



中国科学院高能物理研究所

Institute of High Energy Physics Chinese Academy of Sciences

IHEP activity in module assembly

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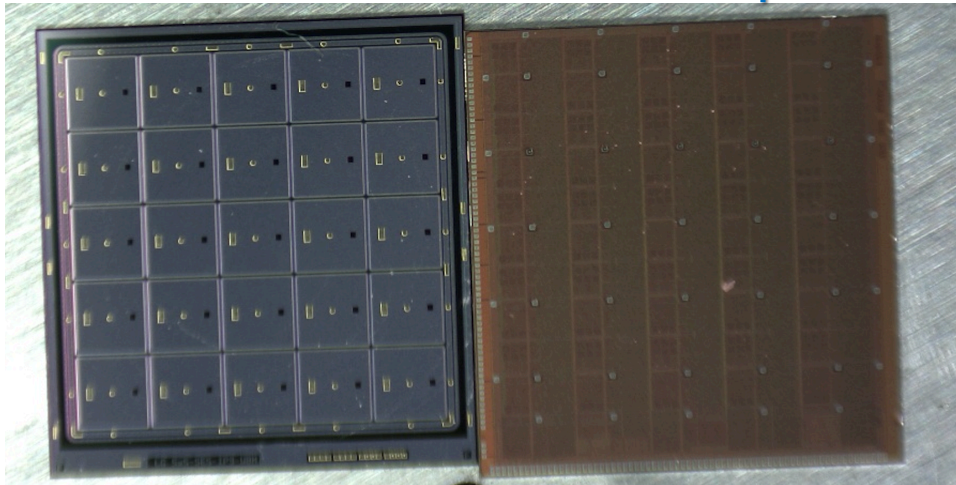
Outline

- Bump bonding study
- Flex cable update

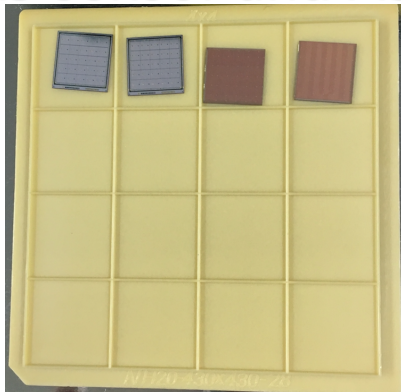
Bump bonding study

- Identify company identified (both are top 10 packaging company)
 - The National Center for Advanced Packaging (NCAP , 华进)
 - <http://www.ncap-cn.com/en/index.aspx>

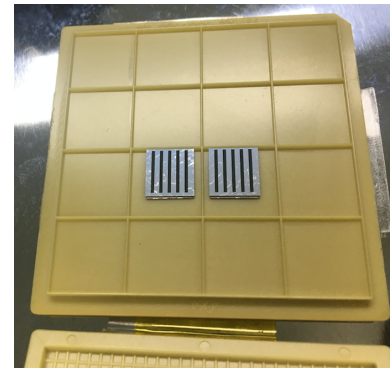
HPK 5x5 Sensors and Altirco1 chip in IHEP



