UNIVERSITY OF CAMBRIDGE

A Summary of Investigations at Cambridge

Making the interconnections between the Slab component PCBs ("ASUs") is difficult.

We have been looking at ways to do it, and testing out our ideas.

- The general interconnect problem
- The way in which "Bridge" pieces could be used
- The initial design work
- Bits we have in hand
- Investigations and first results

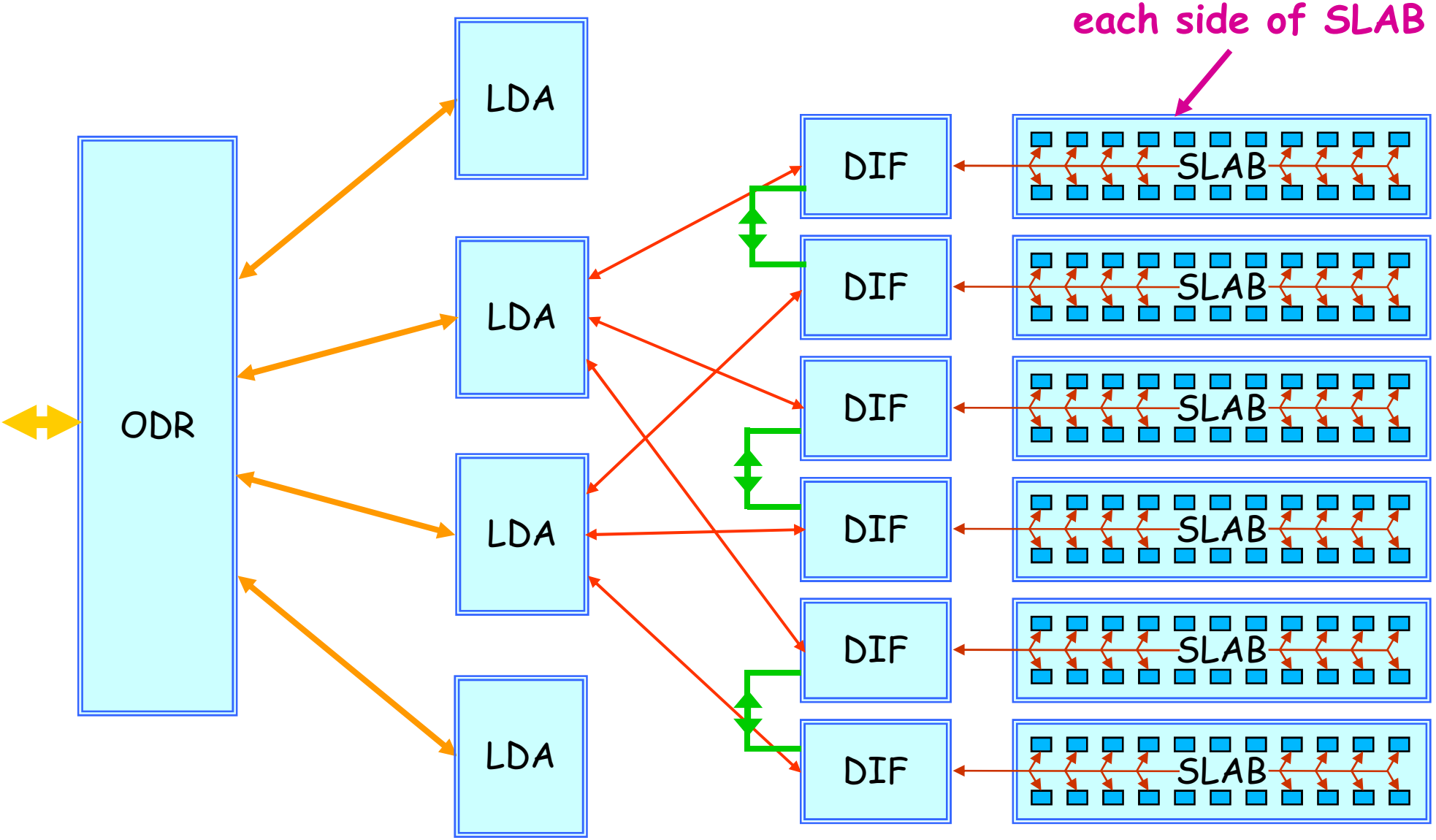
Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect

