Status of Opto-Boards Study

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Outline

- Introduction
- Study of 2013/14 opto-boards
- Study of irradiated opto-boards
- Future Plan

Opto-Board Study Plan

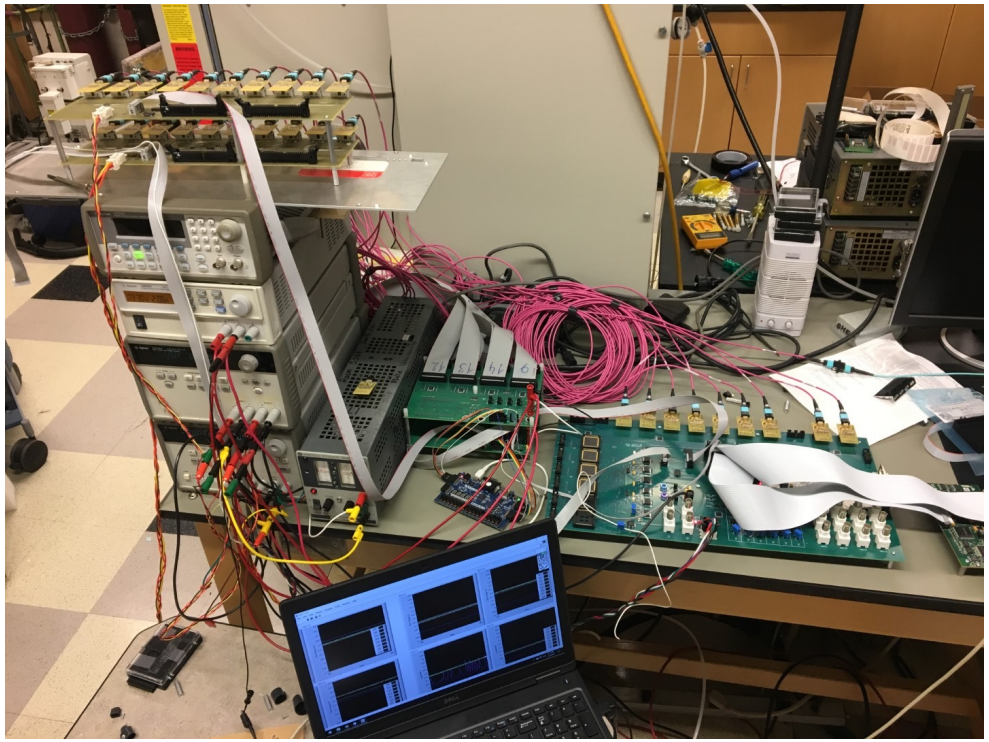
- 2013/14 opto-boards:
  - 4 opto-boards operate with balanced data (40 MHz clock)
  - 4 opto-boards operate with 3 μs burst of data every 10 μs
    - compare failure rate at 85 C/85% relative humidity to see if the burst mode causes more failures

