Call: FAIR-RO 2020 **Project acronym: SISTINA**

Experiment: PANDA

Scientific Domain: AP

Midterm Summary Document[1]

Year: Nov. 2020 - Jun. 2022

Project Title: Strong interaction studies in antiproton annihilation (SISTINA)

Project Work Plan (according to the contract)

Stage: I - 2020

Activities: Process Variables database system

I. 1. - market research and purchase of server and workstations;

- installation and configuration of database management system;

- study of current software tools used by EPICS community for PV archiving.

Stage: II – 2021

Activities: Multipurpose Rack Control Unit 3.0 (MRCU) and Process Variables database system

I. 1. - Epics device support software (IOC) for MRCU;

- Operator interface development (OPI) for MRCU;

- Installation, configuration operation and performance testing of PV archiver application;

Stage: III - 2022

Activities: STT Controls development

I. 1. -Requirements for the STT read-out electronics;

-Integration of STT readout in the control system;

-Gas system.

[1] Please fill in all the required items and do not alter the template

	TOTAL	2020	2021	2022*
Allocated budget:	830.769,00	92.307,00	369.231,00	369.231,00
Realized budget:	632.166,75	92.307,00	369.231,00	170.628,75

***) Realized value for 2022: 1 January 2022 - 30 June 2022**

1. Cover Page (1 page):
    - Group list (physicists, staff, postdocs, students);

Name	Position
Alexandru-Mario BRAGADIREANU	Physicist (Scientific Researcher III) – IFIN-HH
Petre-Constantin BOBOC	Physicist (Research Assistant) – IFIN-HH
Stefan-Alexandru GHINESCU	Physicist (Research Assistant) – IFIN-HH
Ovidiu-Emanuel HUTANU	Engineer - IFIN-HH
Alina MOTORGA	Project accountant - IFIN-HH

- Specific scientific focus of group (state physics of subfield of focus and group's role);

    Physics subfields: QCD bound states, Hypernuclear Physics.

    Taking into account the expertise of our group (ATLAS, EXCHARM, FOCUS, DEAR and SIDDHARTA experiments) we expressed our interest in the measurements dedicated to charmonium and exotic states and in the Hypernuclear Physics with emphasis on Ξ^- atoms were our experience in detecting X-rays coming from transitions in Kaonic exotic atoms would be beneficial for PANDA Collaboration.

- Summary of accomplishments during the reporting period.

    Since PANDA experiment is now in Construction phase our short-term objectives, for 2020, were focused on research and development activities for PANDA STT sub-detector and its integration in the PANDA control system.
    Accomplishments:
    - established the software components to be used for the STT Process Variables Database System;
    - decided the hardware configuration and ordered a server and a workstation to be used in the STT Process Variables Database System;
    - design and assembly of an enhanced Multifunction Rack Control Unit (MRCU v4)
    - development of Epics device support software (IOC) for the MRCU v4;
    - development of the operator interface development (OPI) for MRCU v4;
    - installation, configuration operation and performance testing of PV archiver system;
    - defined the requirements for the integration of STT read-out electronics in the Control System.

2. Scientific accomplishments (max. 3 pages) – Results obtained during the reporting period.

Due to the late contracting of SISTINA project in 2020 we had few time at disposal, about one month, to cope with STT controls. However, we succeed to accomplish the ordering of some hardware components which assured a good start, in 2021, for the STT Process Variables Database System.

The test bed for database storage and retrieval developed at the begging of 2018 in IFIN-HH, with reused IFIN-HH PANDA grid compute nodes, has been updated in 2021 consisting of 10 reused computers and 1 new computer serving as a database server (fig. 1).

