REAL-TIME DATA DASHBOARDS WITH PYTHON

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Pacific University Oregon

AAPT Winter Meeting 2020
Orlando FL

NSF

PYTHON FEATURES

FREE

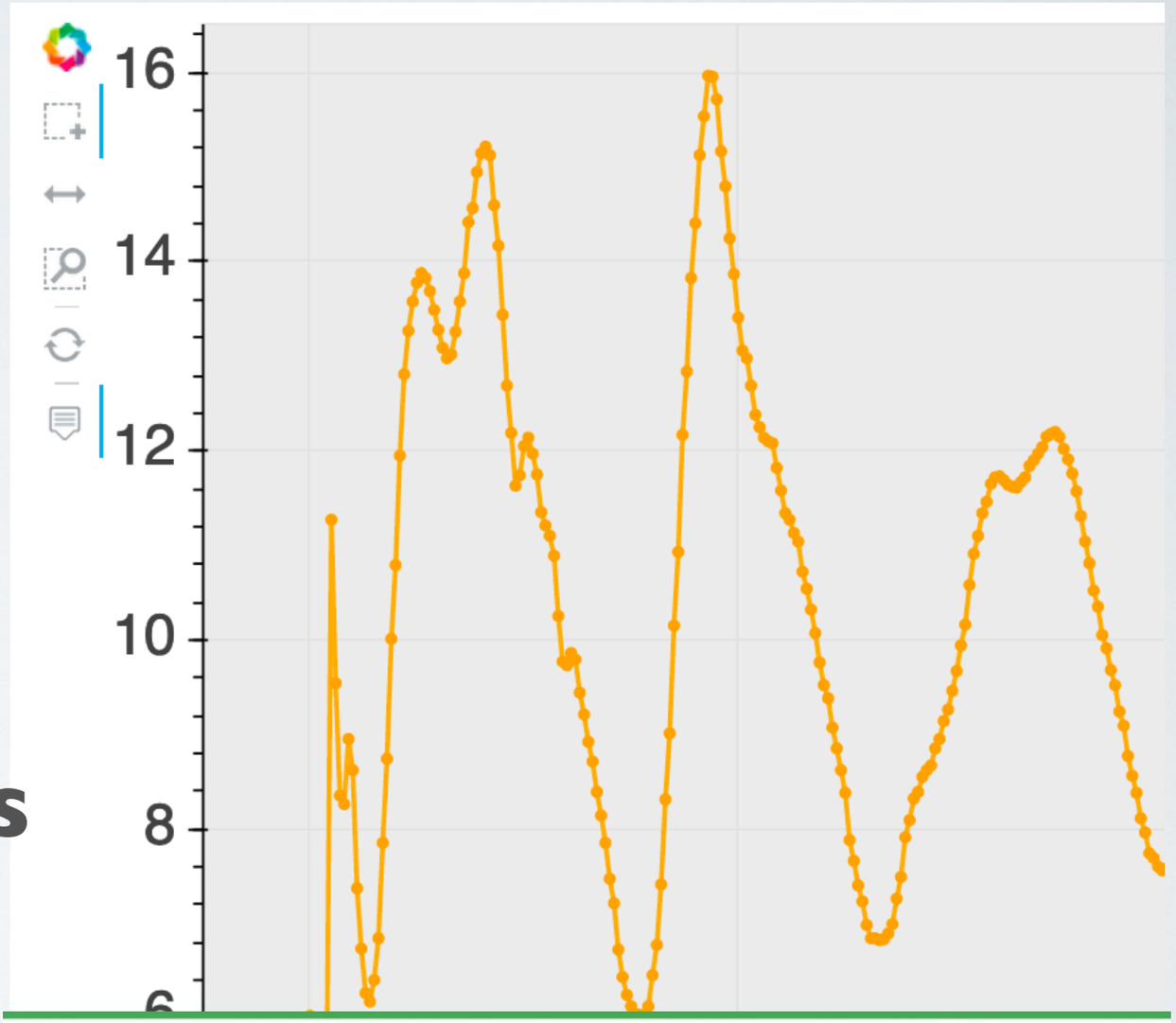
- **Readable**
- **Simple**
- **Extensible**
- **Cross-platform**
- **Community**

python™

Enabling Tools!

DATA DASHBOARDS

- **Display information**
- **Analyze results**
- **Generate reports**
- **Control instruments**
- **Open tools**



