

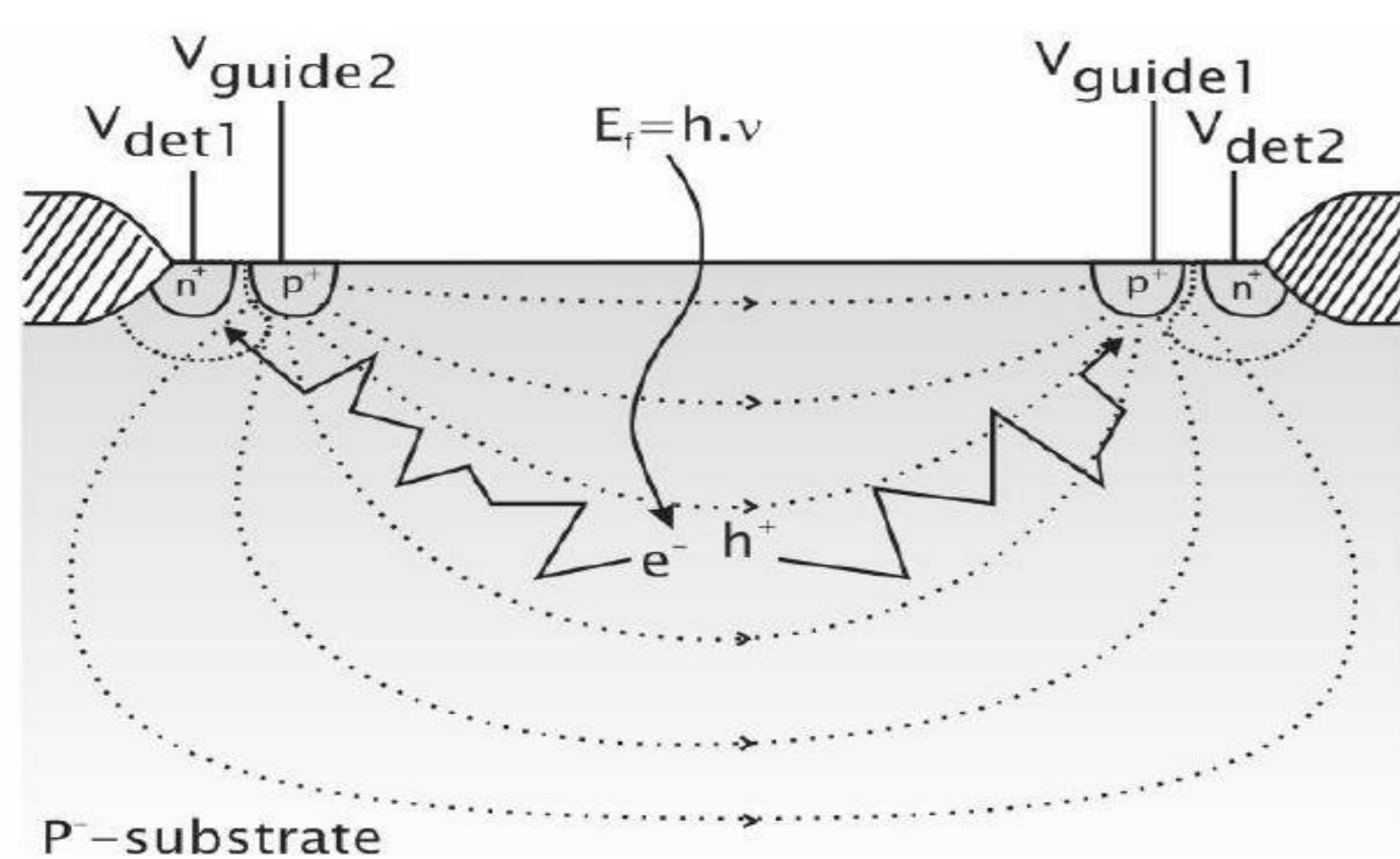
2020 Research Day

Weight Based Current Assisted Photonic Demodulator (WBCAPD)- Expansion towards Neuromorphic Applications

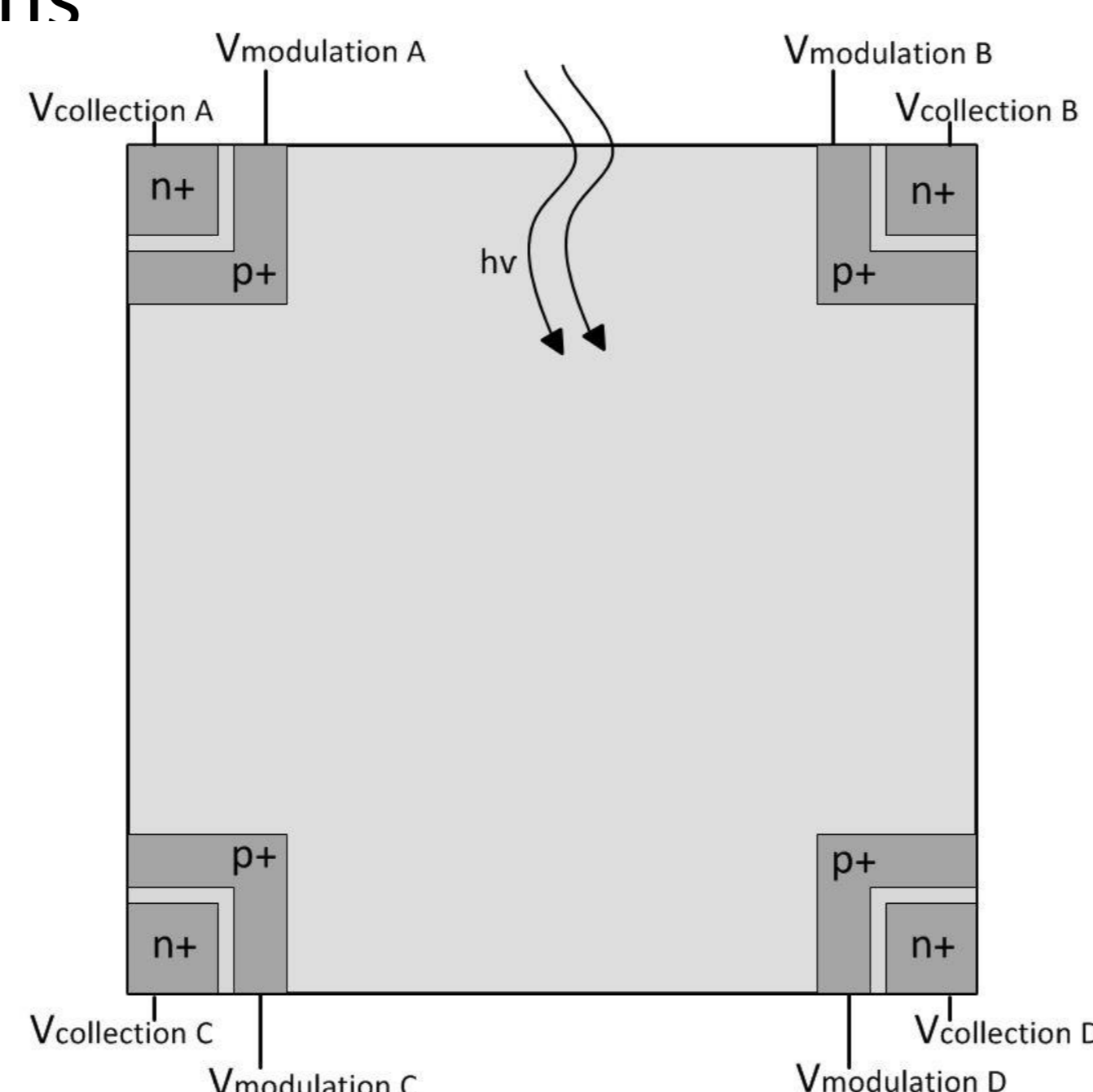
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Expansion of the CAPD from 2-ports to 4-ports