

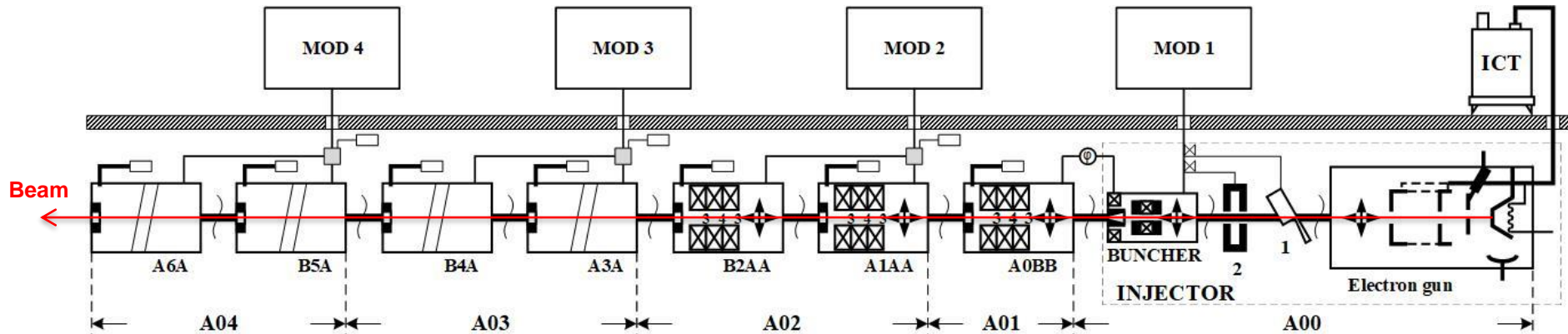
JINR Young Scientists and
Specialists Association
Conference “Alushta-2022”
June 5-12, 2022

The Control System of the Linac-200 Electron Accelerator at JINR

Aleksei Trifonov
DLNP JINR
trifonov@jinr.ru

Linac-200 Electron Accelerator

Parameter	Station	
	A01	A04
Electron energy, MeV	5-25	40-200
Pulse duration, μs	0,1-3,5	
Max. pulse current, mA	60	40
Pulse repetition rate, Hz	1-25	

