

ITS3 WP4 R&D

Thinning, Bending, Interconnections

Status Report

G. Contin (Universita' and INFN Trieste)
on behalf of the ITS3 WP4

ITS3 WP4 Organization and Progress

Several groups showed strong interest and started their activities

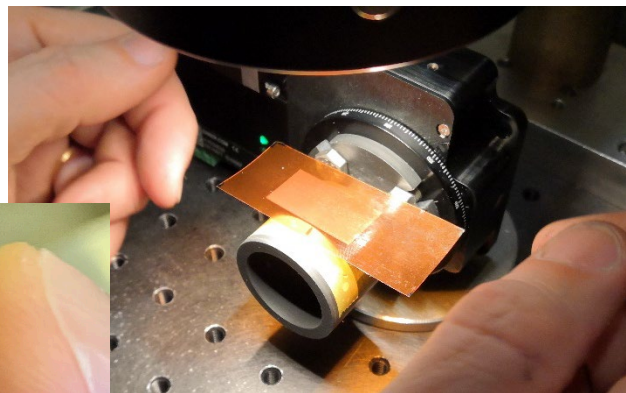
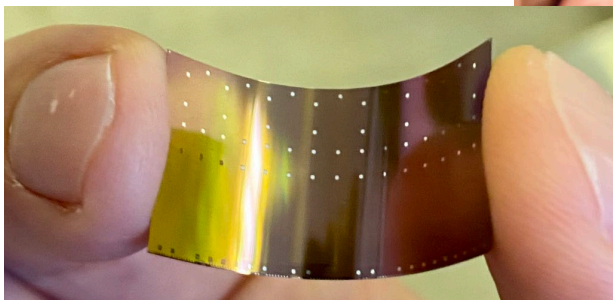
- Regular biweekly meetings until early April:
 - <https://indico.cern.ch/category/11900/>
- Activities slowed down due the COVID19 emergency
 - Hardware development/testing progressed where possible
 - Information exchange continued via email/calls

In this presentation, a progress report on:

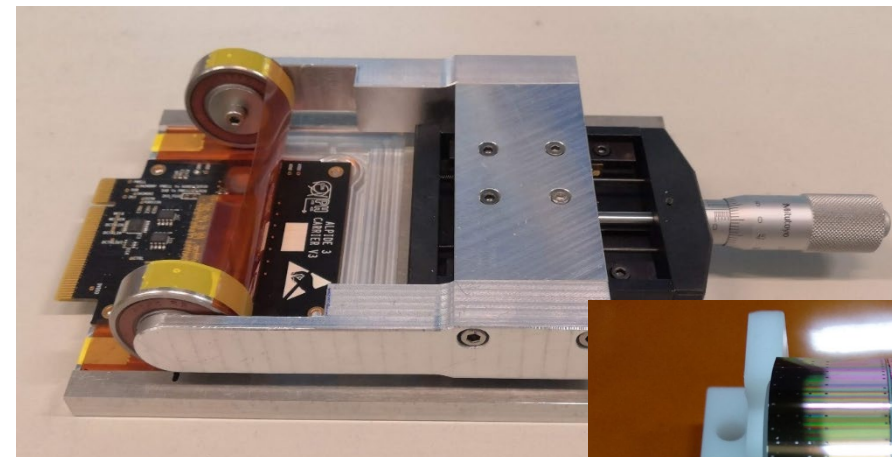
- Tooling development
- Bent chip tests
- Preparation for testbeam

