

LINAC-200 control system status

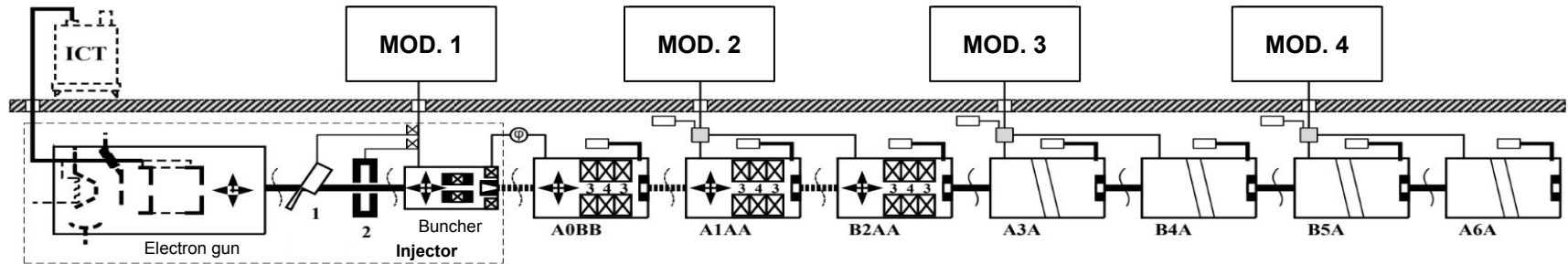
Aleksei Trifonov

engineer at the Beam Colliding Department DLNP JINR

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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Goal of the work

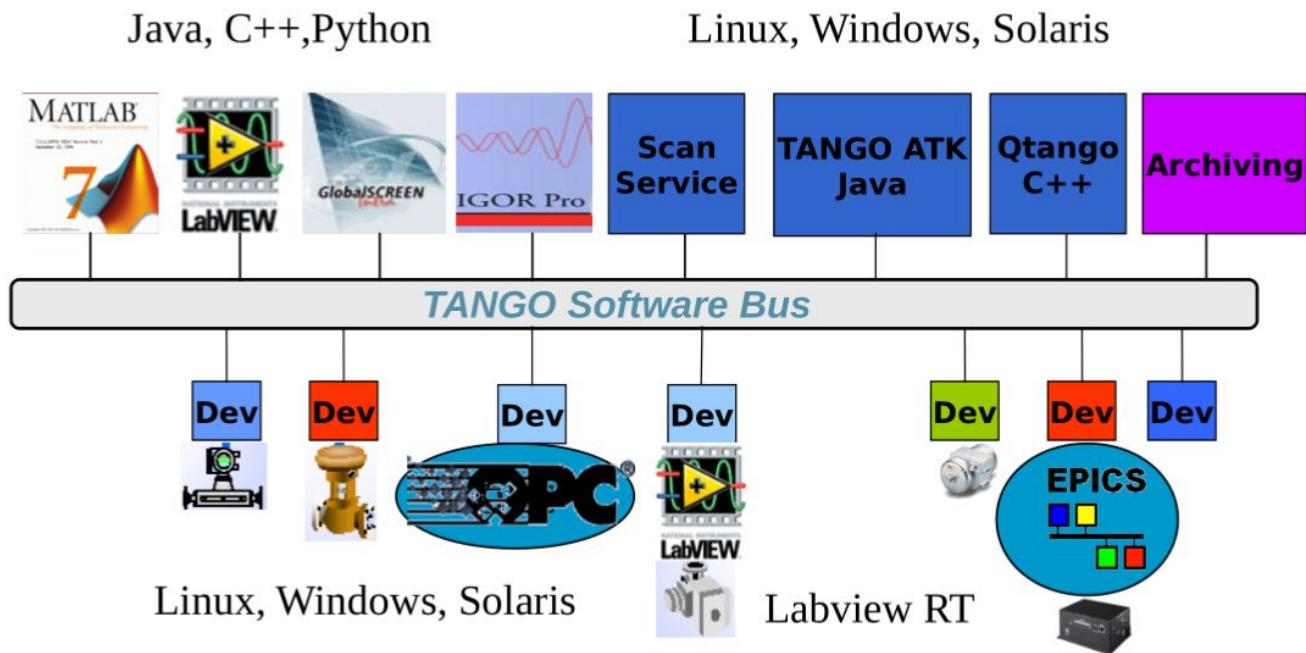
The goal of the work is to develop a new control system that provides automated control of the LINAC-200 accelerator equipment, as well as monitoring the parameters characterizing its state.

