Slow Control Systems at BM@N and MPD/NICA Detector Experiments

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NICA (Nuclotron-based Ion Collider fAcility)

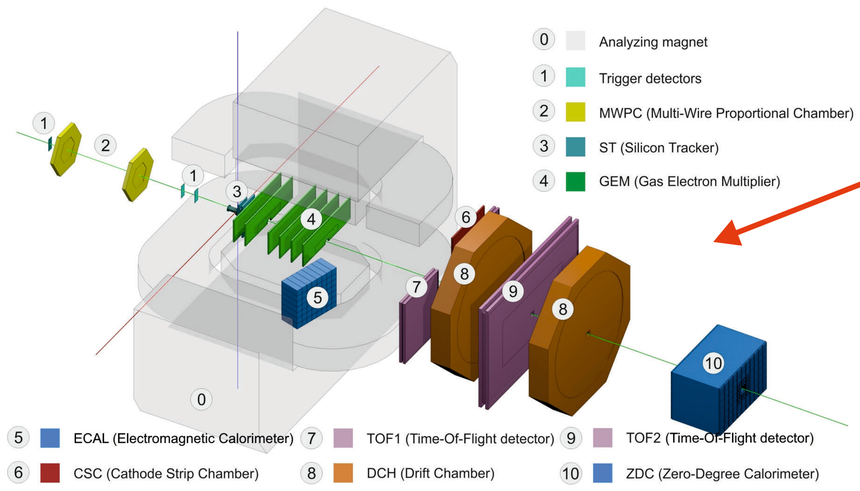

Fig. 1. BM@N detector experiment

BM@N (Baryonic Matter at Nuclotron) is the first experiment at the accelerator complex of NICA. The aim of the BM@N experiment is to study interactions of relativistic heavy ion beams with fixed targets.

First physical run was performed in 2018 with carbon, argon and krypton beams. Next run is planned at the end of 2020 with krypton and xenon beams.

There is the **Short Range Correlations (SRC)** experiment, which is based on BM@N detectors and beamline and NeuLAND detector from GSI. Its collaboration includes groups and organizations from Russia, Israel, Germany, USA and France.

Fig. 2. NICA complex

NICA (Nuclotron-based Ion Collider fAcility) is a new accelerator complex designed at the Joint Institute for Nuclear Research (Dubna, Russia) to study properties of dense baryonic matter.

The facility takes into account the broadened scope of the physics of strong interaction and related problems in the fundamental many-body systems and provides particle beams from protons to gold nuclei.

The range of colliding energy of nuclei is $\sqrt{S_{NN}} = 4 - 11$ GeV, and that for protons $\sqrt{S_{pp}} = 4 - 20$ GeV. The global scientific goal of the NICA/MPD Project is to explore the phase diagram of strongly interacting matter in the region of highly compressed and hot baryonic matter.

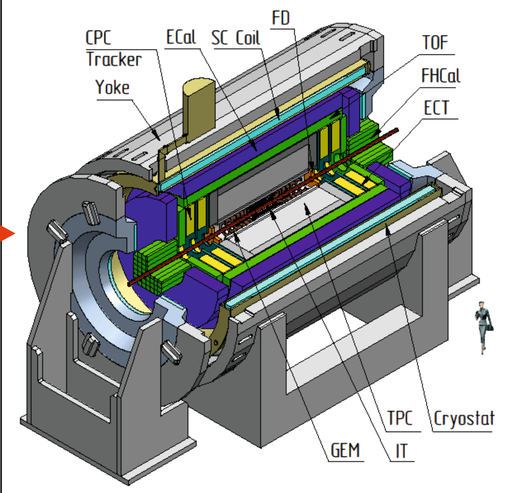

Fig. 3. MPD detector experiment

The **MPD (Multi Purpose Detector)** apparatus has been designed as a 4π spectrometer capable of detecting of charged hadrons, electrons and photons in heavy-ion collisions at high luminosity in the energy range of the NICA collider.

The detector is currently under construction and its first stage will be put into operation in the 2021.

