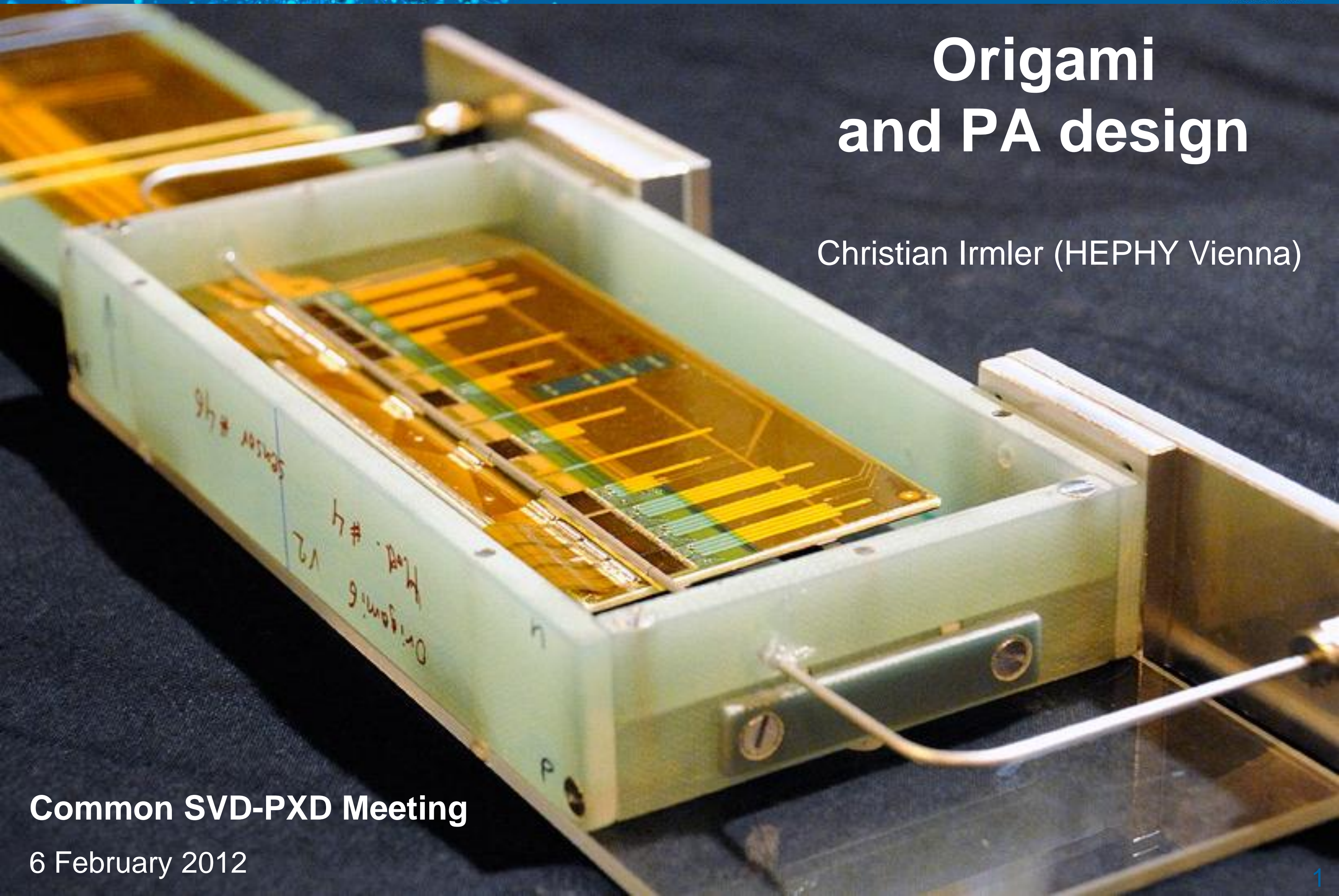


Origami and PA design

Christian Irmler (HEPHY Vienna)