Main requirements for the control system:

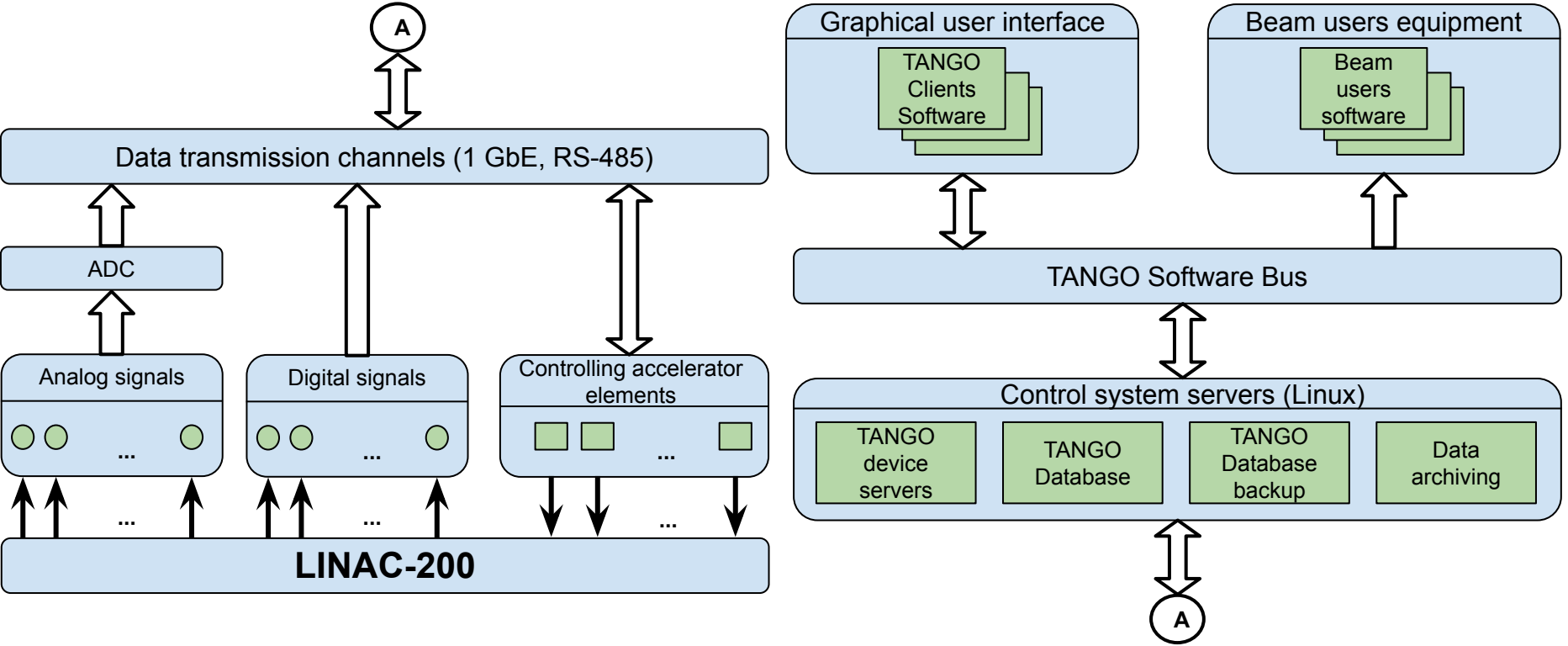
- high reliability
- serviceability
- using standard interfaces for communication between components
- possibility of future modifications and extensions

