BROOKHAVEN NATIONAL LABORATORY

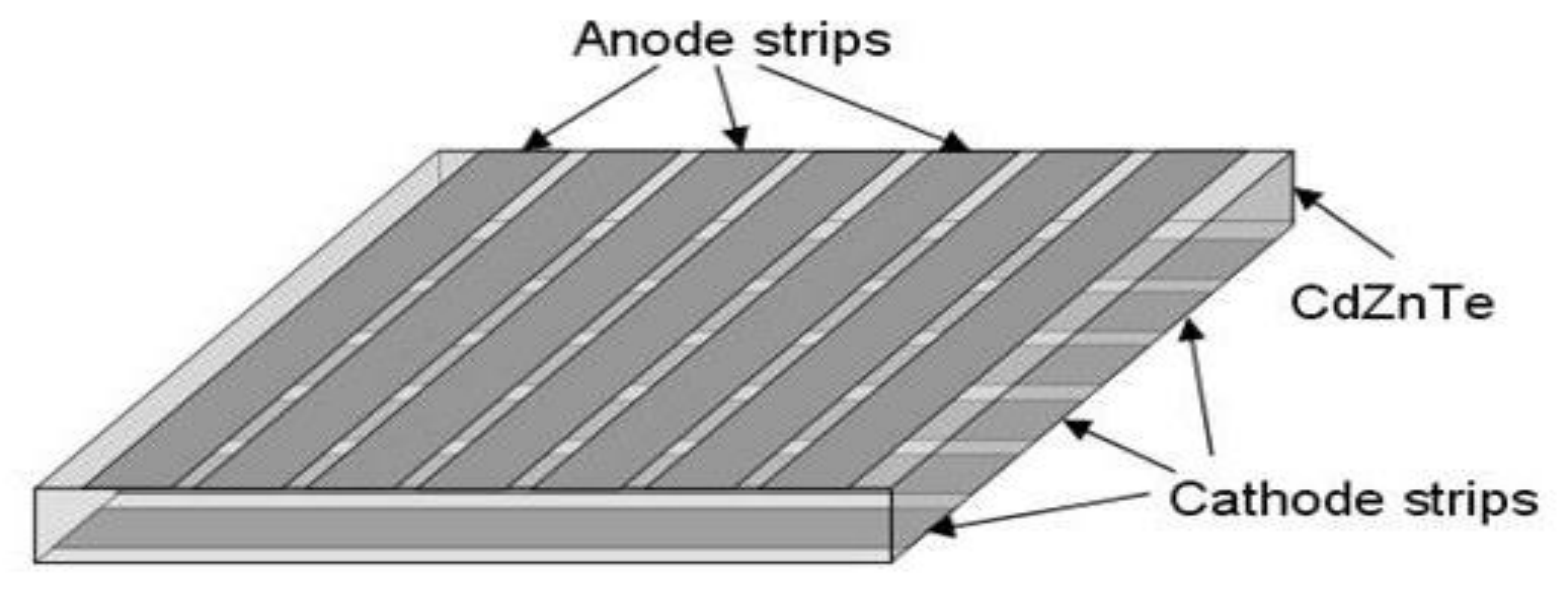
Multi-Layer Cross Strip Semiconductor PET Detector

