IMAGINE-X

The World's Highest-Class Resolution Molecular Imaging System

XCam-CdTe

Contributing to the Development of Healthcare through Our Imaging Technology

iMAGINE-X Inc. was established in 2019 by researchers in astrophysics who have explored black holes and supernova remnants at the forefront of the world. In astrophysics, researchers play a central role in developing detectors mounted on satellites that capture X-rays and gamma-rays from space, and realizing imaging for the first time through advanced analysis. Such imaging technologies, which have been accumulated over many years through the exploration of space have the potential to overwhelmingly surpass the imaging technologies that have been used in healthcare thus far.
For this reason, we have developed the XCam-CdTe, a system that is capable of pharmacokinetic imaging of whole mouse bodies to contribute to society through drug discovery research, as a first step.
Of course, the detectors and analysis software that are utilized in space cannot be used as they are. Accordingly, we were able to release a high-resolution molecular imaging system by making various efforts in the installation and miniaturization of sensor elements, and software improvements. Going forward, we will continue to ceaselessly contribute to the development of healthcare that is centered on imaging technology, without halting development.

IMAGINE-X

By all members of the development team

The World's Highest-Class Resolution Molecular Imaging System Launch of

XCam-CdTe

High-resolution and high-sensitivity pharmacokinetics imaging using X-rays and gamma-rays

The XCam-CdTe is a molecular imaging system that provides the world's highest level of resolution and sensitivity, by adopting a high-performance cadmium telluride (CdTe) semiconductor detector as the imaging sensor, together with a 3D-printed tungsten collimator. This system was developed in response to the growing demand for pharmacokinetic imaging in preclinical studies, particularly with therapeutic radioisotopes such as At-211 and Ac-225. Specifically, it dramatically improves the imaging quality of X-rays/gamma-rays in the 10-200 keV band and has a field of view of 40 mm × 80 mm, which is sufficient to image the whole body of a mouse.

The XCam-CdTe's specifications

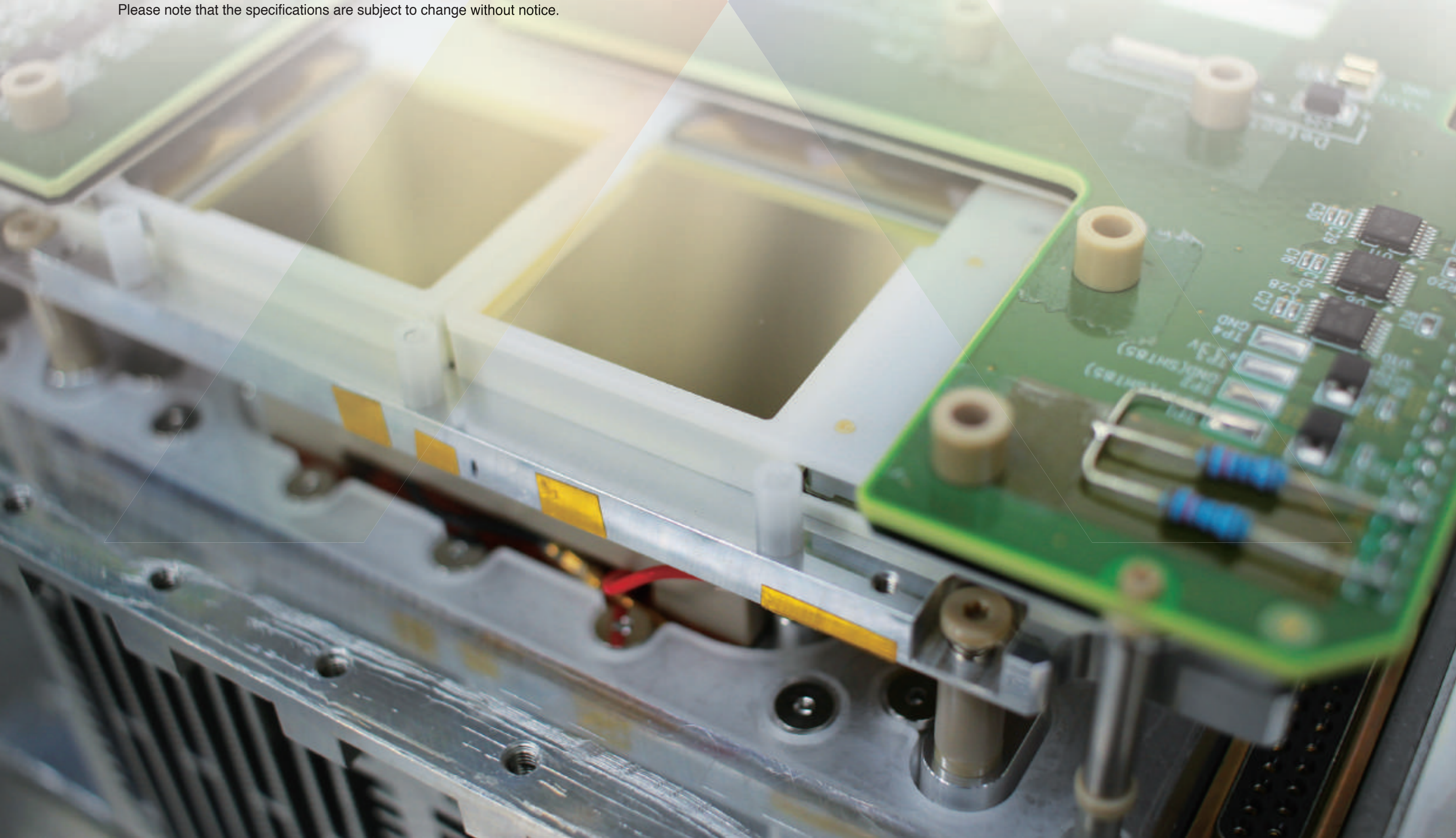
In the case of using High-Efficiency collimator (XCam-CdTe-HE)

