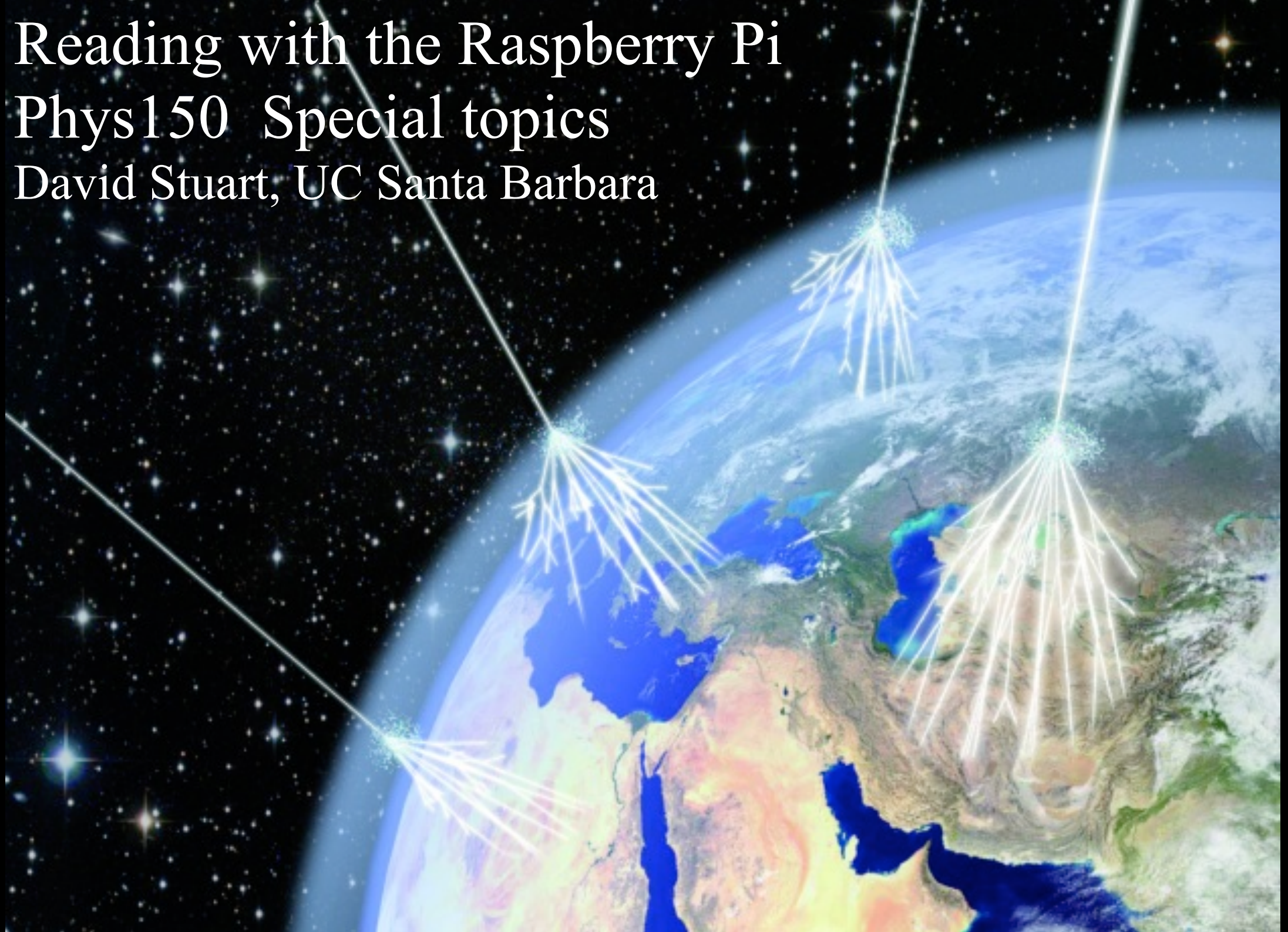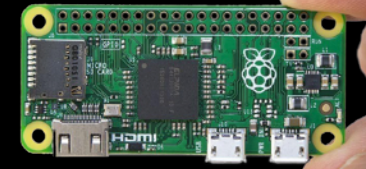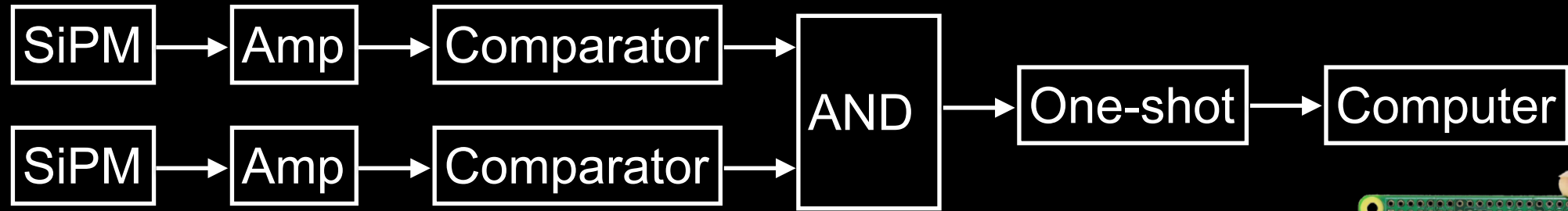# Reading with the Raspberry Pi
Phys150 Special topics
David Stuart, UC Santa Barbara
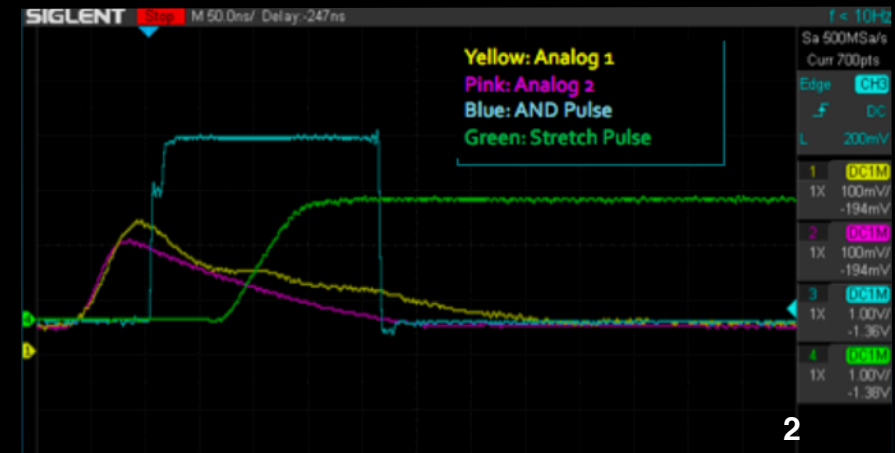
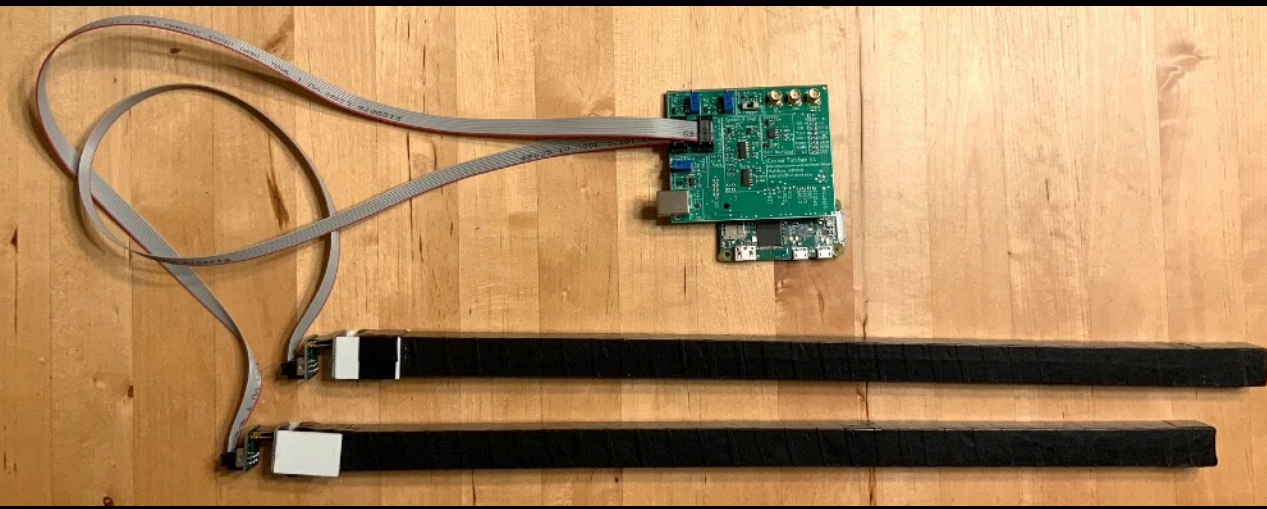# Review: Electronics for the detector

