

WIRE SCANNER DIAGNOSTIC SYSTEM*

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Abstract

Elettra Sincrotrone Trieste Research Center (Elettra) is one of the Italian Institutions, together with Istituto Nazionale di Fisica Nucleare (INFN) and Consiglio Nazionale delle Ricerche (CNR), committed to the realization of the Italian in-kind contributions for the European Spallation Source.

One part of the Elettra in-kind contributions to the proton accelerator is the construction of acquisition system for European Spallation Source (ESS) Wire Scanner (WS). This paper presents an overview of the diagnostic system of the ESS WS, including the first measurements with beam performed at CERN on LINAC4

OVERVIEW

The ESS diagnostic system adopts Wire Scanners for the measurement of the transverse beam profile [1] (Fig. 1). The purpose is to acquire and to made available to the ESS Integrated Control System (ICS) the signals either electrical or optical generated when a thin metal wire is scanned across the ESS accelerator beam. The amplitude of these signals is proportional to the charge density of the beam and the beam transverse profile may be obtained by plotting the signal amplitudes vs. the wire transverse position.

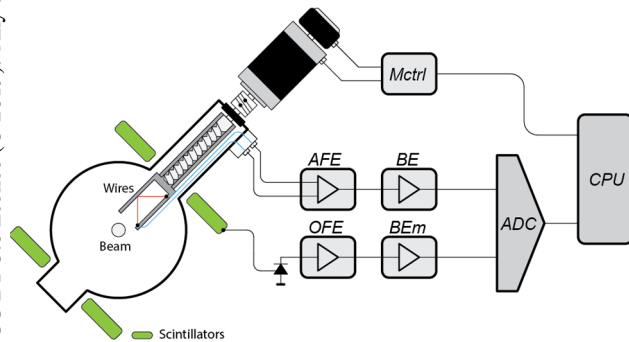


Figure 1: General Layout of wire scanner system.

The system acquires electrical and optical signal when a thin metal wire is scanned across the proton beam. The signal is proportional to the beam charge density. With obtained signal values the beam profile can be plotted.

The system is composed of custom developed hardware as Front Ends, Back Ends linked together and controlled by EPICS control and processing software.

The hardware components are Analog Front End (AFE), Back End (BE), Optical Front End (OFE) and Back End modified (BEm).

AFE-BE FOR THE CURRENT READ OUT

The Analog Front End (AFE) is used to read out the current from the wire intercepting the beam (Fig. 2).

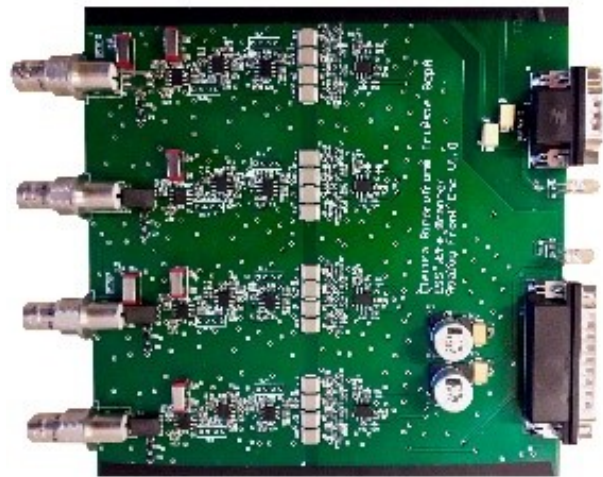


Figure 2: Analog Front End.

It is located in the accelerator tunnel to minimize the signal loss connected to the associated Back End (BE) in the service gallery (Fig. 3).



Figure 3: Back End.

The Analog Front End (AFE) Trans impedance Amplifier (TIA) convert the ultra-low current generated in the wire into a voltage. This voltage is transmitted to the acquisition system at long distance, outside the machine tunnel (Fig. 4).

