Optimization of the Configuration of Pixilated Detectors for the X-Ray Spectroscopy of Hot Plasmas Based on the Shannon-Nyquist Theorem

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Technology description

Inventors from Princeton University's Plasma Physics Lab have developed a novel method of optimizing the configuration of pixilated radiation detectors, such that radiation in different x-ray energy ranges can be simultaneously recorded by a single detector.

In order to detect spectra from multiple ion species or radiation in different energy ranges, existing technologies require separate spectrometers and detectors for each ion species. To maximize efficiency and minimize cost in x-ray spectroscopy, inventors from Princeton have developed a novel method based on the Shannon-Nyquist sampling and interpolation theorem that makes it possible to record spectra from multiple sources simultaneously with only one pixilated detector. The optimization of the detector configuration is such that there are sets of pixels distributed across the entire detector, each assigned to its own frequency range. As a result, data can be collected in less time without any loss of information, using only a single physical detector. This detector optimization was successfully utilized in two major diagnostic systems, a high-resolution x-ray imaging crystal spectrometer and an x-ray pinhole camera. This invention has far-reaching applications in industry and homeland security, where pixel detectors can be used more efficiently.

The U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) is a collaborative national center for fusion energy research. The Laboratory advances the coupled fields of fusion energy and plasma physics research, and, with collaborators, is developing the scientific understanding and key innovations needed to realize fusion as an energy source for the world. An associated mission is providing the highest quality of scientific education.

Application area

· Pixilated Detectors
· Efficient security scans
· X-ray imaging pinhole cameras

Advantages

· Reduced cost
· Single detector can effectively detect more than one type of radiation
· Less hardware
· Efficiency
· Faster and accurate results with less data
· No information loss
· Shannon-Nyquist theory prevents information loss

Institution

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