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Design of a high count rate photomultiplier base board for the sodium iodide detector on PGNAA

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Prompt gamma neutron activation analysis (PGNAA) is a measurement technique for nondestructive elemental analysis. The method is used intensively for on-line and in situ analysis in various fields. It has a short measurement time, usually only about 120s. In order to ensure the measurement accuracy and get better statistics, the measurement system requires a high count rate, which is an important indicator of PGNAA.
Industrial field applications must have large detector sizes to increase the detection efficiency. A sodium iodide (NaI) detector which size is 6×7 inch is used. Resistor divider structure is used in conventional PMT base board. At high count rate condition, the drive current would be insufficient and the output signal would be distorted, which leaded to the destruction of the linear relationship between the PMT output signal amplitude and the incident particle energy. The upper limit of energy spectrum is only 5MeV at 100k count rate.
In this paper, a PMT base board with current amplification design has been developed. The PNP transistor is used to amplify the drive current. It can avoid the AC coupling and can achieve small size. The test results show that the design satisfies the drive current demand at high count rate. The design increases the upper limit of energy spectrum to 10MeV at 250k count rate, which improves the resolution of elements.

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