Tooling/procedures development

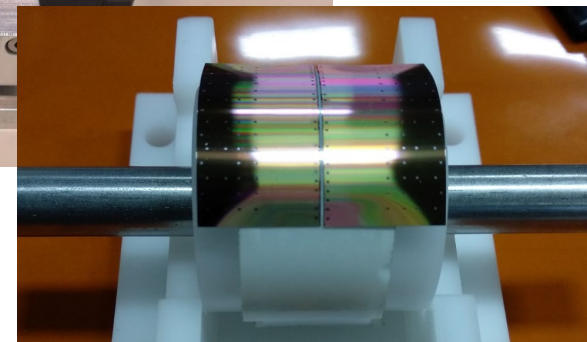
- Bending



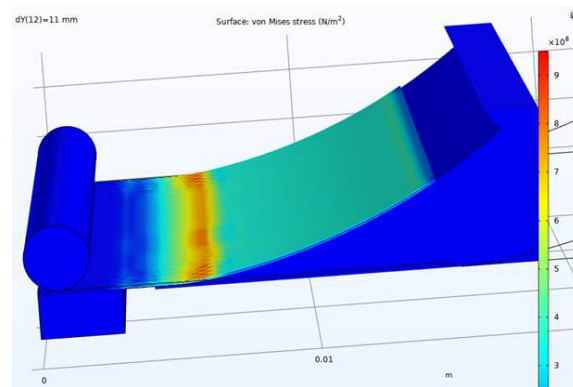
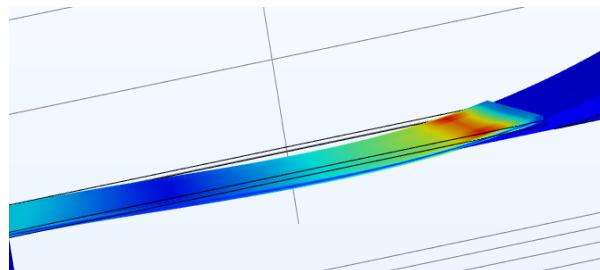
Manual bending



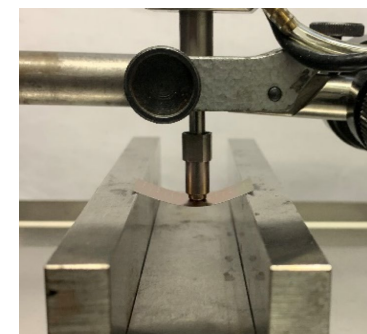
Controlled bending



Strain simulations



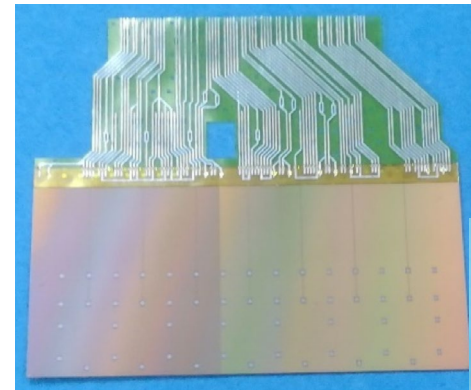
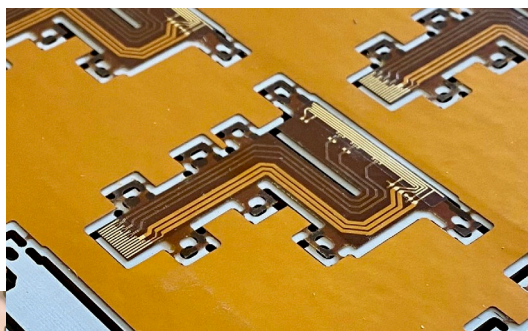
Bending tests



