

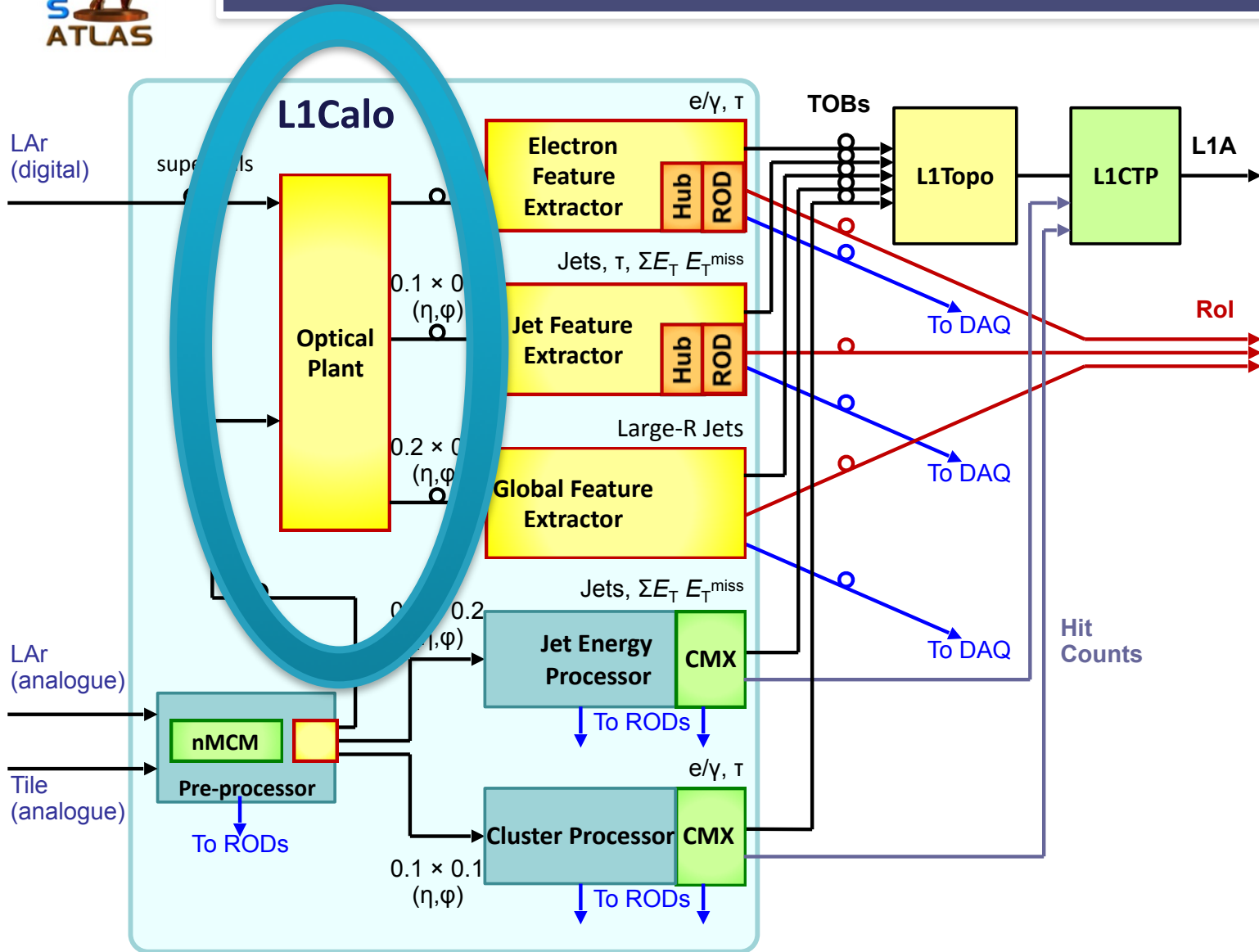


FOX light loss tests with the FOX demonstrator

Reinhard Schwienhorst
Michigan State University

FDR/PRR1
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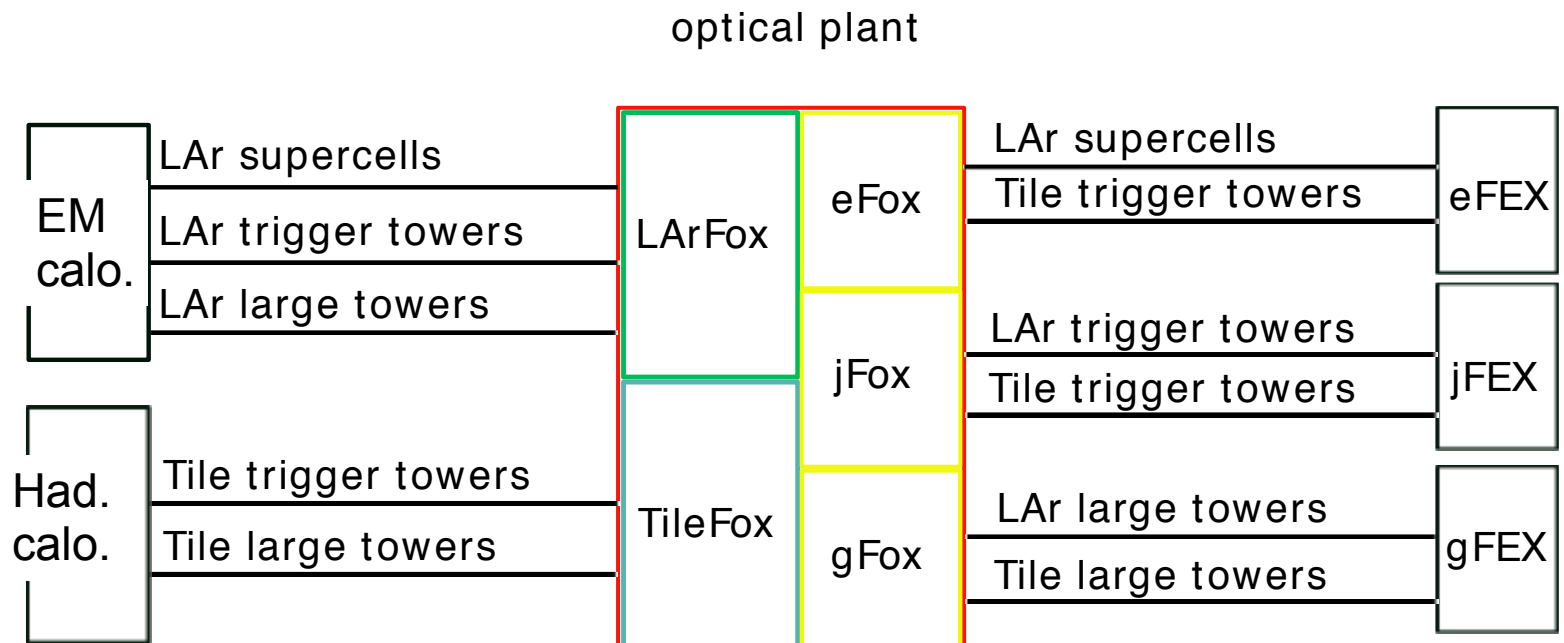
L1 trigger in phase 1





FOX – Fiberplant

- ❖ Fiber-Optic eXchange
- ❖ Note: Figure here and on the testing setup slides refers to LArFox, eFox, etc
- ❖ Actual mapping is more complex than that
 - ❖ But basic picture of one intermediate connection still holds