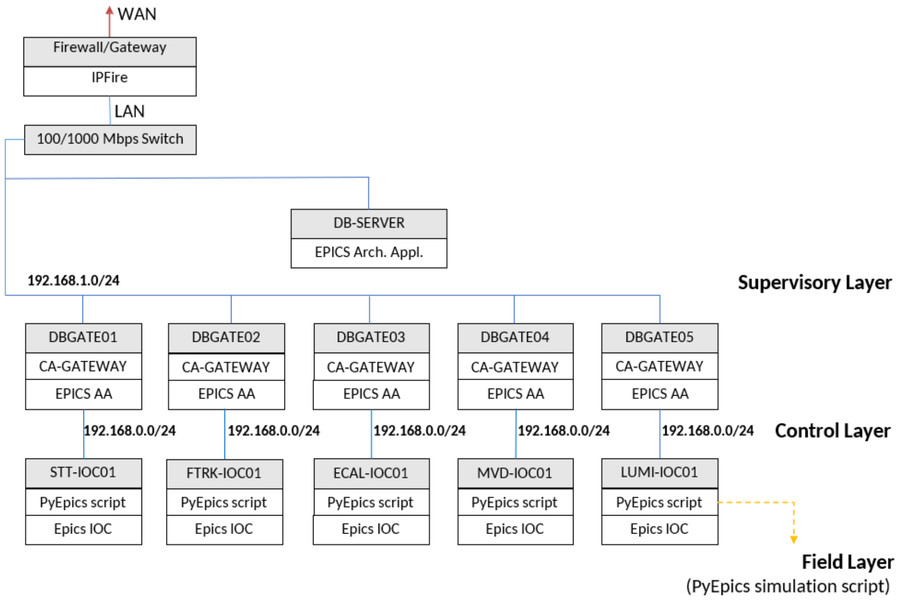

Fig. 1 Process Variable archiving test-bed

We developed a solution to deploy EPICS Archiver Appliance using Docker, the configuration files and the data generated by the Archiver Appliance being able to be stored both locally and on a network file system. The database storage test bed consists of:

- 5 computers in the field layer: each computer runs an EPICS IOC with 12002 Process Variables (PVs) and a Python script used to generate random values for the PVs
- 5 computers in the control layer: each computer runs an instance of EPICS CA-Gateway which serves as a channel access client and server and an instance of EPICS Archiver Appliance archiving 12002 PVs, used as a backup solution for each computer
- 1 computer in the supervisory layer running an instance of EPICS Archiver Appliance which archives all 60010 Process Variables. This computer can also be used as a data retrieval solution using the built-in web data retrieval tool.

Using EPICS' built-in performance monitor, the system load for the machines in the control layer does not exceed 5% and the supervisory layer's computer system load does not exceed 25% (Fig. 2).

Fig. 2 System load and Java Virtual Machine parameters graph

The main difference between MRCU v3 and MRCU v4 (see fig. 3) is that the circuit used to read the temperature of the PT100 RTD sensor, which was a mezzanine board, it was replaced by a dedicated circuit placed on the same board. By replacing this circuit, the boost converter used to generate 12 V DC used to supply the mezzanine board was also removed. The advantage is that the final price of the system was considerable reduced. Another difference is that the circuit which was used to interface the MRCU motherboard with a Raspberry Pi single-board computer was removed because the motherboard has now a dedicated ethernet connection.

