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Sparse Compton X-ray imaging using MAPS technology

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X-ray crystallography is one of the well-known inventions of the 20th century. It is even more impressive considering the facts that both the X-ray sources and detectors were primitive compared with what is available more than one century later. Cast in the context of recent advances in sparse imaging theory and practice, scene redundancy, or atomic periodicity in the case of crystallography, is the key physical basis for the success of X-ray crystallography. Opportunities exist to further apply the concept of redundancy reduction in imaging, including X-ray imaging. Here we summarize the current status of X-ray imaging enhanced through sparse methods, followed by new analysis, simulations, and initial experimental data on using hard X-rays for sparse Compton X-ray imaging. The imaging hardware is based on Monolithic Active Pixel Sensors (MAPS), a technology being developed for high-luminosity colliders. Some of the attractive features of MAPS include high-spatial resolution, small material footprint, low cost, small dynamic-range pixels, high-speed (for the next generation in particular) and radiation hardness, which make them one of the best choices for a sparse Compton X-ray imaging demonstrator. Sparse Compton X-ray imaging can be used to enhance the performance in many traditional areas of Compton imaging.

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