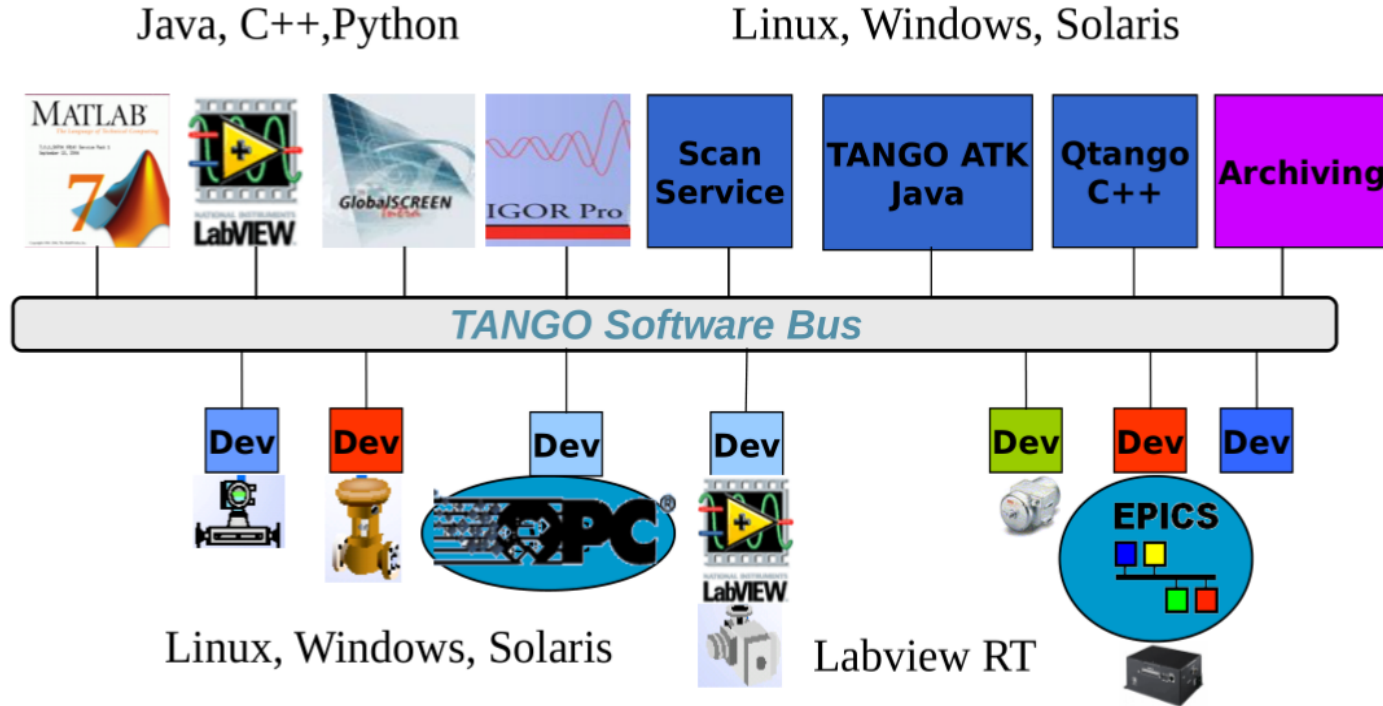


Requirements for the New Global Control System

Main requirements for the control system:

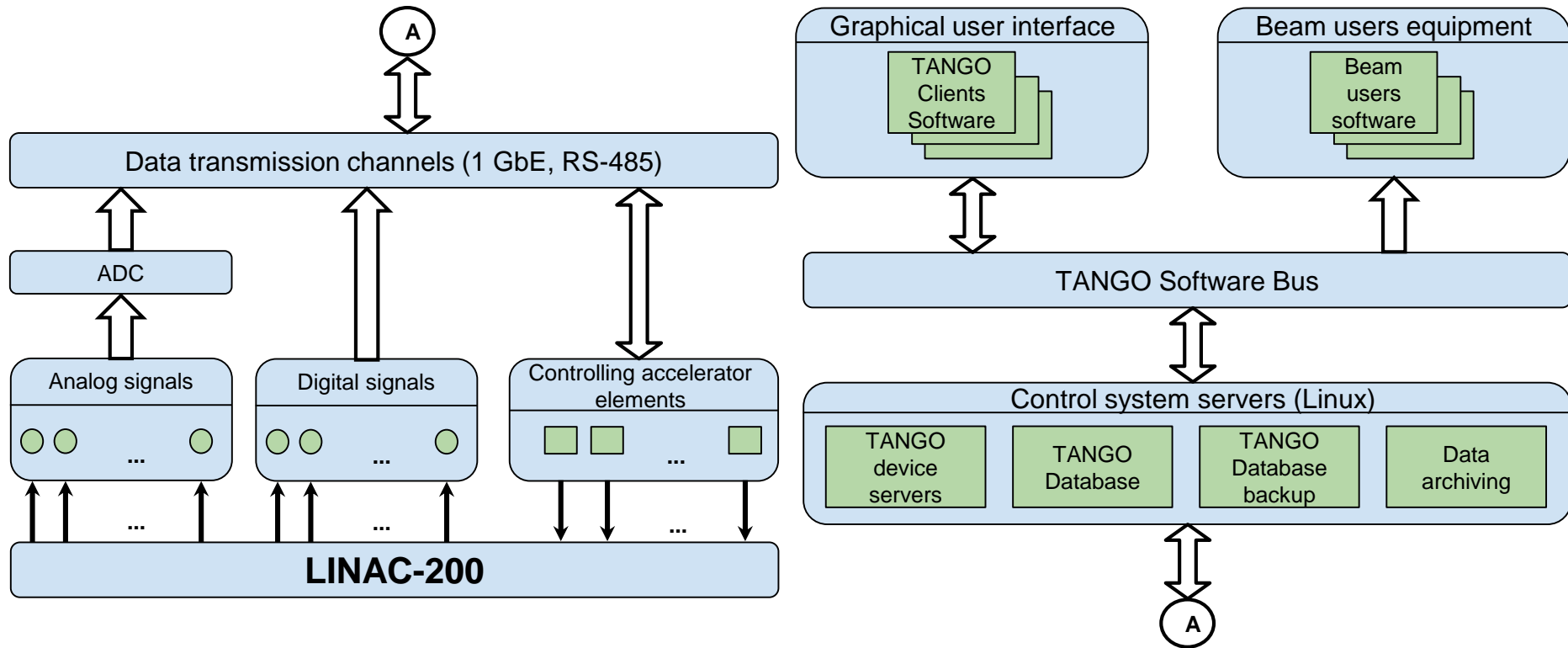
- high reliability
- serviceability
- using standard interfaces for communication between components
- possibility of future modifications and extensions
- possibility of using existing developments of the world community