Imaging band	10-100 keV
Spatial resolution	1.5 mm(max.)
Sensitivity	770 cps/MBq (I-125: 20-38 keV Energy window)
	260 cps/MBq (At-211: 75-95 keV Energy window)
Field of view	40x80 mm
Energy resolution	2.5% (FWHM)@122 keV

In the case of using All-Purpose collimator (XCam-CdTe-AP)

Imaging band	10-200 keV
Spatial resolution	1.5 mm(max.)
Sensitivity	200 cps/MBq (I-125: 20-38 keV Energy window)
	70 cps/MBq (At-211: 75-95 keV Energy window)
	90 cps/MBq (Tc-99m: 135-145 keV Energy window)
Field of view	40x80 mm
Energy resolution	2.5% (FWHM)@122 keV

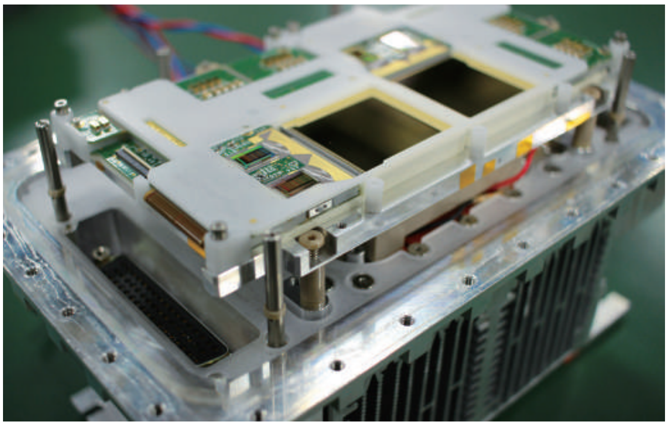
Please note that the specifications are subject to change without notice.



Four characteristics of the XCam-CdTe

1 Quantitative imaging

To accurately image the amount of radioisotopes accumulated in tumors transplanted into or organs in mice, it is necessary to precisely determine the energies of photons, and to separate the background components that are derived from scattered gamma-rays in vivo and fluorescent X-rays in collimators from the signal components that are directly from the mice. The superior energy resolution of the CdTe semiconductor detector has dramatically improved the ability to select the signal photons. As a result, the XCam-CdTe is ideal for applications, including image-based dosimetry, due to its highly quantitative images.