and changing its application from Time Of Flight (TOF) sensor photodiode to a smart Weight-Based neuromorphic sensor photodiode, namely the WBCAPD

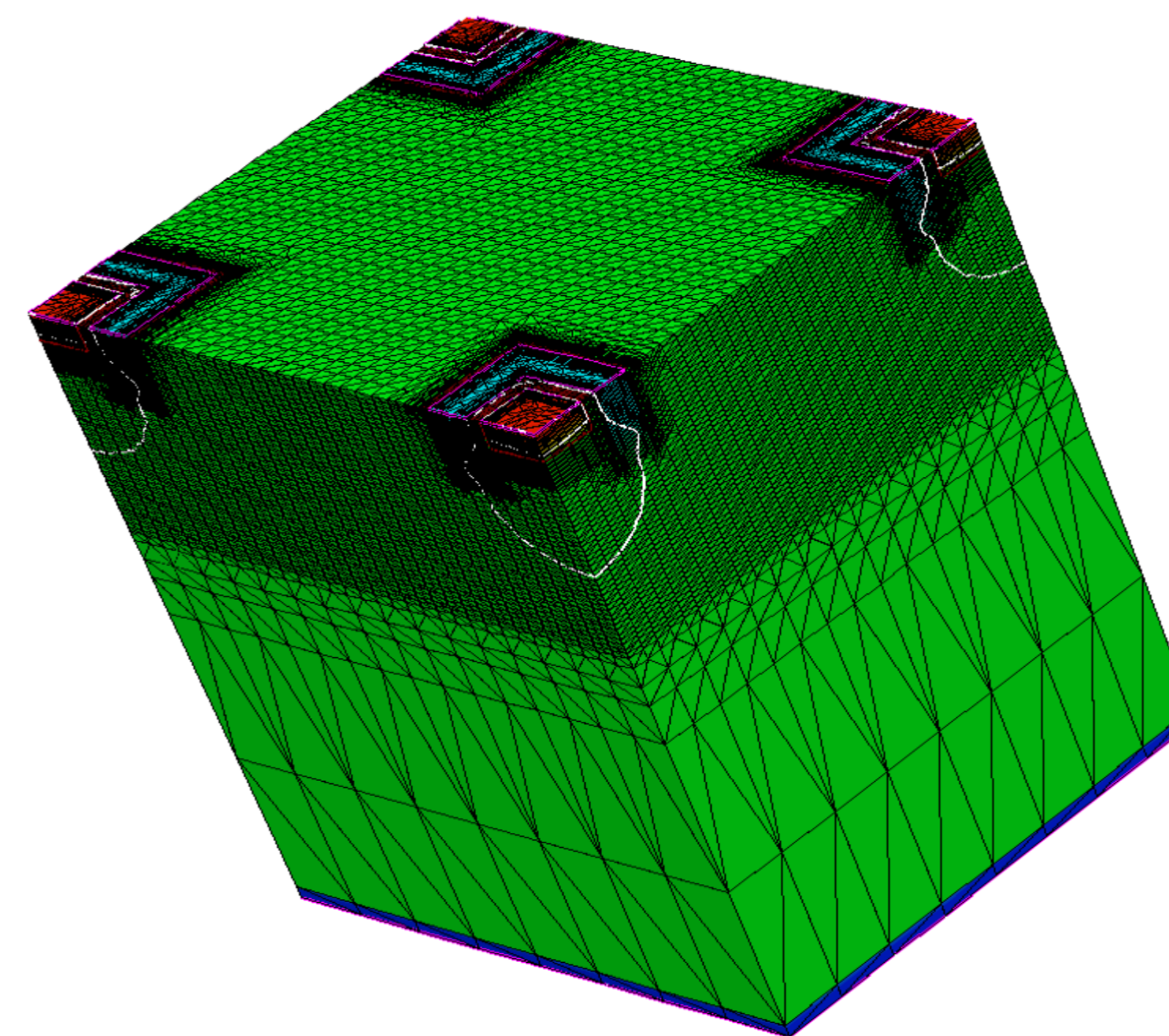
- A repetitive array in which each WBCAPD connects to 4 pixels and each pixel connects to 4 WBCAPD photodiodes is constructed