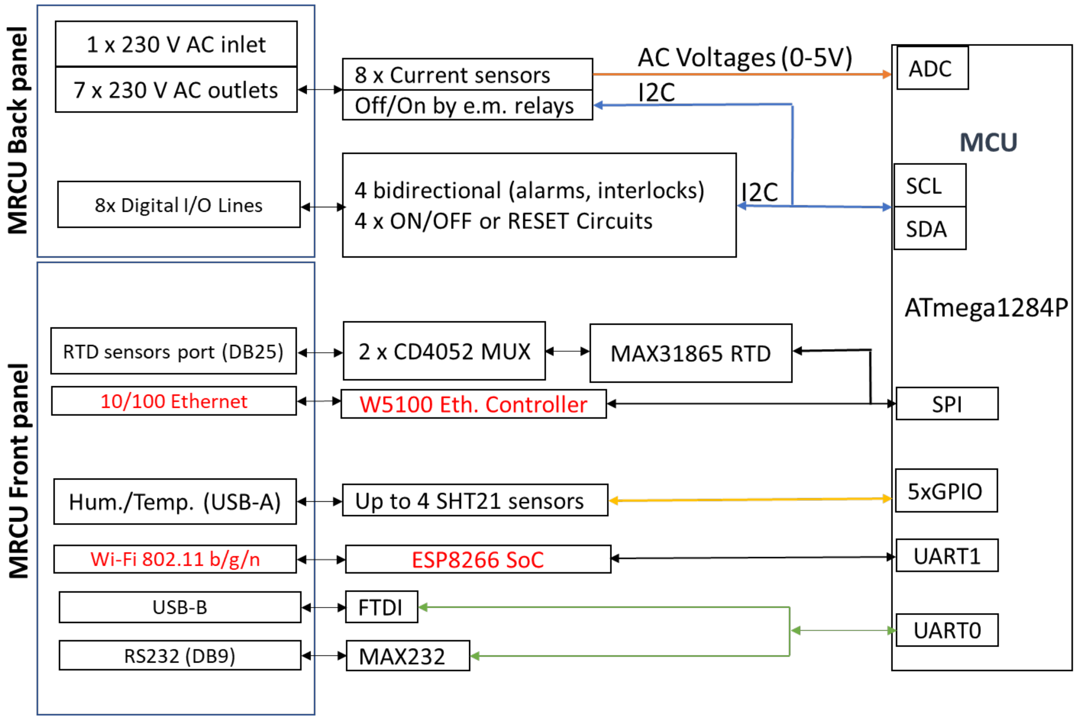

Fig. 3 MRCU v.4 general view

The software controller and the graphical user interface (OPI) were developed using EPICS and Python Display Manager framework (PyDM). The OPI consists on various widgets which can be used to monitor and control the MRCU. As an example, the widget developed to control the AC and the current consumption is shown in fig.4.