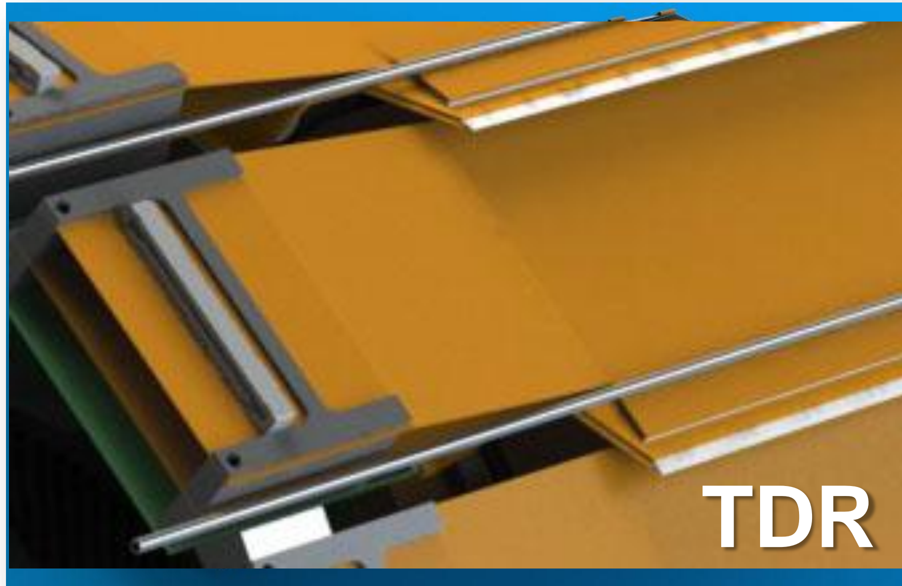
Common SVD-PXD Meeting

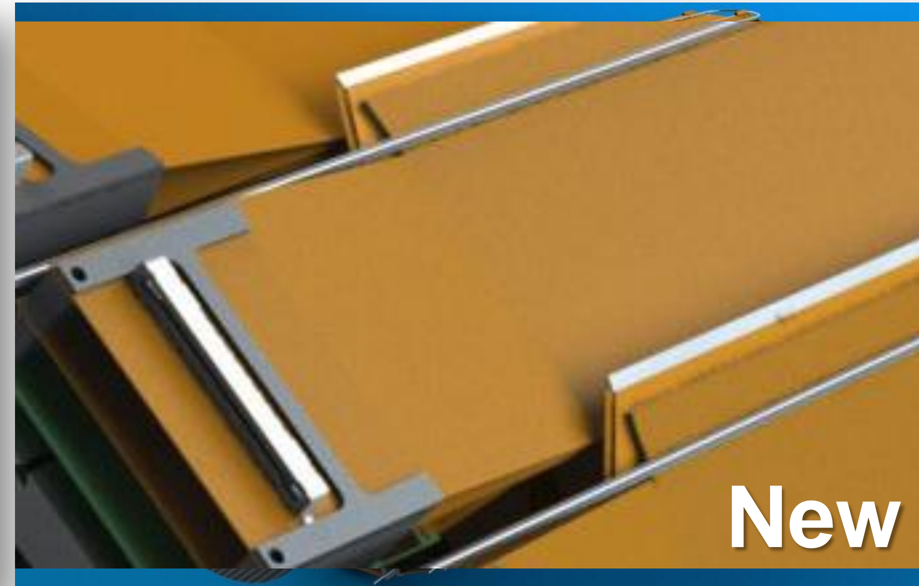
6 February 2012

B2GM Nov. 2011

- **Windmill orientation**
  - intensive discussion
  - Drift field
  - Potential field
  - Simulation by Markus
- **Conclusion:**
  - **Windmill has to be flipped w.r.t. TDR!**

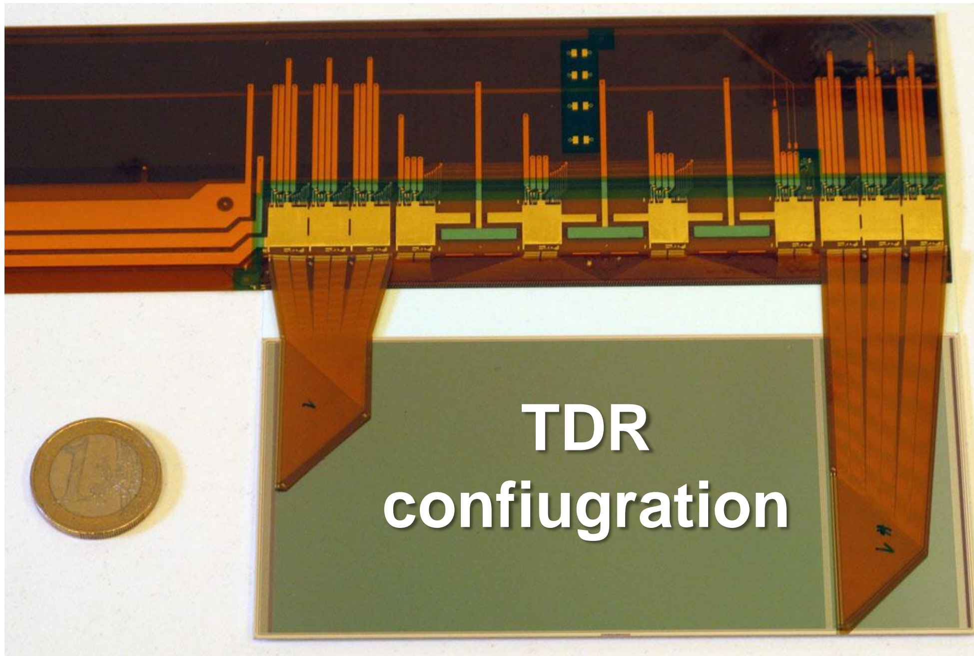
Implications on Origami Design

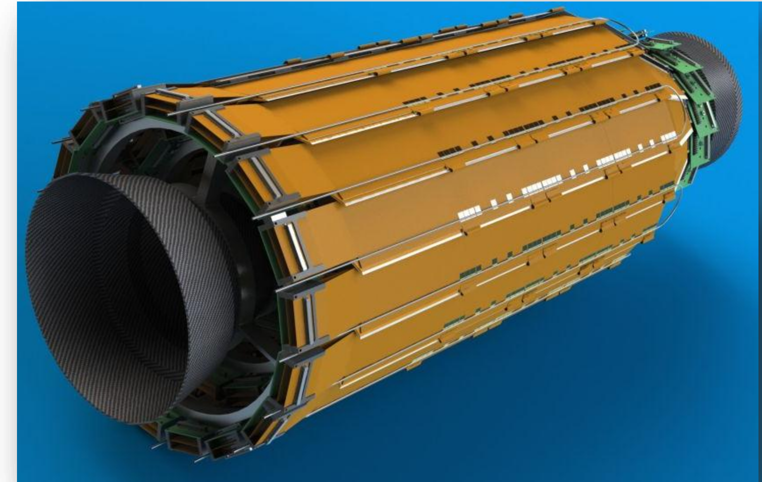




- Located at the opposite edge of ladder:
  - n-side wire bonds & ears of PA1/PA2
  - APV chip and cooling pipe
- **Origami flex has to be mirrored**
  - Old design can be used for forward flex

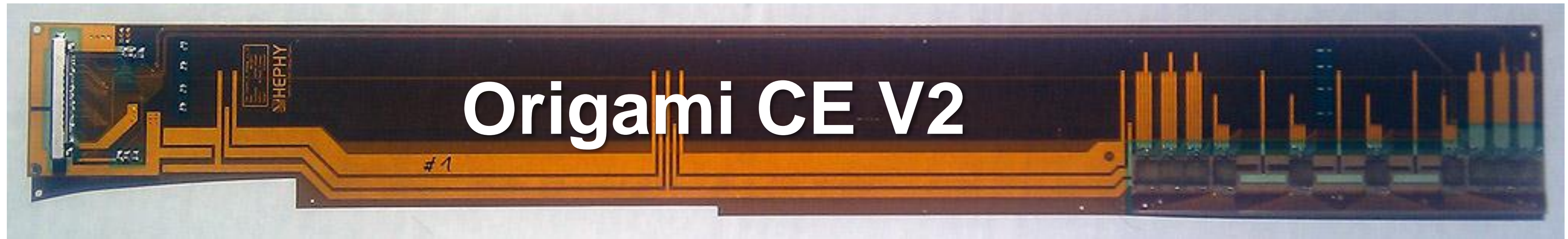
Whats about PA1 and PA2?

