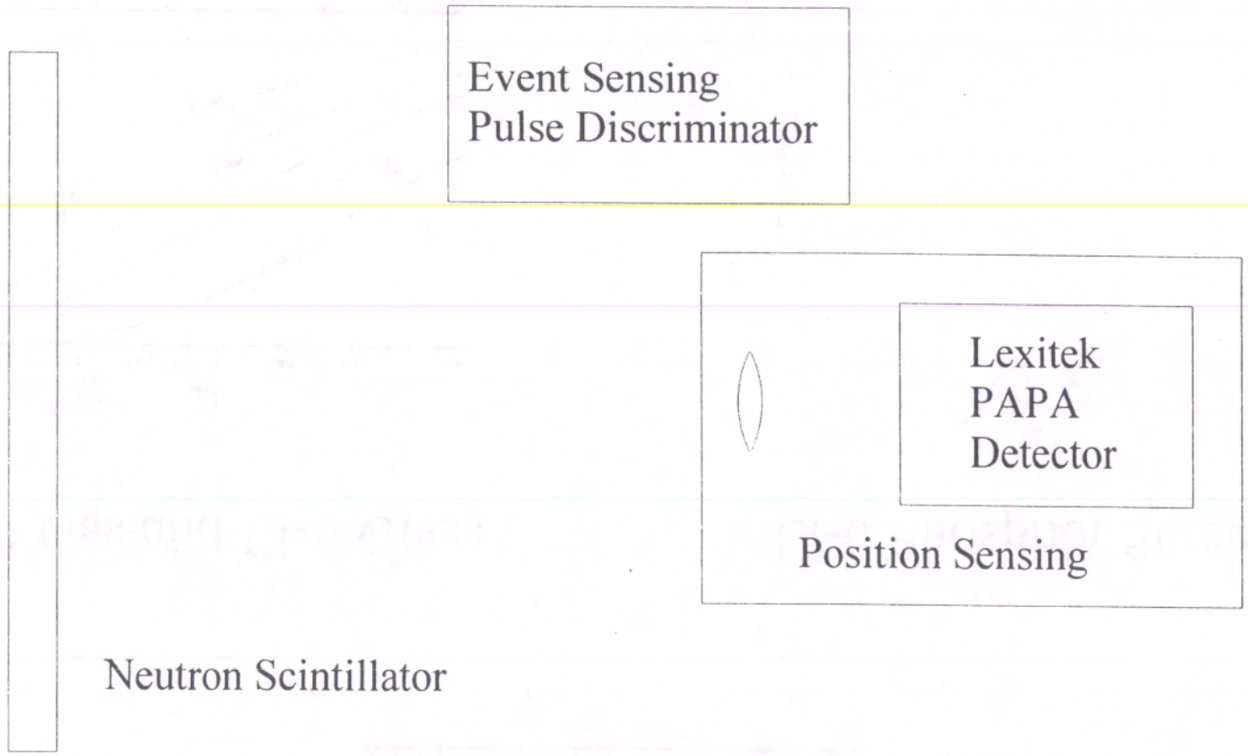
Novel High Resolution Scintillator-Based Neutron Detector

Lexitek, Inc.

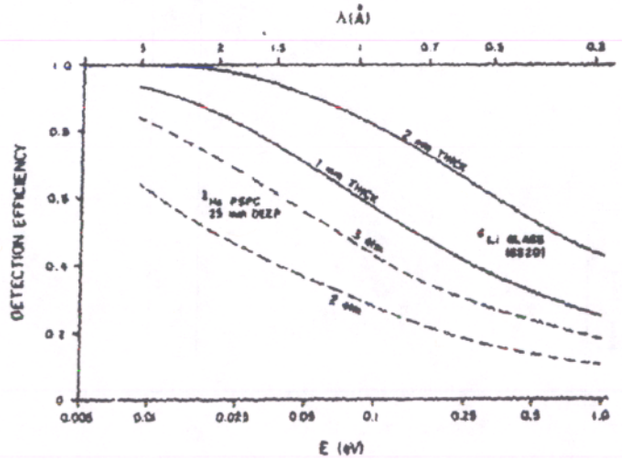
Patent Pending Radiation (γ-ray, Neutron) Detector