- Each pixel output is the sum of its 4 WBCAPD's collection junctions values
- The 4 WBCAPD's modulation junctions currents determine the ratio of photocurrent flowing into each collection junction
- The modulation junctions current is determined in real time either externally or depending on the output of nearby pixels
- The result is a pixel array that is capable of changing the pixel's current collection ability as a function of the lighting intensity and its application in real time
- The WBCAPD photodiode can be used as a building block for neuromorphic sensors and is capable of performing different functions (edge detection, enhanced dynamic range, motion detection etc.) depending on the connectivity between pixels and their surrounding modulation junctions



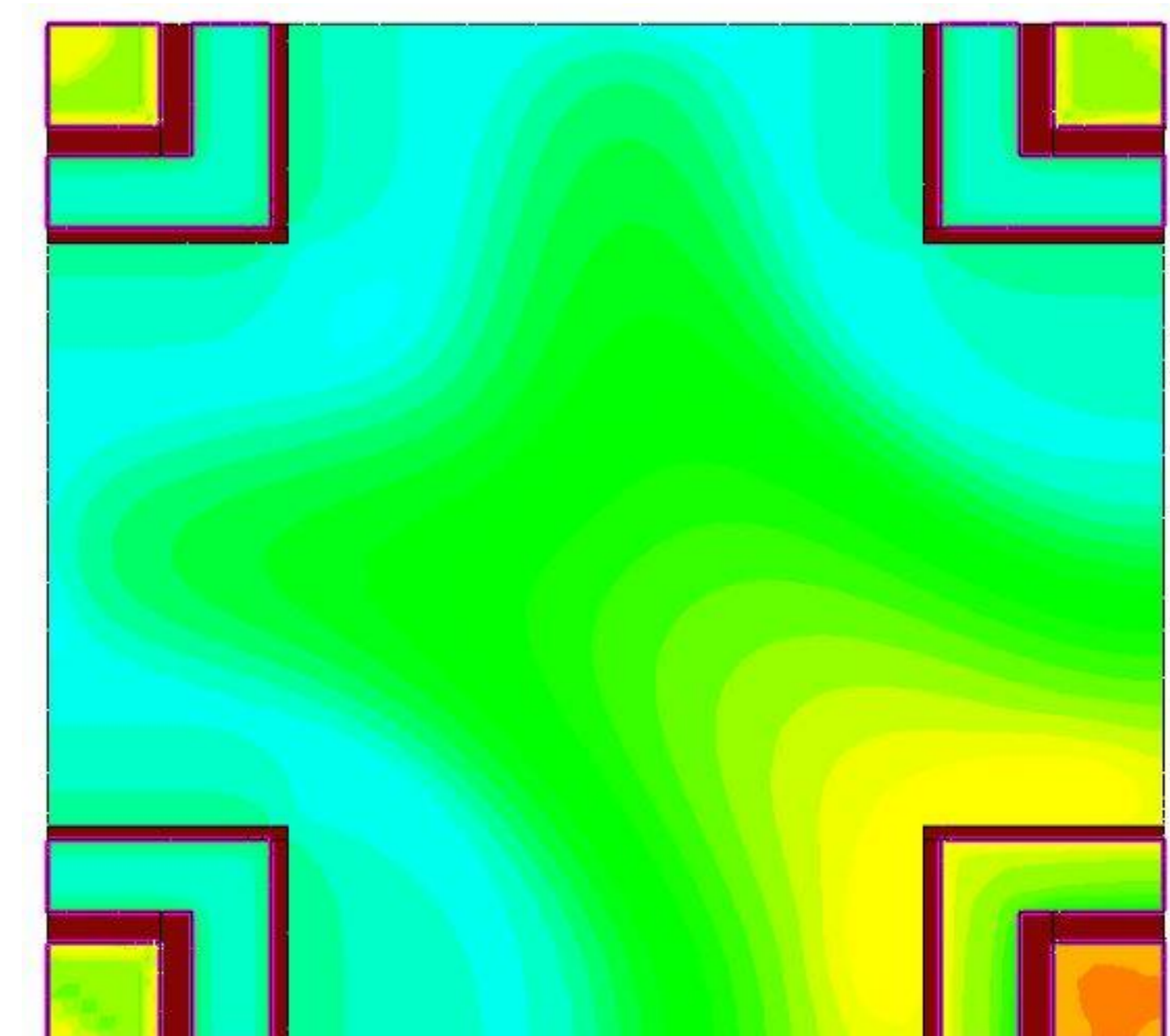
Cross section of a CAPD, photogenerated electrons drift into the collection junction