TANGO-based Control System



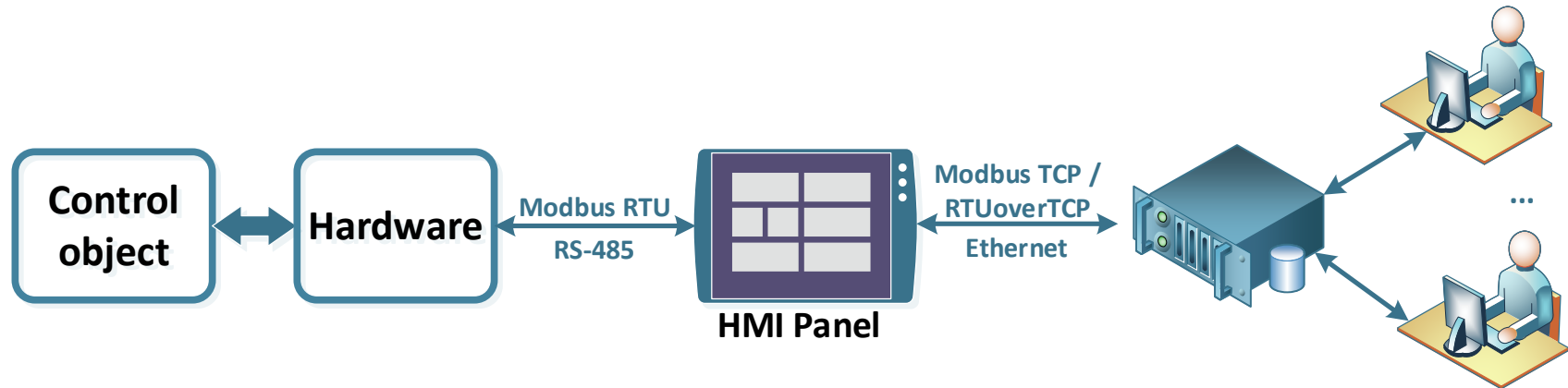
Official website: <https://www.tango-controls.org/>

Control System Concept



Local Control

- Local control is available for modulator control units and phase shifters. It's done with the Weintek MT8071iP operator panel.
- In addition to displaying the local control graphical interface, the Weintek MT8071iP panel acts as a Modbus server.



Technology Stack

In use today

- Tango version – 9.2.5
- Linux Debian/Ubuntu
- C++, Python3
- PyTango
- Qt5, Qtango

Future plans

- Cumbia
- Taurus
- Web client applications

Linac-200 Control System Subsystems

Electron Gun Control System	400-kV DC triode-type electron gun with a thermionic cathode is used. New software for the electron gun control was developed.
Synchronization System Control	New synchronization system by Dialtek will be used. At the moment, a standalone software is used to control the synchronization system. In the future Tango-based software would be developed.
Control of RF System Elements	Master oscillator, preamplifier, klystrons modulator control units, phase shifters.
Vacuum Control System	The vacuum system is controlled by the B&R PLC model X20CP3584. Interaction with the global control system is carried out through the Modbus TCP protocol.
Precise Temperature Regulation System	Its planned to use the Unichiller 100-H circulators by Huber. A special Pilot ONE unit would be used to control the circulators.
Focusing and Steering Magnets Control	Focusing and steering magnets are powered by the KORAD KA3005P and KA6003P power supplies.

Conclusion

The general concept of the global control system which capable of providing launch and control of the main accelerator subsystems has been designed. Tango-based software for individual subsystems of the Linac-200 has been developed.