SiPM → Amp → Comparator →
SiPM → Amp → Comparator →
AND → One-shot → Computer

The "stretched pulse" should last for about 100 µs,
which is plenty of time for the RPi to detect it and record the time.

Yellow: Analog 1
Pink: Analog 2
Blue: AND Pulse
Green: Stretch Pulse

Review: Electronics for the detector

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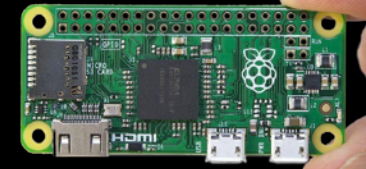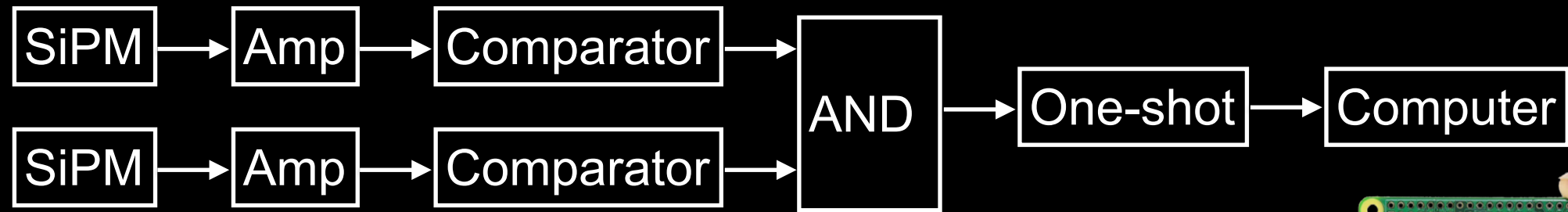
The "stretched pulse" should last for about 100 μs,
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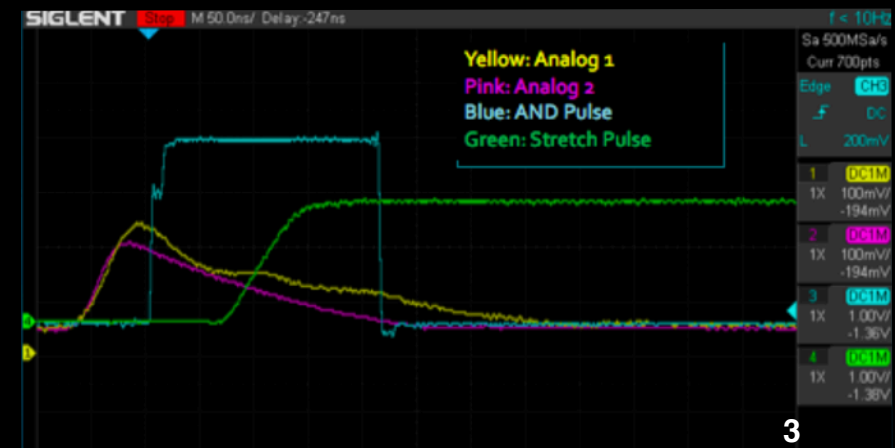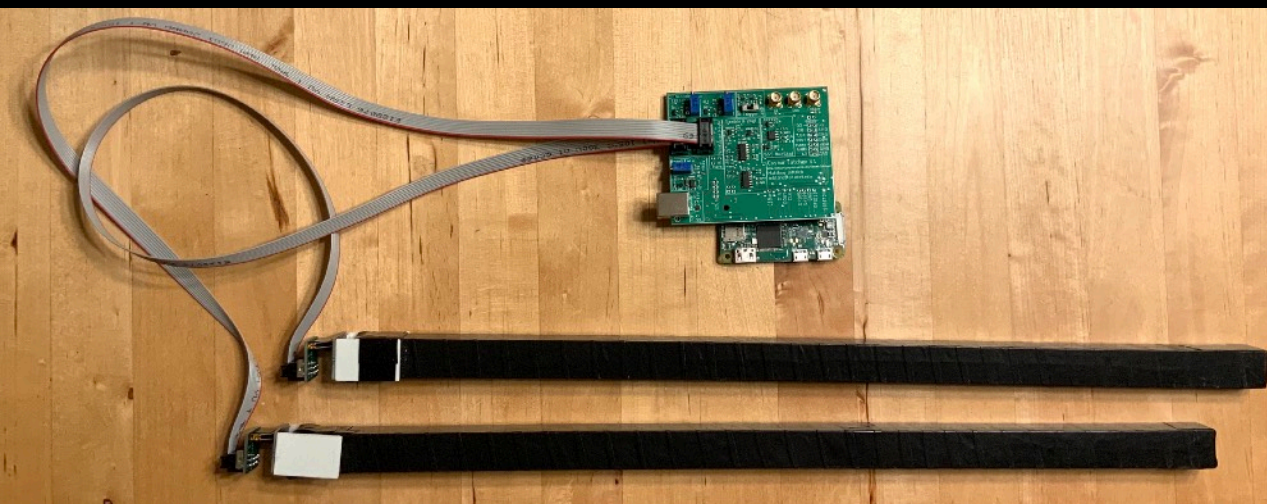Today we will start playing with the detector and discuss how to use it.

