# DEVELOPMENT OF HIGH RESOLUTION TOF DETECTOR FOR RI BEAMS USING CHERENKOV RADIATION

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The production of energetic radioactive isotope (RI) beams is an important means to understand features of unstable nuclear experimentally. Sometimes a high time resolution detector is crucial for such experiments. It is not important only to make clear and better identifications of relativistic RI beams with the use of fragment separators i.e. BigRIPS in RIKEN or FRS in GSI, but also to perform modern nuclear physics experiments in which identification and precise measurements of momentum of isotopes produced through secondary reactions of RI beams are required.

We have developed a high time resolution time-of-flight (*TOF*) detector which detects the Cherenkov light emitted when RI beam passes through the high refractive index glass (n=1.89), 30mm × 30mm area size. Generally, the plastic scintillation counter has been commonly used as a fast *TOF* detector. The fast scintillation light of an organic scintillator could be emitted with a decay time of the order of a few *ns*. On the other hand, Cherenkov light could be instantly emitted without de-excitation delay. Therefore, it would be advantageous to use Cherenkov radiation instead of scintillation to measure *TOF* with high resolution.

Experiments were performed at HIMAC (Heavy Ion Medical Accelerator in Chiba), NIRS [1]. $^{58}$Ni, $^{82}$Kr and $^{132}$Xe beams of which beam energies are from 200*A* to 500*A* MeV have been used for the test of Cherenkov detectors. The digitization of time interval have been done with the combination of TAC (Time-to-Amplitude Converter) and ADC (Analog-to-Digital Converter). The method of optical coupling between the radiator and photomultipliers to achieve the best time resolution has been also studied. An excellent time resolution of 5 *ps* by standard deviation with the inclusion of system resolution has been achieved with 420*A* MeV $^{132}$Xe beam.

In the presentation, the details of the detector and experimental results will be reported and discussed.

REFERENCES

[1] M. Takechi et al., Phys. Rev. C. 79, 061601(2009).