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

Experiment: PANDA

Scientific Domain: AP

Midterm Summary Document[1]

Year: Jul. 2022 – Nov. 2023

Project Title: Strong interaction studies in antiproton annihilation

Project Work Plan (according to the contract)

Stage: III - 2022 (Jul. 2022 - Dec 2022)

Activities: STT Controls development

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

- Integration of STT readout in the control system;

- Gas system.

Stage: IV - 2023

Activities: STT Controls software deployment

III. 1 -Software acceptance;

-Installation and deployment.

	TOTAL (RON)	2022*	2023
Allocated budget:	**567,833.25**	**198,602.25**	**369,231.00**
Realized budget:	**567,833.25**	**198,602.25**	**369,231.00**

***) Realized value for 2022: Jul. 2022 - Dec 2022**

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

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 were focused on research and development activities for PANDA STT sub-detector and its integration in the PANDA control system.
Accomplishments:
- proof of concept for the integration of TRBv3 boards in EPICS;

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

At the end of 2022 we succeed to purchase a TRBv3 board from GSI.

The TRB3 System is a general-purpose board for experimental particle physics currently used (mainly) by HADES and PANDA collaborations, composed of 5 Lattice LF3-150EA FPGAs, one central and four peripheral, the central FPGA's role being the slow control and readout of the peripherals FPGAs, while each of the peripherals provide 64 TDC channels and one reference channel. The TRB3 provides connectivity through eight SFP ports and mezzanine support for each peripheral FPGA.

The TRB3 System [1] is controlled over TCP/UDP through the TrbNet [2] protocol and software package which provides asynchronous control of the TRB3 system registers and DABC (Data

Acquisition Backbone Core) [3] - Go4 [4] software packages are used for data acquisition and data analysis.

By default, two user's interfaces are provided by TRB developers: a command-line interface and a graphical user interface based on interactive web service written in Perl. The main disadvantage of the implementation is that after each TRB3 system restart the registry settings are lost and the configuration parameters needs to be manually reloaded from a local file. Moreover, there is no integration of TRB system in the PANDA Control System which is planned to be EPICS based.

Using pythonSoftIOC [5] and pyTrbNet [6] we created a TRB3 CTS (Central Trigger System) control system based on EPICS. Thanks to the Python script the EPICS process variables (PVs) can be dynamically created and stored in an InfluxDB database. Also, besides the archiving done by the database, the PVs can be archived using the EPICS Archiver Appliance [7].

The main advantage over the default user interfaces, provided by TRB developers, is that the settings of the CTS can be saved either on disk in a file or in a Redis database, and restored when the server is restarted. The PVs are easily archivable thanks to the EPICS Archiver Appliance and InfluxDB. The server and PV definitions are easy to create and manage by the same Python script.

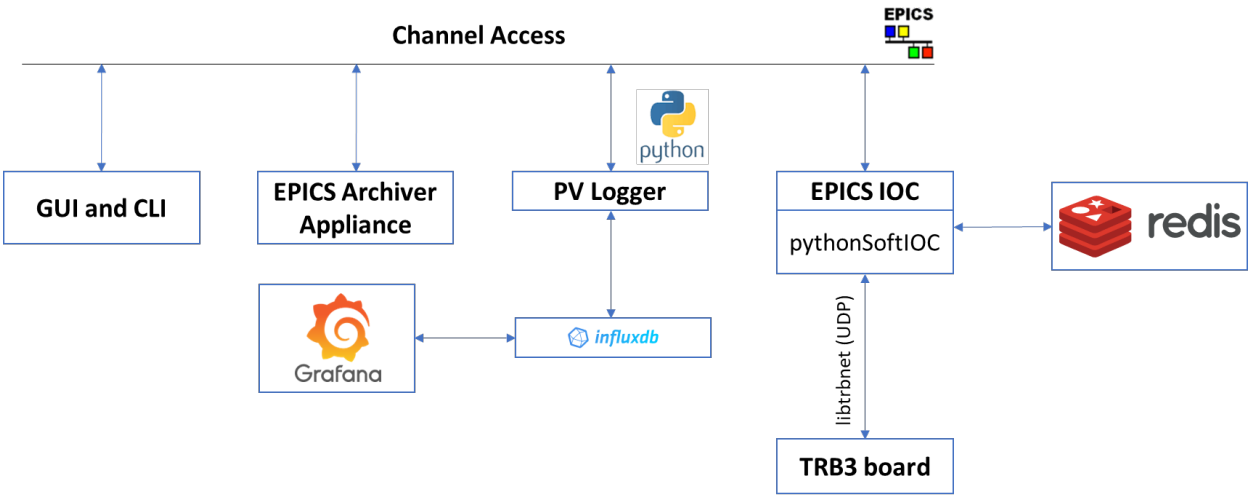

Figure 1: TRB3 control test-bed

In Figure 1 we show the TRB3 control test-bed we implemented in IFIN-HH. When the IOC is started the connection to the TRB3 system is verified. If the board can be accessed the PVs' values defined in the IOC are retrieved from the Redis database and sent to the TRB3 system via TrbNet (using the libtrbnet library). A Python scripts manages the EPICS IOCs and PVs, the connection to the Redis database and the connection to the TRB3 system through TrbNet. Each process variable update routine runs in its own thread. After each PV update, the value is written into the Redis database for persistency. Also, the PVs are archived by the EPICS Archiver Appliance running in a Docker container. The PVs can be read and written using the build-in EPICS Command Line utilities or using a Graphical User

Interface (GUI) – planned to be developed at a later stage. A GUI can be easily implemented using tools like PyDM and/or CS-Studio (Phoebus) [8].

