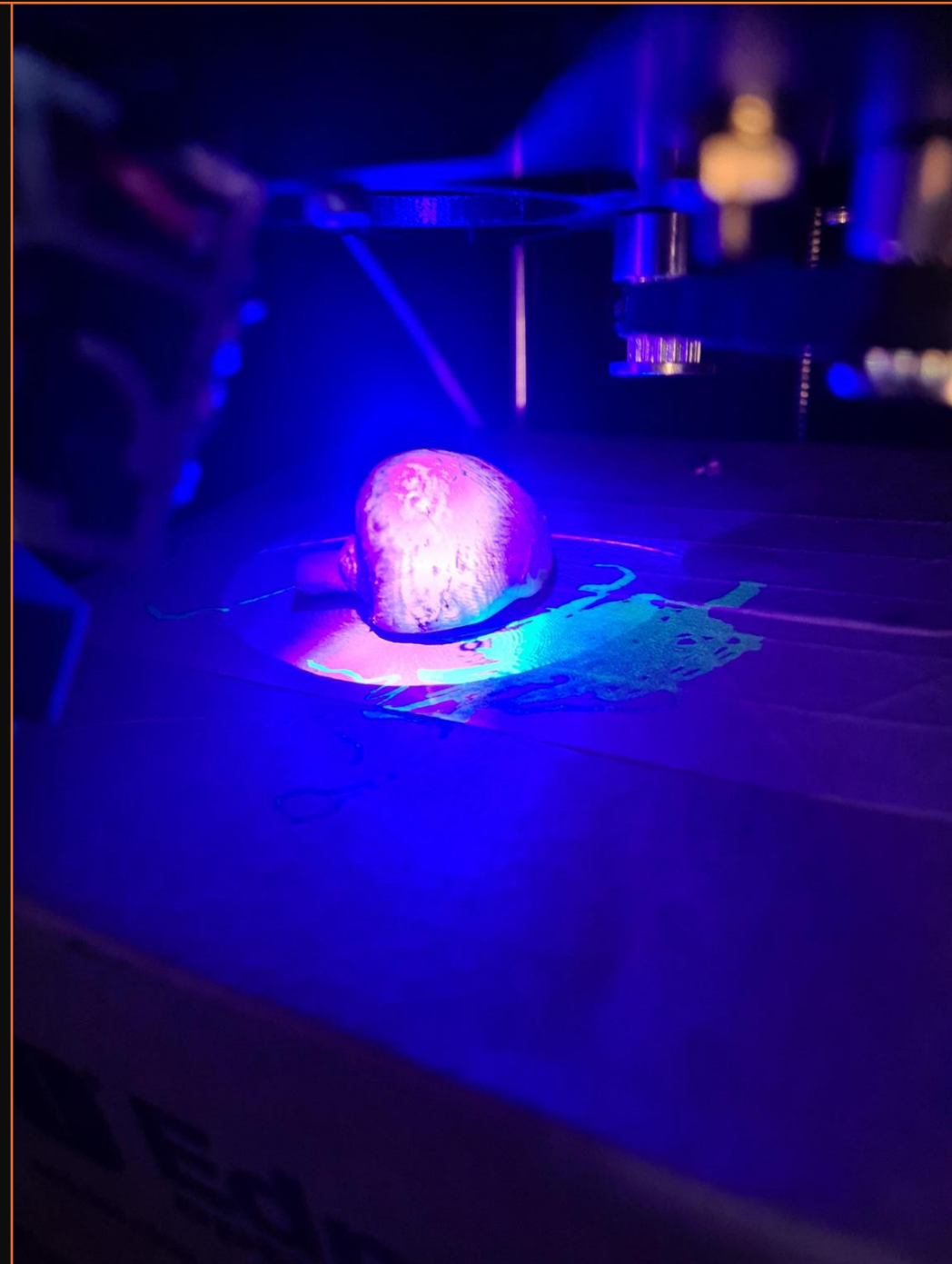


On a real time method for the detection of Mold using fluorescence imaging

Matthew Macklin, Wayne Holmes,
Deepinder Sidhu, Nigel Yee



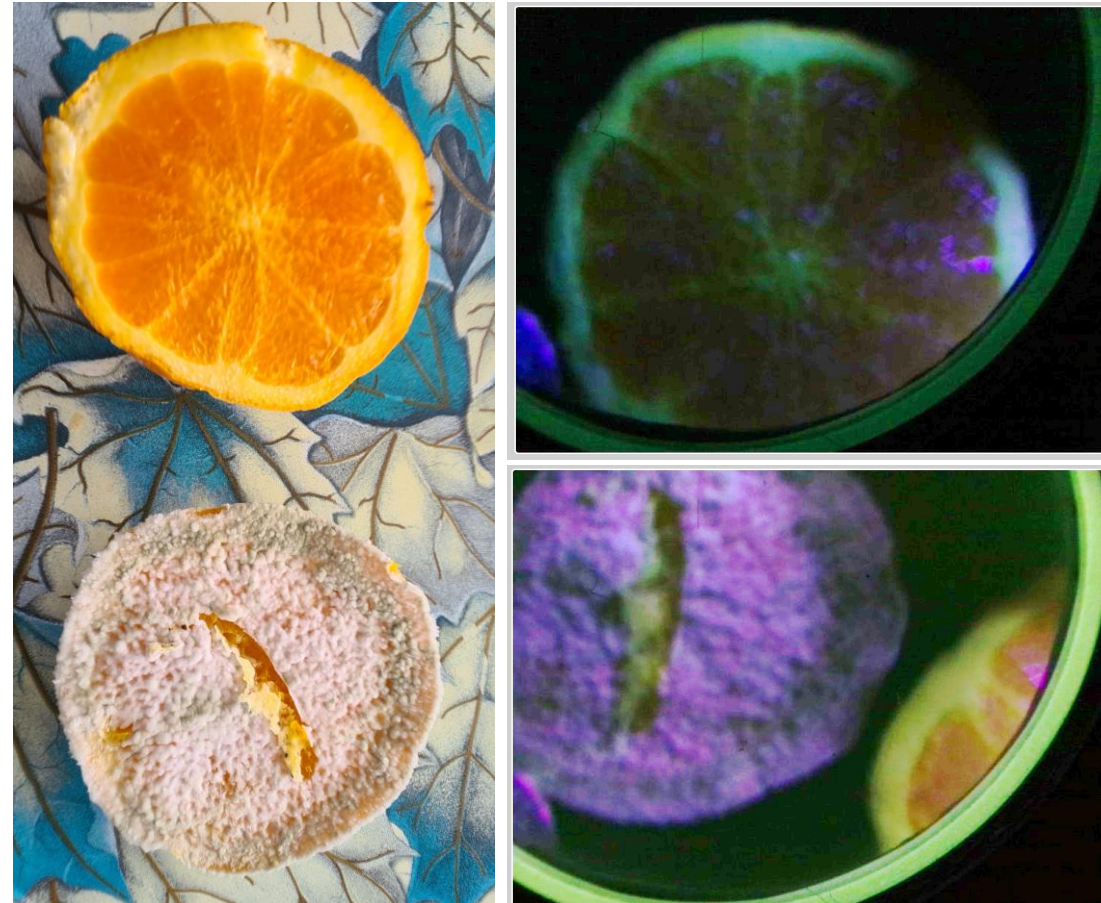
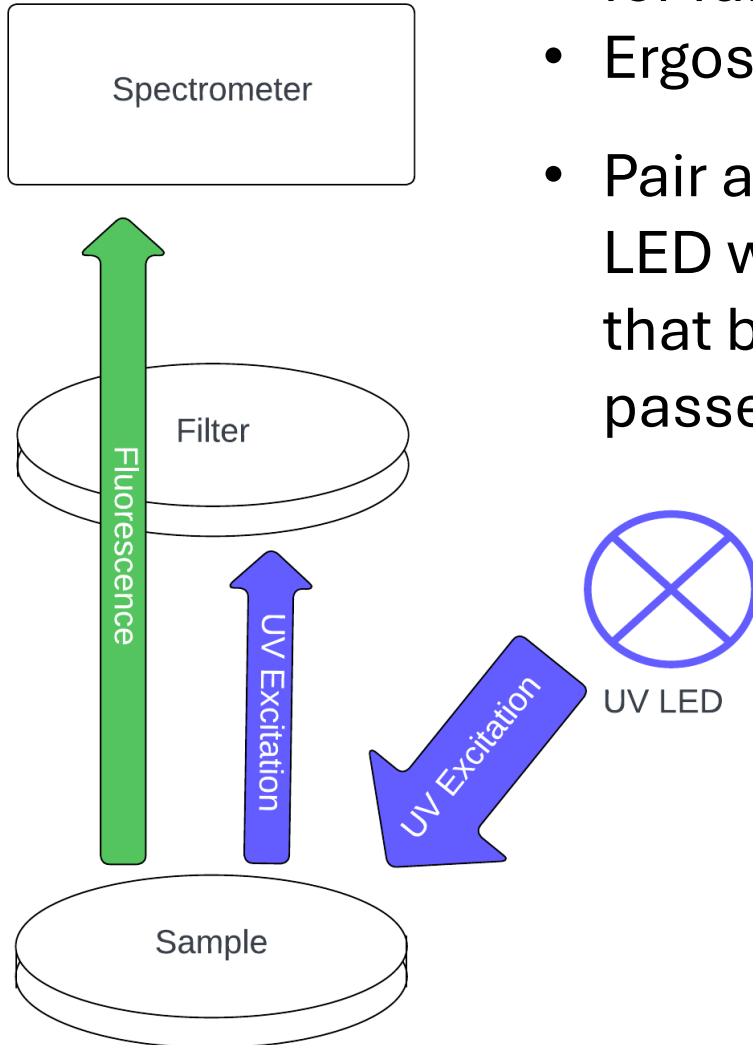


Mold

- Ubiquitous in the environment, can grow rapidly
- Exposure is linked to range of health conditions, many serious
- Detection relies on lab testing, slow and expensive

The idea

- Fluorescence: Some molecules absorb light and re emit at a different wavelength
- Ergosterol is present in fungal bodies including spores, biomarker for fungi
- Ergosterol excited strongly at 280nm, emits at ~390nm.
- Pair a narrow spectrum LED with an optical filter that blocks light, yet passes fluorescence