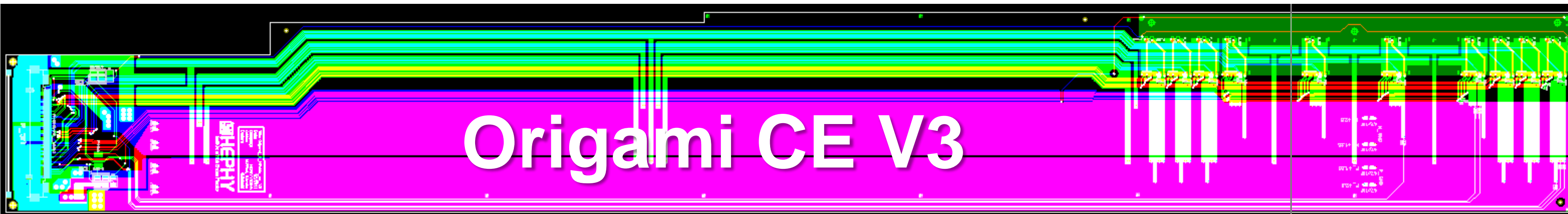




- Mirrored design of PA1 and PA2 required?
- **No, old design can be kept, when each sensor is rotated by 180°.**
- Only the tail of the Origami flex has to be mirrored.

Mirrored Origami for Center Sensor





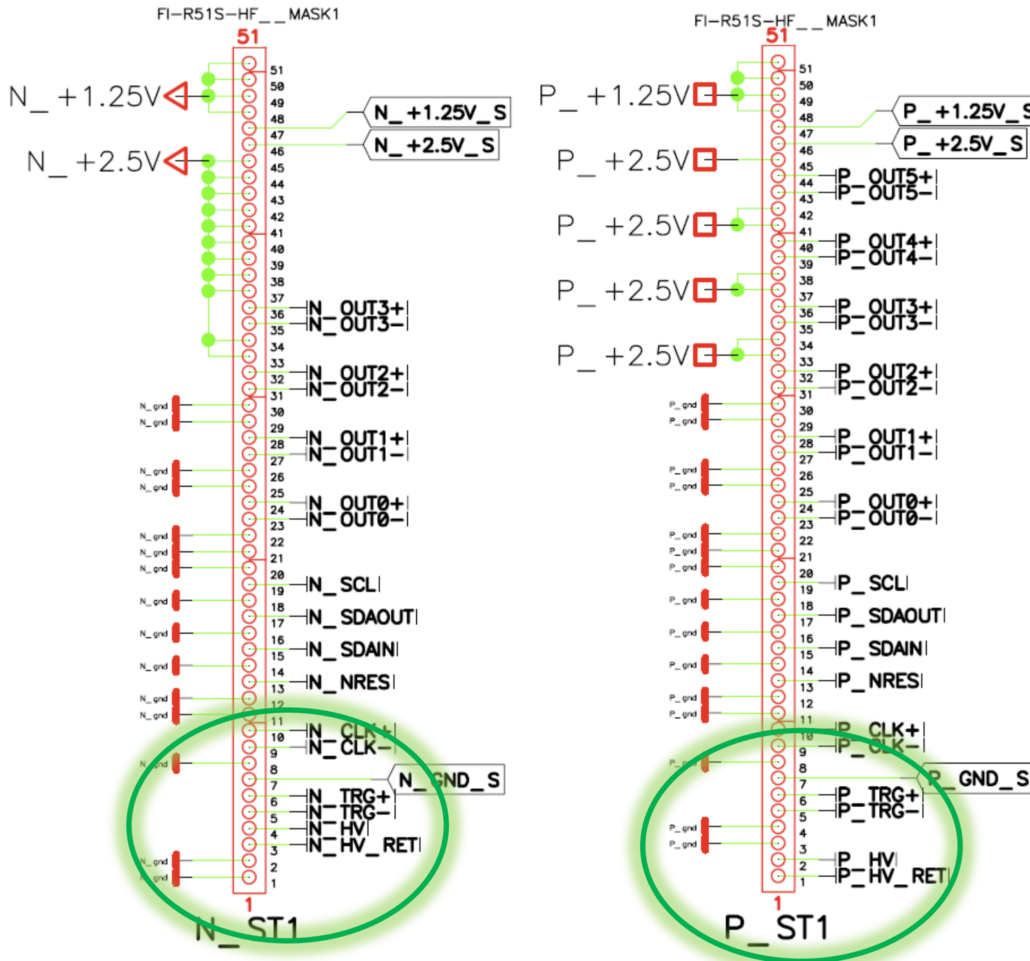
- Whole Origami design rotated
- JAE connectors can not be rotated
  - requires to interchange connector sides
  - p-side connector is now on top layer
- In layer 6 both versions are required
  - different connector order in forward and backward direction
  - causes the danger to attach cables to wrong connector

Mixed Connectors

- Routing constraints don't allow to avoid mixing of connector order.
- p- and n-side connectors have same pin assignment for power and HV.
- Wrongly attached connectors causes forward biasing of DSSD → dangerous.

- Failsafe pin assignment required!

Connector Pin Assignment

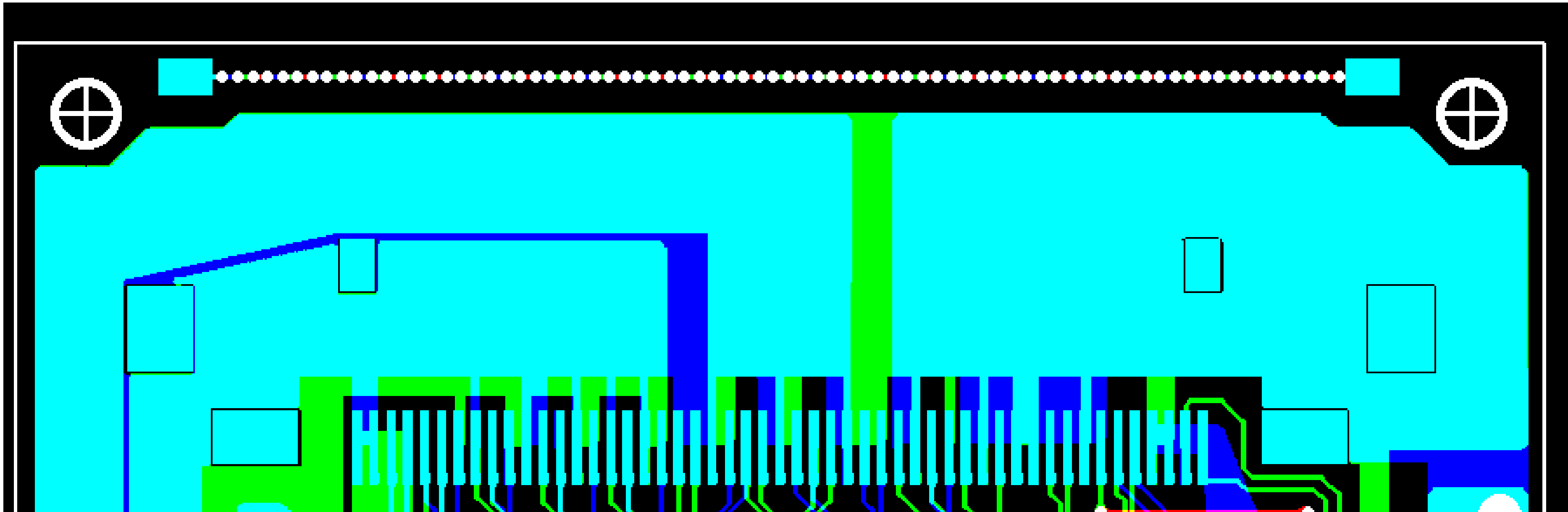


- Different pin assignment for HV on n- and p-side
- Wrong connector causes HV shortcut
- Easy to detect
- Harmless for Sensor
- Drawback: 2 types of cables or different pin out on junction box needed

