

[2-4-10] Total Internal Reflection Cherenkov (TIRC)

* Design

TIRC is a Cherenkov detector operated at the total internal reflection (TIR) threshold. Since photon numbers increase sharply at the TIR threshold, good velocity resolution is expected. Refractive index of the radiator chosen is $n \sim 1.9$ so that the TIR threshold is around 250 MeV/A.

radiator	TAFD30($n \sim 1.92$), 65mm x 240mm x 2mm ^t (max. size available)
PMT	HPK H6559 (3" ϕ) with booster connector, radiator is viewed by 2 PMT's. 10 PMT's available
effective area	632(317)mm x 240mm(V), covered by 10(5) elements
HV	20(10) ch, CAEN A1733N x2(1)
readout	20(10) x 500nsec cable delay, CAEN 32ch ADC V792AC x1

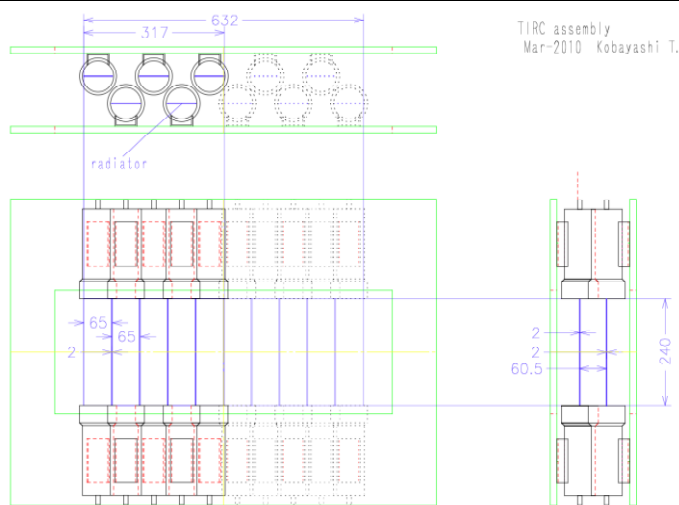


Fig 2-4-10 : TIRC assembly

We have tested prototypes with radiators of 240 x 65 x 1mm^t and also 2mm^t using energy-degraded Ar & Kr beams between 170 – 400 MeV/A. From the study on position & angle dependences, we decided to put PMT's on both side of the radiator. From the energy dependence of the Cherenkov light yield (Fig. 2-4-11a), energy dependence of the velocity resolution is estimated (Fig. 2-4-11b). Effect of the TIR threshold is clearly seen. Velocity resolution of about 0.2% (rms), which is factor of 2 worse than necessary, was obtained. We also decided to use 2mm-thick radiators.

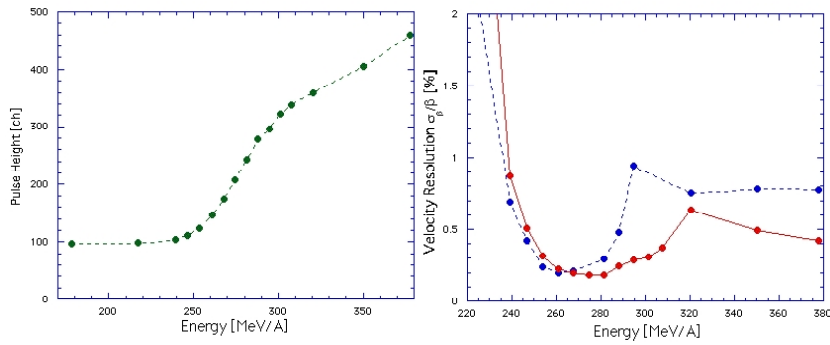


Fig 2-4-11 : Energy dependence of (a) light yield and (b) velocity resolution for Kr beam.

Using rigidity-analyzed ($\Delta p/p \sim 0.1\%$) secondary beams at ~ 270 MeV/A, we have studied the mass separation. As shown in Fig. 2-4-12, isotopes around mass 70 could be separated with about 4σ separation for rigidity-analyzed secondary beams ($\Delta p/p \sim 0.1\%$). Due to the thickness of the radiator (~ 1.2 g/cm²), reaction loss in the radiator is estimated to be about 5%.

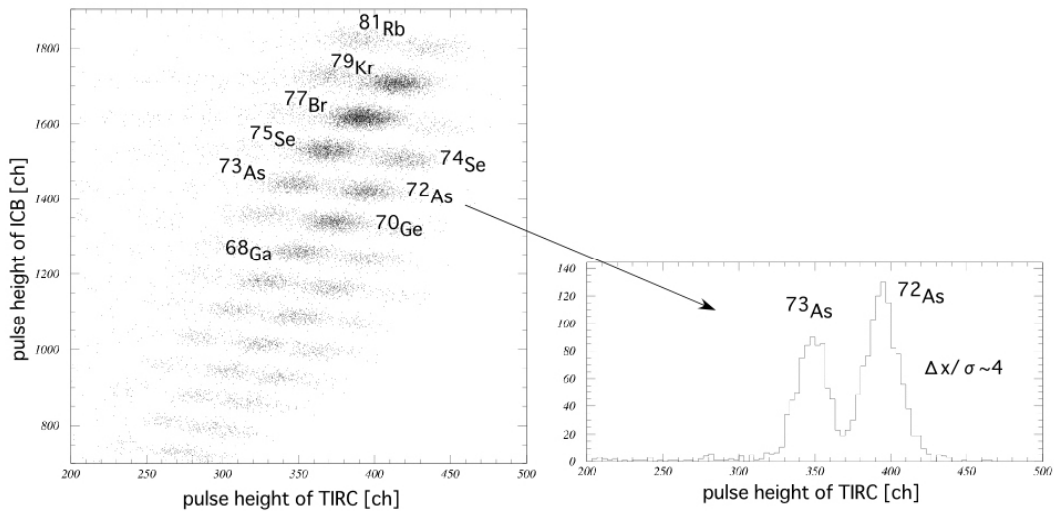


Fig. 2-4-12 : Isotope separation of A~80 region for rigidity-analyzed secondary beams at 270MeV/A

Prototype study shows that TIRC has enough mass resolving power below mass 80 around 270 MeV/A. But we have also noticed the radiation-damage effect.

We have 10 radiators and 10 PMT's available. Using available parts, we can build a TIRC hodoscope with can cover 320mm (H) x 240mm (V) with 5 elements as shown in Fig 2-4-10. Radiators and PMT's will be housed in a detector box which serves as a magnetic and light shield box.