The build

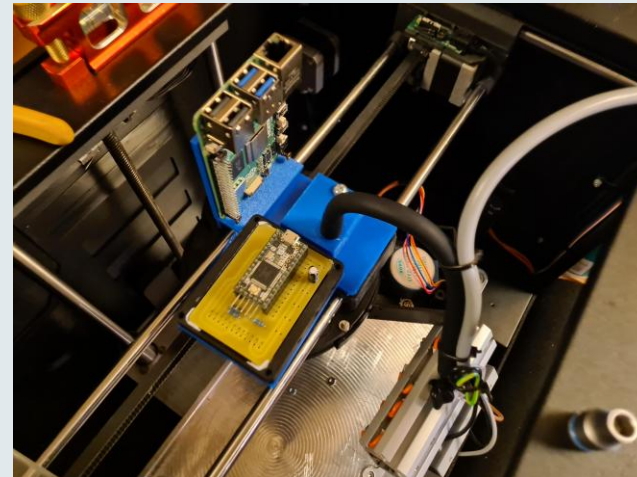
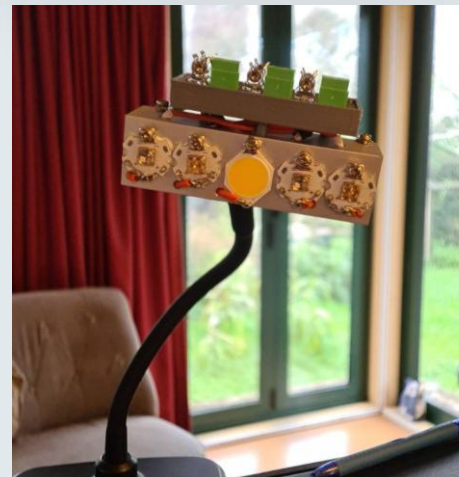
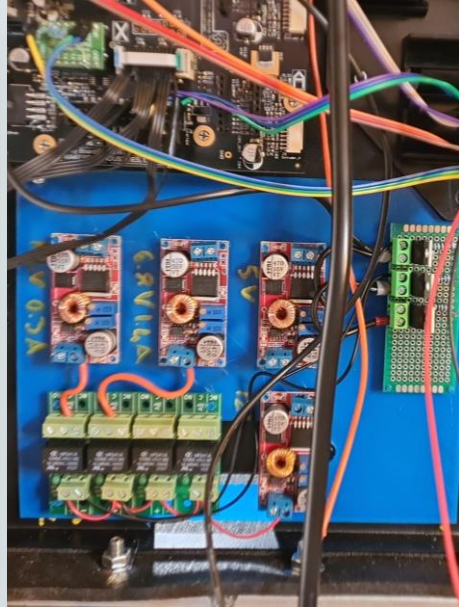
- Repurposed 3d printer
- Lightproof enclosure with safety interlocks
- XYZ gantry, Raspberry Pi 5 control
- LED power distribution and switching

Hamamatsu spectrometer with 340-850nm range

280nm, 365nm UV LED array.

320nm, 395nm Schott longpass filters in motorized filter wheel

Pi HQ camera, 6mm lens



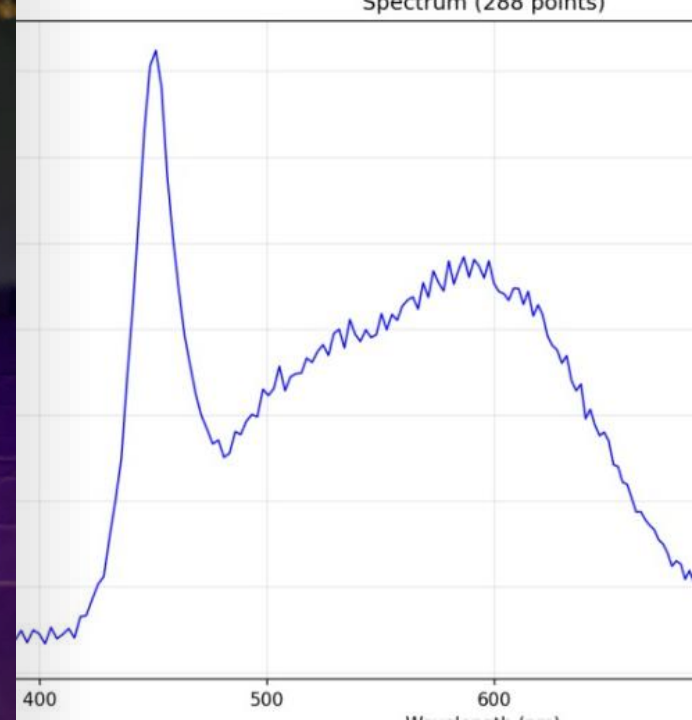
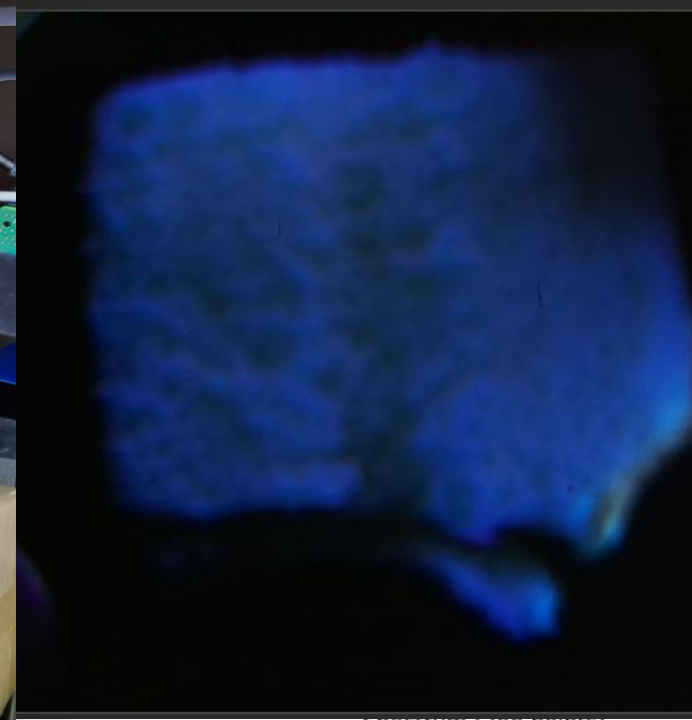
Pivot

