

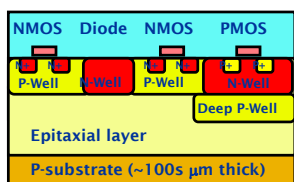
# PImMS – an intelligent pixel sensor

## Introduction

The PImMS sensor is an optical imaging sensor, based on an array of pixels which record up to four timestamps per experimental cycle.

## Sensor technology

• On the “INMAPS” imaging process developed by STFC-RAL.



Silicon cross-section, INMAPS - R. Turchetta

• Key advantage: can implement full CMOS circuitry with 100% fill factor.

• This allows complex in-pixel processing: a total of 710 transistors for the PImMS pixel.

• This is enabled by the deep p-well implant which shields PMOS transistors, which would otherwise parasitically collect charge.

## Sensor specifications

Version one of the sensor:

- 72 by 72 pixel array; 70 μm x 70 μm pixel size
- Time-code resolution < 100 ns
- 4 x 12 bit time-code storage registers per pixel
- < 1 us dead time within a pixel after a hit
- 200 μs experimental cycle (extendable); minimum 20 cycles per second with USB readout; can be improved in future (CameraLink)
- External trigger enabled
- Analogue readout for intensity

## Status

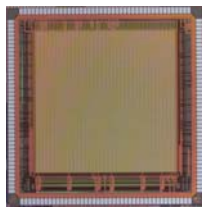
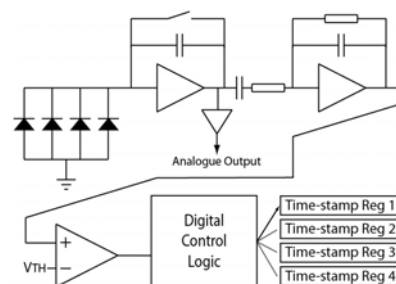


Photo of the PImMS sensor

- Sensors received mid-November
- Characterisation: Nov-Dec 2010
- First lab experiments expected January 2011
- Next version: larger array, design during 2011

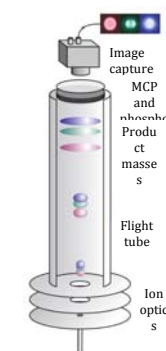
## The pixel design



PImMS pixel schematics – A. Clark, J. Crooks

- 4 diodes collect charge, which is then pre-amplified
- A shaper converts steps in charge to pulses
- A comparator discerns events above threshold
- Up to 4 events can be time-stamped in each pixel

## Pixel Imaging Mass Spectrometry

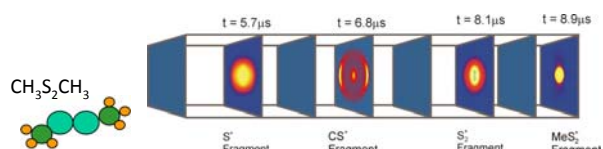


Velocity-map imaging time-of-flight mass spectrometer  
-- C. Vallance

Pixel Imaging Mass Spectrometry (PImMS) is a combination of traditional Time of Flight mass spectrometry and ion imaging.

• Molecules are analysed by mass, by dissociating them into ions with lasers, then accelerating the ions down a flight tube using a tuned electric field. Lighter ions arrive first, giving the mass spectrum.

• Ions arrive at a microchannel plate (MCP) coupled to a phosphor screen.



Velocity mapping of dimethylsulfide  
-- A. Johnsen

- Compared to traditional time of flight instruments, the pixel array provides valuable additional information on structure.
- Velocity mapping preserves initial velocities of ions, for studies of reaction dynamics among others.
- Spatial mapping preserves the initial positions of ions, useful for surface imaging, among others.

M. Brouard, E. Campbell, A. J. Johnsen, C. Vallance, W. H. Yuen and A. Nomerotski  
Velocity map imaging in time of flight mass spectrometry, *Rev. Sci. Instrum.* **79** (2008) 123115.

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