Yellow: Analog 1
Pink: Analog 2
Blue: AND Pulse
Green: Stretch Pulse

Pi and board overview

Embedded linux with GPIO pins

40-pin connector hard to remove; don't need to press it in fully.
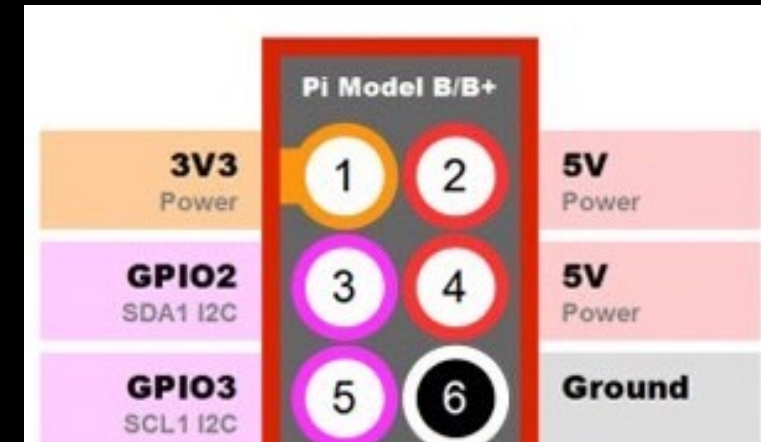
Tour of the detector board: Power

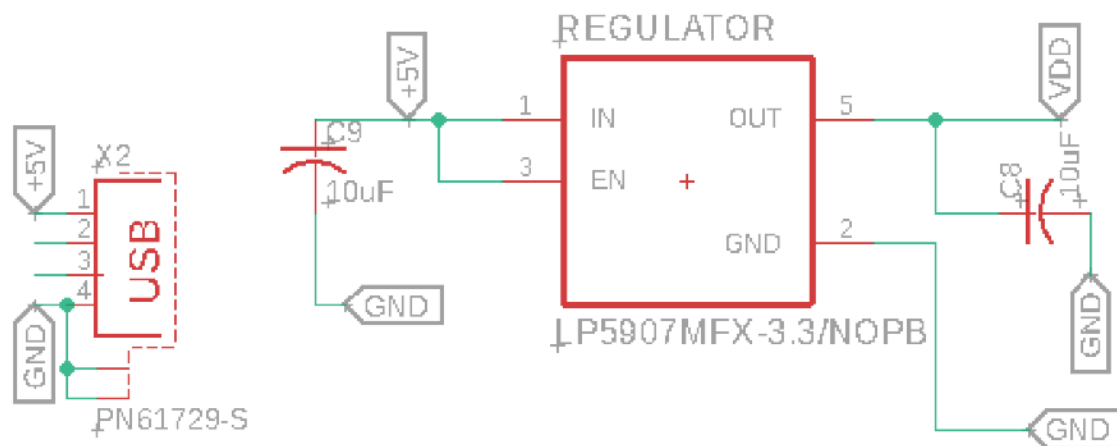The 5V input is unstable and noisy. Regulate it down to 3.3 V. The RPi has a 5V supply and a 3.3 V regulated supply. Keep them separate to avoid noise from Pi or load to Pi.