UNIVERSITY OF CAMBRIDGE

DAQ Architecture – Overall view

~150 VFE ASICs on each side of SLAB

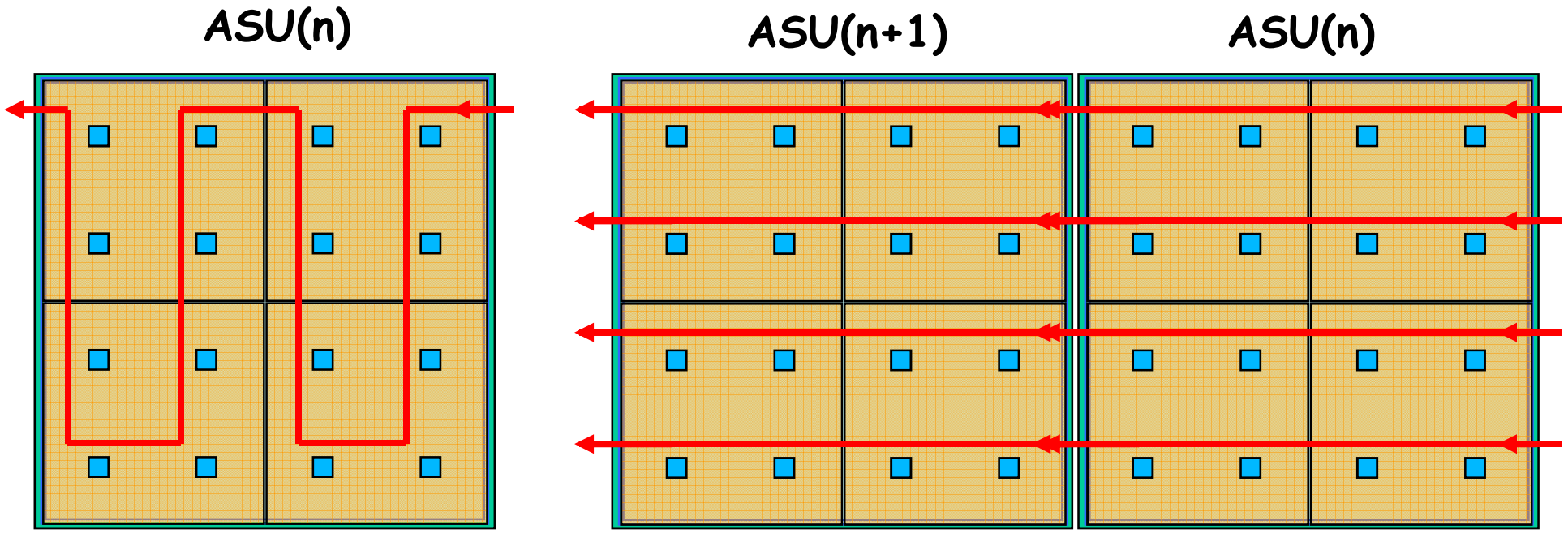


Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect – Why Multi-Rows?

UNIVERSITY OF CAMBRIDGE

How to read them out – **single path** or in **4 rows?**



Single path

4 rows

Per ASU: L ~ 720mm, C ~ 72pF

Per ASU: L ~ 180mm, C ~ 18pF

Per Slab of 9 ASUs:
L ~ 6.5m, C ~ 650pF

Per Slab of 9 ASUs:
L ~ 1.6m, C ~ 160pF

Do these look **BIG ??**

Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect – Why Multi-Rows?

UNIVERSITY OF CAMBRIDGE

Multi Row is aesthetically **much more pleasing** J J J J

- but what material advantages does it offer?

Clock and Control Lines: LVDS, controlled impedance

- length of each C&C trace reduced below $1/N_{ROWS}$:
  - less signal degradation
  - far cleaner routing – no need for stubs

Read-Out Lines: low voltage swing CMOS

- data load is shared between the rows, so lower rate needed
- length (and hence capacitance) of each readout trace reduced below $1/N_{ROWS}$
- power for R/O reduced in same ratio

The power savings not large compared to Slab power budget

But achieving data rates of several Mbits/sec over complex traces of several metres length will be **difficult** L or **impossible** L L L

But Multi-Rows means lots of connections - **is this possible?** L **or** J

ECAL SLAB Interconnect

UNIVERSITY OF CAMBRIDGE

We have been looking at using "Bridges" to jumper multiple connections between adjacent ASUs

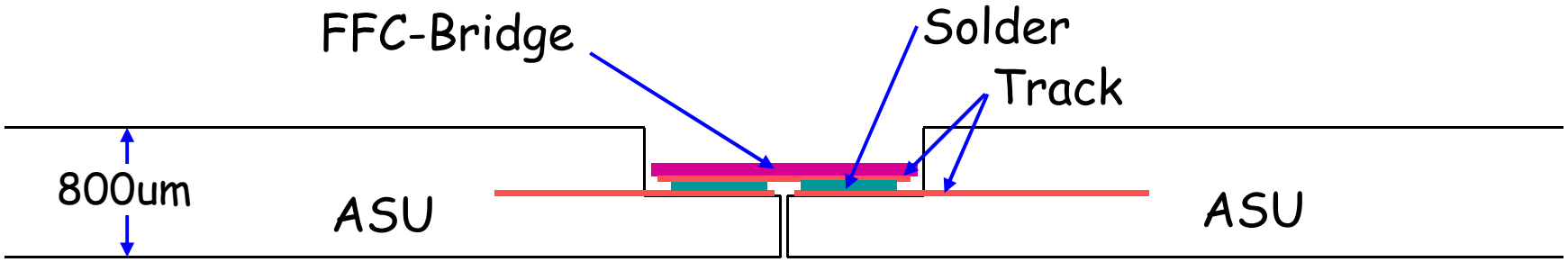
The Bridge would be soldered onto pads on the ASU (or DIF) PCB

Each Bridge would provide 30-40 connections
Up to 4 Bridges fit in the width of an ASU
… 1 per path would be an ideal solution J J

