A. PAPA - PSI

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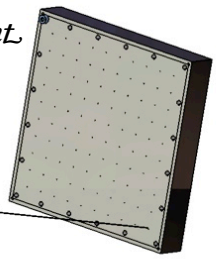
ACTIVE TARGET

ATAR

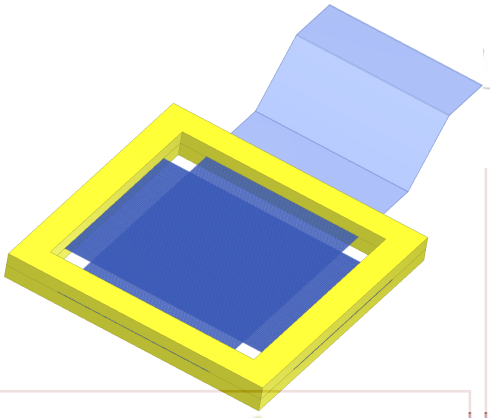
"visible and invisible fire"
(Avestan language)

The thinnest available scintillating fibers coupled to SiPM to detect minimum ionizing particles and stopping particles in high magnetic field environment.



A grid made up of two orthogonal fiber layers with a pixel size of 250 um allows to reach superior position resolutions (<100 um) in both the fiber directions, namely (X,Y).

The grid high granularity and the fast detector time response are mandatory requirements to sustain high rate. Beam intensity up few x 10^8 particles/s can be measured at a focused beam spot of 1x1 cm2, as in the case of the most intense continuous muon beam on the world at the Paul Scherrer Institut, PSI (CH).



Scintillating medium

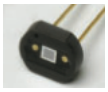
Squared 250 x 250 um2 *multi-clad scintillating fibers* ***BCF12 (Saint-Gobain)****, peak emission @ 435 nm) with a light yield of ~8000 ph/MeV, a trapping efficiency of 7.3% , 1/e length 2.7 m and a time decay of 3.2 ns are the detection medium.*

Photon detector

SiPM will be used to detect extremely weak light and to be operated in an high magnetic field (1.3 Tesla).

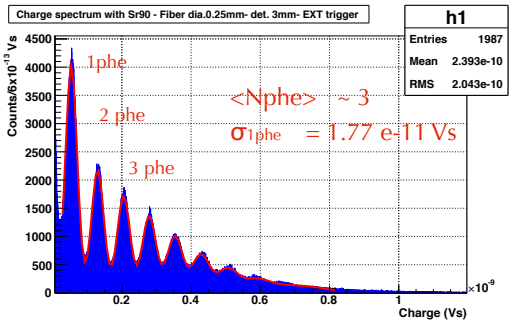
Each Fiber is readout by a single detector. The detector efficiency is optimized using the SiPM with the higher PDE (65%) and gain(2.4 x 10^6), and low dark current rate (600 KHz@0.5phe).

HAMAMATSU s10362-11-100C

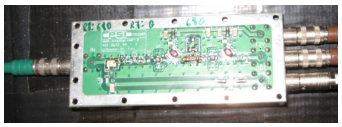


M.I.P. detection

Although an average energy of 40 keV is deposited within the fiber, the small attenuation length allows the collection of the few photons after a short distance on a detector, mounted into a high magnetic field region. The measured phe number as a function of the fiber thickness (1, 0.5 and 0.25 mm) scales as expected.The light collection can be enhanced by an aluminum coating on the other end of the fiber. The high dark current rate (0.3-3.5 MHz @ 0.5 phe) is suppressed using an external trigger.



FRONT-END ELECTRONICS

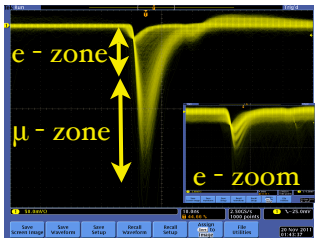


A smart and low-noise (<10 mV peak-to-peak) front-end board (PSI) is used to amplify the signal a factor 10. Input attenuation, output shaping are tunable parameters. The same board provides the power to the detector.

5GHZ WAVEFORM DIGITIZER

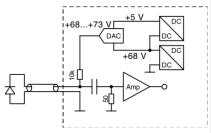
The signal is digitized using the DRS4 evaluation board (PSI development, [1]), with a sampling speed up to 5 GSPS. Excellent time and amplitude performances are reached. A custom analysis waveform can be easily implemented (pile-up rejection, template, after-pulse tagging etc.).

PARTICLE ID

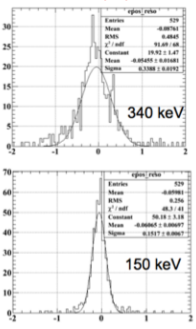


CUSTOM LOW POWER SUPPLY

Based on the Midas Slow Control Bus system developed at PSI, an accurate and cheap low power supply is used and remotely controlled.



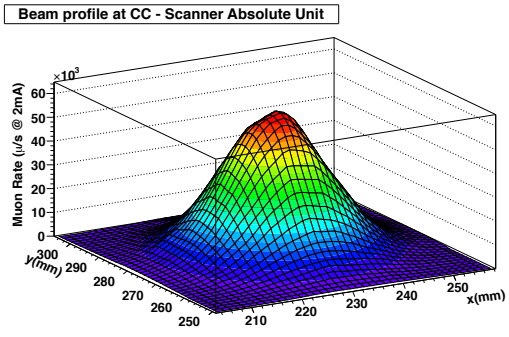
σ(E$_e$)



APPLICATIONS

The ATAR is a stand-alone tool for the measurement of high beam intensity and 2-dimensional beam profile.

In the framework of the MEG experiment [2] it is considered as a possible upgrade. Coupled with the actual spectrometer, it should provide a precise measurement of the muon decay vertex and its timing, with a consequent improvement of the positron momentum and angular variables resolutions.



Ref.: [1] S. Ritt, NIMA **494** (2002) 520;
[2] J. Adam *et al.*, PRL **107**, (2011) 171801.