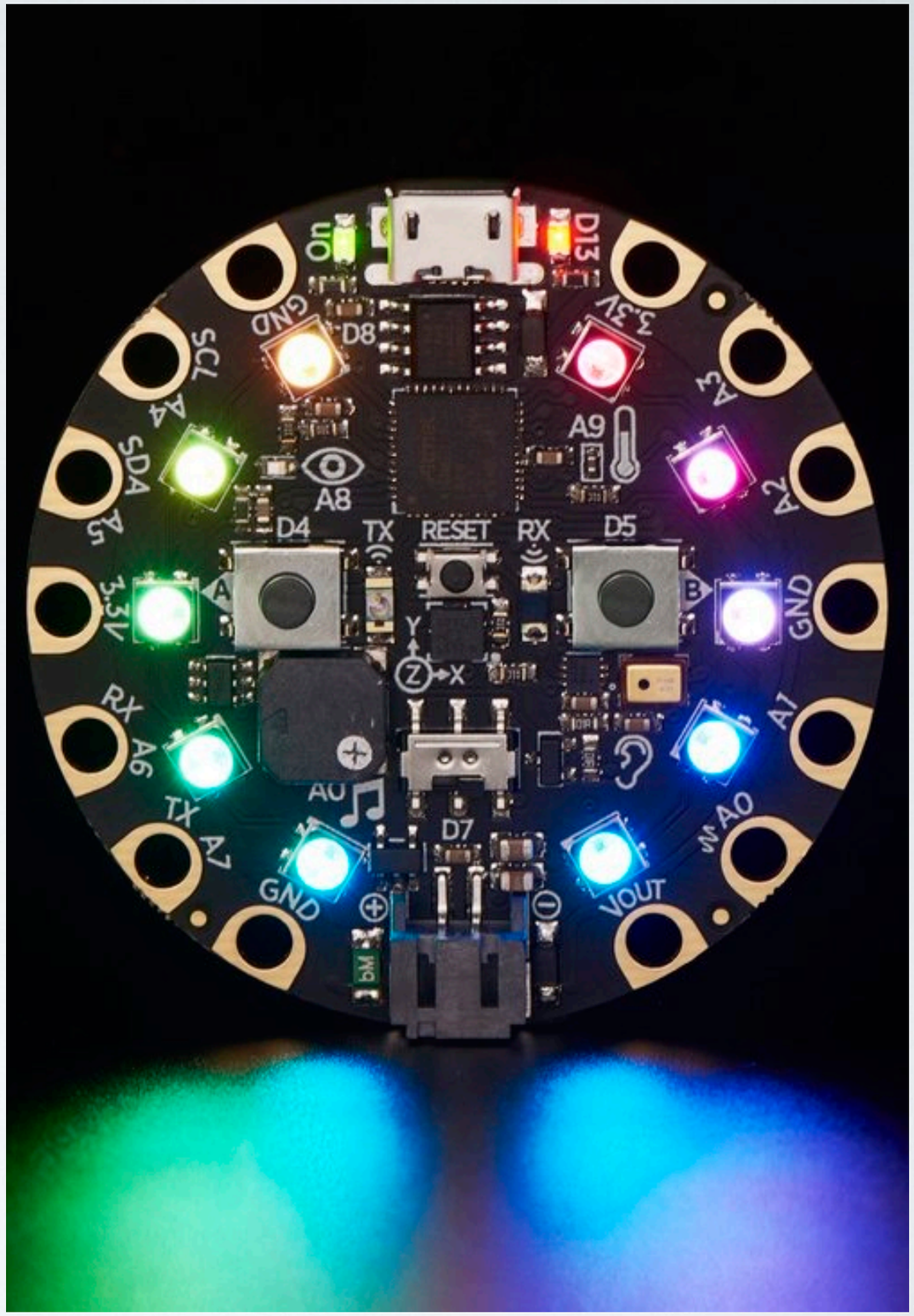
open source hardware

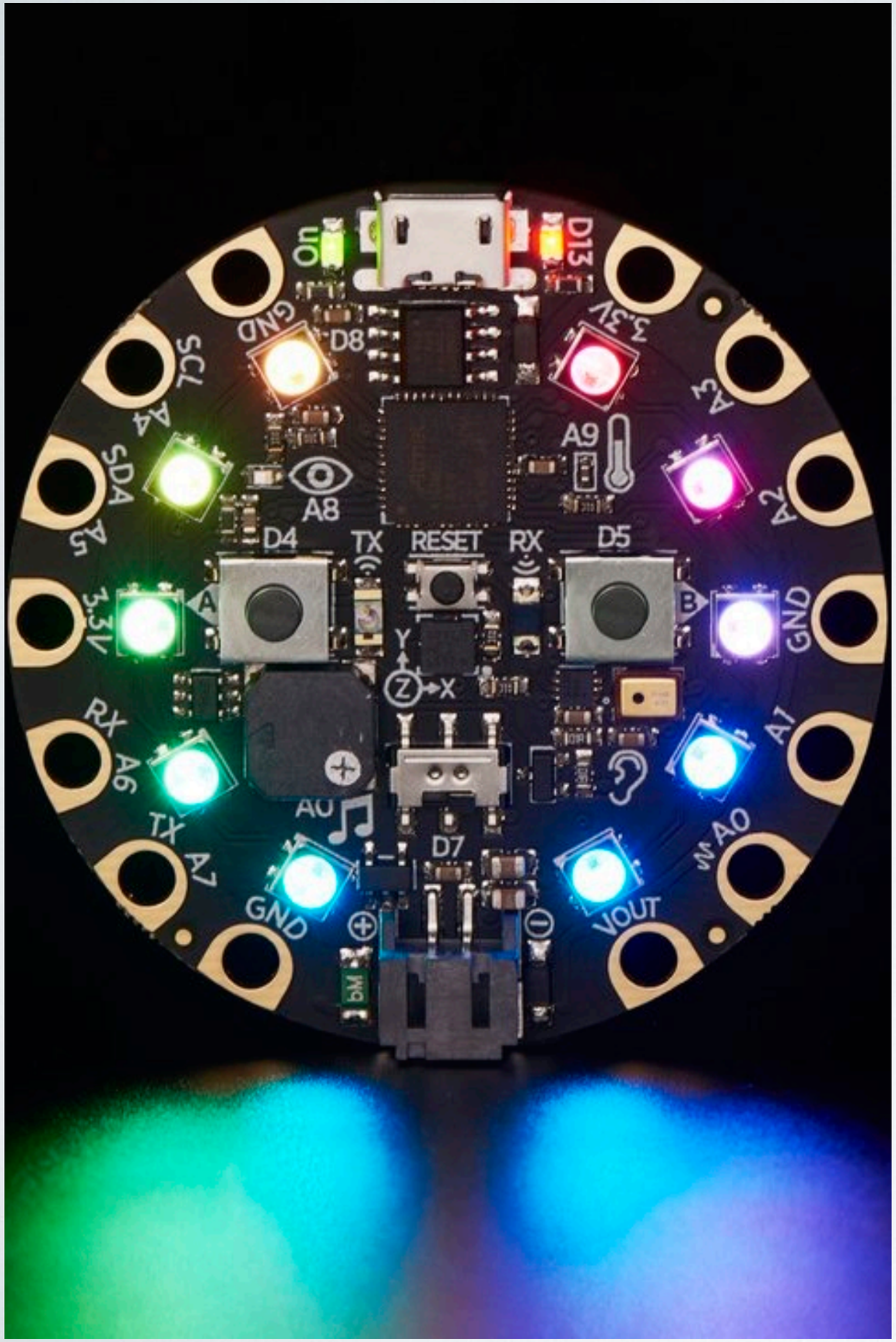
open source™

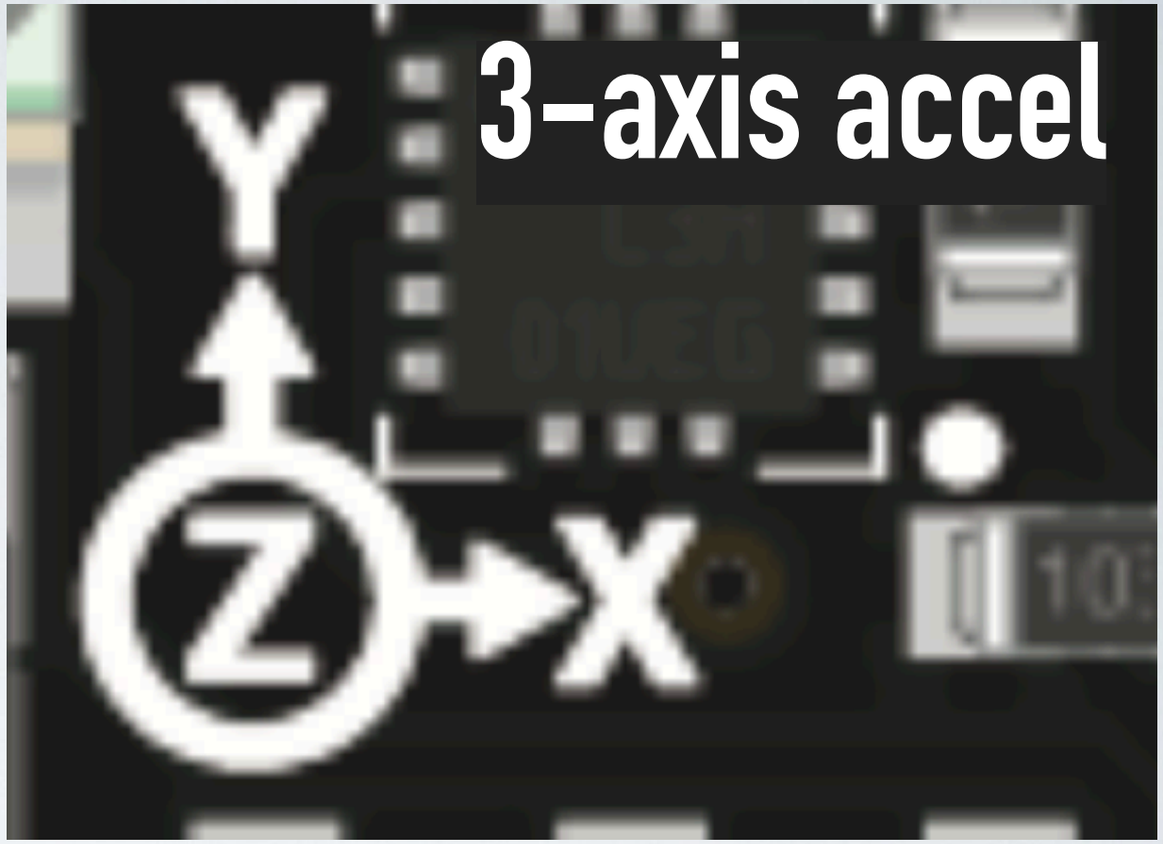
CC

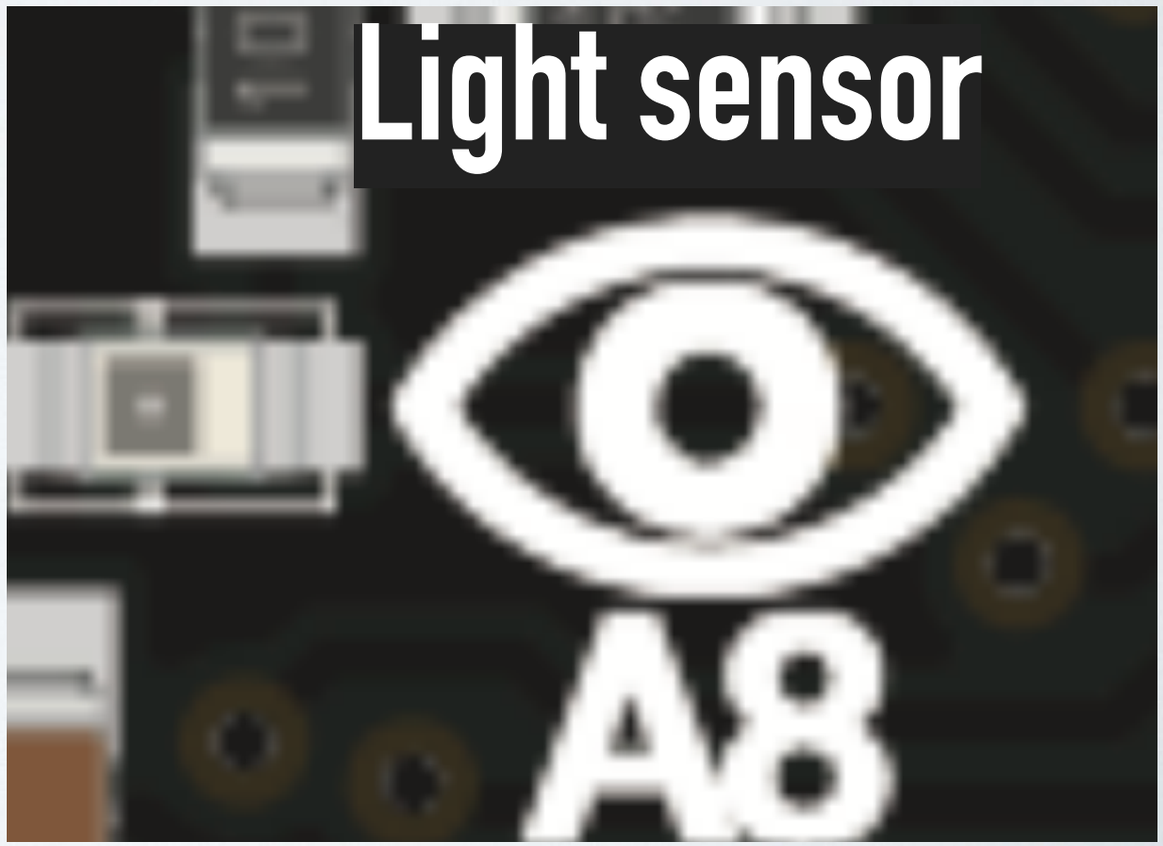
HARDWARE

Features and specifications



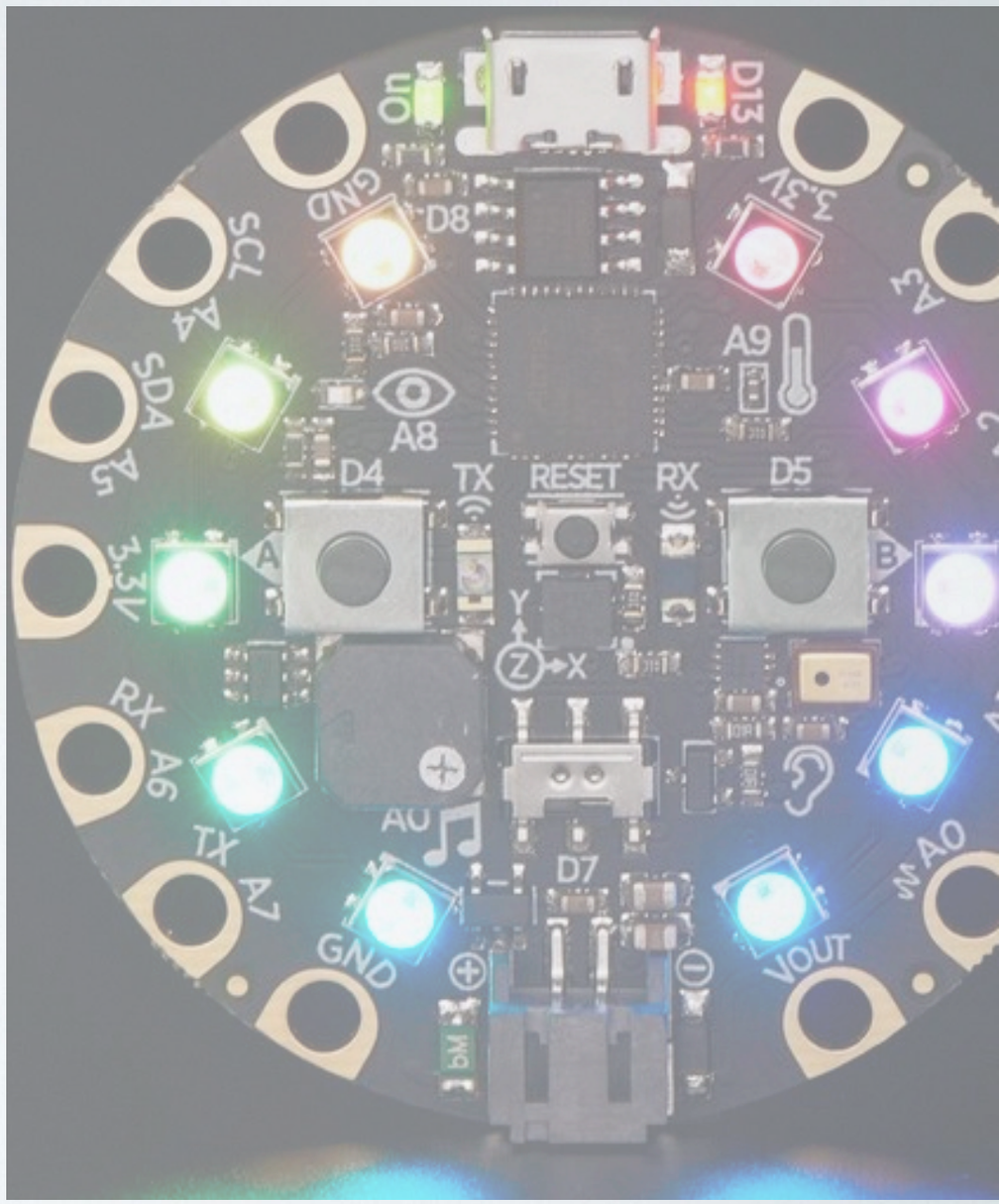

On
D13
GND
3.3V
D8
SCL
A4
SDA
A5
A9
A3
A2
A8
D4
TX
RESET
RX
D5
3.3V
A
B
GND
Y
Z
X
RX
A6
A1
TX
A7
A0
GND
VOUT
bM


3-axis accel
Y
Z
X


Light sensor
A8

ADAFRUIT CIRCUIT PLAYGROUND EXPRESS (CPE)

- **Open source**
- **$24.95**
- **Software options:**
  - **Arduino**
  - **CircuitPython**
  - **Microsoft MakeCode**



adafruit CIRCUIT PLAYGROUND ex

I/O

NeoPixel	38	PB23	EINT7	S5:3			8
Speaker	3	PA02	EINT2	DAC		AIN0	A0
Temp. Sensor	14	PA09	EINT9	S2:1	I2SMC	AIN17	A9
					I2SF0	AIN19	A8
					I2SD1	AIN16	
					I2SCK	AIN18	

Button A	41	PA28	EINT8	S5:3			4
Button B	23	PA14	EINT14	S2 4:2			5
Slide Switch	24	PA15	EINT15	S2 4:3			7
IR TX	32	PA23	EINT7	S3 5:1	I2C	SOF	25
IR RX	21	PA12	EINT12	S2 4:0	I2C		26

