THE DATABASE OF THE VEPP-4 ACCELERATING FACILITY PARAMETERS

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Abstract

The new PostgreSQL [1] database is developed for the data archiving and observation at the VEPP-4 facility. About three thousands parameters are set and checked for the VEPP-4 control. The control system server programs read the current values from the control and measuring electronics and store them into the frame-files with different time intervals. The storing intervals vary from one second for the pulse systems to several minutes for the slowly changing parameters. The data are transfer to the database as soon as the frame-files are renewed. Twelve independent processes running under Linux provide the data transfer from the frame-files to the database.

The graphical interface is developed for user's access to the database. It provides observation of the stored data in graphical or textual form and monitoring of the selected parameter values. The interface allows us to observe any collection of parameters in a single or in different diagrams for any period of time.

INTRODUCTION

The VEPP-4 [2] (see Fig. 1) is constructed for high-energy physics experiments.

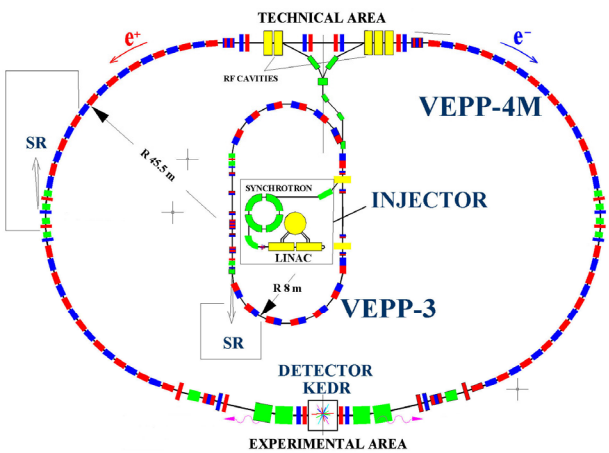

Figure 1: VEPP-4 layout

The VEPP-4M facility consists of three parts: the injection complex, the VEPP-3 storage ring, the VEPP-4M electron-positron collider (see Fig. 1). VEPP-3 can operate as injector for VEPP-4M as well as SR machine. VEPP-4M also can provide experiments with synchrotron radiation from electron beams.

Now the VEPP-4M electron-positron collider operates for high-energy physics experiments in the 1.5-2.0 GeV energy range. The most important of the experiments are: precise measurement of tau-lepton and psi-mesons masses and study of psi-mesons and c-quarks physics. VEPP-4M has a unique method for precise measuring of the beam energy - method of the beam resonance depolarization. This method allows us to measure the energy with the accuracy of several keV. But there it is no possibility to perform experiments during the energy measurements. So, the energy calibrations are performed with some intervals when the gathering of statistics is interrupted, and the beam energy value can be reconstructed in any time using the stored values of VEPP-4M collider parameters between the calibrations. Totally about three thousands parameters are stored to the database. This paper describes the VEPP4 database structure and method of data collecting.

GROUPS OF PARAMETERS

The VEPP4 stored parameters can be divided in the next groups: Status parameters, Beam Diagnostic parameters, Power Supply parameters, Temperature Measurements, and Cooling System parameters.

Status Parameters

VEPP4 status parameters include the most important information about all parts of VEPP-4 Control System. About 200 parameters stored each second to the database. They are: facilities operation modes, beam currents, set energy, luminosity, average vacuum values, temperatures of the most important points, etc. Also the values of magnetic fields of some important magnets are stored as status parameters.

Beam Diagnostic Parameters

Beam diagnostics group consists of four parts: the beam orbit of the VEPP3 storage ring, the beam orbit of the VEPP4-M collider, luminosity of VEPP4-M, and the VEPP-4M beam dimensions. The stored measurements of the VEPP-4M beam orbits with the measurements of the magnetic fields allow us to reconstruct the beam energy value between the calibration procedures.

Power Supply Parameters

This group of parameters consists of four parts: injector, VEPP-3, transport channel from VEPP-3 to VEPP-4M, and VEPP-4M. These parts include a full set of the facility Power Supplies parameters: totally about 1000 parameters. This group of parameters allows checking of power supplies operation stability. These parameters also are taken into account in the beam energy value reconstruction.

Temperature Measurements

The temperature measurements are performed in order to protect the devices and equipment from the overheating. Almost 500 temperature sensors are distributed at the VEPP-4M [3]. The temperature measurements also are used for the beam energy reconstruction. For this purpose a lot of temperature sensors are mounted on the bending magnets yoke, on the tunnel walls, and in the all collider areas for air temperature measurements.