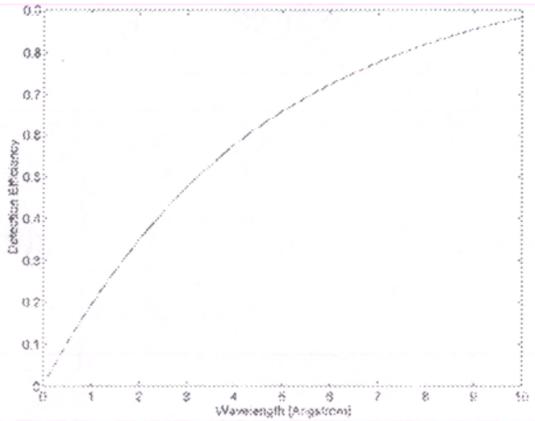
Lexitek, Inc. 9/24/98

Detection Efficiencies

He-3 Gas and Li-6 Glass

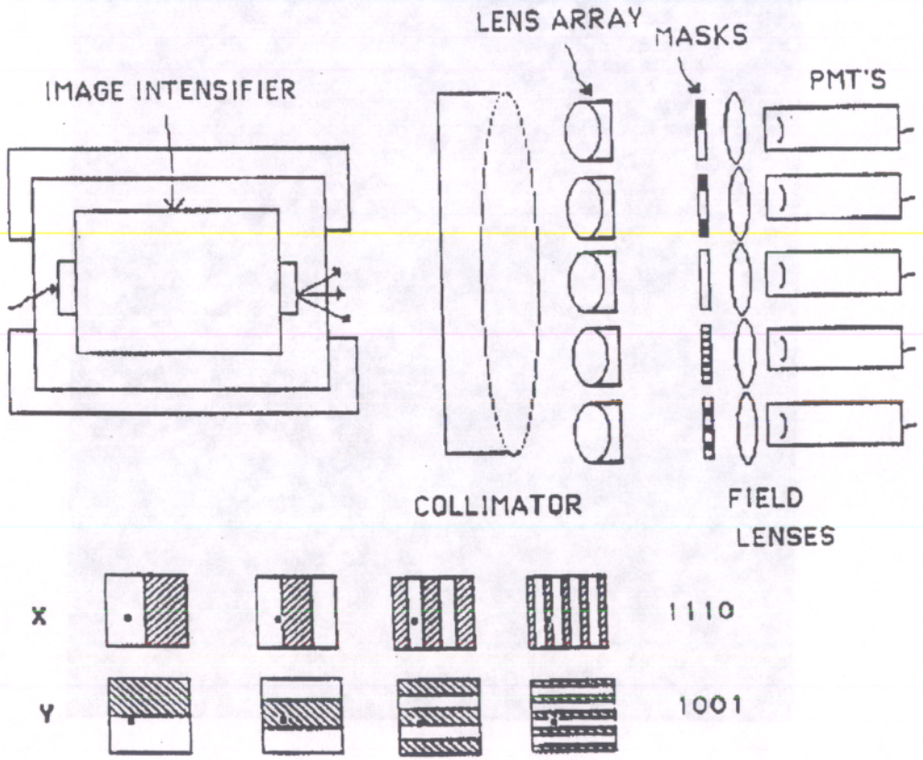


Li-6 Phosphor Screen



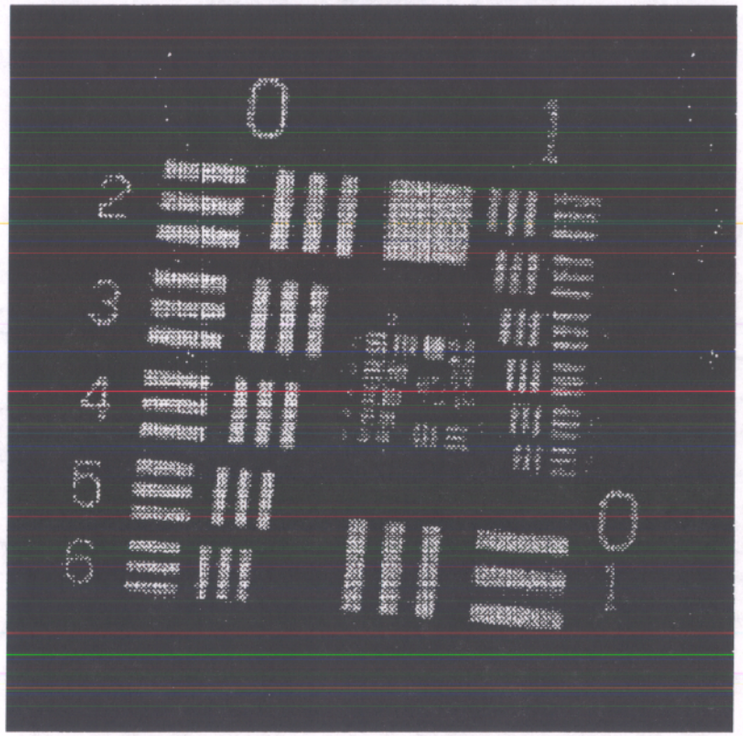
Lexitek, Inc. 9/24/98

Schematic of the PAPA Detector and Gray Code Masks



Lexitek, Inc. 9/24/98

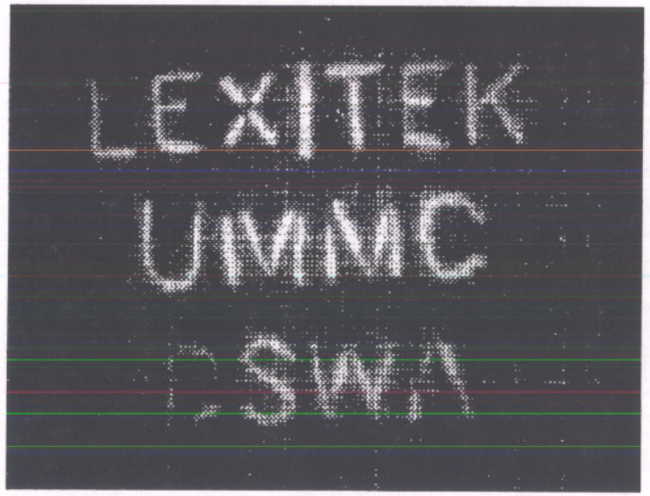
USAF Resolution Target Imaged onto the PAPA Detector.