Origami Flex Quality Assurance

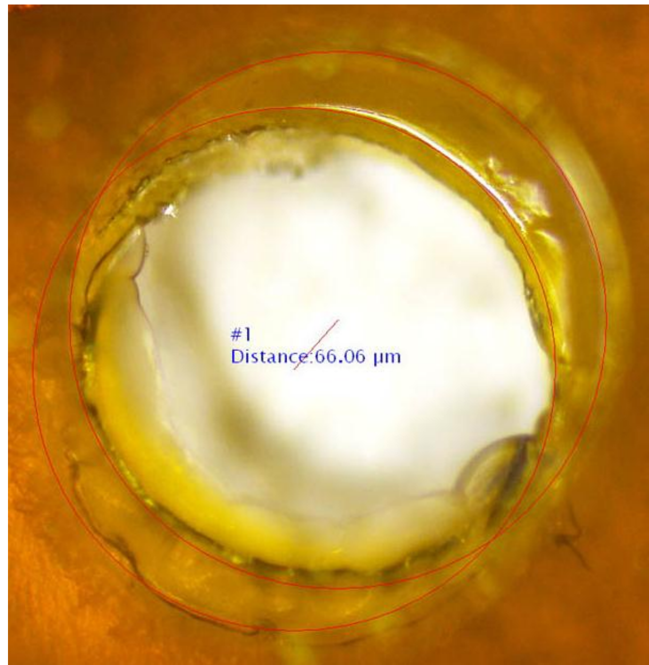
- Presentation by ***Rui de Oliveira*** from CERN at the CERN QA workshop in Nov. 2011.
- Bad plated through holes (Vias) are often source of PCB failures.
  - Hard to find
  - Usually not repairable
  - Can occur delayed
  - Sometimes caused by thermal stress
- Via chain for quality testing

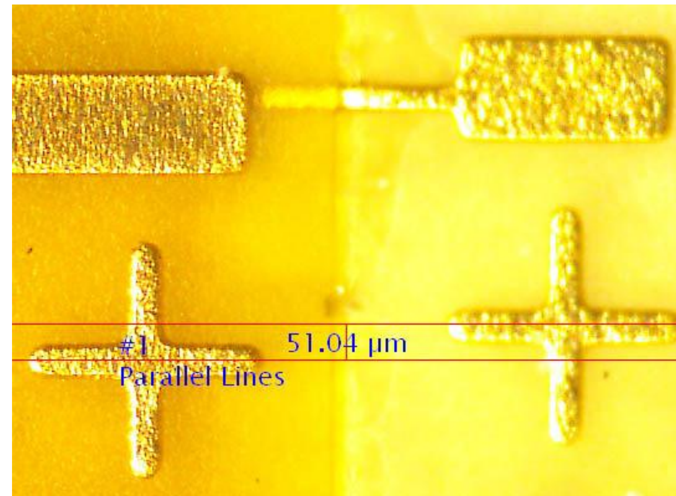
Via Chain

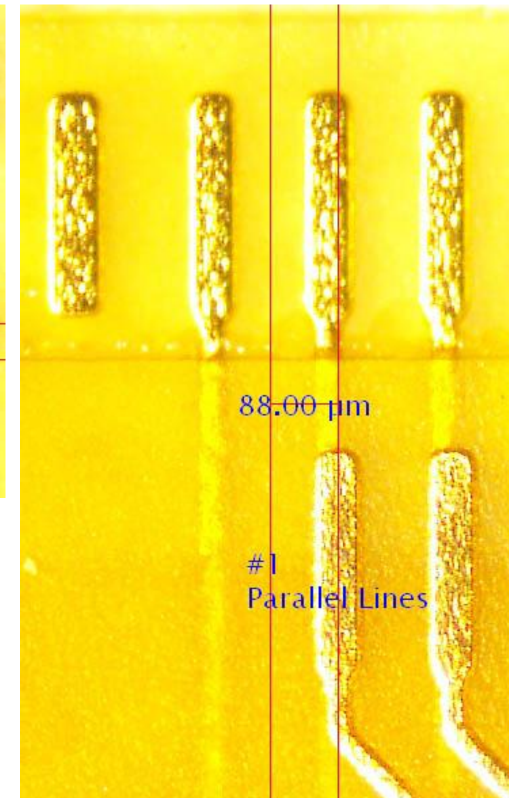


- Via chain with 76 vias
- Each connects two out of the 3 layers
- Will be used for tests, e.g. thermal cycling