5x5 sensor and ASIC

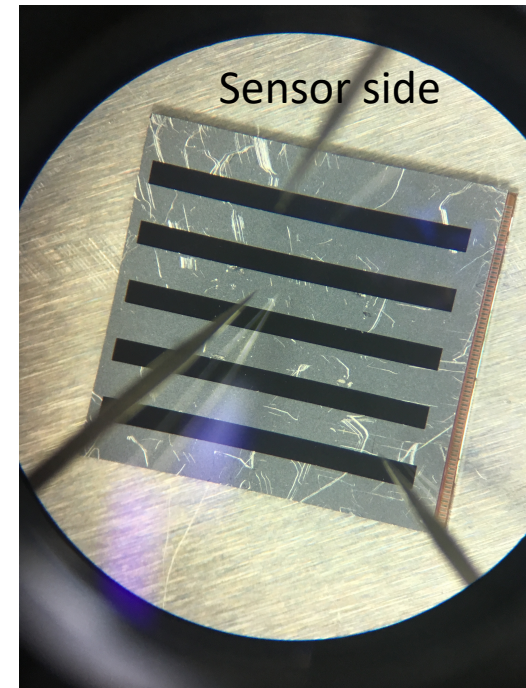
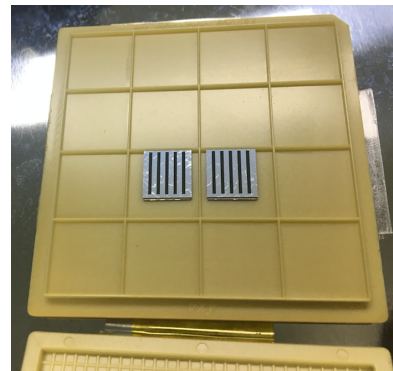
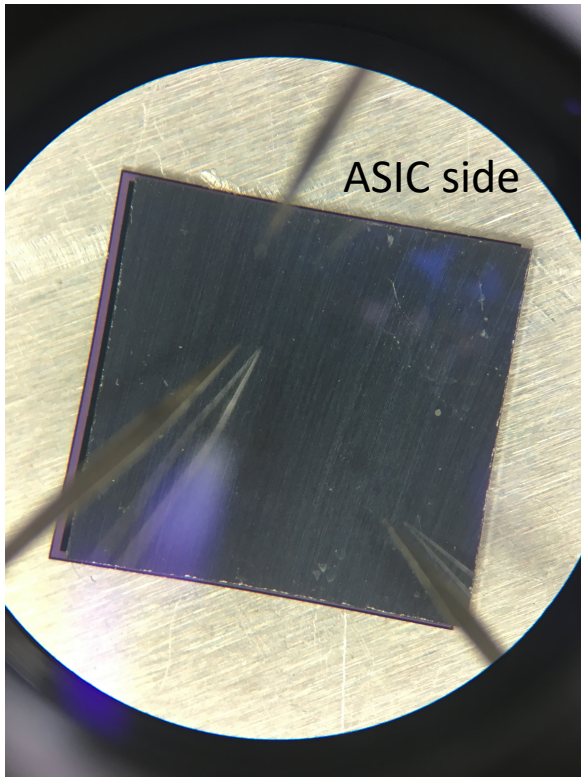


Bare module



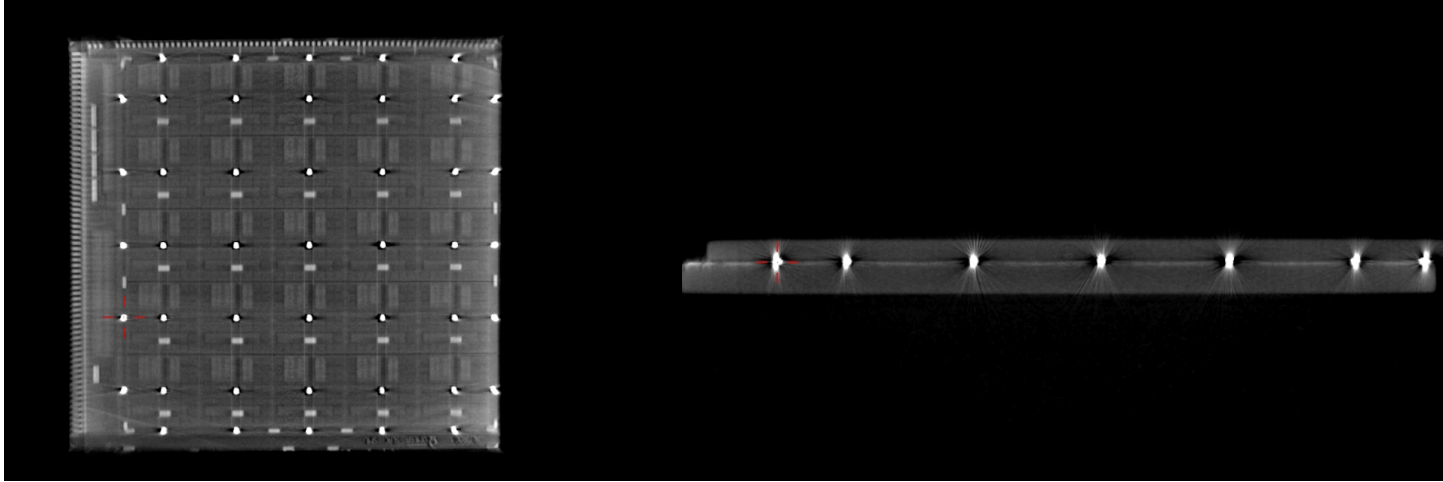
Bump bonding for 5x5 bare module

- Two ASIC and two HPK 5x5 sensors (with UBM) sent to NCAP
 - Bump bonded in next day. (photo below)
- ASIC chip is without UBM.
 - It is not easy to implement UBM in chip level (usually in wafer level)
 - They implant gold ball in ASIC for this bare module bonding.
 - suggest to use copper pillar instead of SnAg Solder bump for production
 - Will use ultrasonic imaging to evaluate the bonding quality (to be done)