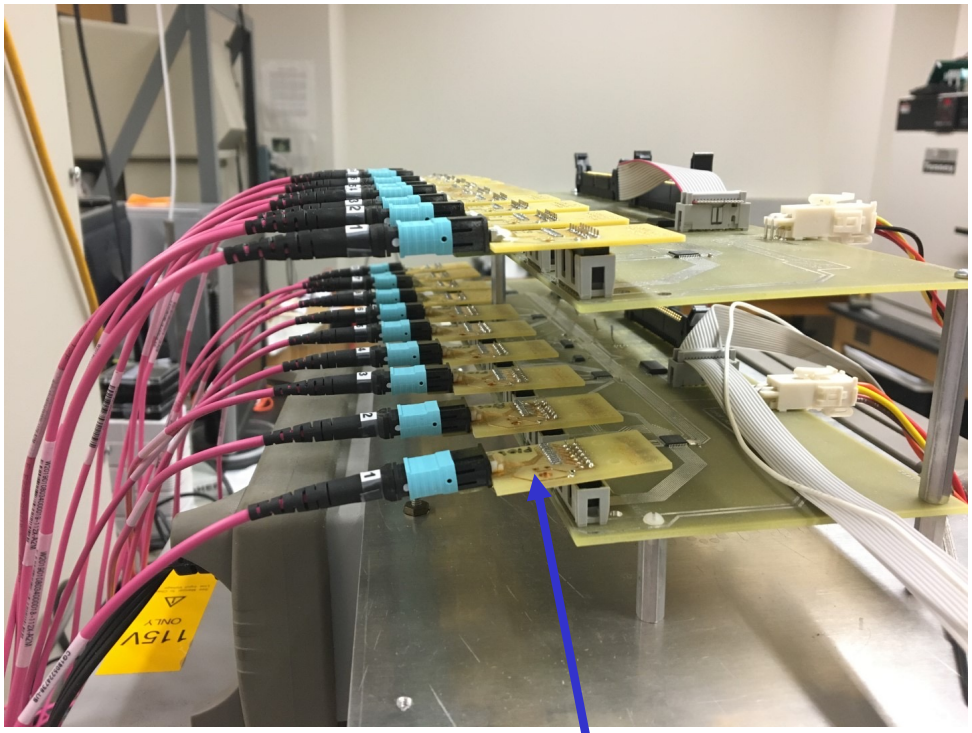
VCSEL/PIN Qualification Plan

- 2018 opto-boards:
  - irradiation I:
    - 4 Finisar and 4 ULM opto-boards
      - 64 Finisar and 64 ULM VCSEL channels
      - 32 Finisar and 32 ULM PIN channels
  - irradiation II:
    - 4 II-VI, 1 Finisar, 1 ULM opto-boards
      - 32 II-VI VCSEL channels
      - 8 Finisar and 8 ULM VCSEL channels
  - target dose with 24 GeV protons: 3 x 10^{12} p/cm^2 for 200 fb^{-1}
    - received dose: ~3.8 x 10^{13} p/cm^2
  - compare failure rate at 85 C/85% relative humidity to select vendor with less failures in 1,000 hours