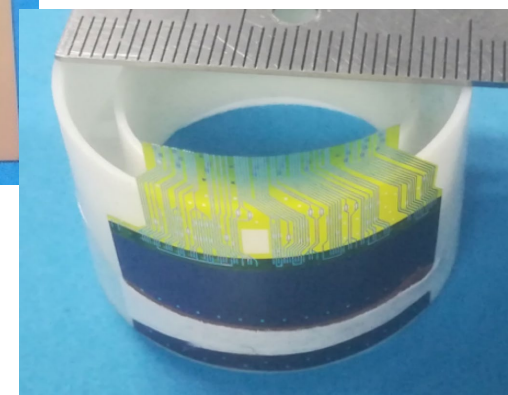
Tooling/procedures development

- Interconnections

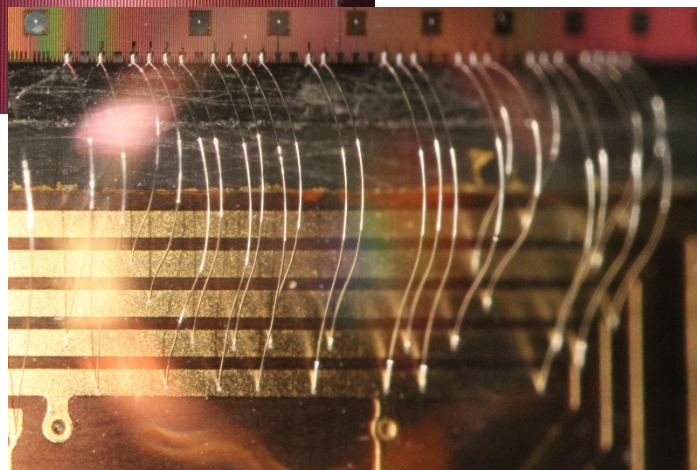
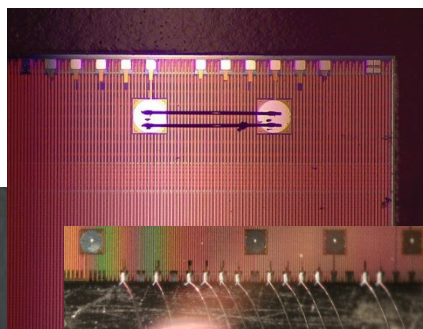
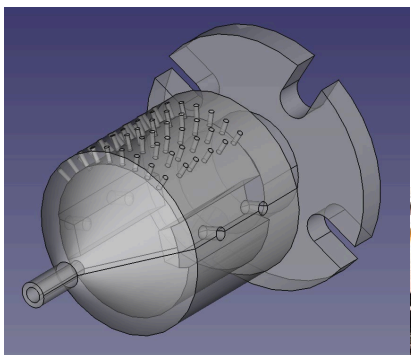
Bendable FPC



SpTAB bonding
Bending after bonding



Cylindrical bonding tool

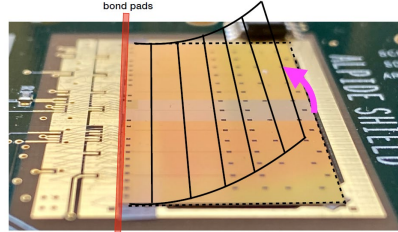


Wire bonding on curved surface
Bonding after bending

Bending and testing 50 μ m ALPIDE (@Trieste)

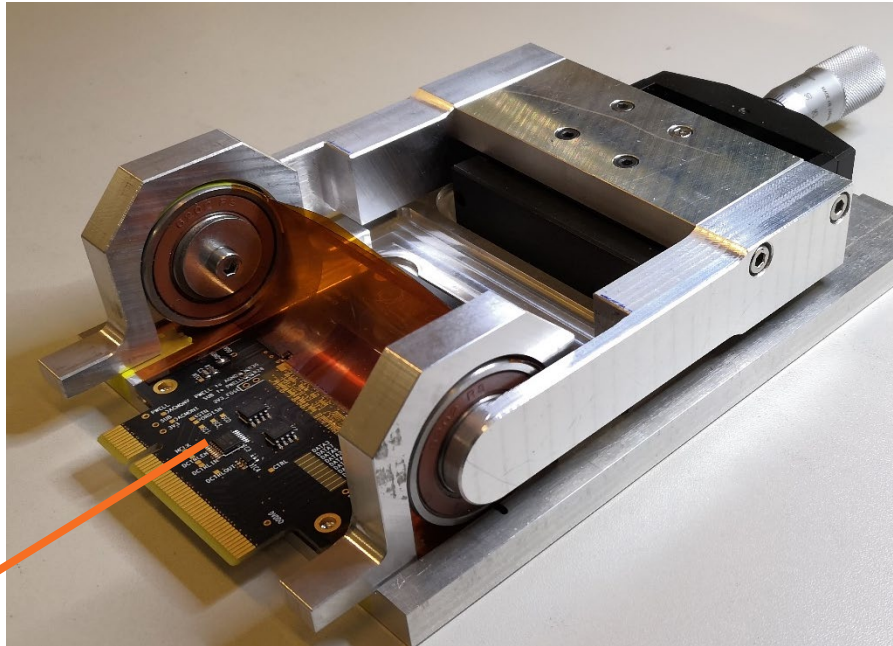
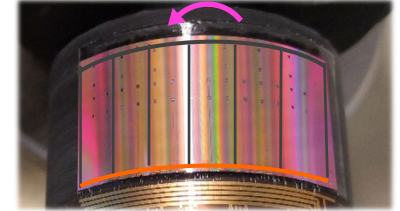
- **On carrier board**