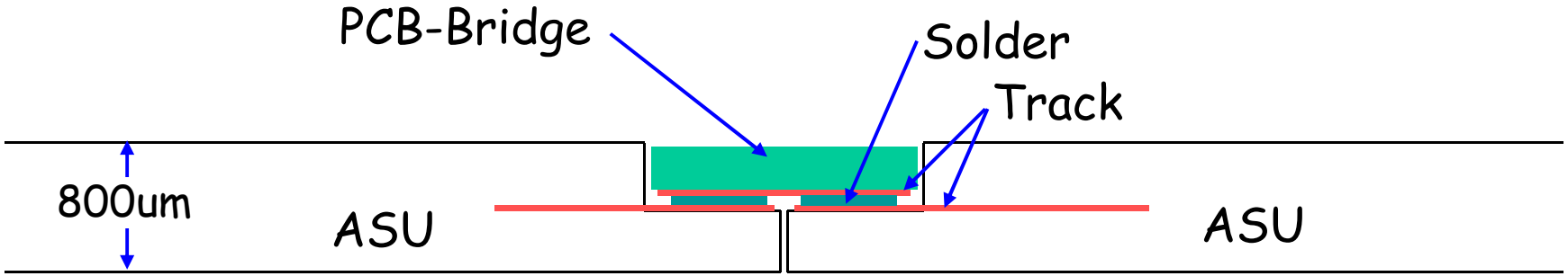
ECAL SLAB Interconnect

UNIVERSITY OF CAMBRIDGE

Short FFC (Flat,Flexible-Cable) Bridges make connections on a 1mm pitch – OK for at least 120 connections



Alternatively the Bridges can be thin PCBs, also with 1mm pitch connections. This gives a mechanical as well as electrical joint



Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect - Bridge advantages

UNIVERSITY OF CAMBRIDGE

- Provides copious connections (4 x 35 across ASU)
  - plenty for Power Planes
  - would allow 4 or more rows of connections
- Solder joints well proven electrically
- Signal transmission likely to be less compromised
- Rework possible

- Using an FFC-Bridge would make the mechanical joint independent: this might appeal to the mechanical designers