Cooling System Parameters

The Cooling System parameters include information about distillate cooling equipment. This equipment provides distillate temperature stabilization during the all facility operations. It is not easy task, because the power consumptions of the VEPP-3 storage ring in the mode of the beam accumulation almost twenty fife times less than in the mode of the beam extraction to the VEPP-4M collider.

DATA COLLECTION

Figure 2 shows the data collection process.

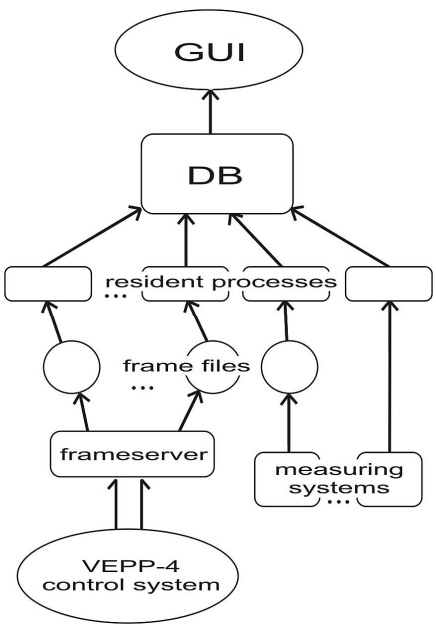

Figure 2: The scheme of the data collection.

The VEPP-4M control system includes several control computers which send the data packets to the special frame server program running in PC [4]. The frameserver puts the data into the text files (frame-files) with the time stamp in the first line. There are about twenty text files which includes the data about VEPP-4 facility subsystems: injector, VEPP-3, VEPP-4M. These files include the data about set and measured currents and voltages, parameters of pulsed devices, temperature data, beam orbits, etc. Also there are several measurement programs running in PCs which measure the beam parameters of VEPP-4M. These programs also put the data into the text files. Using of the text files provides the possibility for different user's programs to access the data asynchronously.

There is a corresponding name configuration file for the each frame-file. These name configuration files are renewed if the data structure is changed in the case of addition or dropping of control or measurement parameters in the VEPP-4 control system.

There are twelve resident processes which check if the frame-files renewed or not. In the case of renewing of the data file the corresponding process sends the data to the postgreSQL server. The postgreSQL server puts the data to the corresponding table of the database.

In the case of a new parameter in the name configuration file the corresponding process sends to database server the request to renew the data table: to add new attribute.

THE DATABASE STRUCTURE

The database consists of two parts: description of the systems and storage tables.

Description of the Systems

There is the main configuration table, which includes information about data tables, corresponding data acquisition processes and frame-files.

Each data table has corresponding configuration table which includes parameter names, dividing factors and physical units for the values presentation, the name of the VEPP-4 control system servers which is the data source, etc. An example of configuration table structure is shown in Fig. 3.

```
v4parameters=> \d stap_config
                Table "public.stap_config"
     Attribute   |             Type             |
-----------------+------------------------------+
 param_name      | character varying(32)        |
 writer          | character varying(16)        |
 group_id        | integer                      |
 param_id        | integer                      |
 param_type      | character varying(16)        |
 divider         | double precision             |
 units           | character varying(32)        |
 event_date_time | timestamp without time zone  |
 status          | boolean                      |
```

Figure 3: An example of configuration table.

Data Tables

The example of short data file with magnetic field measurements is shown in Fig. 4.

```
v4parameters=> \d nmr
                  Table "public.nmr"
  Attribute|             Type             |
-----------+------------------------------+
 date_time | timestamp without time zone  |
 H         | double precision             |
 NEM       | double precision             |
 SEM       | double precision             |
 SIM       | double precision             |
 EM3       | double precision             |
 VEPP3     | double precision             |
 KEDR2     | double precision             |
```

Figure 4: An example of data table.