Power
GND
Physical
Port PIN
Analog

PWM P
Port

3 A4

2 A5

Abso
the

GPIO
Neve

0 A6

1 A7

I/O

NeoPixel
Speaker
Temp. Sensor
Light Sensor
Sound Sensor

Button A
Button B
Slide Switch
IR TX
IR RX
Accelerometer

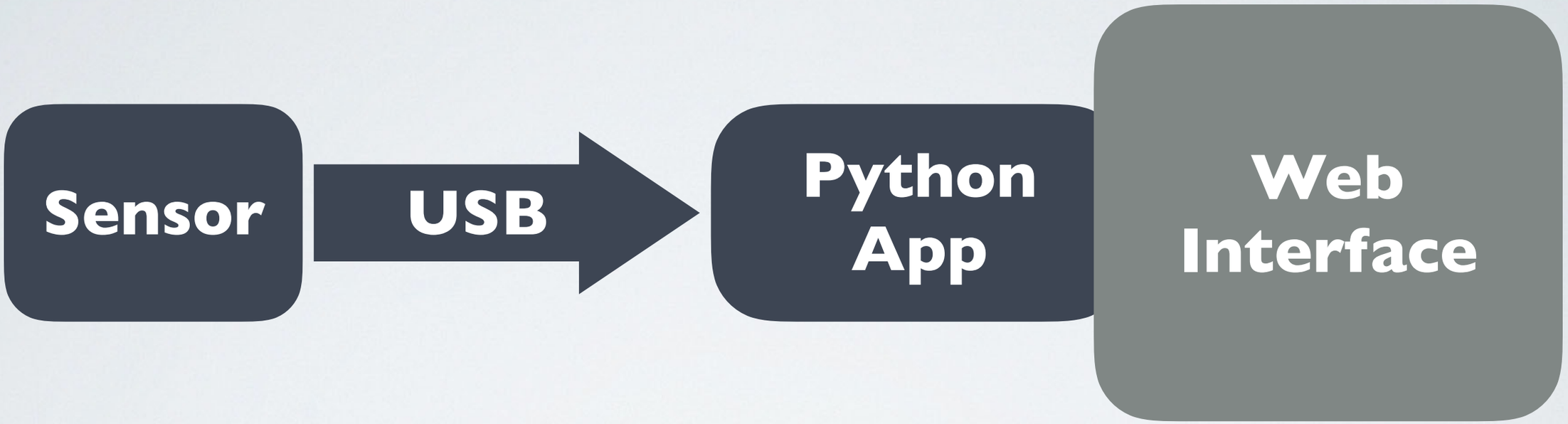
Optional LiPoly Battery

adafruit INDUSTRIES

https://www.adafruit.com/product/3333

12 SEP 201
ver 1 rev

GOAL



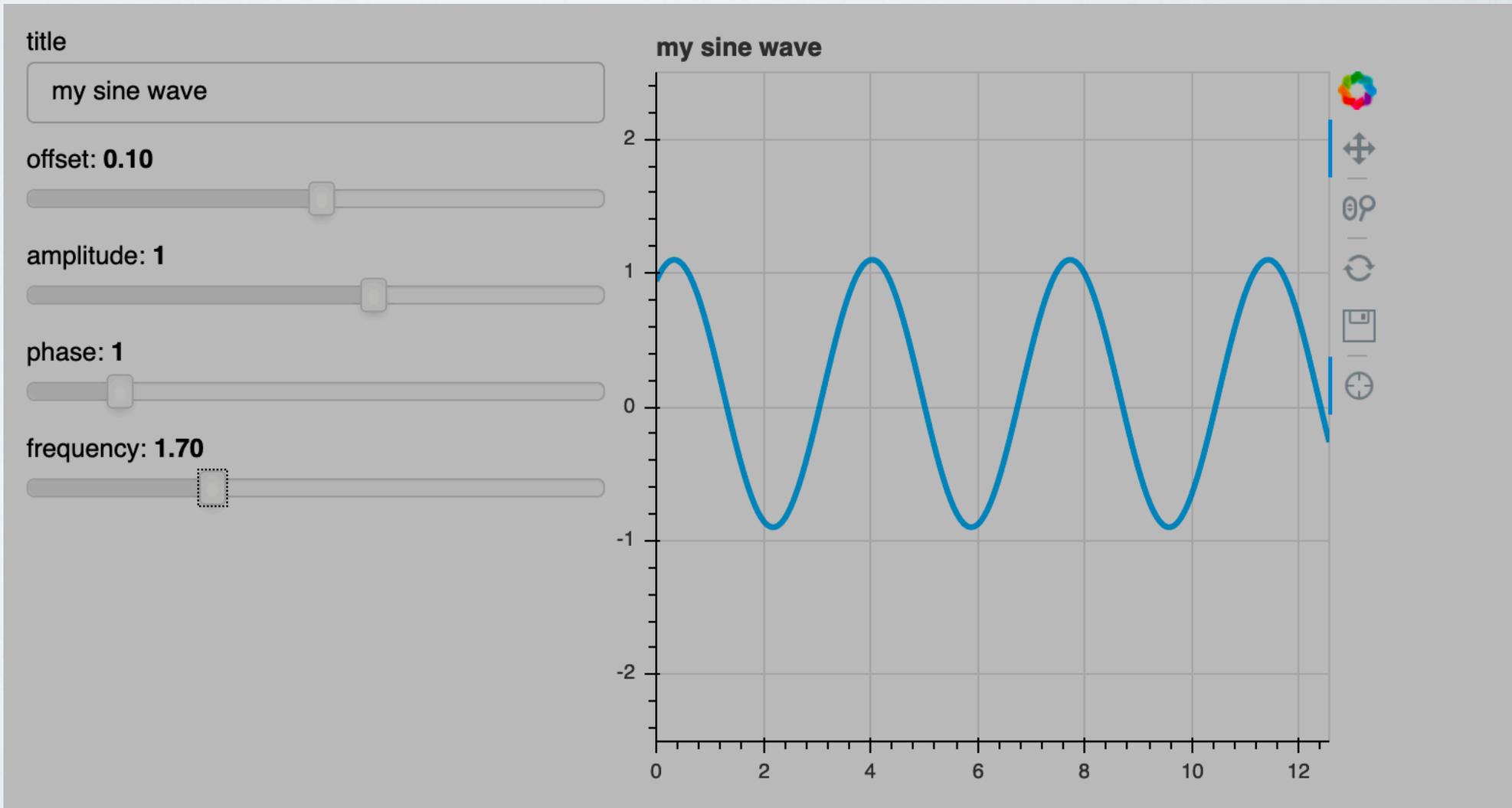
Why?

- **Good frameworks exist**
- **Custom graphs/interactions**
- **Narrow the student options**
- **Authentic experience for upper-div**


bokeh

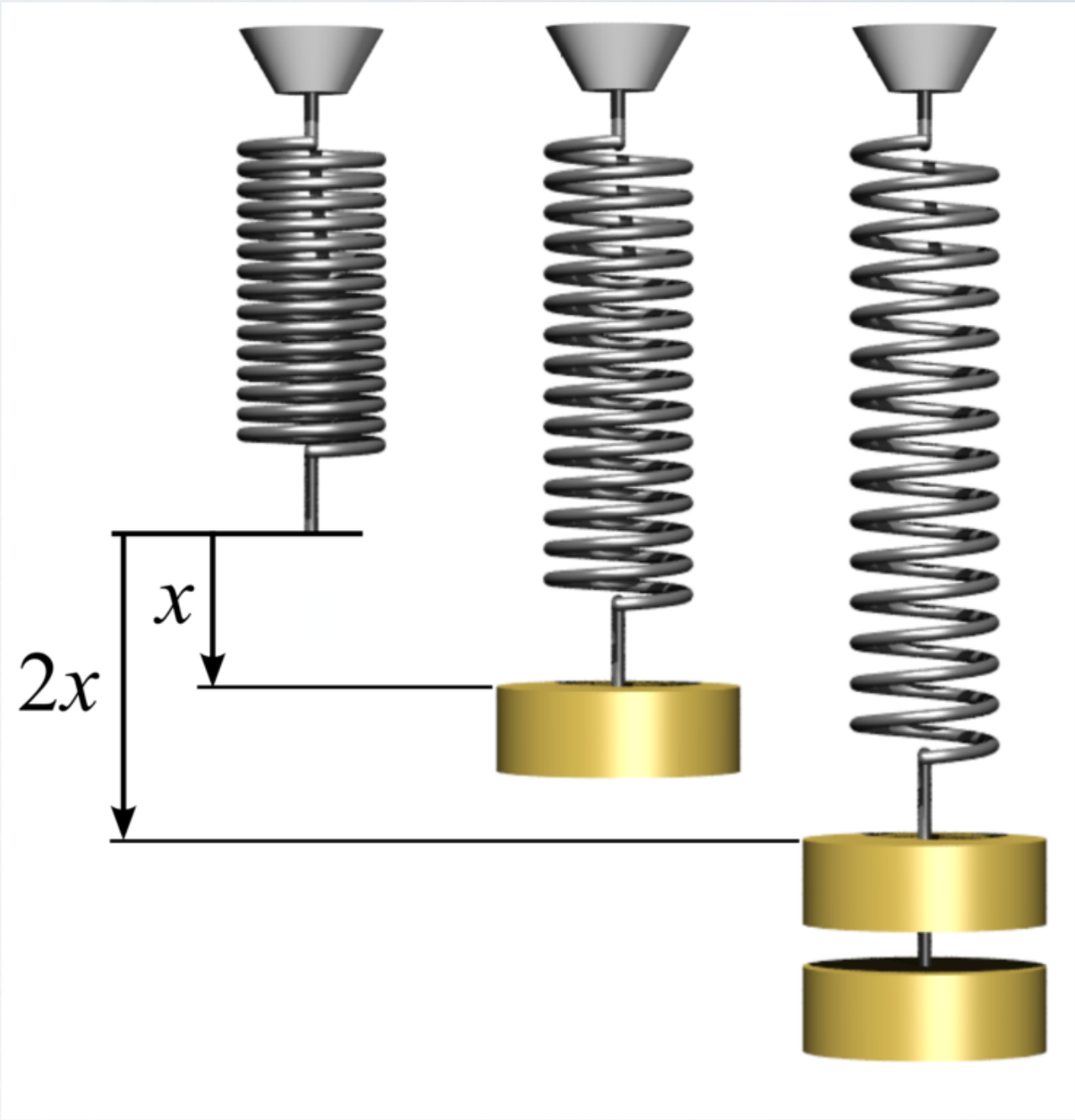
BOKEH

- **Python/R/Julia/Scala support**
- **Only advanced features require JavaScript**
- **App model server or notebook as output**