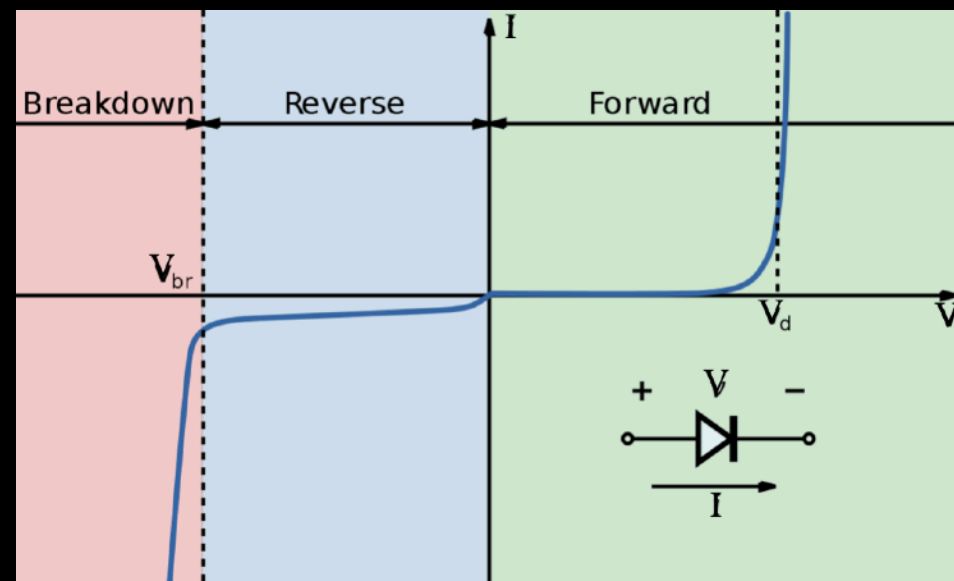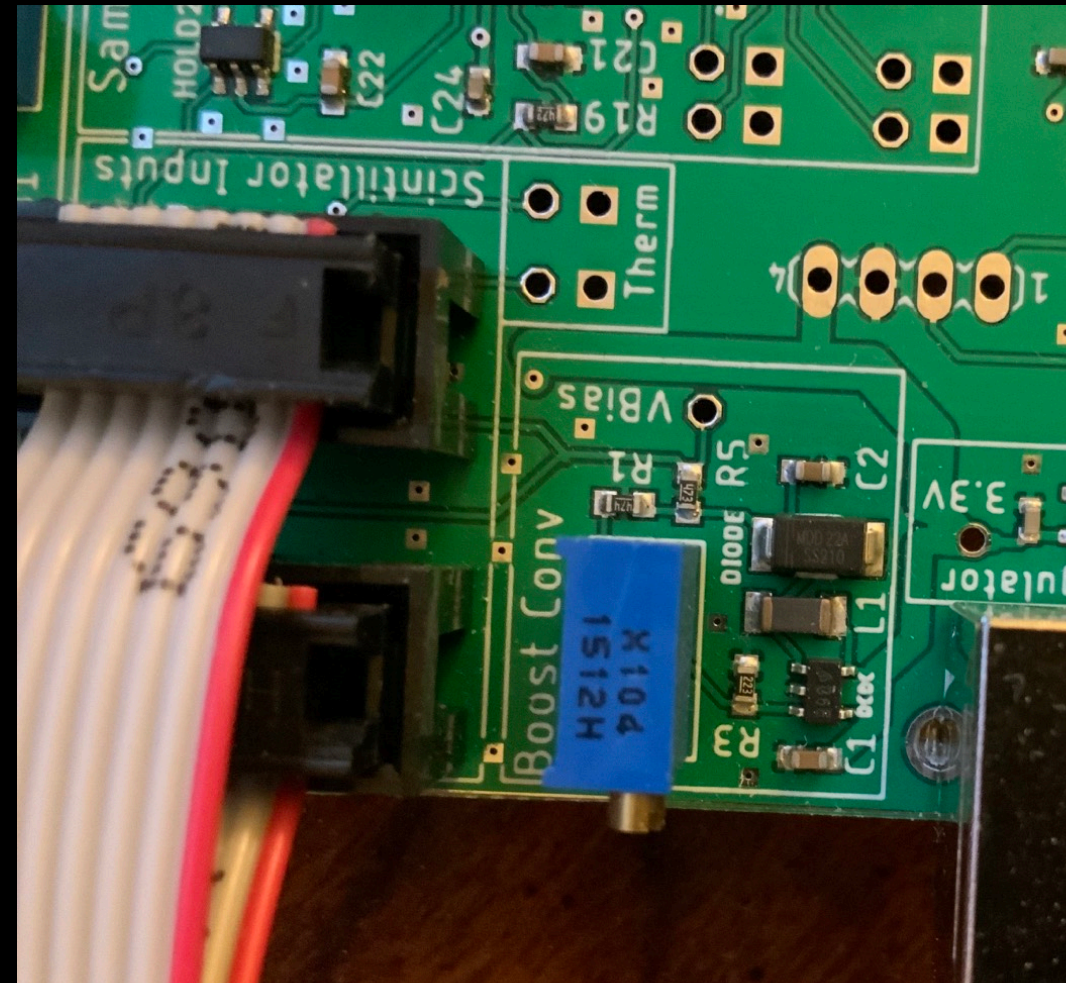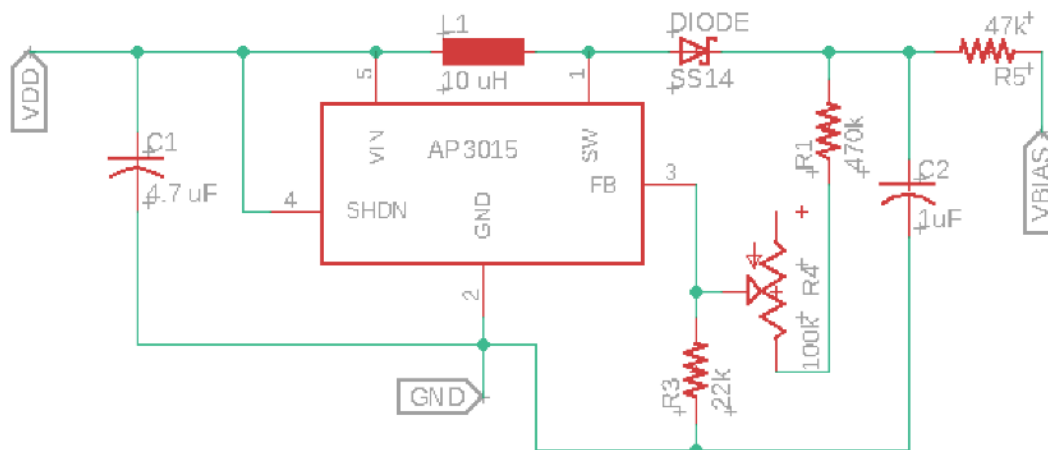Note probe points to measure supplies.

