

# Electrical ATLAS Pixel Read-Out System

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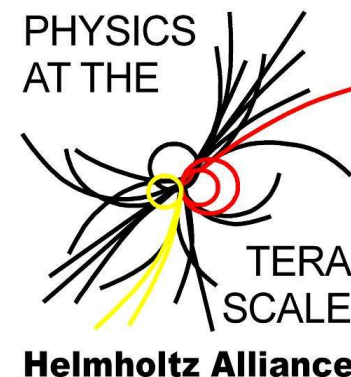
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GEFÖRDERT VOM

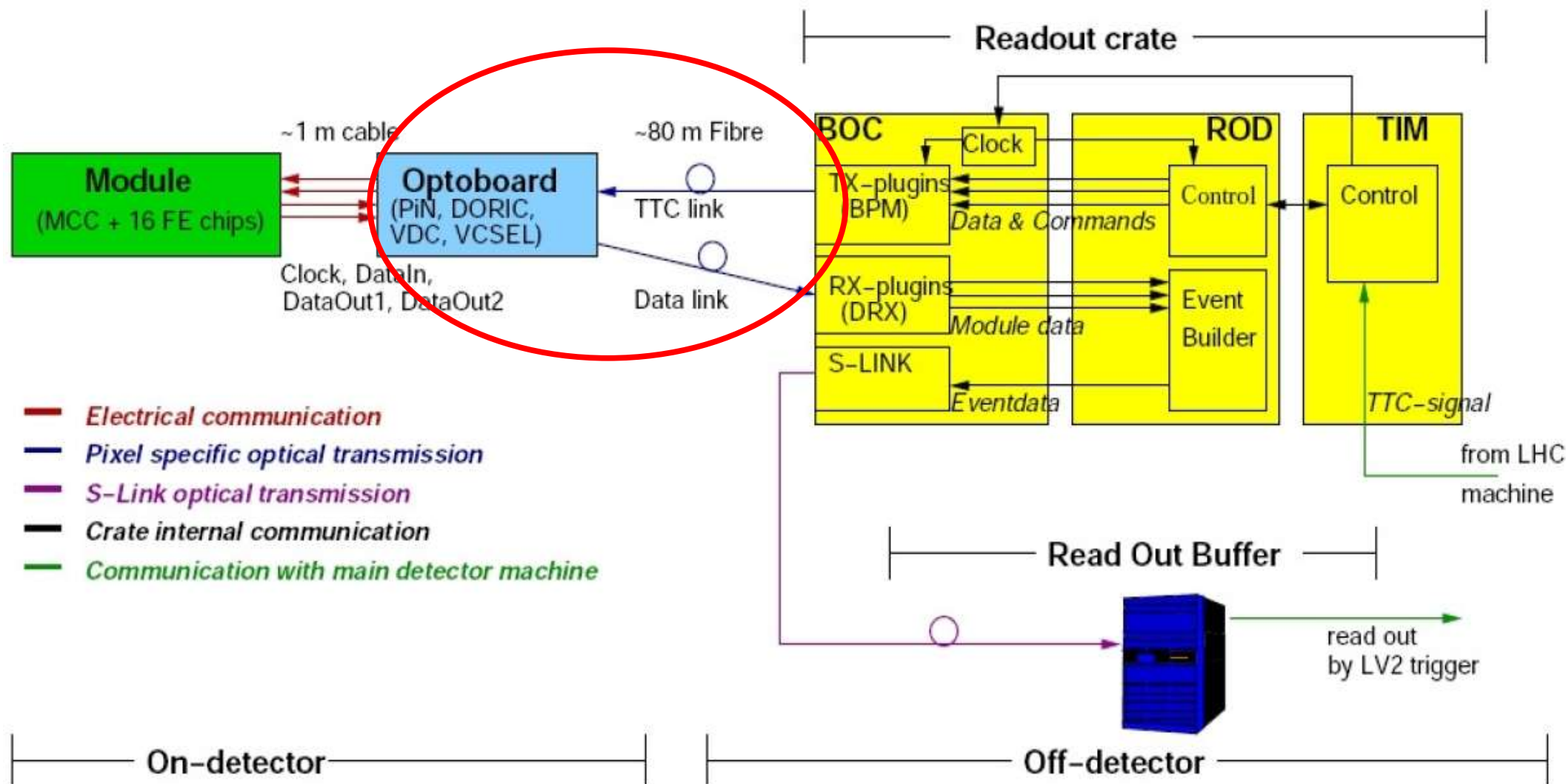


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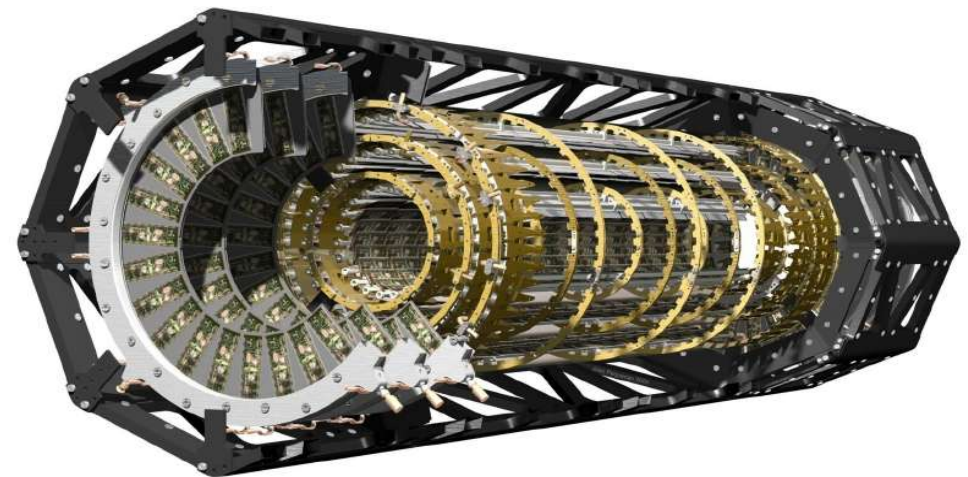
## Outlook

- The ATLAS Pixel DAQ system
- Requirements for detector upgrade
- Electrical detector read-out – status & outlook
- Summary



- ReadOutDriver  
performs main  
functions of detector  
control and read-out
- Provides event building
- ROD data channels  
only run at 40 MBit/s
- BackOfCrate Card is  
the off-detector opto-  
electrical interface
- Is connected one-to-  
one to a ROD
- Every BOC provides  
adjustment of its optical  
interface

- ATLAS Pixel Detector is arranged in 3 layers
- Read-out speeds:
  - 1<sup>st</sup> layer: 2 x 80 Mbit/s
  - 2<sup>nd</sup> layer: 80 MBit/s
  - 3<sup>rd</sup> layer: 40 MBit/s
- Data streams of 1<sup>st</sup> and 2<sup>nd</sup> layer have to be decoded on the BOC into 40 MBit/s streams