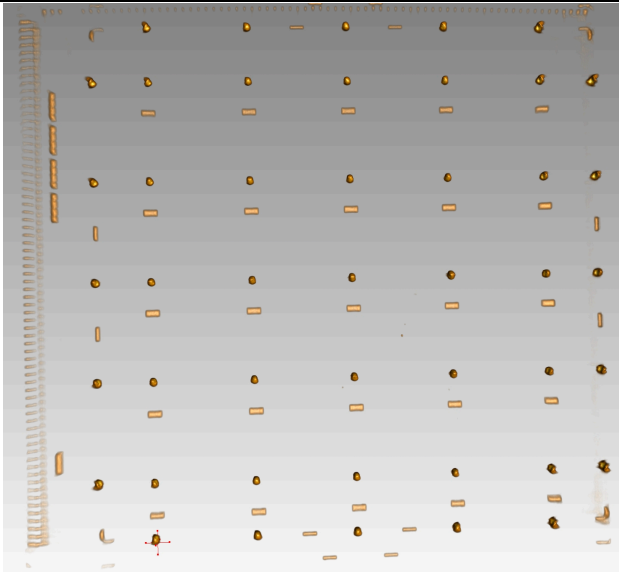


Bump bonding study (3)

- Bump bonding quality is good according to 3D X ray imaging.
 - One hour per module using 3D X ray imaging



3D profile
X ray photo



3D X ray photo

Shear testing – bond quality check

- Shear and pull tester in IHEP
 - One old Dage tester is under repairment
 - purchase a new Dage4000 for ATLAS upgrade (Share with ITK)
 - Machine training in August
- Shear testing service in NCAP
 - MFM2000 shear and pull tester (half an hour per module)

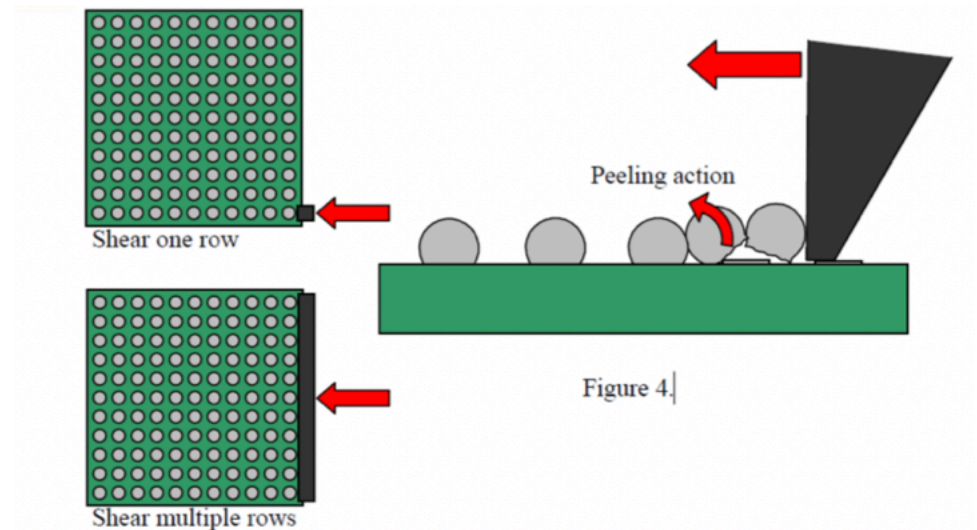
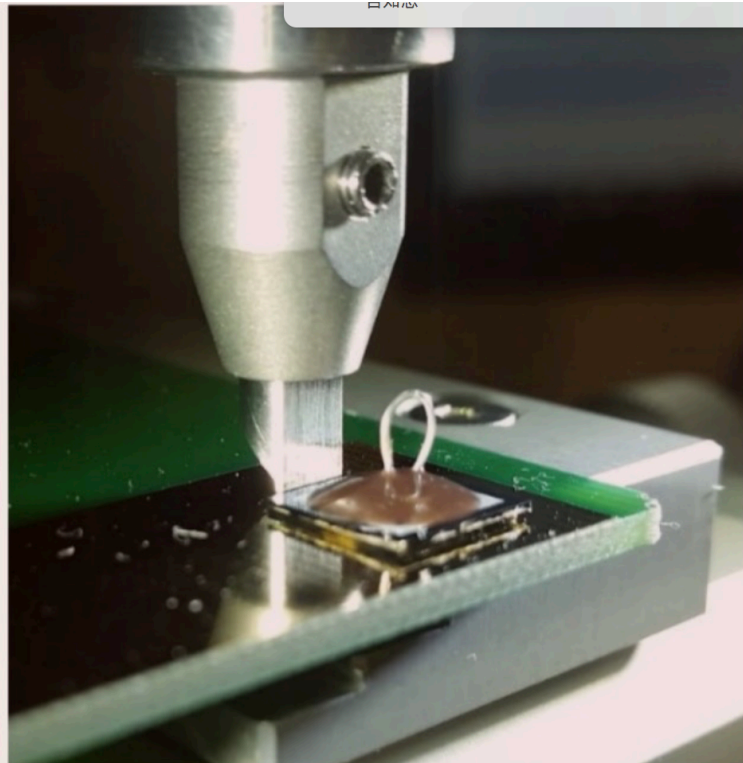
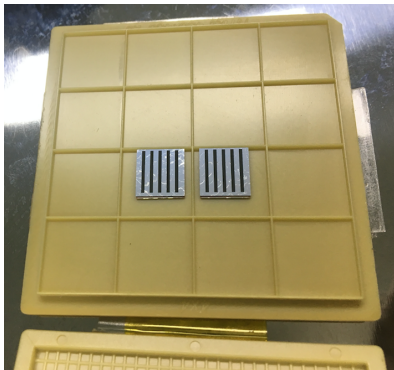