US Provisional Patent Application 61/508,113

July 16, 2012

BROOKHAVEN NATIONAL LABORATORY
U.S. DEPARTMENT OF ENERGY | Office of Science

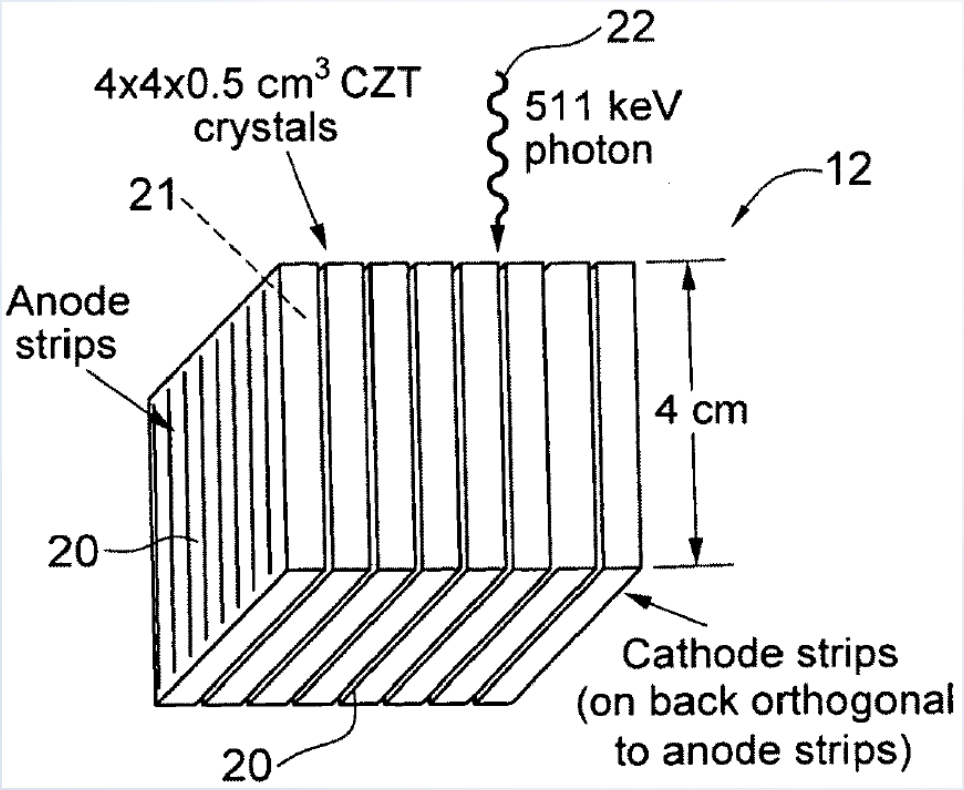
Using Orthogonal Cross Strip Anode and Cathode Electrodes Is a Well Known Design



Position sensitivity can be achieved using cross strip electrodes rather than a pixilated electrode

Reduced number of readout channels – i.e. 2*(n electrode strips)*(m detector stack elements) vs. (m detector stack elements)*(1 + (n pixels)^2)

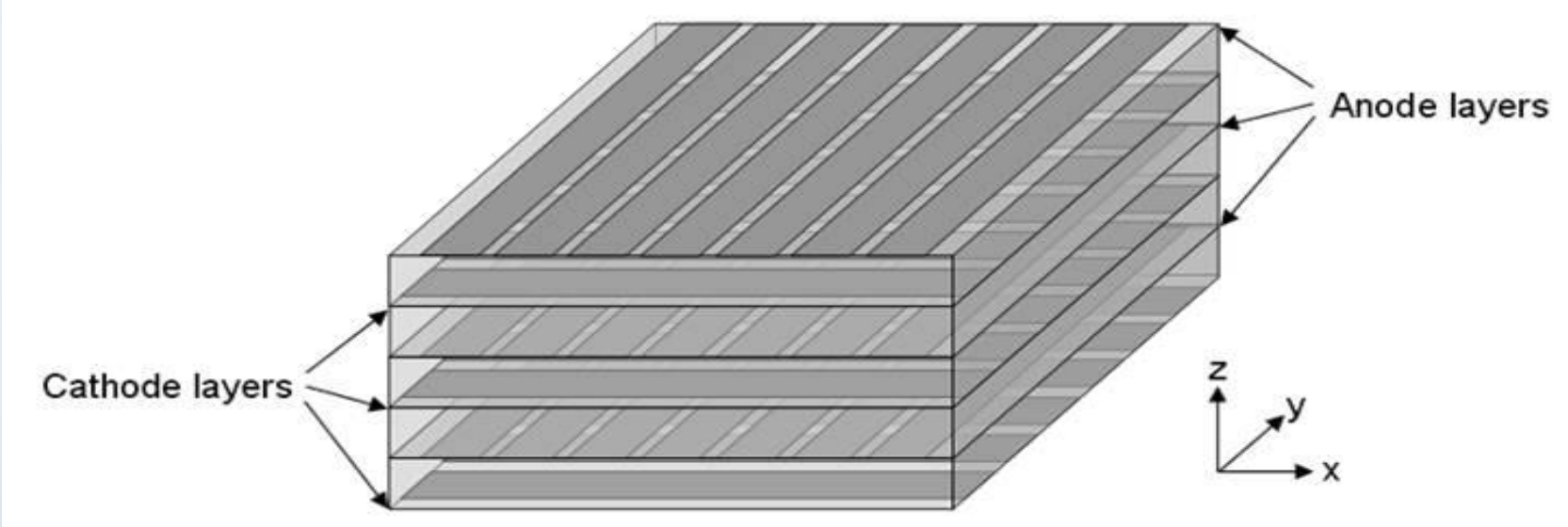
Stanford Patent Application Presents a Detector Stack Design Using Cross Strip Electrodes