- Bend along shorter side
- Mostly affecting matrix
- Only the bonding area is glued
- Variable curvature (down to 1 cm radius)



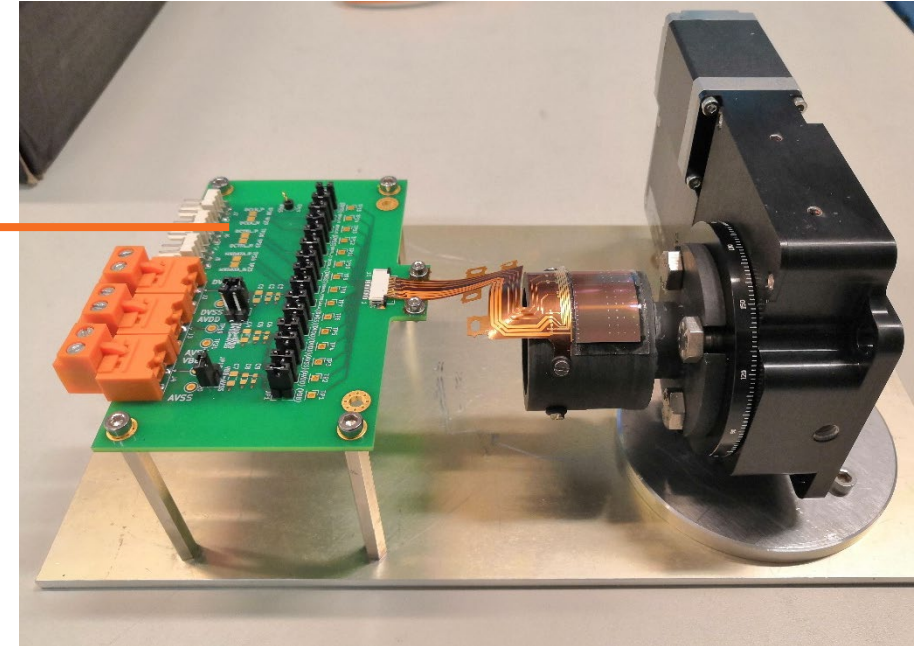
- **On cylindrical tool**

- Bend along longer dimension
- Affecting matrix and periphery
- Completely glued onto support
- Fixed curvature (1.8 cm radius)