Low intensity with 280nm LEDs

Low magnification stage for camera

Difficult to extract useful data, spores too small

Switched to spectroscopy approach





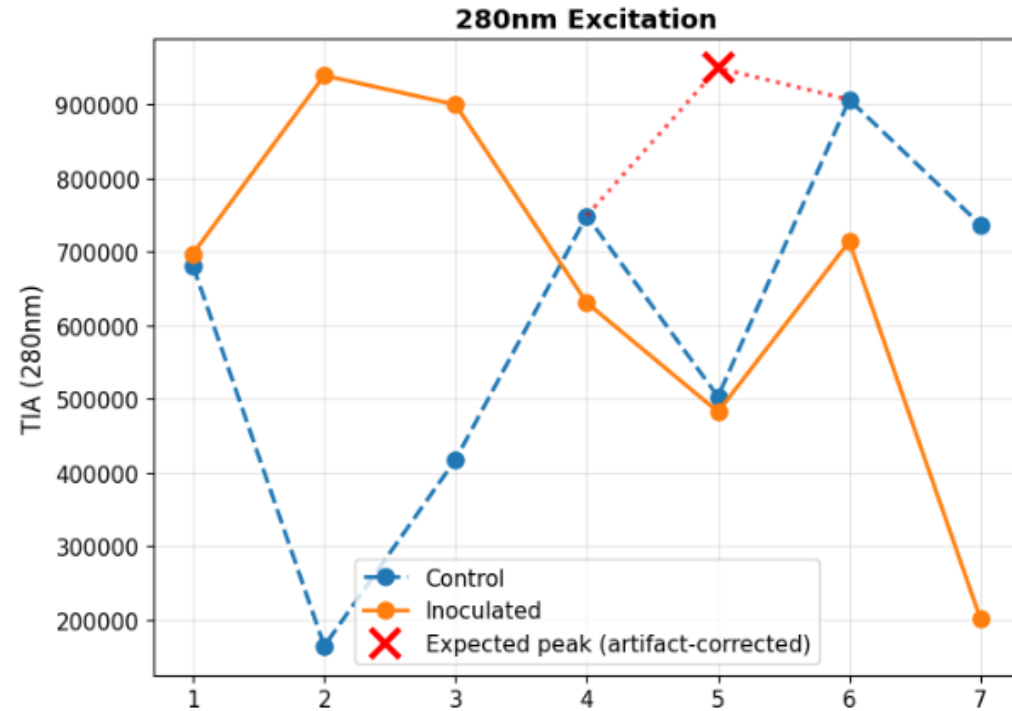
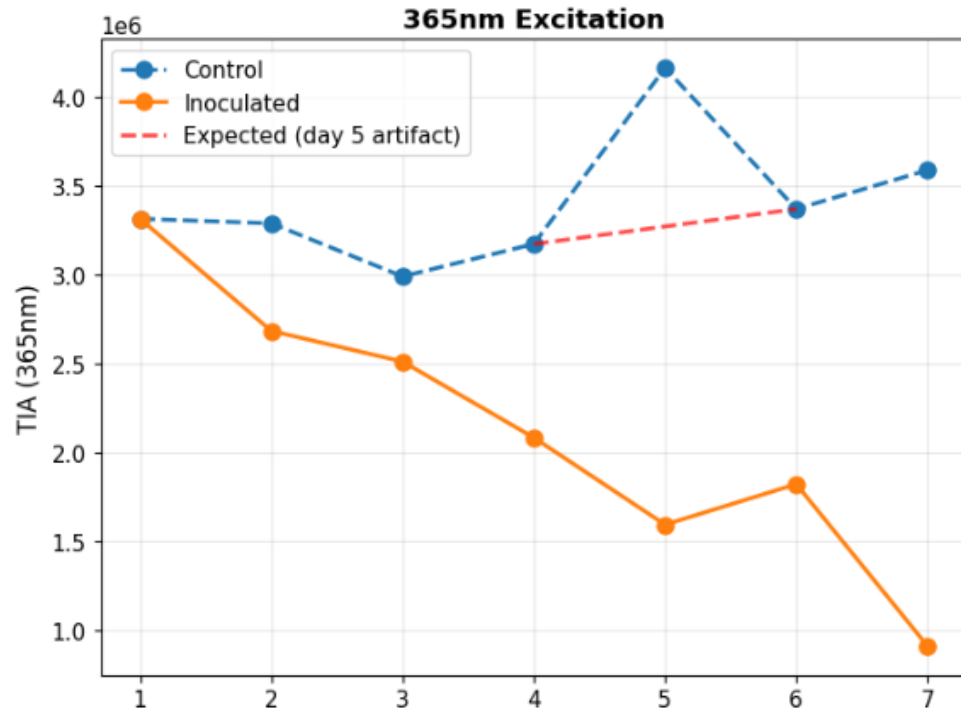
Experiment

- Cooked white rice, 2x samples inoculated, 2x control
- 2x measurements at 180 degrees, per wavelength per sample, per day (n=4)
- Kept in a sealed Tupperware at approx. 27 degrees, very humid
- Species unknown

Finding 1:

Growth monitoring

- Linear decline under 365, control extremely stable
- 280 followed same growth pattern, delayed (~3.5 days)
- Corrections made for day 5 (24 hours in fridge)

