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Update

Report on Data Acquisition Tests

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In Canberra this January some further tests of the new data acquisition system for Megha were performed. The main aim of the tests were to evaluate the performance of the new data acquisition system as a whole compared with the old/existing system. Due to difficulties in linking the two systems together, so that data could be compared on an event by event basis, the tests were not realised in their entirety. However, we were able to make some important comparisons between the performance of the two systems.

The tests followed a strip detector run, so we selected 8 strips, instrumenting the two ends, giving 16 channels of energy and 16 channels of time information. The signals from the preamplifiers were split so that they could be simultaneously processed by the two systems. We used pulser and elastic scattering data to perform the measurements (30 MeV 12C beam off 12C and 197Au) targets.
The new data acquisition system contained 32 channels of David Smiths programmable amplifiers, each containing a variety of shaping constants (0.75, 1.1, 1.65, 2 us), this permitted an evaluation of the best time constant for use with the position sensitive strip detectors.
The analogue signals were then processed by the Silena peak detect and hold circuits followed by Dicks CAT (amplitude to time converter), which converts the analogue signal to a representation which can be processed by the Multi hit TDCs. One of the amplifiers also contained a peak detect and hold circuit designed by David Smith.

Pulser Tests

Matchsticks data provided by the BNC pulser were processed by the new system to evaluate the linearity of the response. These measurements indicate a extremely high degree of linearity over the dynamic range 1000-8000 (the TDCs have an 8k range) with the deviation from linear being of the order of +/-2 channels (0.2% - in the worst case). This deviation is significantly less that our energy resolution. The previous tests had shown that the CAT circuit suffered from rather extreme deviations from a linear response below channel 1000, with deviations of up to 100. The current tests indicate that these deviations are now much smaller, +/-8 channels in the worst case. This performance is now comparable to, if not better than, that of the Silena ADC. There were rather large offsets (250 channels) though, however these can be adjusted and thus should not be considered to be a problem. There was no apparent difference between the performance of the Silena and David Smith peak detect circuits.

Elastic Scattering Data

Two types of tests were performed with the reaction products. The first was a study of the complete response of the new system (which piped the data words into the data stack in the old system), this was then compared with the measurements with the old amplifiers and the Silena ADCs. The second set of tests involved patching the new amplifiers into Silena ADCs so that the data could be compared on an event by event basis.

The spectra constructed from the first set of tests demonstrated that there were no significant differences between the two systems, apart from the higher thresholds in the new system. The energy resolutions appeared to be approximately the same, 250 keV (new) 240 kev (old) for the 30 MeV 12C ions. There appears to be a slight dependence of the resolution on the shaping time of the amplifier;

2.00 us - 250 keV
0.75 us - 235 keV
1.10 us - 220 keV

This difference is marginal and thus may not be significant, but does suggest that the energy resolution is not compromised by the data acquisition system.

The second set of tests allowed the same pulses processed by the two systems to be compared on an event by event basis. Interestingly there were some deviations between the two systems, this was particularly for the amplifiers with longer shaping times (although not universally). It is believed that this may by due to either the differing response of the amplifiers to the noise or due to charge collection. Certainly amplifiers with shaping constants closer to those of the old amplifiers showed a much closer agreement. Importantly though, the energy resolution is independent of the shaping time, and the position resolutions is such that the positions calculated for the two sets of amps agree within 0.5 mm. Grids or masks would be required to provide a better determination of the position resolution. These measurements were made with the same shaping constants for the signals from either end of each strip. Hence, although there exists some deviation between the amplifier responses, there may be some cancelation of this effect in the calculation of position and energy. It would be interesting to see the effect of different time constants on either end of the strips.

In conclusion, I observe no significant differences between the two systems. The energy and position resolution are similar. The performance of the CAT circuit appears to be improved - particularly in terms of the deviation at low channels, and there is no discernible difference between the performance of the D. Smith and Silena peak detect circuits. Thus from the point of view of the experimental measurements the new system would appear to provide an equivalent response to that which we have already. We were unable to compare the performance of the two systems from the point of view of rate capacity, this of course is important, but will have to wait until the new system is further developed.