Strong interaction studies in antiproton annihilation (SISTINA)

- 2017 Annual Summary Document for the ISAB FAIR-RO-

1.1 Group list (physicists, staff, postdocs, students);

Name	**Position**
Alexandru-Mario BRAGADIREANU	Physicist (CS III) – IFIN-HH
Valeriu-Florin COTOROBAI	Physicist (CS III) – IFIN-HH
Dan PANTEA	Physicist (CS I) – IFIN-HH
Alin C. BROASCA	Technician – Bachelor Student (Faculty of Physics)
Nicoleta DUMITRU	Project accountant (until 08.2017)) - IFIN-HH,
Alina MOTORGA	Project accountant (since 07.2017)- IFIN-HH

1.2 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.

1.3 Summary of accomplishments during the reporting period

Since PANDA is now in the Construction phase our short term objectives were focused on the research and development activities for PANDA STT sub-detector, coordination and integration of PANDA control system(s), PANDA grid computing.

Accomplishments:

- In-house Development of a Compute Module I/O Board with 10/100 Ethernet, USB 2.0 and HDMI interfaces;

- In-house Development of a Communication Mezzanine board with RS232, RS485 and CAN-BUS for the Compute Module Board;

- Test-bed for the evaluation of PANDA controls database archiving;

- Development of a Process Variable software generator and simulation application for PANDA STT controls;

- PANDA Controls TDR draft;

- Maintenance of local PANDA middleware and software framework.

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

The Multipurpose Rack Control Unit (MRCU) developed by our group, in Q2 of 2016 was updated with a Compute Module I/O Board with Communication mezzanine (fig.1). The Compute Module I/O and the Communication mezzanine boards (fig. 2) were designed, assembled and tested.in IFIN-HH. The I/O board is compatible with Raspberry Pi Compute Modules (2.5 V SODIMM) and Raspbian Jessie OS. The Communication mezzanine provides three serial interfaces RS232, RS485 and CAN BUS via two IC's SC16IS752 for RS232, RS485 and MCP 2515 for CAN-BUS communication.

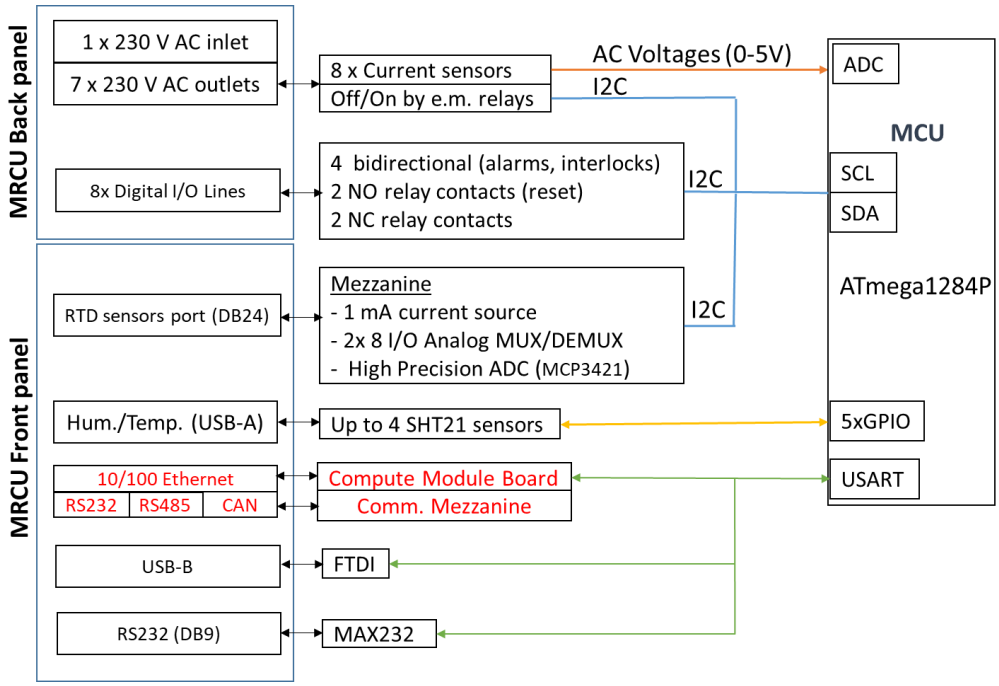

Fig. 1 Multifunction Rack Control Unit hardware architecture

The new board was presented in July 2017 in a PANDA Controls TDR dedicated meeting and it was agreed with PANDA technical coordinators that the solution should be included in the TDR as PANDA rack controller together with the MRCU or as a standalone general purpose EPICS IOC.