ACCELERATION DATA

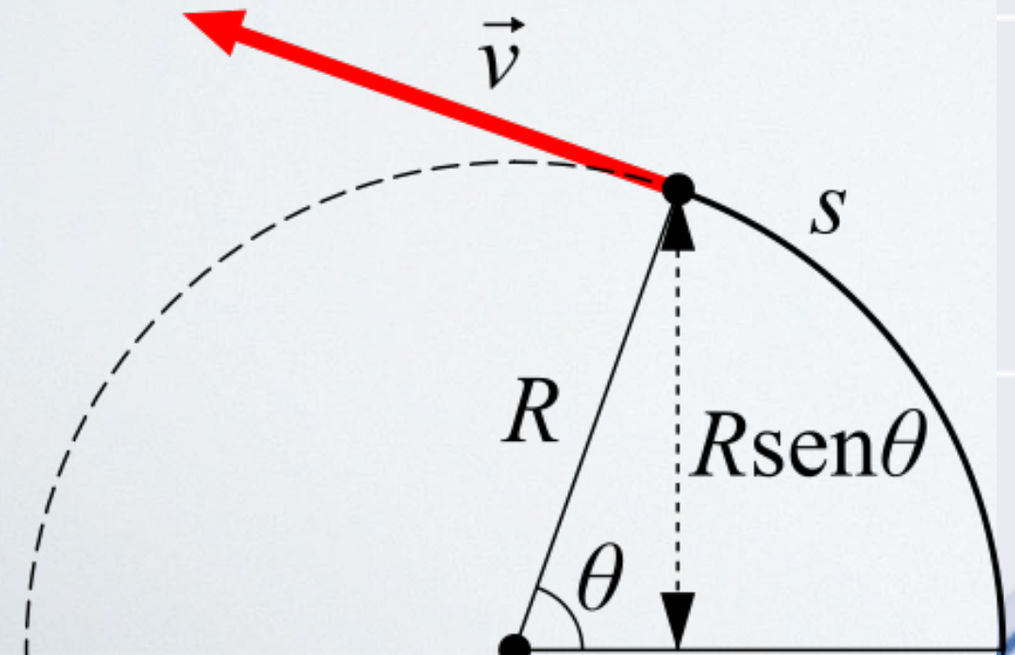
- **Data logger in Arduino:**
  - **Button 1: collect data**
  - **Button 2: download**
- **Drag-select period**
- **Display calculated result**

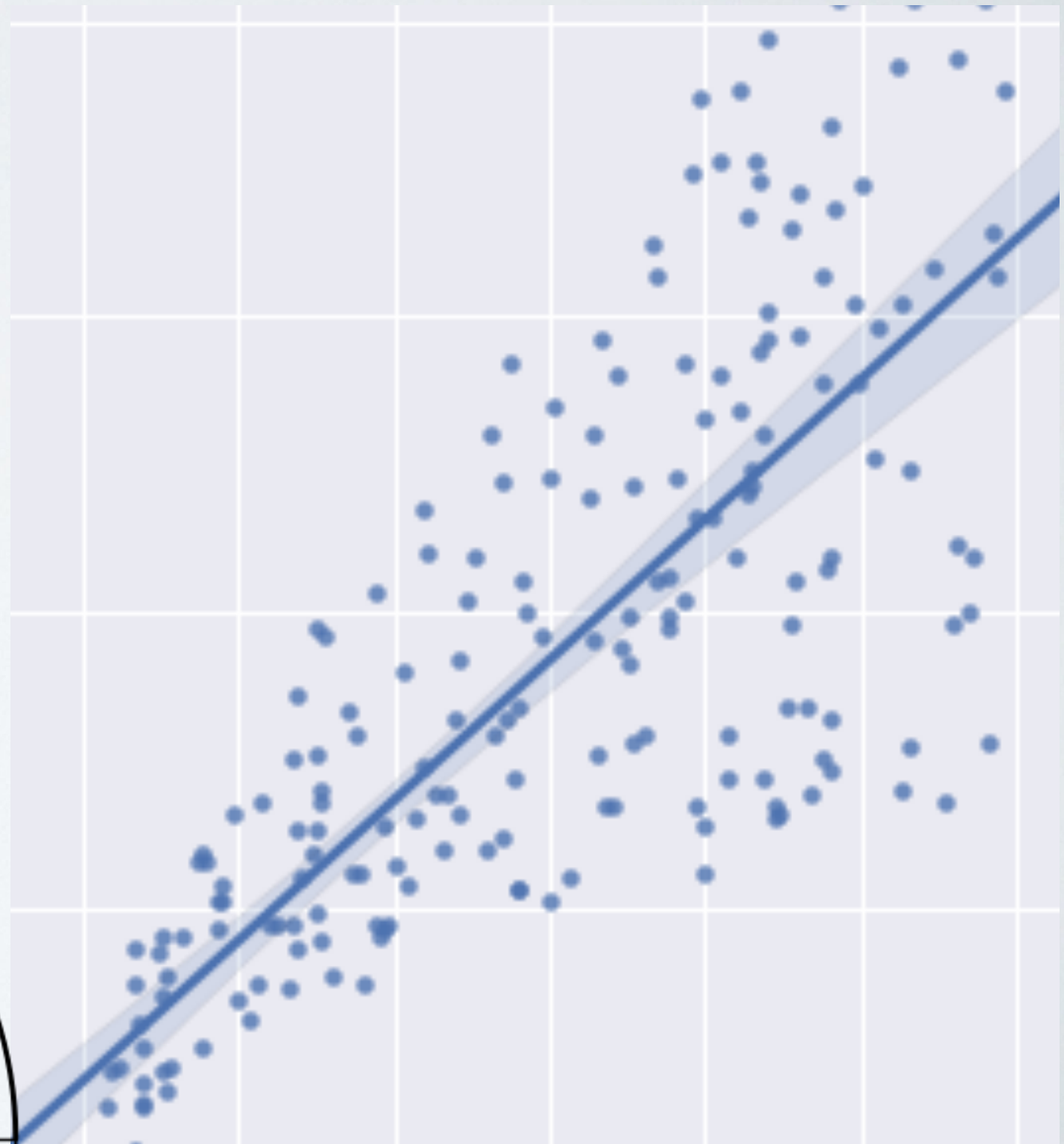


ACCELERATION DEMO

EXTENDING THE EXAMPLE

- **Additional calculations**
- **Curve fitting**
- **Couple with rotation sensor**