Stanford patent – reference character 20 represents both "orthogonal anode and cathode cross strip electrodes" in each interstitial between the elements of the CZT crystal detector stack

May require 2*(n electrode strips)*(m detector stack elements) readout channels, but preferably only 2 readout channels per detector element, i.e. 2*m

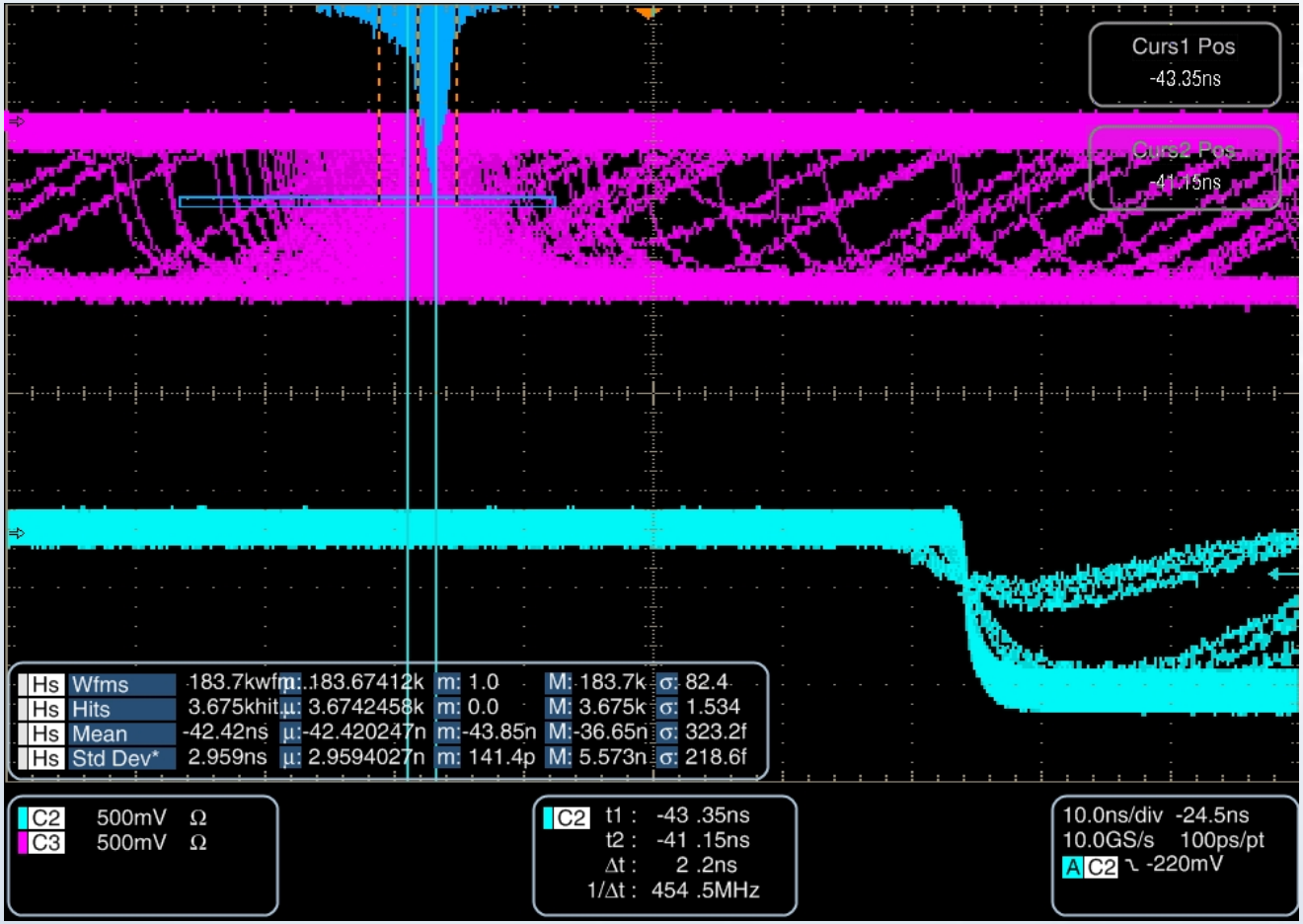
Multi-Layer Cross Strip Semiconductor PET Detector Design Has Less Readout Channels