Figure 2: Grafana TRB3 Central Trigger System monitoring dashboard

As a prototype for the CTS monitoring and alerting, we implemented a PV Logger which is reading the PVs' values via Channel Access – in parallel with the rest of functionalities – and writes them into an InfluxDB database. The values are retrieved from this database by Grafana and displayed in a dashboard (Fig. 2).

References

[1] M. Böhmer, "A Users Guide to the TRB3 and FPGA-TDC Based Platforms," [Online]. Available: http://jspc29.x-matter.uni-frankfurt.de/docu/trb3docu.pdf.

[2] J. Michael, "A Users Guide," [Online]. Available: https://jspc29.x-matter.uni-frankfurt.de/docu/trbnetdocu.pdf.

[3] "The Data Acquisition Backbone Core," [Online]. Available: https://github.com/gsi-ee/dabc. [Accessed 1 11 2023].

[4] "The Go4 Project," [Online]. Available: https://github.com/gsi-ee/go4. [Accessed 1 11 2023].

[5] "pythonSoftIOC," [Online]. Available: https://github.com/dls-controls/pythonSoftIOC/. [Accessed 1 11 2023].

[6] "pyTrbNet," [Online]. Available: https://github.com/pklaus/pytrbnet. [Accessed 1 11 2023].

[7] "EPICS Archiver Appliance," [Online]. Available: https://slacmshankar.github.io/epicsarchiver_docs/. [Accessed 1 11 2023].

[8] "CS-Studio (Phoebus)," [Online]. Available: https://controlssoftware.sns.ornl.gov/css_phoebus/. [Accessed 1 11 2023].

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 2022 1 Jul. 2022 – Dec. 2022	Realized FTE 2023
Alexandru-Mario BRAGADIREANU	PhD	0.14	0.33
Petre-Constantin BOBOC	Master	0.12	0.33
Stefan-Alexandru GHINESCU	PhD	0.17	0.33
Ovidiu-Emanuel HUTANU	Master	0.04	0.11
Alina MOTORGA	Master	0.12	0.21
	TOTAL	**0.59**	**1.31**

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

  - Petre-Constantin BOBOC– PhD student / research assistant.

4. Deliverables in the last year related to the project:

Hyperon signatures in the PANDA experiment at FAIR, arXiv:2304.11977.
EPICS-TRBv3 interface – proof of concept, presentation at PANDA Collaboration Meeting 23/3.

Other deliverables: Project webpage

5. Further group activities (max. 1 page):

- Collaborations, education, outreach.

  In 2023 our team joined DRD1 Collaboration – aimed for the development and application of gaseous detectors. We participated at the elaboration of the proposal for “Straw chamber technologies for hadron physics applications” work package. Currently the proposal is submitted for evaluation.

- Pandemic-related problems/topics

  There were no COVID-19 pandemic related problems.

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

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

Taking into account the delay in the installation of the PANDA experiment at FAIR due to the lack of FAIR funding in PANDA experimental hall, CR and HESR and the deficiency of manpower in STT group, in 2023 we discussed with PANDA STT Coordinator the possibility to increase our contribution to PANDA STT construction. Together we identified the following STT related tasks which can be performed by our team in 2024:

- Design and prototyping of straw high voltage distribution boards;
- Design and prototyping of straw front-end electronics coupling;
- Software proof of concept for the configuration of straw front-end electronics (PASTTREC ASIC) via EPICS.

To implement the above tasks, we will use a 4-layer straw module – consisting of 86 straws, 1200 mm long and 10 mm diameter – borrowed from IKP FZ Jülich together with front-end electronics, and the TRB3 test-bed setup.

For the funding of 2024 activities we are planning to apply to the next Call for funding within FAIR-RO programme.

Annex

Financial Report July 2022 – November 2023

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

= currency RON =

	Type of expenditures	TOTAL Jul. 2022 – Nov. 2023		2022* Jul. 2022 - Dec 2022		2023	
		Planned	**Realized**	**Planned**	**Realized**	**Planned**	**Realized**
1	**PERSONNEL EXPENDITURES**, from which:	**270,861.00**	**272,817.00**	**80,181.00**	**82,137.00**	**190,680.00**	**190,680.00**
	1.1. wages and similar income, according to the law	264,901.00	266,814.00	78,417.00	80,330.00	186,484.00	186,484.00
	1.2. contributions related to wages and assimilated incomes	5,960.00	6,003.00	1,764.00	1,807.00	4,196.00	4,196.00
2	**LOGISTICS EXPENDITURES**:	**126,541.75**	**127,449.05**	**60,830.75**	**73,475.73**	**65,711.00**	**53,973.32**
	2.1. capital expenditures	116,541.75	110,402.69	55,830.75	70,833.73	60,711.00	39,568.96
	2.2. stocks expenditures	10,000.00	17,046.36	5,000.00	2,642.00	5,000.00	14,404.36
	2.3. expenditures on services performed by third parties, including:	0.00	0.00	0.00	0.00	0,00	0,00
	2.3.1 contribution to FAIR	0.00	0.00	0.00	0.00	0,00	0,00
3	**TRAVEL EXPENDITURES**	**20,000.00**	**14,587.51**	**10,000.00**	**0.00**	**10,000.00**	**14,587.51**
4	**INDIRECT EXPENDITURES – (OVERHEADS) ***	**150,430.50**	**152,979.69**	**47,590.50**	**42,989.52**	**102,840.00**	**109,990.17**
	TOTAL EXPENDITURES *(1+2+3+4)*	**567,833.25**	**567,833.25**	**198,602.25**	**198,602.25**	**369,231.00**	**369,231.00**

* Specify the rate (%) and key of distribution (excluding capital expenditures).