- Using a PCB-Bridge combines mechanical and electrical joint

ECAL SLAB Interconnect - Where we are

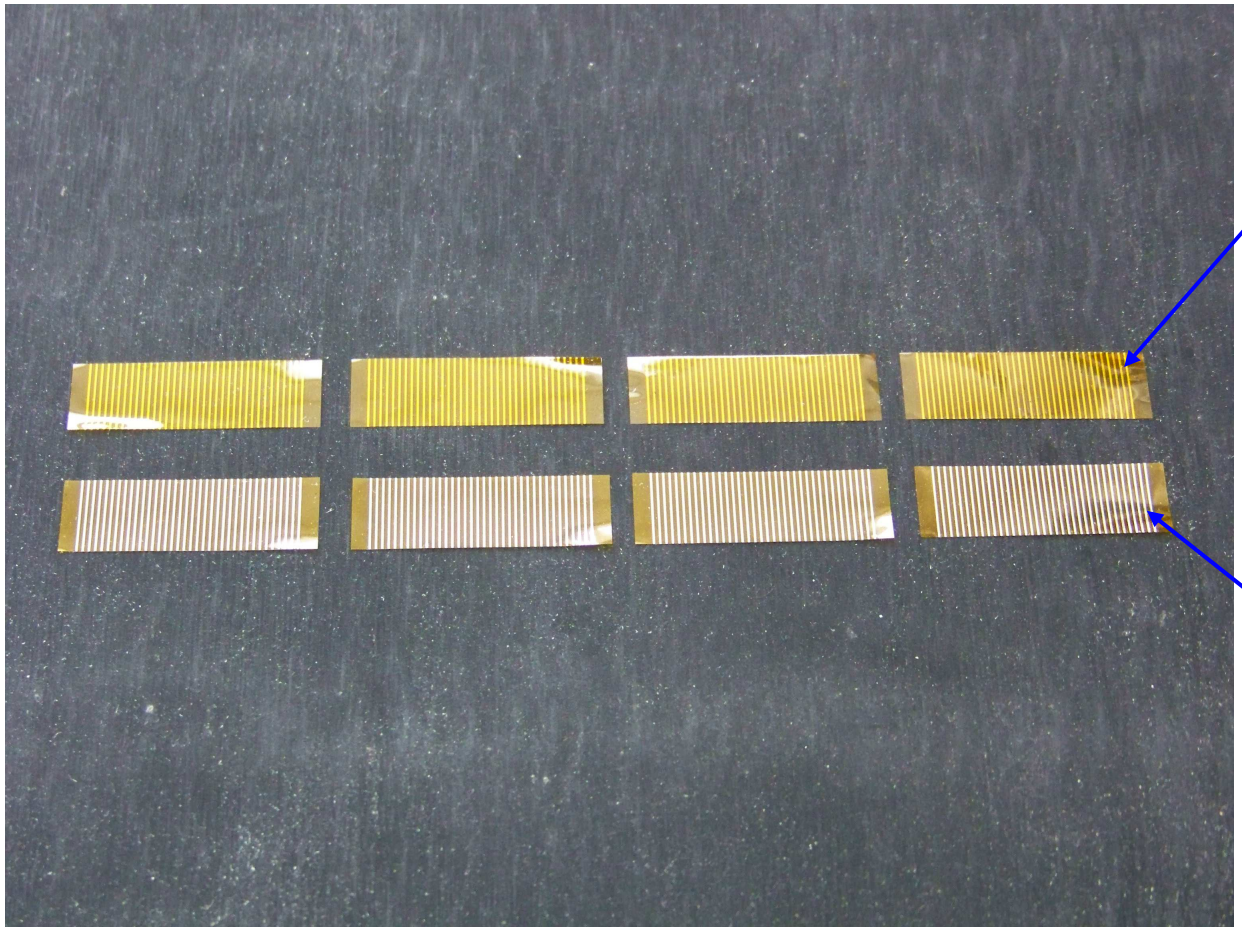
UNIVERSITY OF CAMBRIDGE

The following slides give a glimpse of what we have … and some results

Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect - Where we are

UNIVERSITY OF CAMBRIDGE



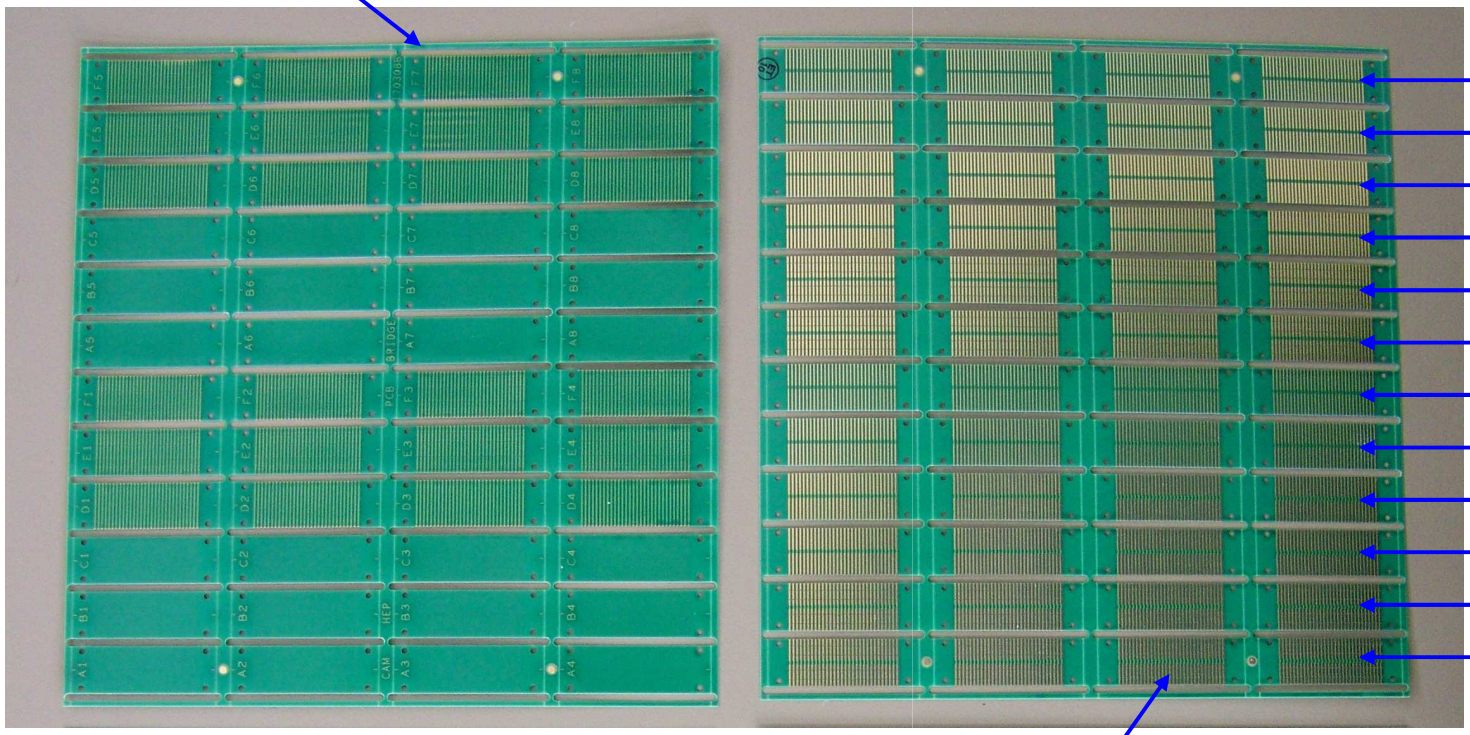
FFC-Bridges: we have 250 cut, 250 on roll

Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect - Where we are

UNIVERSITY OF CAMBRIDGE

Top View



Under View

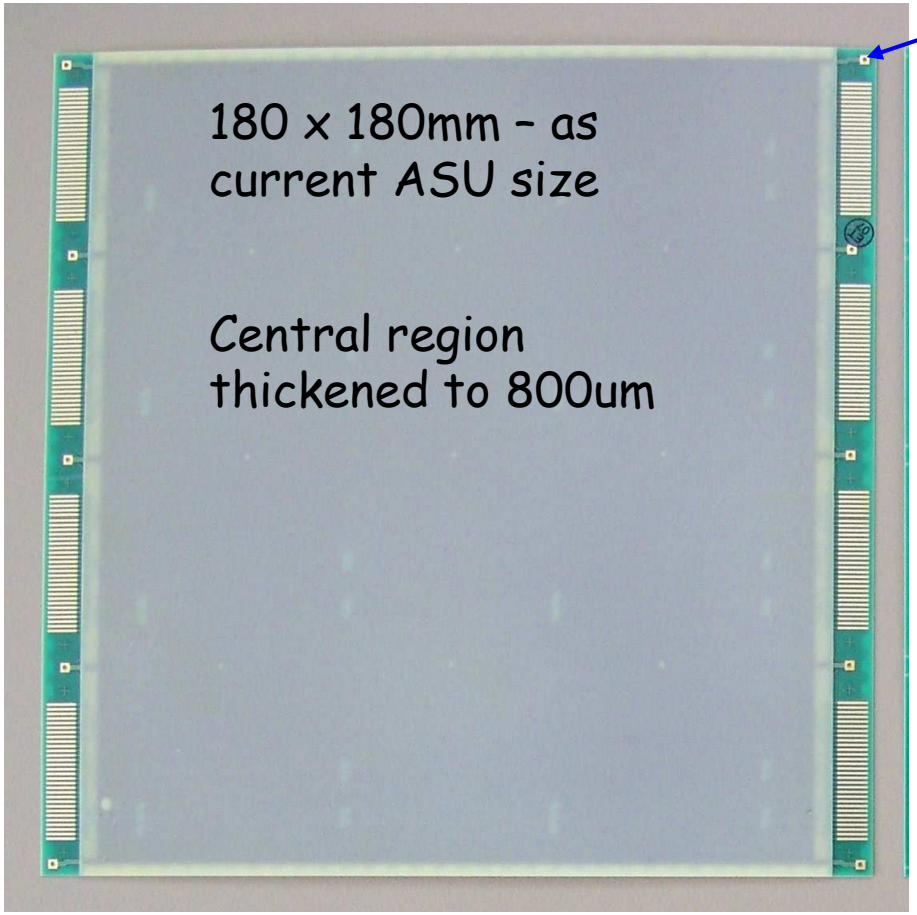
PCB-Bridges: have 15 Panels of 8 lots of 6 variants

Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect - Where we are

UNIVERSITY OF CAMBRIDGE

Top View



Interconnect region 400um

4 identical rows of differential tracks connecting 36 way

interconnect pads on left and right

Can be sliced into 4 sections, so provides for many trials

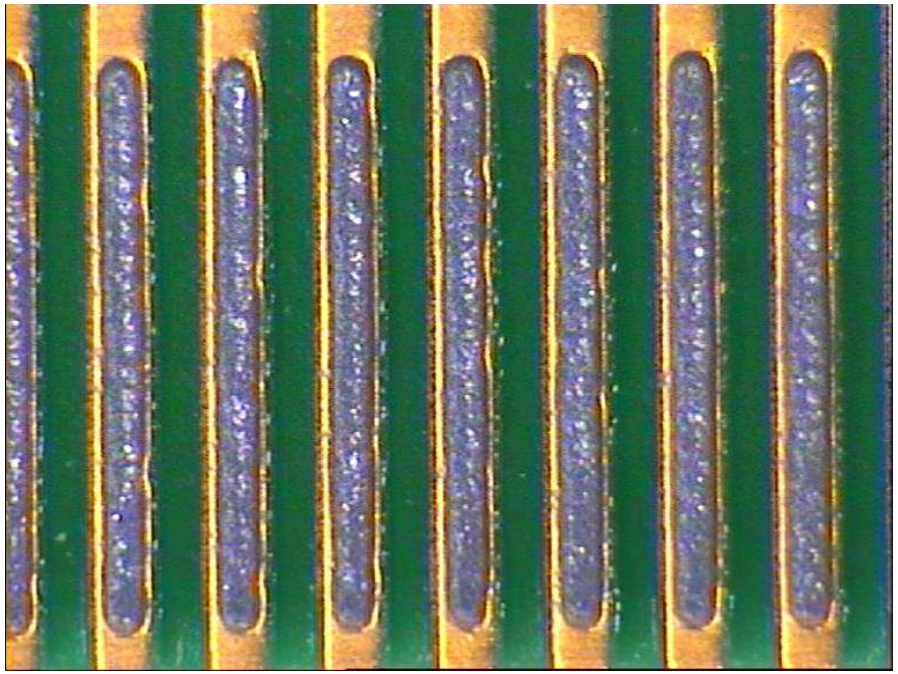
Differential tracks have a range of spacings & other charcteristics to test signal propagation and cross-talk

