high performance operations have realized. In this paper, we list the operator-developed tools and report the merits of developing tool by the operators.

1 INTRODUCTION

The main tasks of the operators at KEKB [1] accelerator are beam tuning, safety management and operation logging. According to requests from KEKB staff, i.e. the accelerator scientist or engineer, the operators tune the accelerator.

To realize stable and high luminosity, the operators have to regulate the accelerator condition very carefully. Effecting directly to luminosity, beam tuning has been requiring operator experience and skill. And, when accidents occur to accelerator operation, the operators should perform adequate procedures quickly.

Therefore, from the viewpoint of the operators, we thought that the requirements for efficient operation were as follows.

- To make more time for beam tuning, the other operator's tasks should be automated.
- Routine parts in beam tuning should be automated.
- In order to perform beam tuning more accurately, the useful application programs, which have only required function of monitor and control for beam tuning, should be developed.
- All operators should be able to carry out adequate procedures in the event of trouble.

Fortunately, the following conditions had already been satisfied.

- The operators could acquire technical knowledge about the accelerator from KEKB staff.
- The operators already had basic backgrounds of hardware and software.
- Since the operators had been always close to the scene of the accelerator operation, the operators were able to get information about the operation state relatively quickly.
- The KEKB accelerator control system was built based on EPICS. Because of high data accessibility of EPICS, the data was able to be easily handled.
- Python/TK was able to be used to easily develop application programs with GUI.
- Data from various equipments of KEKB are automatically logged by using EPICS tools.

2 TOOLS

From the discussion above, we have developed the following useful tools.

2.1 Operation log monitor

We have developed an application, consists of two Python programs, for operation logging: One of these tools, Logger (see Fig 2.1.1), saves the operation data, which operator should log and monitor, to files, and the other, Viewer (see Fig 2.1.2), displays the logged data in the files.

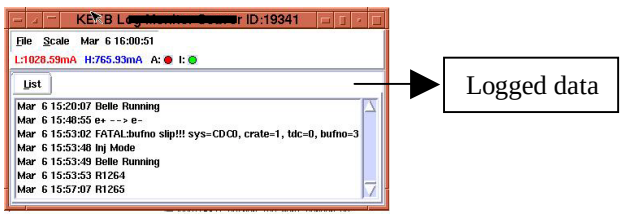


Fig 2.1.1: Logger (Real time logging)

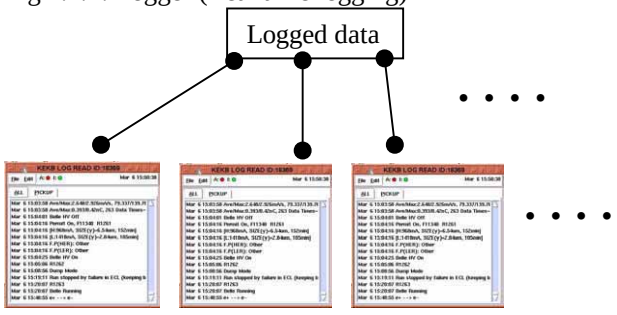


Fig 2.1.2: Viewer (Automatically updated every minute)

2.2 Safety management tools for integrated radiation doses

We have developed an application, consists of two Python programs for the archived data of accumulative doses in each area of KEKB (see Fig 2.2): One of these tools prints out the data of dose per hour once, and the other displays the archived data graphically on the operator's console.

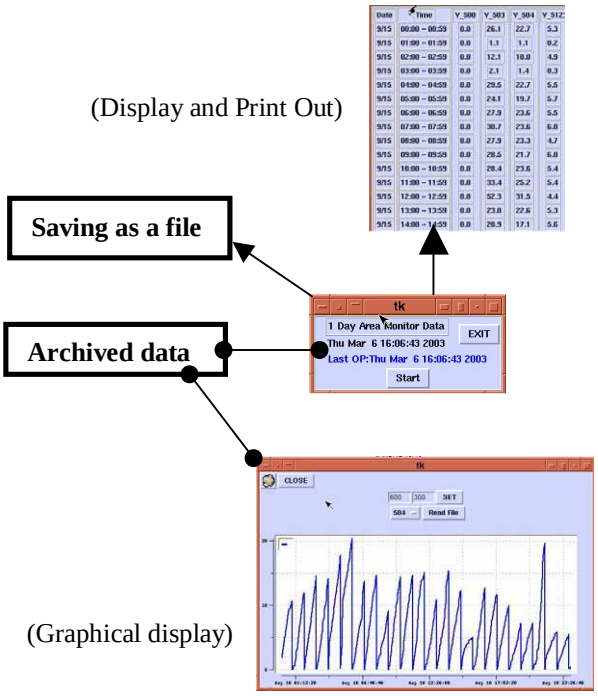
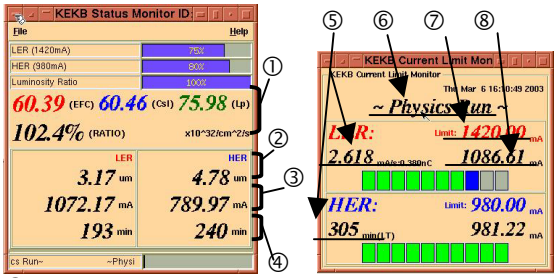