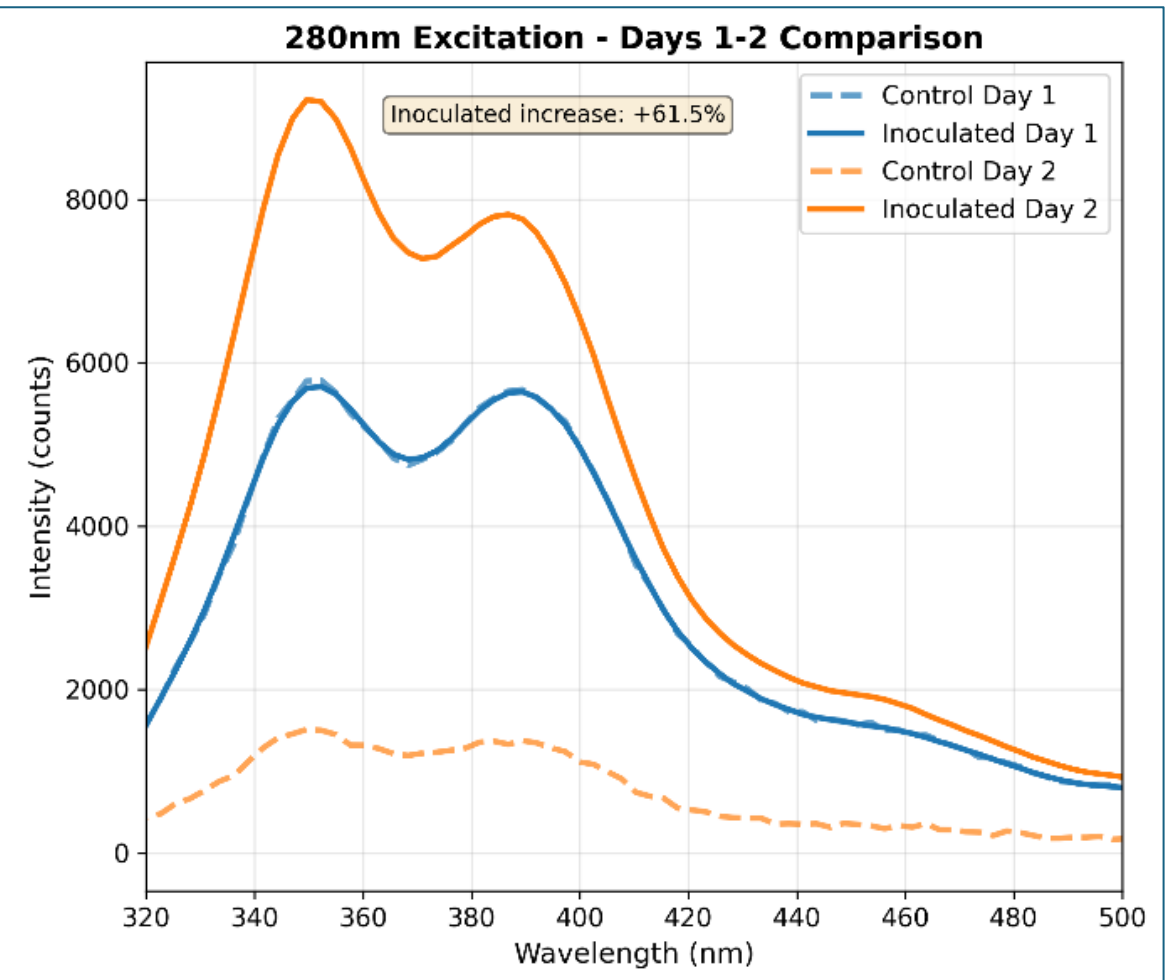
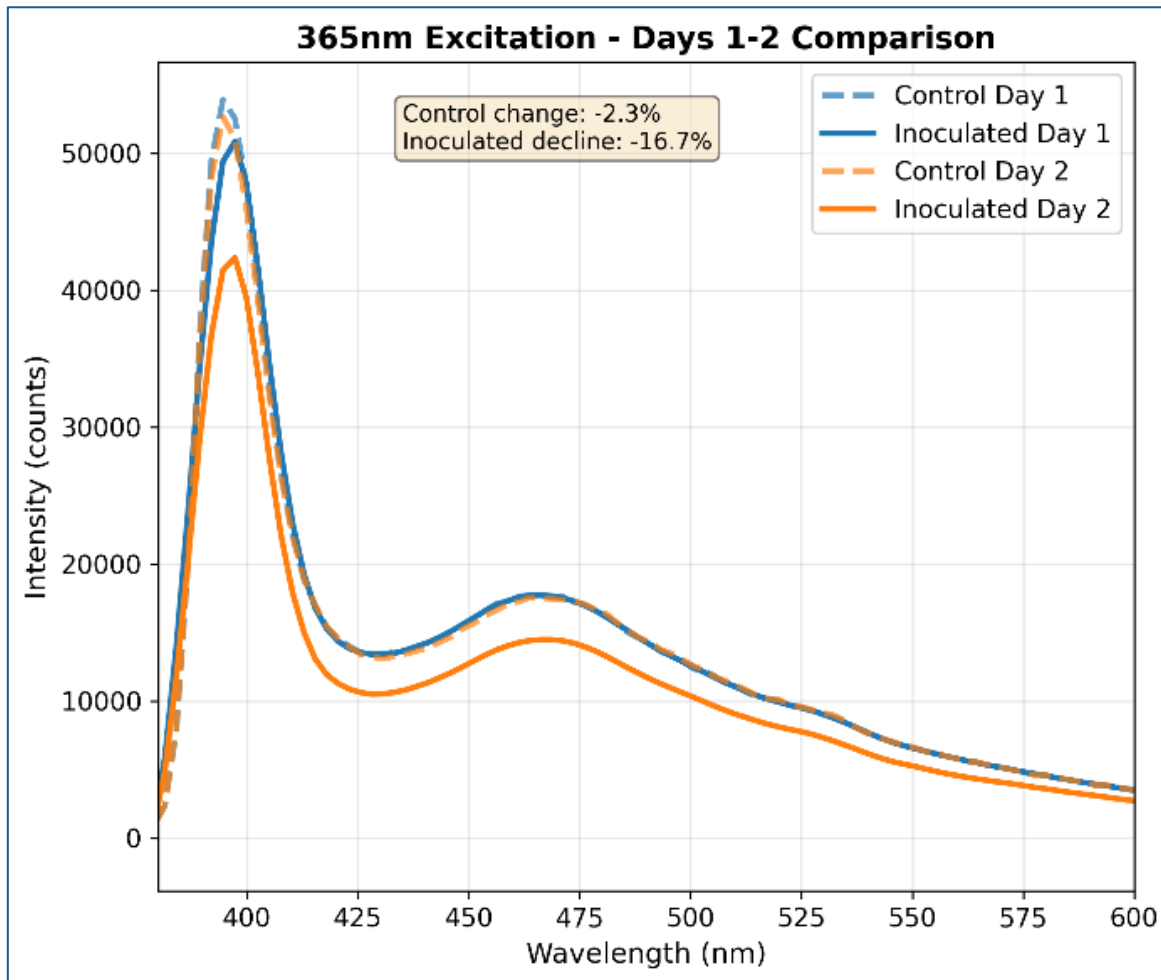


