$\overline{\text{P}}$ANDA

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1 Introduction

$\overline{\text{P}}$ANDA is one of the biggest experiments of hadron and nuclear physics that will be carried out at the new Facility for Antiproton and Ion Research (FAIR) at Darmstadt, Germany. It is dedicated to the study of the annihilations of antiprotons on nucleons and nuclei up to a maximum center-of-mass energy in $\overline{\text{p}}$p of 5.5 GeV.

The $\overline{\text{P}}$ANDA collaboration consists of 420 physicists from 17 countries spread all over the world. The Italian groups involved are: Torino, University, Politecnico and INFN, Trieste, University and INFN, Genova INFN, Pavia, University and INFN, Ferrara, University and INFN, Legnaro INFN laboratory and Frascati INFN laboratory. The LNF group is involved in the design and construction of the central straw tube tracker of the $\overline{\text{P}}$ANDA detector.

2 $\overline{\text{P}}$ANDA experiment

A new facility for hadronic physics is under construction in Germany. It consists of a major upgrade of the presently running GSI accelerator complex of Darmstadt [1)]. An intense, high momentum

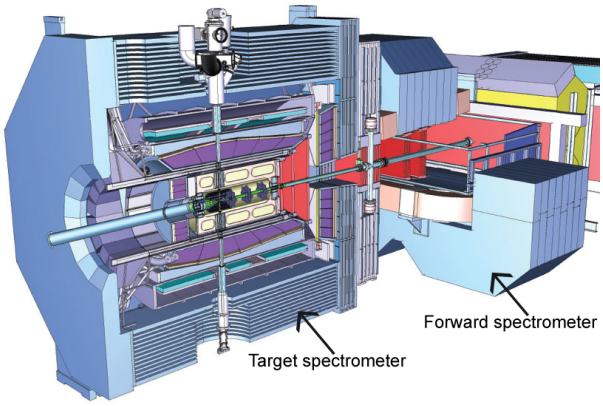

Figure 1: *A schematic view of the $\overline{\text{P}}$ANDA apparatus consisting of two distinct detectors: the target spectrometer (left) and the forward spectrometer (right).*

resolution antiproton beam, with momenta between 1.5 and 15 GeV/c, will be available at the High Energy Storage Ring (HESR), and the experimental activity will be carried out using a general purpose detector $\overline{\text{P}}$ANDA that will be build surrounding an internal target station installed in one of the two straight sections of the storage ring. Figure 1 shows a schematic drawing of the $\overline{\text{P}}$ANDA apparatus. It is designed as a large acceptance multi-purpose detector consisting of two distinct parts: a solenoidal spectrometer, surrounding the interaction target region, and a forward spectrometer to cover the solid angle between 5 and 22 degrees. It will allow the detection and the identification of either the neutral and the charge particles emitted following $\bar{p}$ annihilation.

3 The $\overline{\text{P}}$ANDA Central Tracker

For tracking charge particles in the target spectrometer, $\overline{\text{P}}$ANDA will use different detectors: a silicon Micro Vertex Detector (MVD) a Straw Tube Tracker (STT) and a set of forward GEM chambers [3]. Figure 2 shows the layout of the Target Spectrometer tracking system.

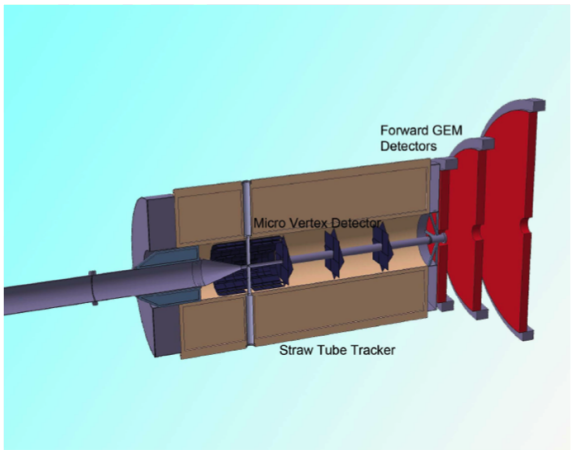

Figure 2: *The $\overline{\text{P}}$ANDA tracking system of the Target Spectrometer. It consists of three detectors: Micro Vertex Detector, Straw Tube Tracker, Forward GEM.*

The requirements for this system are:

- almost full solid angle coverage;
- momentum resolution $\delta p/p \sim 1.5\%$;
- low material budget $\text{X}/\text{X}_0 \sim$ few %;
- good spatial resolution $\sigma_{r,\phi} = 150$, μm, $\sigma_z =$ few mm.