Measurement case using the XCam-CdTe

It is possible to track the distribution of drugs in a mouse's body, which changes over time, via the temporal behavior of the drugs, even with conventional imaging techniques. However, in the case of therapeutic radioisotopes with relatively short lifetimes, such as At-211 (half-life: 7.2 hours), it may be a challenge to track the distribution because the radioactivity quickly becomes weak.

The images at right were acquired using the XCam-CdTe, which show the distribution of an At-211 drug candidate administered into a tumor-bearing mouse. With its high sensitivity, the XCam-CdTe detected the accumulation of At-211 in the tumor (red arrow) in roughly 30 minutes of observation, even at 21 hours post-injection. These images revealed that the radioactivity in the tumor decreased from 18.8 kBq (after 3 hours) to 1.4 kBq (after 21 hours), allowing an estimation of the applied dose.

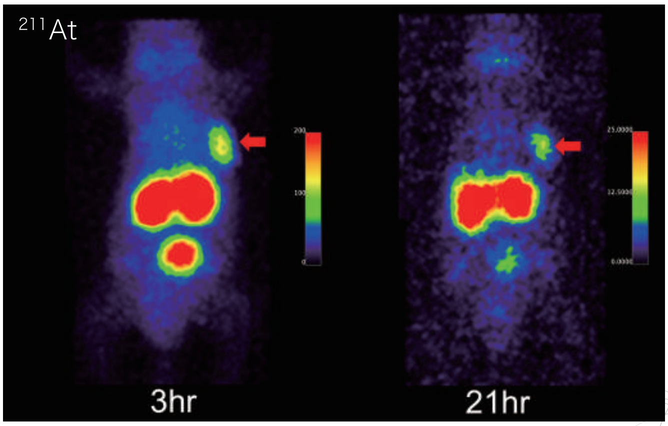


Image supplied courtesy of Graduate School of Medicine/ Faculty of Medicine, Osaka University

2 Dynamic imaging

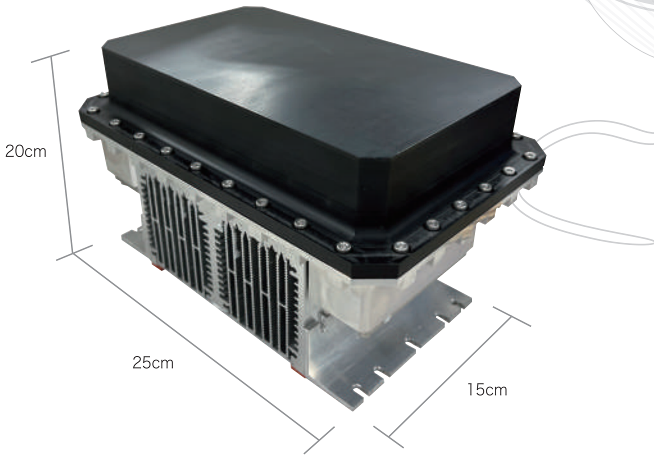
The XCam-CdTe uses a high-efficiency tungsten collimator manufactured using metal 3D printing technology to quickly collect and image the photons that are necessary for imaging. As a result, the system is highly advantageous for the dynamic imaging of pharmacokinetics.

3 Multi-isotope imaging

The XCam-CdTe is ideal for multi-isotope imaging, because it has an energy resolution that is approximately two times better than systems based on current commercially available high-grade CZT semiconductor detectors. A significant improvement in image quality is expected when combining radioisotopes whose emission lines have peak energies that are close to each other, such as Tc-99m (140 keV)/I-123 (159 keV) and Lu-177 (113 keV)/At-211 (76-92 keV).

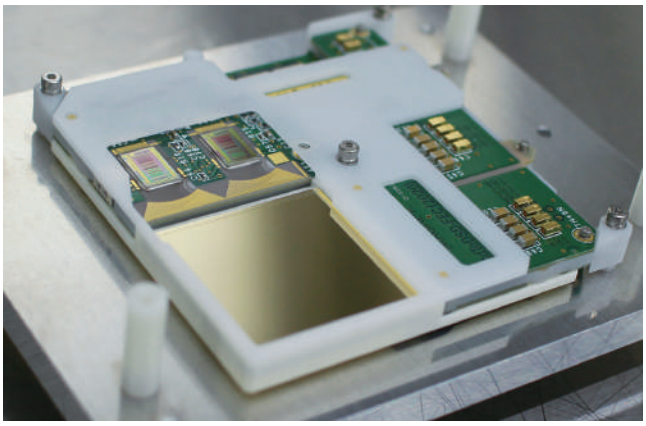
4 Easy operation and compact size

After placing a mouse on the XCam-CdTe and operating the easy-to-use attached software, the system starts data acquisition, and the distribution of the radioisotopes is displayed. The XCam-CdTe has a very compact design, with a size of 25 cm × 20 cm × 15 cm.



