

LINAC-200 control system status

Aleksei Trifonov

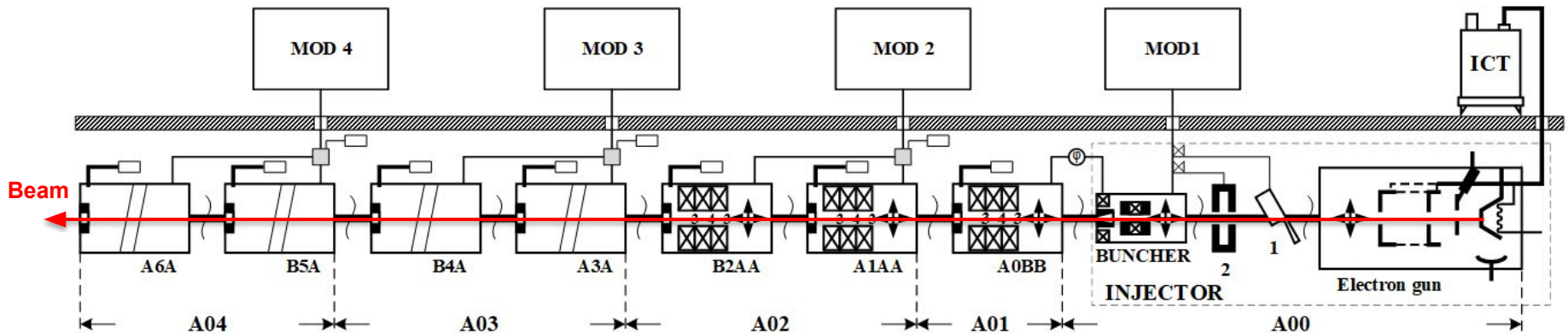
engineer at the Beam Colliding Department DLNP JINR

JINR Young Scientists and Specialists Association Workshop “Alushta-2021”
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Control object

At the moment - 4 accelerating stations, energy 200 MeV

In the future - 13 accelerating stations, energy 800 MeV



LINAC-200 subsystems

- Electron gun
- Synchronization system
- Magnetic elements for focusing and correcting the beam position
- RF system (master oscillator, preamplifier, klystron modulators, phase shifters, attenuators)
- Vacuum equipment
- Thermal stabilization system
- Radiation monitoring system
- Beam extraction channels

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- Beam extraction channels

Goal of the work

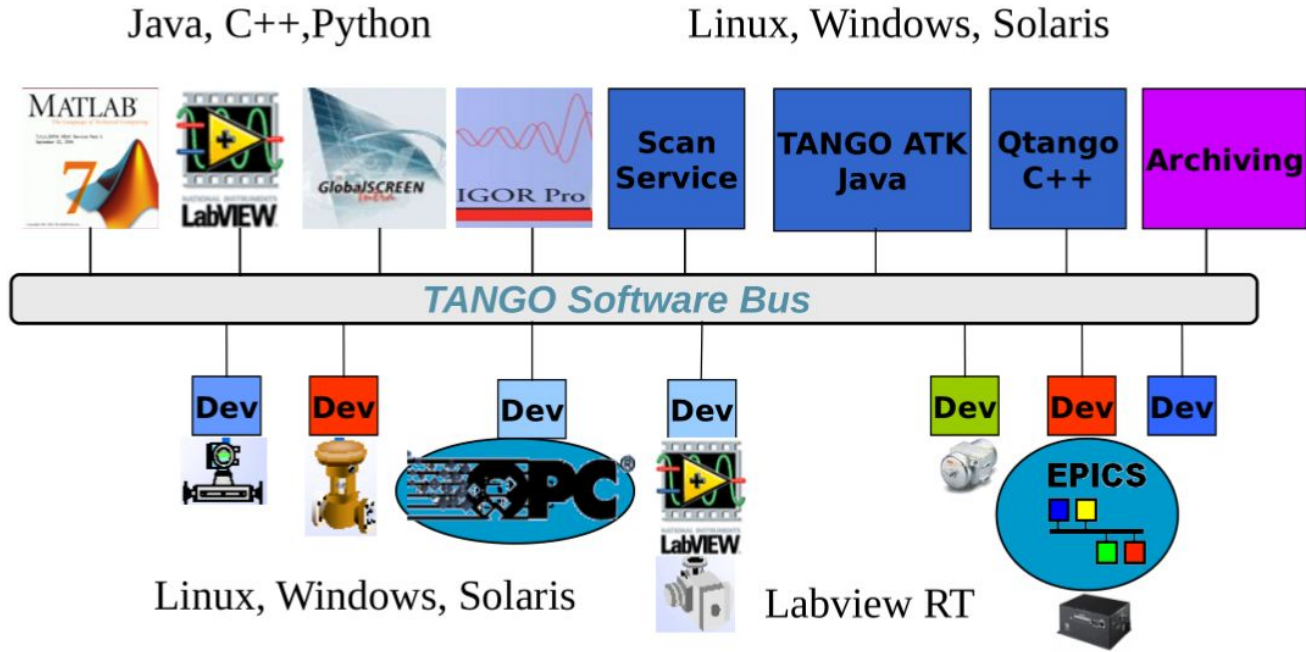
The goal of the work is to develop a new control system that provides automated control of the LINAC-200 accelerator equipment, as well as monitoring the parameters characterizing its state.

