



# ***Medipix2*** ***Technology Market Evaluation***

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## ***Science and Technology Facilities Council***

- Formed as a new Research Council on 1 April 2007 through a merger of the Council for the Central Laboratory of the Research Councils (CCLRC) and the Particle Physics and Astronomy Research Council (PPARC)
- Responsible for astronomy, particle physics, space science and nuclear physics



## *KITE Club*

- Part of the Science and Technology Facilities Council
- Supports developing collaborations between industrial companies and scientific groups
- Strategic objectives:
  - Spread technologies to broader market areas:
    - Through industry & interdisciplinary collaborative research
    - By supporting entrepreneurial activity in our community
  - Support UK academic and industrial leadership in the Science and Technology Facilities Council programme through Programme Technology Development



## *Technology Market Evaluation*

### ■ **Primary Questions**

- What detector performance characteristics would make the detector suitable for various markets?
- What is the potential market size?

### ■ **Secondary Questions**

- Which are the key competitive established and entrant technologies?
- How easy would it be to displace these technologies?
- What other barriers to entry exist?
- Are there other suitable applications for the detector?
- What is the appropriate business model for CERN to pursue?
- What potential partners are there for CERN in the UK (and other Member States)?
- What further market research / business development should be undertaken?



## Medipix 2

- Medipix is a photon counting chip
- Developed by an international consortium (led by CERN)
- Available for commercialisation
- Future development plans: Medipix3
- **Medipix2** active area is about 2 cm<sup>2</sup>
- **256 x 256** pixels form the pixel matrix
- Good spatial resolution: the square pixel size of 55 μm
- Low noise (photon counting)
- High frame rate: each pixel can handle count rates of about 1 MHz.



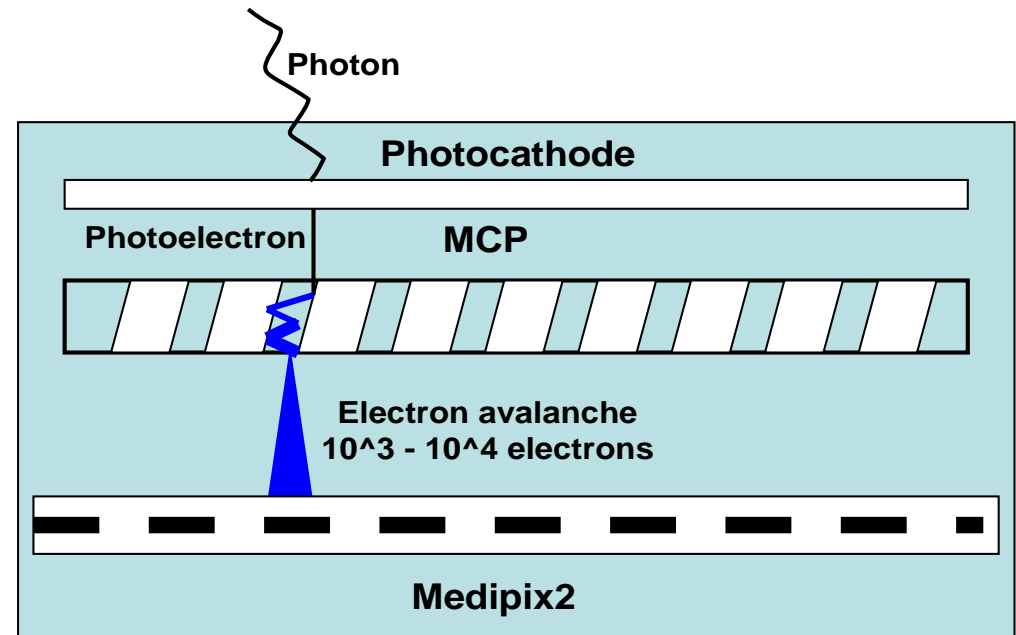
## Medical X-Ray Imaging

- Market size: \$1.49 billion in 2005, are expected to reach \$2.68 billion by 2009 (Frost and Sullivan)
- Major constraint: microchip size
- Possible solutions:
  - Tile and move: technically complex, expensive
  - Medipix2 arrays: RELAXD
    - Medipix2 is 3 side buttable: is it enough?
    - Can we make 4 side buttable Medipix3?
  - Find applications where Medipix2 size is Ok:
  - Dental imaging
    - Benefits: lower radiation dose
    - Problems: substitute technologies



## Visible Light Applications: Adaptive Optics

- Medipix2 could be used for detecting visible light
- Requires an amplification system: Microchannel Plate (MCP) or Avalanche Photodiode (APD) (Optically sensitive Medipix2 detector for adaptive optics wavefront sensing, John Vallergaa)
- Achieved benefits:
  - Quantum efficiency around 40%
  - High frame readout rate
  - Low noise (single photon counting)



## Visible Light Applications: Night Vision

- Fully digital solution: eliminates need in phosphorous screen
- Low noise picture
- Advanced functionality (optical device detection and recognition, range finding, day light operation, etc.)
- Applications: fire & rescue, security