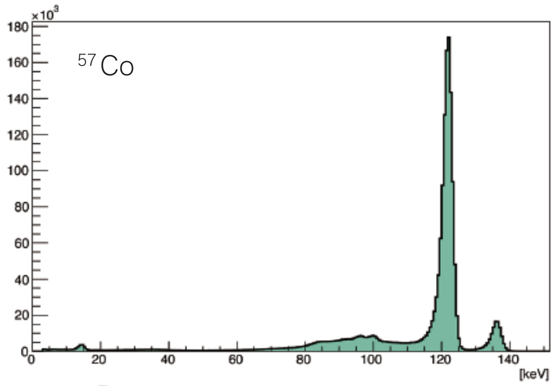
Two Technologies that Support the XCam-CdTe

1 Our unique CdTe detector



Large area, high energy resolution, and high position resolution

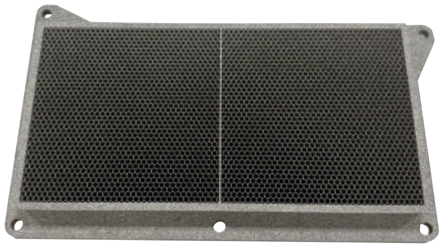
Instead of using a pixel-type detector, iMAGINE-X Inc. has developed a CdTe Double-sided Strip Detector (CdTe-DSD) to obtain a large effective area (32 × 32 mm^2) with fewer readout channels and lower power consumption. A special algorithm using both anode and cathode signals provides a high energy resolution of 2.5% (FWHM) at 122 keV, even for the thick (2 mm^t) detectors used in the XCam-CdTe. The position resolution of the detector is 250 µm, which is sufficiently smaller than the collimator's hole size and contributes to the excellent spatial resolution of the XCam-CdTe. The XCam-CdTe aligns two detectors to achieve a large field of view that covers the entire body of a mouse.



2 Our unique tungsten collimators

High-efficiency pure-tungsten collimators based on metal 3D printing technology

Through our efforts, we have developed our own computational code for designing collimators, and successfully "printed" collimators optimized for the XCam-CdTe that are made of pure tungsten based on the latest metal 3D printer technology. We can provide a collimator for you, and you may select it from our existing collimator family or order a newly developed, custom-made collimator depending on your purpose.



Our collimator family

High-Efficiency collimator (HE)

This collimator is recommended for imaging in the 10-100 keV band, specifically for high-energy X-rays emitted from heavy radioisotopes such as At-211 (76-92 keV) and Ac-225 (70-100 keV), or low-energy X-rays such as In-111 (23.2 keV) and I-125 (27.5 keV). Its collimator efficiency is approximately five times greater than the standard collimators used in clinical imaging.

All-Purpose collimator (AP)

This collimator is designed for various radioisotopes that emit X-rays or gamma-rays in the 10-200 keV band. While less efficient than the High Efficiency (HE) collimator, this collimator can image various radioisotopes such as In-111 (171 keV), Lu-177 (113, 208 keV), Tc-99m (140 keV), and I-123 (159 keV).

Coded Aperture (CA)

Coded aperture collimators can also be produced, at your request.

IMAGINE-X

XCam-CdTe

Space to Life

iMAGINE-X Inc. is a startup company established in 2019 by the researchers of the Kavli Institute for the Physics and Mathematics of the Universe at the University of Tokyo (Kavli IPMU).
We are driving the imaging system business by expanding the results of research on high-energy astrophysics, such as black holes, into various industries centered on medicine.

iMAGINE-X Inc.

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	Atsushi Yagishita,	Director/Project Assistant Professor, Kavli IPMU
	Tadashi Orita,	Director/Project Assistant Professor, Kavli IPMU
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