Strong interaction studies in antiproton annihilation (SISTINA)

- 2019 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
Dan PANTEA	Physicist (CS I) – IFIN-HH
Stefan-Alexandru GHINESCU	Physicist – IFIN-HH, PhD *Student (Physics),*
Ovidiu-Emanuel HUTANU	Engineer - IFIN-HH, *Master Student (Electronics)*
Alina MOTORGA	Project accountant - 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 computing.

Accomplishments:

- PANDA Controls TDR submitted for evaluation;
- Software for the Integration of STT gas and power system in the STT control system;

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

We developed a software application for the control and monitoring of the gas system and power supply used by STT using the hardware available at IFIN-HH. This application is divided in multiple parts:

a) **EPICS IOC and Control System Studio (CSS) interface for the control of one gas line and the initial admission of Ar and CO_2 in the system**. The admission is controlled via 2 Bronkhorst mass flow controllers (MFCs) while the line consists of one MFC which regulates the incoming gas mixture flow in the straws volume and one Bronkhorst pressure controller (PC) which regulates the gas evacuation from the straws. Additionally, we have also used and implemented one pressure meter and one mass flow meter to monitor the mixture state at the straws volume ends.

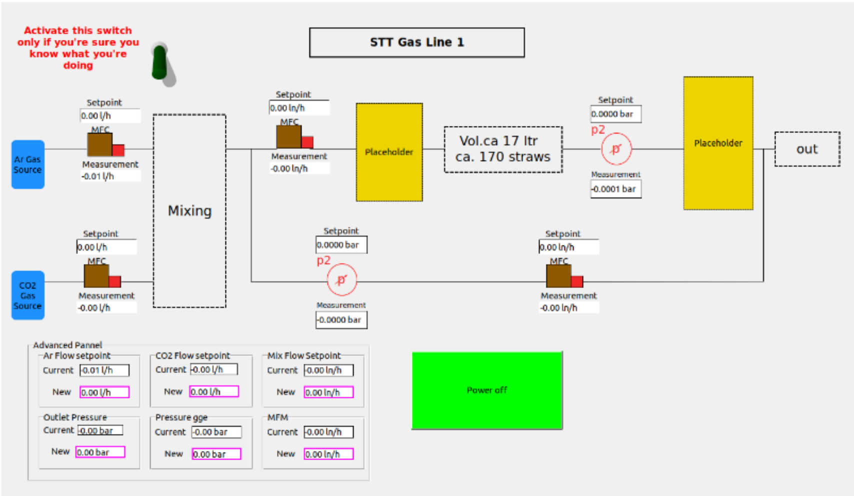

Fig. 1 CSS OPI showing on STT gas line.

The IOC operates as a Finite State Machine (FSM) application for the line operating modes: STARTING (pressure steadily builds up in the Straws volume), NORMAL (parameters are kept at a certain level ensuring optimal gas mixture flow through the Straws), FLUSHING (output flow is set to maximum), STANDBY (the output flow is reduced to 0) and ERROR. Communication between the host running the IOC and Bronkhorst devices is realized through the RS232 interface which outputs and receives as input bit strings. We have developed a dictionary managed by the IOC for the most critical messages.

The requirement of PANDA regarding Detector Control System (DCS) integration is that IOCs dedicated to device controls should be accompanied by a CSS application, namely a Guided User Interface (GUI), to facilitate user action. We have done this for one gas line (fig. 1) and foreseen the possibility to add any number of subsequent lines. Due to different options for the final design we left open the possibility to change the structure in the GUI to accommodate the real setup. Also, since troubleshooting might require special parameters for the control devices, we implemented a clear way to operate each hardware piece.

b) **EPICS IOC and CSS interface for the control of the Wiener MPOD Crate which powers the STT**. We developed a software application for an MPOD present at IFIN-HH having 64 High Voltage (HV) channels and 24 Low Voltage (LV) channels, again considering the possibility that the final number of channels might change. The communication between the IOC Host and the MPOD takes place through Simple Network Management Protocol (SNMP) implying that the messages sent and received by the Host are encoded. Thus, we developed a dictionary, a C++ routine, that parses the messages and decodes them such that the commands and responses of the MPOD are easily understandable.

Each HV and LV channel is operated by the IOC in a FSM fashion with the possible states being: OFF (the channels have no output voltage/current), RAMPING (the voltage/current output of the channel slowly builds up or decreases to the desired value), ON (the voltage/current output have reached the desired value) and ERROR (e.g. a trip occurred or the communication with the channel is lost etc.).

Fig. 2 CSS OPI showing HV and LV displays for the Wiener MPOD.

The CSS GUI in this case is split into two parts (one for the HV channels and one for the LV channels) to allow for easy navigation and fast error spotting. For each group we have added the possibility to set the voltage on all channels at the same time (facilitates standard operation) and also on each channel individually (useful for spotting problems). The general layout is presented in fig. 2.

