The ISiS detector solid angle/energy acceptance is significantly improved compared to currently operating 4π arrays based on phoswich technology. The figure of merit here is the product of solid angle coverage and the fraction of the total fragment energy spectra that is above threshold. For ISiS the total solid angle is 80% of 4π, as determined by simulations with the GEANT code. The major acceptance advantage of the ISiS array is its very low detector thresholds ($E/A \approx 0.5$ MeV compared to $E/A \approx 2.0$-3.5 MeV for phoswich telescopes). Due to the distortions of the fragment spectra toward low energies for light-ion-induced reactions above about 500 MeV/nucleon, the relative gain in differential cross section is substantial (~ a factor of three) for the ^{3}He + ^{nat}Ag system which we have been studying.

The present status of the detector is summarized briefly as follows:

(1) Mechanical components – These are complete and assembled.

(2) Detector components – Ion chamber housings are complete with anode wire installation in progress; 95% of the silicon detectors have been delivered, with all devices mounted in frames and electrical leads attached; all CsI crystals have been machined, polished and attached to light guides; 25% of the photodiodes have been delivered.

(3) Electronics – preamplifier/shaper design is complete and production of all modules will begin shortly. Constant fraction discriminators of the APEX design are beginning to arrive; peak-sensing ADCs are on order, and TDCs have been delivered.

(4) Computer – As a starting configuration, we will use CAMAC/VME for data acquisition, using XSYS and/or PAW software.

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IDENTIFICATION AND ENERGY MEASUREMENTS OF LIGHT PARTICLES WITH A CsI(Tl)–PHOTODIODE COMBINATION

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Recently with the availability of large-area silicon photodiodes, the use of CsI(Tl) scintillator detectors has enjoyed a renaissance. CsI(Tl) scintillator material has several advantages over NaI(Tl). It is less hydroscopic, has a shorter radiation length and the photon yield per energy loss is higher.[1] Moreover, the relatively long wavelength emission of

CsI(Tl) is optically well matched to the spectral sensitivity of photodiodes which are much more stable than photomultipliers. Thus the properties of the CsI(Tl)–photodiode combination lend themselves for their use in magnetic fields or inaccessible locations. Another characteristic feature of the CsI(Tl) scintillator is the fairly strong dependence of the light emission decay time on the ionization density produced by the exiting particle. This allows identification of light charged particles using pulse-shape discrimination techniques.[2,3]

In order to study the performance of a CsI(Tl)–photodiode detector, a CsI(Tl) scintillation crystal with a dimension of $4.0 \times 4.0 \times 0.35$ cm^3 was optically coupled to a pyramidal Lucite light guide tapering off towards a 1.8×1.8 cm^2 surface to which a silicon photodiode (Hamamatsu S3204-3) was cemented. The sides of the crystal and the light guide were wrapped with white Teflon tape, and the front surface of the crystal was covered by a thin aluminized mylar foil to provide reflection of the scintillation light.

The signals from the photodiode were amplified by a charge-sensitive preamplifier and a spectroscopy amplifier with a shaping time of 3 μs. Pulse-shape analysis was performed by measuring the zero-crossing-time of the bipolar pulse relative to the start of the signal.

The particle identification capability of the CsI(Tl)–photodiode combination is demonstrated in Fig. 1. It shows a portion of the scatter plot of the zero-crossing-time versus light output measured for spallation products of 200 MeV protons on an Al target. A good separation of ^{3}He and ^{4}He particles is clearly observed.

Another aspect of the present test of a CsI(Tl)–photodiode detector is energy resolution and count rate capability. The rather long decay time of 7 μs of the slowest scintillation component will affect the count rate capability. A reduction of the amplifier shaping time will on the one hand reduce pile-up, but on the other hand will increase the noise and fail to fully integrate all of the CsI(Tl) scintillation, thus worsening the energy resolution. Tests using different commercially available preamplifiers with various RC shaping time constants are under way.

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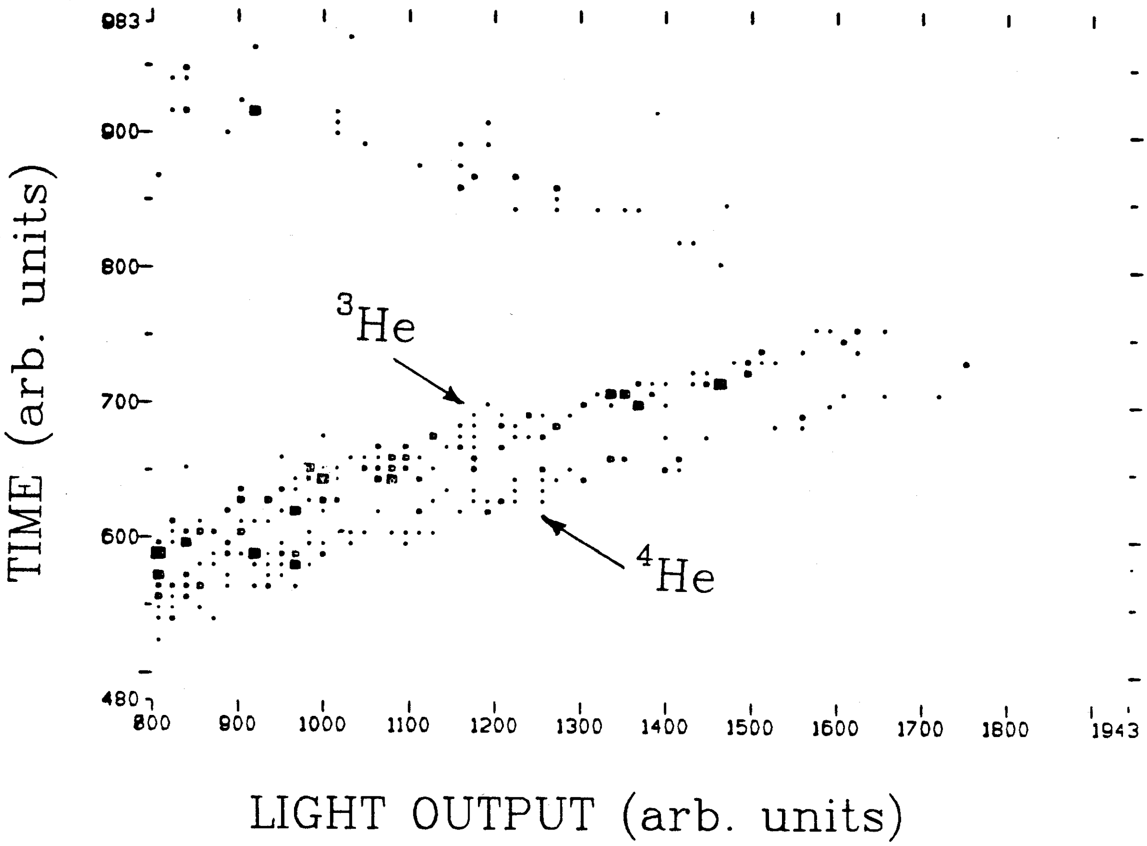

Figure 1. Scatter plot of zero-crossing-time versus light output. The reaction was 200 MeV protons on ^{27}Al and the laboratory angle $\Theta = 30°$.