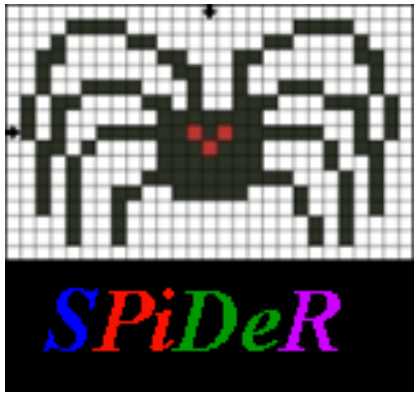
UK Activities since Elba

- SPiDeR project
- Arachnid project
- Mechanical, coatings and thermal progress
- Plans for next 12-15 months

SPiDeR Collaboration

- Created following the demise of Linear Collider R&D in the UK (~2007).
- Silicon Pixel Detector Research
- Original Collaboration: Birmingham, Bristol, Imperial College, Oxford, RAL.



SPiDeR Project

- *Goal: Develop monolithic silicon active pixel sensors for future particle physics experiments and to demonstrate their viability for vertexing, tracking and calorimetry applications.*
- *Still aimed at linear collider (CALICE-UK) but with an eye on medical, nuclear and other particle physics experiments.*

	Vertexing	Tracking	Calorimetry
Pixel size (um)	20	25-50	50
Spatial occupancy (/mm^2)	100	0.1-2	0.002
Material per layer (X0)	< 0.1%	<1%	
Output signal	>5 bit analogue	Analogue or binary	binary
Noise (MIP)	<0.1	<0.1	<0.1

SPiDeR goal

- *Build 3 chips: ISIS (vertexing), TPAC (calorimetry, a number of versions), Cherwell (tracking)*

	ISIS	Cherwell	TPAC
Charge Collection	Photogate + CCD register	Pinned Photodiode (4T)	4T diodes plus >100 transistors /pixel
Pixel size (um)	20	25 (50)	50
Time slicing	X 20 in-situ storage cells	X10 rolling shutter	X 8192 time stamp
Noise Minimisation	Raw charge storage and CDS	CDS	signal shaping and pseudo-CDS
Power Minimization	Delayed slow readout (rolling shutter)	Rolling shutter	Asynchronous operation
Radiation Tolerance		High resistivity study to enhance tolerance	High resistivity study to enhance tolerance
Yield and cost	Custom CMOS	Standard CMOS	Standard CMOS

SPiDeR proposal (2009)

SPIDER – A Silicon Pixel Detector Research programme

R. Staley, N.K. Watson, J.A. Wilson
University of Birmingham,

D. Cussans, J. Goldstein, R. Head, S. Nash, J.J. Velthuis
University of Bristol

P.D. Dauncey
Imperial College London

R. Gao, J, Jaya John, A. Nomerotski
University of Oxford

R.E. Coath, J.P. Crooks, C.J.S. Damerell, P. Murray, M. Stanitzki, J. Strube, S.L. Thomas, R. Turchetta, M. Tyndel, E.G. Villani, S.D. Worm, Z. Zhang
Rutherford Appleton Laboratory

- *SPiDeR project awarded £3M 1st April 2009. Cancelled 4th April 2009.*
- *All chips built but only ISIS and TPAC partially characterized.*
- *Some funding for Pixel Imaging for Mass Spectroscopy (PImMS) for Oxford and RAL but not useful for HEP.*
- *Work continued but without funding so is coming to an end.*
- *CERN has taken up interest in testing TPAC chip for ALICE upgrades.*

Rising from the flames of SPiDeR (2011)

Project Research and Development 2011

ARACHNID

A next generation silicon pixel detector for Particle and Nuclear Physics

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J.P. Crooks, R. Turchetta, F.F. Wilson, Z. Zhang
STFC Rutherford Appleton Laboratory, Chilton, Didcot, Oxon, OX11 0QX

R.C. Lemmon, I.H. Lazarus
STFC Daresbury Laboratory, Warrington, Cheshire, WA4 4AD