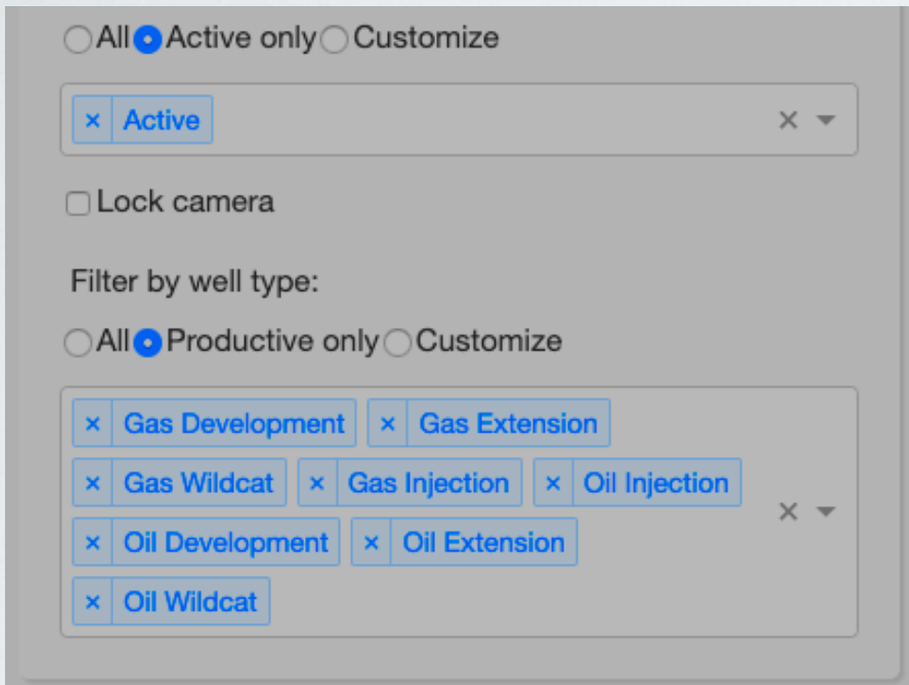


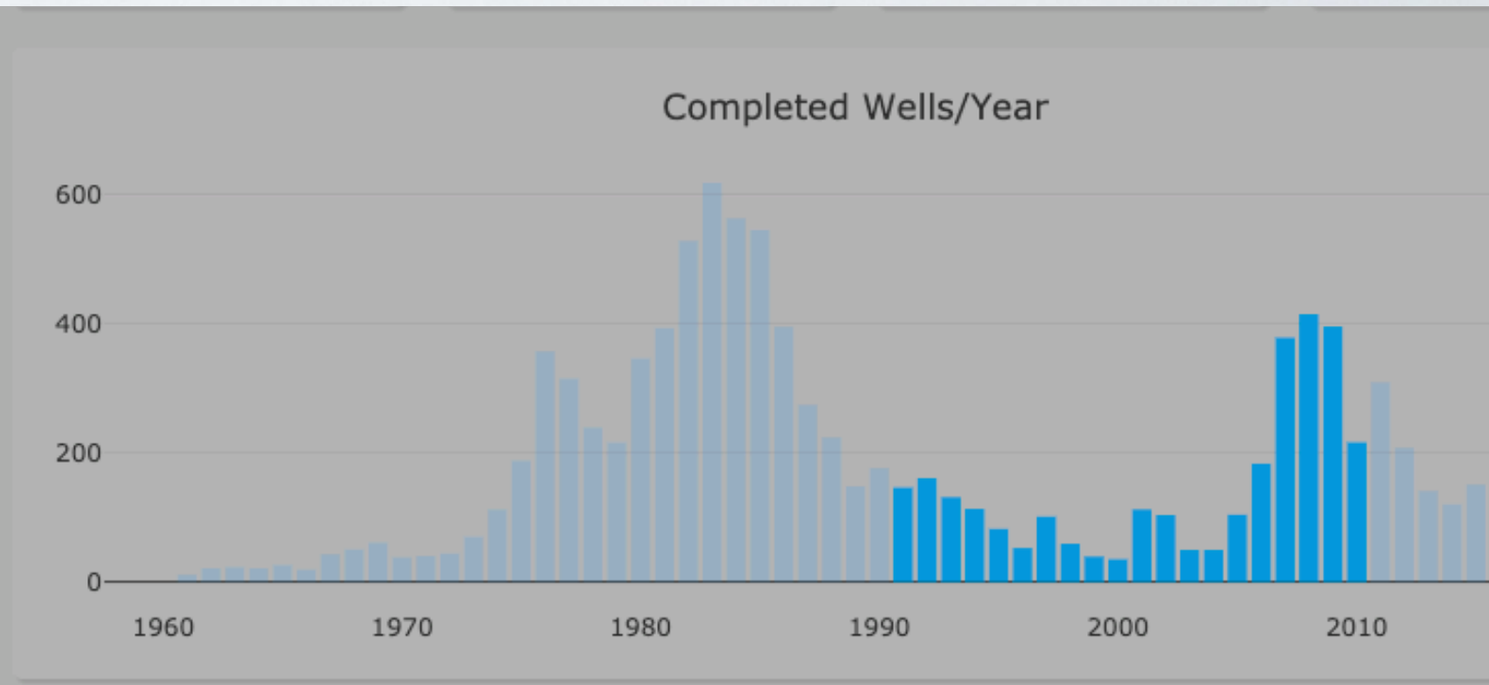


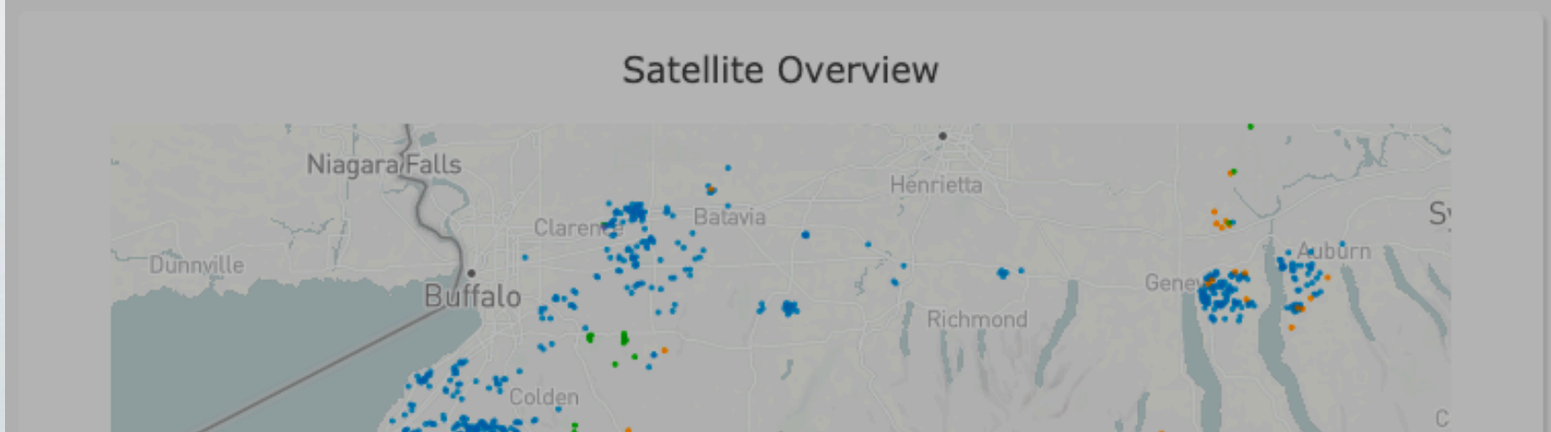
plotly

PLOTLY AND DASH

- **Pure Python (no HTML/JS)**
- **Server output only**
- **DashDAQ designed for instrument control**