next to the modulation junction with the highest current



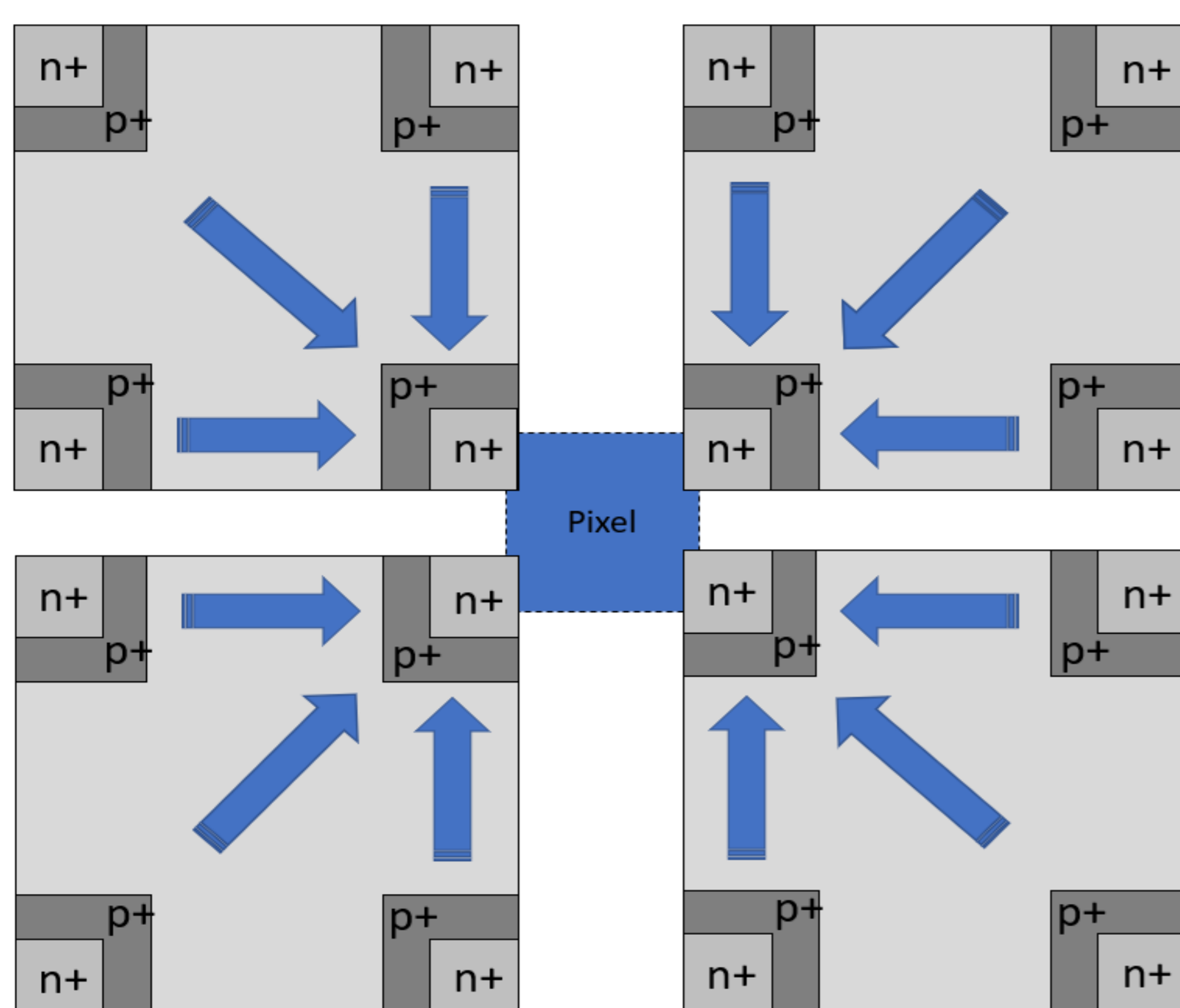
A look from above of the 4-ported WBCAPD



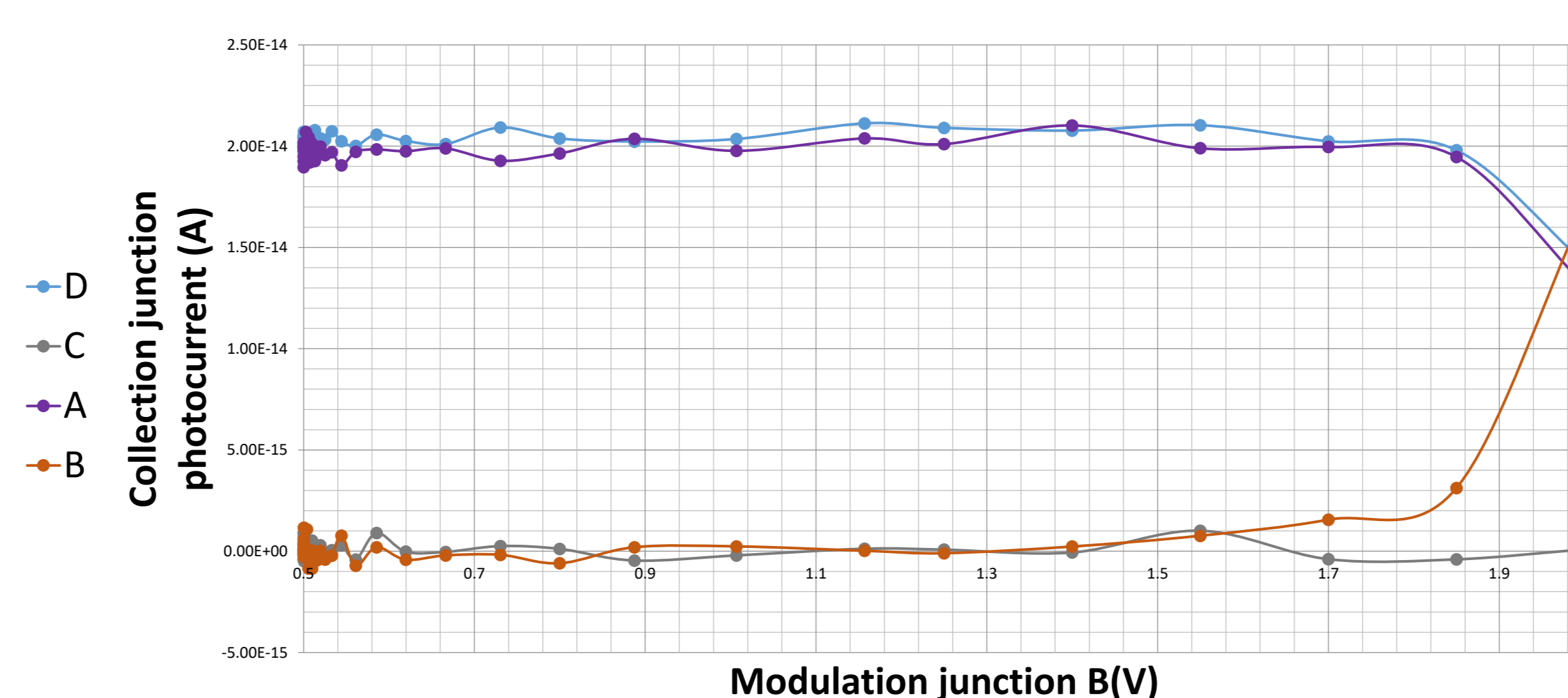
WBCAPD simulated in TCAD
A thin layer of oxide separates the collection junctions (n+) from the modulation junctions (p+)