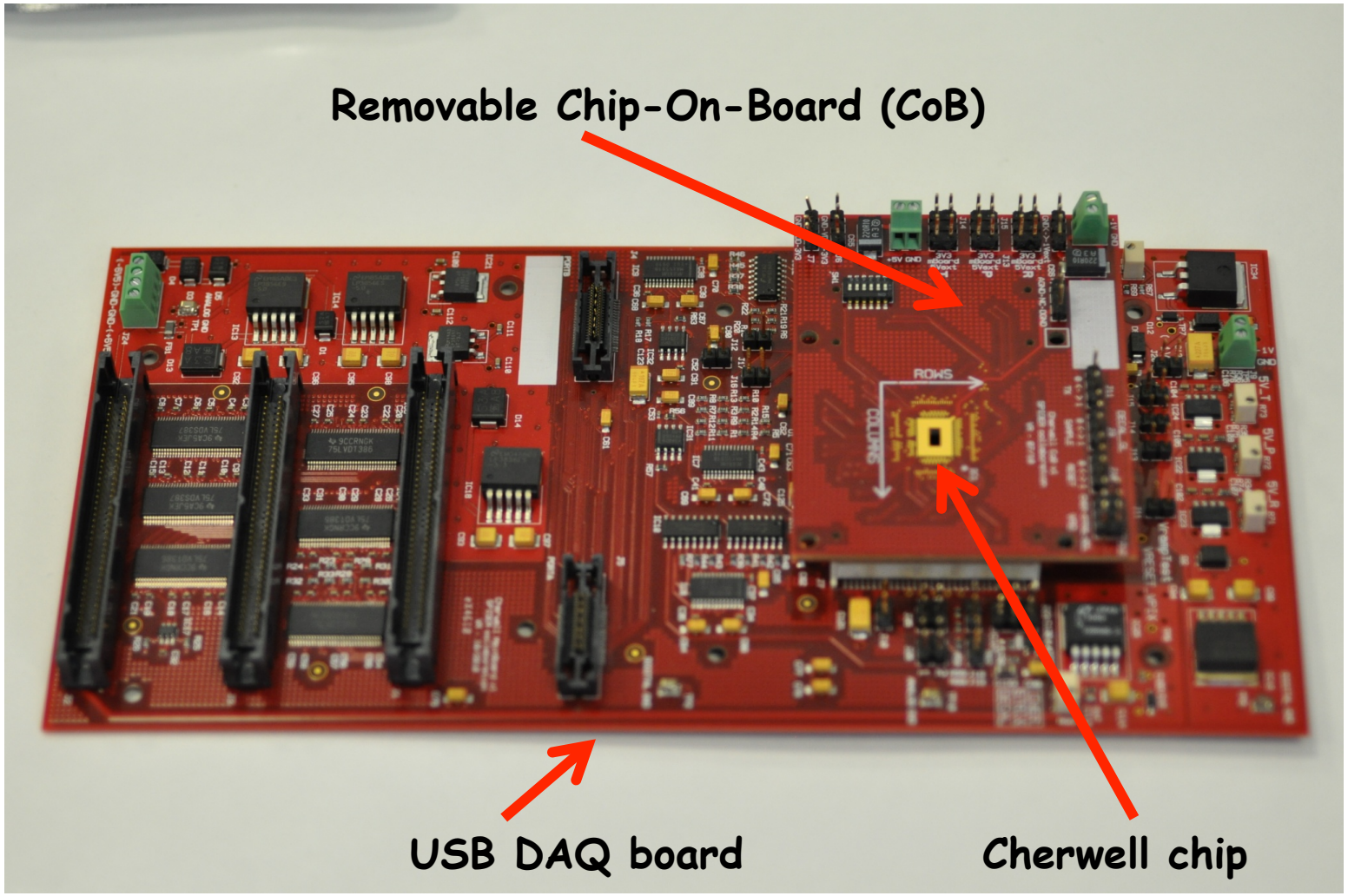
April 28, 2011

Generic R&D program.
Targets: SuperB, ALICE upgrade and T2K upgrade
€500k requested for 15 month programme.
Decision was made mid-July but still not announced!