Precision of Pitch Adapters

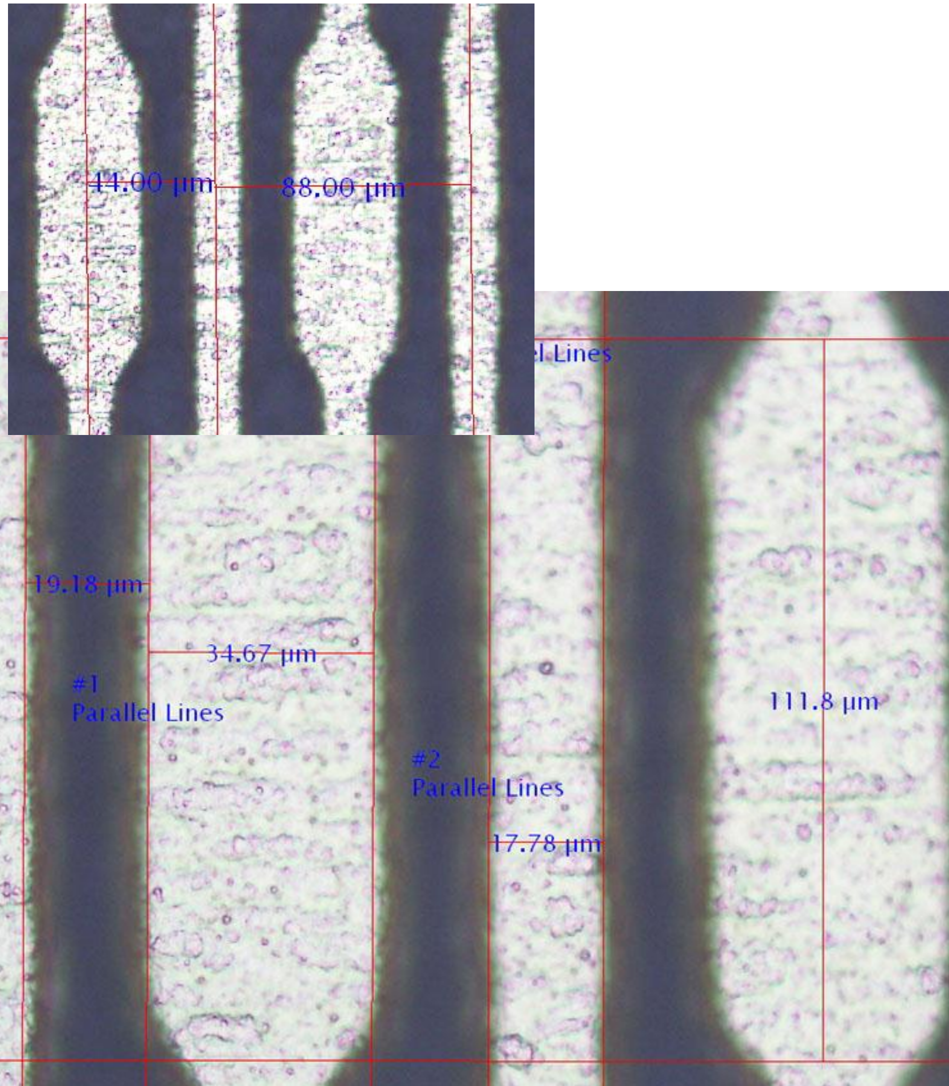






- Prototypes made by Taiyo
  - 2 layer design → glued together
  - Alignment between the two layers is poor
  - **20 to 90µm offset →** pitch is 44µm, staggered!
- **Other vendor: Azuma → can produce single layer PA**

Test PA made by Azuma



Pitch adapter APV side

- Pad size: 35µm x 112 µm
- Line width: 18µm
- Spacing: 19µm
- Pitch
  - pad to pad: 44µm
  - line to line: 88µm

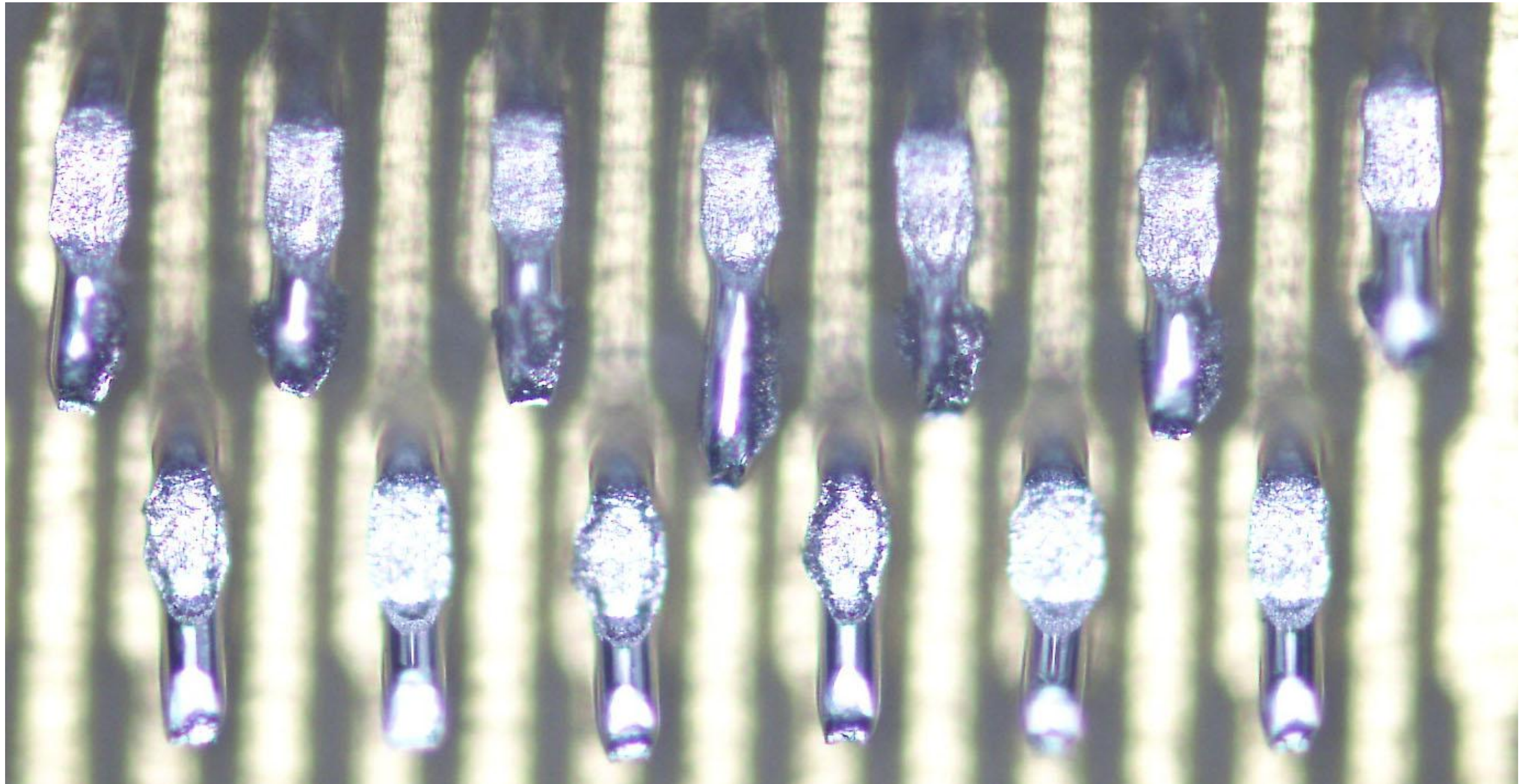
APV25

- Pad size: 58µm x 136µm

Bond pads are smaller than that of the APV chip!