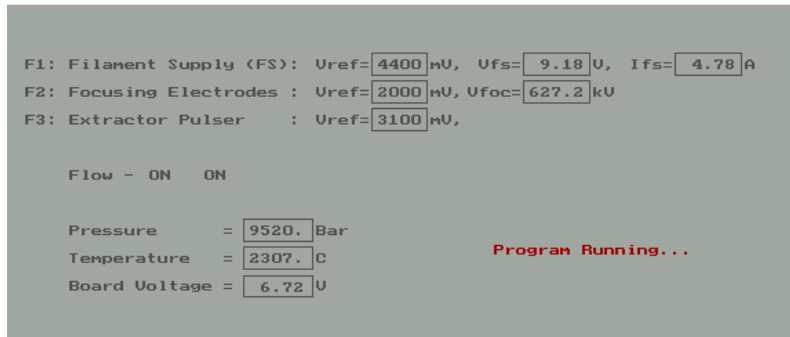
The accelerator building is undergoing major repairs. After the completion of the repair, it is planned to launch the accelerator with a new control system.

Backup slides

Publications

1. A. Trifonov et al. “The Control System of the Linac-200 Electron Accelerator at JINR”, in Proc. ICALEPCS’21, Shanghai, China, October 2021, paper TUAR03 (to be published).
2. M. Nozdrin, A. Trifonov, V. Kobets, V. Minashkin, “Linac-200 Gun Control System: Status and Plans” in Proc. ICALEPCS’21, Shanghai, China, October 2021, paper MOPB018 (to be published).
3. А.Н. Трифонов, и др., “Система автоматизированного управления магнитными элементами для фокусировки и коррекции положения пучка ускорителя ЛИНАК-200” // Приборы и техника эксперимента 2021, Т. 3, С. 152–154.

