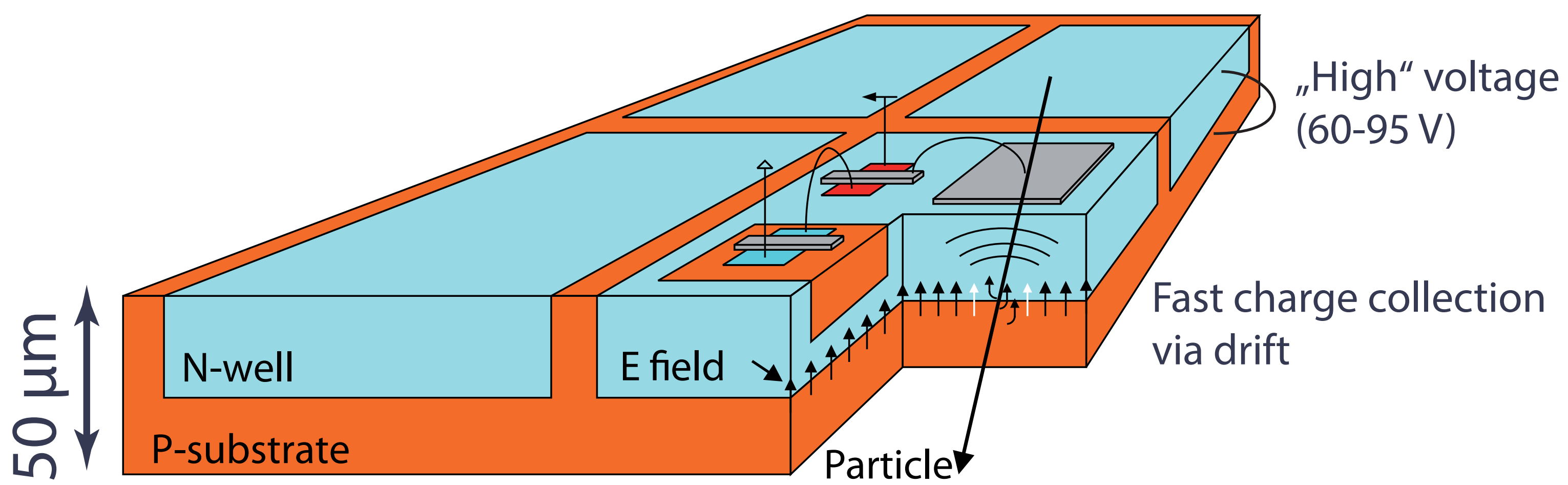


# The MuPix7 High-Voltage Monolithic Active Pixel Sensor

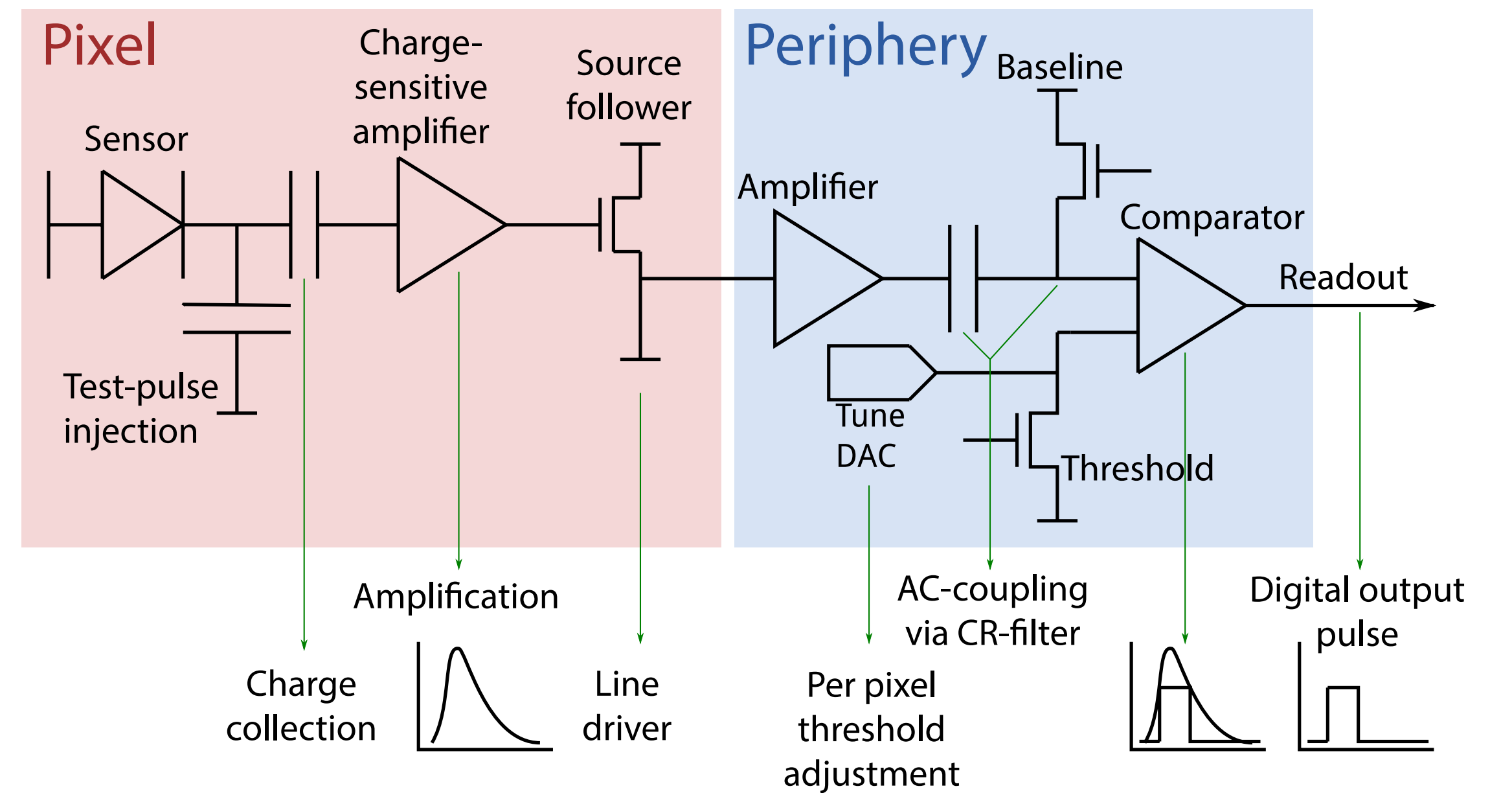
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## Working principle