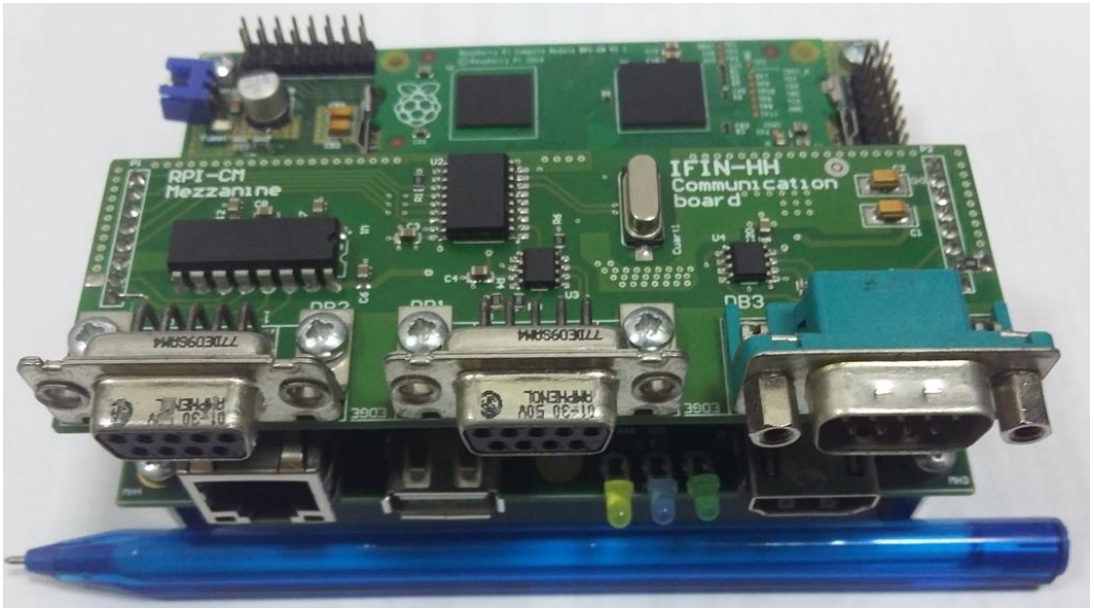

Fig. 2 IFIN-HH Compute Module I/O board with Communication Mezzanine

The contents of PANDA Technical Design Report were discussed in various dedicated meetings in 2017. As anticipated in 2016, we concluded that the archiving of process variables has to be addressed in more detail in the TDR. Moreover, in 2017, a hardware proof of concept for PANDA controls was asked by the technical coordinator. The hardware proof of concept test is planned to take place in October-November 2017 in Mainz using three PANDA prototypes of Backward Endcap EMC, Luminosity Detector and Germanium Hypernuclear Setup.

For process variable archiving, we reused four IFIN-HH PANDA grid compute nodes to assembly a test bed for database storage and retrieval. Using Control System Studio (CSS) GitHub Repository we built a customized cs-studio application using the stable 4.4.2 release – for testing purposes also the development 4.5.2 release was used successfully.

Various archive engine clients can be used in the above test bed, RDB Archive Engine and Archiver Appliance which are included as features during Maven build of CSS 4.x, and Cassandra PV Archiver which is installed as a separate plugin - JSON Archive Proxy for CSS.

To test the performance of archive engines we developed a Python application based on PCASpy library developed at PSI to interface Python with EPICS Portable Channel Access Server. The application simulates the High and Low Voltage system of PANDA STT (currently 1248. Process Variables) but it can be easily scaled up by increasing the number of prefixes to the PV names. Another option is to run same application in parallel (on different computers) thus emulating different PANDA sub-systems sending data to a centralized archiver situated on the supervisory layer (fig. 3).