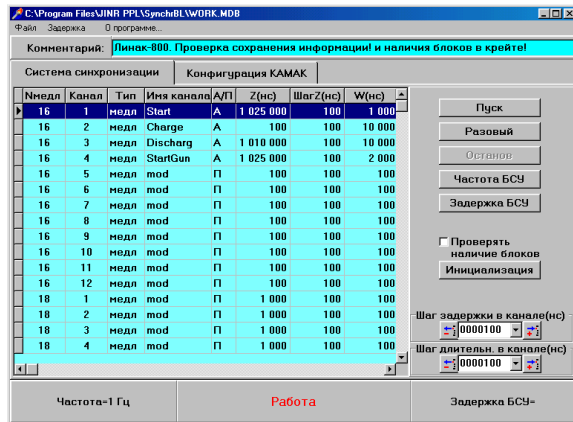
First Control System Upgrade



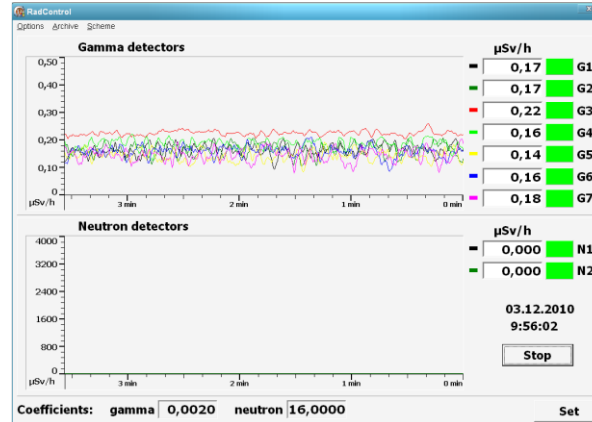
Electron gun control system software



General view of the temperature control system



Synchronization system software



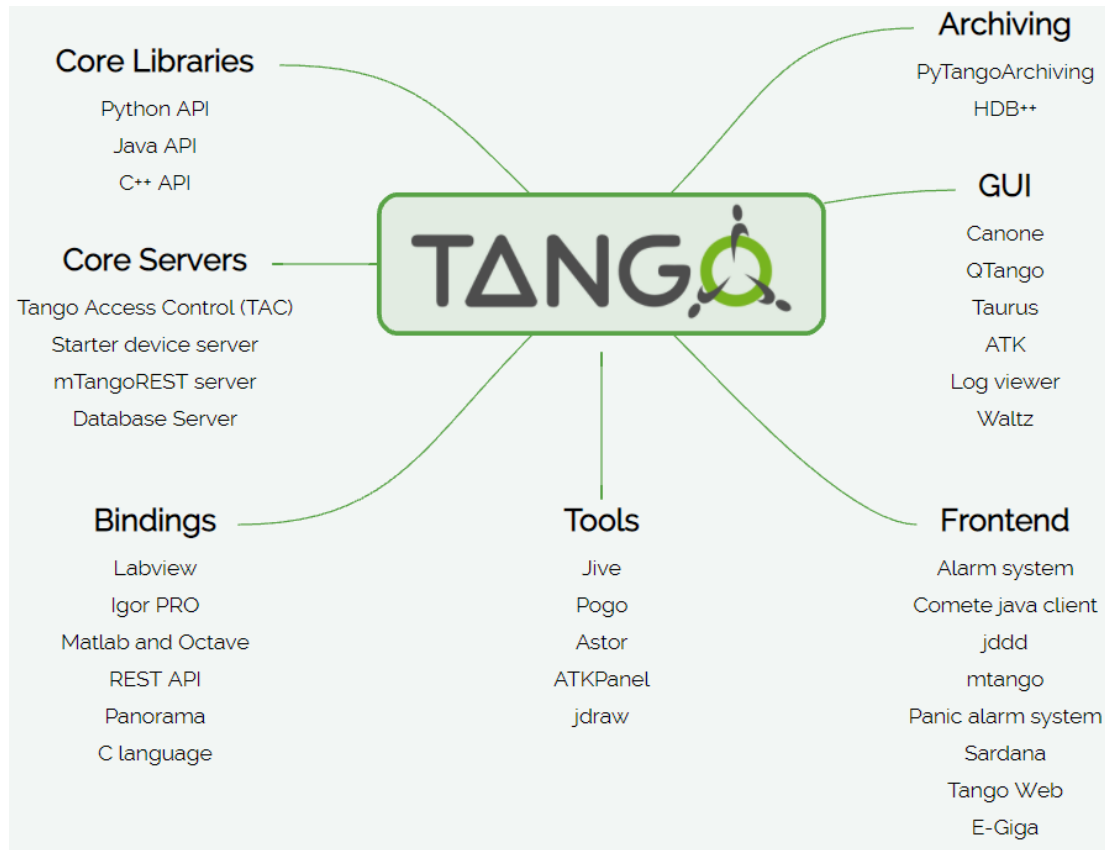
Radiation control system software



Interlocking and alarm system switchboard

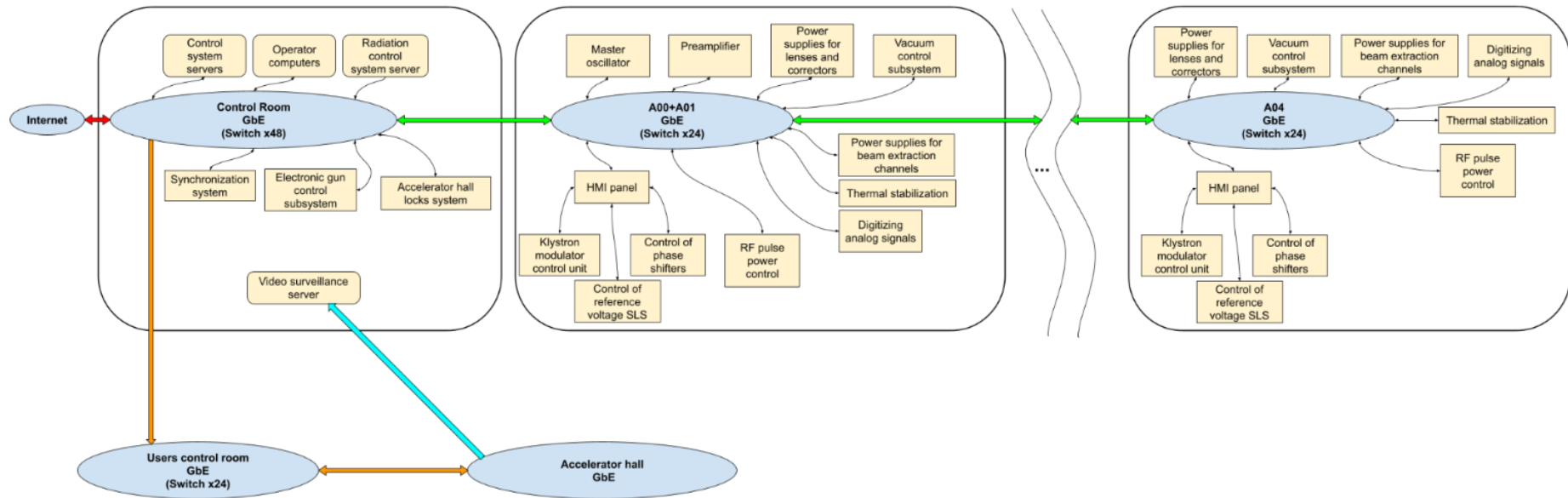
M. A. Nozdrin, "A set of hardware-software control and diagnostic tools for the Linac-200 electron accelerator and the prototype of the JINR photoinjector," Cand. Sci. (Tech. Sci.) Dissertation, Joint Inst. Nucl. Res.

