

Medical camera under development could help cut time and cost of procedures

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Compton camera being tested at Kavli IPMU. Credit: Kavli IPMU

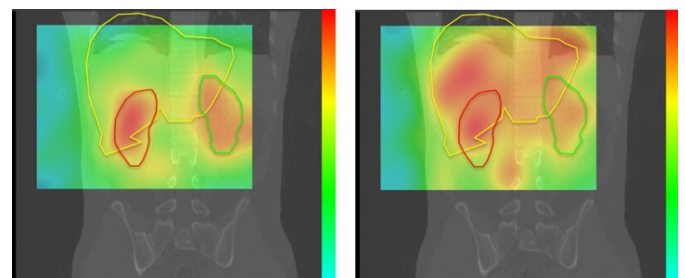
Researchers have completed a successful clinical trial, managing to detect and image radioactive tracers used in PET and in SPECT scans at the same time, with the hope of enabling doctors to scan patients for abnormalities in shorter times while reducing the amount of radiation patients would be exposed to.

With today's technology, patients who might have life-threatening illnesses are required to undergo a number of tests such as a PET (Positron Emission Tomography) scan or a SPECT (Single-Photon Emission Computed Tomography) scan in order to look for a particular disease, or check if their organs are functioning properly, respectively. Both PET and SPECT scanners require exposing the patient to a small amount of radiation, which enables devices to capture an image of the patient's internal organs that are then analyzed by medical specialists. PET scans detect gamma rays with a specific [energy](#) of 511 keV, while SPECT can only detect gamma rays at relatively lower energies because collimators used in SPECT become transparent for high energy gamma-rays.

Performing separate PET and SPECT scans is both time consuming and exposes the patient to increased levels of radiation.

A team led by Gunma University Heavy Ion Medical Center Special Professor Takashi Nakano, a pioneer in heavy particle beam therapy in Japan, has been working to combine these procedures. They worked in collaboration with teams at Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU), led by Professor Tadayuki Takahashi, the National Institutes for Quantum and Radiological Science and Technology, led by Naoki Kawachi, and the Japan Aerospace Exploration Agency (JAXA), led by Assistant Professor Shin Watanabe, and completed a successful clinical trial using a newly-developed imaging diagnosis device called a Compton camera that makes it possible to detect gamma rays in both low and high energy ranges.

This is the first time a research group has managed to move onto carrying out the procedure on human patients.



(Left) an image of gamma rays with energy of 141 keV from $^{99m}\text{Tc-DMSA}$, and (right) an image of gamma rays with energy of 511keV from $^{18}\text{F-FDG}$ detected at the same time using the Compton camera. Credit: Nakano et al

During the trial, patients were given with two of the

most commonly used [radioactive tracers](#) in PET and in SPECT; ^{18}F -FDG radioactive tracer (fludeoxyglucose) used in PET, and $^{99\text{m}}\text{Tc}$ -DMSA, or 2,3-dimercaptosuccinic acid used in SPECT. These tracers accumulate in the patient's liver and kidney after being consumed, where they emit concentrated amounts of gamma rays with differing energies. Using the Compton camera, the researchers were able to simultaneously create two-dimensional images from different radio isotopes of the patient's organs.

One of the characteristics of this medical camera is its adaptation of silicon/cadmium telluride (Si/CdTe), originally developed by Takahashi's team at Japan's space agency JAXA in order to study cosmic [gamma rays](#). The silicon and cadmium telluride semiconductors are capable of accurately detecting gamma ray energies emitted from radioactive elements over a wider range of energies without the need of collimators.

A new image reconstruction algorithm for nearby objects was also developed by Kavli IPMU Project Assistant Professor Shinichiro Takeda, which analyzes the image data.

After several more trials, the researchers are optimistic that their imaging system will lead to new forms of medical analysis. Furthermore, it could help create completely new radioactive tracers. Details of their study were published online in *Physics in Medicine and Biology* on July 20.

More information: Takashi Nakano et al, Imaging of $^{99\text{m}}\text{Tc}$ -DMSA and ^{18}F -FDG in humans using a Si/CdTe Compton camera, *Physics in Medicine and Biology* (2019). [DOI: 10.1088/1361-6560/ab33d8](https://doi.org/10.1088/1361-6560/ab33d8)

Provided by Kavli Institute for the Physics and Mathematics of the Universe

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