Bond Test

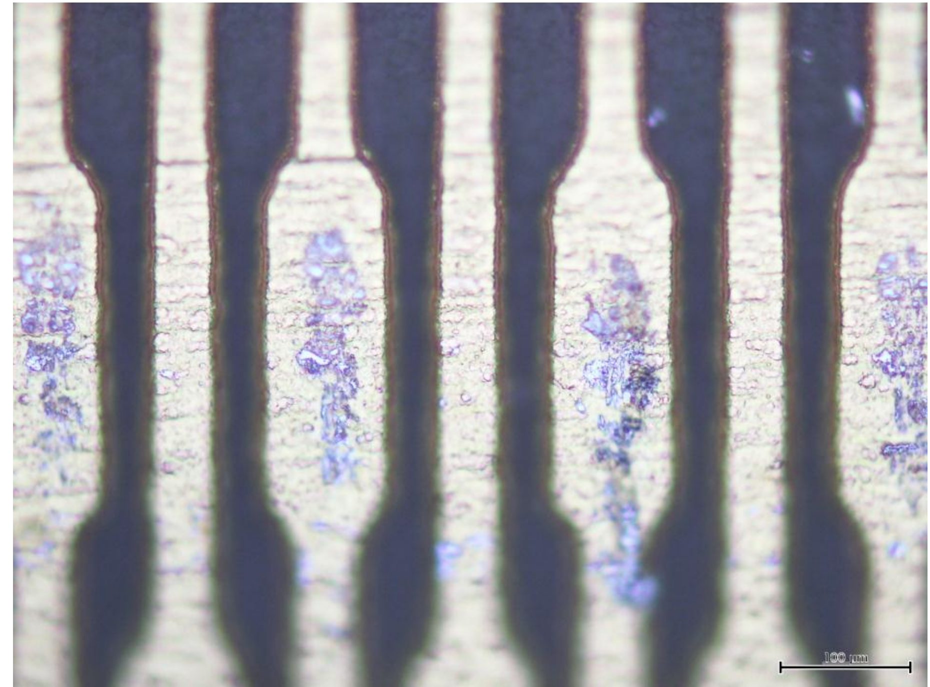
- Bonder: Delvotec 6400
- Wire: ∅ 25μm (our standard)
- Wedge: Gaiser 2145-**1520**-1.0
  - small wedge
  - intended for 17μm wire
  - but can be used for 25μm wire, too → smaller bond feet
- Made around 20 bonds with different bonding parameters (US power, bond force)



- Bond pads are small, but wire bonding is possible without shorts
- Single bond per pad → no second attempt
- Can we make 2 pads per connection? → Enough Space?

Pull Test

- Good results, independently from used parameters
- Result: 7 to 11.5g
- Avg: ~10g