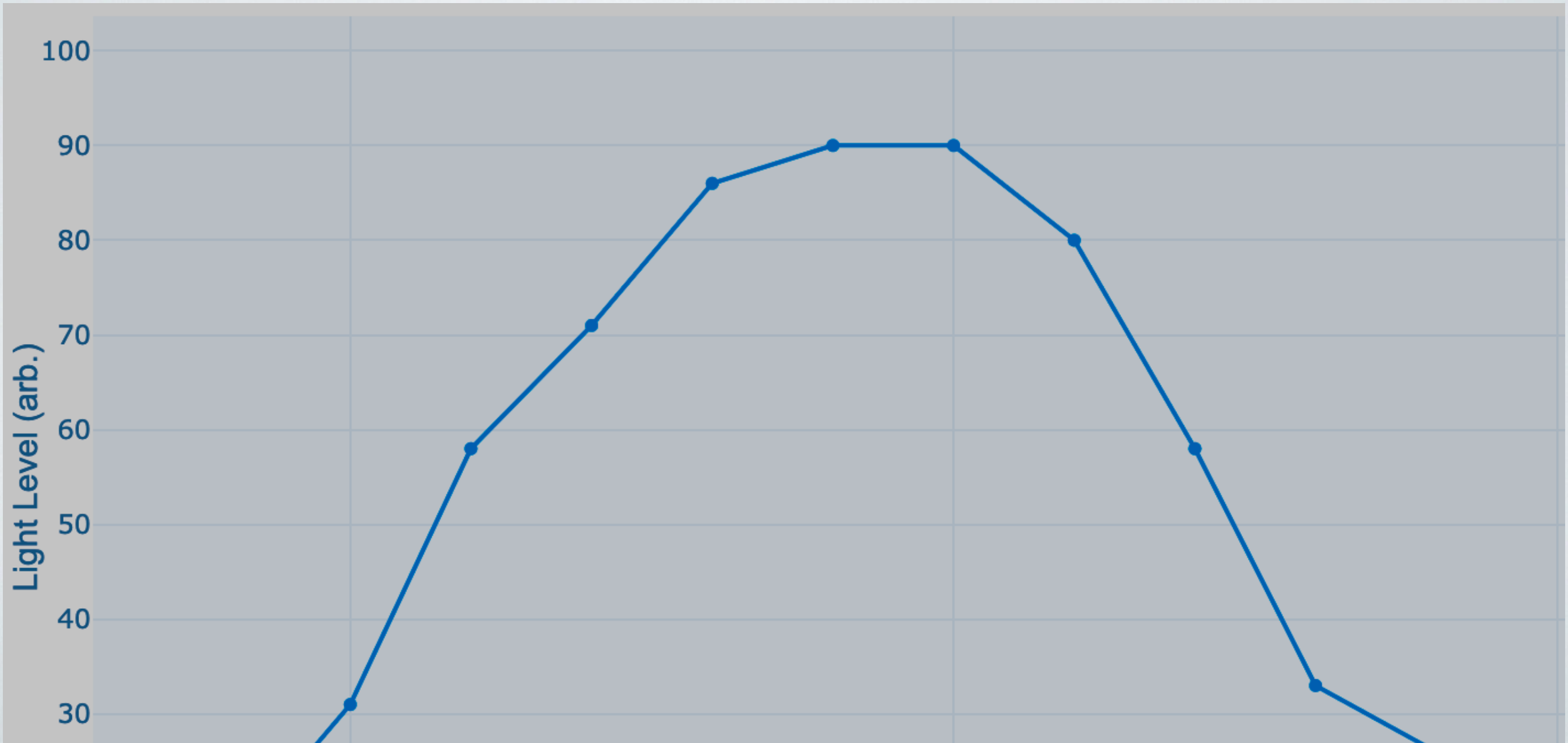






OPTICS DATA

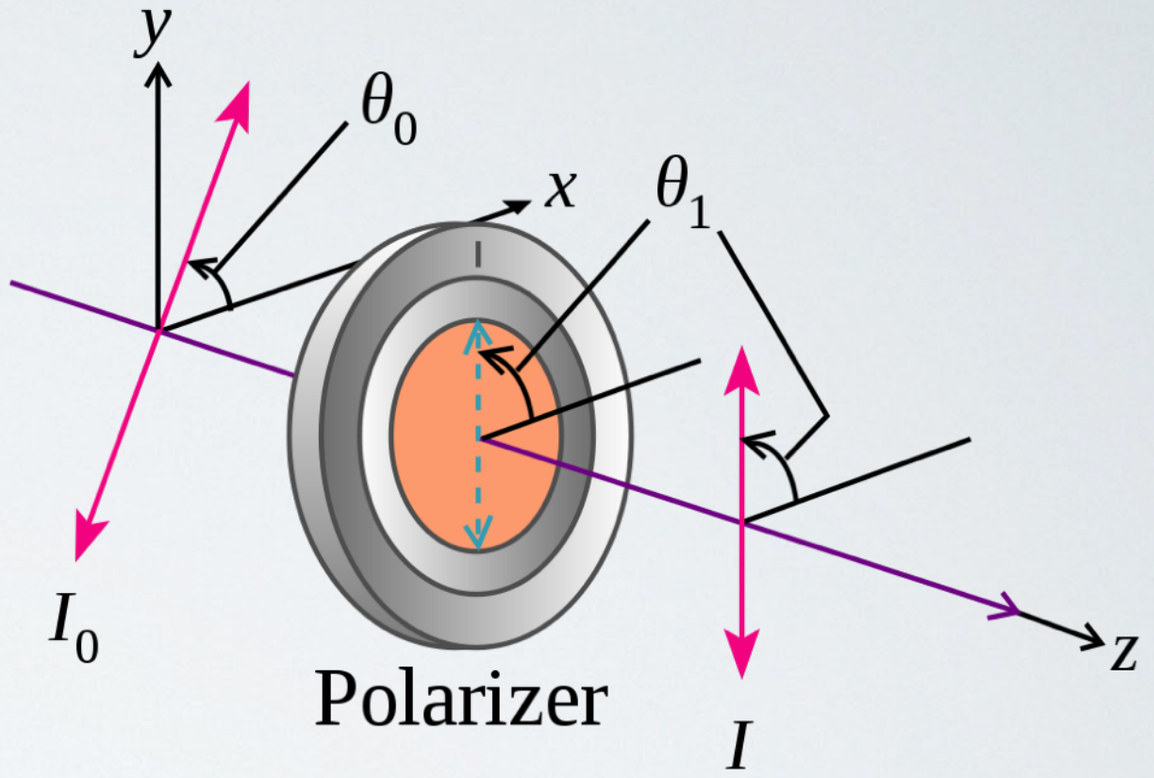
- **Realtime data from Arduino**
- **Scrolling chart display**
- **Sensor becomes a meter**

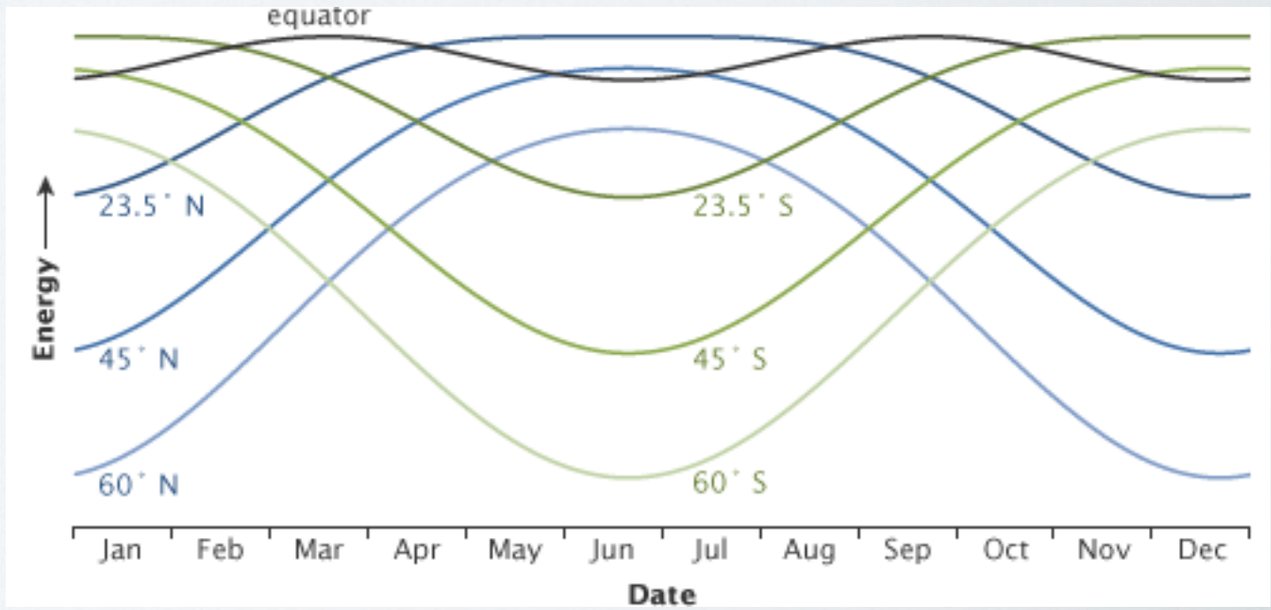


LIGHT SENSOR DEMO

EXTENDING THE EXAMPLE

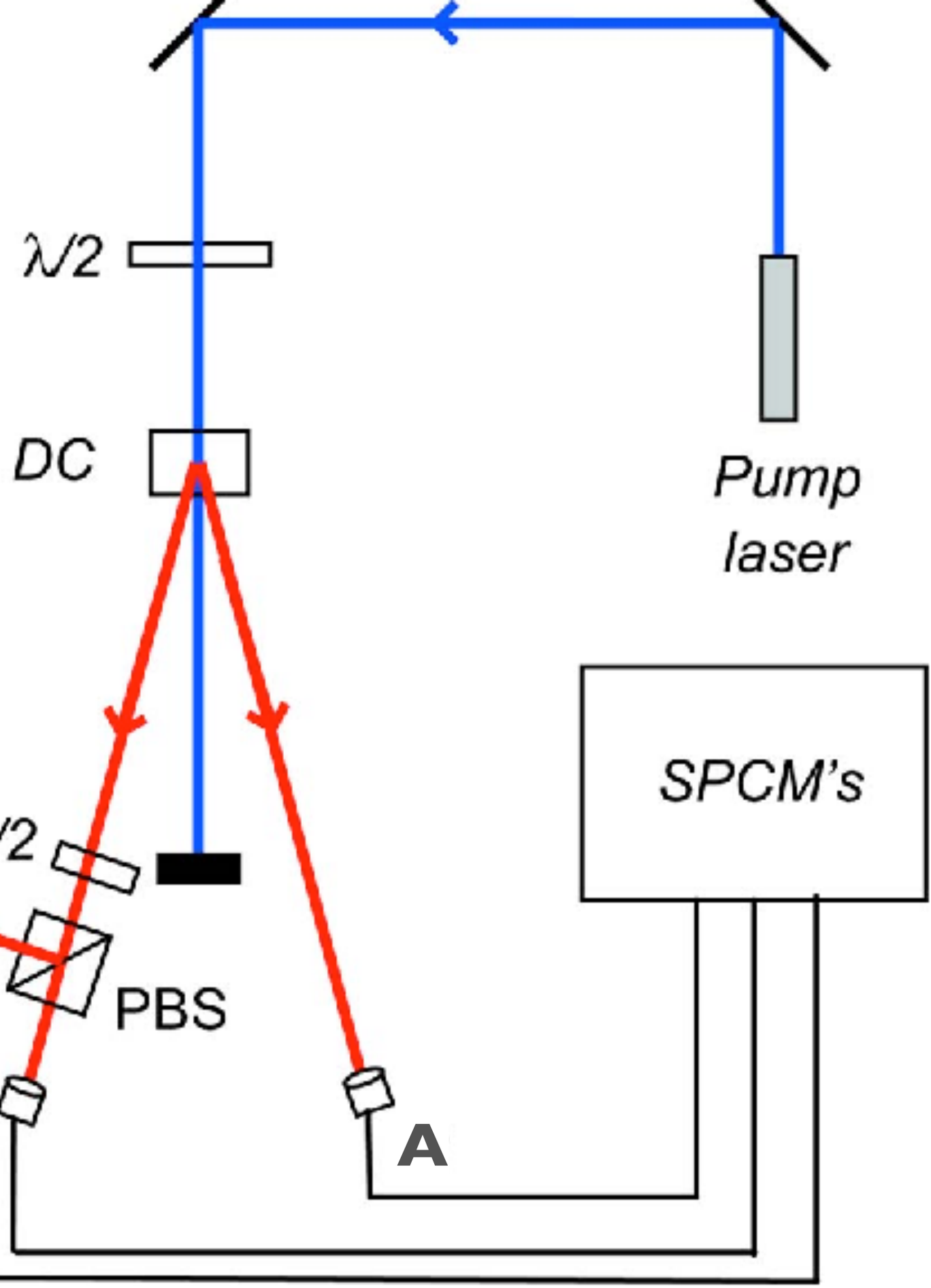
- **Coupled sensors:**
- **Light vs. angle**
- **Sunlight vs. time**