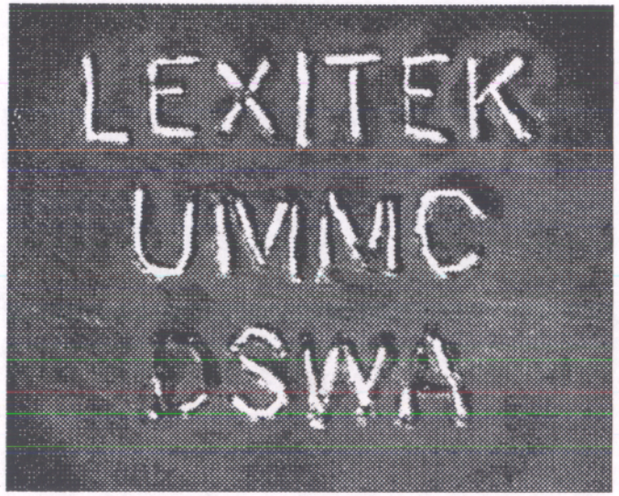
Lexitek, Inc. 9/24/98

Lead Plate Images

AM^{241} γ-ray PAPA Image

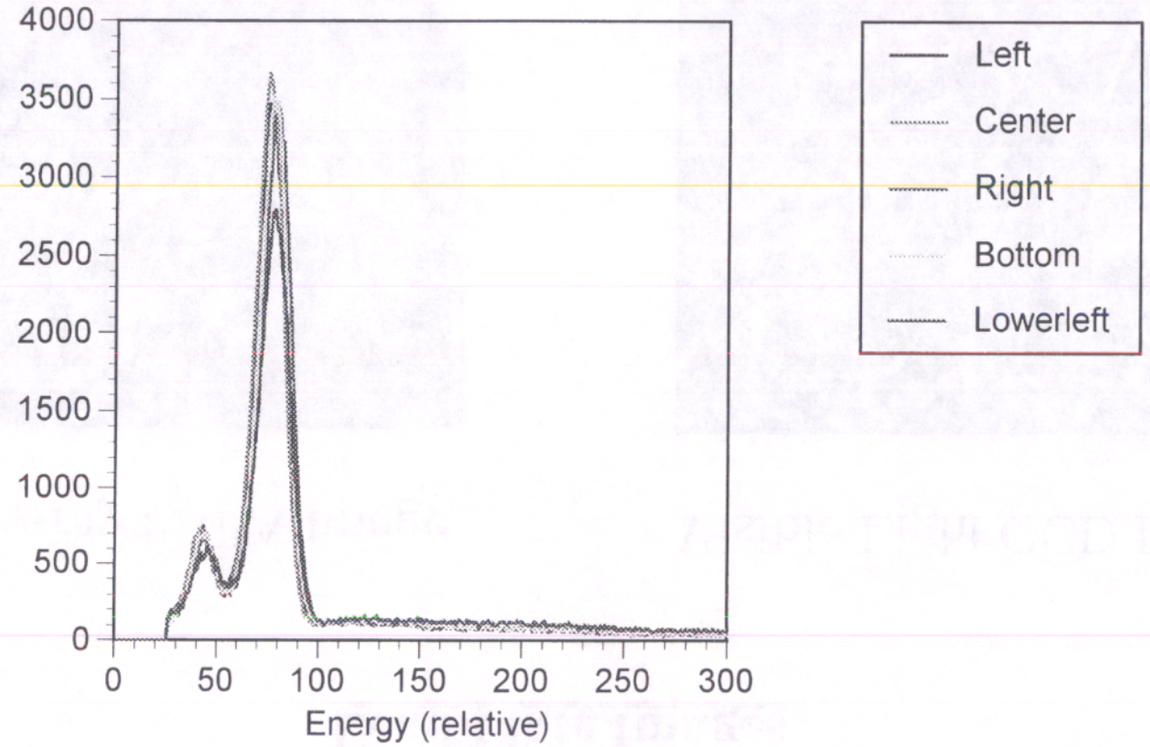


Visible Light CCD Image



Lexitek, Inc. 9/24/98

Energy spectra of an Am^{241} source



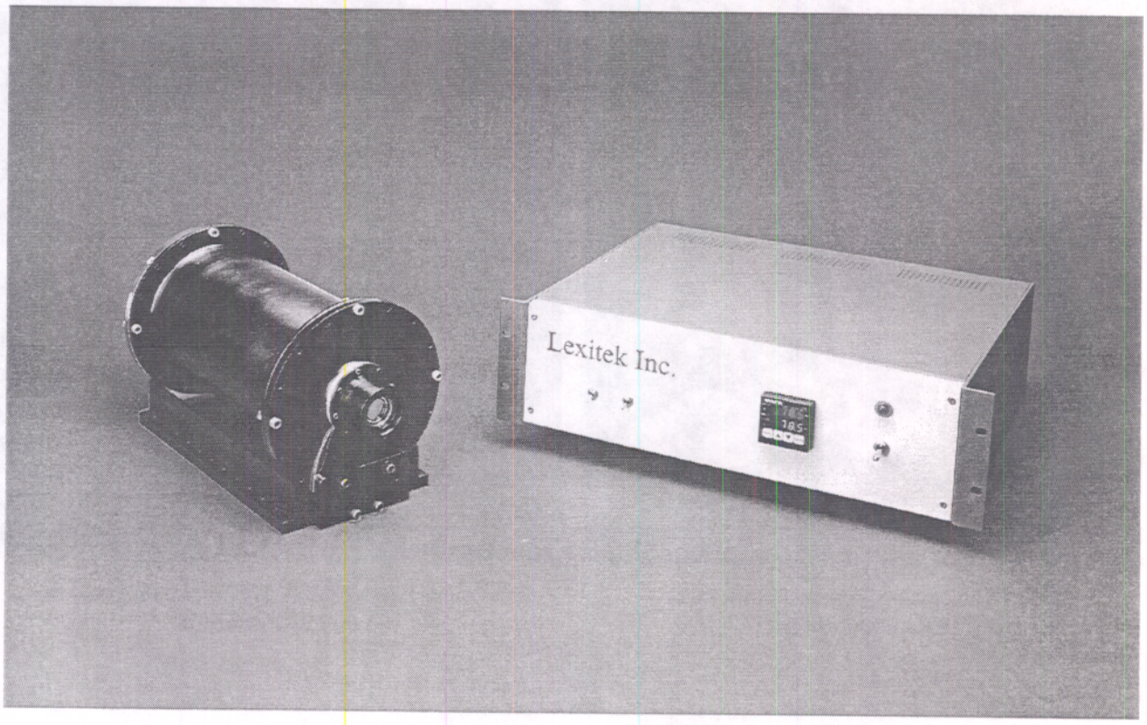
Lexitek, Inc. 9/24/98

Specs:

- $\geq$ 1 MHz count rate
- $\geq$ 512 x 512 format
- $\leq$ 90 cm diameter ^{6}Li phosphor screen
- $\leq$ 45 cm diameter ^{6}Li glass

2,000 –10,000 cps/pixel (2-D)
Thermal DQE ~ 30% for phosphor
$\geq$ 80% for glass

Lexitek Inc.



The Lexitek PAPA Detector (LPD) is a position-sensitive photon-counting focal plane detector offering the highest spatial and temporal resolution commercially available. The LPD output is a digital stream of pixel coordinates for each detected photon. Each photon position is available nanoseconds after its detection. The LPD is a robust implementation of a detector originally invented for astronomy (Papaliolios et al, *Appl. Opt.* **24**, 285, 1985), which Lexitek has developed with NASA SBIR support.