TANGO Ecosystem



<https://www.tango-controls.org/developers/#tango-ecosystem>

Network Infrastructure



Focusing and Steering Magnets Control

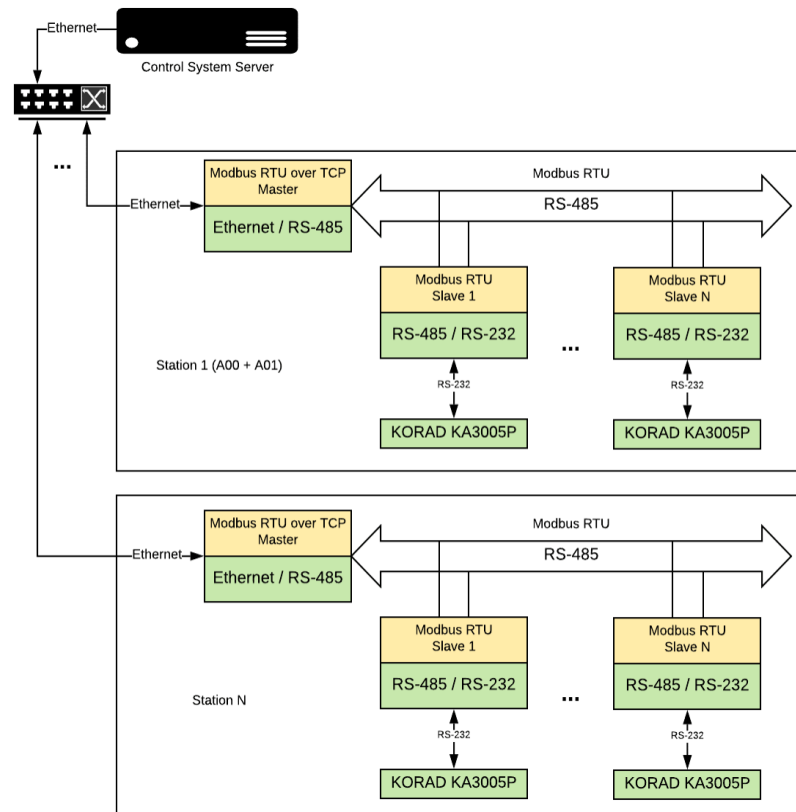
20 KORAD power supplies

- 18 (30 V, 5 A)
- 2 (60 V, 3 A)