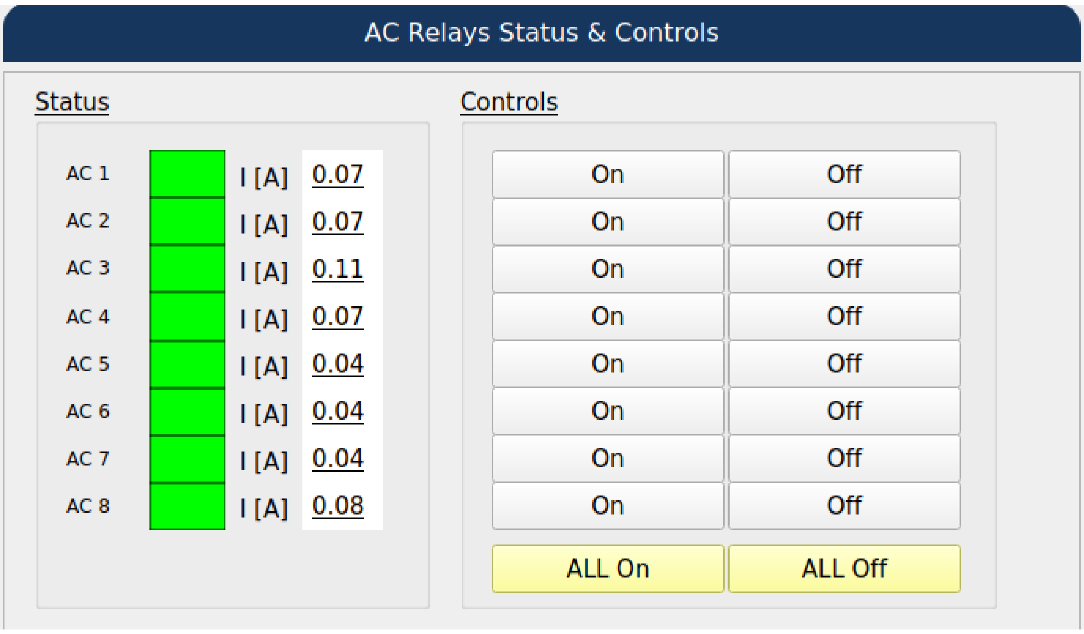

Fig. 4 MRCU v.4 operator interface component

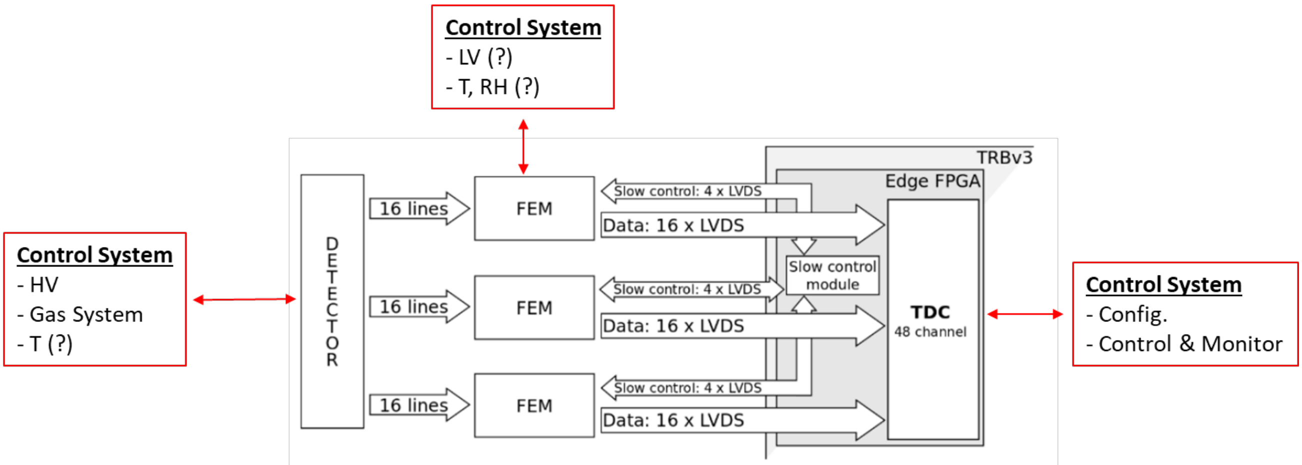

Fig. 1. Schematic view of the readout system. Analog signals from the detector are shaped and discriminated by the FEM. Timing of output LVDS signals is digitized by the TDC firmware running on the edge FPGA in the TRBv3 module. One TDC can control and collect data from three FEMs, which, in turn, serve 48 detector channels.

In 2022, together with PANDA STT Coordinator and DAQ expert we defined the requirements for the integration of STT read-out electronics in the Control System. Currently we are making prospects in order to purchase or borrow a TRBv3 board from GSI.

Regarding the development of controls for the (final) STT gas system, foreseen for this year, the situation is critical because of lack of gas hardware expertise at Forschungszentrum Jülich, IKP STT group. To mitigate this a collaboration with CERN was foreseen some years ago but no real progress was made so far.

3. Group members (table):

- List each member, his/her role in project and the Full Time Equivalent (FTE) time in project. The FTE formula to be used is: FTE = Total number of worked hours /Total number of hours per reporting period;

First Name, Last Name	Academic Degree	Realized FTE 2020	Realized FTE 2021	Realized FTE 2022 (30 June)
Alexandru-Mario BRAGADIREANU	PhD	0.03	0.37	0.13
Petre-Constantin BOBOC	Master	0	0.33	0.10
Stefan-Alexandru GHINESCU	Master	0	0.33	0.11
Ovidiu-Emanuel HUTANU	Master	0.03	0.33	0.22
Alina MOTORGA	Master	0.07	0.17	0.13
	Total	**0.13**	**1.53**	**0.69**

- List PhD/Master students and current position/job in the institution.

- Petre-Constantin BOBOC– PhD student / research assistant;
- Stefan-Alexandru GHINESCU – PhD student/ research assistant;
- Ovidiu-Emanuel HUTANU – Master student/ engineer.