The LPD is a modular detector with three main components: a front end Image Intensifier Tube (IIT), an electro-optical (EO) position readout, and an electronics module. The IIT defines the focal plane (18 or 25 mm diameter) and sets the spectral sensitivity, X-ray, UV, visible, or near IR. The EO readout uses a novel arrangement of optics, Gray code masks, and small PMTs to determine the detected photon position. The position is an 18-22 bit coordinate, normally localizing the detection on a 512 x 512, 1024 x 1024, or 2048 x 2048 grid of square pixels. The electronics module houses power supplies and generates a 32-bit TTL data word.

QUANTUM EFFICIENCY

- Set by the IIT photocathode.
- 20-25% maximum

DARK COUNT

- Set by the IIT photocathode.
- << 100 s^{-1} typical.
- Visible and near IR require cooling.

COUNT RATE

- 2 MHz

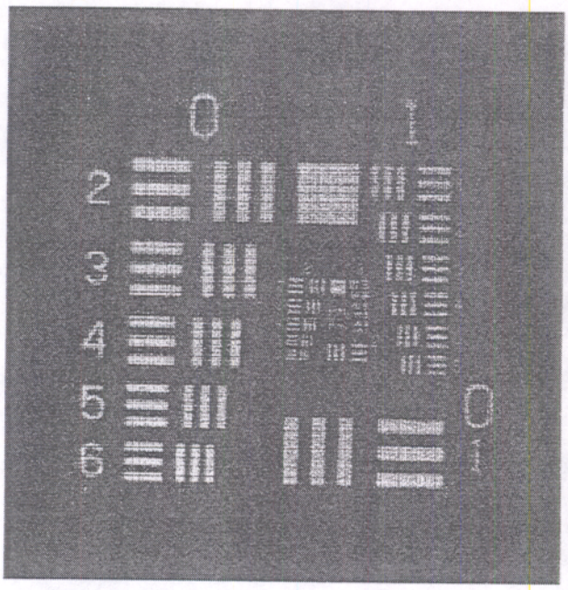
POWER REQUIREMENTS

- < 100 W total
- < 20 W EO module.

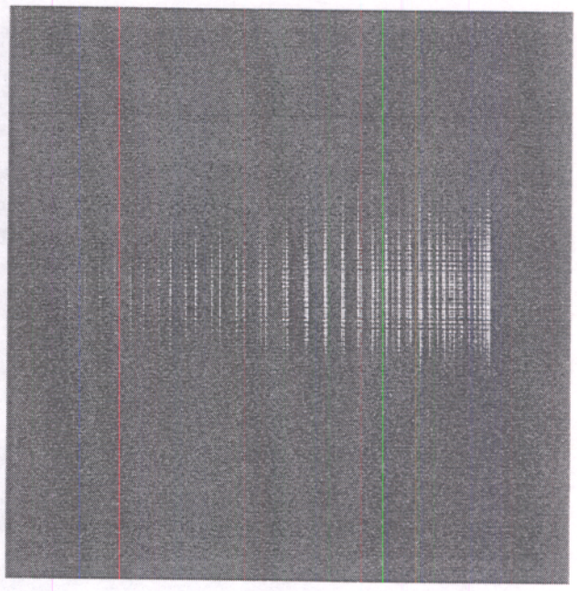
APPROXIMATE SIZE AND WEIGHT

- IIT (uncooled) - 50 mm L x 50 mm D, 0.2 kg.
- EO module - 300 mm L x 150 mm D, 5 kg.
- Electronics module - 480 mm W x 355 mm L x 125 mm H, 10 kg.

Lexitek Inc.



USAF Resolution Target, 1024 x 1024
1,000,000 photons



Spectrum, 2220-2230Å, SAO vacuum chamber,
1,000,000 photons

STANDARD FEATURES

- 512 x 512 square pixels (18 bits)
- 2 MHz count rate
- Detector head with chevron-MCP intensifier
- Interface box with power supplies
- Cables - interface box to detector head, 5 m
- Temperature controlled detector head
- 110 V, 60 Hz power supply

APPLICATIONS

- Low Light Level Imaging
- Astronomy
- Spectroscopy
- Fluorescense Studies

CUSTOM OPTIONS

- Pixel Coordinate: 20 bits (1024 x 1024)
  22 bits (2048 x 2048)
- Pixel Format - square or rectangular
- Sensitive Area - 18 or 25 mm diameter
- Spectral Sensitivity - intensifier photocathode
- PC Interface
- Gating
- Time Tagging
- Shutter
- Lens Mounting
- Vacuum Chamber Compatible
- Custom Cabling
- International Voltages

LEXITEK Inc.
14 Mica Lane #6, Wellesley, MA 02481-1708
Tel: (781) 431-9604 Fax: (781) 431-9605
www.lexitek.com