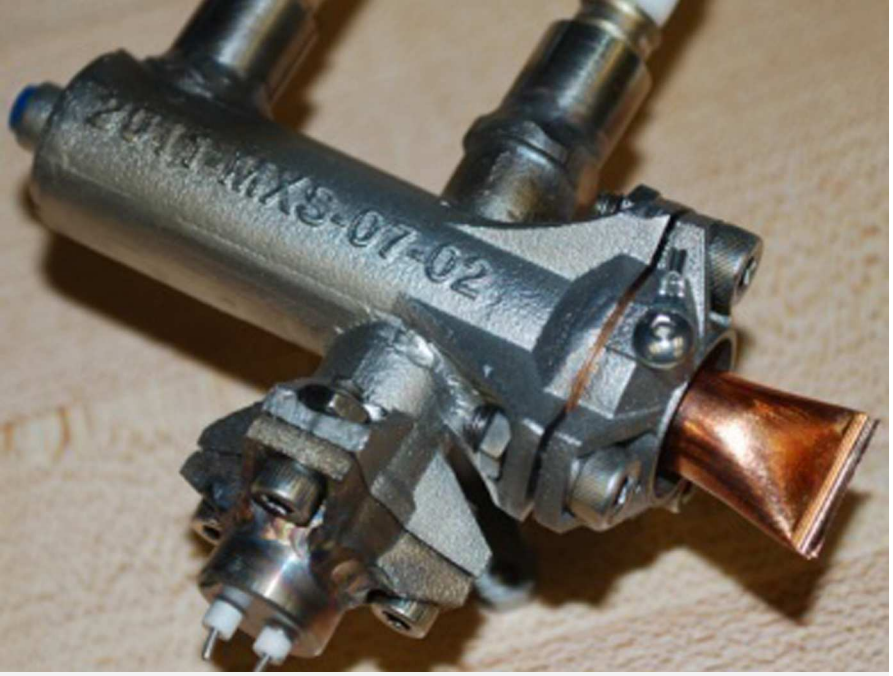


National Aeronautics and Space Administration

Optics

Miniaturized High-Speed Modulated X-Ray Source (MXS)

Small, Low-Cost Option for High-Speed Modulation of X-Ray Intensity

This miniaturized X-ray source can be modulated in intensity from completely off to full intensity, over 100 keV, in subnanosecond timescales. The high speed switching capability and miniature size make possible many new technologies including X-ray-based communication, compact time resolved X-ray diffraction, novel X-ray fluorescence instruments, low precise dose medical X-rays, and more.

BENEFITS

- Arbitrary modulation from 0 to 100+ keV within a nanosecond
- Small size: Weighs around 160 g
- Low cost to produce
- Energy efficient
- RuggedNo filament burnout and no vacuum or cooling systems required
- Enables X-ray communication
- Secure, fast, and long-range
- More power efficient than current and next-gen laser-based space communication
- Works with hypersonic aircraft in atmosphere

APPLICATIONS

- Secure, power-efficient X-ray-based communications
- In-flight calibration of X-ray detectors
- Compact, time-resolved X-ray diffraction and fluorescence
- Precise- and low-dose medical X-ray imaging
- Chemical/material analysis, resource identification (e.g., mining), and nondestructive testing (e.g., metal fatigue)

technology solution

THE TECHNOLOGY

The MXS produces electrons by shining UV light from an LED onto a photocathode material such as magnesium. The electrons are then accelerated across several kV and into a chosen target material; deceleration produces X-rays characteristic of the target. The MXS uses an electron multiplier for high X-ray production efficiency.

The MXS is more compact, rugged, and power-efficient than standard X-ray sources. It can be manufactured using commercially available components and 3D printed housing, resulting in a low cost to manufacture. Unlike traditional X-ray sources, the MXS does not require a filament or vacuum and cooling systems. Most importantly, enabling rapid and arbitrary modulation allows using X-rays in the time domain, a new dimension to X-ray applications.

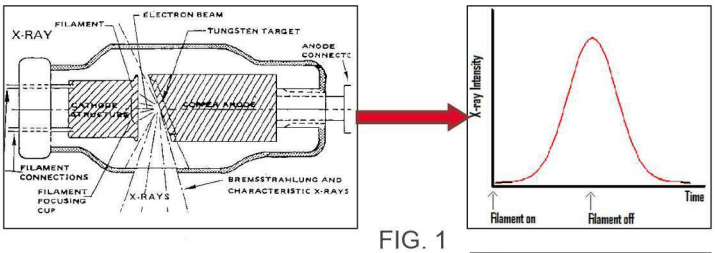


FIG. 1

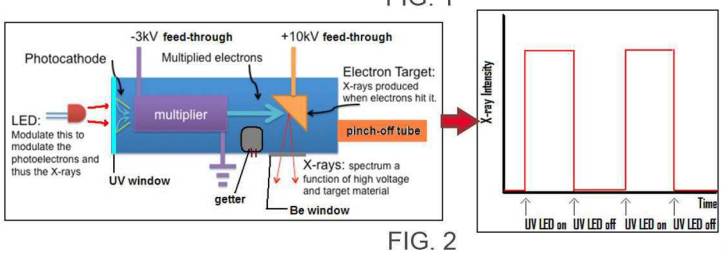
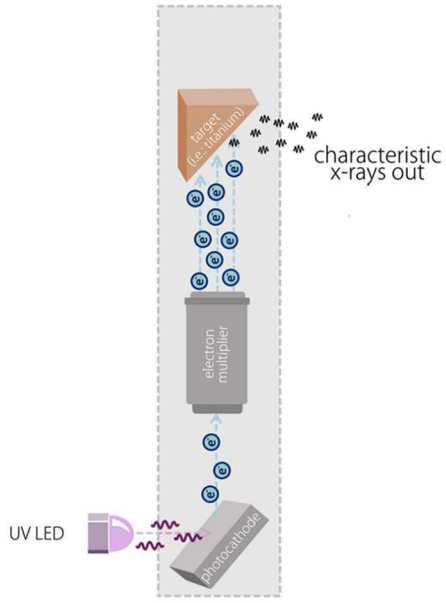


FIG. 2

FIG. 1: Conventional X-ray sources use a heated filament with on/off transitions of several seconds. FIG. 2: The MXS uses photoelectrons to vary X-ray output on nanosecond timescales.



MXS Diagram

PUBLICATIONS

Patent Pending

More Information

National Aeronautics and Space Administration

Innovative Technology Partnerships Office

Goddard Space Flight Center

Code 504
Greenbelt, MD 20771
301.286.5810
techtransfer@gsfc.nasa.gov

http://technology.nasa.gov/

www.nasa.gov

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