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 Interface

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 on a Linux system (NF-29-116). The interface is divided into several sections:

- Reference Voltage:** A control panel with three rows of DAC settings. Each row has a label, a '+' sign, a digit, and four up/down arrow buttons. An 'APPLY' button is to the right of each row.
 - Filament Supply, mV: + 5 0 0 0
 - Focusing Electrode, mV: + 2 0 0 0
 - Extractor, mV: + 3 0 0 0
- Real Voltage:** Two digital displays showing 9.18 V and 626.7 V.
- Real Current:** A digital display showing 4.779 A.
- Status:** A message at the bottom of the control panel reads: "OK. All errors reset. Coolers:1 - ON; 2 - OFF;"
- Terminal:** A terminal window at the bottom shows the execution of a program: `alex@NF-29-116: /home/nozdrin/src/gunemul`
`alex@NF-29-116:/home/nozdrin/src/gunemul$./a.out 3`
The terminal output is:
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)

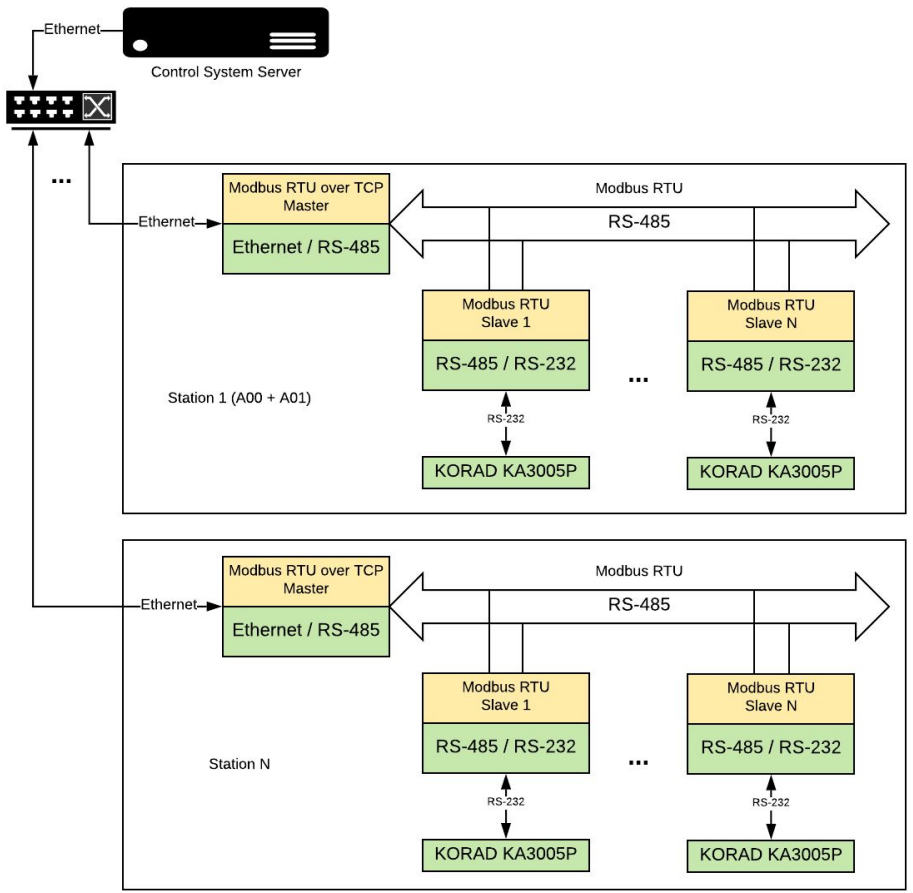
Magnetic system

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

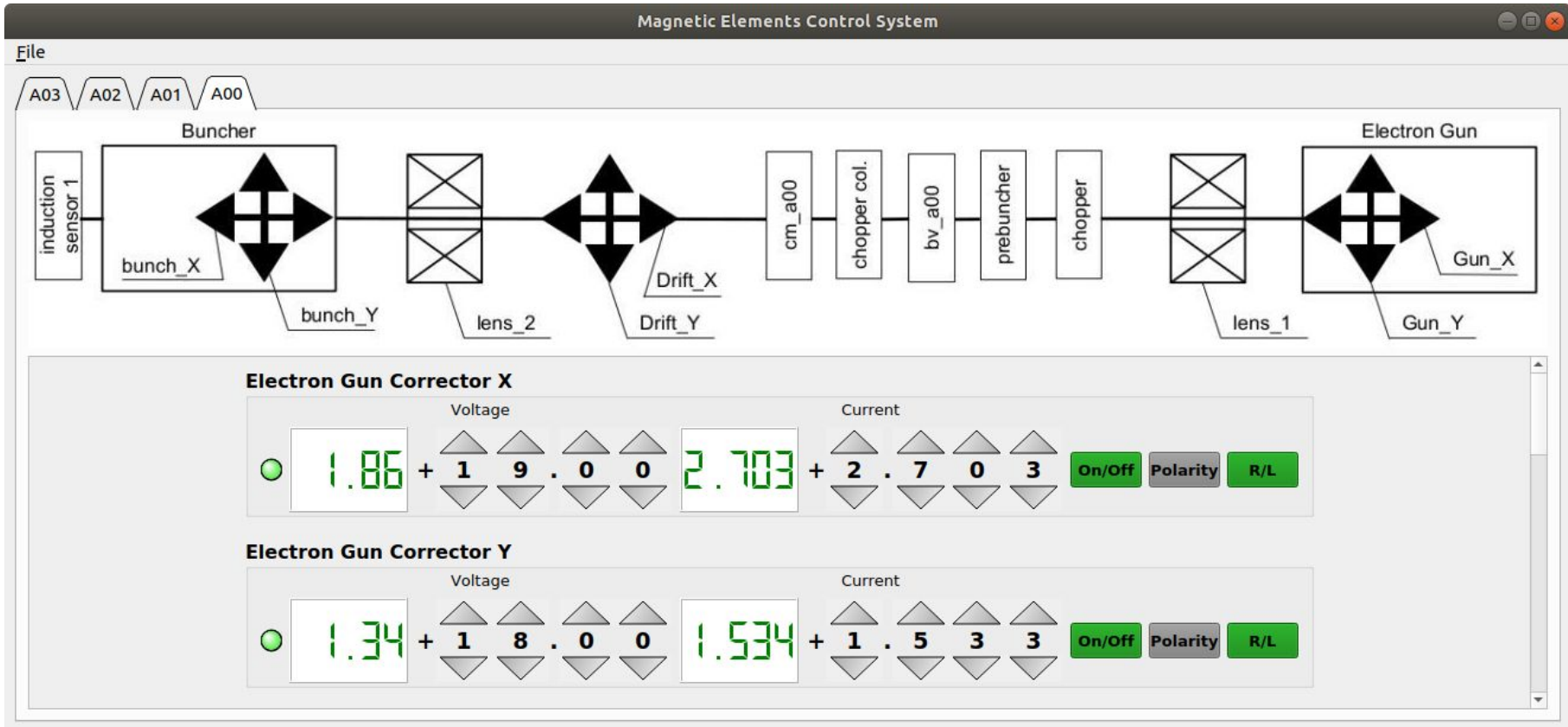


Ethernet to RS485 converter

Modules for communication with power supplies



Magnetic system

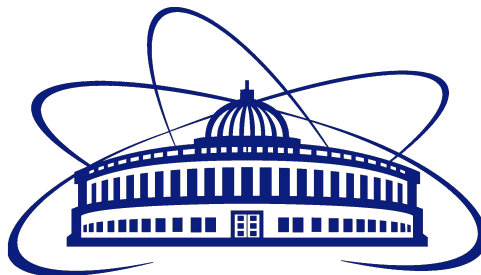


Conclusion

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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