Main requirements for the control system:

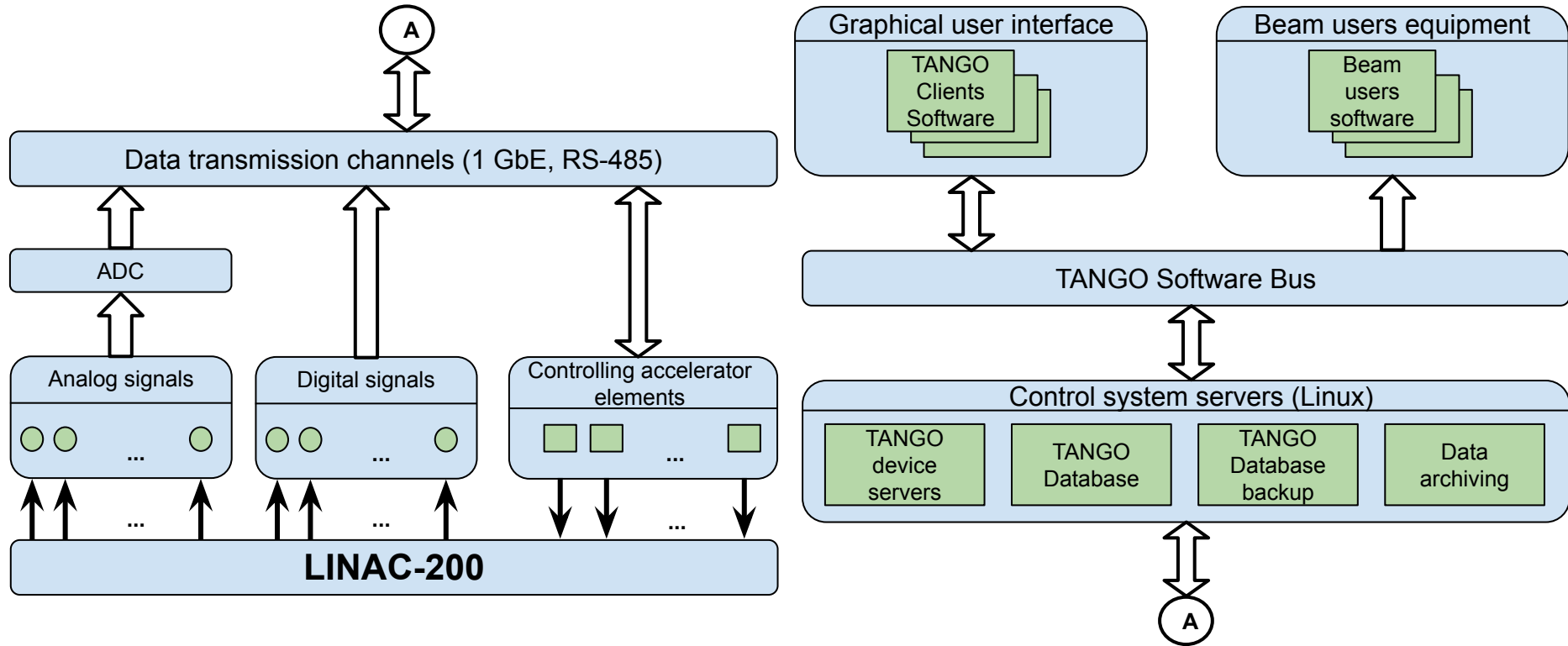
- high reliability
- serviceability
- using standard interfaces for communication between components
- possibility of future modifications and extensions

TANGO-based control system

Official website: <https://www.tango-controls.org/>



Control system block diagram



Software development for TANGO-based control system

Technology stack:

TANGO version - 9.2.5; Linux Debian/Ubuntu; C++, Python; QTango framework

The server and client software for the following equipment is at the stage of development and testing:

- Master oscillator AKIP-7SG384
- Klystron modulator control unit
- Magnetic system (power supplies for solenoidal and quadrupole lenses and correcting magnets)
- Electron gun

Master oscillator AKIP-7SG384

MasterOscillator

Go to LOCAL **Turn OFF nType output**

Frequency, MHz

+ 2 8 5 6 . 0 0

Amplitude, dBm

- 0 0 5 . 6 0

Remote control enabled

SG380

TANGO Control System

SG380

- Class Properties
- Device Properties
 - Socket
- Commands
 - State
 - Status
 - disp_frequency
 - disp_ampl_typeN
 - checkError
 - goToRemoteControl
 - goToLocalControl
 - connectionStatus
- Scalar Attributes
 - Frequency
 - Amplitude
 - chEnable
- Spectrum Attributes
- Image Attributes
- Forwarded Attributes
- Pipes
- States
 - RUNNING
 - FAULT

Tango DeviceImpl

- + State
- + Status
- + ...

↑

SG380

- + State
- + Status
- + ...

Electron gun

The screenshot displays the ElectronGunClient software interface. The main window is titled "ElectronGunClient (on NF-29-116)". It features three control sections under the heading "Reference Voltage":

- Filament Supply, mV:** Set to + 5 0 0 0. An "APPLY" button is to the right.
- Focusing Electrode, mV:** Set to + 2 0 0 0. An "APPLY" button is to the right.
- Extractor, mV:** Set to + 3 0 0 0. An "APPLY" button is to the right.

Each control section includes four digital potentiometer-style controls (up/down arrows) and a plus sign. To the right of the control sections, there are two digital readouts:

- Real Voltage:** Displays 9.18 V and 626.7 V.
- Real Current:** Displays 4.779 A.

Below the control sections, a status message reads: "OK. All errors reset. Coolers:1 - ON; 2 - OFF;".

At the bottom, a terminal window is open, showing the following commands and output:

```
alex@NF-29-116: /home/nozdrin/src/gunemul
File Edit View Search Terminal Help
alex@NF-29-116:/home/nozdrin/src/gunemul$ ./a.out 3
Port opened succesfully
New filament supply voltage set: 5000 mV (DAC code 32765)
New focusing electrode voltage set: 2000 mV (DAC code 13106)
New extractor voltage set: 3000 mV (DAC code 19659)
```

