Commissioning of a sensitive tune monitoring system in SIS-18

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The front-end hardware of the baseband tune measurement system (BBQ) [1] has been routinely used for sensitive tune measurements at SIS-18 with real time spectrum analyser as the acquisition component [2]. The new TUne MEasurement system (TUME) integrates the BBQ front-end hardware with a FESA [3] based data acquisition and control element, and a Java based graphical user interface. The first operational results of the new TUME system at SIS-18 are presented.

The TUME system is designed to fulfil the following requirements :

- Monitor the tunes during the whole acceleration cycle or the time specified by the user. It should be possible to use different time-scales for calculating tunes.
- Provide facilities to filter and store the measurement data via a simple user interface.

Figure 1 shows the various components of the tune monitoring system. The pick-up signal is connected to the BBQ front-end hardware which consists of peak detectors and an amplifier chain. The output of BBQ front-end is connected to a VME based front end controller (FEC) which consists of the 8 channel, 16-bit, 100 MSa/s SIS-3302 ADC module. Two channels are used for the digitization of the output of the BBQ front-end for horizontal (x) and vertical (y) planes. The ADC module is clocked by the SIS-RF signal

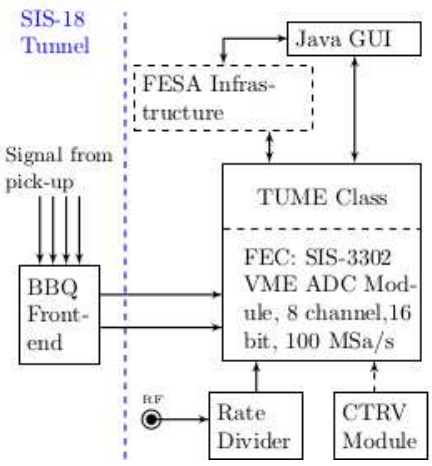

Figure 1: The data acquisition scheme for the tune measurement system.

followed by a rate divider to control the clock rate. This is required to support the various harmonic operational modes of SIS-18. The GSI machine timing events are converted to CERN timing events which are fed to the TUME FESA class via the CERN timing receiver VME (CTRV) module.

A TUME FESA class performs an FFT on the acquired samples based on user preferences to obtain the tune spectrum. A peak search routine extracts the tune value from the spectrum. Clients can subscribe to the properties of this FESA class to obtain the tune spectrum and tune values throughout the acceleration cycle. A Java based GUI (shown in Fig. 2) was developed to display the evolution of tune spectrum during the whole cycle. It provides further options for FEC settings, filtering the data, storage of data and advanced techniques for frequency spectra estimation.

The first beam based tests were performed in Autumn 2014 with 10^9 U^{28+} particles accelerated from 11.4 to 300 MeV/u. The BBQ front-end was connected to a pick-up in the quadrupolar configuration. Therefore, both x and y tunes are visible in channel 1 as shown in Fig. 2.

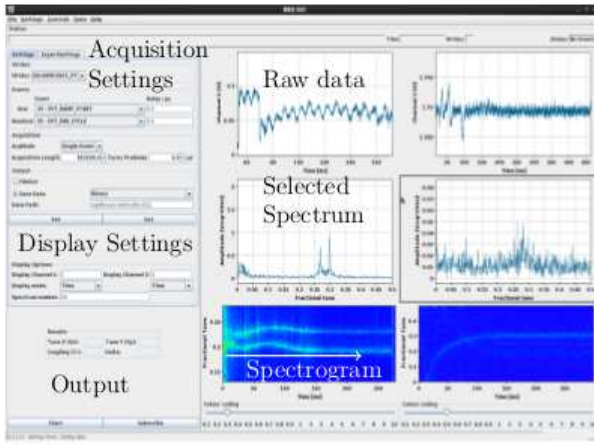

Figure 2: The TUME GUI shows the evolution of tune spectrum and tune over time.

The top plot shows the raw time domain data from the BBQ front-end. The middle plot shows the spectrum for a selected time window (from display settings). The lowest plot shows the tune spectra over time for the specified duration in acquisition settings. The FESA class and GUI are still under development, and will be brought into regular operation at the beginning of next SIS-18 run.

References

[1] M. Gasior, "High sensitivity tune measurement using direct diode detection", Proc. of BIW'12 (2012)

[2] R. Singh, "Tune measurements at GSI SIS-18: Methods and applications", PhD Thesis, TU Darmstadt (2012)

[3] T. Hoffmann, "FESA - The front end software architecture at FAIR", Proc. of PCaPAC08, Ljubljana, Slovenia (2008)

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