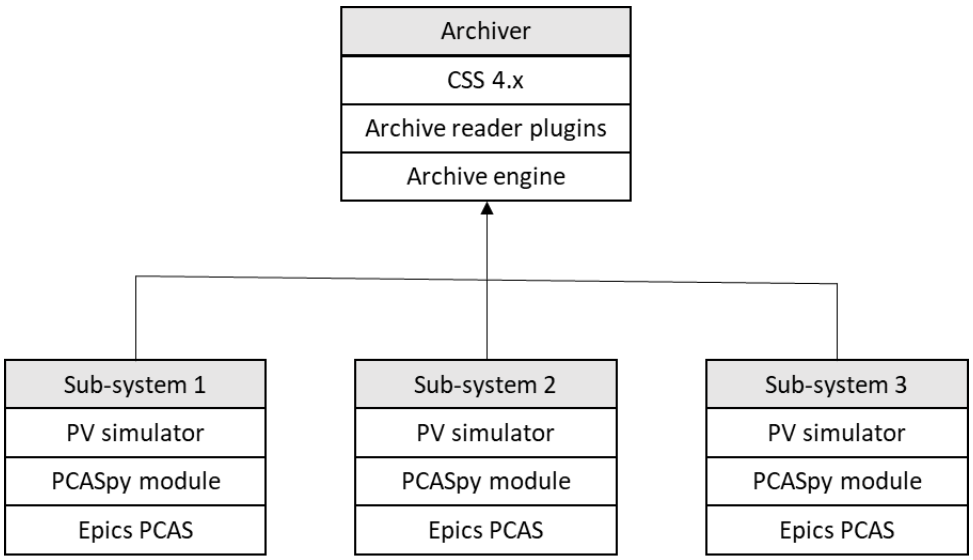

Fig. 3 Process Variables archiving test-bed

As archive engine servers we installed on one server the EPICS Archiver Appliance (developed at SLAC, BNL and MSU) and Cassandra PV archiver (Aquenos GmbH, Eclipse Public License). At the moment we are evaluating the performance of archive engines on a single appliance or single-node cluster (following Cassandra naming) but in the beginning of 2018 the archiving application will be deployed on a 4 node cluster with common storage (PowerEdge VRTX).

On July 13, at the PANDA Controls TDR meeting we decided that an updated database with the requirements for each PANDA sub-systems should be collected in order to evaluate the extent of PANDA control system, supervisory network traffic, and controls database storage cost. A requirements .xls template file was distributed and at the moment about 50% of PANDA sub-systems replied with the best knowledge information.

Maintenance of local PANDA middleware and software framework

The conventional strategy for the background events rejection, largely used in the most experiments in the field of high energy physics, is to decide, on the basis of the analysis of the signal coming from only a part of the detector, to register the complete data coming from all sub-detectors and related to current interaction event – for events considered as interesting. The experimental data registered using this strategy has a linear structure, consisting of isolated events, clearly separated in time from each other.

For PANDA project, this procedure cannot be used anymore, because of the large similarity between the events of interest and the background ones, their separation requiring a detailed knowledge of the data coming from all detector subsystems in the time frame relevant to a particular event. The strategy proposed by PANDA for the data acquisition is different. Because various subsystems of the experimental setup produce response signals for a given interaction event at different speeds, the corresponding data coming from several different events aren't clearly separated in time. This is why one must register continuously all data coming from all sub-detectors, labeled with high resolution time tags. Thus in PANDA experiment the temporal information has a primordial role in the structure of data records. The raw data coming from the whole detector have to be analyzed online on computing nodes built on FPGA processors. The software algorithms in use will allow a full preliminary reconstruction of the complete event, and events passing selection criteria will be saved on disk for final offline processing. This approach has been started to be implemented in the PANDA collaboration framework for simulation, reconstruction and analysis at all its levels:

1. **FairSoft** – updates for some common libraries (e.g. ROOT, GEANT, VGM, etc.) and new versions for some special packages like ZeroMQ (4.2.0) and NanoMessage (1.0.0), used for data transfer and organization between system processes and/or network nodes;
2. **FairRoot** – the common framework of the main experiments from FAIR (CBM, R3B, PANDA) used to solve some general tasks: I/O operations, event generators, base classes for detector handling, magnetic field description, etc. A new package FairMQ, based on ZeroMQ or NanoMessage, recently introduced in FairRoot, will be used for the reconstruction and data analysis according to the new data format adopted in PANDA;
3. **PandaRoot** – the framework for simulations, reconstruction and data analysis based on the specific features and the new introduced facilities of PANDA, as well as the new analysis macros prepared for the initial data taking period with PANDA setup.

