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Garcia, Francisco

2017

Garcia , F , Turpeinen , R , Äystö , J , Grahn , T , Rinta-Antila , S , Jokinen , A , Voss , B , Kunkel , J , Kleipa , V , Risch , H , Caesar , C , Simons , C , Prochazka , A , Schmidt , C J , Hoffmann , J , Rusanov , I , Kurz , N & Heggen , H 2017 , ' Twin GEM-TPC prototype þÿ(HGB4) beam test at GSI a tracking detector for the Super-FRS ' , GS vol. 2017 , no. 1 , pp. 456-457 . https://doi.org/10.15120/GR-2017-1

http://hdl.handle.net/10138/231957
https://doi.org/10.15120/GR-2017-1

Twin GEM-TPC prototype (HGB4) beam test at GSI – a tracking detector for the Super-FRS

F. García[*1], *R. Turpeinen*[1], *J. Äystö*[1,2], *T. Grahn*[1,2], *S. Rinta-Anttila*[1,2], *A. Jokinen*[1,2], *B. Voss*[3], *J. Kunkel*[3], *V. Kleipa*[3],*H. Risch*[3], *C. Caesar*[3], *C. Simons*[3], *A. Prochazka*[3], *C. J. Schmidt*[3], *J. Hoffmann*[3], *I. Rusanov*[3], *N. Kurz*[3], *H.Heggen*[3]

[1]Helsinki Institute of Physics, University of Helsinki, 00014 Helsinki, Finland
[2]University of Jyväskylä, Department of Physics, 40014 Jyväskylä, Finland
[3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt 64291, Germany

INTRODUCTION

The GEM-TPC detector will be part of the standard Super-FRS detection system, as tracker detectors at several focal diagnostic stations along the separator and its three branches.

GEM-TPC DETECTOR DEVELOPMENT

A group was created in 2009 for the development of a tracking detector to be located along the Super-FRS. Since then a series of prototypes were built and tested at GSI[1] The main requirements for the operation of those chambers are: close to 100% tracking efficiency at 1 MHz rates and position resolution less than 1 millimeter in the full acceptance on each diagnostic station. In order to, achieve such requirements a new configuration was proposed with two GEM-TPCs enclosed in one vessel; in such a way that one is flipped in the middle horizontal plane against the other one, thus the electric field of the field cages will be in opposite directions. Therefore, constraining the time of arrival of the hits in each GEM-TPC can drastically reduce the ambiguity of association of hits to a single track and therefore achieving the desired tracking efficiency.

BEAM TEST AT GSI & JYVÄSKYLÄ

The twin prototype 2 called HGB4-2, is shown in Fig. 1 was tested at GSI in cave S4 and in Jyväskylä.

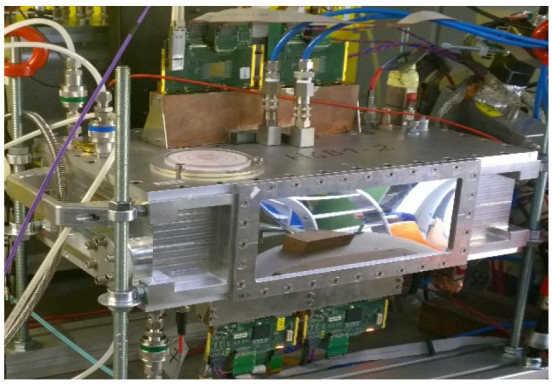

Fig. 1. Super-FRS GEM-TPC prototype HGB4, equipped with four GMX-NYXOR cards.

During these campaigns the readout system was the GMX-NYXOR cards, which contains two n-xyters chips to readout a total of 256 channels per card.

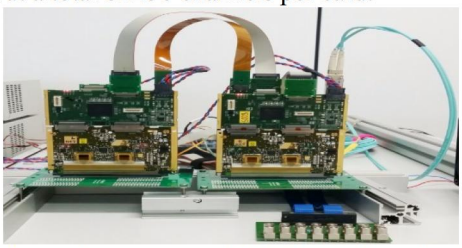

Fig. 2. The readout system GMX-NYXOR cards during testing in the laboratory.

Below is shown a correlation plot of the two GEM-TPCs X-axis projection of the HGB4-2 chamber.

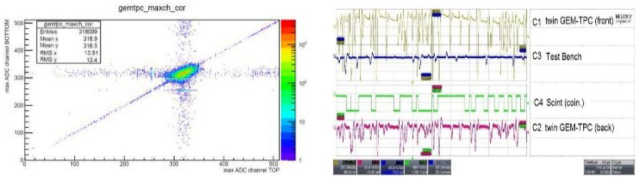

Fig. 3. Position correlation of the Top and Bottom GEM-TPCs of the HGB4-2 prototype for ^{124}Xe projectiles (left) and signals from the Bottom of both GEM #3 at 2.20 MHz rate under Protons at Jyväskylä.

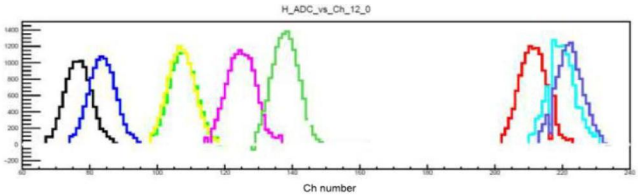

Fig. 4. Single clusters for primary ^{124}Xe @ 660 MeV/u beam.

Results from the test Beam campaign at Jyväskylä and GSI has shown that twin GEM-TPC (HGB4-2) has operated very stable in continuous mode and the concept has been proven to be the final one.

REFERENCES

[1] F. Garcia et al., 2011 IEEE Nuclear Science Symposium conference record, ISSN: 1082-3654, pp. 1788-1792.

DOI:10.15120/GR-2017-1