Opto-Boards in 85/85 Chamber

85/85 Test System

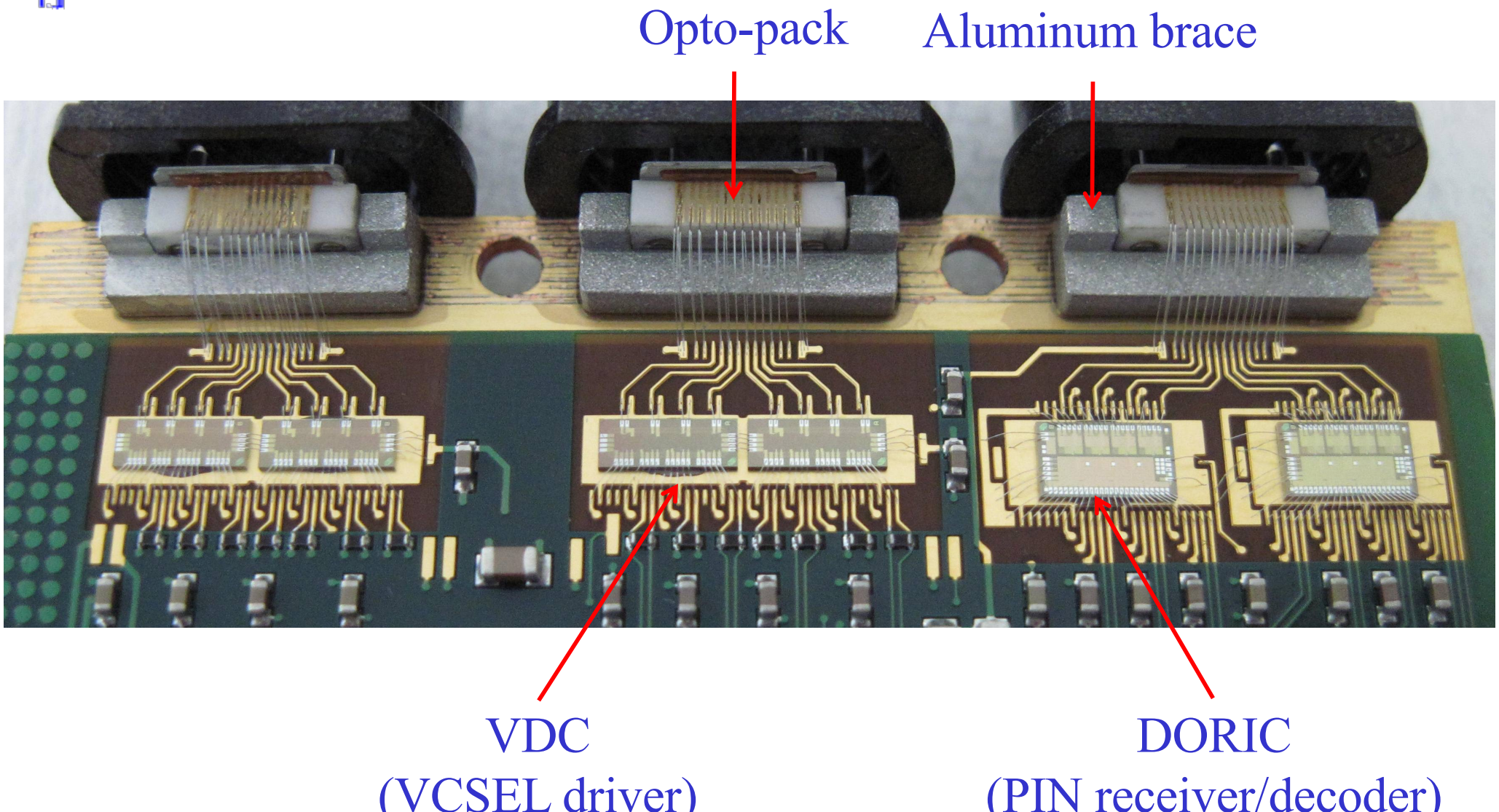




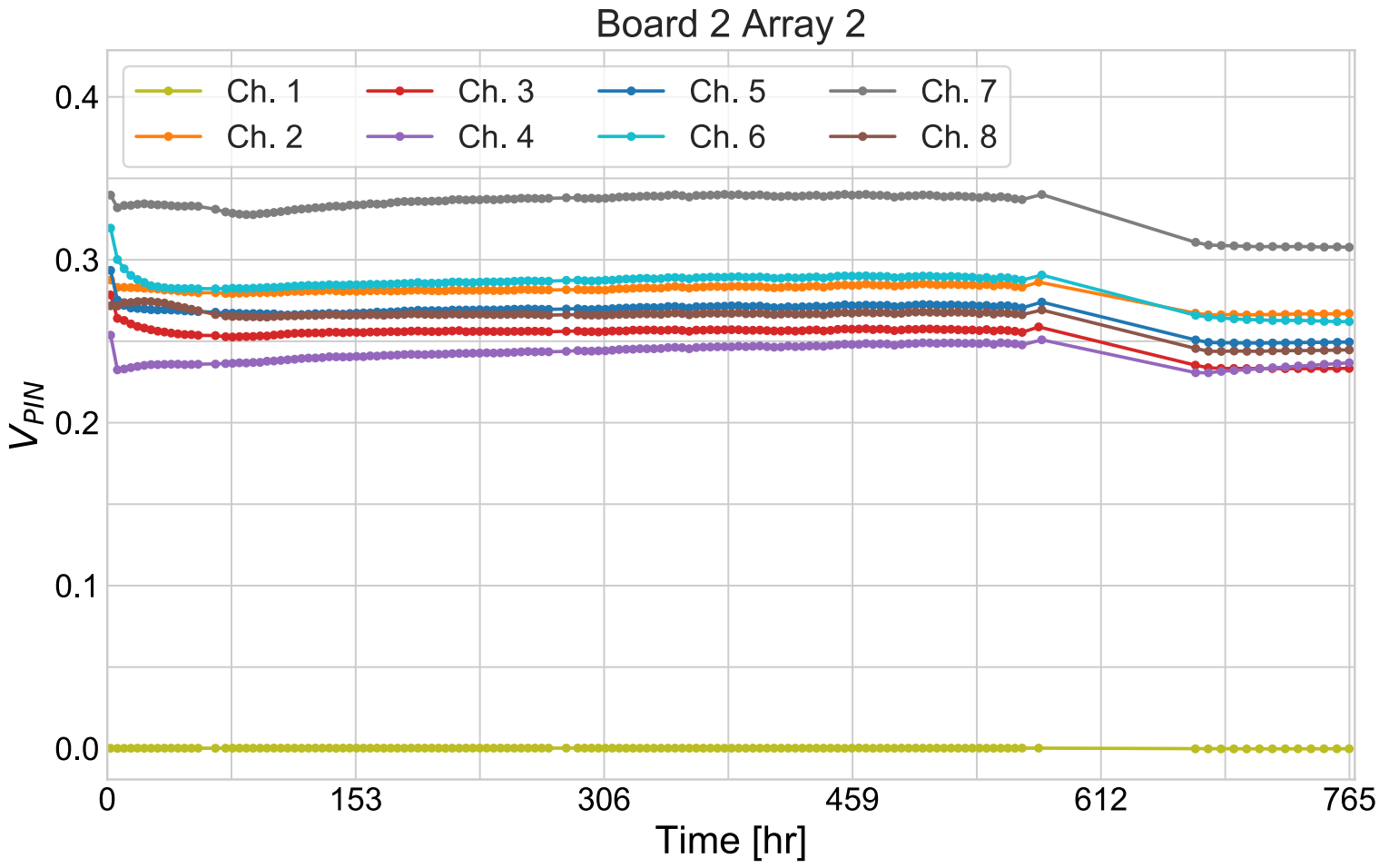
2013/14 Opto-boards Test History

- 8 opto-boards were studied
  - ran for ~3 days at room temperature
  - one VCSEL array from two boards produce no optical power within few hours of operating at 85 C/85% RH
    - both arrays confirmed to have no power at QA system
    - no new failures after several days of testing at room temperature, 85 C, 85% RH
      - ⇨ resume operation at 85 C/85% RH
      - ⇨ one more array from one of the two boards failed few days later…
      - ⇨ VCSELs recovered if pressed on wire bond encapsulant
      - ⇨ VCSEL arrays detached at 85 C due to thermal stress
      - ⇨ both boards are labeled “second class” and “no opto-pack reinforcement” in database
      - ⇨ resume operation at 85/85