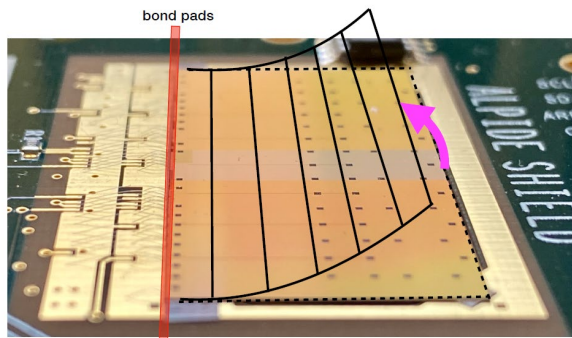


DAQ board

DAQ board /
Power Supply

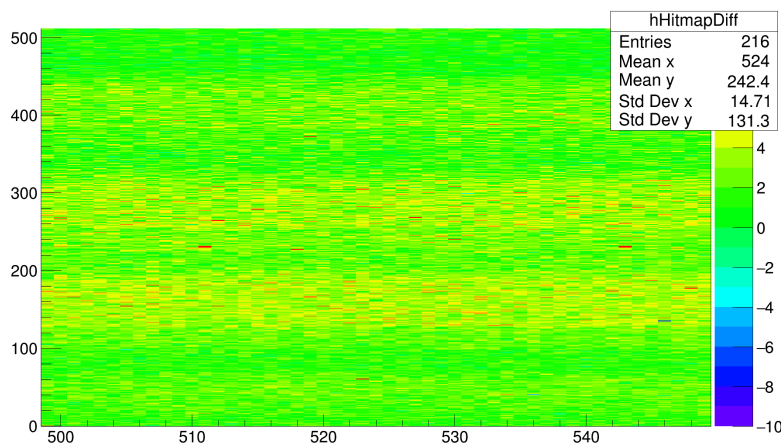


Tests results on carrier board

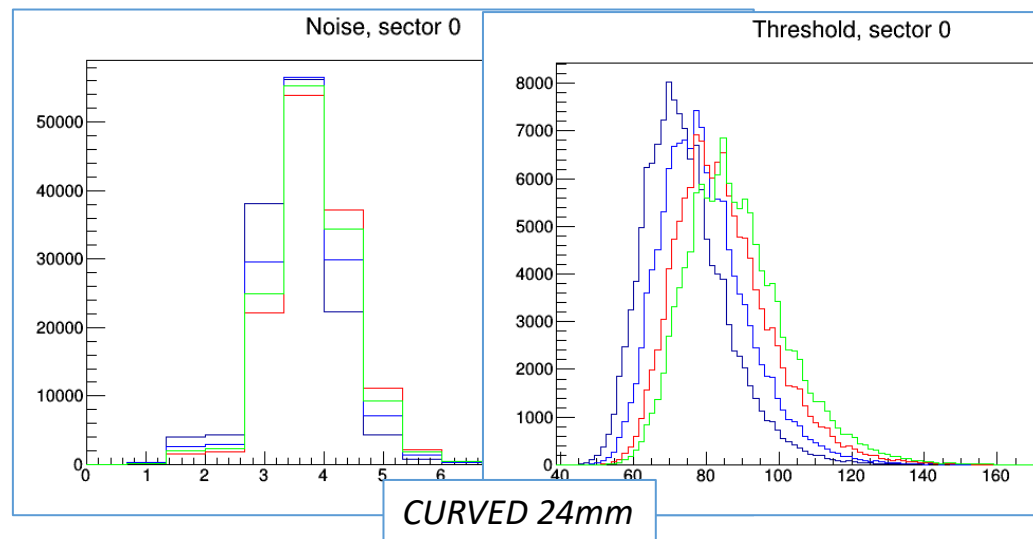


- The chips maintained their functionalities at 1.8 cm radius
 - Thresholds seem to be unaffected by curvature
 - Temperature gradient effects studied and understood
 - No appearance of new malfunctioning pixels
 - Digital-only chip curved to 1 cm radius → digital scan unchanged

Threshold variation: CURVED - FLAT

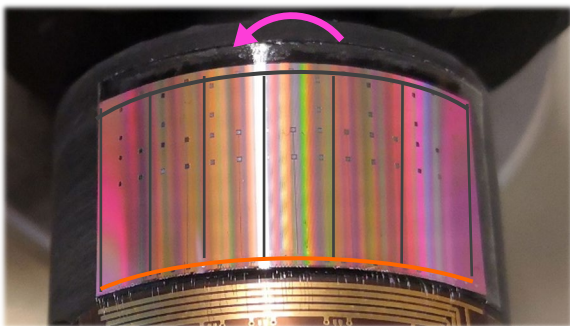


Only temperature gradient effect ($< 5 e^-$)