Use a DC-DC boost converter to generate ~28 V for SiPM

Can look up the data sheet for the AP3015 part number.
Adjust pot for bias voltage.

Scintillator Inputs

OR AND Trigger

INV1 C7

555 OneShot

INV2 C25

R2
C10
C11

OUTPUT

D2		D1
OR		AND
CLK		TRG
DOUT		DIN
CSBAR		VDD
GND		GND
A2		A1

CSBar DIN DOUT CLK GPIO5 GPIO6 GND GPIO13 STRETCH
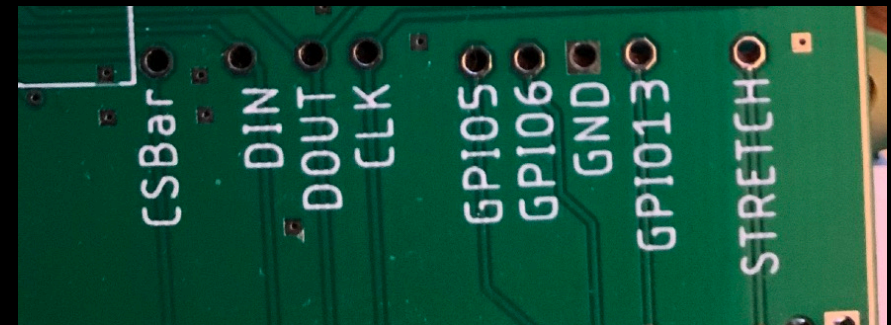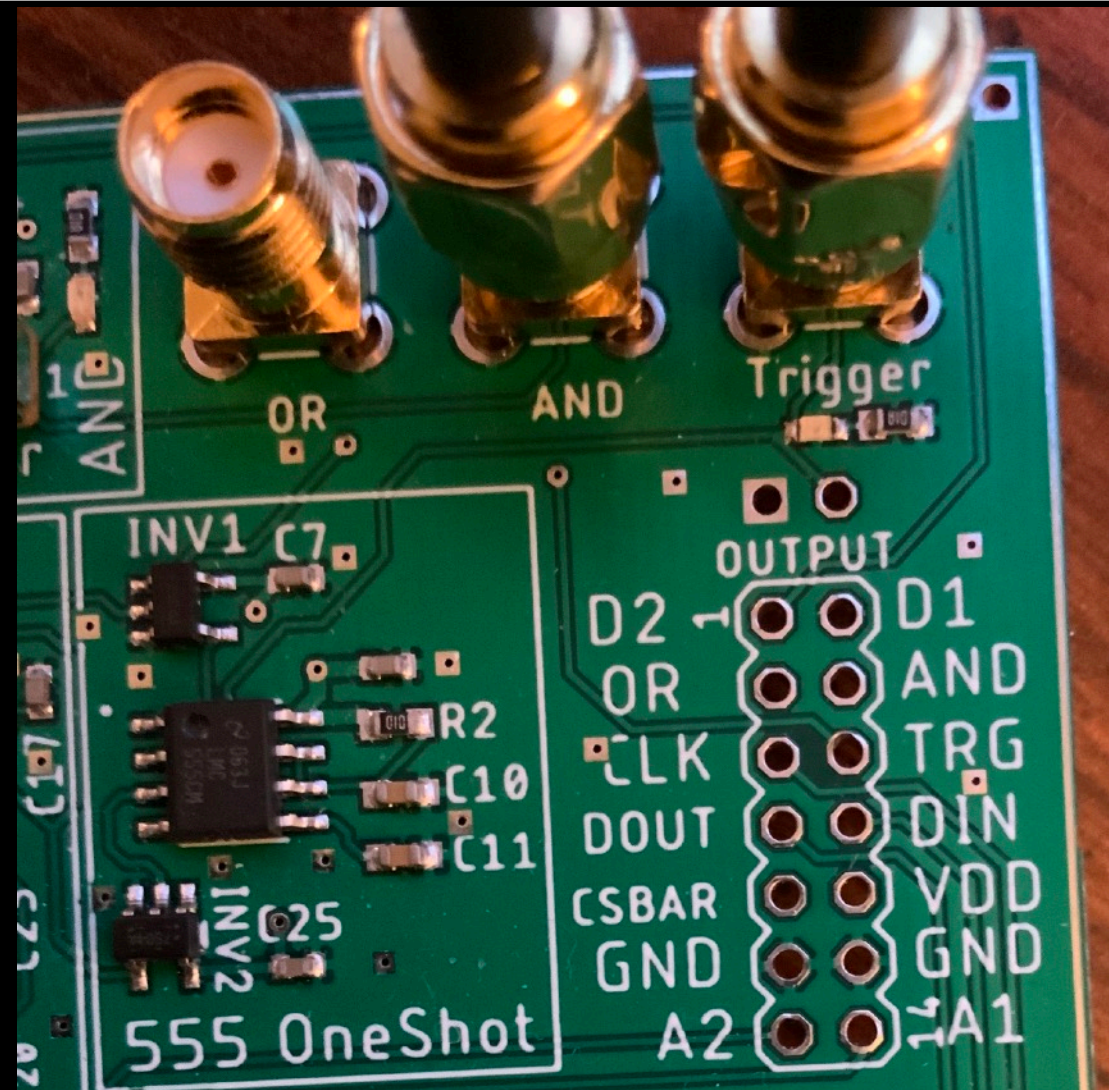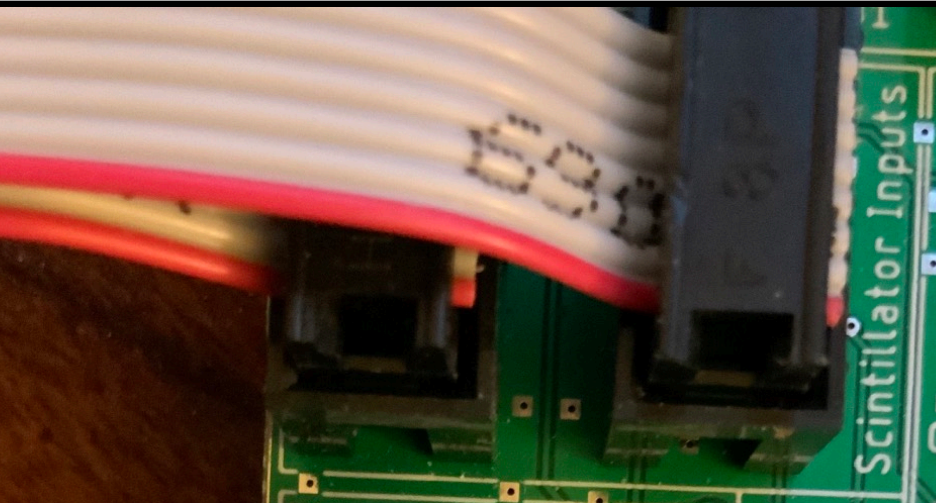
Tour of the detector board: discriminators (AKA comparators)