Finding 2: Early detection

- Comparing inoculation against control
- Within 24 hours large spectral shifts are apparent
- 16.7% **decrease** under 365nm, 61.5% **increase** under 280nm
- This occurs well before any visible indication of contamination

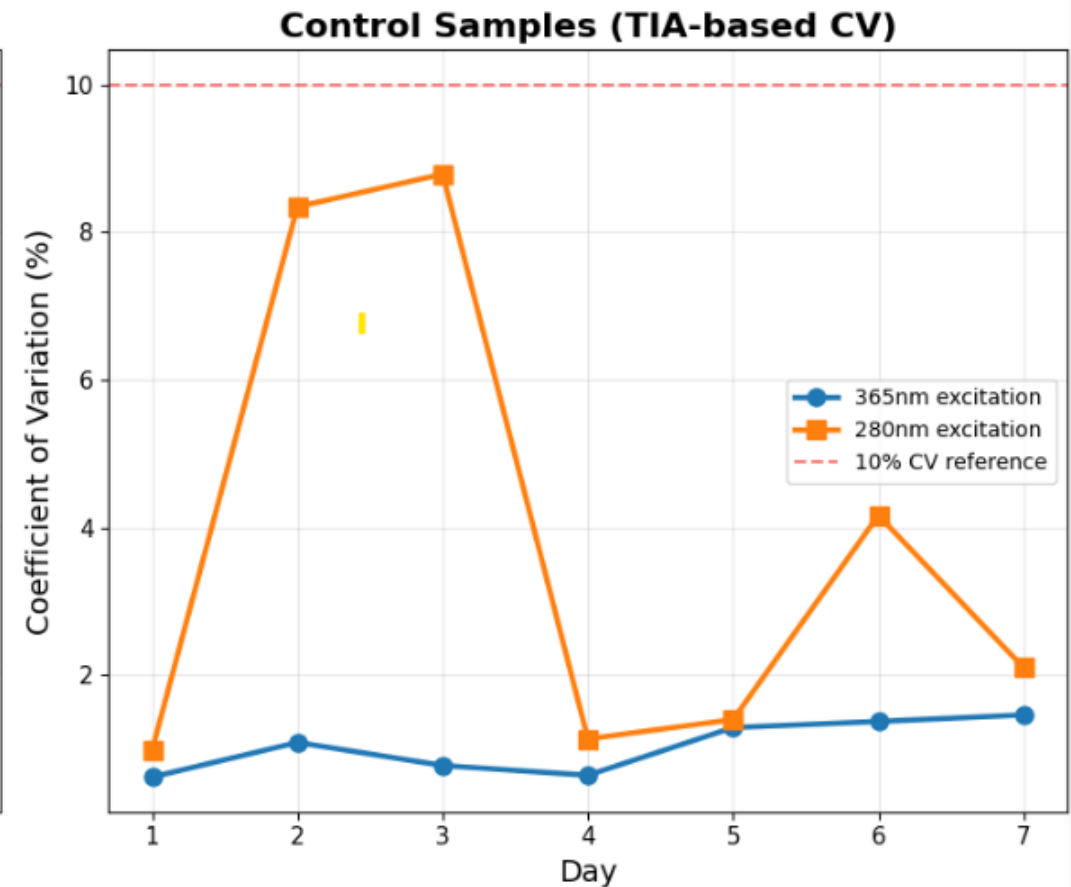
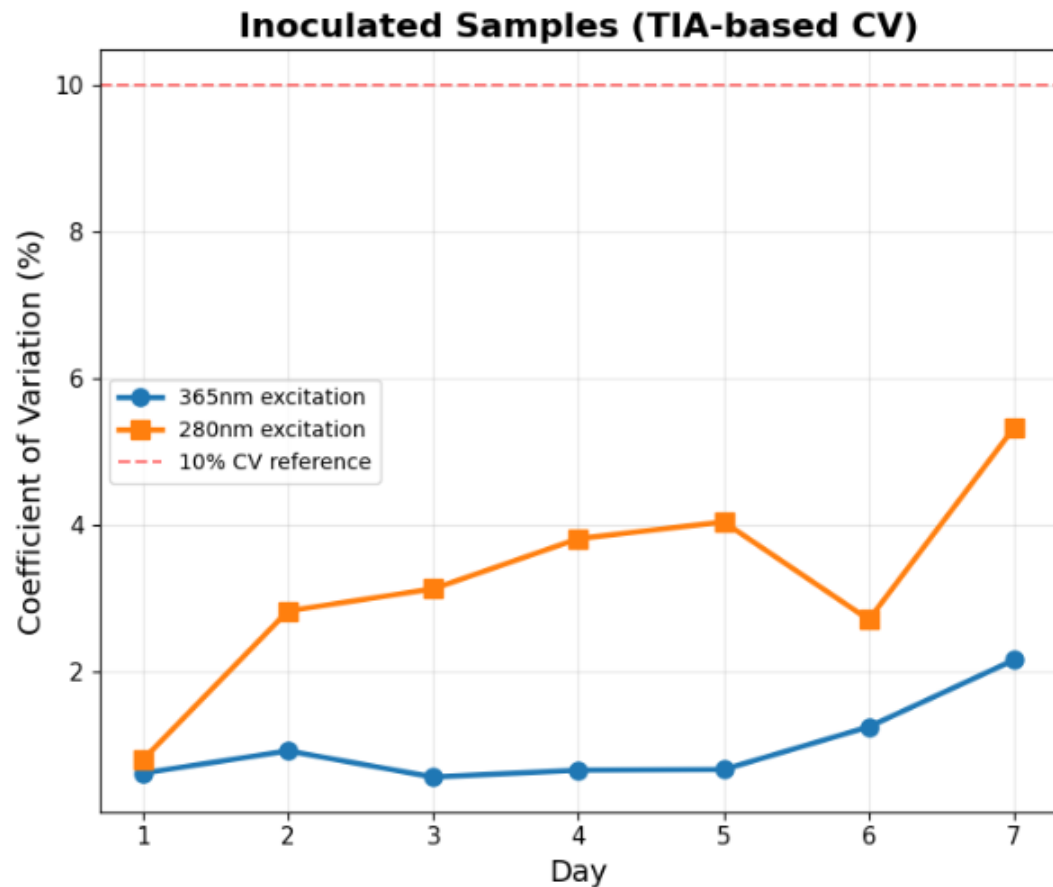