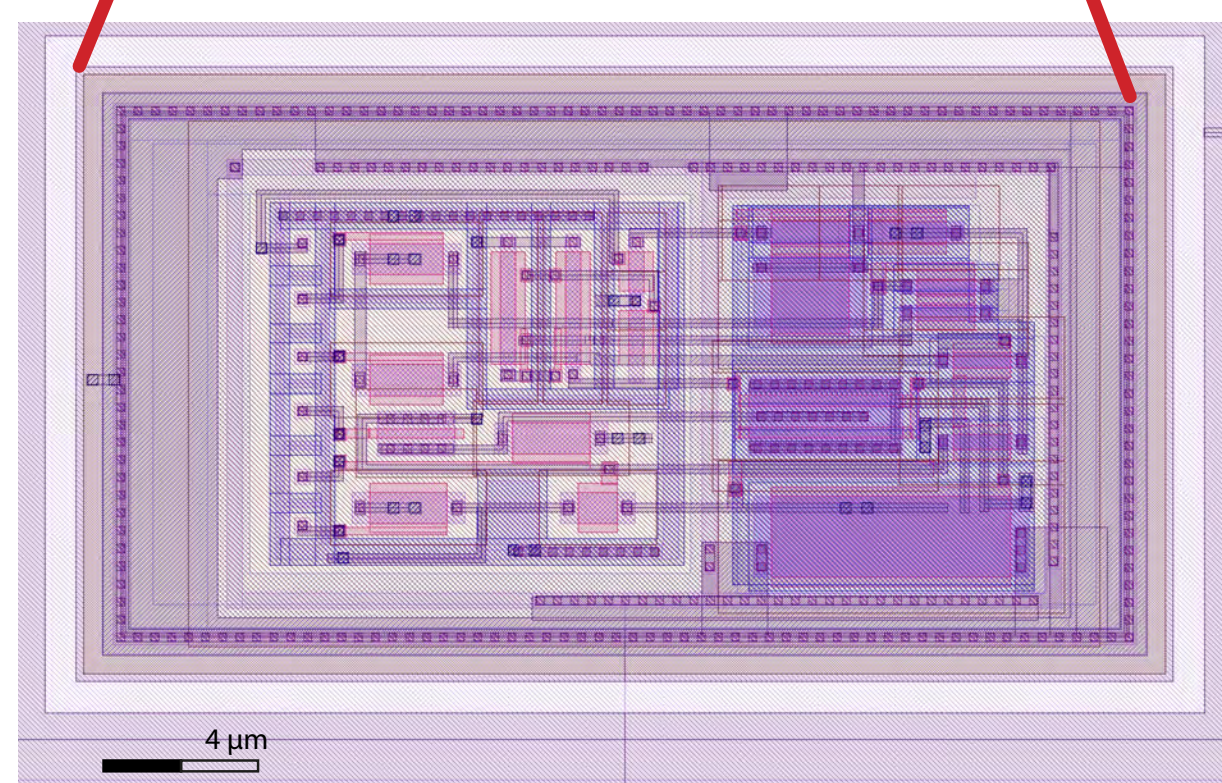