Adjust pots to set threshold for each channel. (Probe points.)
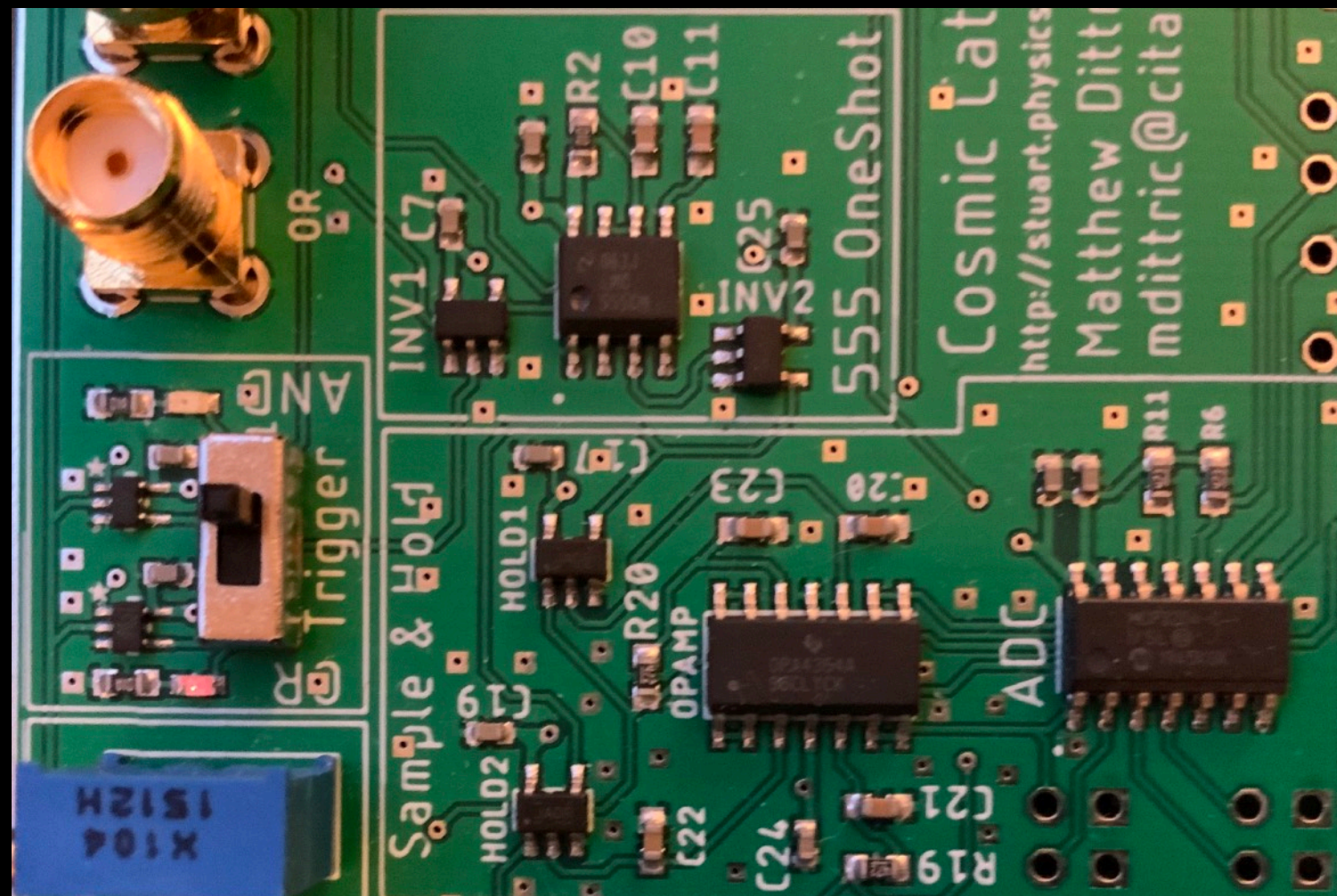Note ~50 mV DC offset.
Scope trace taken with threshold = 248 mV.

