Semiconductor Lateral Drift Detector for Imaging X-rays

Tech ID: 34407 / UC Case 2021-643-0

ABSTRACT

Researchers at the University of California, Davis have developed a solid-state X-ray imager with high temporal resolution.

FULL DESCRIPTION

Imaging devices are available in various designs, including solid-state imagers, which can realize spatial resolutions of approximately 10 um-100um but only offer temporal resolutions in the millisecond range. These solid-state systems can be manufactured in a compact size and at a low cost. Streak cameras using a vacuum tube design allow for temporal resolutions of between 10 and fs-100 fs and, as a result, are often used to achieve ultrafast imaging. However, such vacuum tube imagers only offer 1-D acquisition, require complicated procedures for spatial mapping, are large, costly to maintain, and can cost up to $250,000/unit.

Researchers at UC Davis have developed a solid-state imaging technology that can realize improved imaging capabilities compared to current vacuum tube designs/systems while offering added system flexibility and operational options. The developed solid-state X-ray imager offers temporal resolutions into the 10 ps-30 ps range while achieving spatial resolutions of approximately 30 um. The developed solid-state imager acquires an X-ray pulse in a semiconductor chip, creating an electron cloud. A series of voltages are applied across drift cathode strips on either side of the semiconductor chip, creating an electric field exhibiting a linear profile. The created linear electric field causes the electron cloud to move/drift along the middle region of the semiconductor chip, thereby activating a counter cathode and one or more readout anodes, which collect the electron cloud after it has spread across the middle section of the chip. Alternatively, the drift cathode strips, counter cathode, and one or more readout anodes can be used to create a potential across the chip's middle section, creating an electron cloud generated by an X-ray pulse. The electron cloud drifts along the middle section of the chip, creating a linear potential along the chip, whereby the electron cloud is collected after its movement across the middle of the chip.

APPLICATIONS

- Plasma physics, high-energy-density physics, life sciences.
- Characterization of single or discrete events.

FEATURES/BENEFITS

- Low manufacturing cost as compared to vacuum tube streak camera.
- High temporal resolution.
- Ultrafast imaging capabilities.
- Operational flexibility.

PATENT STATUS

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OTHER INFORMATION

KEYWORDS

X-rays, imaging, ultrafast imaging, solid-state, temporal resolution, spatial resolution

CATEGORIZED AS

- **Engineering**
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  - Other
- **Imaging**
  - Medical
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Patent Pending

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