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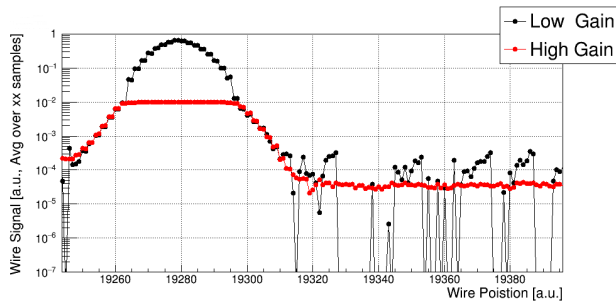


Figure 4: Beam profile obtained from AFE.

THE OPTICAL FRONT END (OFE)

The Optical Front End (OFE) is an 8 channel front end used to acquire the light generated in the Scintillator detectors (Fig. 5.), located down-stream the wire scanner connected to the associated Back End modified (BEm).



Figure 5: Optical Front End.

The Optical Front End (OFE) convert into electrical signal the light pulses (Fig. 6. and Fig. 7.) coming from the scintillator [2] (Fig. 8.) and propagates up to the service gallery in optical fibers where OFE is located [3]. The control and processing software is running under EPICS system software [4].

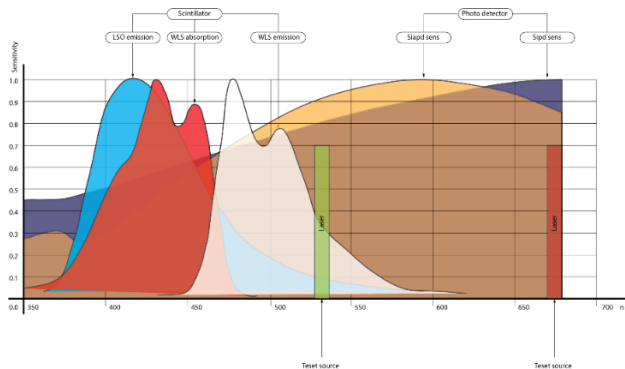


Figure 6: Light spectrum from scintillator.

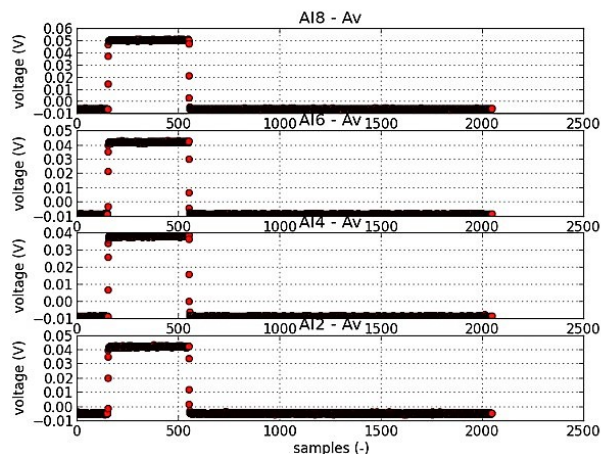


Figure 7: Electrical signal.

The control software of Wire Scanner Acquisition System (WS ACQ SYS) [4] is interfaced to the Back Ends (BE) and to European Spallation Source (ESS) Motion Controller that control the mechanical motion of the Wire Scanner.



Figure 8: Scintillator.

CONCLUSION

This overview is the Elettra in-kind contributions to ESS WS ACQ SYSTEM that present the research and development of diagnostic electronic front ends firmware for communication protocols and control system software.

ACKNOWLEDGEMENTS

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REFERENCES

- [1] Timo Korhonen, ICS Handbook, ESS-0067637, Oct. 2016.
- [2] Benjamin Cheymol, Wire scanner scintillator, ESS-0068702, Sep. 2016.
- [3] Benjamin Cheymol, Scintillator application for beam profile measurement with wire scanner, Aug. 2016.
- [4] B. Cheymol, H. Kocevar, Wire scanner functionalities.