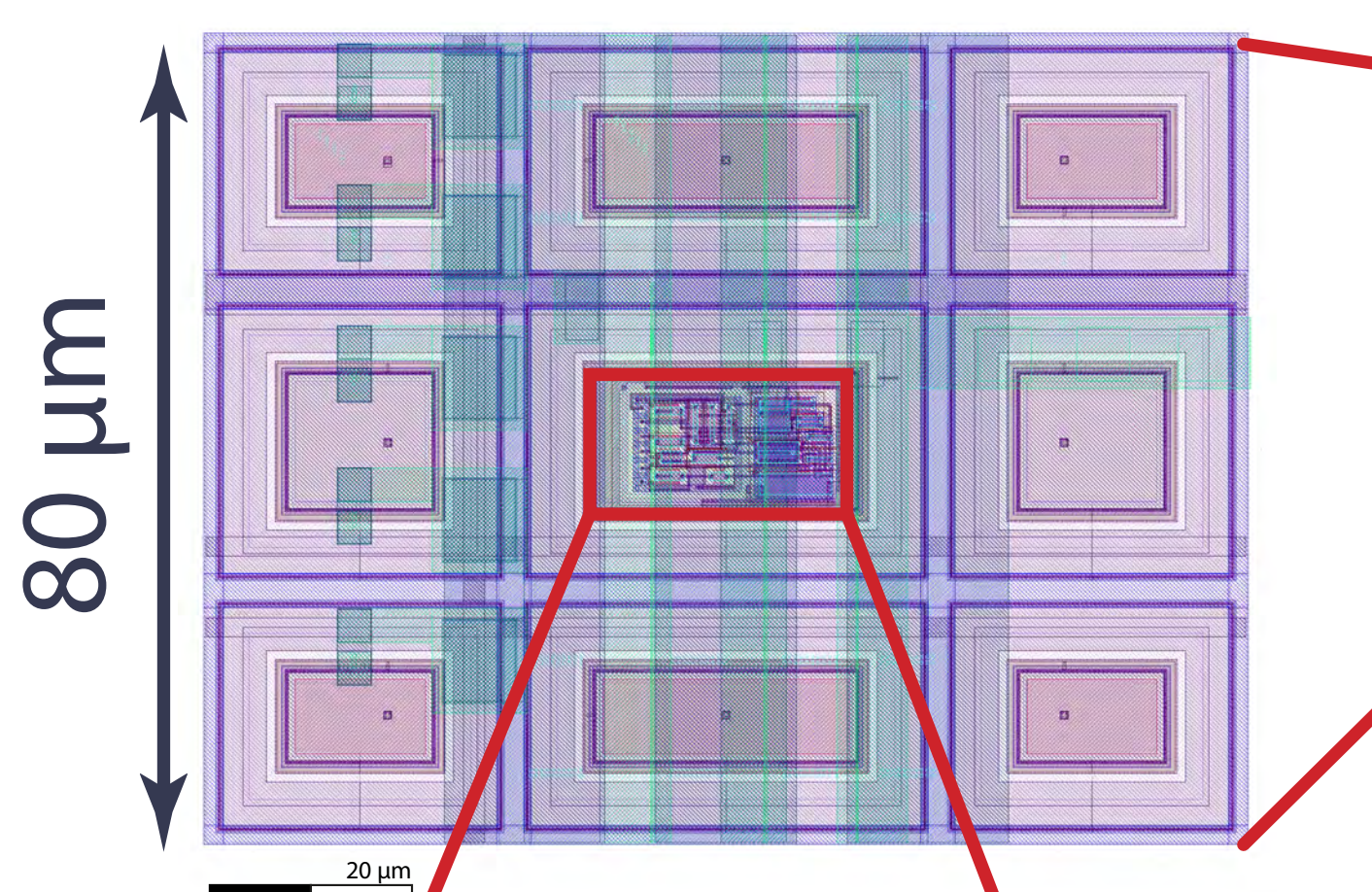