4. Deliverables in the period Nov. 2020 – June 2022 related to the project:

- MRCU device with native EPICS support and operator interface (2021);

- Docker image for EPICS Archiver Appliance (2021);
- Prospects for Spin-Parity Determination of Excited Baryons via the $\Xi^+ \Lambda K^-$ Final State with PANDA, PANDA Collaboration V. Abazov et al. (Jan 11, 2022), e-Print: 2201.03852 [hep-ex].

Other deliverables: Project webpage.

5. Further group activities (max. 1 page):
   - In 2020 the Multipurpose Rack Control Unit v.3 was upgraded- with embedded ethernet and Wi-Fi controllers. The unit was built in the framework of NUCLEU project, a new firmware being developed and tested successfully at the end of 2020
   - The impact of COVID-19 pandemic is noticeable in the travel budget allocated in 2020-2021
   - Since the cooperation with Russian Institutes is suspended due to the war on Ukraine, several PANDA sub-systems are affected. STT available man power and expertise is affected due to Moscow State University, The most affected sub-systems are Forward TOF, FS Calorimeter, Muon System, PANDA Solenoid magnet and the HESR PANDA Dipole.

6. Financial Report (budget usage) for the reporting period (see the Annex).

7. Research plan and goals for the next year (max. 1 page).

Year	2020				2021				2022				2023			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Requirements for the STT read-out electronics																
Integration of STT readout in the control system																
Gas system																
STT Controls software deployment																
Software acceptance																
Installation and deployment																

The goals of 2023 are difficult to be completed due to the delay in the production of final STT gas system (red) and some delays can be also accumulated due to the availability of TRB v3 boards (yellow). A prototype software, based on Bronkhorst gas devices, developed by our group is available but, at least 6 months are needed to develop and test the final software.

Financial Report Oct. 2020 – 30 June 2022

according to the regulations from H.G. 134/2011

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	Type of expenditures	**TOTAL 2020 - 2022**		**2020**		**2021**		**2022**	
		Planned	**Realized**	**Planned**	**Realized**	**Planned**	**Realized**	**Planned**	**Realized (30 June)**
1	**PERSONNEL EXPENDITURES**, from which:	**393.171,00**	**315.848,00**	**11.811,00**	**12.457,00**	**190.680,00**	**192.892,00**	**190.680,00**	**110.499,00**
	1.1. wages and similar income, according to the law	384.519,00	308.897,00	11.551,00	12.183,00	186.484,00	188.647,00	186.484,00	108.067,00
	1.2. contributions related to wages and assimilated incomes	8.652,00	6951,00	260,00	274,00	4.196,00	4.245,00	4.196,00	2.432,00
2	**LOGISTICS EXPENDITURES**:	**206.012,50**	**154.916,07**	**74.590,50**	**73.542,00**	**65.711,00**	**76.493,82**	**65.711,00**	**4.880,25**
	2.1. capital expenditures	196.012,50	148.246,60	74.590,50	73.542,00	60.711,00	69.824,35	60.711,00	4.880,25
	2.2. stocks expenditures	10.000,00	6.669,47	0	0	5.000,00	6.669,47	5000,00	0
	2.3. expenditures on services performed by third parties, including:	0	0	0	0	0	0	0	0
	....	0	0	0	0	0	0	0	0
3	**TRAVEL EXPENDITURES**	**20.000,00**	**0**	**0**	**0**	**10.000,00**	**0**	**10.000,00**	**0**
4	**INDIRECT EXPENDITURES – (OVERHEADS) ***	**211.585,50**	**161.402,68**	**5.905,50**	**6.308,00**	**102.840,00**	**99.845,18**	**102.840,00**	**55.249,50**
	TOTAL EXPENDITURES *(1+2+3+4)*	**830.769,00**	**632.166,75**	**92.307,00**	**92.307,00**	**369.231,00**	**369.231,00**	**369.231,00**	**170.628,75**