Only one orthogonal cross strip electrode (anode or cathode) is placed in each interstitial between the elements of the CZT crystal detector stack

Adjacent element shared electrodes requires only (n electrode strips)*(m detector stack elements +1) or (m+1) readout channels, ~ 1/2 compared to Stanford

Using a Multi-Layer Cross Strip Detector Stack Improves Both Timing and Position Resolution



2 ns timing resolution – (FWHM)

Critical for applicability of Semiconductors to PET

Applications – Target Customers – Current Practice

Application Description	Target Customers	Current Practice
PET Detector Modules Compton Imaging Compact Gamma Cameras SPECT - complements any gamma imaging study amenable to 3D representation	• Nuclear Medicine • Homeland Security • Cargo container scans • Nuclear nonproliferation • Non-destructive testing/detection • Radiation imaging • Nuclear power plants • Any use of radioactive materials • Nuclear physics • X-ray and gamma ray astronomy • GE, Siemens, Inveon, Canberra, Hitachi, Toshiba, Philips, etc.	• Scintillator crystals attached to arrays of position sensitive photomultiplier tubes • Thallium doped Sodium Iodide (NaI(Tl)) • Halide Scintillators $LaBr_3$(Ce) and $LaCl_3$(Ce) • Pixilated semiconductor crystal detectors • Planar cross-strip semiconductor crystals • Silicon • High Purity Germanium (HPGe) • Cadmium-Zinc-Telluride (CZT) • Cryogenically cooled, large-volume Si(Li) and HPGe detectors in double-sided strip configuration (LLNL) • 18 CZT detectors arranged in a two-level 3 x 3 array (PNNL)

Competitive Differentiation

Main advantages:

- Enhanced image quality
  - CdTe semiconductor detectors enhance PET image contrast ~ 30%
  - Higher spatial resolution
  - Reduction of noise and irrelevant images
- Reduced number of readout channels
  - Better interconnect density and improved management of thermal power dissipation
- Smaller semiconductor detector modules
  - Easier to adjust, arrange and reconfigure than bulkier PET scintillator detectors

Revenue and Profit Potential: PET / SPECT and PET-CT Markets: Growing the Future

Global PET / SPECT market

- PET accounts for ~ 75% of the overall PET and SPECT installations in 2010 at ~ 3,691 units
- Expected to reach ~ $10.3 billion in 2015, at a CAGR of ~ 9.4% from ~ $6.5 billion in 2010

PET-CT segment

- Accounts for ~ 97% – of overall PET market
- Expected to reach ~ $ 9.8 billion in 2015, at a CAGR of ~ 9.8% from ~ $6.1 billion 2010

Intellectual Property

U.S. Provisional Patent Application No. 61/508,113 – filed on July 15, 2011 and entitled "Radiation Detector Modules Based on Multi-Layer Cross Strip Semiconductor Detectors";

PCT Patent Application No. PCT/US12/46936 – filed on July 16, 2012 and entitled "Radiation Detector Modules Based on Multi-Layer Cross Strip Semiconductor Detectors"

Contact Information

Poornima Upadhya
+1 (631) 344-4711
pupadhya@bnl.gov