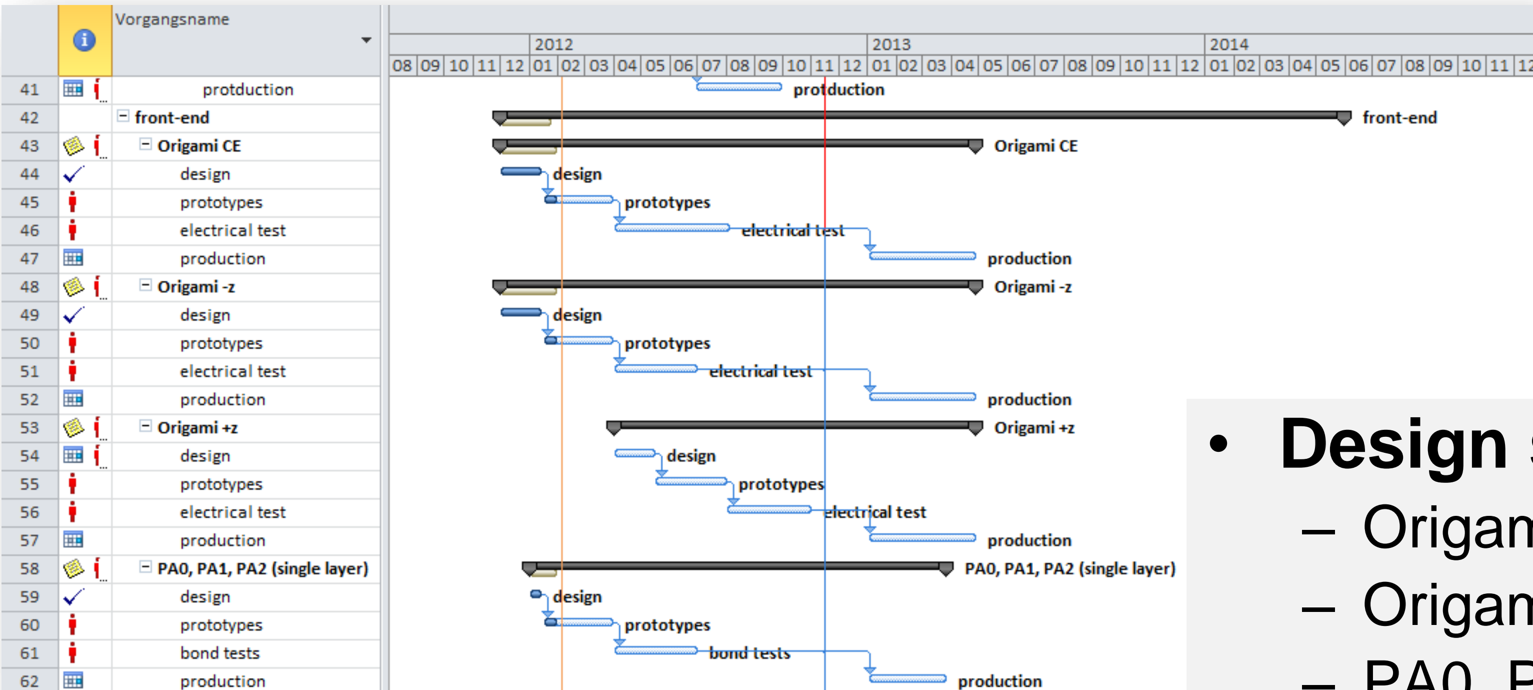


→ **very good bondability**

Pro and Contra of Single Layer PA

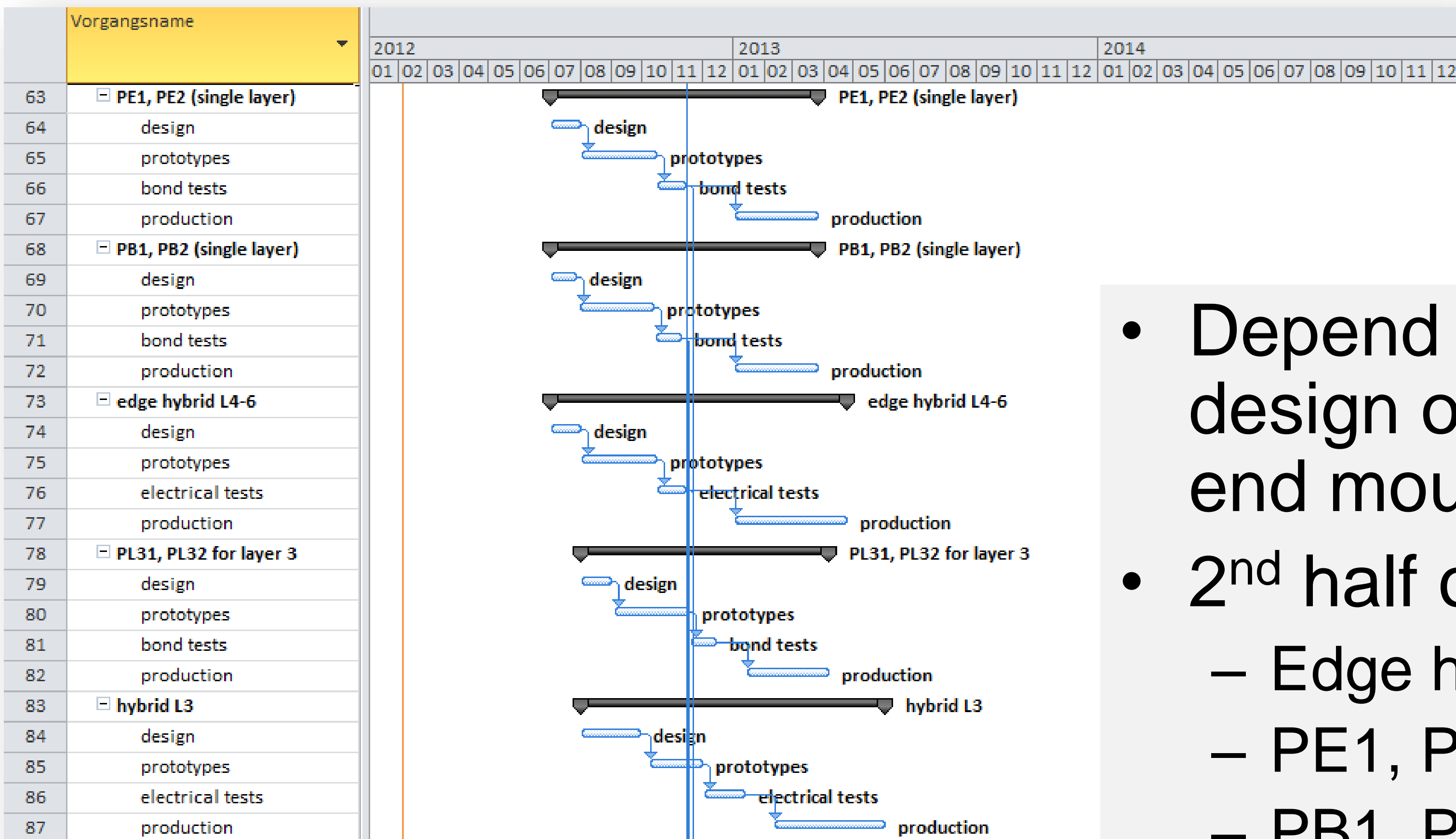
- Thinner structure
  - ~90µm compared to ~145µm
  - **easier to bend**
  - thinner copper layer (3µm, asked for 5µm)
- Smaller bond pads → but bondable
- Thinner lines (~20µm)
- No offset possible
- Single layer PAs are cheaper
- **Will make single layer PA0, PA1 and PA2**

Schedule Origami



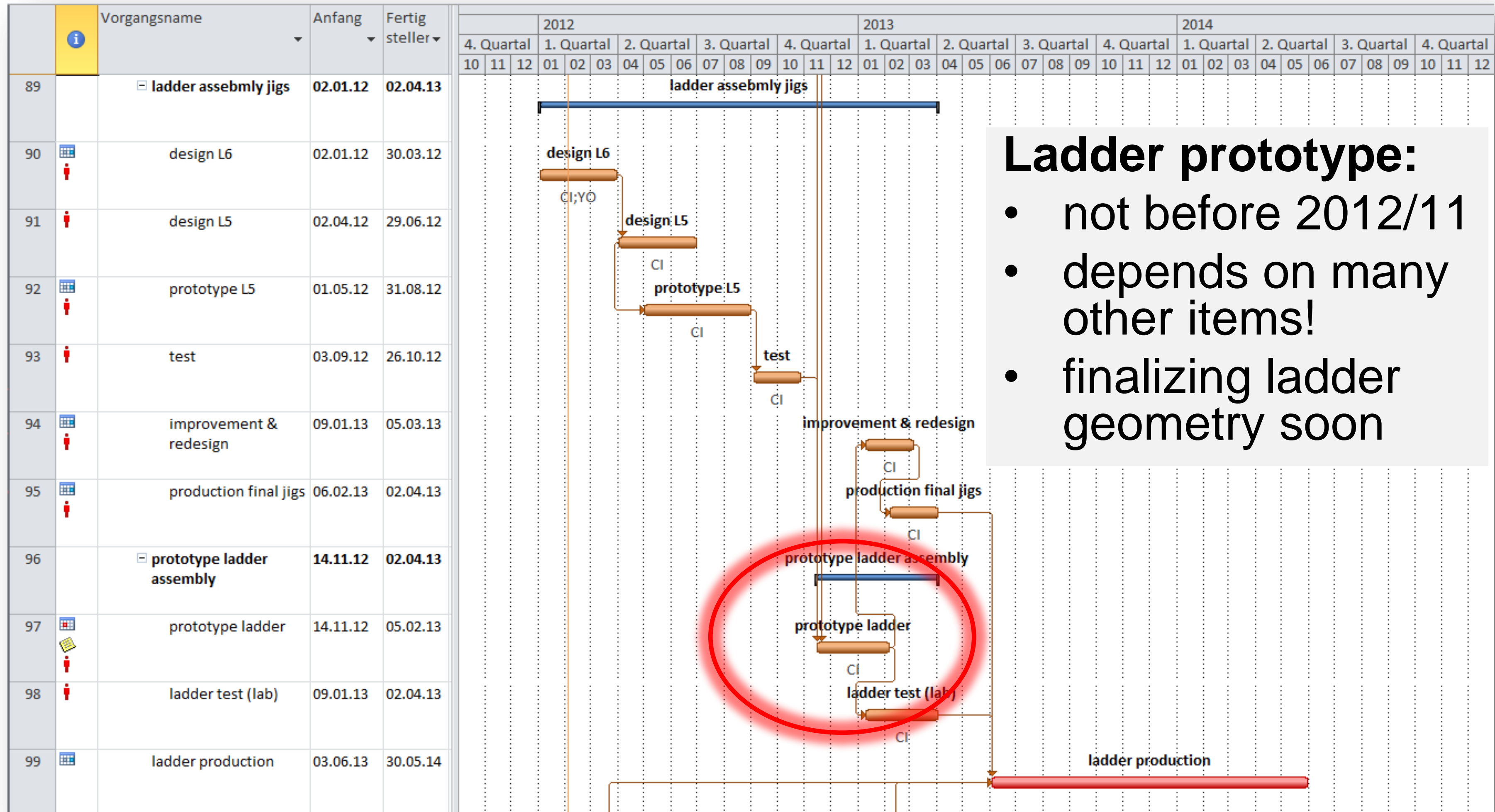
- **Design submitted**
  - Origami CE
  - Origami –z
  - PA0, PA1, PA2
- Prototypes soon available (B2GM?)

