Development of a control application for sPHENIX-INTT detector operation

H. Imai,[*1,*3] Y. Akiba,[*1] J. Bertaux,[*2] K. Fujiki,[*1,*3] M. Fujiiwara,[*4] T. Hachiya,[*1,*4] S. Hasegawa,[*1,*5] M. Hata,[*4] M. Kano,[*4] T. Kato,[*1,*3] T. Kondo,[*6] C. Kuo,[*7] R.-S. Lu,[*8] I. Nakagawa,[*1] Y. Namimoto,[*1,*4] R. Nouicer,[*9] G. Nukazuka,[*1] C. Shih,[*7] M. Shimomura,[*4] R. Shishikura,[*1,*3] M. Stojanovic,[*2] Y. Sugiyama,[*4] R. Takahama,[*1,*4] W.-C. Tang,[*7] H. Tsujibata,[*4] M. Watanabe,[*4] and X. Wei[*2]

The sPHENIX experiment will begin at Brookhaven National Laboratory (BNL) in 2023 to study quark-gluon plasma (QGP) using Relativistic Heavy Ion Collider (RHIC). We have developed a tracking detector which is named INTT for several years and the barrel assembly was completed by the end of 2022.[1)]

The INTT barrel consists of 56 silicon ladders. The analog signal from the silicon sensor is amplified, digitized, and transmitted downstream in an integrated circuit chip (FPHX) mounted right next to the silicon sensors. There are as many as 2912 FPHX implemented in the entire INTT barrel, and each can be customized operation parameter such as gain, threshold, *etc.* Developing a software application to centralize the control of FPHX chips all at once is mandatory. The application is called "expert GUI."

The development of the expert GUI can be divided into the following three categories.

1) Graphic User Interface (GUI) is designed to be intuitive for a user and interactively allows operation; 2) setting up a database to store the latest operation parameters for the FPHX chips; 3) establishing the communication between the server (Felix)[2)] which collects data from the FPHX chips and the client PC using Remote Procedure Call (RPC) protocol.

The front-end code is written in Python3, especially using Tkinter as a toolkit for developing GUI. Figure 1 shows the main control panels of the expert GUI. The left panel displays the cross-section layout of the INTT barrel, and the right represents the layout of Read Out Cards (ROC). The ROC relays data from FPHX to the downstream server (Felix). The trapezoid objects are clickable and will launch a new pop-up window with fields where the user can type in a desired value of a parameter for a given FPHX chips. The color of objects shows the LV power status of ROC and ladders.

As the database engine, PostgreSQL[3)] is used. It is operated on a dedicated server. We introduced four categorized tables to be stored in the database. They are 1) operation parameters for FPHX chips, 2) status of channel masks, 3) ladders and ROCs, and 4) ROCs and Felix servers.

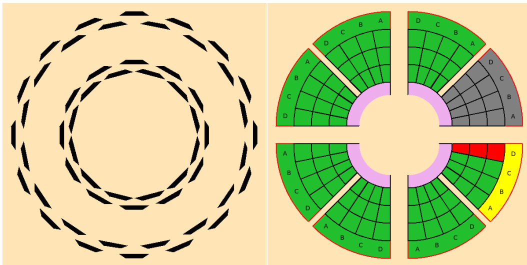

Fig. 1. The main control panel of the expert GUI.

Our choice of the RPC framework is gRPC[4)] as the communication protocol between the Felix server and the client PC where the GUI runs. The infrastructure of the communication can be established by setting up a gRPC-server on the server end and registering all functions to be executed on the server. Once it is established, the user can send a request for a function to be executed on the server from the client's PC.

The initial communication test was carried out by sending a function from the GUI to the Felix server using established RPC and checking the resulting response from the server. The function executed was "establish the optical communication between the ROC and the Felix." Then the GUI received the response from the server, which tells "the requested communication was established successfully," as shown in Fig. 2. Development of the expert GUI is ongoing.

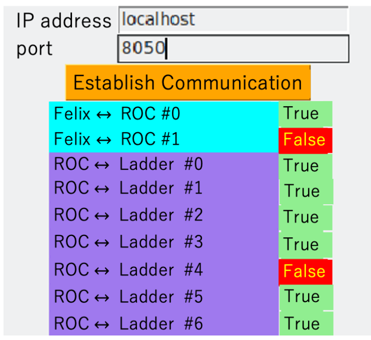

Fig. 2. Result of the attempt to establish communication using gRPC. Neither ROC#1 nor ladder#4 are physically not connected.

References
1) I. Nakagawa *et al.*, in this report.
2) G.Nukazuka *et al.*, in this report.
3) https://www.postgresql.org/.
4) https://grpc.io/.

*1 RIKEN Nishina Center
*2 Department of Physics and Astronomy, Purdue University
*3 Department of Physics, Rikkyo University
*4 Department of Mathematical and Physical Sciences, Nara Women's University
*5 Japan Atomic Energy Agency
*6 Tokyo Metropolitan Industrial Technology Research Institute
*7 Department of Physics, National Central University
*8 Department of Physics, National Taiwan University
*9 Physics Department, Brookhaven National Laboratory