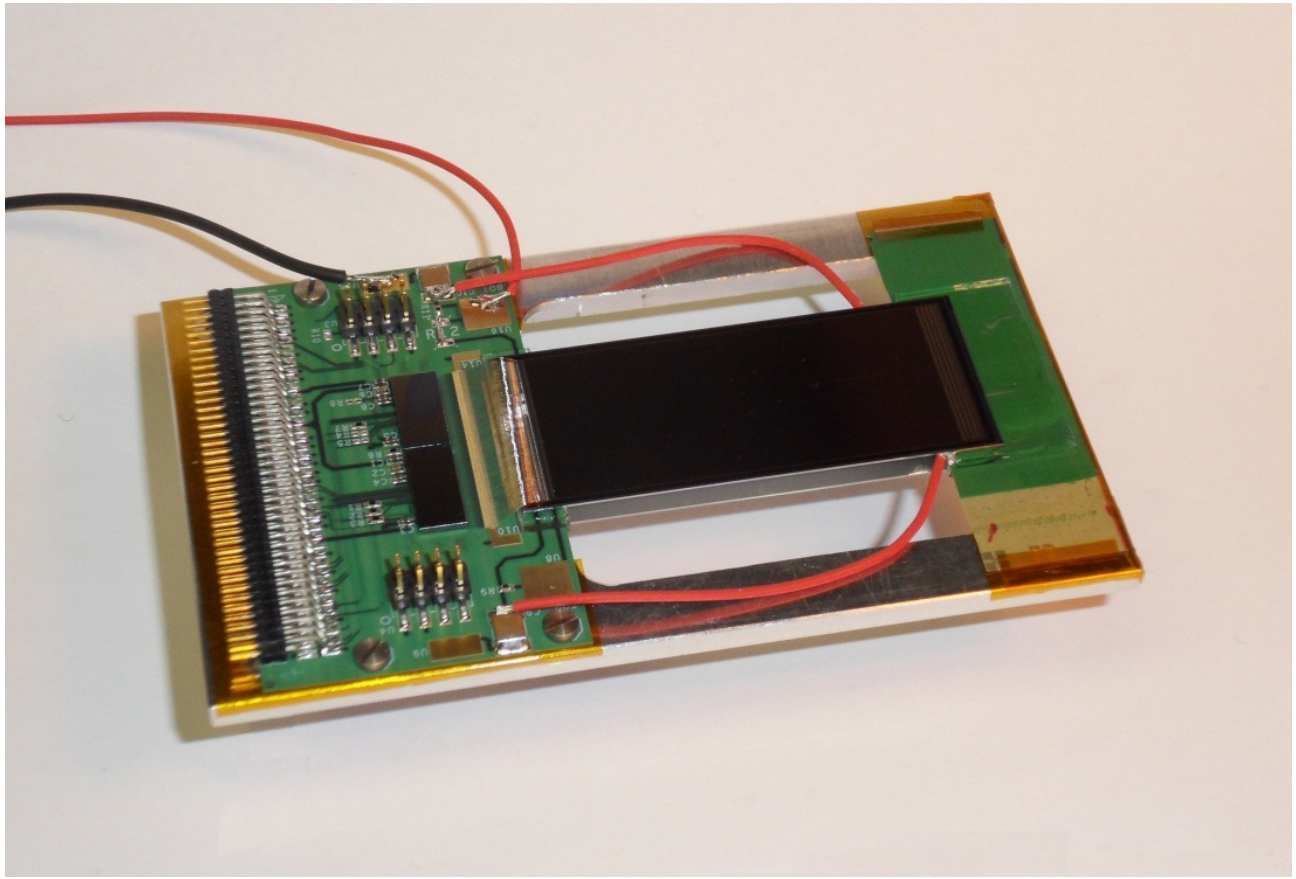
first experience with mini-modules



re-cap: last Phase II electronics meeting in May

CBC2 test results and plans:

http://www.hep.ph.ic.ac.uk/~dmray/CBC_documentation/Phase_2_elec_CBC2_May_2013.pdf

CBC2 working well - front end performance similar to CBC1 and CBC1 bugs fixed
new stub-finding logic confirmed working

very high yield of good chips from probing first wafer

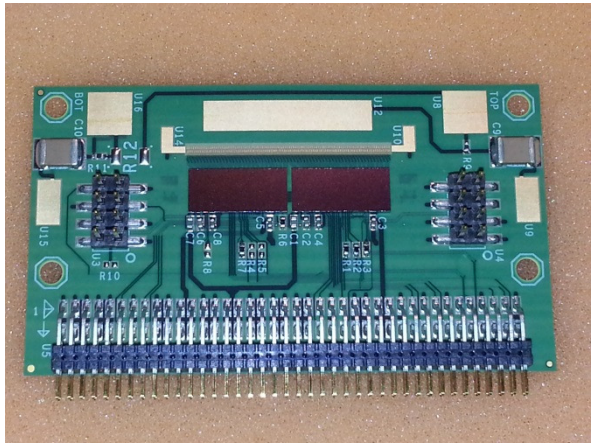
2xCBC2 hybrid functional test results:

http://www.hep.ph.ic.ac.uk/~dmray/CBC_documentation/Phase_2_elec_2xCBC2_May_2013.pdf

results from screening first five bump-bonded hybrids

all chips functional, good uniformity of performance

strong evidence of very high yield of bump-bond connectivity



since May

2 modules assembled using 2 of 1st 5 hybrids and Infineon sensors (Alan Honma)

testing at IC - results discussed in systems meetings

for details see:

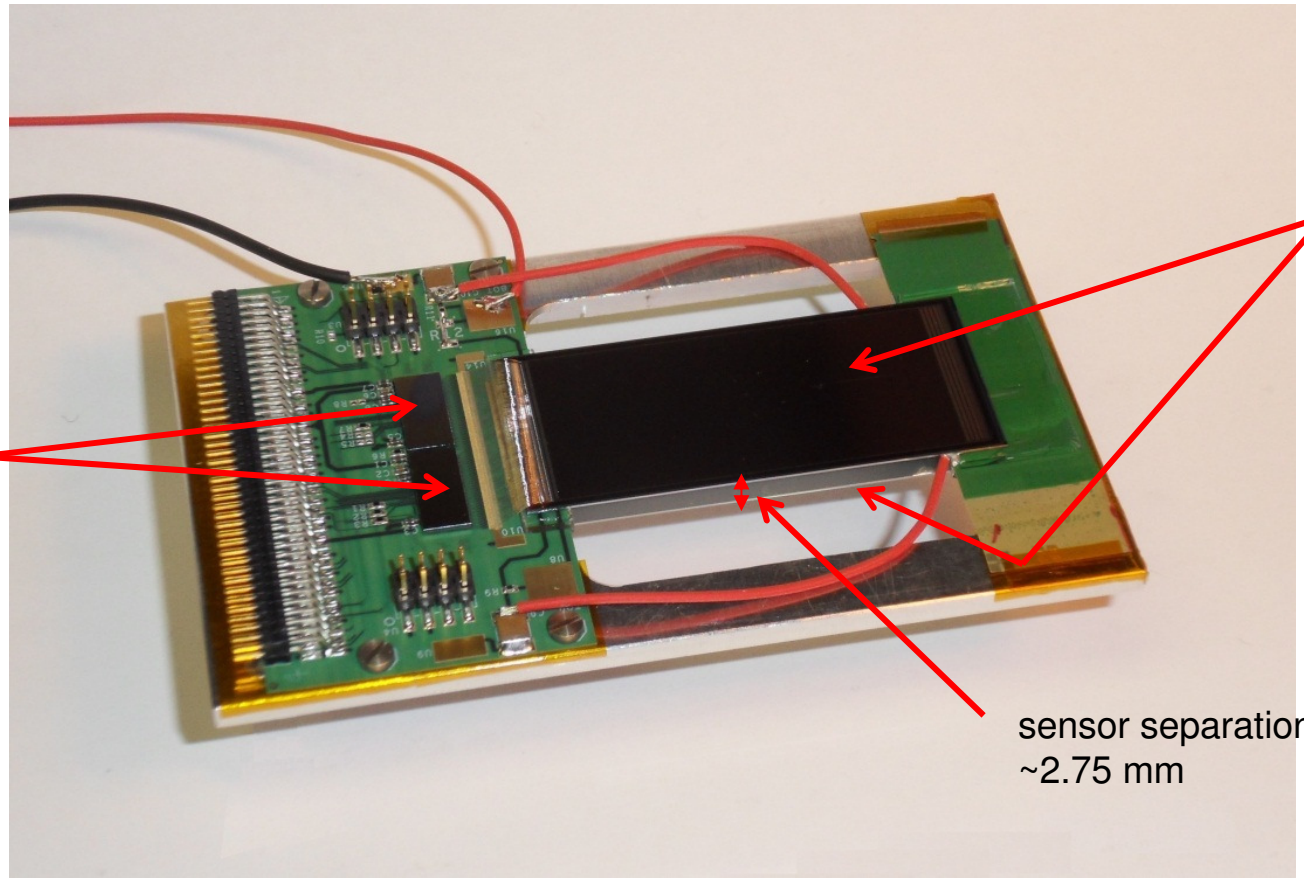
https://indico.cern.ch/getFile.py/access?contribId=4&sessionId=1&resId=2&materialId=slides&confId=265897

& https://indico.cern.ch/getFile.py/access?contribId=7&sessionId=1&resId=1&materialId=slides&confId=257862