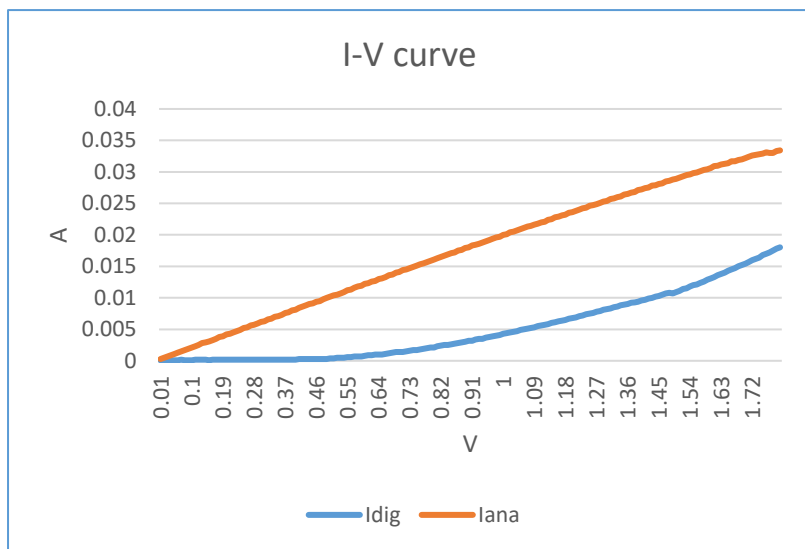


units: e^-

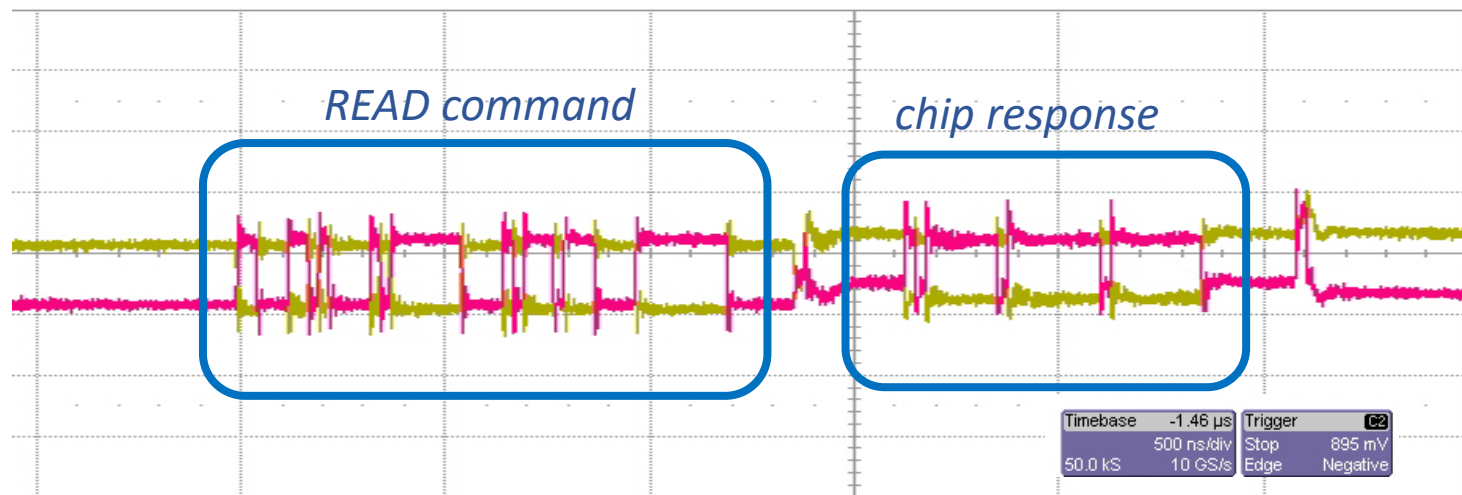
Tests results on cylindrical tool – new!



I-V characterization

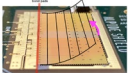
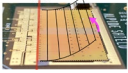
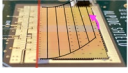
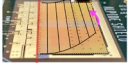
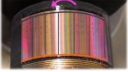
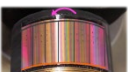


Full READ transaction observed

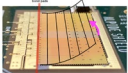
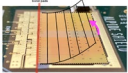
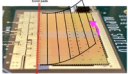
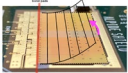
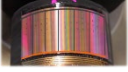
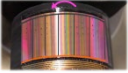


- Basic response seems ok
 - I-V behavior same as before bending
 - Chip response visible on DCTRL line
 - Now completing the setup for full functionality characterization

Bent chip tests - summary table

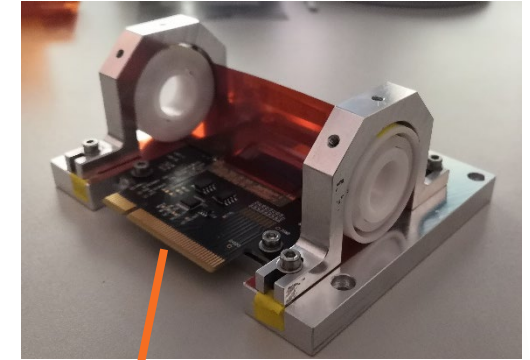
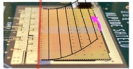
CHIP Nickname	CHIP ID	Classification – quality	Support	Max curvature radius reached	Compare performance before/after bending
 digital-only	T854193W09R23	NOK – digital only	Carrier board	~10 mm	Same
 NOK/ manydeadpixels	T854193W09R26	NOK – >4000 bad pixels	Carrier board	24 mm	Same <i>4255 – 4309 Bad pixels</i>
 BRONZE1	T854193W09R42	BRONZE	Carrier board	~ 24 mm	Same
 BRONZE2	T854193W09R04	BRONZE – 1 column dead	Carrier board	16 mm	Same
 Cylinder1	T854193W09R39	NOK – Digital only	Cylindrical bonding tool	18 mm	Same I-V characteristics Response untested
 Cylinder2	T854193W09R34	NOK – Digital only	Cylindrical bonding tool	18 mm	Same I-V characteristics Response seen