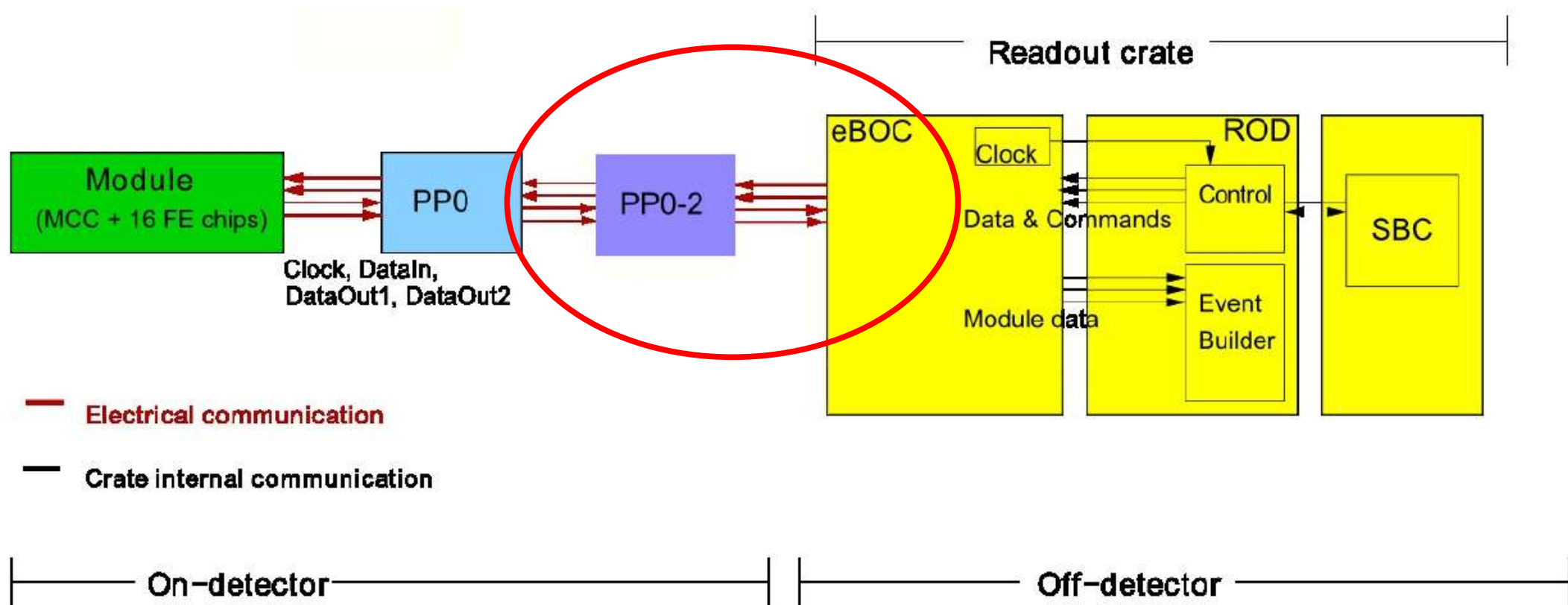


- Additional layer will be inserted close to beampipe („insertable b-layer“)  $\Rightarrow$  read-out at 160 MBit/s
- New IBL pixel modules are currently under development
- Testsystem for new modules is needed
- Aim: try to keep as many parts of the current read-out chain as possible (in particular the ROD)

- Current ATLAS pixel DAQ system uses optical link between on- and off-detector electronics
- Optical link requires complex tuning procedure for stable operation
- Even after tuning a stable operation is hard to achieve during testing procedures  
⇒ electrical read-out system for testing purposes