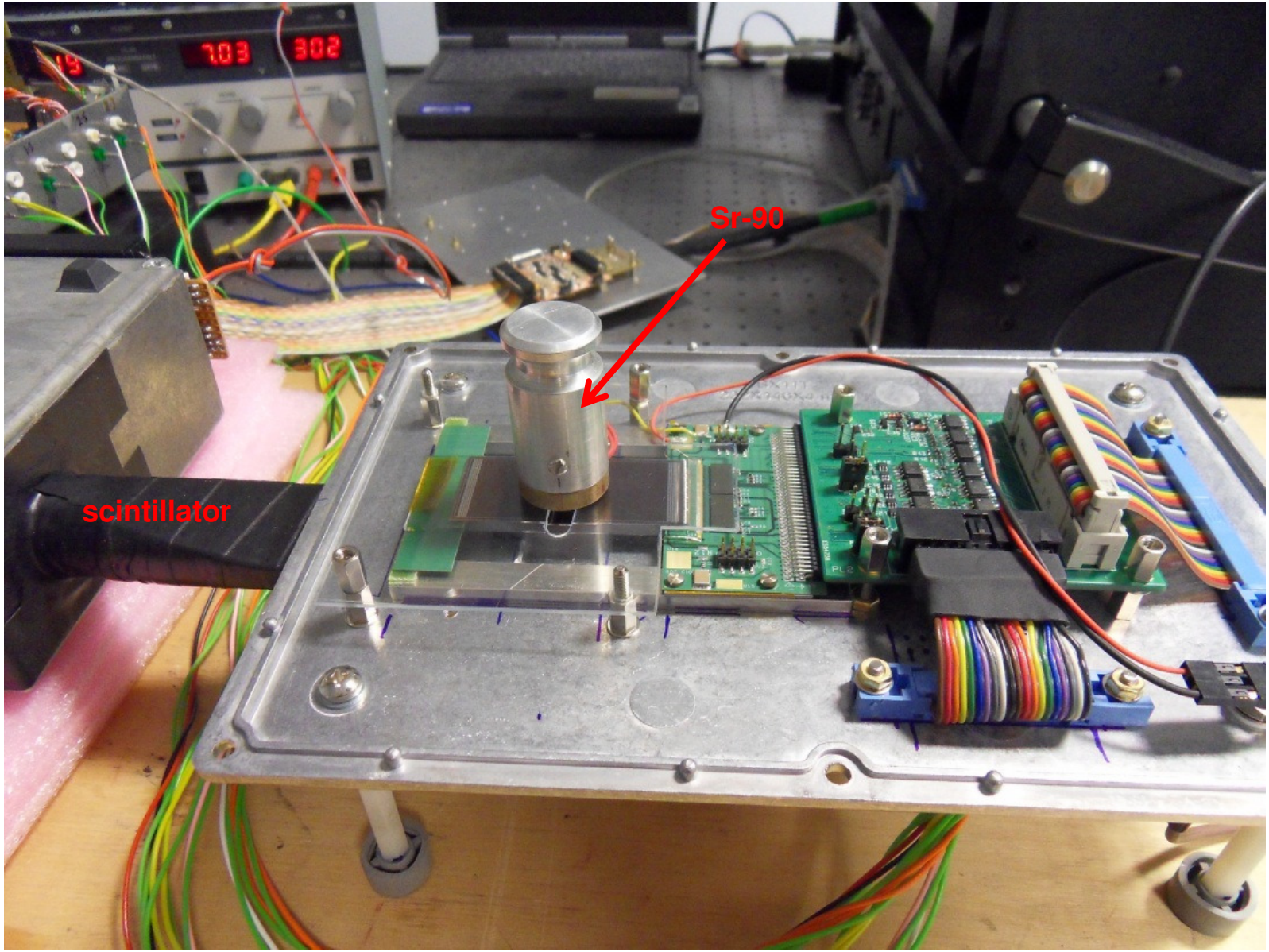
a lot of material to summarize

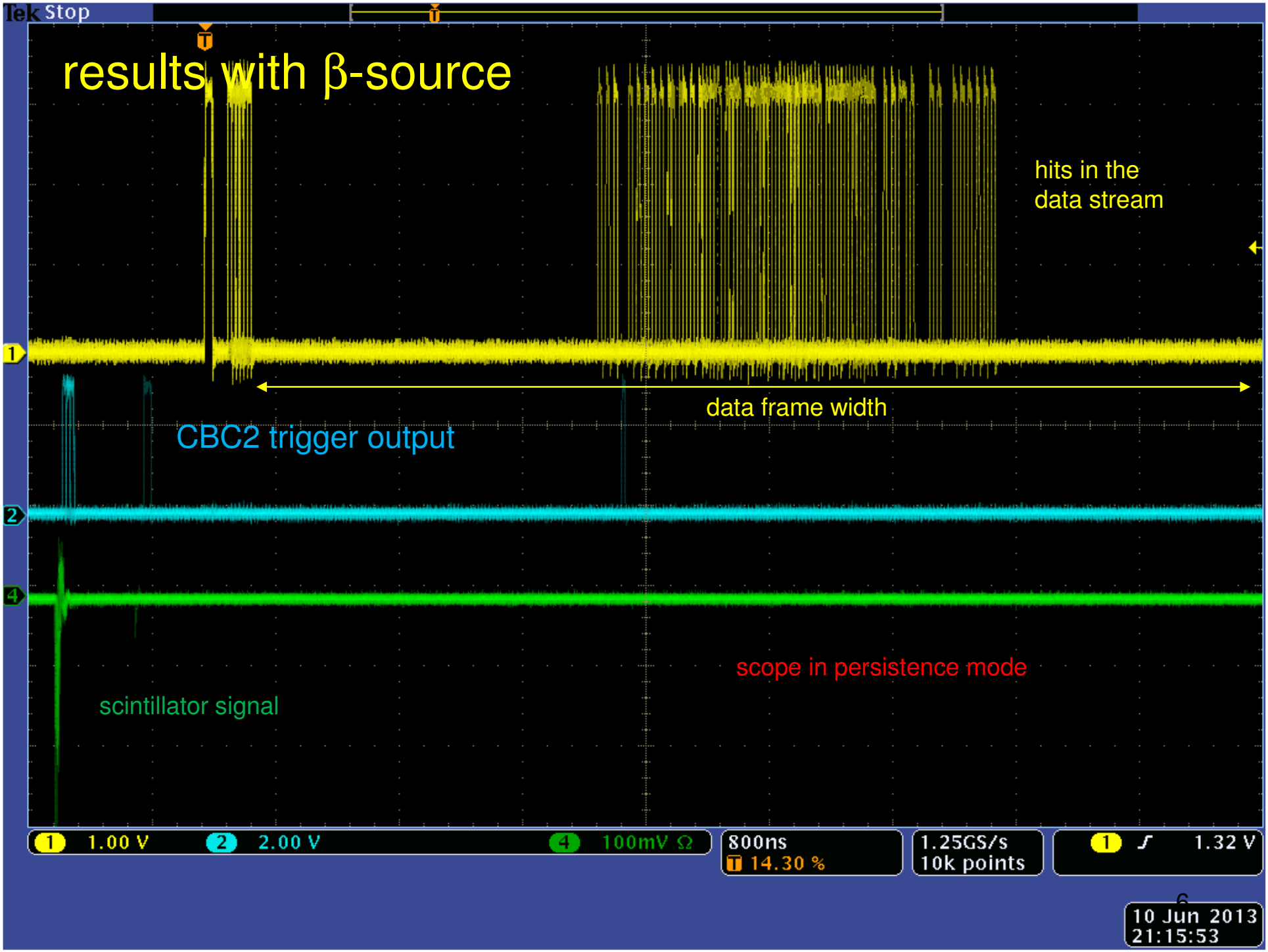
=> go to above slides for details

mini-pT modules

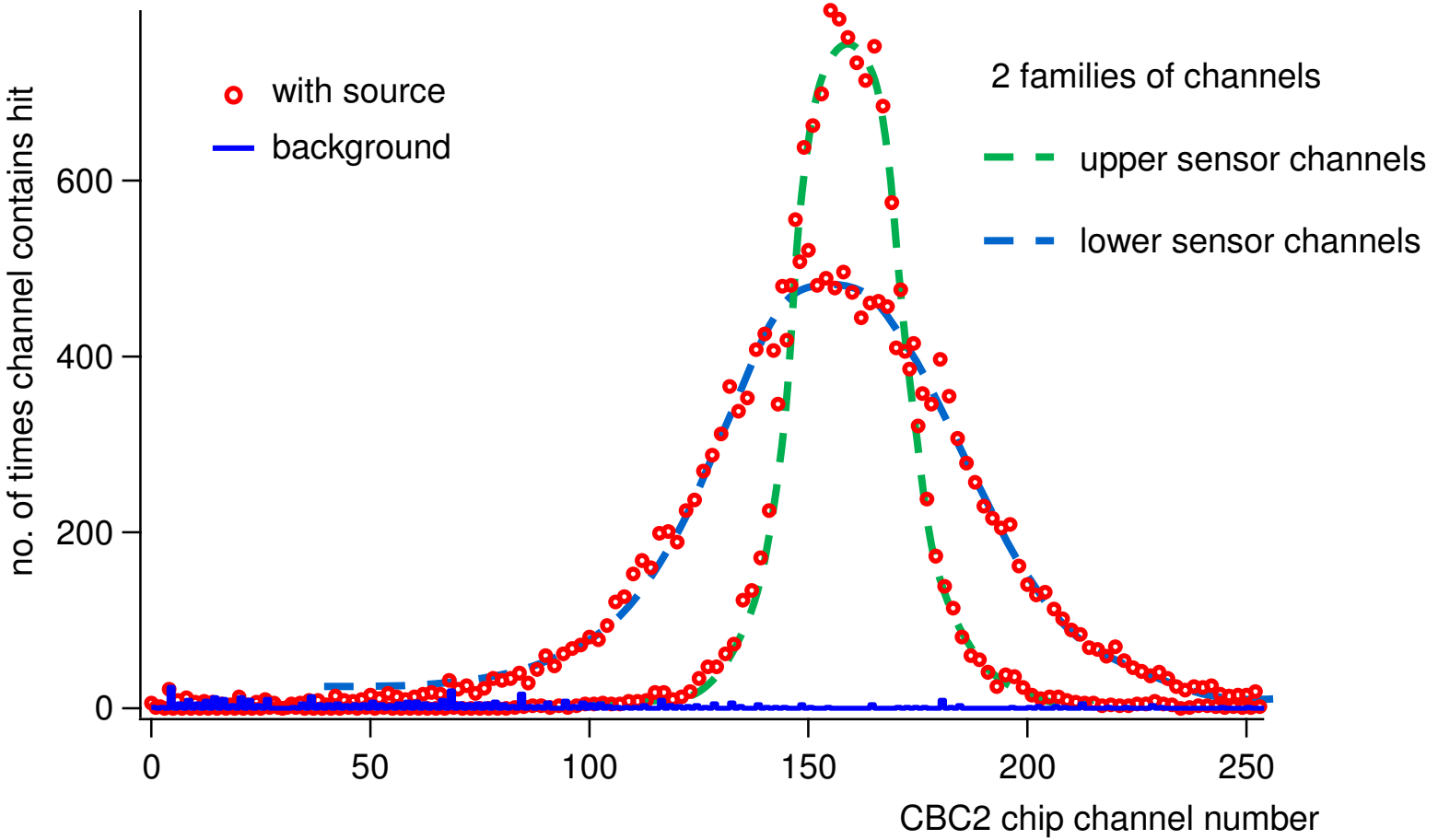


mini-module in test setup




Tek Stop
results with β-source
hits in the
data stream
data frame width
CBC2 trigger output
scintillator signal
scope in persistence mode
1 1.00 V
2 2.00 V
4 100mV Ω
800ns
T 14.30 %
1.25GS/s
10k points
1 1.32 V
10 Jun 2013
21:15:53