Schedule Edge Hybrids



- Depend on design of ladder end mounts
- 2nd half of 2012
  - Edge hybrid L4-6
  - PE1, PE2
  - PB1, PB2
  - Edge hybrid and PA for L3

Schedule Ladder Assembly



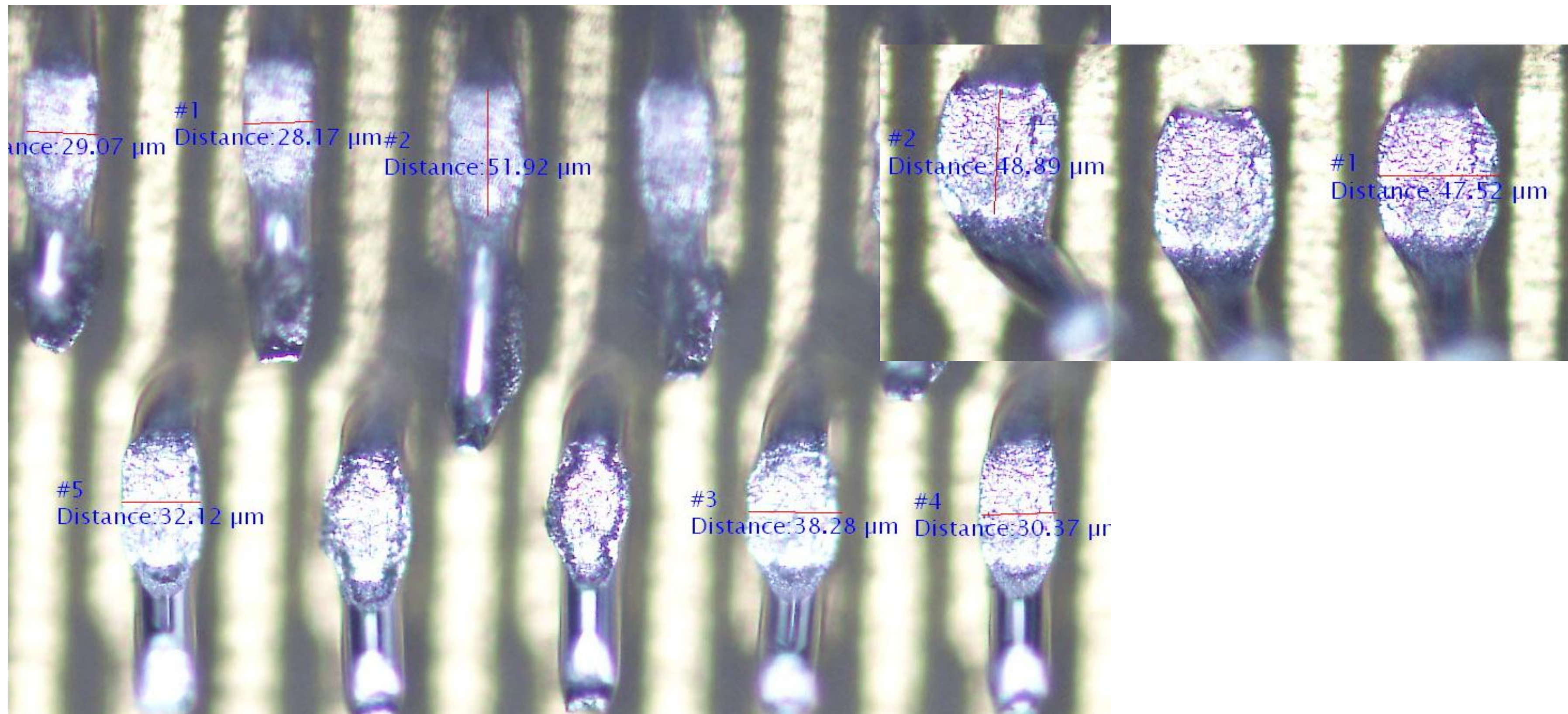
	Vorgangsname	Anfang	Fertigsteller
89	**ladder assebmly jigs**	**02.01.12**	**02.04.13**
90	design L6	02.01.12	30.03.12
91	design L5	02.04.12	29.06.12
92	prototype L5	01.05.12	31.08.12
93	test	03.09.12	26.10.12
94	improvement & redesign	09.01.13	05.03.13
95	production final jigs	06.02.13	02.04.13
96	**prototype ladder assembly**	**14.11.12**	**02.04.13**
97	prototype ladder	14.11.12	05.02.13
98	ladder test (lab)	09.01.13	02.04.13
99	ladder production	03.06.13	30.05.14

Summary

- New mirrored Origami design
- New failsafe connector pin out
- Single layer pitch adapters
- Design submitted → awaiting prototypes soon
- Tight schedule
  - many items depend on mechanics design!
- Prototype ladder not before end of this year

THANK YOU

Bond foot dimensions



Bond foot length: **~52 µm**

Bond foot width: **28 µm to 50 µm depending on bond force**

Gluing masks

- **Idea:**
  - Self-adhesive plastic film (~60µm thick)
  - Openings at gluing locations only
  - Glue the mask onto the device
  - Dispense a ropes of glue at that locations.
  - Smooth rope with scraper
  - Remove mask
- **Result:**
  - Areas with uniformly dispensed glue
  - Same thickness as film
  - Works excellent
  - Easy and cheap method