Fig 2.2: Safety management tools for integrated radiation doses tools

2.3 Operation status panels

There are Python tools that display only indispensable data for status monitor, and data currently used for beam tuning by the operators. (Fig 2.3)



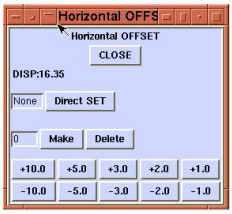
① : Luminosity
② : Beam size(y)
③ : Beam current
④ : Beam Lifetime or Injection rate
⑤ : Beam Lifetime or Injection rate
⑥ : KEKB status message
⑦ : Beam current Limit
⑧ : Beam current

Fig 2.3: Operation status panels

2.4 iBump Horizontal offset tools [2], [3]

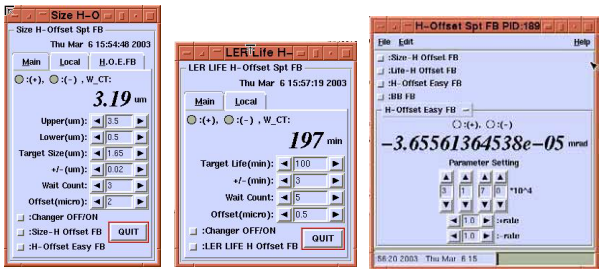
"iBump horizontal offset" is a bump height near the beam colliding point. Since the luminosity is very sensitive to the iBump offset, we have to set the offset on the best point correctly during accelerator operations.

There are Python tools (see Fig 2.4.1,2.4.2) that assist adjustments of iBump horizontal offset. The adjustments are based on observed beam size, beam lifetime and a kick angle of a steering magnet at the vicinity of IP.



(Manual setting)

Fig 2.4.1: Setting tool for iBump horizontal offset



Beam Size FB* Beam Lifetime FB IP Steering FB
*: Feedback

Fig 2.4.2: Feedback tool for Beam size, Beam lifetime and IP Steering.

2.5 Communication sheets and Manuals

The operators work in three eight-hour shifts. They have been using a "Communication sheets" to take over their information to next shift. The operators save and number operation information, which should be taken over, on a communication sheets. Shortly afterwards, the operators arrange the Communication sheets and move manual sheets of the Communication sheets to the binder for manuals. To search quickly the manual sheets, these are divided into some topics, which are magnet, RF, safety, etc, by the operators. These two documents have been used for daily operations and for newcomer's training. (see Fig 2.5.1,2.5.2,2.5.3)

Fig 2.5.1: Communication sheets (LEFT) and Manuals (RIGHT)

Fig 2.5.2:Communication sheets (LEFT),
Fig 2.5.3: Manuals (RIGHT)

3 THE MERITS OF DEVELOPING TOOL BY THE OPERATORS

It is clear that the operation can be efficiently performed by using operator-developed tools. We regard the development tools is greatly contributing to stable and high luminosity of present KEKB operation.

From the present state of developing tools, the merits of developing tools by the operators as follows.

- What is needed for the operation? What operation tool should be developed first? The operators can answer these questions. Therefore, tools developed by the operators are exactly adapted to operator's needs.
- Since the operators are the tool developer and also the tool user, the user's idea can be imported to the development immediately and correctly.
- KEKB staff's tasks to accelerator operation can be reduced, and that leads further developments of the KEKB accelerator.

4 PROBLEMS AND OUR FUTURE PLANS

There are two problems applying the "operator-developed tools" concept to KEKB.

- The time for software-development is very much limited for operator's, because the operators primary jobs is accelerator operation.
- Training of software-engineering are required to operators, because the application programming is not familiar for all operators.

We have opened two training courses for new operators, the Python programming course and the EPICS programming course, as one of our future plans. In these courses, trainees are given exercises of developing practical tools for accelerator operation. We think that two problems, making the time for software-developing and training of software-engineering, must be both solved at the same time.

5 ACKNOWLEDGMENTS

We would like to express our sincere appreciation here to Professor T. Kato Dr. N. Yamamoto and Dr. T.T. Nakamura of KEK for giving us the opportunity to prepare this paper.

REFERENCES

[1] S.Kurokawa and E.Kikutani, "Overview of the KEKB accelerators", Nucl. Instr. and Meth. A 499(2003) 1.

[2] http://www-kekb.kek.jp/review_2003/satoh.pdf

[3] T. Aoyama, H. Iida, T. Kawasumi, T. Kitabayashi,Y. Satoh, H. Shimizu, M. Tanaka, K. Yoshii, "iBump feedback tuning for KEKB accelerator", Proceedings of The 13th Symposium on Accelerator Science and Technology, Osaka Univ., Osaka, Japan, October 29-31, 2001.