Tour of the detector board: AND and one-shot

OR and AND gates provide both signals; switch chooses one for output.
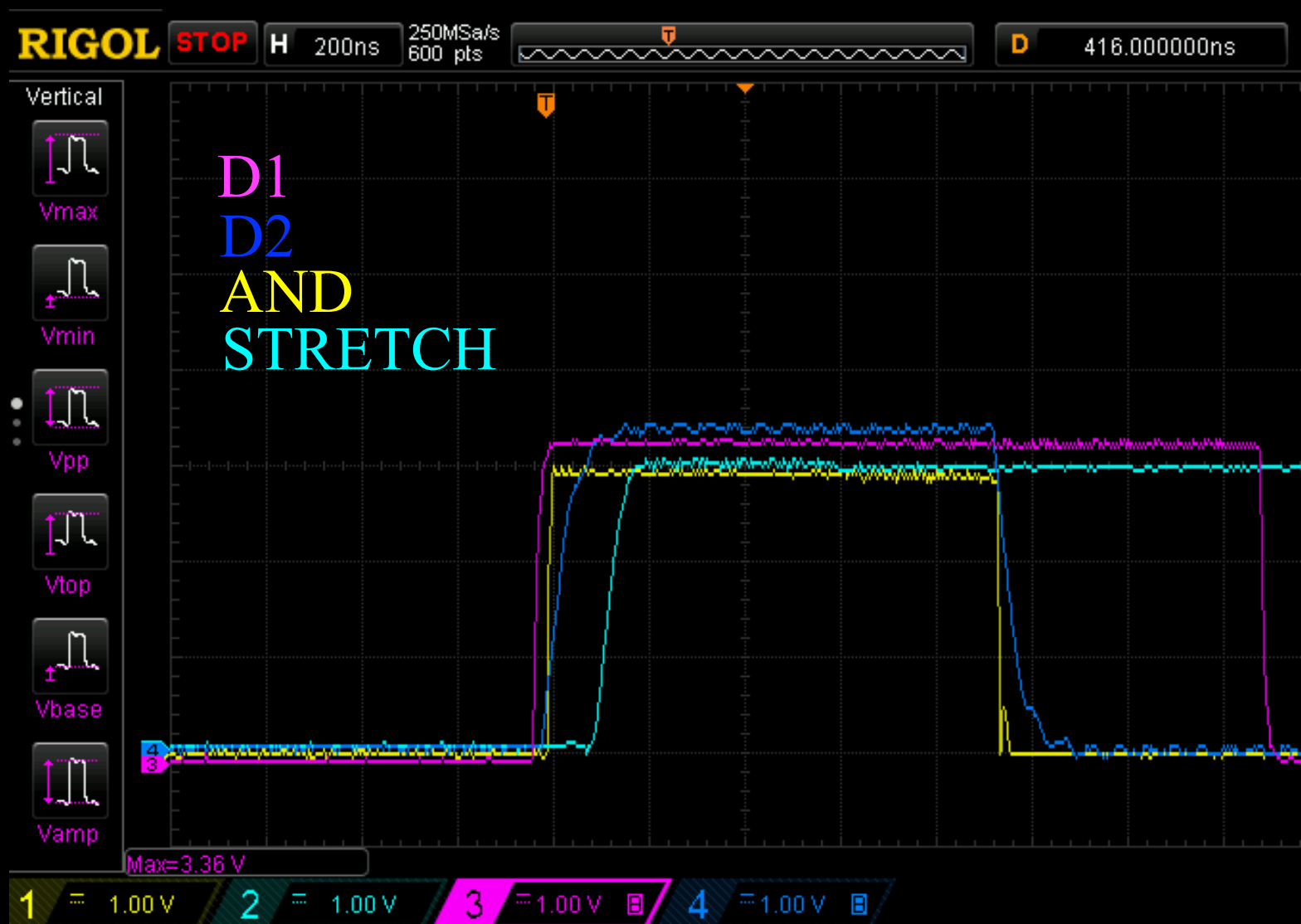
The AND is what we use for cosmics.
One-shot stretches pulse to about 100 μs.
The Sample & Hold + ADC will be used later.
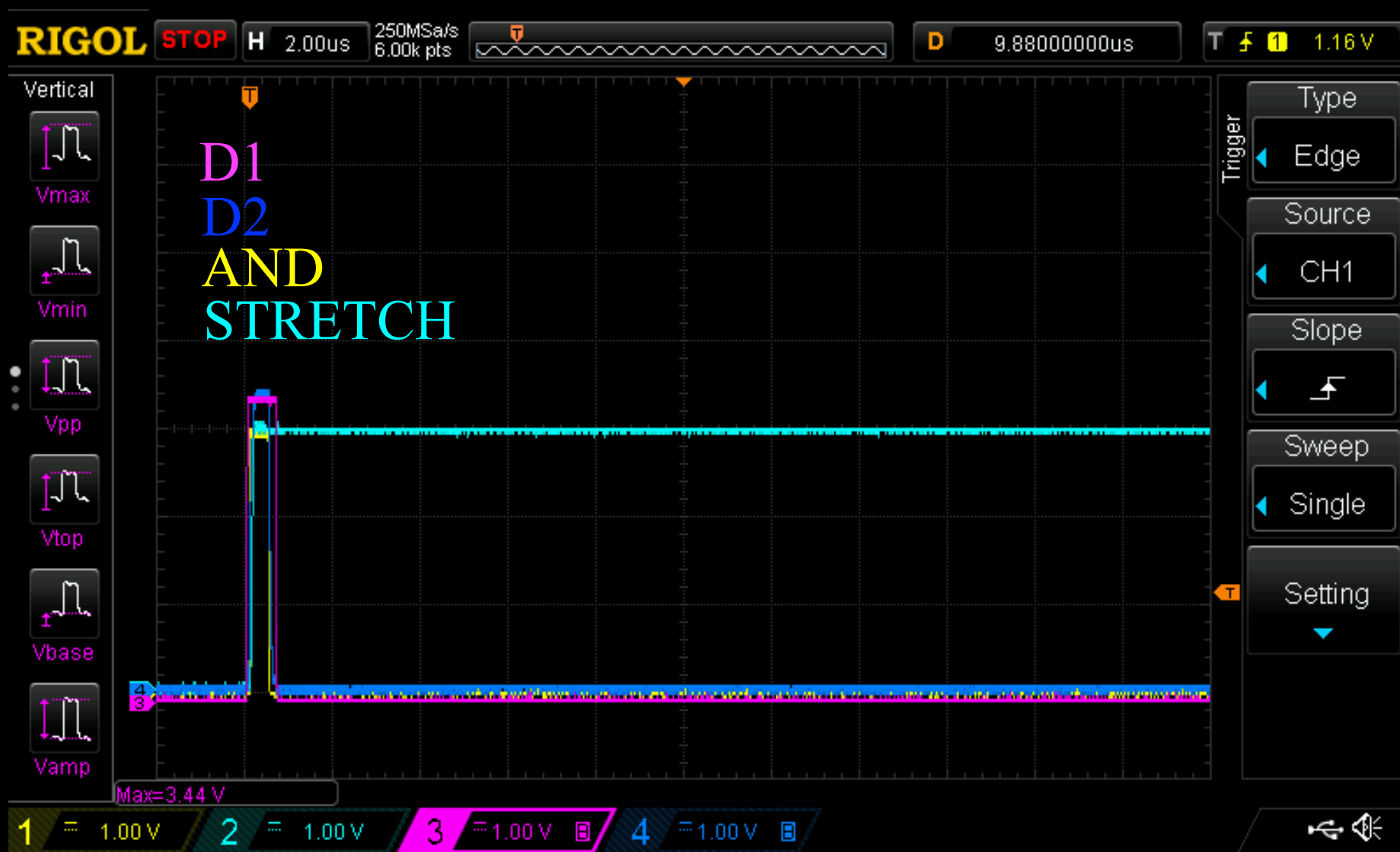
Tour of the detector board: AND and one-shot