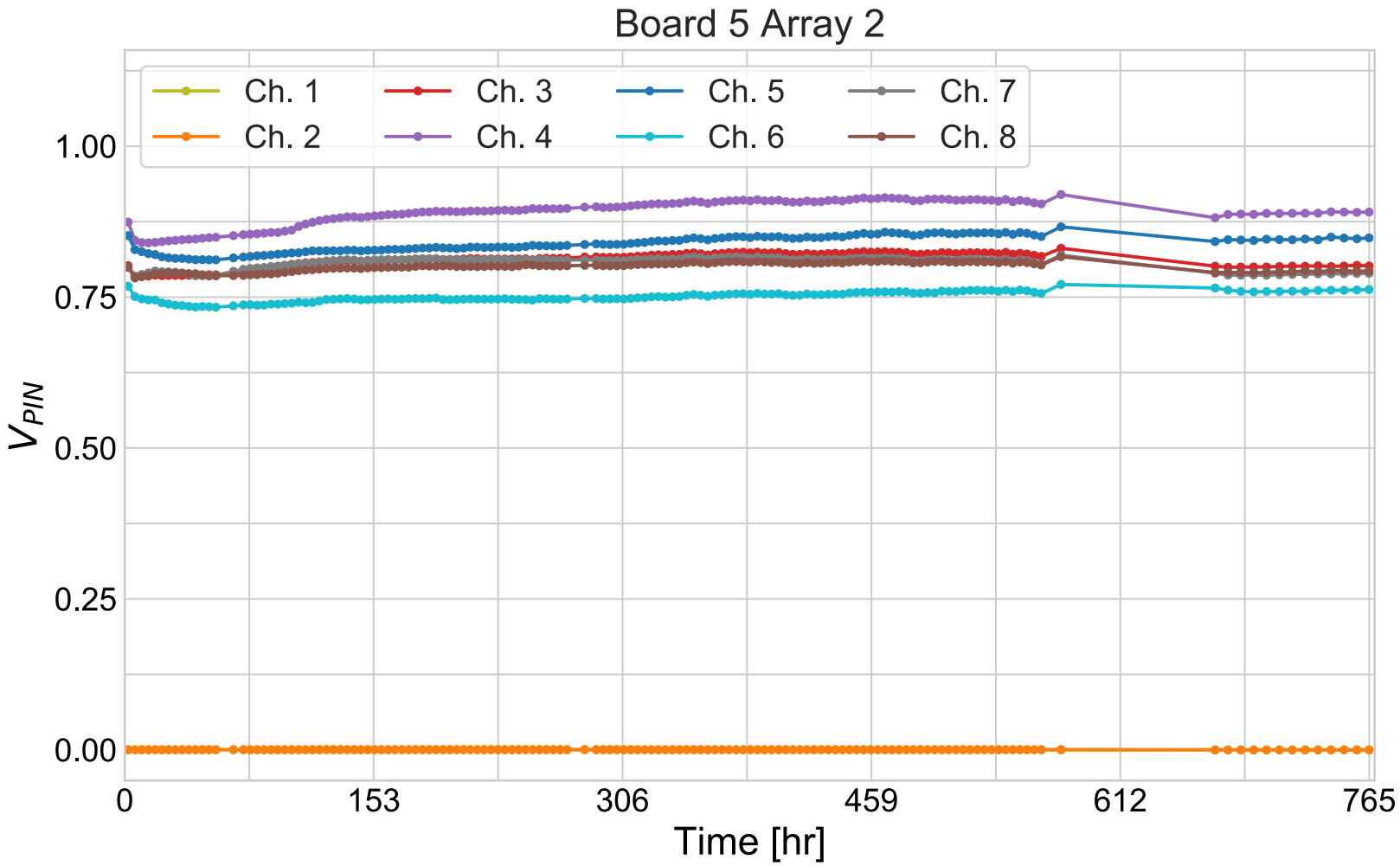
Opto-Pack Reinforcement



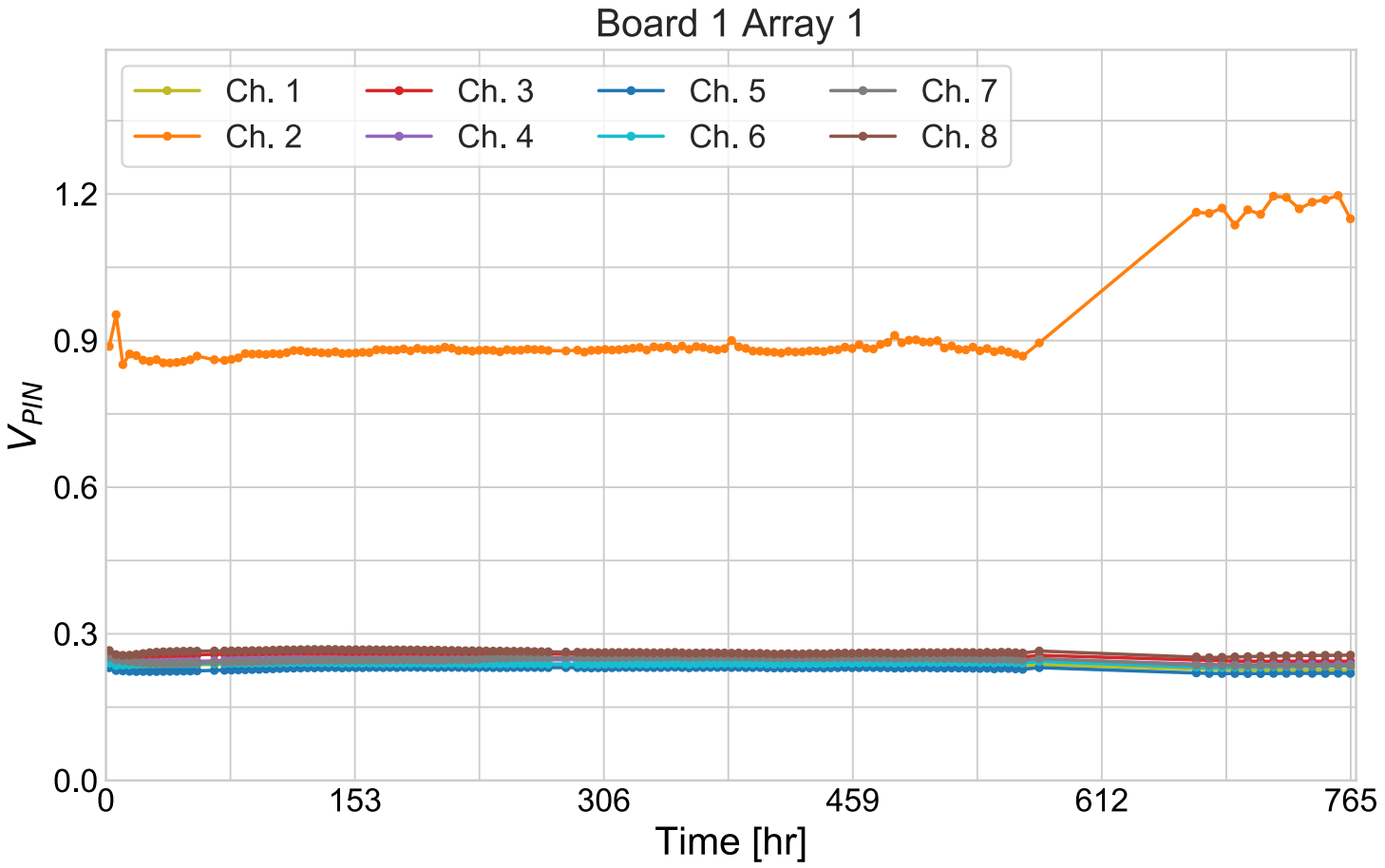
Optical Power vs. Time (Burst)