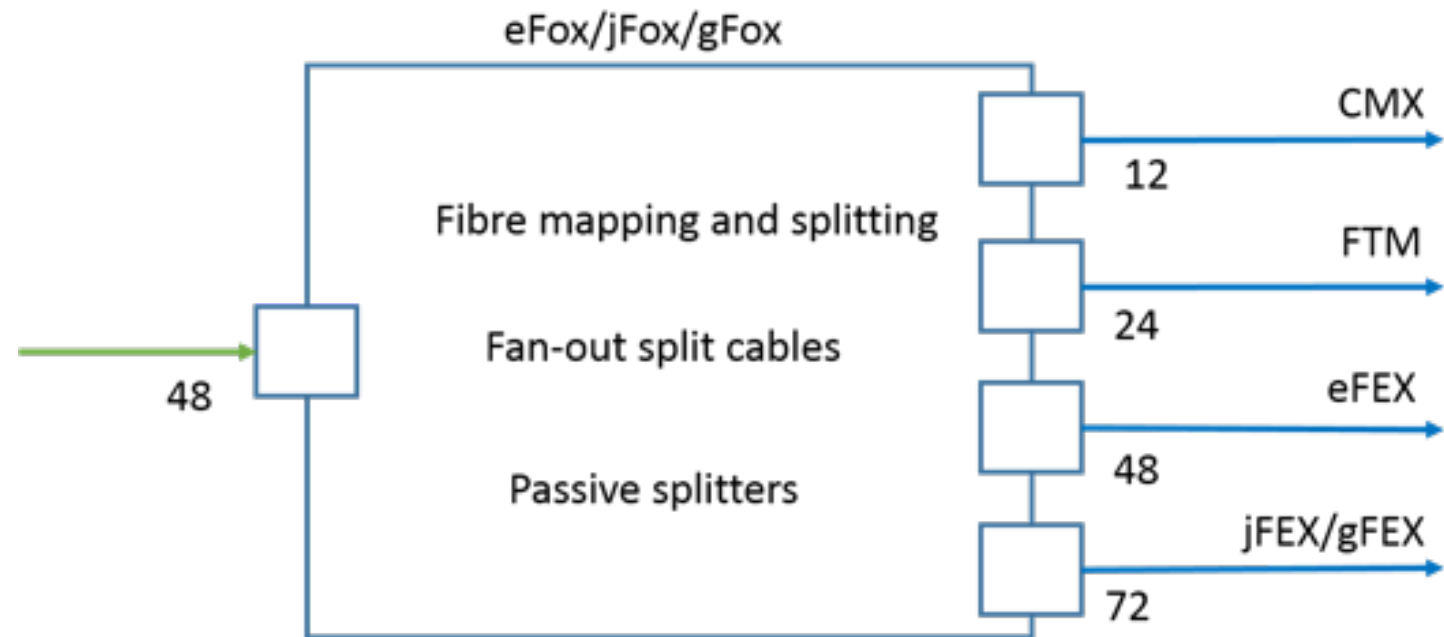
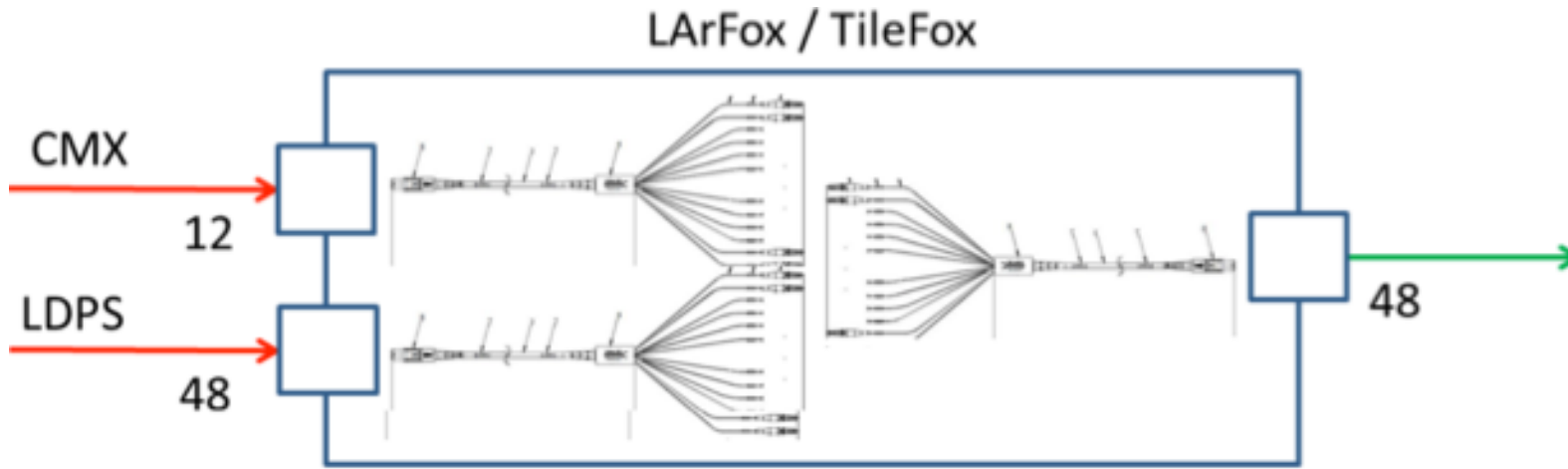
Light loss tests at MSU and CERN

