Active bases in NIMROD

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Scientists using multidetector arrays that employ scintillating detectors with photomultiplier tubes (PMT) must decide what type of voltage divider to use in order to collect the signal from the PMT. On the one hand are the so called passive bases which are simply resistor chains with the resistance tuned to provide the proper voltage for the proper dynode. Such bases have the advantage of simplicity. However, the voltage over the later stage dynodes drops when the PMT detects a photon, thus changing the voltage divide ratio and hence affecting the eventual signal from the PMT. A further drawback of such passive bases is that when the rate of detected photons is high, the voltage can sag as well causing a count rate dependent output from the PMT. It is possible to compensate for this effect by suitably choosing a resistor series that allows a large enough current that the relative drop of the voltage is very small. This is usually of the order of a milliamp. This requires the use of power supplies which can supply at least that much current. Such power supplies are typically more expensive. Heat from the increased power can also be an issue.

Another approach is to use so called active bases. Such bases are also voltage dividers, but they employ Field Effect Transistors (FETs) which restore the sagging voltage by opening the gate when the voltage sags. This leads to stability relative to the counting rate. Because the voltage is restored when it sags, the amount of current required is much less leading to less heat load and hence less stringent requirements for cooling. Active bases have been employed INDRA [1] and the design and performance of them has been detailed in that reference.

We have to date employed passive bases in NIMROD [2]. This was possible because the high voltage power supply that was available supported high current. In addition, because of the forward silicon detectors, NIMROD demands a low counting rate removing the problem of count rate dependent gains resulting from passive bases. Due to various upgrades, it has become necessary to upgrade the HV power supply that is used in NIMROD. In order to find the most cost effective solution, we have developed active bases for the various PMTS used in NIMROD. These developed bases are based on the active bases employed in INDRA [1].

The bases were tested in several test runs where we used some available CsI detectors with the newly designed active bases. Figure 1 shows the results of a run with 20 MeV deuterons incident on a Gold target. We note the deuteron elastic peak at 25000 in fast (x-coordinate). We note a very good separation of deuterons from protons down to less than 4 MeV. Triton and ^{3}He lines are absent due to kinematics in this reaction system. The line of alpha-particles is very well separated and extends as far as it is kinematically allowed.

As the test described used a very low energy ^{2}H beam, we plan a “final” test of the new active bases in NIMROD using a typical beam for experiments performed in NIMROD. One active base will be implemented in each ring. Assuming a positive result, we will construct the rest of the bases before the next production experiment.

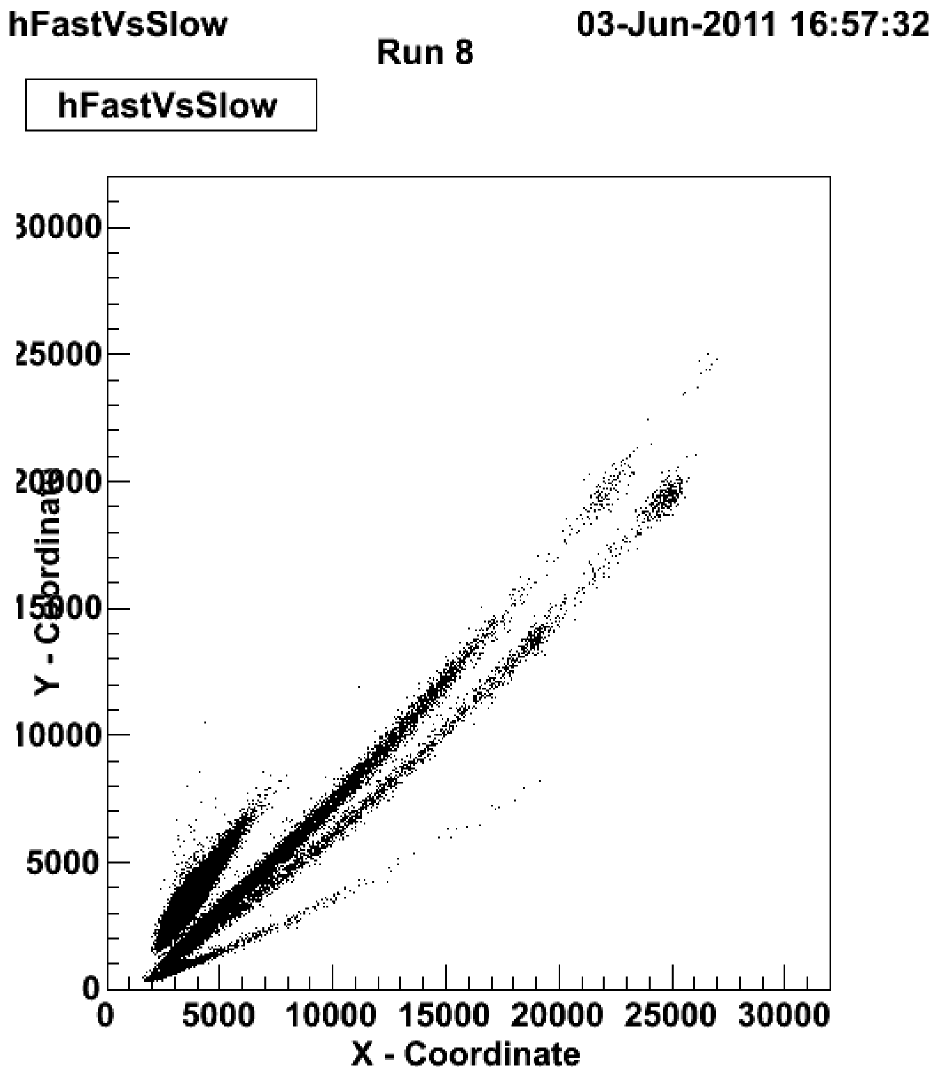

FIG. 1. Fast vs slow plot showing the performance of the active base.

[1] J. Pouthas *et al.*,Nucl. Instrum. Methods Phys. Res. **A369**, 222 (1996).
[2] S. Wuenschel, *et al.*, Nucl. Instrum. Methods Phys. Res. **A604**, 578 (2009).