Optical Power vs. Time (Clock)



Optical Power vs. Time (Burst)

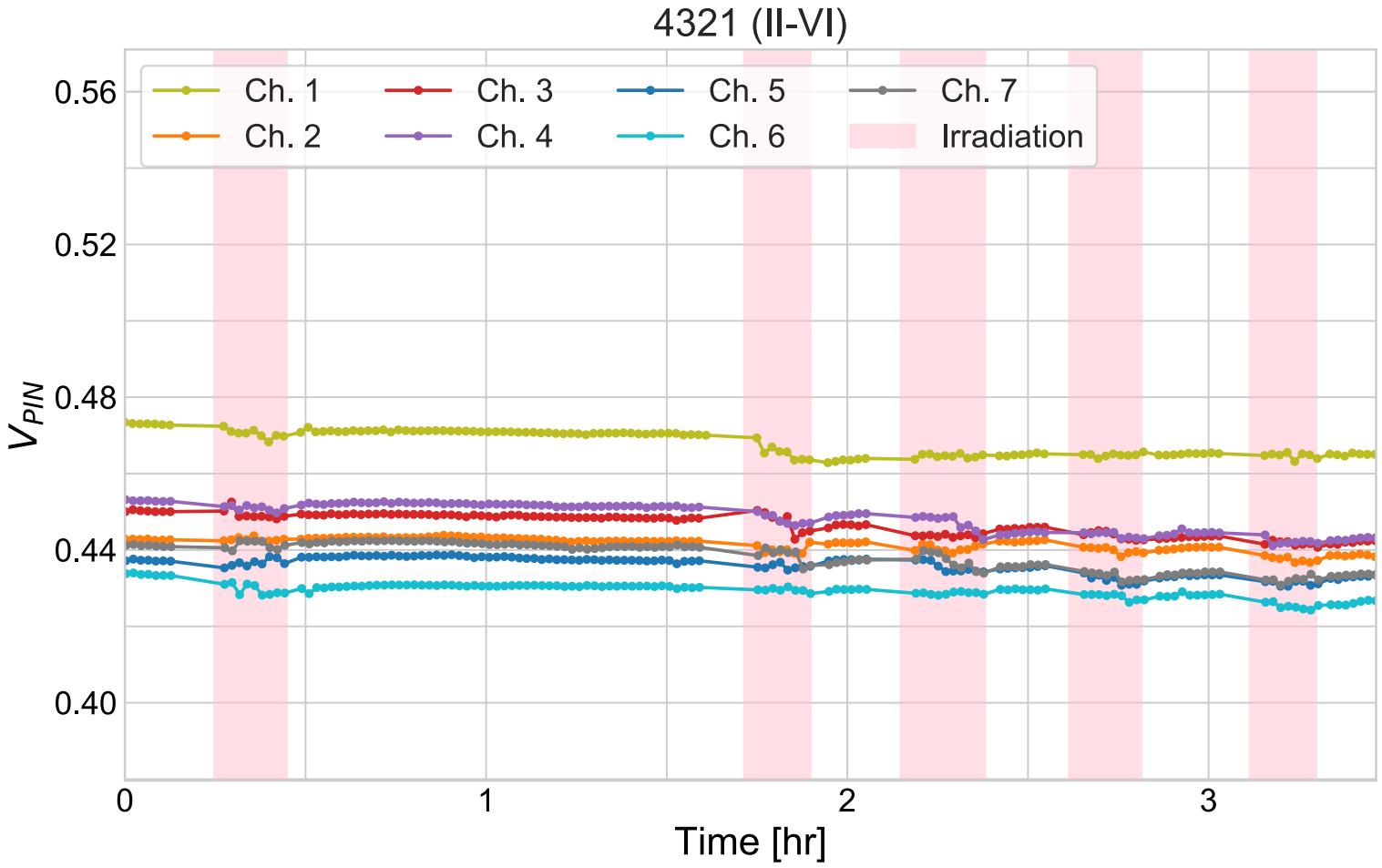


- one channel has connection problem: receiving all “1”
  - VCSEL not dead!!