The Technical Design Report (TDR) of the STT has been completed in April 2012 and it has been positively evaluated by the FAIR technical committee (ECE).

The LNF $\overline{\text{P}}$ANDA group is deeply involved in the STT realization and has the responsibility of the mechanics of the whole tracking system.

3.1 Layout of the straw tube detector

The $\overline{\text{P}}$ANDA STT will consist of two identical chambers separated by the beam-target cross-pipe that is cutting the x, y plane in two halves (see fig. 3). Each chamber is made of aluminized mylar straw tubes, diameter 10 mm, length 1500 mm, thickness 30 μm, arranged in planar double layers.

Inside a double layer the tubes are glued together and operated with an Ar+CO_2 (90+10) gas mixture with an over-pressure of 1 bar. This solution has been chosen to avoid strong support structures and to keep the detector design modular and simple. To measure also particle z coordinate, some layers will be mounted with a skew angle $\pm 3^o$ with respect to the beam axis.

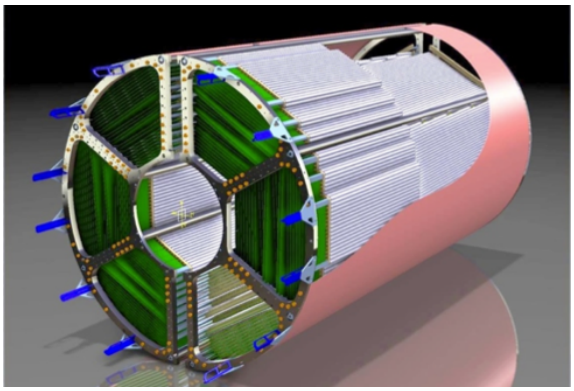

Figure 3: *CAD drawing of the $\overline{P}$ANDA Straw Tube Tracker*

4 Activity of the LNF $\overline{P}$ANDA group

The STT mechanical structure has to support also the beam-target cross-pipe and the MVD. This frame, has to be extremely light and has to allow the movements of the whole block of detectors during the installation procedure or the maintenance operations.

Figure 4 shows the prototype of the mechanical structure of the whole $\overline{P}$ANDA Central Tracking (CT). It has been designed by LNF SPAS and realised with the cooperation of the Torino INFN mechanical workshop.

Figure 4: *The prototype of the Central Tracker mechanics hold by the insertion support system.*

The activity of the LNF $\overline{P}$ANDA group during 2012 has been devoted to the following tasks:

- test of straw tubes prototypes in oder to determine the detector performances;
- development, together with the Torino INFN group, of the mechanical structure for the CT;
- TDR editing.

Concerning the first item, LNF $\overline{\text{P}}$ANDA group has collected data with radioactive sources, cosmic rays that have been included in the detector TDR.

Since the TDR of the STT has been approved, we can consider almost completed the R&D phase for this system. At present, the tracking group is defining the protocols for the straw tube construction and the module's assembly. Quality tests and quality assurance procedures are being defined in order to start soon the mass production that will be the main activity during 2013.

5 List of Conference Talks presented by LNF group members in Year 2012

1. P. Gianotti, "Future facilities for hadron spectroscopy", invited talk at the *International Workshop on new partial wave analysis tools for next generation hadron spectroscopy experiments (ATHOS 2012)*, Camogli, Italy, 20-22 Giugno 2012.

2. P.Gianotti, "The antiproton physics program of the PANDA experiment", invited talk at the *II European Nuclear Physics Conference*, Bucharest, Romania, 17-21 Settembre 2012.

6 Publications

1. P. Gianotti,"Results and perspectives in hadron spectroscopy", Phys. Scripta T150 (2012) 014014.

2. $\overline{\text{P}}$ANDA Collaboration, "Technical Design Report for the: PANDA Straw Tube Tracker ", arXiv:1205.5441.

3. $\overline{\text{P}}$ANDA Collaboration,"Technical Design Report for the: PANDA Micro Vertex Detector", arXiv:1207.6581

References

1. `http://www.fair-center.com/`.

2. `http://www-panda.gsi.de/`.

3. S. Costanza *et al.*, Nucl. Instr. Meth. **A617**, 148-150, 2010.