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Development of a Wide-Band Gamma-Ray Camera Onboard a 50 kg-Class Small Satellite GRAPHIUM

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More than 300 satellites are being developed worldwide, some of which are used to promote the space sciences. Waseda University and Tokyo-Tech are developing a 50 kg-class satellite "GRAPHIUM,"scheduled for launch in FY2026. The satellite aims to expand MeV gamma-ray astronomy that has stagnated for over 30 years. The primary detector of the satellite is a box-type Compton camera (INSPIRE) that covers a dynamic range spanning over two orders of magnitude by observing low energy (30–200 keV) in the pinhole mode and high energy (200 keV–3 MeV) in the Compton mode. The CC-BOX consists of pixelized Ce:GAGG scintillators coupled with an MPPC array covering a total geometric area of 10 × 10 cm^2, surrounded by BGO active shields. The scatterer has a 5-mm square pinhole that enables imaging using low-energy gamma rays according to the principle of a pinhole camera. The rear absorber has a four-layer depth-of-interaction (DOI) structure with a total thickness of 20 mm that improves sensitivity to MeV gamma rays. Consequently, the location of the gamma-ray interaction is identified three-dimensionally by reading of the signals by the MPPC at both ends of the scintillators. This significantly improves the spatial resolution of the detector . The design of the CC-BOX is now complete, and we have developed an engineering model (EM) equipped with actual sensors.
In this presentation, first, we describe the detailed configuration of INSPIRE, including its data acquisition (DAQ) and power supply system. Then, we evaluate the operating system and data processing flow, including a DAQ board, USB board, and Raspberry Pi. Finally, we present the results of wide-band imaging performed using the EM and discuss its performance in terms of energy and angular resolution.

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Author: Mr MORI, Ryohei (Waseda University)

Co-authors: Prof. KATAOKA, Jun (Waseda University); Prof. TANAKA, Kaduo (Waseda University); Mr SUGA, Tomoya (Waseda University); Mr OGASAWARA, Shojun (Waseda University); Mr YAMAMOTO, Kazuki (Waseda University); Prof. YATSU, Yoichi (Tokyo Institute of Technology); Prof. NAKANISHI, Hiroki (Tokyo Institute of Technology); Prof. CHUJO, Toshihiro (Tokyo Institute of Technology); Ms MIYAMOTO, Kiyona (Tokyo Institute of Technology); Mr WATANABE, Kei (Tokyo Institute of Technology); Dr KOBAYASHI, Hiroyuki (Tokyo Institute of Technology); Dr AMAKI, Yuki (Tokyo Institute of Technology); Dr TAKAHASHI, Kenichiro (Tokyo Institute of Technology); Dr YASUDA, Moe (Tokyo Institute of Technology); Dr KOBAYASHI, Daiki (Tokyo Institute of Technology); Dr OTSUBO, Keito (Tokyo Institute of Technology); Mr ARAI, Yusuke (Tokyo Institute of Technology); Mr YOSHIMURA, Daiki (Tokyo Institute of Technology); Mr OZEKI, Yusaku (Tokyo Institute of Technology); Mr TASHIRO, Kazuki (Tokyo Institute of Technology); Mr HAYATSU, Shunsuke (Tokyo Institute of Technology); Mr KAWAGUCHI, Yusei (Tokyo Institute of Technology); Mr YOSHIDA, Hideo (Tokyo Institute of Technology); Mr FUKUDA, Minori (Tokyo Institute of Technology); Mr SEKI, Hibiki (Tokyo Institute of Technology); Mr JOSHIMA, Shigeaki (Tokyo Institute of Technology); Mr ONISHI, Mitsunobu (iMAGINE-X Inc.); Mr TAKEDA, Shinichiro (iMAGINE-X Inc.)

Presenter: Mr MORI, Ryohei (Waseda University)

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