- ❖ Extensive testing with MiniPods with CMX test bench
 - RuthAnn Gregory, MSU undergrad student
- ❖ Individual cables, connectors, attenuators, splitters
 - Using the CMX MiniPods at 6.4 GB/s
 - Using FLUKE DC light meter
 - Fluke consistently shows light loss about 1 dB higher than MiniPod setup - likely due to losses in Fluke connectors
- ❖ Receiver optical power variations
 - 0.2 dB to 0.4 dB for disconnecting and reconnecting MTP connectors without and with cleaning
 - 0.2 dB for a temperature increase from 36.4 to 38.2 Degrees C
 - 0.9 dB for variation amongst MiniPod channels
 - 3 dB for an optical splitter (not used)
- ❖ Bit-error rate tests with variable attenuator show 8-10 dB is where CMS loses sync and regains sync



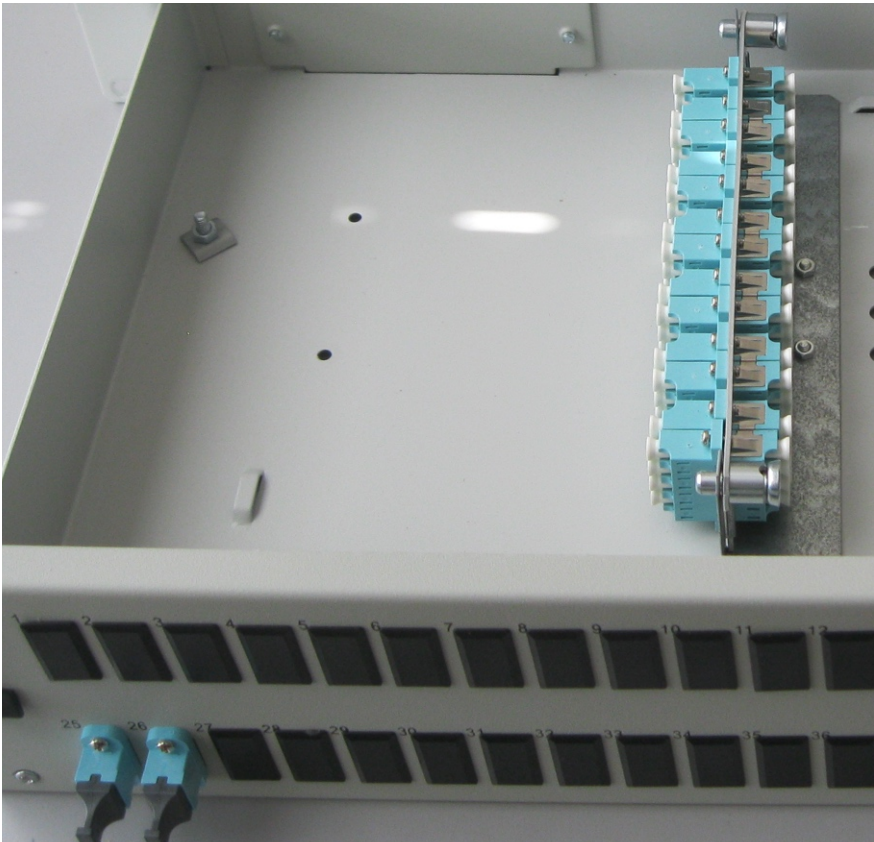
Demonstrator

- ❖ FOX demonstrator to be used for integration testing at CERN



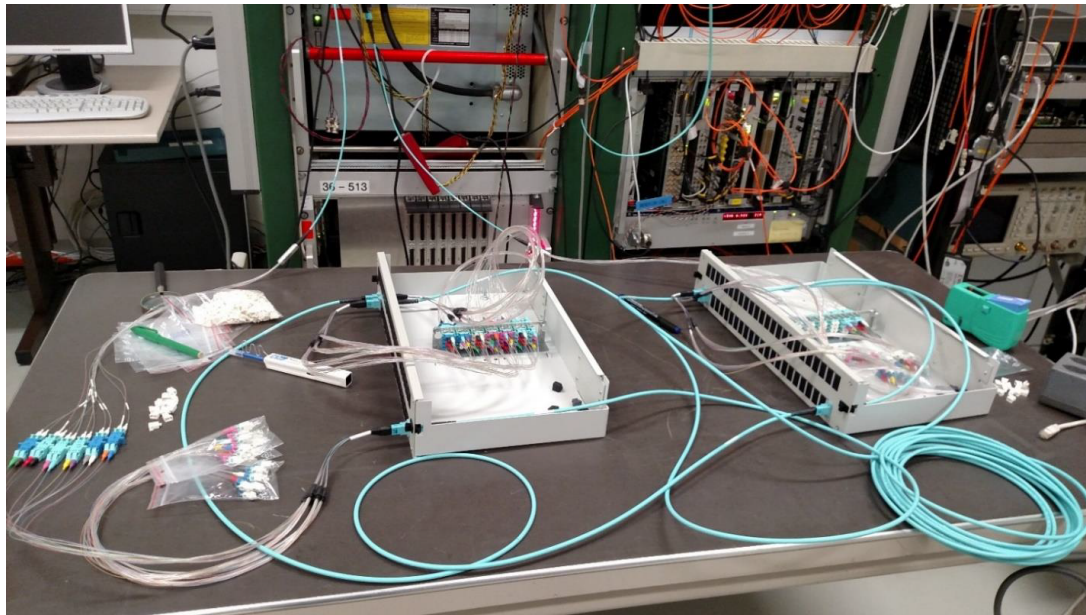


FOX Demonstrator



Light loss tests

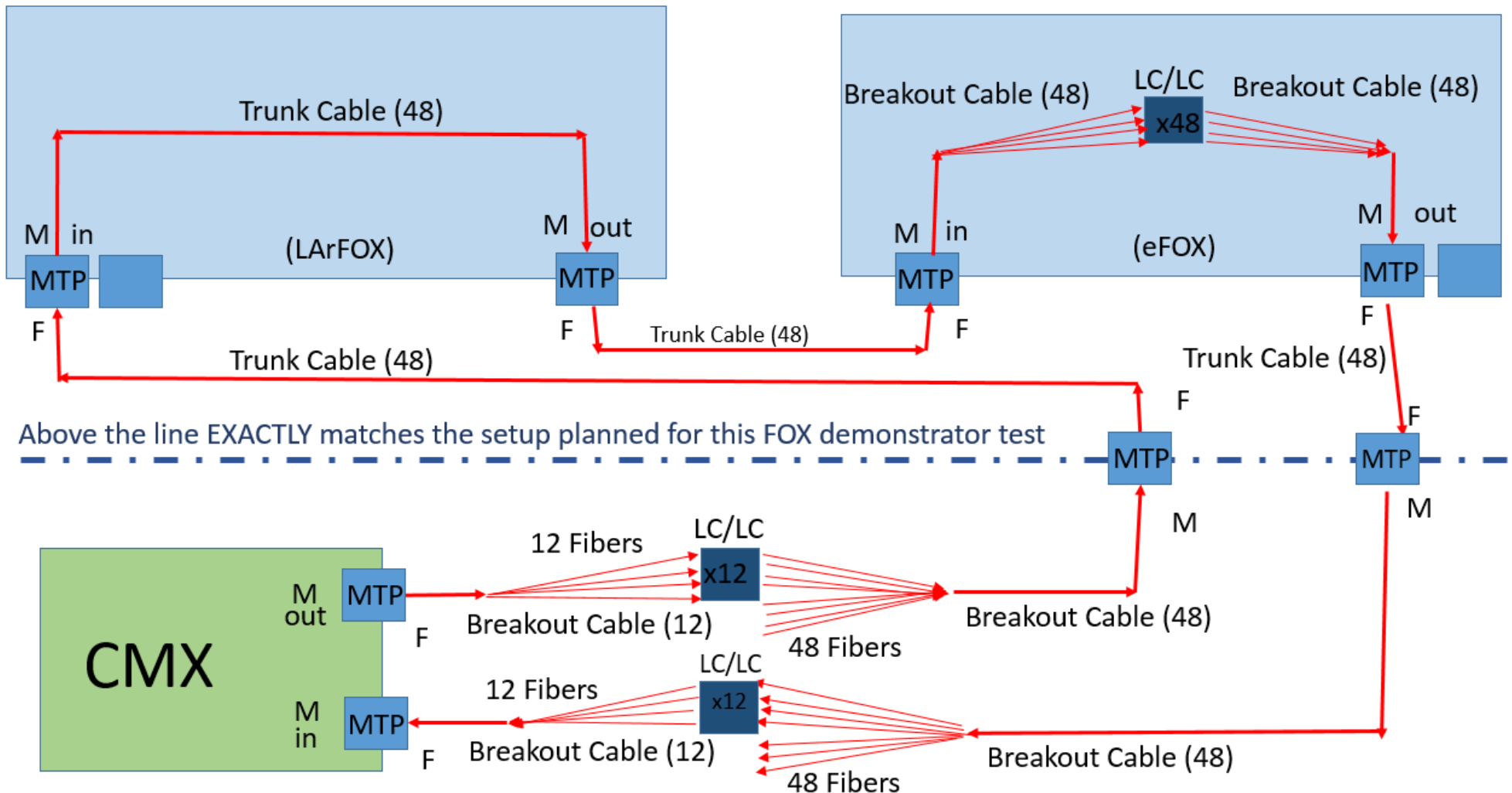
- ❖ Constructed demonstrator to be used for integration testing at CERN
 - Slice-test of FOX light path, representative optical properties
 - LAr FOX module with input connector for up to 48 fibers
 - e/j/g FOX module with output connector for 48 or 72 fibers





Integration tests at CERN

❖ CMX or LATOME as transmitter, FEXes as receivers





Integration tests at CERN

- ❖ Tests done with LAr LATOME, FTM as transmitters
- ❖ eFEX, jFEX, gFEX as receivers
- ❖ At nominal link speed of 11.2 Gb/s
- ❖ Maximum light loss is 8-10 dB
 - tests with FTM to jFEX confirm CMX measurements
- ❖ Nominal light loss per MTP connector is 0.2 to 0.3 dB
- ❖ Actual light loss lower
 - LATOME and gFEX setup with 8 MTP connectors and 3 LC connectors gave 1 dB typical loss total and 3.5 dB loss max for 72-fiber connector
 - LATOME and eFEX setup gives 0.2 to 1.4 dB loss for 48 fiber connector
- ❖ Also BER tests
 - LATOME to jFEX gives BER better than 10^{-16}



