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INSPIRE: challenge of 50-kg class satellite to open up MeV gamma-ray astronomy

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Recently, more than 300 satellites are launched globally every year, significantly lowering the hurdle to space exploration. Particularly, small satellites weighing less than several tens of kilograms are widely used in industry and telecommunications, but they are also crucial as a pathfinder for cutting-edge space science. Tokyo Tech successfully launched the 50 kg university satellite HIBARI in 2021, and plans to launch a second satellite, PETREL, in the second half of FY 2023. Both satellites attempt to control the attitude by variable geometry in orbit, and to observe ultraviolet radiation in the very early phase of the gravitational wave objects like kilonova (neutron star–neutron star merger). In this talk, I will first review these university satellite projects and then report on the world's first MeV gamma ray small observation satellite (tentative name: INSPIRE), which is scheduled to be launched in FY2026. The satellite carries a Compton-camera box (CC-BOX), which can visualize 30–3000 keV X-/gamma-rays, along with high-sensitivity UV camera. CC-BOX consists of large area Si-PM (MPPC) array optically coupled with 3D position-sensitive Ce:GAGG scintillator to achieve an angular resolution of 7° (FWHM) by simultaneous imaging of 30–200 keV in pinhole mode and 200–3000 keV in Compton mode. The field of view is ~ 1 str in every pointing. The prototype model of CC-BOX has already been installed and tested for diagnostic imaging in nuclear medicine and observation of atmospheric phenomena, such as in the world's first successful gamma ray imaging of thunderclouds (Kuriyama et al. 2022, GRL). In this talk, I will describe in detail the imaging experiments using the prototype model to date, along with various environmental tests for the launch in FY2026. I will also discuss expected performance and observation plans in orbit to achieve various scientific goals.

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