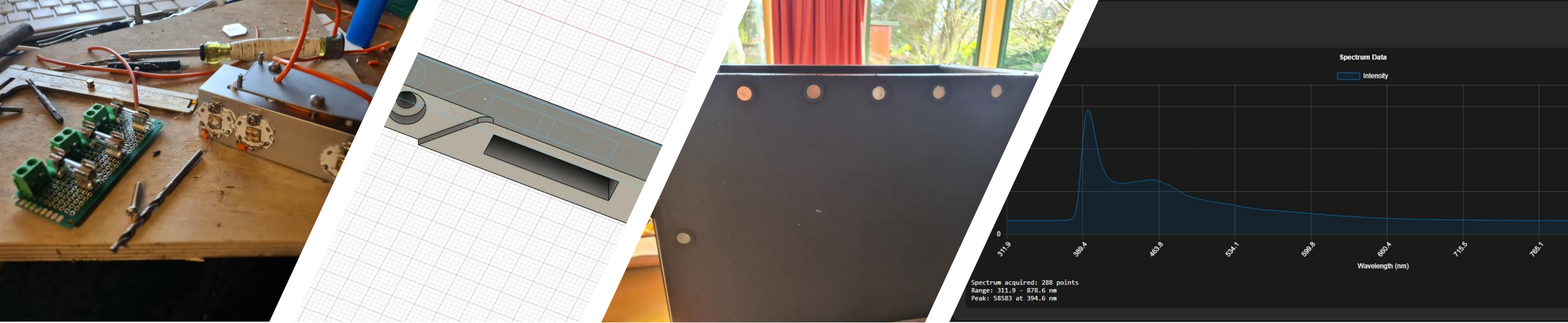
Days 1 & 2, inoculated



Validation

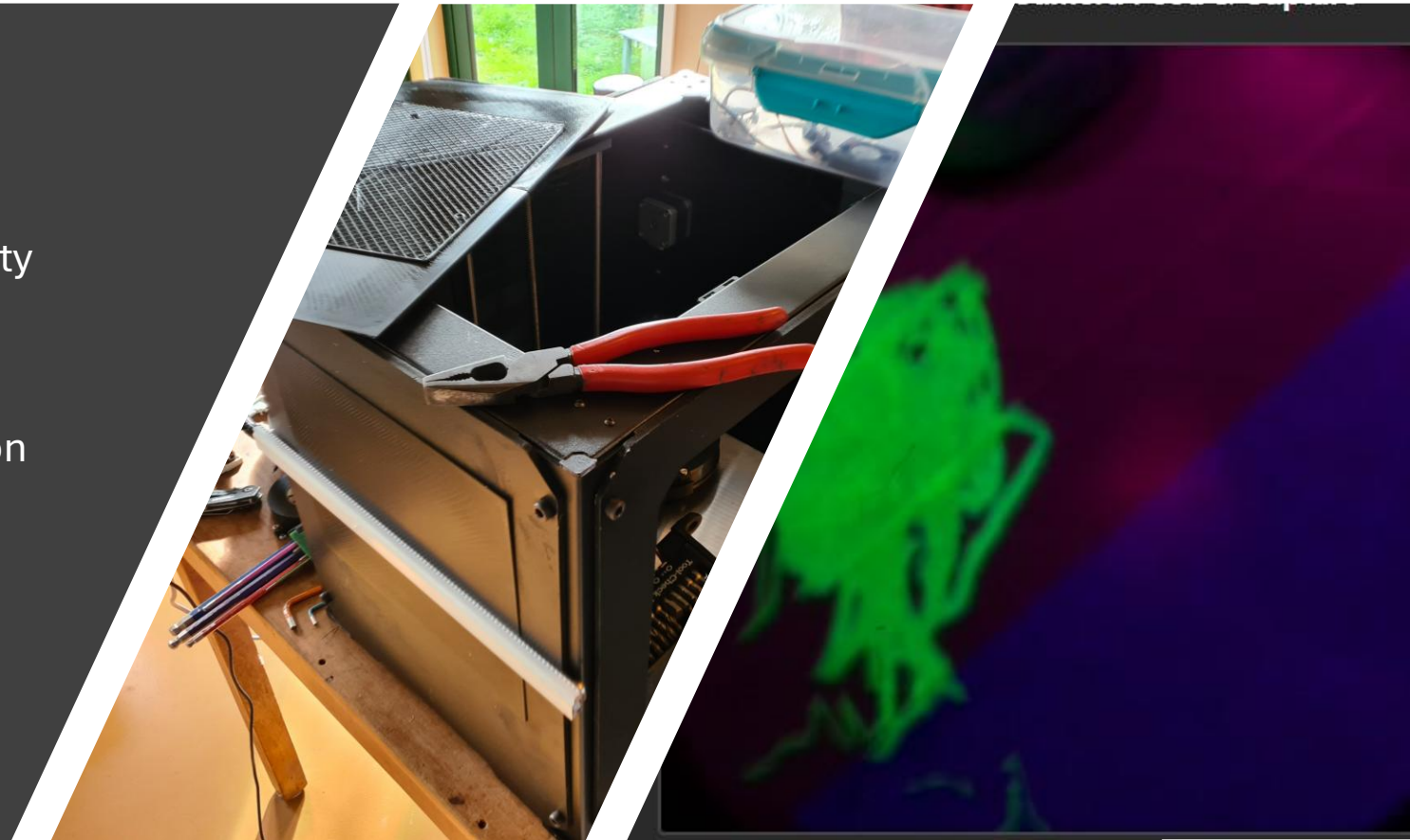
- Inoculated samples: <10% CV at 365nm (days 1-5)
- 280nm higher noise (~15-20% CV) due to weaker LED
- n=4 per timepoint
- Control stability validates biological signal
- TIA total integrated area, area under the curve, total summed signal
- $CV = (\text{standard deviation} / \text{mean}) \times 100$ for each day