In conformity with recommendations of PANDA collaboration management for the year 2017, there have been installed and tested the following versions for FairSoft, FairRoot and PandaRoot:

For analysis			For code development		
FairRoot	FairSoft	PandaRoot	FairRoot	FairSoft	PandaRoot
v-16.06b	may16p1	feb17p1	v-17.10	oct17₁	Trunk

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 in the last year/1992 hours[*];

Name	Role	FTE
Alexandru-Mario BRAGADIREANU	Controls Software development, Hardware integration	0.15
Valeriu-Florin COTOROBAI	CSS Software development	0.66
Dan PANTEA	PANDA software framework - maintenance and support	0.5
Alin C. BROASCA	Software development (until 04.2017)	0.25
Nicoleta DUMITRU	Accounting (until 08.2017)	0.075
Alina Motorga	Accounting (since 07.2017)	0.075

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

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

- List of papers (journal or conference proceeding):
  Feasibility study for the measurement of π N transition distribution amplitudes at P^{-} ANDA in p^{-} $p\rightarrow$ J/ψ π 0, PANDA Collaboration, PHYSICAL REVIEW D, Volume: 95 Issue: 3, 032003
- List of talks of group members (title, conference or meeting, date):

  A sketch of Detector Controls TDR, Detector Control System Session at CM 17/1, GSI, March 7, 2017
  PANDA Controls TDR, Technical Coordinators Meeting, GSI, July 13, 2017
  Status and Plans on Detector Control System, Plenary talk at PANDA Collaboration Meeting 17/3, Novosibirsk, *September 8, 2017*

- Other deliverables (patents, books etc.).

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

- Coordination of PANDA DCS;
- Chairing of PANDA DCS group;
- Maintenance of PANDA DCS Wiki page.

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

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

In Q1 of 2018 we are planning to conclude the archiving tests, the hardware proof of concept for PANDA DCS and to submit the Controls TDR.

[*] 2040 hours = 170 average monthly hours x 12 months

After TDR submission the STT controls activities will be resumed with the development of Pre-production software for STT HV & LV control, and gas system. There is a risk of not having at disposal the complete STT gas system due to the freezing of Italy participation in PANDA.

Maintenance of local PANDA middleware and software framework will be continued in 2018

Annex

Financial Report

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

			lei
Type of expenditures		**Year 2017**	
		Value	
		Planned (with 2018 credit)	**Realized at 30.09.2017**
1	**PERSONNEL EXPENDITURES**, from which:	**173,982.50**	**132,832.64**
	1.1. wages and similar income, according to the law	141,621.90	108,125.00
	1.2. contributions related to wages and assimilated incomes	32,360.60	24,707.64
2	**LOGISTICS EXPENDITURES**, from which:	**304,734.00**	**8,280.90**
	2.1. capital expenditures	295,677.00	0.00
	2.2. stocks expenditures	9,057.00	8,280.90
	2.3. expenditures on services performed by third parties, including:	0.00	0.00
3	**TRAVEL EXPENDITURES**	**30,000.00**	**9,189.14**
4	**INDIRECT EXPENDITURES – (OVERHEADS) ***	**100,660.50**	**72,530.84**
TOTAL EXPENDITURES *(1+2+3+4)*		**609,377.00**	**222,833.52**

* Specify the rate (%) and key of distribution (excluding capital expenditures).
Indirect Expenditures = General IFIN-HH Overheads (35% from 1+ 2.2 +2.3 +3) + Particle Physics Department Overheads (15. % from 1)

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Financial Report 2016

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

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	Type of expenditures	2016
1	**PERSONNEL EXPENDITURES**, from which:	**39,995.37**
	1.1. wages and similar income, according to the law	32,556.00
	1.2. contributions related to wages and assimilated incomes	7,439.37
2	**LOGISTICS EXPENDITURES**, from which:	**0.00**
	2.1. capital expenditures	0.00
	2.2. stocks expenditures	0.00
	2.3. expenditures on services performed by third parties, including:	0.00
3	**TRAVEL EXPENDITURES**	**4,741.68**
4	**INDIRECT EXPENDITURES – (OVERHEADS) ***	**21,762.95**
	TOTAL EXPENDITURES *(1+2+3+4)*	**66,500.00**

* Specify the rate (%) and key of distribution (excluding capital expenditures).
Indirect Expenditures = General IFIN-HH Overheads (35% from 1+ 2.2 +2.3 +3) + Particle Physics Department Overheads (15. % from 1)

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