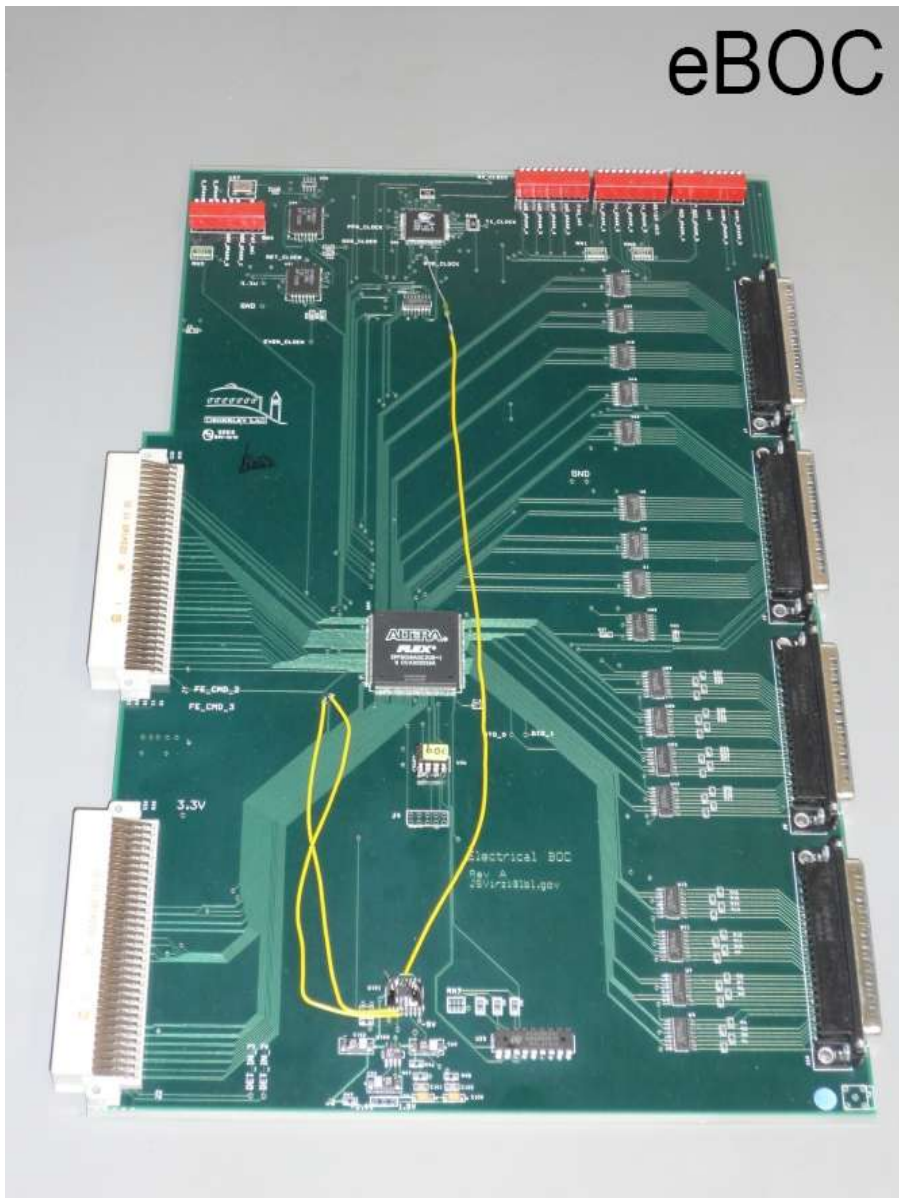
- For test and development purposes often beneficial to avoid optical components

⇒ electrical BOC („eBOC“)