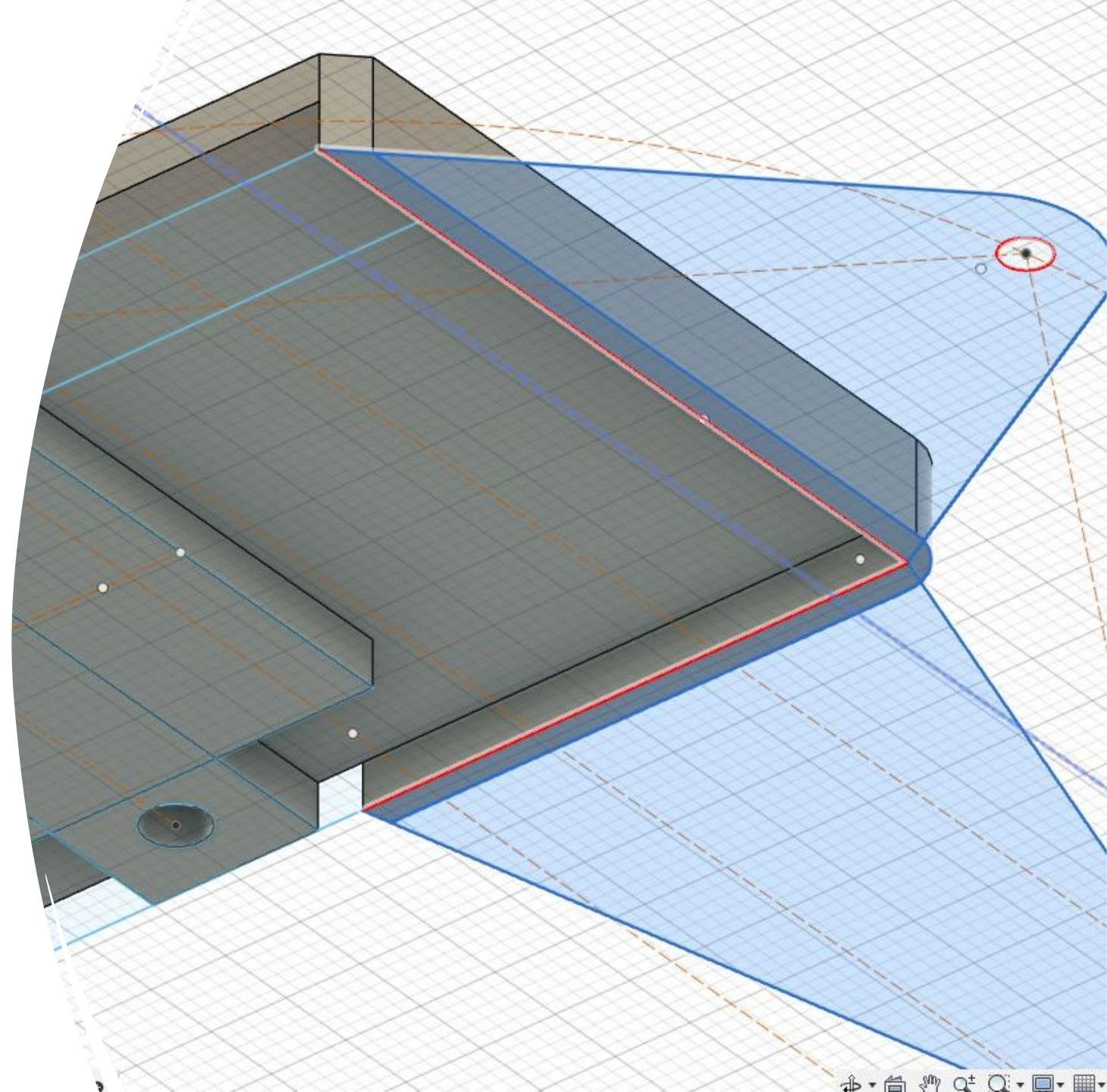
Limitations, future work

- Kitchen science. Unknown species, possibility of contamination
- Proof of concept achieved
- With increased 280nm light and magnification stage, revisit spore detection goal.
- Incorporate other techniques, eg polarized light



Conclusion

- Promising results
- Evidence suggests potential for mapping fungal life cycles, pre-visual contamination detection
- Could be applied to food safety, bulk contamination testing



Supplements