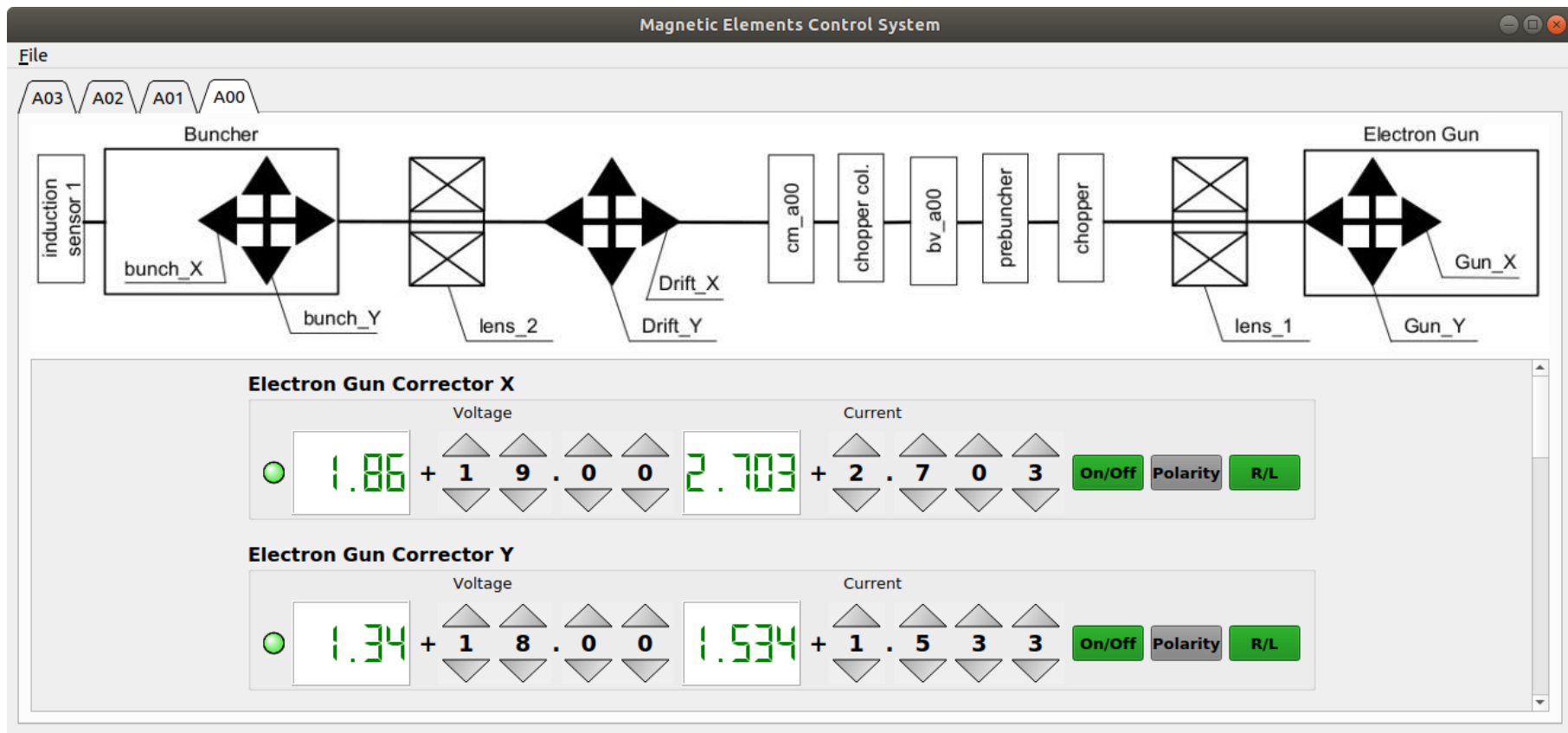
Ethernet to RS485
converter

Modules for communication
with power supplies

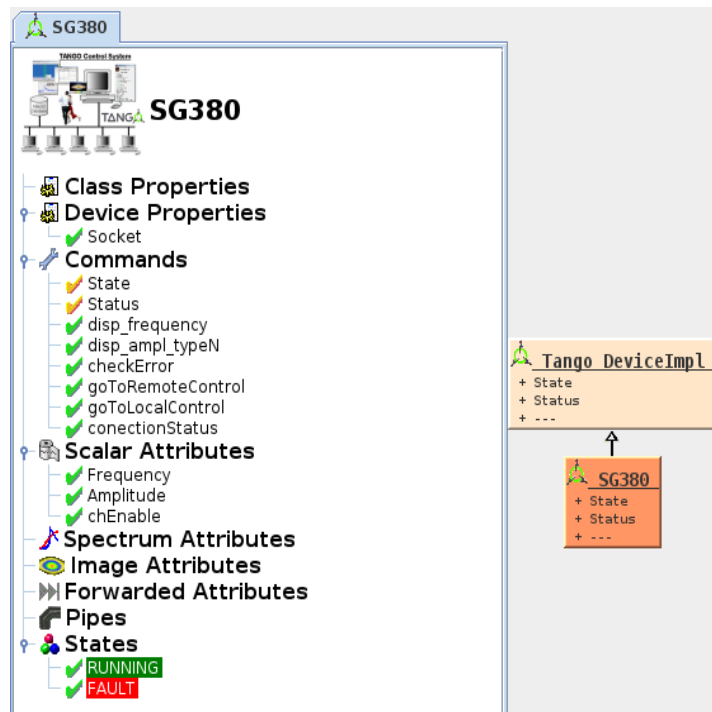
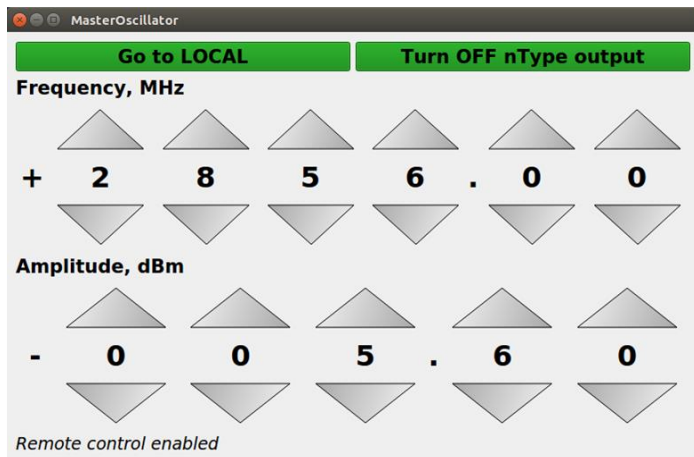