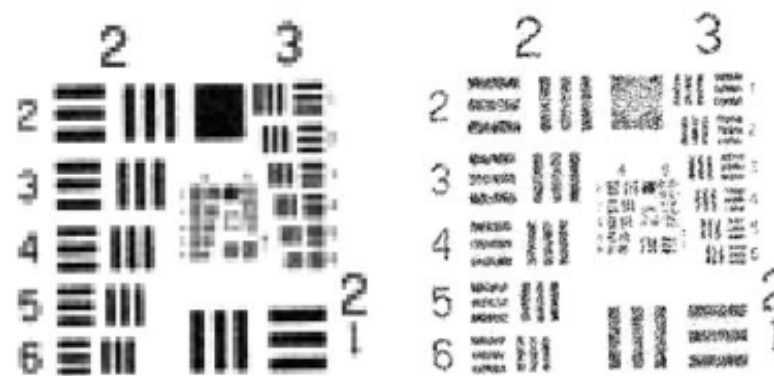
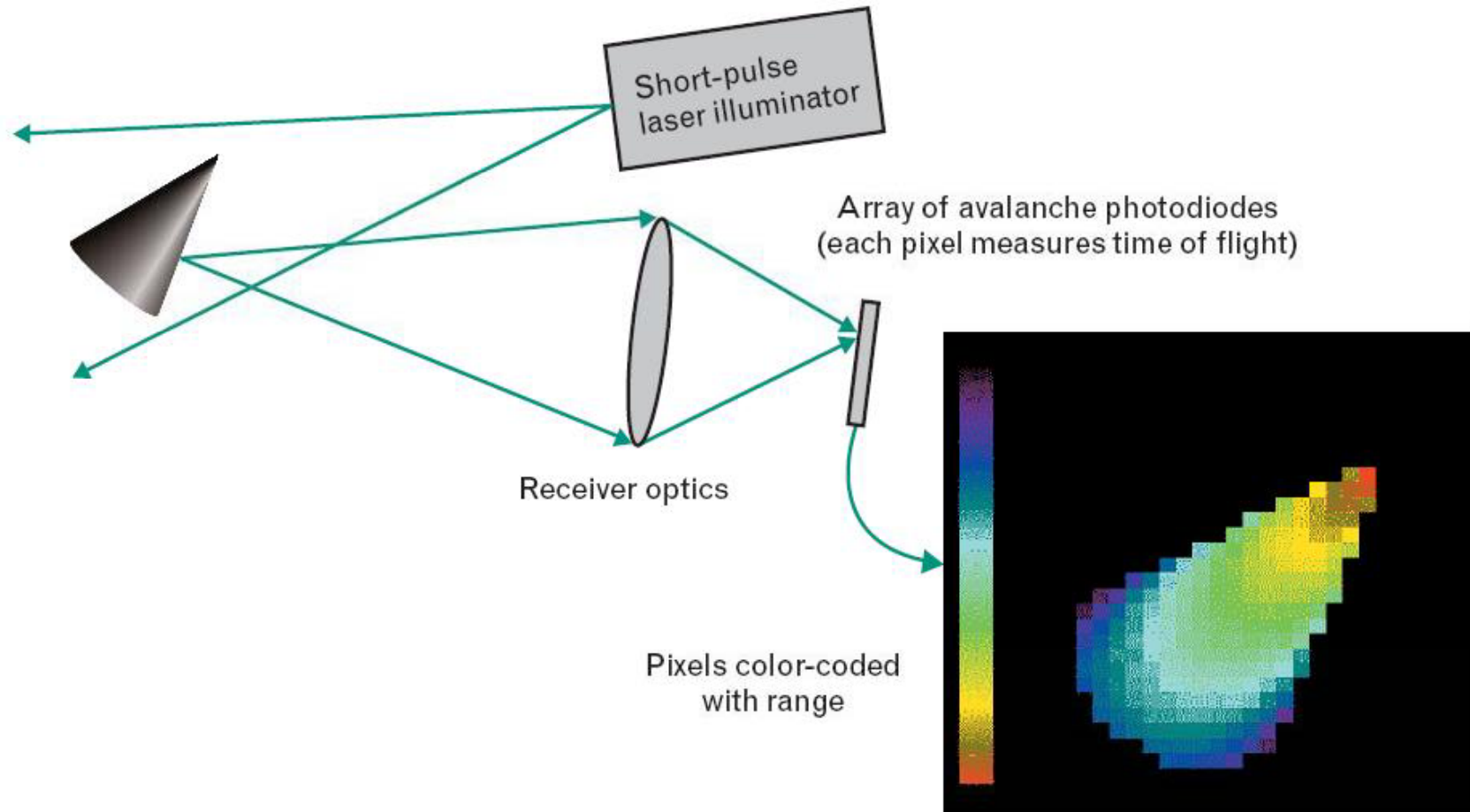


Fig. 9. Air Force test pattern mask showing the detector spatial resolution. On the left is the standard Medipix2 readout where each pixel value is the number of events detected. On the right is a 2D histogram of detected event centroids using a binary algorithm showing sub-pixel resolution of 16 lp/mm.





# LIDAR





## LIDAR Applications

- Geology and engineering geology
- Seismology
- Remote sensing
- Atmospheric physics
- Machine Vision/Autonomous Vehicles
- Automotive Safety/Obstacle Sensing

## LIDAR Markets

- The market for obstacle sensing technologies is set to grow from €14.4m in 2004 to €194.7m in 2015.
- The machine vision market was \$5.3 billion in 2002



## Medipix2 TME Outcomes

- Medipix2 is suitable for a broad range of applications
- Visible light and laser applications have significant market potential
- Important constraints: size and resolution
- Commercial availability of Medipix2 is important for market adoption



## *PIPSS Award*

- Maximum project value is **£125k at Full Economic Cost (FEC) per year**
- Maximum project duration: **3 years**
- Calls: **quarterly**
- The closing dates for PIPSS funding in 2006/07 are: **9 Jan, 3 Apr, 3 Jul, 2 Oct 2007**

## *Mini-PIPSS*

- Maximum project value is **£130k at FEC**
- Maximum project duration: **12 months**
- Calls: **applications may be made at any time**



## *Conclusions*

- Medipix2 has strong commercialisation potential
- Medipix3 is on its way
- Please send us your ideas for Medipix2 collaborative projects!