Sr-90 beta source profile



note that CBC2 channels alternate between upper and lower sensor

1,3,5,… read out lower sensor, 2,4,6,8,…. read out upper sensor

hit distribution broader in lower sensor

expect large-angle scatter in upper sensor layer

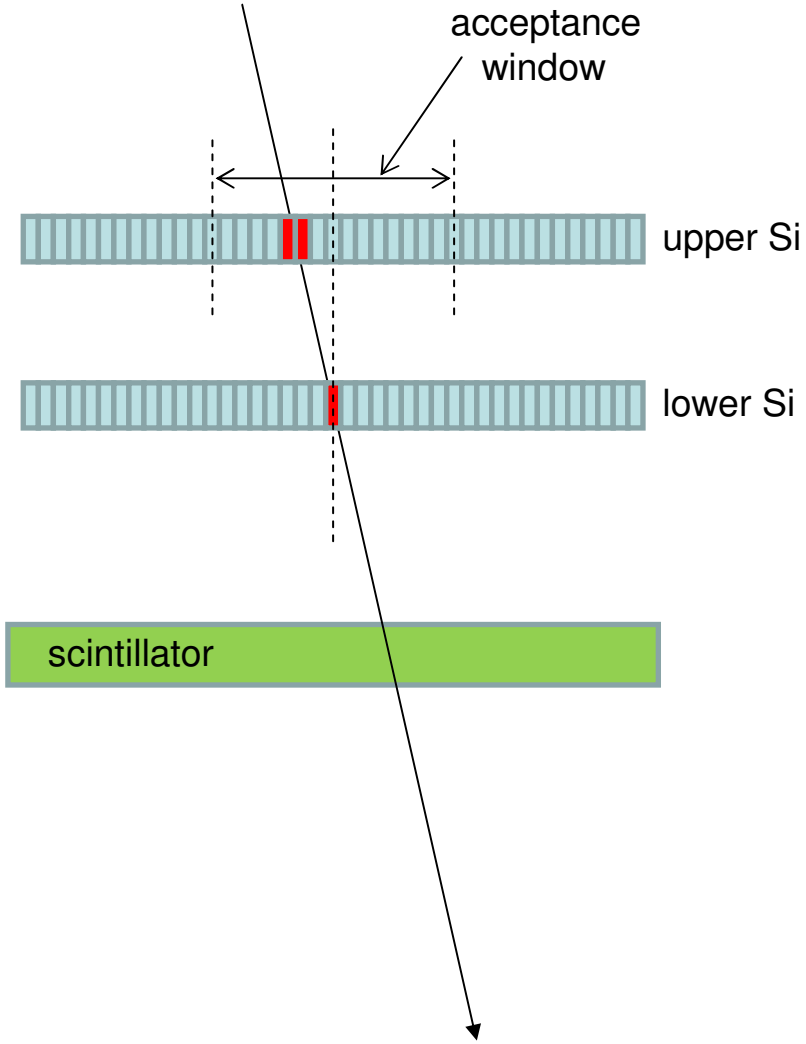
results with cosmics

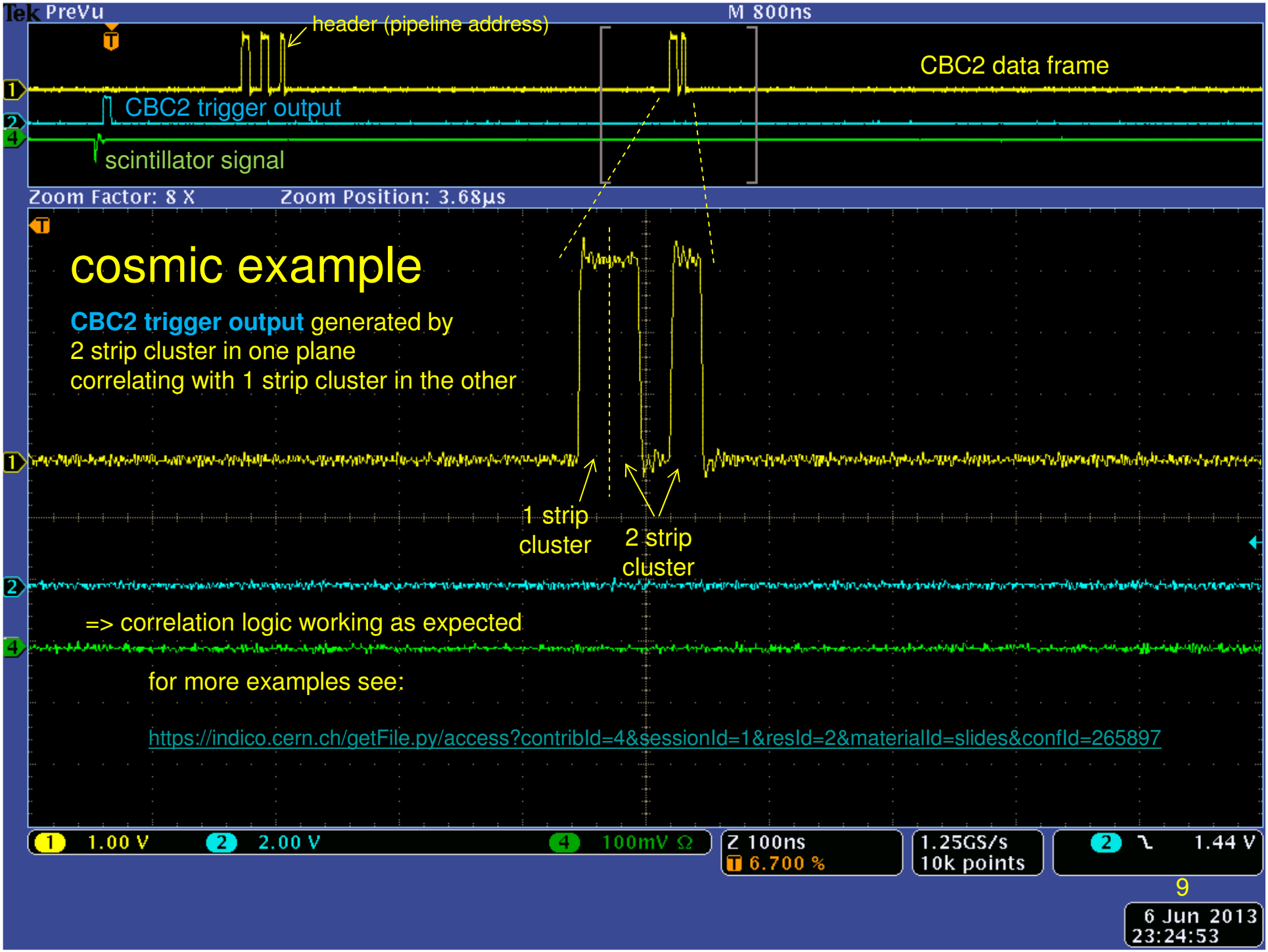
coincidence window set to max in upper sensor
to maximize sensitivity

+/- 8 strips

rate still very low

<< 1 Hz




Tek PreVu
M 800ns
header (pipeline address)
CBC2 data frame
CBC2 trigger output
scintillator signal
Zoom Factor: 8 X
Zoom Position: 3.68µs
cosmic example
CBC2 trigger output generated by
2 strip cluster in one plane
correlating with 1 strip cluster in the other
1 strip cluster
2 strip cluster
=> correlation logic working as expected
for more examples see:
https://indico.cern.ch/getFile.py/access?contribId=4&sessionId=1&resId=2&materialId=slides&confId=265897
1 1.00 V
2 2.00 V
4 100mV Ω
Z 100ns
T 6.700 %
1.25GS/s
10k points
2 1.44 V
6 Jun 2013
23:24:53

noise studies

results show unexpected noise dependence on sensor bias

also significant number of channels with anomalously low noise

remember both modules constructed using 2CBC2 hybrids from 1st batch of 5 tested at IC

CBC2 chips not underfilled (bump-bonds **not** encapsulated) but all channels verified working