Magnetic element control system layout

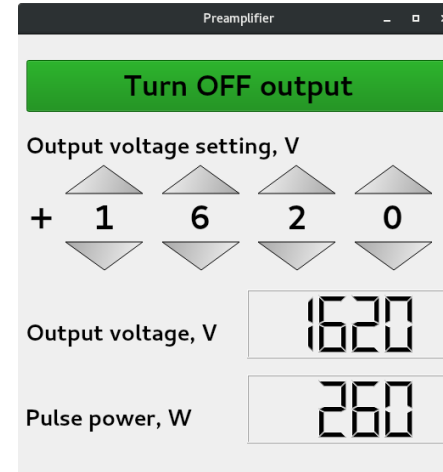
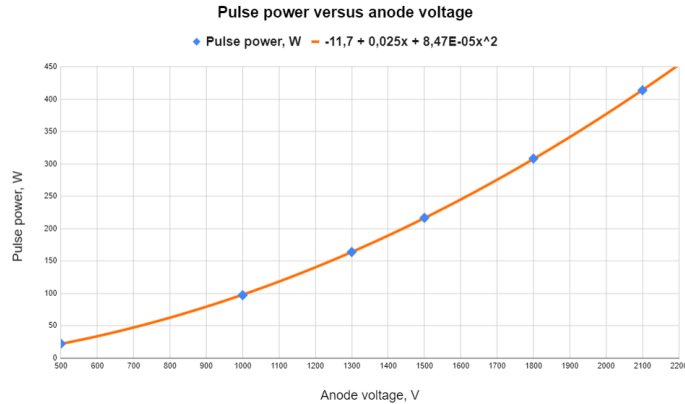
Focusing and Steering Magnets Control



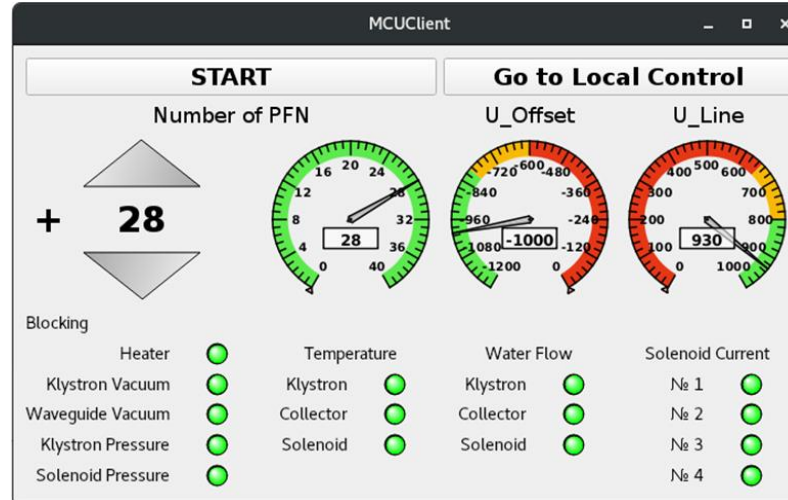
Master oscillator



RF preamplifier



Modulator control unit



Communication

PyModbus based device server for communication via Modbus protocol.

Support RTU, TCP and RTUoverTCP communication formats.

