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# Development of TOF-PET using Compton scattering by plastic scintillators

Positron Emission Tomography (PET) is an effective method of cancer diagnostics.
One of the major approaches to improve the spatial resolution is the time-of-flight technique (TOF),where the initial position of back-to-back $\gamma$-rays is constrained by the differences in arrival time. Better time resolution could achieved with faster scintillators due to less time jitter. Hence, we focused on a plastic scintillator having a time constant faster than that of typical inorganic scintillators used in PET scanners. We thus propose TOF-PET using Compton scattering with plastic scintillators. Compton-PET consists of inner scattering and outer absorbing layers, made of plastic and inorganic scintillators, respectively. When we obtain the position and energy deposit for both scattering and absorption point, we can estimate the incident direction in a conical shape.
As the first step, we made a pair of timing measurement systems, that used $3 \times 3 \times 3$ mm$^3$ scintillators and $3 \times 3$ mm$^2$ MPPCs. We compared the time resolution of the plastic scintillator with that of LYSO(Ce) and GAGG(Ce) scintillators. The obtained time resolution of each scintillator (FWHM) is 249, 336, and 376 ps, for the plastic, LYSO(Ce) and GAGG(Ce) scintillators, respectively. Plastic scintillators could achieve a time resolution better than that of LYSO(Ce) and GAGG(Ce).
Other basic experiments to verify the feasibility of our Compton-PET will be presented.

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