Tango-based Slow Control System

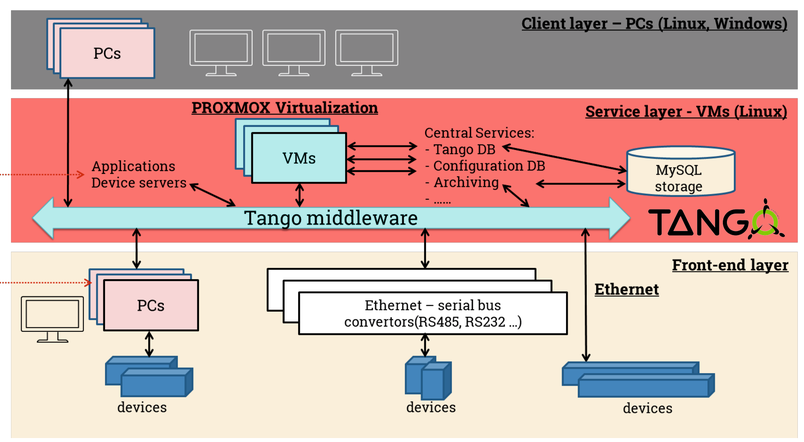

Fig. 4. Tango-based detectors slow control scheme

The layout of the BM@N and MPD Slow Control system is presented at Figure 4. Three layers of software – front-end layer, service layer and client layer are connected by Tango Controls middleware.

The service layer includes all central services like Tango Database, archiving, configuration Database, application device services, etc. All the software of the Service Layer is running on several virtual machines at the existing computing farm. Virtualization is done using PROXMOX Virtual Environment.

The frontend layer includes a wide variety of devices using different buses – Ethernet, RS485, RS232, etc. and protocols – Modbus, SNMP, Socket etc.

The client layer is presented by clients PCs running Linux or Windows operating systems.