Integration tests at CERN

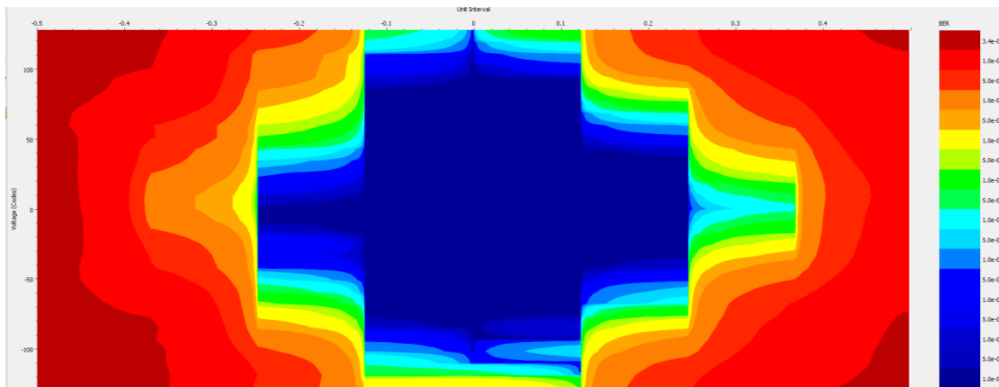
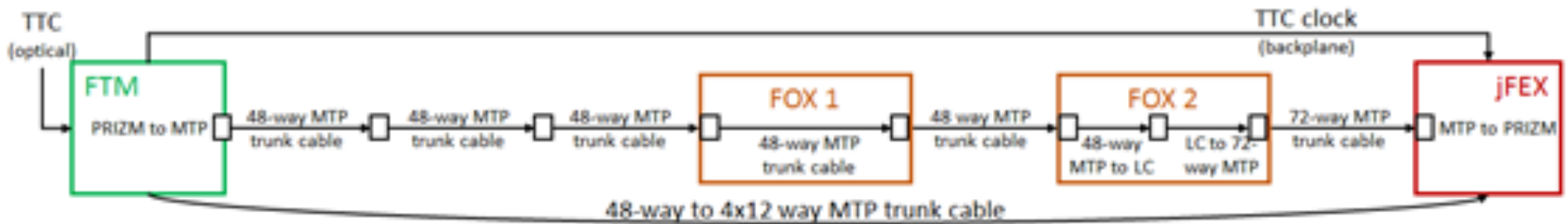
- ❖ Eye diagram tests, BER tests, light loss measurements
- ❖ Maximum light loss is 8-10 dB
 - tests with FTM to jFEX confirm CMX measurements
- ❖ Nominal light loss per MTP connector is 0.2 to 0.3 dB
- ❖ Actual light loss lower
 - LATOME and gFEX setup with 8 MTP connectors and 3 LC connectors gave 1 dB typical loss total and 3.5 dB loss max
- ❖ Also BER tests
 - LATOME to jFEX gives BER better than 10^{-16}



Integration tests at CERN

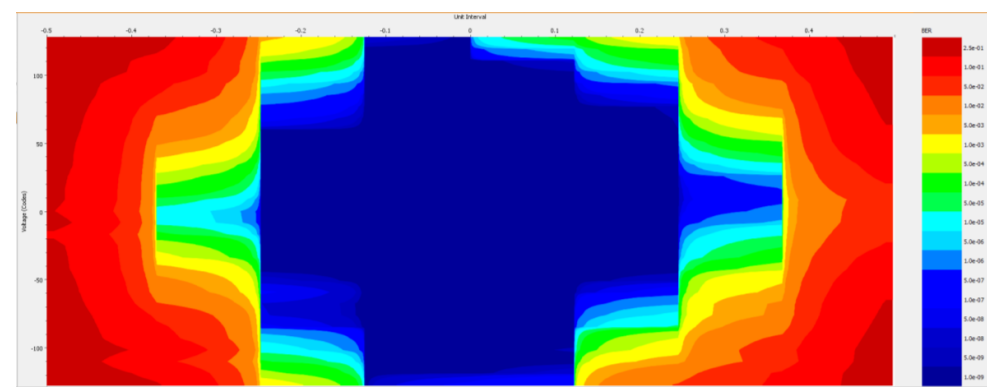
❖ jFEX eye diagram and BER tests

- LATOME to jFEX gives BER better than 10^{-16}



Name: SCAH_27
Description: Scan 27
Start: 2017 Mar 21 09:26:30
End: 2017 Mar 21 09:32:31

Open area: 4352
Link settings: N/A
Horizontal increment: 0
Horizontal range: -0.500 Lt to 0.500 Lt
Vertical increment: 0
Vertical range: 100%



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Description: Scan 26
Start: 2017 Mar 21 09:24:10
End: 2017 Mar 21 09:26:17