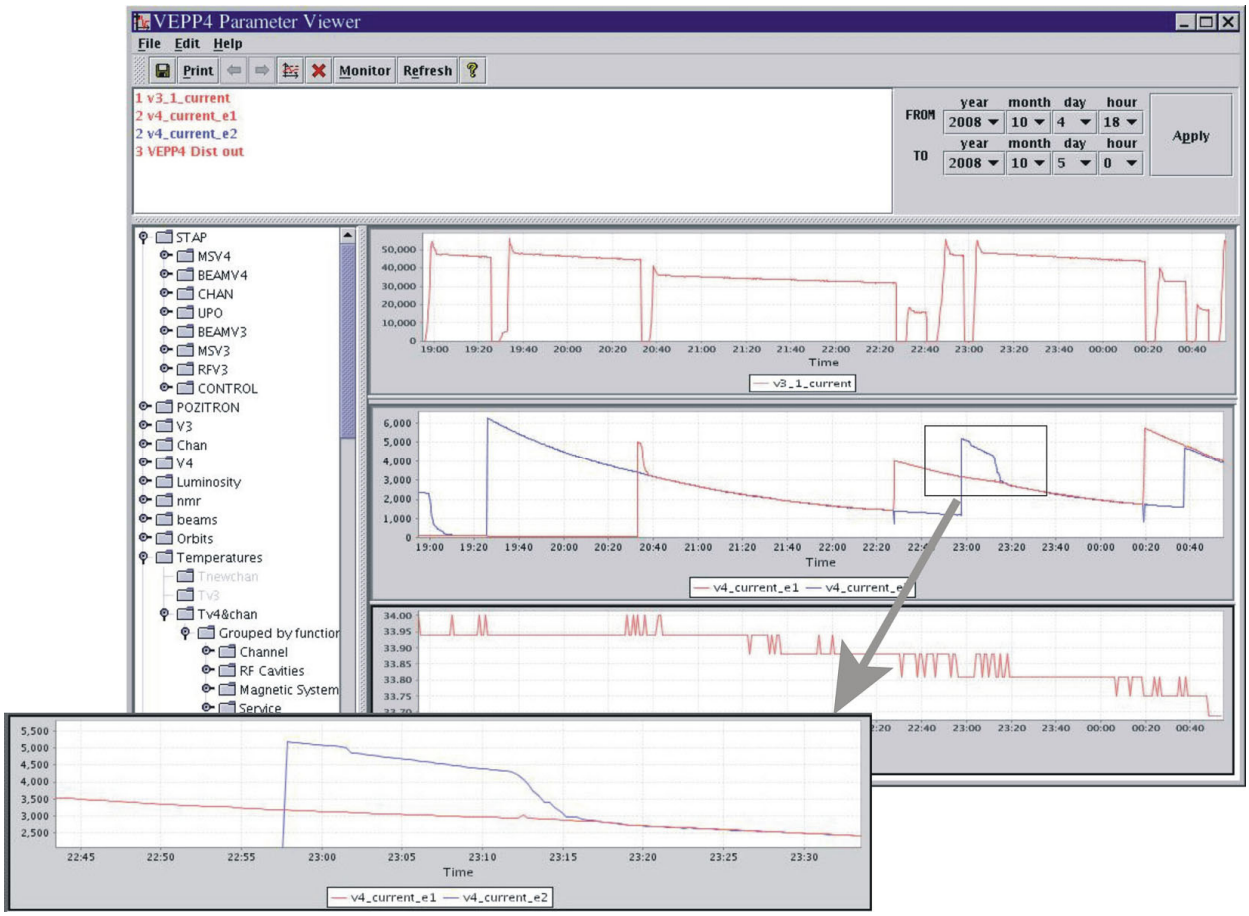

Figure 5: GUI Window

All the data tables have the identical structure: the first attribute is timestamp followed by the sequence of attributes determined in the corresponding name configuration file.

GRAPHICAL INTERFACE

The handy graphical interface is developed for user's access to the parameters stored in the database. It provides observation of the stored data in graphical or textual form and monitoring of the parameter values. The interface allows us to observe any collection of parameters in a single or in different diagram (in sub-windows) for any period of time. The interface provides the parameters observation with varying time and amplitude resolution (see Fig. 5). The user can capture any square region of diagram and extend it. At the same time the other diagrams if any automatically change the scale.

The program is developed using client-server technique. That provides easy following to the database development.

CONCLUSION

The database and graphical interface are used since 2006/2007 operating seasons. Since that time all the VEPP-4 control and measurement parameters were included to be stored into the database. This provides permanent observation of any combinations of parameters for any period of time. The database is used for the beam energy value calculations during the experiments on high precision tau-lepton and psi-mesons masses measurements.

Also the database provides new possibilities in automation and visualization in machine operations.

REFERENCES

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