Figure 4

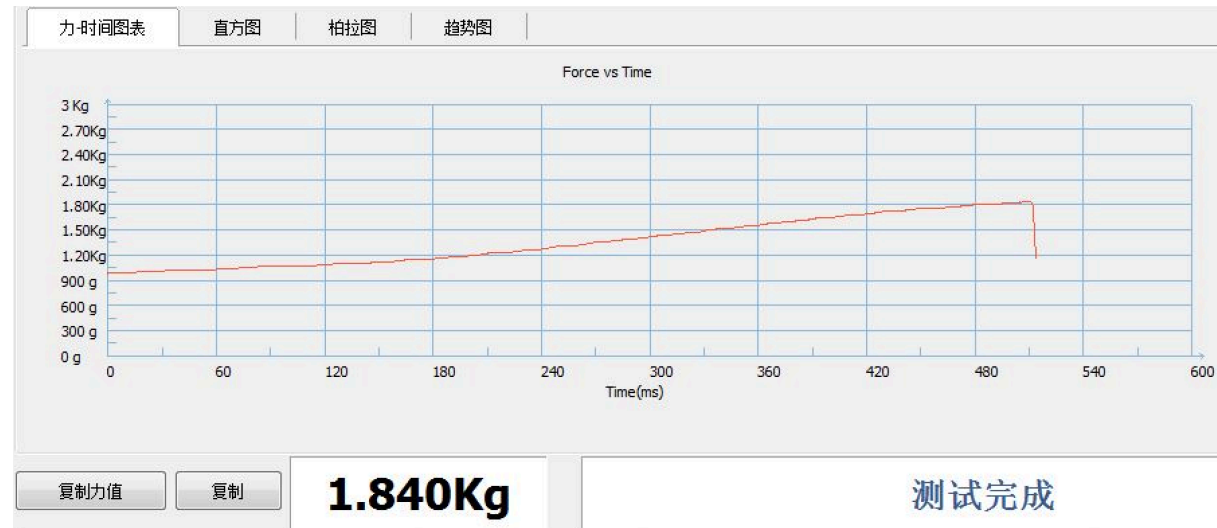
Shear test for bond quality

- Shear test result

- Module 1: 1.694Kg
- Module 2: 1.840Kg
- Both >1Kg
- Meet TDR requirement



编号	力值	类型	分级	描述
1	1.694Kg	合格	0: ungraded	



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2	1.840Kg	合格	0: ungraded	

Plan for next step

- Plan to bump bonding for Altroc1v2 (July)
 - Bump bond 20 bare modules for August DESY test beam
 - Expect to take less than one week once received 5x5 sensors and Altroc1v2
- Plan to bump bonded ~100 modules using Altroc2
 - Test final step with full size wafer, certify this NCAP for production
 - Need two wafer of ASIC and 100 sensors (5x5)
 - NCAP prefer to have full ASIC wafer without thinning (700um).
 - Shear and pull tests (10 modules)
 - In R & D phase, they offer 76400 RMB (~11kCHF) for bump bonding two wafer of ASIC and making 100 bare modules.