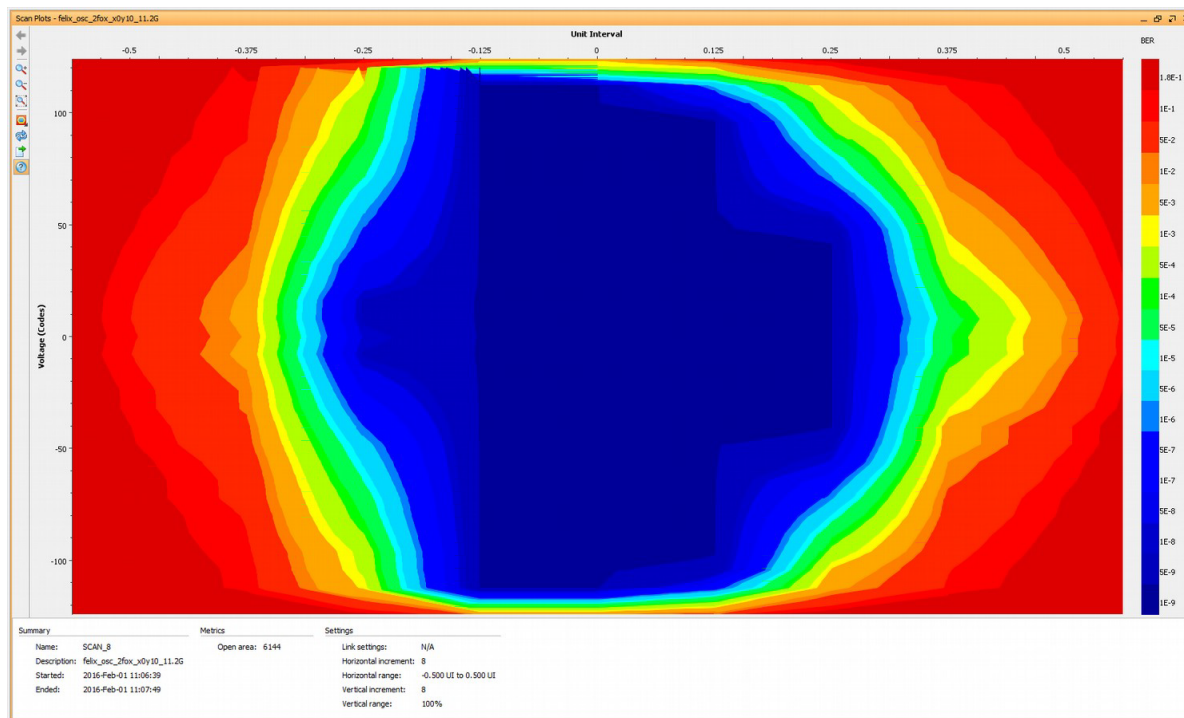
Open area: 6328
Link settings: N/A
Horizontal increment: 0
Horizontal range: -0.500 Lt to 0.500 Lt
Vertical increment: 0
Vertical range: 100%



Integration tests at CERN

❖ gFEX eye diagram and BER tests

- At 11.2 Gb/s
- LATOME to gFEX gives BER better than 10^{-14}





Summary

- ❖ Light loss limit 8-10 dB
- ❖ Successful tests with FOX demonstrator for all FEX modules
- ❖ Inputs from LATOME and FTM
- ❖ Typical light loss through FOX with 8 MTP connectors 1 dB, max 3.5 dB
- ❖ Reminder:
 - ❖ Optical power transmitted and received is available in MiniPods
 - ❖ Should be recorded by transmitters and FEX receivers
 - ❖ as part of monitoring
 - ❖ Important for FOX debugging



Documentation of Integration tests at CERN

- ❖ Integration tests documented at
- ❖ <https://indico.cern.ch/event/626456>
- ❖ Link speed test daily meetings eFEX (04/2016)
<https://indico.cern.ch/event/519805/>
- ❖ Link speed test daily meetings gFEX (01/2016)
<https://indico.cern.ch/event/491079/>
- ❖ Link speed test summary jFEX (03/2017)
https://indico.cern.ch/event/626456/contributions/2529620/attachments/1435785/2211284/Summary_of_LATOME-jFEX_tests.pdf
- ❖ Ruth's summary of studies
<https://indico.cern.ch/event/486597/contributions/1996585/>



FLUKE Meter