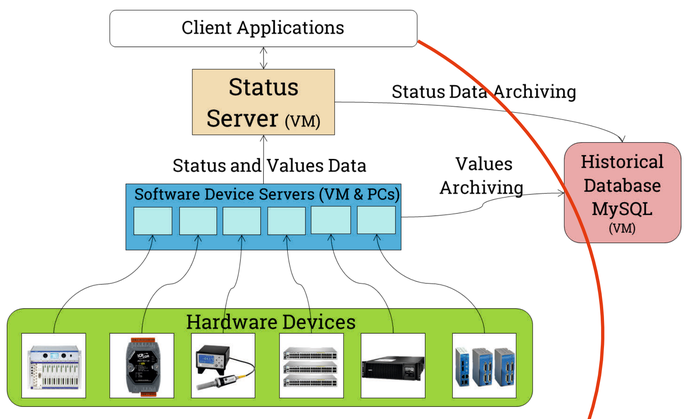

Fig. 5. Subsystems status server scheme

Fig. 6. Wiener MPOD crate

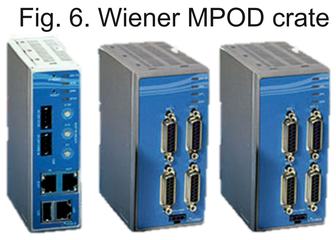

Fig. 7. MKS PAC 100-based TOF BM@N gas system

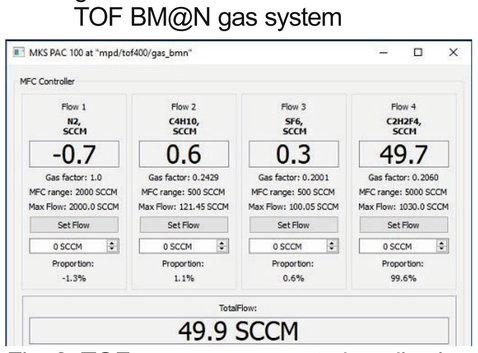

Fig. 8. TOF gas system control application

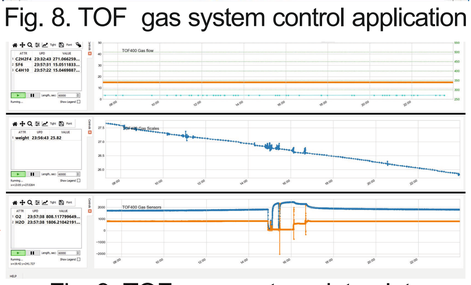

Fig. 9. TOF gas system data plots

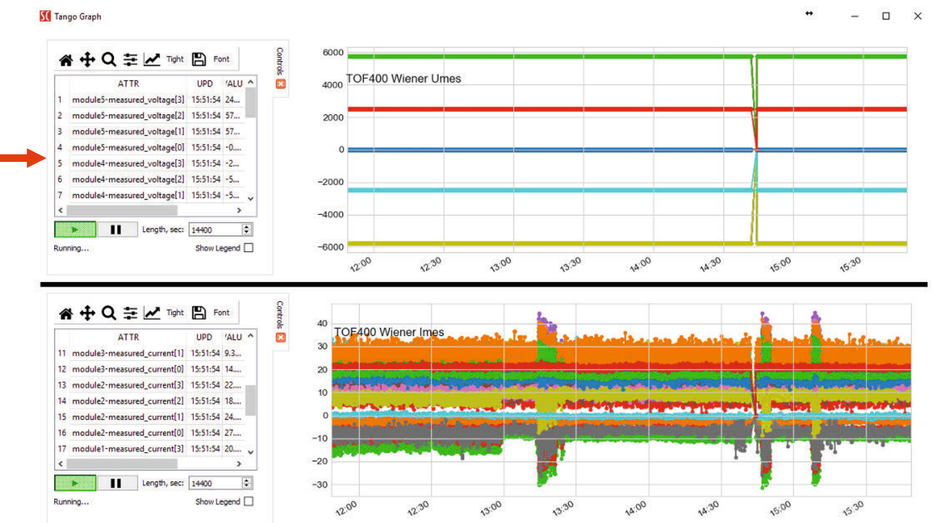

Fig. 12. Tango Graph application with data from Wiener HV power supply

Fig. 10. Wiener and ELMA VME crates

Fig. 11. Keithley 6485 Picoammeter

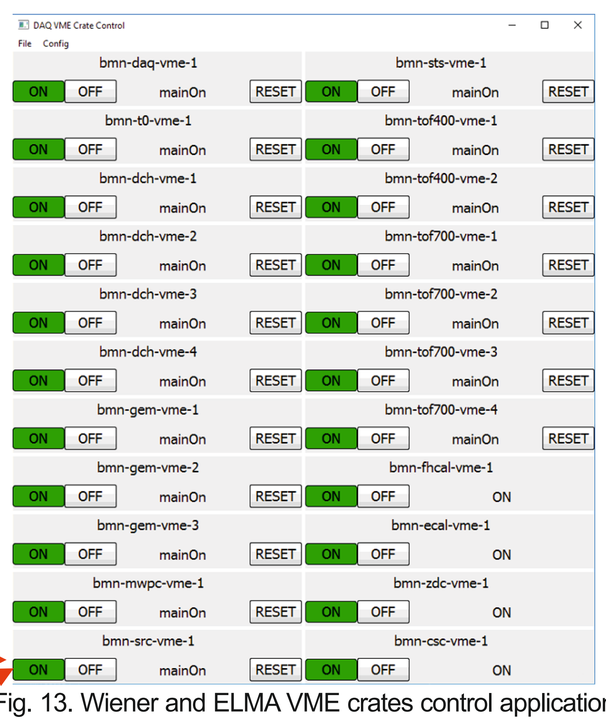

Fig. 13. Wiener and ELMA VME crates control application

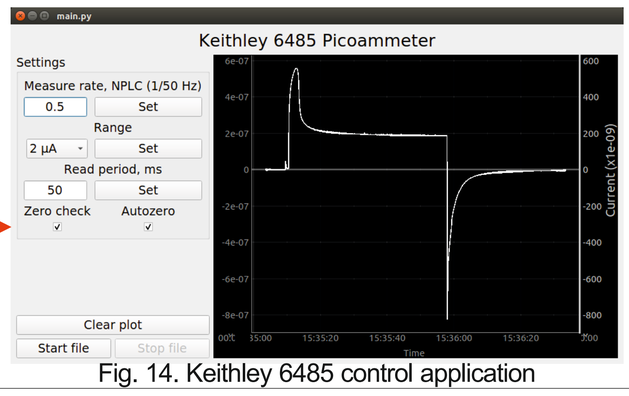

Fig. 14. Keithley 6485 control application