Summary: 2013/14 Opto-Boards

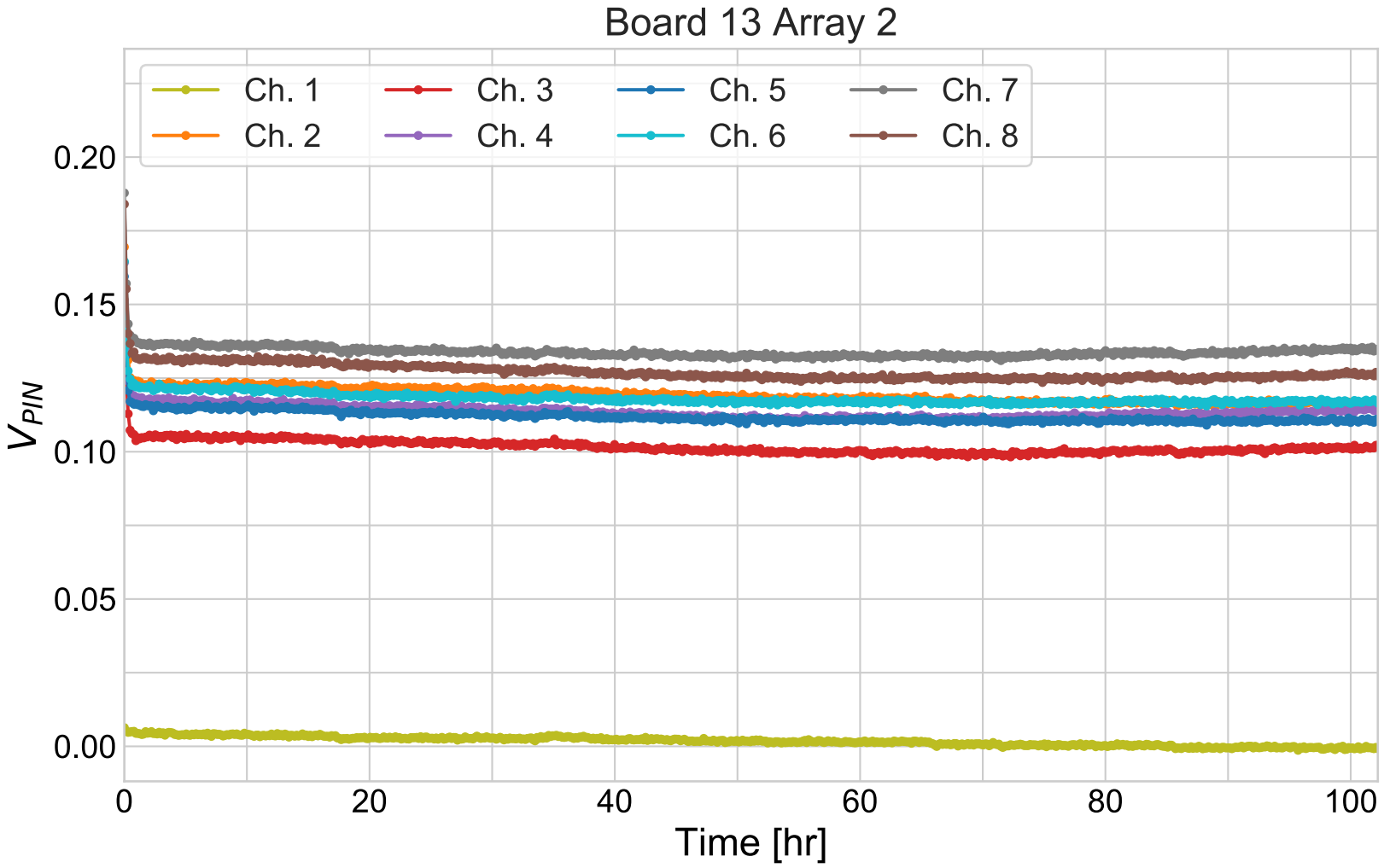
- accumulated ~700 hours of operation at 85 C/85% RH
  - no VCSELs have died yet…