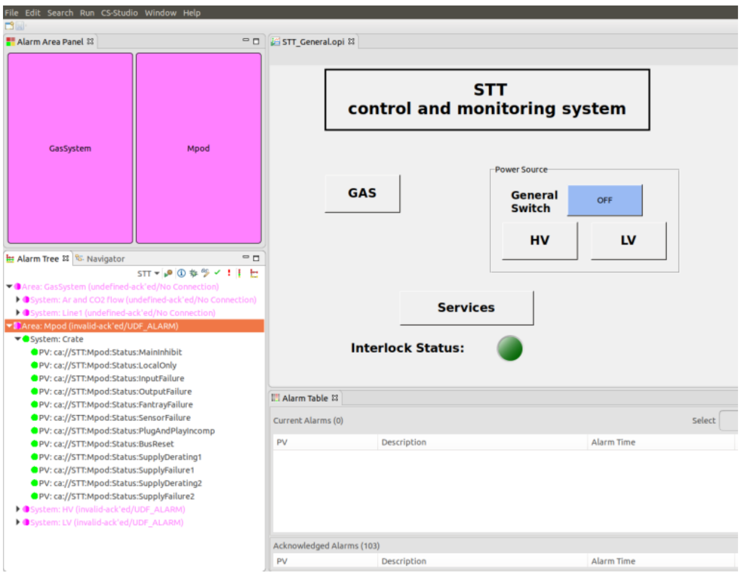

Fig. 3 CSS top-level OPI and Alarm System for STT.

To wrap everything on a single display, we implemented a top-level CSS display which facilitates the navigation and error spotting at end user level (fig. 3). When paired with the Alarm Display (next item on this list), the system is completely monitored and controllable, furthermore, it can be easily integrated in a larger-scale DCS which monitors the global status of all PANDA sub-systems.

c) **CSS Alarm System and Alarm Database for both the gas and power systems**. One of the components of CSS is the so-called Alarm Server which monitors the state of some user-defined EPICS process variables (PVs) and notifies the user in the case of problems, e.g. unusual values of their associated parameters or connection problems.

The PVs are organized in a Top Down arrangement with the top being the STT system (the next level consists of the gas and MPOD systems, each of those being further divided into gas lines and channel groups respectively) with the bottom consisting of individual voltage channels (for the MPOD) and flow/pressure control devices (for the gas system) (fig. 3, left side). The general philosophy of the arrangement is that errors are propagated upwards the tree, for example an occurring in a particular low voltage channel is transmitted to the engulfing system and the global status of the power system becomes “ERROR”. Hence, end-users have the possibility to react quickly to problems without spending much time on spotting the offending device.

In order to automatize the building of PVs database, we developed a Python script which reads a list provided by the user with the names of the PVs which should be monitored and writes an XML file in the standard form accepted by the Alarm Server tool. The integration of the resulting database in a bigger system is trivial with this tool.

As a summary, more than 2000 EPICS PVs are created with the software described above. Since most of them do not communicate directly with hardware components, the load on an average PC used as host is reasonable even with the extension from one to twenty gas lines.

3. Group members (table):

- List each member, his/her role in project and the Full Time Equivalent (FTE) % time in project.

Name	Role	FTE
Alexandru-Mario BRAGADIREANU	Controls Software development, Hardware integration	0.05
Dan PANTEA	PANDA software framework - maintenance and support	0.15
Stefan-Alexandru GHINESCU	Software development	0.38
Ovidiu-Emanuel HUTANU	Electronics hardware design, assembly and testing	0.27
Alina Motorga	Accounting	0.19

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

Stefan-Alexandru GHINESCU – PhD student;
Ovidiu-Emanuel HUTANU – Master student.

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

- List of talks of group members (title, conference or meeting, date):

  Status of the STT Controls, PANDA Collaboration Meeting 19/3, 08 November 2019 (https://indico.gsi.de/event/9538/)

- Other deliverables (patents, books etc.):

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

- Improvement of the software application developed during last year by including a full-fledged decoder of the RS232 messages received from the gas system components.
- Addition of troubleshooting information regarding the STT power and gas system.

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

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

The software package we developed for the STT control system is now fully functional, but there is still room for improvement. First of all, when the final quantities of hardware will be available, the software needs to be scaled. This operation will go smoothly, but tests need to be performed to ensure optimal operation. A subsequent, very useful, feature which we plan to add to the existing system is a collection of guidelines for troubleshooting the most common problems that might emerge during the operation of the detector. This has to be performed in synergy with experts for the gas and power systems in order to provide clear and straight-forward procedures for the shifters.

Given the high number of parameters for each gas line hardware piece (~250), an exhaustive decoding of these messages could not be implemented and is planned for the next year. The completion of this task relies on a joint effort with a gas system expert since the vast majority of the Bronkhorst device parameters are specific to that domain.

Financial Report 2019

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

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	Type of expenditures	2019
1	**PERSONNEL EXPENDITURES**, from which:	**114,338.00**
	1.1. wages and similar income, according to the law	111,822.00
	1.2. contributions related to wages and assimilated incomes	2,516.00
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**	**4,188.90**
4	**INDIRECT EXPENDITURES – (OVERHEADS) ***	**55,573.10**
	TOTAL EXPENDITURES *(1+2+3+4)*	**174,100.00**

* 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 (12.322 % from 1)

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