Example of AND and STRETCH

Tour of the detector board: AND and one-shot

Example of AND and STRETCH

Tour of the detector board: AND and one-shot

Example of AND and STRETCH
Looks more like 230 μs.

Tour of the detector board: AND and one-shot

Example of AND and STRETCH
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Tour of the detector board: AND and one-shot

Example of AND and STRETCH
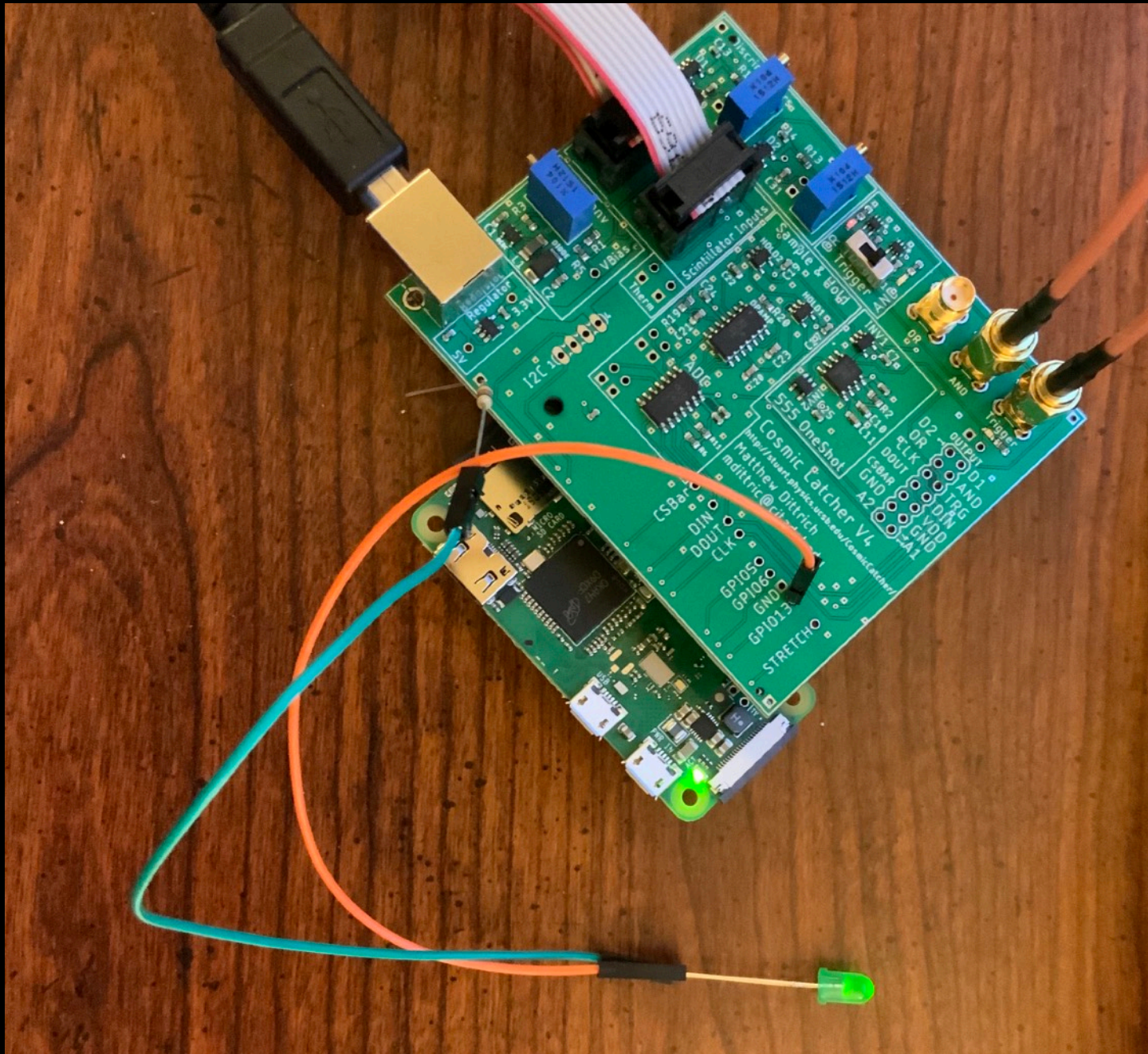Looks more like 230 µs.

Playing with the board

Check for light leak…

Adjust bias down until AND flashing is about 1 Hz when vertical stack.

Compare trigger flash rate in vertical vs side-by-side orientation.

Demo the pi to flash an LED and read the STRETCH signal.

Long end is positive.

Saving data

We will want to save the data in a format that allows later offline correlation. So, I will define an output file format as a text file with each line corresponding to one measurement or other data point.

DataType PiID Date Values

But, you are free to design your own, just document it.