Quotation for bump bonding

- NCAP offer 3345k RMB(~475k CHF) for producing 10k bare modules.
 - UBM for sensors included
 - First complete quotation and cost estimate from NCAP

#	Items	Spec	Unit	Qty	Unit price(RMB)	Amount(RMB)
1	NRE	Process setup, tooling etc	set	1	50000	50000
		ASIC wafer Bumping Mask	pcs	1	15000	15000
2	Bumping	8" ASIC Wafer Bumping	pcs	500	2000	1000000
3	NiAu Process	6" Sensor Wafer NiAu Process	pcs	1100	800	880000
4	Assembly	Chip to Chip Bonding	ea	10000	140	1400000
	Total					3345000

Flex cable update

- Received Flex cable design from Mainz group (Thanks !)
- Search for company for Flex cable production in China.

From Mingyi

Flex cable number	Cost per Flex	Total
10,000	140 RMB (~20CHF)	1.4M RMB (~200k CHF)
5000	160 RMB (~22.7CHF)	0.8M RMB (~113k CHF)

The flex cable produced by this company
BESIII pixel prototype R &D project



Plan

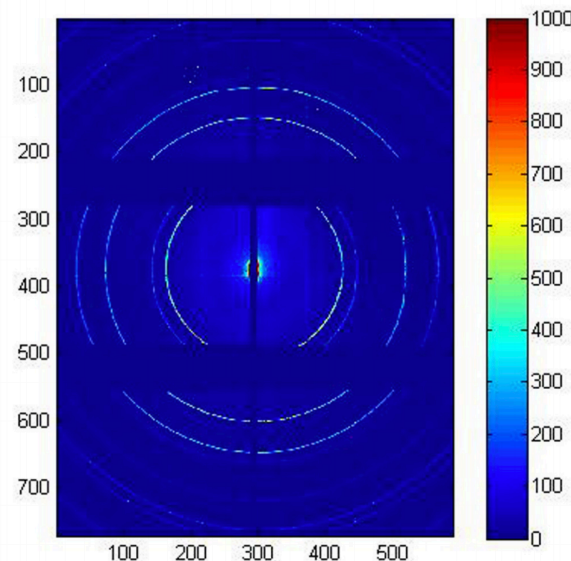
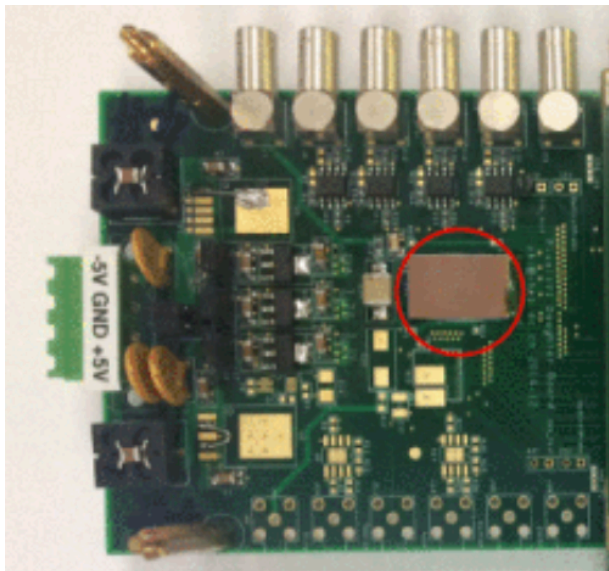
- Receive 6 ALTIROC1v2 ASIC from CERN
- Make 4~5 bare modules in one week
 - Mainly focus on HPK type 3.2 5x5 sensors
 - Make sure 2 modules working for August 19th test beam
 - Lower priority for type 3.1 and type 1.2 sensors
 - Reserve 2 ASIC for our own sensors

Summary

- Identified one company (NCAP) for bump bonding production
 - Two bare module bump bonded
 - X ray imaging and Shear test showed the bond quality is good
 - Plan to contribute to bump bonding of Altroc1v2 for August beam test
- Identified one soft PCB company for Flex cable production

Bump bonding foundry in China

- Two company identified (both are top 10 packaging company)
 - Tianshui Huatian Technology Co., LTD (TSHT, China)
 - <http://en.tshtkj.com/index.html>
 - The National Center for Advanced Packaging (NCAP China)
 - <http://www.ncap-cn.com/en/index.aspx>
- IHEP has tested bump bonding by NCAP before on pixel detector project for light source (HEPS-BPIX)



HEPS-BPIX, a hybrid pixel detector system for the High Energy Photon Source in China, Journal of Instrumentation, 12(01):C01041

Shear testing

- Proper tools needed
 - DIE SHEAR
 - FLIP CHIP PULL
- Operator

