**ROIC for High Dynamic Range X-ray Detector**

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**X-ray Detector Concept for APS-U**

CMOS X-ray camera beyond the dynamic range of a CCD with sensitivity of a photon counting detector
- Excellent burst image rate (= 13 MHz),
- Small pixels size (100x100 µm²)
- High resolution from 2.2M pixels
- Single to 10³ photons per pixel

Bringing Fermilab HEP experience to BES

**Fast frame rate, five orders of magnitude dynamic range, and small pixel size on a seamless fully active wafer scale detector.**

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**130 nm SiGe BiCMOS 8HP Technology**

- High-performance SiGe hetero-junction bipolar npn at moderate cost
- Small, fast, and low-power CMOS
- 8 metal layers, thick top layers
- High-density capacitors
- Good substrate isolation
- Peak $f_t = 2000$GHz; $\beta_{MAX} = 600$

- The input signal is swept over large range on one pixel in a 32 x 32 pixel test array
- Response measured at output of back end
- Readout circuit biases not optimized, could get more dynamic range
- Max gain is 8.8 mV/IC
- Current splitting verified; scaling = x32, scale ratios stay constant over wide range!
- Bias current required to fully integrate small signal in 50 ns is only 0.6 µA

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**State-of-the-art Performance**

**Proposed Specs Compared to Similar Detectors**

<table>
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<tr>
<th></th>
<th>FOV</th>
<th>Size (µm²)</th>
<th>Dynamic Range @ 12keV</th>
<th>Gain Switching</th>
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<tr>
<td>FASPAX</td>
<td>100 x 100</td>
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<td>100 x 100</td>
<td>Auto ranging</td>
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<tr>
<td>High gain, Pixel 24, Row 1, ASIC4</td>
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Versatile, fast integrating, large area detector:
- MHz burst frame rates for movies of millisecond phenomena
- Flexible dynamic range on per pixel basis from single photon to $10^5$ photon/pixel

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**References**


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