



## DHI Prototype Test Results and Cluster Format Data Size

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- 12 new (v3.1) DOCKBOXes are in TUM
- C150 is shorten
- R22 is detached
- After changes all links are stable (GCK 76 MHz)
- All DOCXBOXes are tested
- Last step: attach transmitters to DOCKBOXes (TBD)



# DHI prototype



- DHI prototype:
  - Galvanic isolation
  - GCK and TRG amplification
- Final variant of DHI purpose:
  - ASICs control
  - Simultaneous operation of 5 modules
  - Link: https://confluence.desy.de/pages/ viewpage.action?pageId=43903275



## TUM setup



#### TUM setup



DHI prototype



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## **Clustering algorithm**

- Remapping
- Apply algorithm to the whole DEPFET matrix (768x250)
- If there are hits on the matrix DHE sends 4 frames per each event:
  - DHE start of event (16 Bytes)
  - Data frame (Not fixed, minimum 12 Bytes)
  - Common mode frame (200 Bytes)
  - DHE end of event (16 Bytes)
- If there are no hits, DHE sends 3 frames:
  - DHE start of event (16 Bytes)
  - GHOST frame (8 Bytes)
  - DHE end of event (16 Bytes)

# Remapping (Florian Lütticke talk on Seeon 2016)

- Partial mapping of DHP data in DHE/DHC
  - Do a simple "premapping" on the DHE, so that data is mapped but there are still regions with unconnected channels
  - For DHE: First step to cluster format

if dhp%2==0:

c[row, LUP(dhp) + col\_in\_dhp ^
0x3c]=b[row, 64\*dhp + col\_in\_dhp ]
else:

c[row ^ 0x2, LUP(dhp) +
(((col\_in\_dhp ^ 0x3c) + ((row & 2)
>>1 )%64))] = b[row, 64\*dhp +
col\_in\_dhp ]



60

Column on Matrix

80

100

LUP = [0,62, 125, 187]

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20

n

40

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120



## Cluster data format

Ε	0001		n	DHI ID	Reserved	Trigger Nr. 15:0				
0	S	S dE/dX Col[7:6] Row address [9:0]				1	Ι	Column Address	ADC Value	
CRC32										

- 32-bit DHE header
- First hit of a cluster:
  - 16 bit word with 10 bit row address and upper 2 bits of absolute column address
  - Pixel word with absolute column address (lower 6 bits)
- Next hits of the cluster
  - Only pixel word with relative column address [5:0] (SIGNED INTEGER!, {two's complement})
  - If 6-bits for column is not enough: as the first hit with zero StartOfCluster flag
- Alignment 16-bit word if necessary
- 32-bit CRC
- Common mode frame: always 200 bytes.

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- *Pro* clustering format:
  - No DHPT headers
  - Only one data frame instead of four
  - Absolute row address
  - Takes into account real geometry of cluster
- Contra clustering format:
  - Common mode frame
- Take into account that 3% occupancy level corresponds to ~ 10 kB of DHE event size.

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### Beam Test 2017 data



- Run #244:
  - Energy of beam: 4 GeV
  - The beam is perpendicular to plane of sensors
  - Magnetic field: 1.0 T



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## Size difference





- Clustering engine DHE event size is bigger by ~200 bytes in average
- This difference comes from common mode frame



## Conclusion



- DOCKBOX:
  - 12 Dbs are tested in TUM, next step: transmitters attachment
- DHI:
  - 6 DHIs were produced and passed tests
  - DHPT-DHE links are up with 76 MHz GCK
  - 4 DHIs are in KEK, one is in TUM and one took Botho
- Clustering engine format:
  - Data rate is bigger by ~200 bytes per event bigger
  - This could be acceptable in case of 3% occupancy level (event size is ~ 10 kB, 200 B is increase by 2% ,data rate from one module 0.48 Gb/s).



# Thank you!

## Backup Zero suppressed format

E	0101		n	DHE ID				Reserved		Trigger Nr. 15:0			
	101		Res	С	0	Ρ		DHE ID DHP# DHP Frame ID				ame ID	
0	RowRedd #essr[8:51] (							Со	Common Mode		1	Row(0) Column(5:0)	ADC Value
CRC32													

- 32-bit DHE header
- 32-bit DHP header
- First hit of a double-row:
  - Double-row 16-bit word, only 9 upper bits of row are there
  - Pixel word with absolute column address in DHPT
- Alignment 16-bit word if necessary
- 32-bit CRC
- Common mode frame: in double-row 16-bit word