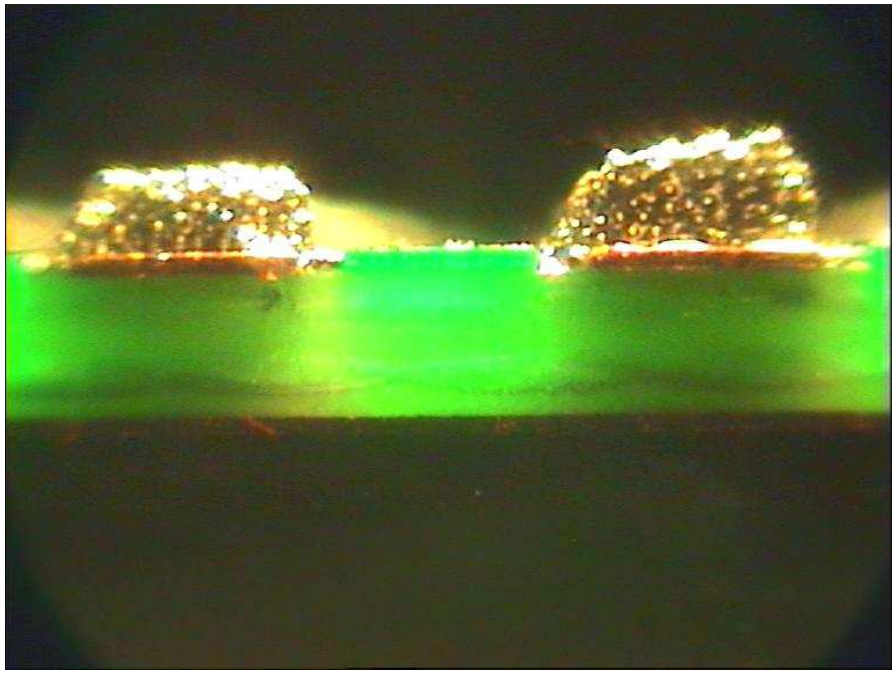
ASU-Test PCB: we have 15

Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect - Where we are

UNIVERSITY OF CAMBRIDGE





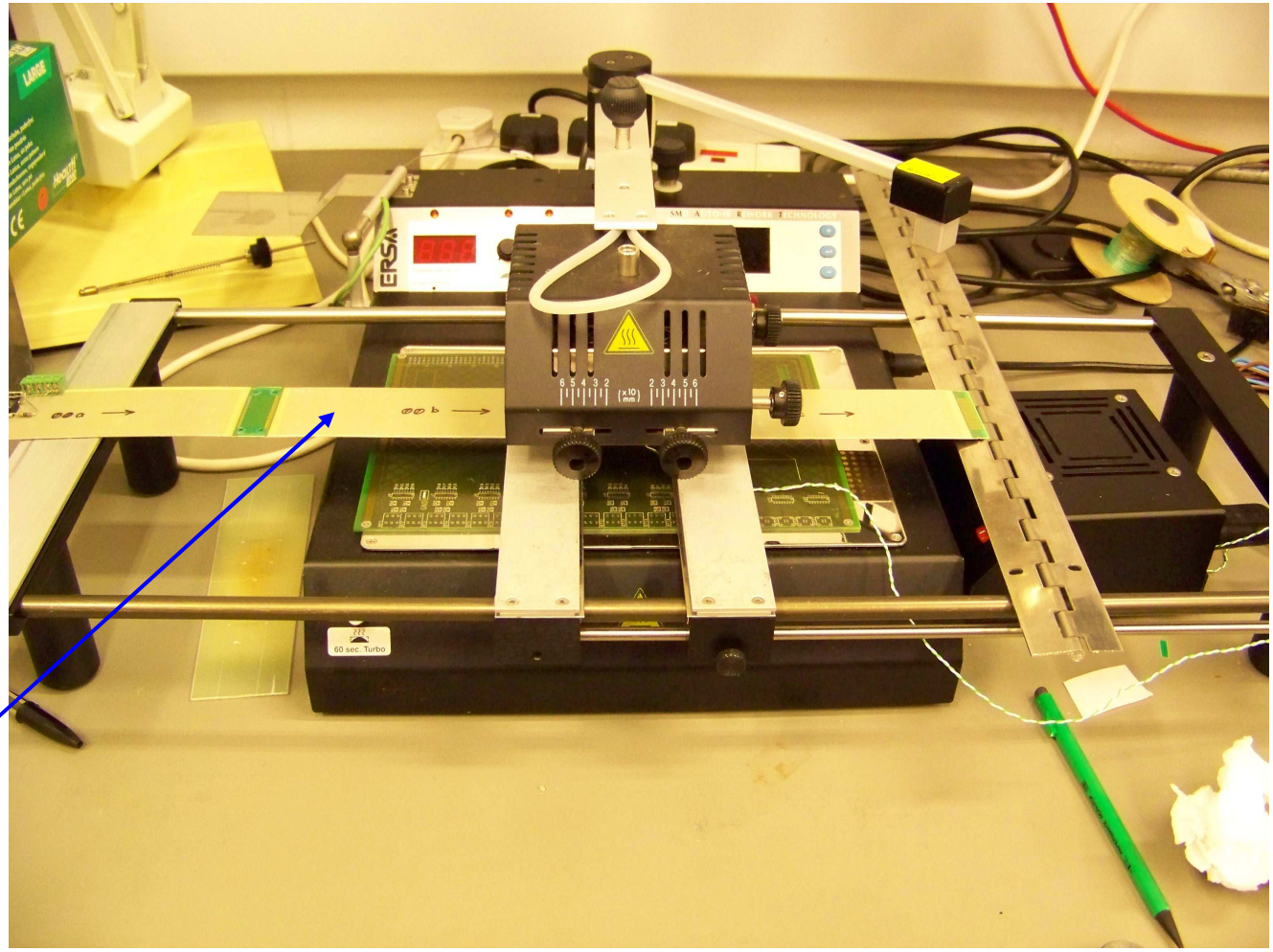
PCB-Bridges: solder pasting

Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect - Where we are

UNIVERSITY OF CAMBRIDGE

3 bits of ASU-Test being joined: reflow of 2nd and 3rd



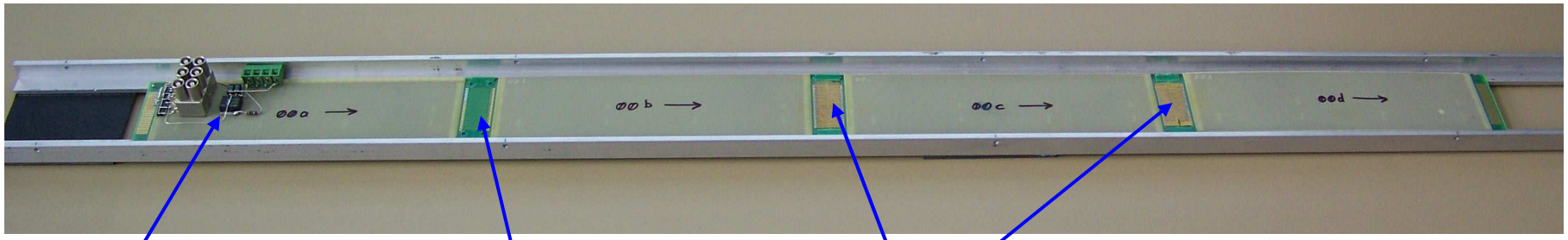
Using the IR Re-work station

Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect - Where we are

UNIVERSITY OF CAMBRIDGE

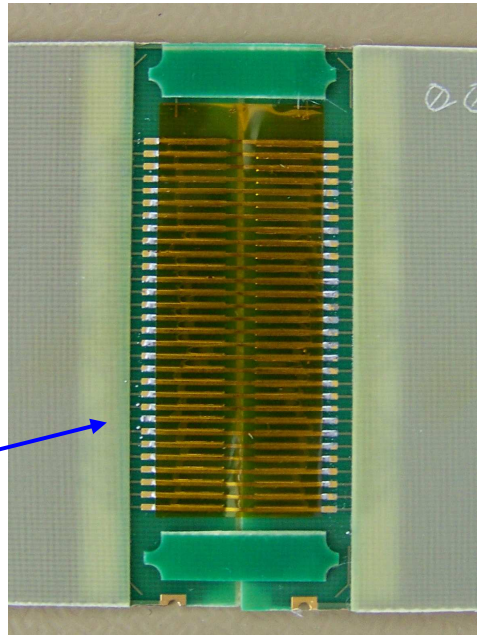
4 Section ASU-Test Assembly



LVDS Drive Circuit

