[2-4-11] Total Energy Detector (TED)

* Design

crystal	Pure CsI, 100mm x 100mm x 50mm-thick
PMT	HPK – R6233HA(3" ϕ), with non-UV window, booster connector
breeder	tapered, with high breeder current (3mA @1kV),
effective area	800mm(H) x 400mm(V), with 8 x 4 (32) crystals
HV	32 ch, CAEN A1733N x3
readout	32 x 500nsec cable delay, CAEN 32ch ADC V792AC x1

* R&D for TED

As a total energy detector, we have tested (1) NaI(Tl) coupled to PMT, (2) HP-Ge crystal, (3) CsI(Tl) coupled to photodiode, using Ar & Kr & secondary beams between 200 – 400 MeV/A. Energy resolution of 0.3 – 0.4 % (rms) for total energy of 25 – 30 GeV was obtained only at low counting rate (below 1kHz).

Since above detectors are relatively slow, we have also tested pure CsI crystal coupled to PMT. It has smaller light output compared to CsI(Tl), but has faster decay time and believed to be strong against the radiation damage. After high-current tapered breeder was designed, energy resolution of 0.2 to 0.4% was observed for Kr beams at 400 MeV/A. By comparing the light output between Ar and Kr beams, large saturation effect was observed. Since energy resolution between PMT with UV window and with non-UV window has no noticeable difference, PMT with non-UV window was selected. Light output was stable for beam rates up to 10-20kHz. It was also observed that the pulse shape for heavy ion is different from those for γ -rays, electrons, and possibly protons.

Although there are many phenomenon which we cannot understand, we studied the isotope separation for rigidity-separated (Δ p/p~0.1%) secondary beams at 270 MeV/A. Configuration of the detector is shown in the table. Combined with the energy degrader in front of TED, isotopes around mass 70 region could be separated with ~6 σ separation as shown in Fig 2-4-13. The reaction loss in the degrader and the CsI crystal is estimated to be about 15%.

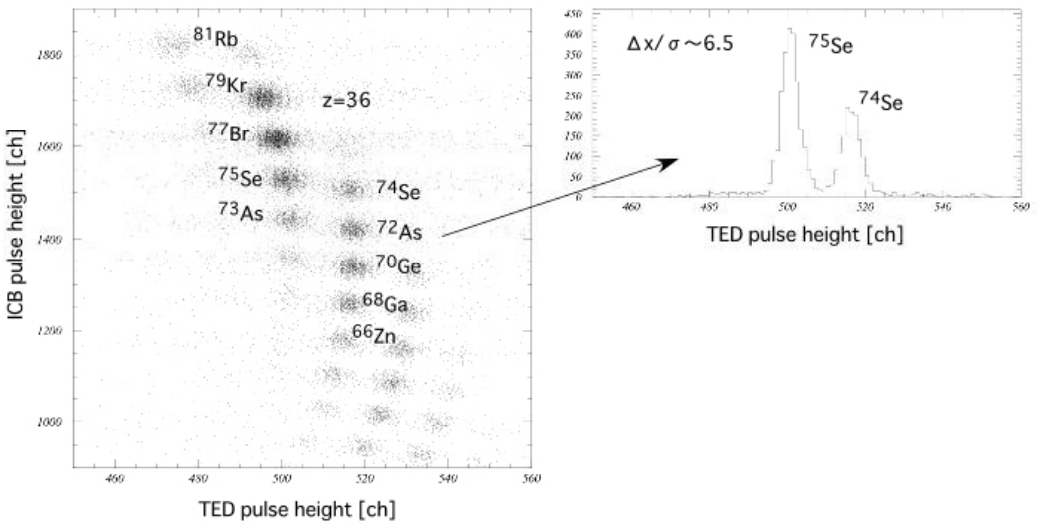

Fig 2-4-13 : Isotope separation of A~80 region for rigidity-analyzed secondary beams at 270 MeV/A

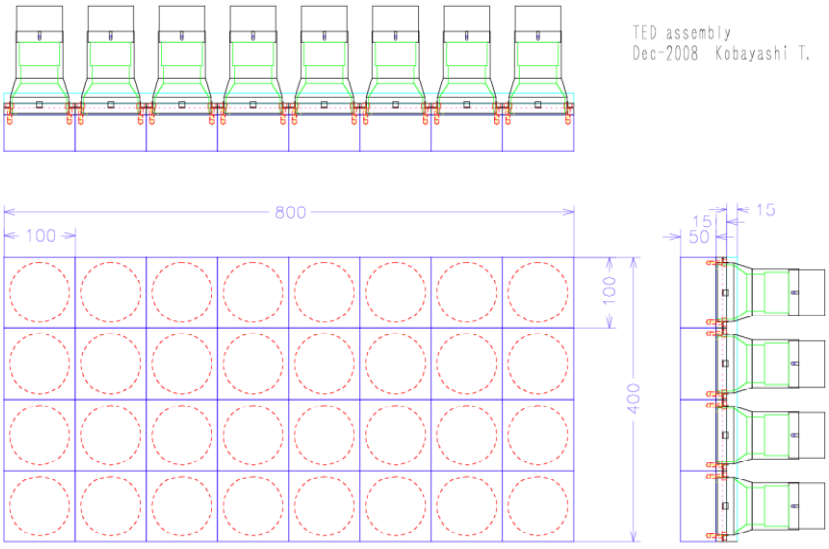

Fig 2-4-14 : TED assembly