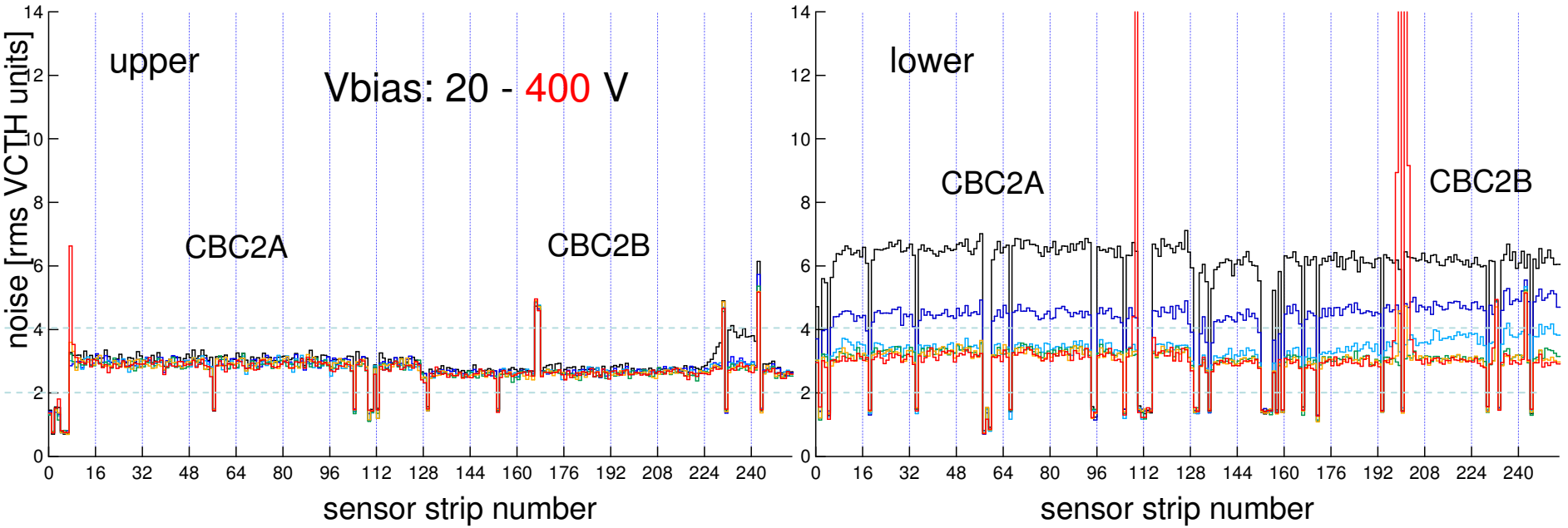
(see: http://www.hep.ph.ic.ac.uk/~dmray/CBC_documentation/Phase_2_elec_2xCBC2_May_2013.pdf)

investigations are ongoing - will briefly summarize status here

for up-to-date details, see:

https://indico.cern.ch/getFile.py/access?contribId=7&sessionId=1&resId=1&materialId=slides&confId=257862
(systems meeting 21st August)

comparison of two sensors on mini-module#1

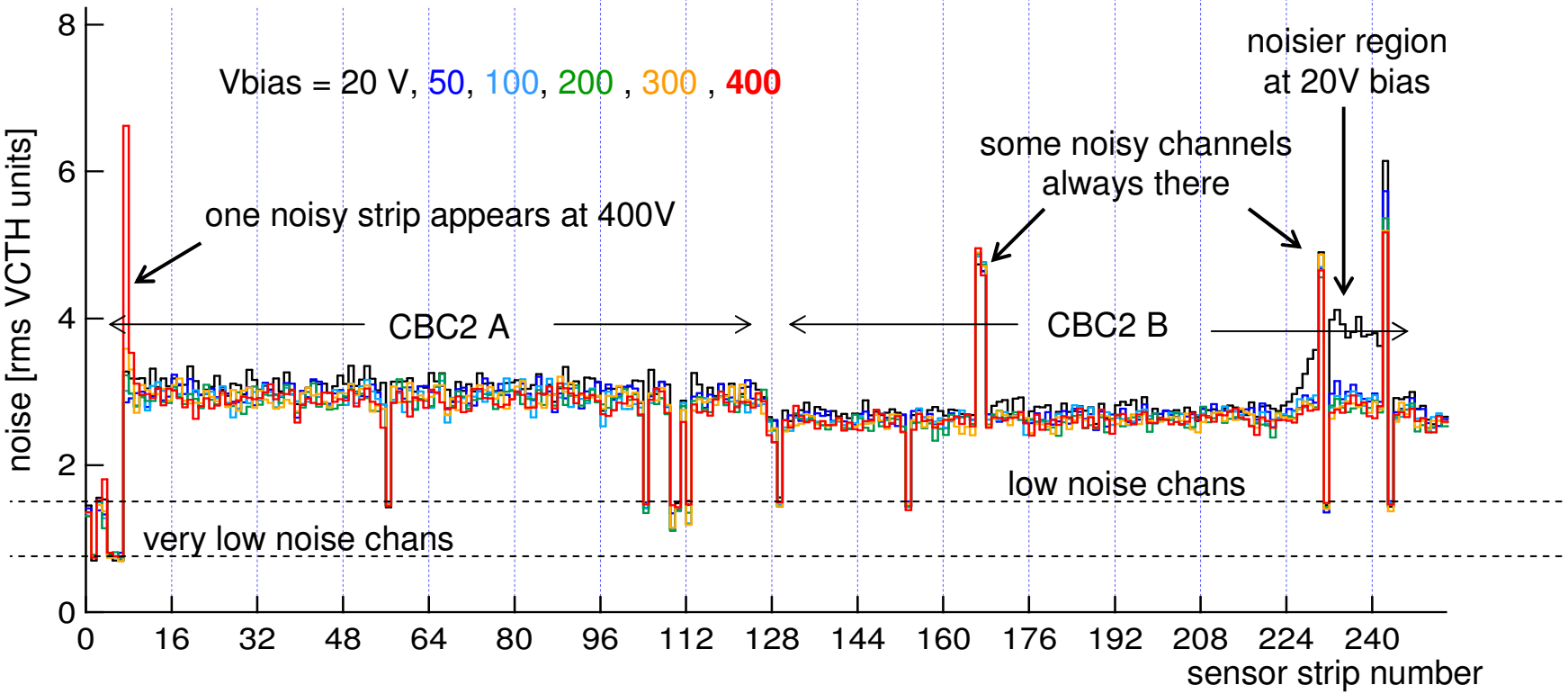


lower sensor needs higher bias (>100V) before noise reaches minimum value

final levels ~same - lower and upper (slightly higher on lower)
behaviour suggests different capacitance dependence on bias for lower sensor