PCB-Bridge joint

FFC-Bridge joints



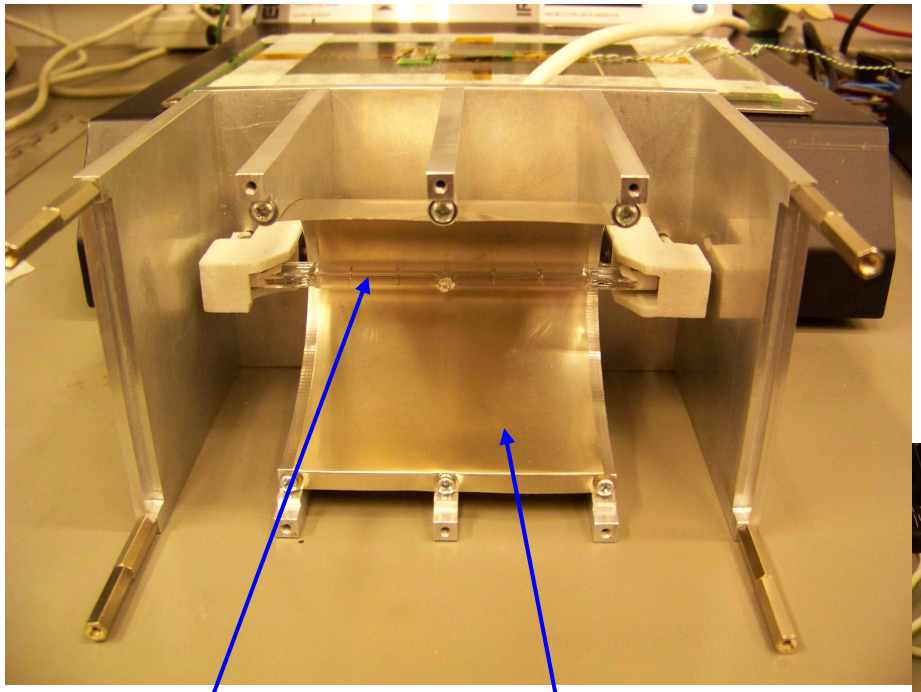
View of FFC-Bridge joint

ASU-Test: 4 Section Assembly

Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect - Where we are

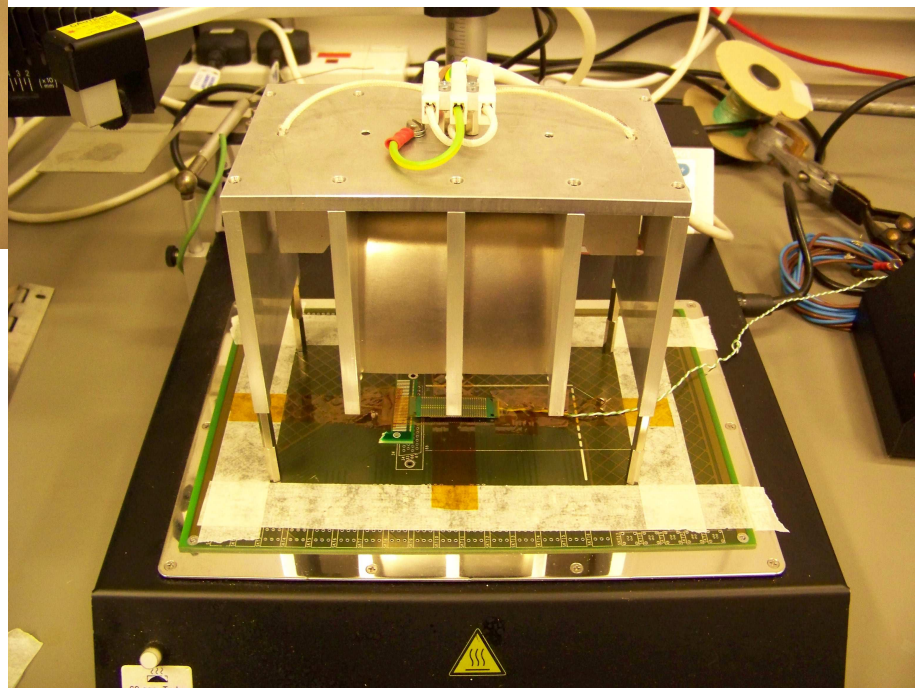
UNIVERSITY OF CAMBRIDGE



Linear Halogen Lamp

Elliptical Reflector

Re-flowing a PCB-Bridge



Imaging Halogen IR Source: first test

Maurice Goodrick & Bart Hommels , University of Cambridge

ECAL SLAB Interconnect: Conclusions

UNIVERSITY OF CAMBRIDGE

There are major advantages in using Bridges:

- Removes major bottleneck in number of connections
- Promises greater reliability