Report on Irradiation II

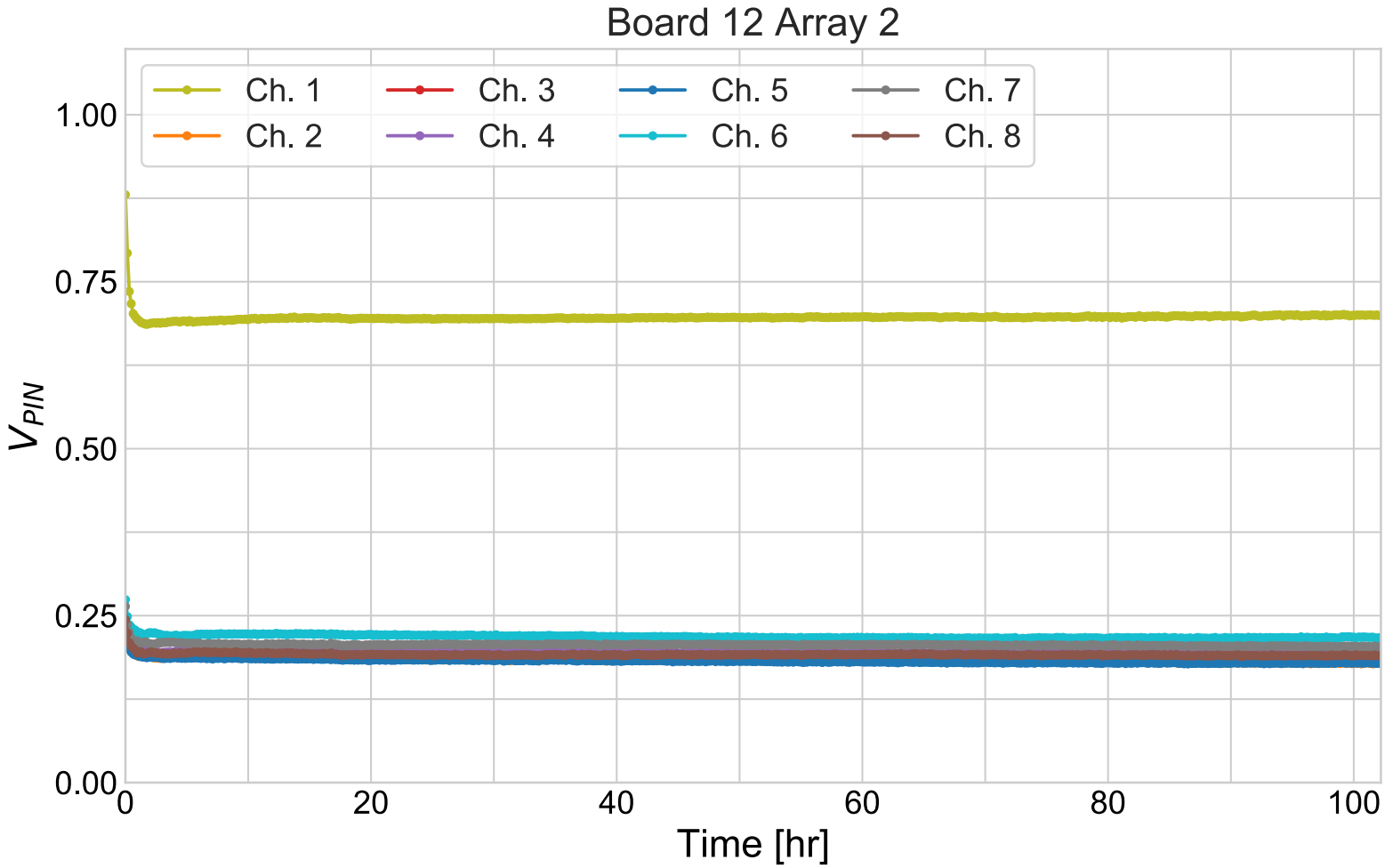


- no VCSELs died during irradiation

85/85 Test on Irradiated Boards



85/85 Test on Irradiated Boards



- one channel has connection problem: receiving all “1”
  - VCSEL not dead!!

Summary: Irradiated Opto-Boards at 85/85

- accumulated ~100 hours of operation at 85 C/85% RH for 4 Finisar + 4 ULM opto-boards
  - 9 out 132 channels have connection problems but VCSELs not dead yet…
- 6 boards from irradiation II will be added this week

Summary/Plan

- accumulated ~700 hours at 85C/85% RH for 2013/14 opto-boards
  - no VCSELs have died yet
- four II-VI opto-boards have been irradiated
  - good optical power at end of irradiation
- accumulated ~100 hours at 85C/85% RH for opto-boards from 1st irradiation
  - no VCSELs have died yet
- opto-boards from 2nd irradiation will be operated at 85 C/85% RH this week