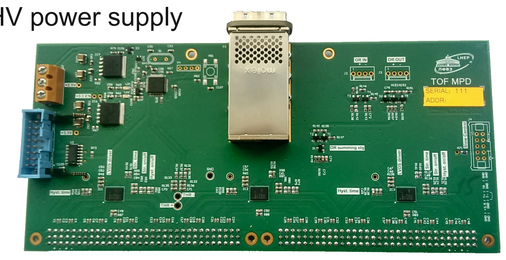

Fig. 15. TOF preamplifier board

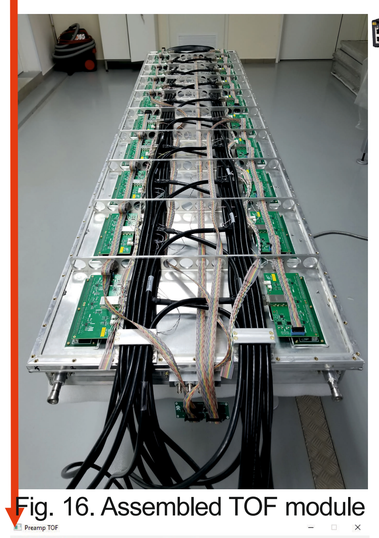

Fig. 16. Assembled TOF module

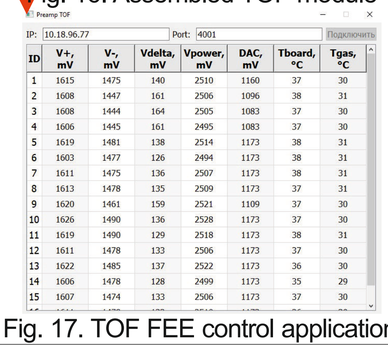

Fig. 17. TOF FEE control application

Fig. 18. HP Network switch

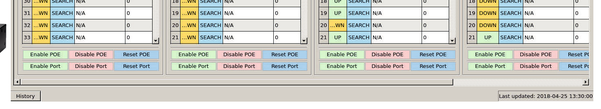

Fig. 19. HP Network switch control application

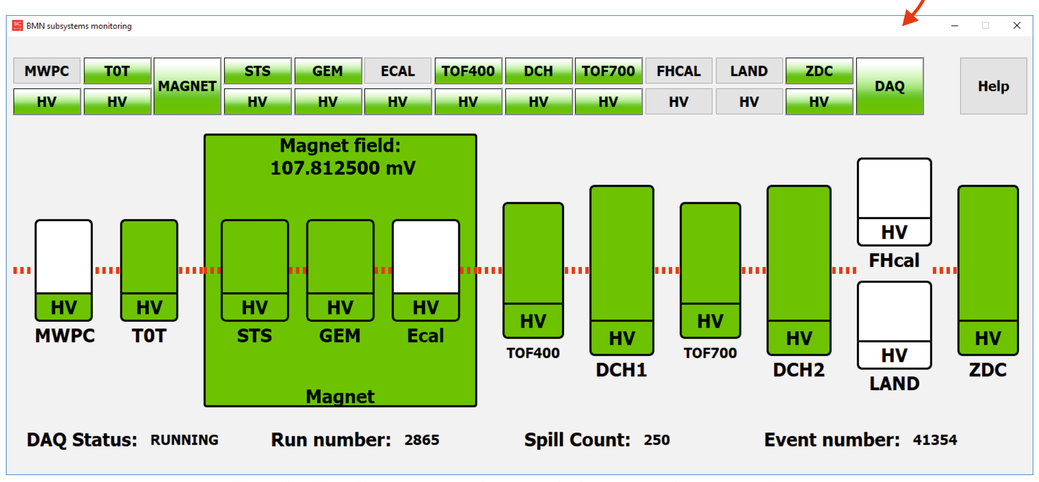

Fig. 9. BM@N subsystems status client application

TOF MPD assembly and cosmic rays test stand

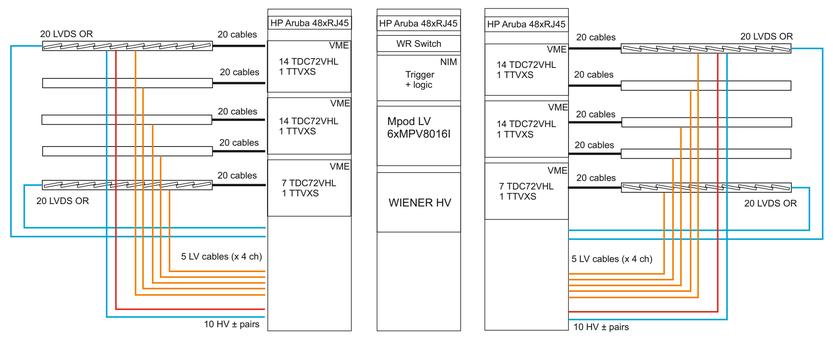

Fig. 20. TOF MPD test stand scheme

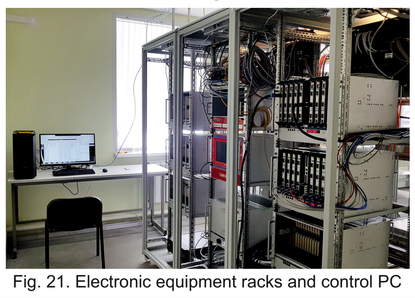

Fig. 21. Electronic equipment racks and control PC

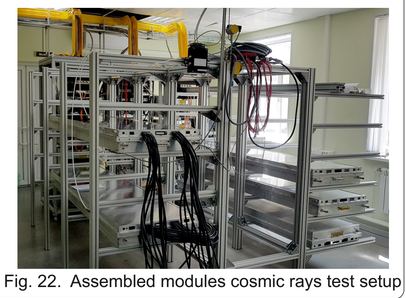

Fig. 22. Assembled modules cosmic rays test setup