## Pixel electronics



## Pixel Cell

Nine deep N-wells collect charges



## Amplifier

First amplification stage inside each pixel

## Digital Control

Timestamp generation  
 Readout control state machine  
 Data encoding (8bit/10bit)  
 Synthesized from Verilog code

## Clock Generation and Serializer

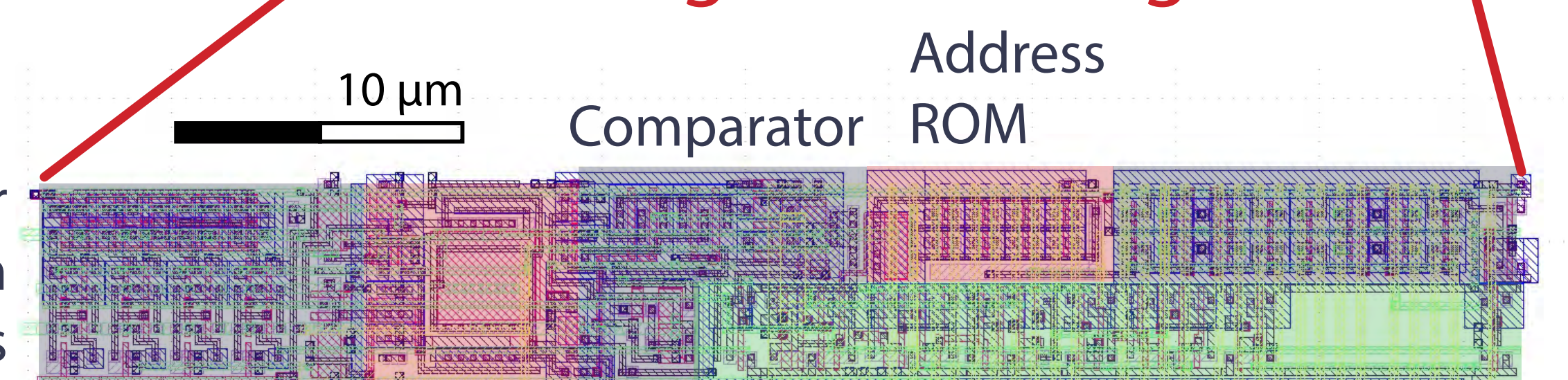
Voltage-controlled oscillator (VCO)  
 Phase-locked loop (PLL)  
 Serializer (up to 1.6 Gbit/s)