Arachnid Work Packages

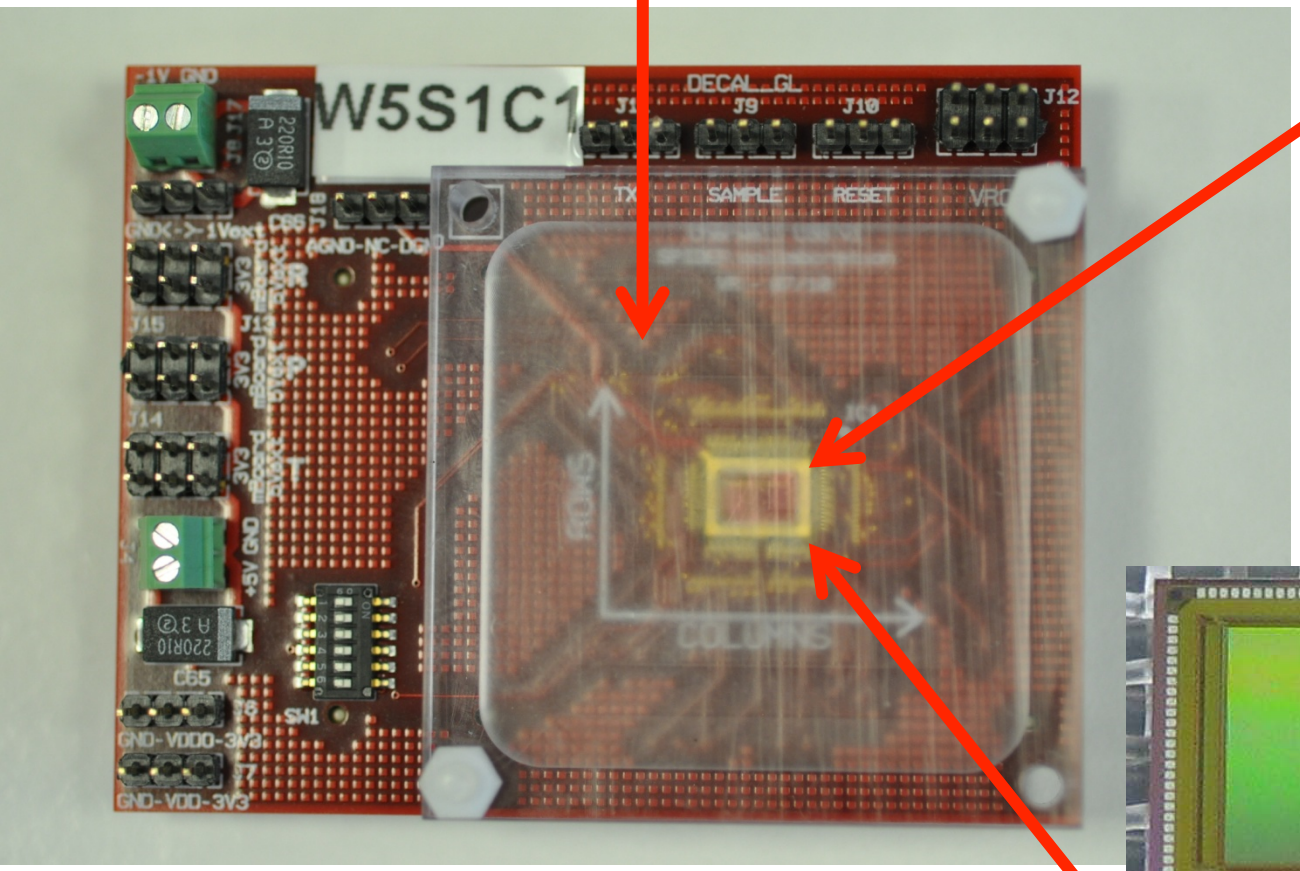
- *1) MAPS Device characterisation*
  - Test stand setup
  - Detailed characterization
  - Laser tests
  - Gain calibration with radioactive sources
- *2) Radiation Hardness and test beams*
  - Alpha, beta and gamma irradiation
  - DESY/CERN test beams
- *3) Advanced MAPS operation*
  - Thin detector development
  - Cryogenic Operation
  - High Magnetic Field operation
  - Surface Coatings
- *4) Sensor design for real-world applications ready for fabrication.*
  - SuperB
  - ALICE

Cherwell USB-DAQ board

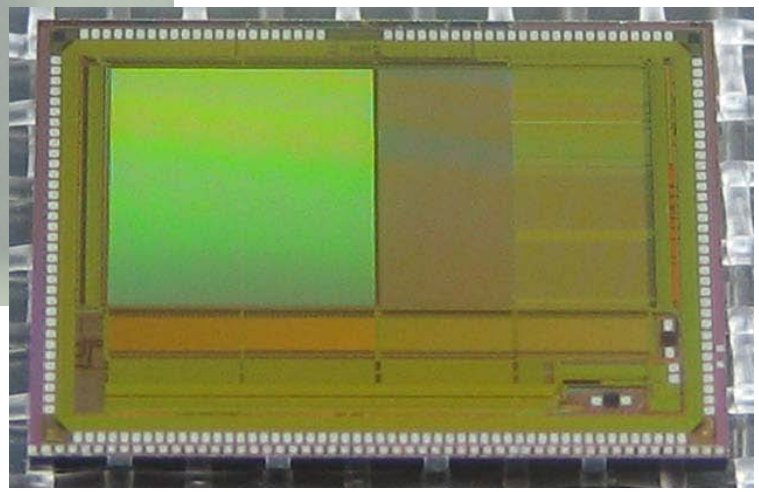


Cherwell Stand Off Board

Protective nitrogen environment



A few chips already bonded. Rest can be completed in a week.



Cherwell chip

Over the summer…

- *We have setup some test stands ready for Cherwell testing.*
- *Bonded some Cherwell chips to DAQ CoB board.*
- *Getting up to speed on the VHDL needed for the FPGA programming.*
- *Testing of TPAC chip at 110K – pixels still functions; not tested the memory arrays etc….*
- *Testing of TPAC with >1 Mrad shows ~no change in gain.*
- *Prepared support equipment to allow test beam work at DESY or CERN or elsewhere.*
- *On-going simulations of temperature rises and cooling with MAPS chip.*
  - 2.5cm wide staves can be cooled with two pipes running lengthways.
  - Ability to run with cooling at ends only if use ILC-like readout.
- *Thinning and bending of 2.4 x 2.5 cm piece of silicon. Shown we can bend 50um silicon elastically around beam pipe. Developing new jigs and testing effect on electrical connections.*
- *Dedicated vacuum pump ordered for coatings*
- *Continued investigating support structure design (in context of ATLAS upgrade).*

Plans 2011-2012

- *Still waiting for PRD 2011 results to be announced.*
- *Start the Arachnid programme. Design the logo (very important!). Design FPGA, setup test stands, plan test beam campaign.*
- *Design detailed Arachnid work breakdown schedule around SuperB R&D timescales.*
- *Leverage UK University resources to complement Arachnid project.*
- *Use EUDET Transnational Access for test beam funding.*
- *Use as basis for Royal Society/Leverhulme International Schemes (deadline December 2012).*