Bent chip tests - summary table

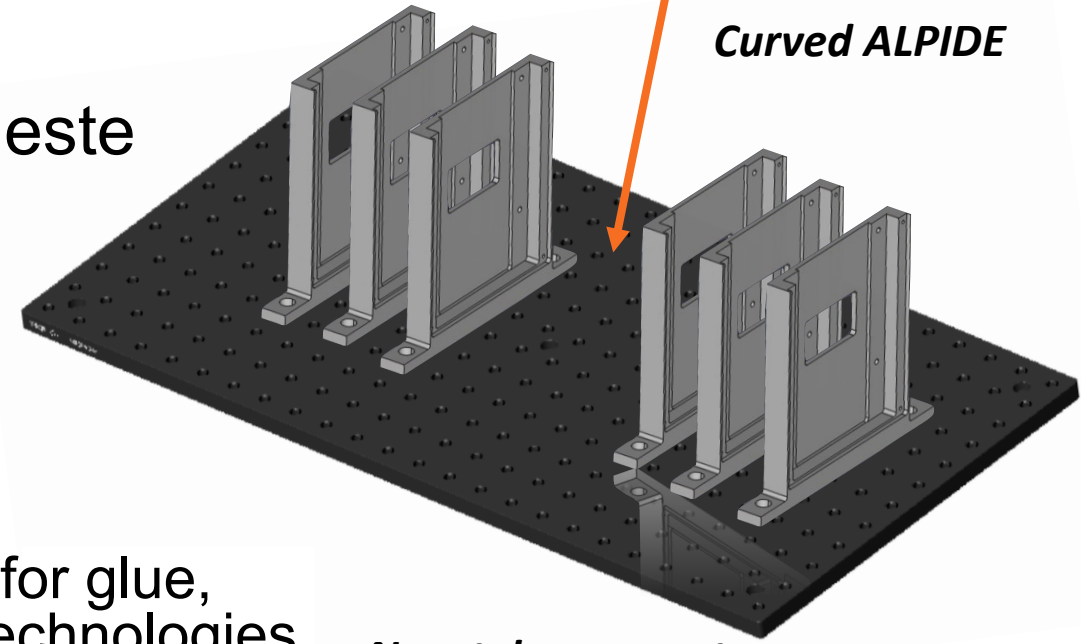
CHIP Nickname	CHIP ID	Classification – quality	Support	Max curvature radius reached	Compare performance before/after bending
 digital-only	T854193W09R23	NOK – digital only	Carrier board	~10 mm Can't break it!	Same
 NOK/ manydeadpixels	T854193W09R26	NOK – >4000 bad pixels	Carrier board	24 mm	Same <i>4255 – 4309 Bad pixels</i>
 BRONZE1	T854193W09R42	BRONZE	Carrier board	~ 24 mm	Same
 BRONZE2	T854193W09R04	BRONZE – 1 column dead	Carrier board	16 mm	Same Prepare for testbeam!
 Cylinder1	T854193W09R39	NOK – Digital only	Cylindrical bonding tool	18 mm	Same I-V characteristics Response untested
 Cylinder2	T854193W09R34	NOK – Digital only	Cylindrical bonding tool	18 mm	Same I-V characteristics Response seen

Summary and Plans

- Testbeam preparation for bent chip on carrier
 - Investigating early-June time slot @DESY
 - Shipping one BRONZE chip bent to $\sim 16\text{mm}$ radius and locked in position from Trieste to CERN this week
 - Setup being prepared and tested at CERN
- Functional tests of chips on cylinder @Trieste
 - Complete setup and study response
 - Try on fully functional ALPIDE
- All groups involved
 - Resume suspended activities if possible
 - Complete and compare catalogue of options for glue, bending and bonding tools, interconnection technologies



Curved ALPIDE



New telescope setup