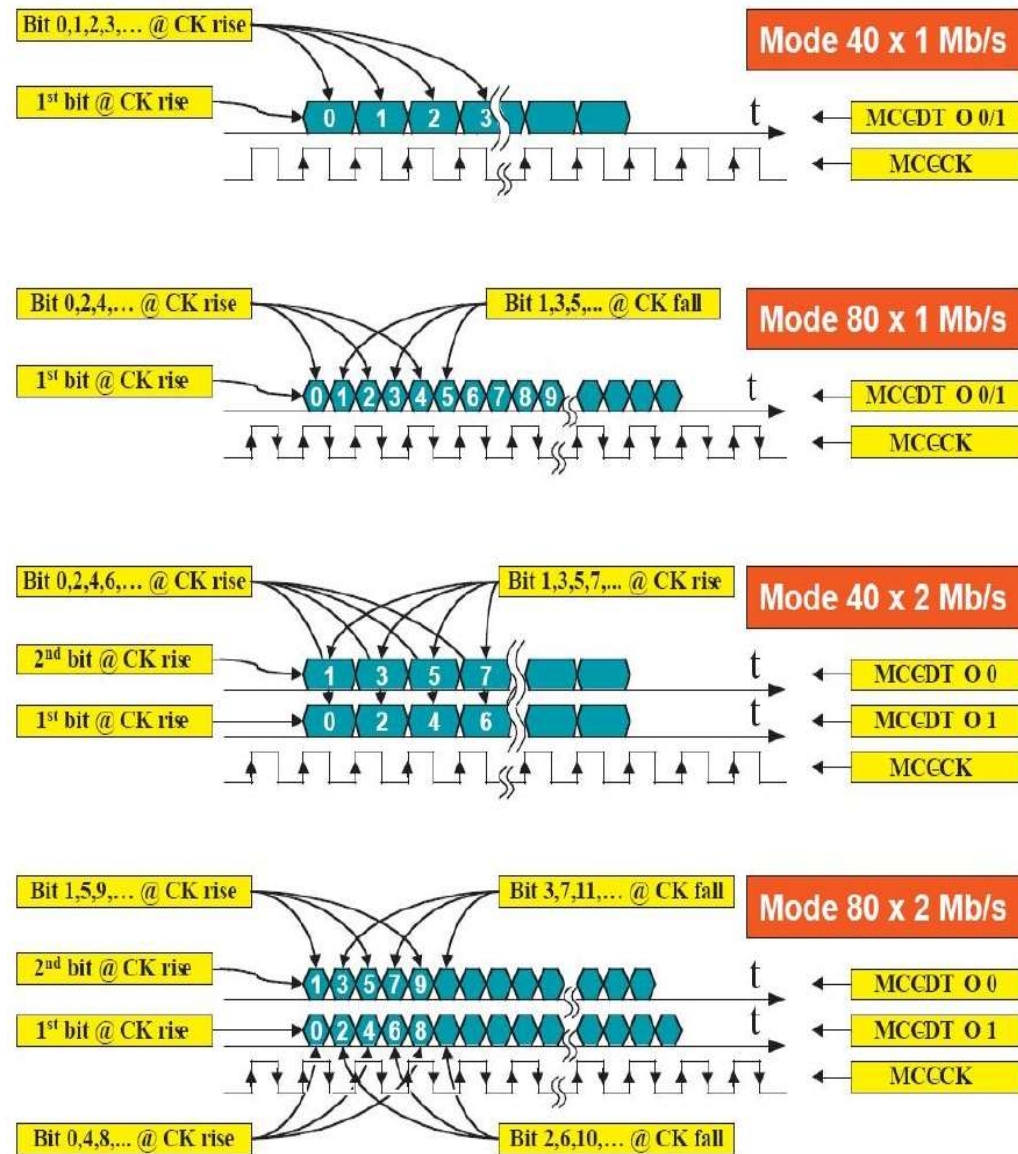


eBOC



- eBOC has already been used for system tests several years ago
- Old configuration: only 40 MBit/s mode available
- Data decoding and hardware fixes were needed

- Now: data decoding procedure for 80 MBit/s and 2 x 80 MBit/s streams has been implemented
- Bitlength:
  - At 40 MBit/s: 25 ns
  - At 80 MBit/s: 12.5 ns



## Test of reliability:

- Known bit pattern is created on pixel modules and sent back via electrical read-out chain (size: 848 bit)
- Received and sent pattern is compared  $\Rightarrow$  bit error measurement
- Test runs at 40 MBit/s and 80 MBit/s

- Results:

Bandwidth	Number of Error Counts	Number of Bits sent
40 MBit/s	0	$4.7 \cdot 10^6$
80 MBit/s	0	$2.15 \cdot 10^7$

⇒ Electrical read-out chain works reliable at both desired bandwidths

- Link misalignment between eBOC and ROD prevented test of double line mode

- Decoding of the new pixel modules data format will be implemented on the eBOC soon
  - In particular:
    - 8b/10b encoding (bit checksum & clock recovery)
    - Stream splitting: 1 x 160 MBit/s  $\Rightarrow$  4 x 40 MBit/s
- Electrical read-out chain will be adjusted to Bonn's module emulator  $\Rightarrow$  new firmware for ROD and eBOC can be written and tested

- ATLAS pixel DAQ system uses an optical link for data transmission
- For testing and development of IBL pixel modules the electrical read-out chain is more practical and easier to handle
- Electrical BOC can handle data streams at 40 MBit/s, 80MBit/s and 2 x 80 MBit/s now
- Stable operation has been proved