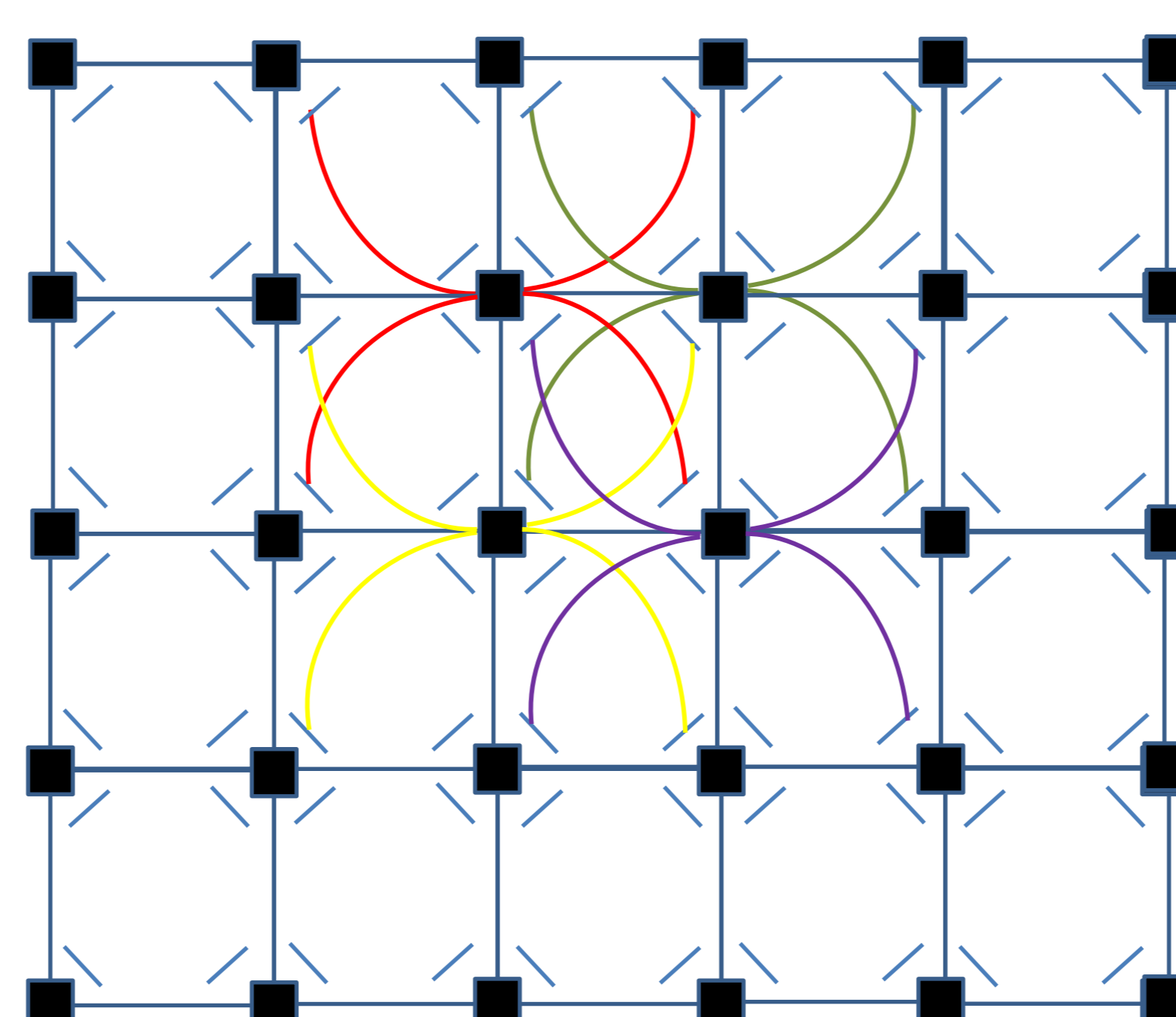
A look from above at the WBCAPD electron current density map
The lower right corner injects the highest modulation current



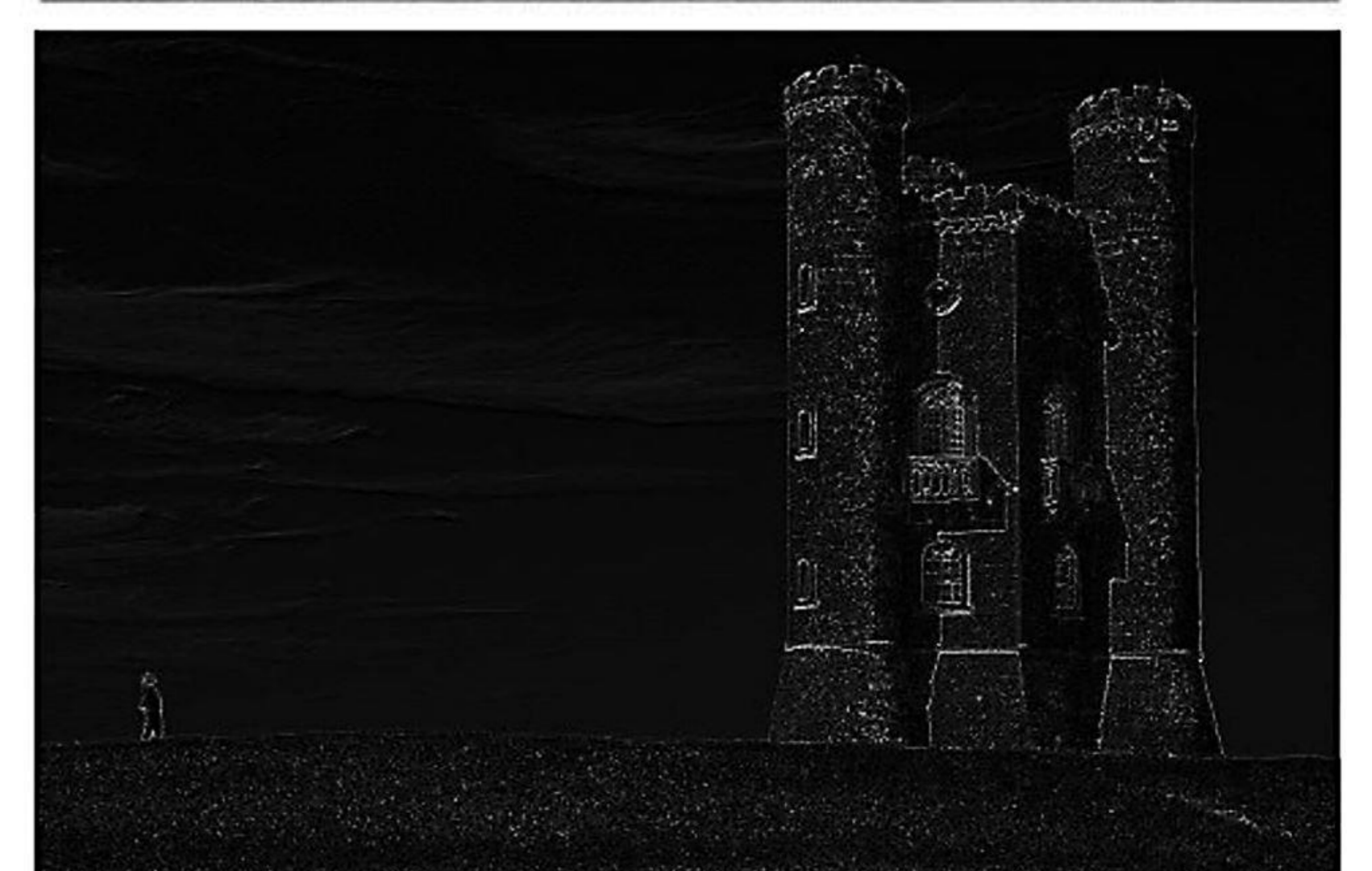
WBCAPD pixel with 4 WBCAPD photodiodes
Each pixel sums the photocurrent from its 4 collection junctions



Modulation current through terminal B is ramped from low to high while A,D are held at high current and C at low



Possible averaging scheme connectivity



Edge detection MATLAB scheme
The proposed 4CAPD array was simulated in MATLAB with connectivity appropriate for edge detection