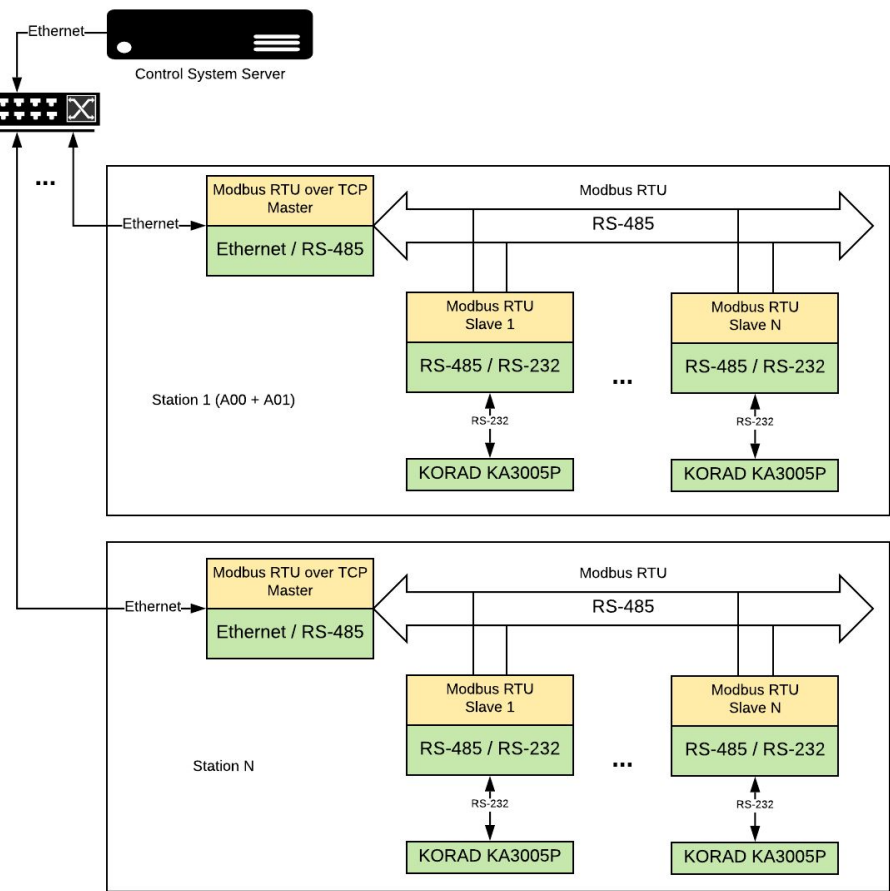
Magnetic system

20 power supplies KORAD
30 V, 5 A / 60 V, 3A

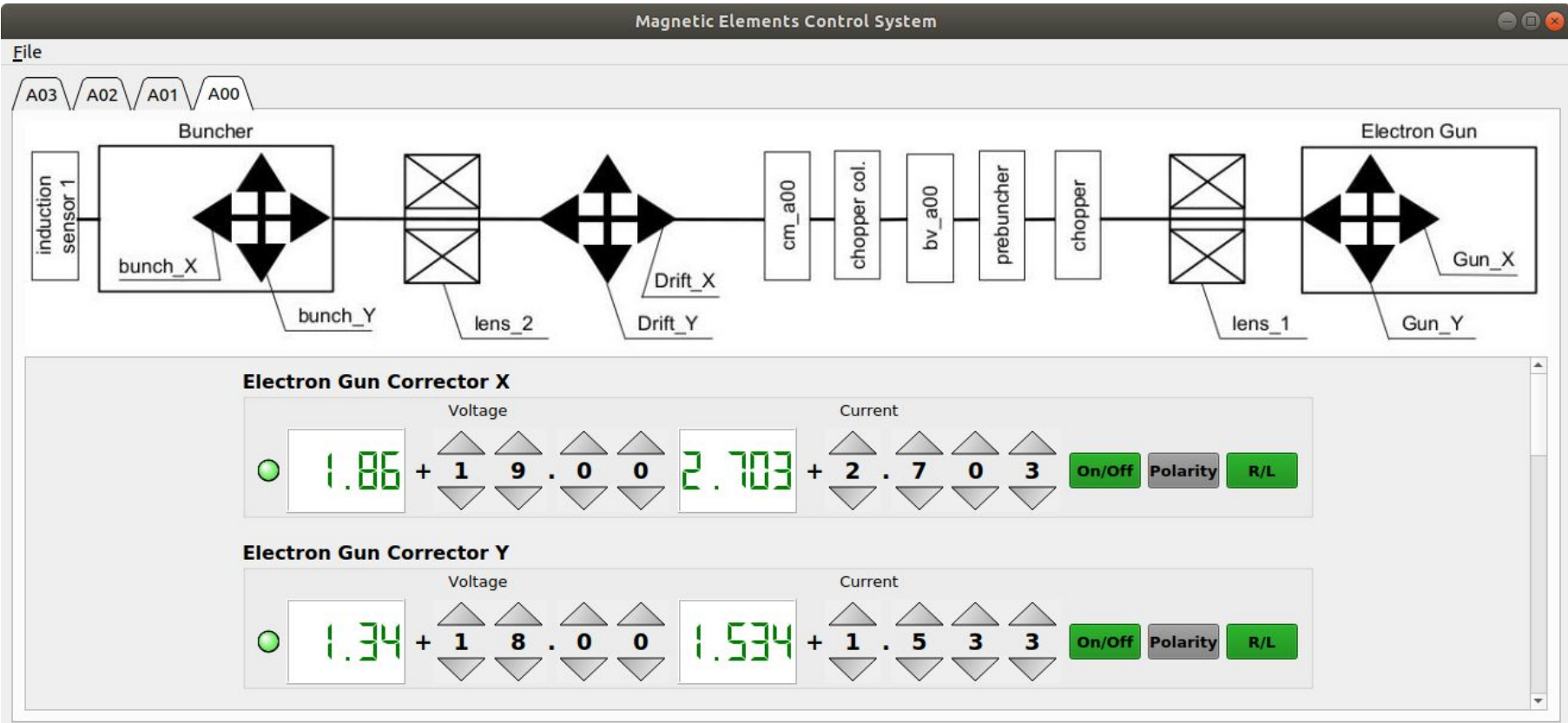


Ethernet to RS485
converter

Modules for communication
with power supplies



Magnetic system



Conclusion

At the moment, the general concept of the control system has been designed. TANGO-based software has been developed for individual subsystems of the LINAC-200.

The accelerator building is undergoing major repairs. It's planned to integrate TANGO-based software when the accelerator is launched after the first phase of repair.

The next stage in the development of control system is the automation of a number of other LINAC-200 subsystems (synchronization, vacuum, diagnostics, thermal stabilization, new channels for beam extraction from the accelerator).



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engineer at the Beam Colliding Department DLNP JINR
e-mail: trifonov@jinr.ru

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