- Rework likely to be easier

There's a lot to be done:

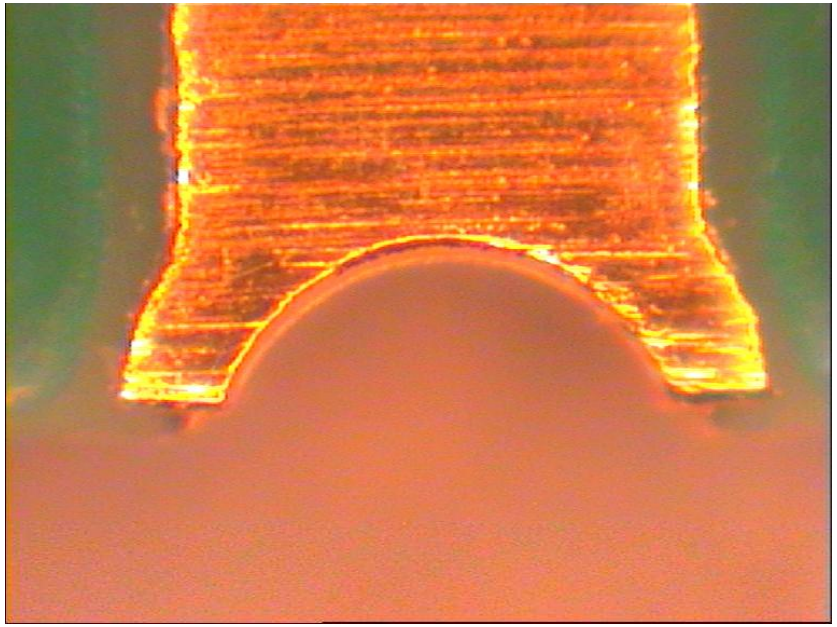
- We are trying out many things
- LAL Mechanical Prototype will also test PCB-Bridge mechanics

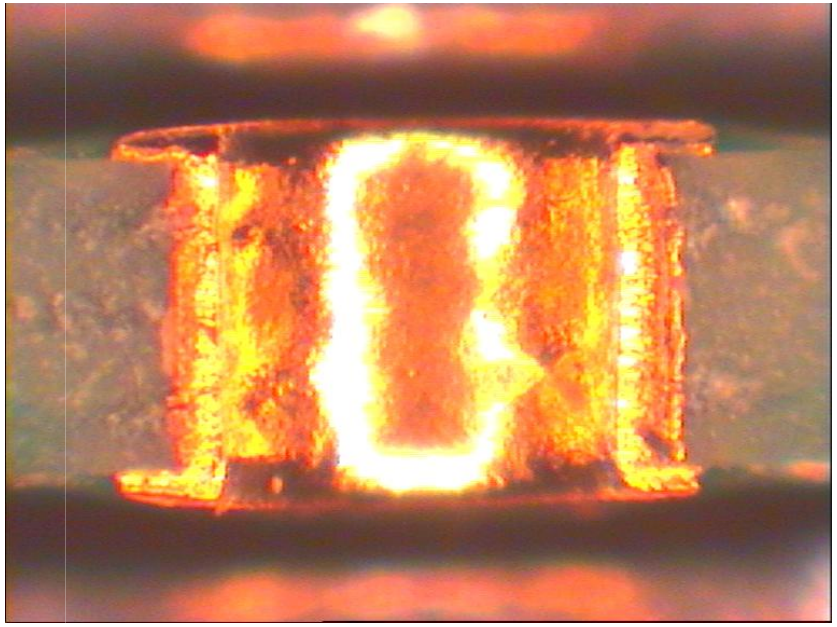
We are finding answers:

- 1mm pitch connections with continuity and no shorts
- IR re-flow looking very good:
  - ERSA Re-work station OK
  - Home-brew Imaging IR source may fit well into large-scale assembly procedures: full width re-flow, multiple heads,…

ECAL SLAB Interconnect - Where we are

UNIVERSITY OF CAMBRIDGE





PCB-Bridges: half-via variant

Maurice Goodrick & Bart Hommels , University of Cambridge