~ similar behaviour of second module (lower sensor has bias dependent noise, upper does not)
some kind of effect due to hybrid?
=> can't see a reason why and don't get effect for electrical test setup

low noise channels



low noise channels

studies show these channels have somehow become disconnected at bump-bond level
presumably during module assembly and bonding (the hybrid is very flexible)?

very low noise channels

studies show these channels either shorted to ground, or damaged => not clear how

higher noise channels

behaviour ~consistent with two channels shorted together

summary

- mini-module results with source and cosmics show full functionality
- some anomalous behaviour found in the noise dependence on bias for lower layer sensors

  different inter-strip capacitance dependence on bias for these sensors?

  or some effect due to the hybrid?
- low noise channels are disconnected from amplifiers - both modules, both sensor layers

  evidence points to the bump-bonds

  disconnection during the module assembly/wire-bonding process?
- very low noise channels show no response to test pulse

  damaged or shorted somewhere/somehow?
- high noise (low-gain) channels (not those bias related) appear to be shorted

  but weren't there prior to module assembly (would have shown up in acceptance tests)

next step

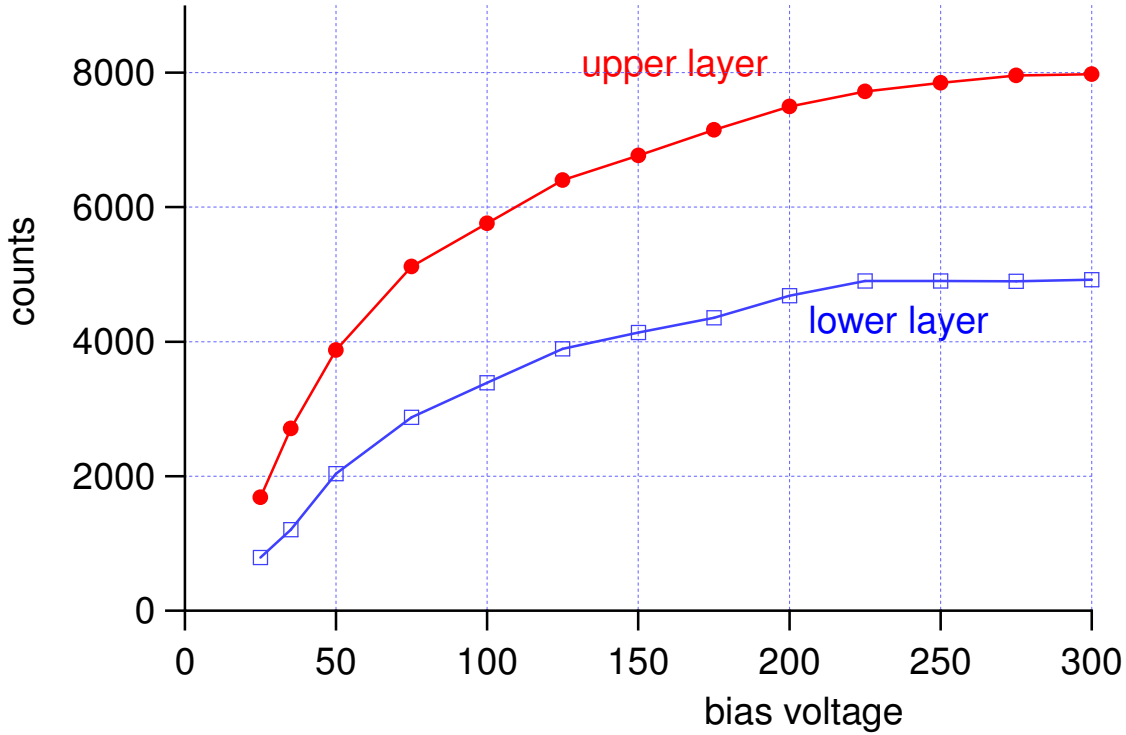
make another module - use hybrid with under-filled chips (bonds encapsulated)

should not be possible to disturb bump-bonds

use hybrid where wire-pad to amplifier connectivity has been verified for all channels

extra

signal vs. bias - mini-module#1



method:
threshold set at ~ 1 fC, Sr-90 source
look at one channel from each layer in middle of area “illuminated” by source
count number of times comparator fires for 100,000 scintillator triggers

counts saturate as bias voltage approaches 250 Volts

consistent with depletion behaviour measured in Vienna

(other module behaves similarly)