## LVDS output

Low-voltage differential signalling  
 Up to 1.6 Gbit/s

4 bit digital-to-analog converter (DAC) for threshold tuning with 4 SRAM cells

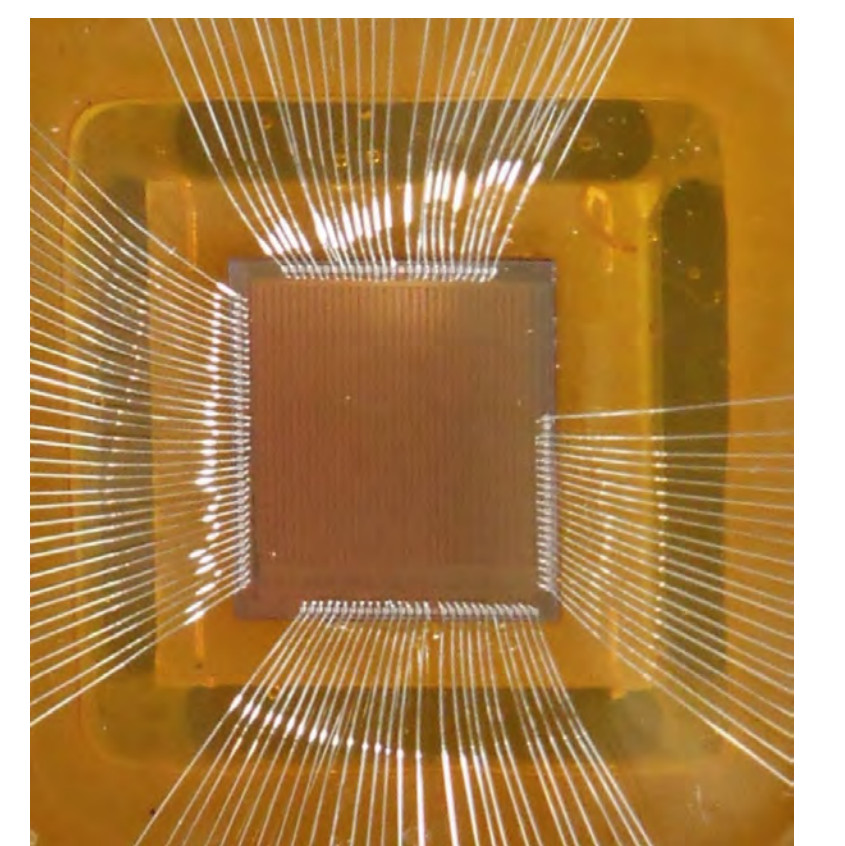
## Digital Pixel Logic



Coupling capacitor and second amplification stage

Digital control logic

## Bonded Chip

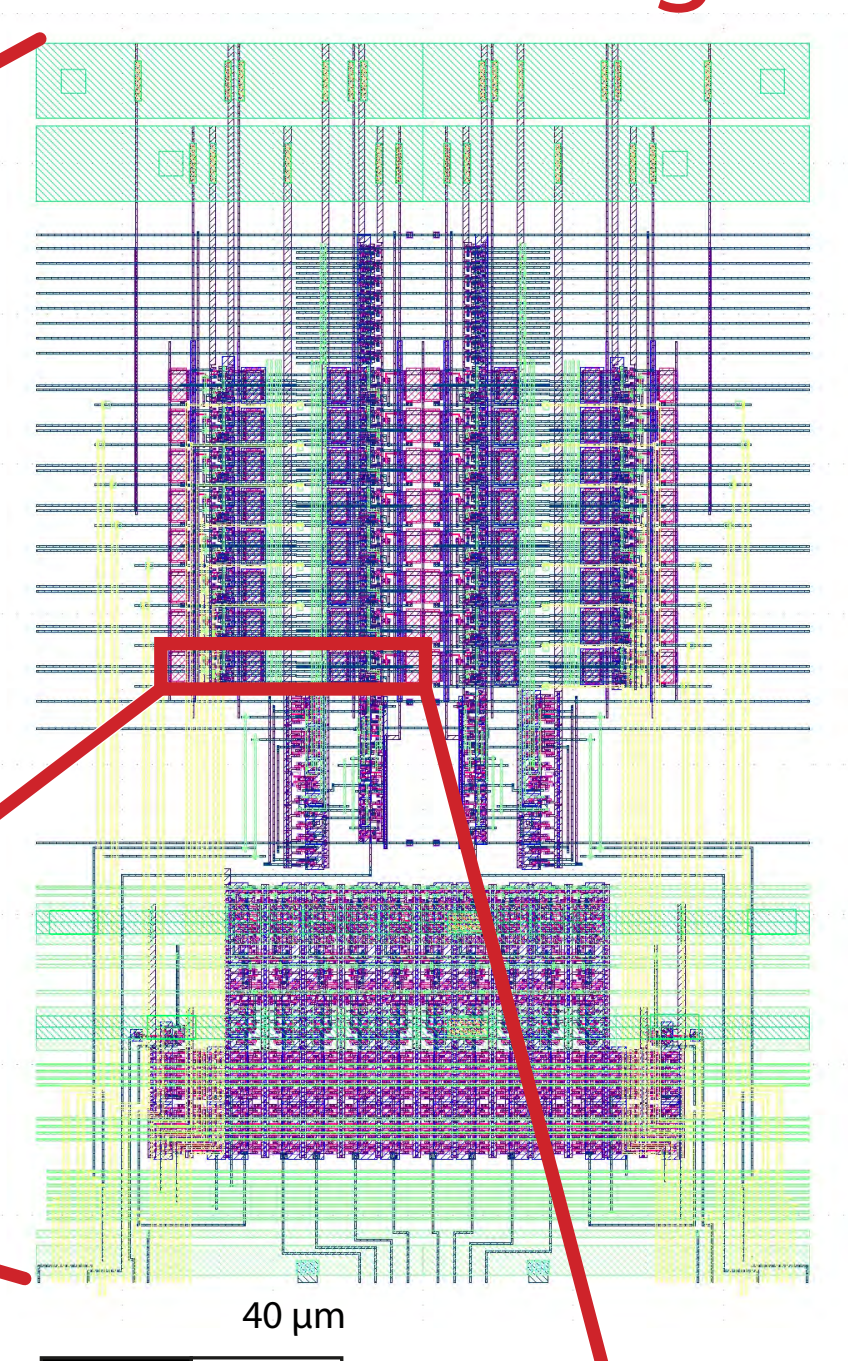


Manufactured in a Austria Microsystems High-Voltage CMOS process with 180 nm feature size

32 x 40 pixels with 80 x 103  $\mu\text{m}^2$  size

Thinned to 50  $\mu\text{m}$

## Column Logic



## References

I. Perić: *A novel monolithic pixelated particle detector implemented in high-voltage CMOS technology* Nucl. Instrum. Meth., 2007, A582, 876

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I. Perić, C. Kreidl, and P. Fischer: *Particle pixel detectors in high-voltage CMOS technology - New achievements* Nucl. Instrum. Meth., 2011, A 650, 158

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H. Augustin et al.: *The MuPix high voltage monolithic active pixel sensor for the Mu3e experiment* JINST, 2015, 10, C03044



Mu3e Experiment at PSI  
[www.psi.ch/mu3e](http://www.psi.ch/mu3e)



Berger group in Mainz  
<http://agberger.kph.uni-mainz.de/>