REAL-LAB EXAMPLE

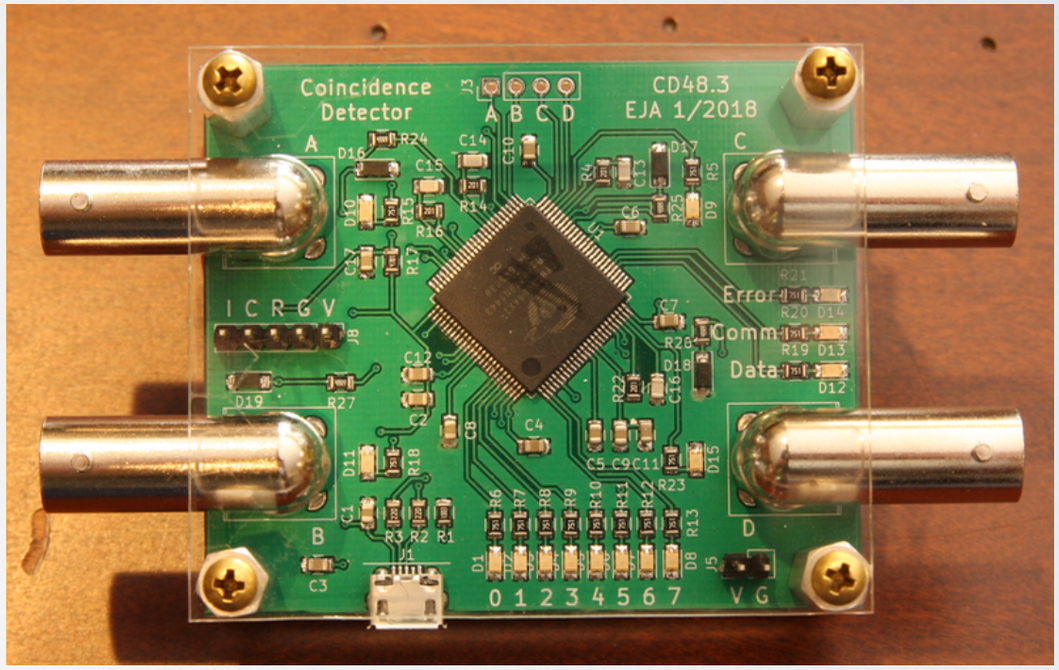
Quantum Mechanics photon counting lab



bokeh

HARDWARE

- **Eric Ayars (Red Dog Physics)**
- **4-channel coincidence counter**
  - **25 ns resolution**
  - **8 counters**
- **USB-serial data readout**

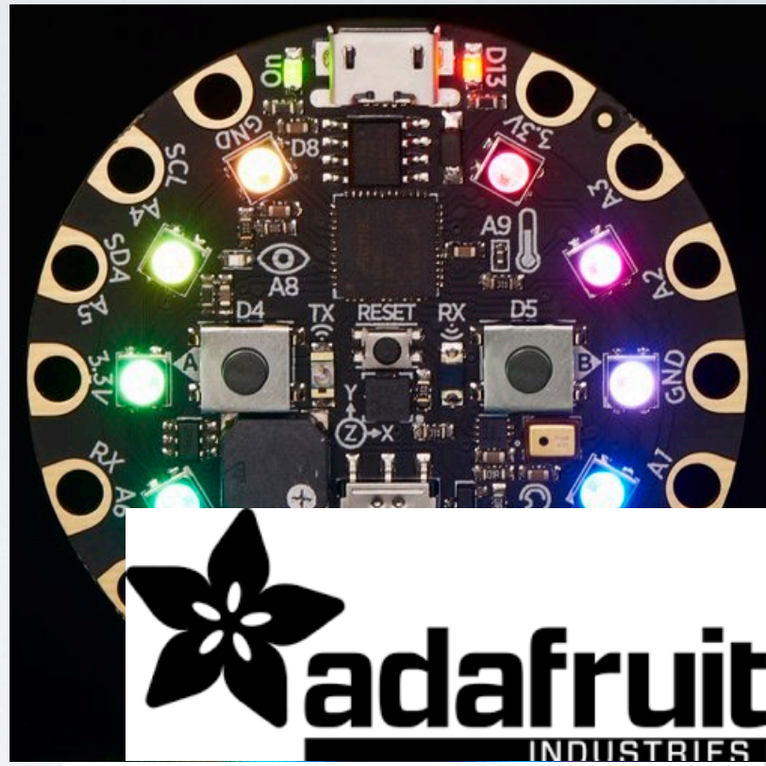


http://reddogphysics.com/cd48.html

PHOTON COUNTING DEMO

OPEN TOOLS IN THE PHYSICS CLASSROOM

- **Hardware and Software**
- **Free**
- **Authentic student projects (job skills!)**
- **Full control and customization**



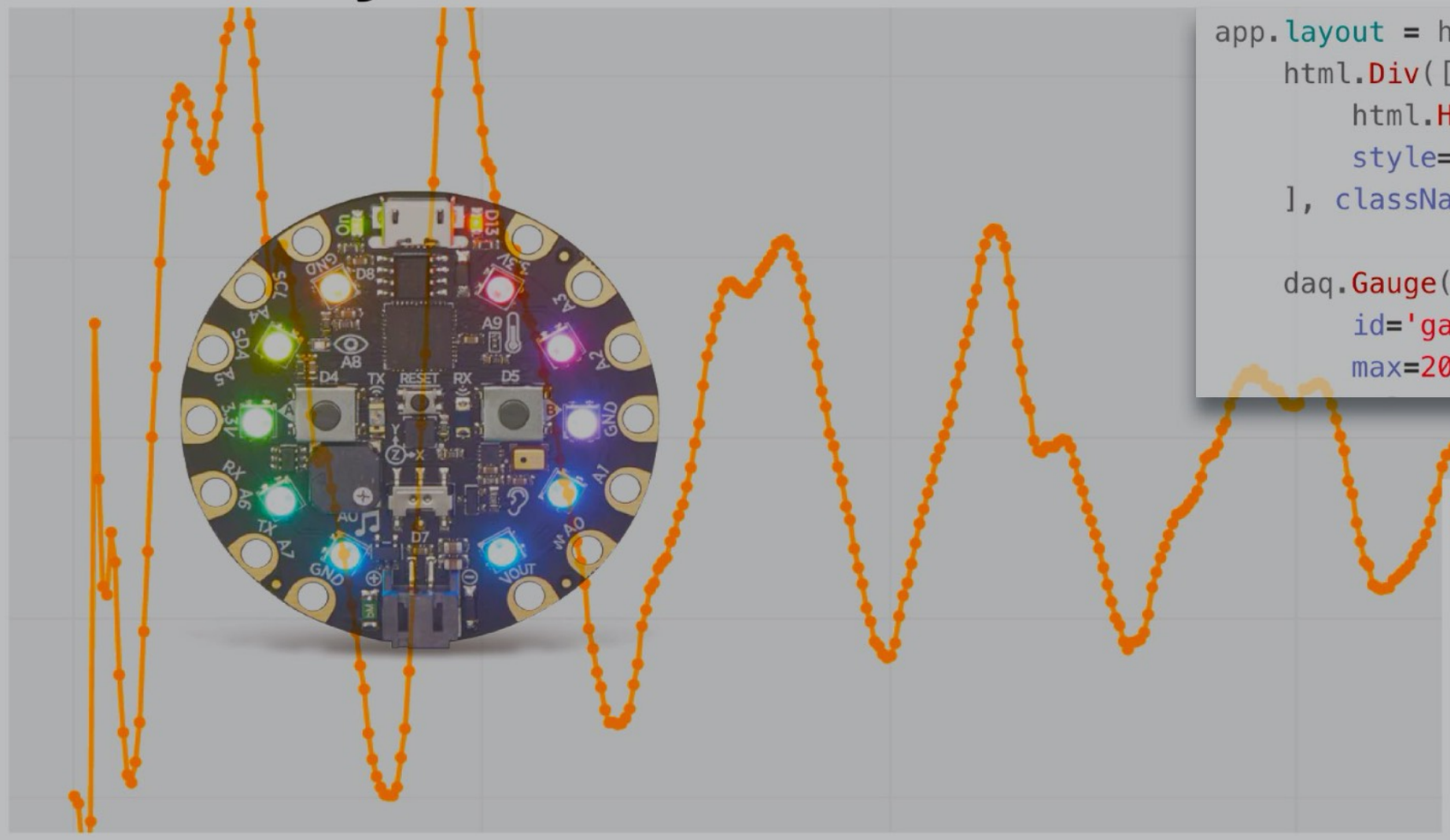
adafruit INDUSTRIES

plotly

bokeh

python™

Physics Dashboarding




```
app.layout = html.Div(id='container', children=[
    html.Div([
        html.H2('Realtime arduino data',
        style={'marginLeft':'40px'})
    ], className='banner', id='header'),

    daq.Gauge(
        id='gauge',
        max=20,
```

github.com/amcdawes/phyboarding

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