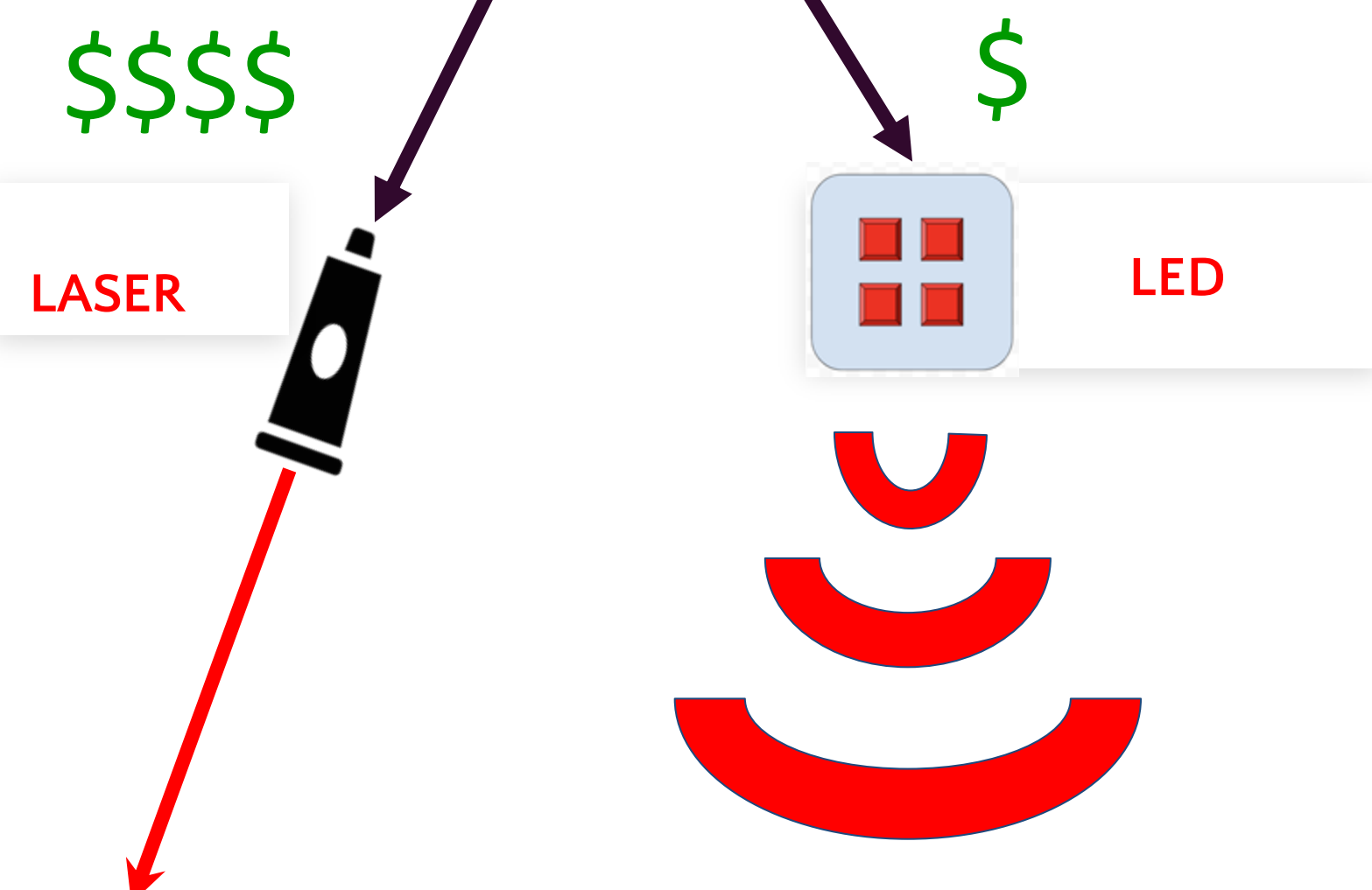


ReDesigned LED Device to Stimulate Transcranial PhotoBioModulation (tPBM)

BACKGROUND

- Transcranial Infrared **Laser** Stimulation (TILS) activates mitochondrial enzyme **Cytochrome C Oxidase (CCO)**
- Transcranial Photobiomodulation (tPBM):
 - ↑ Brain **Oxygenation**
 - ↑ Cognition and emotional function

tPBM



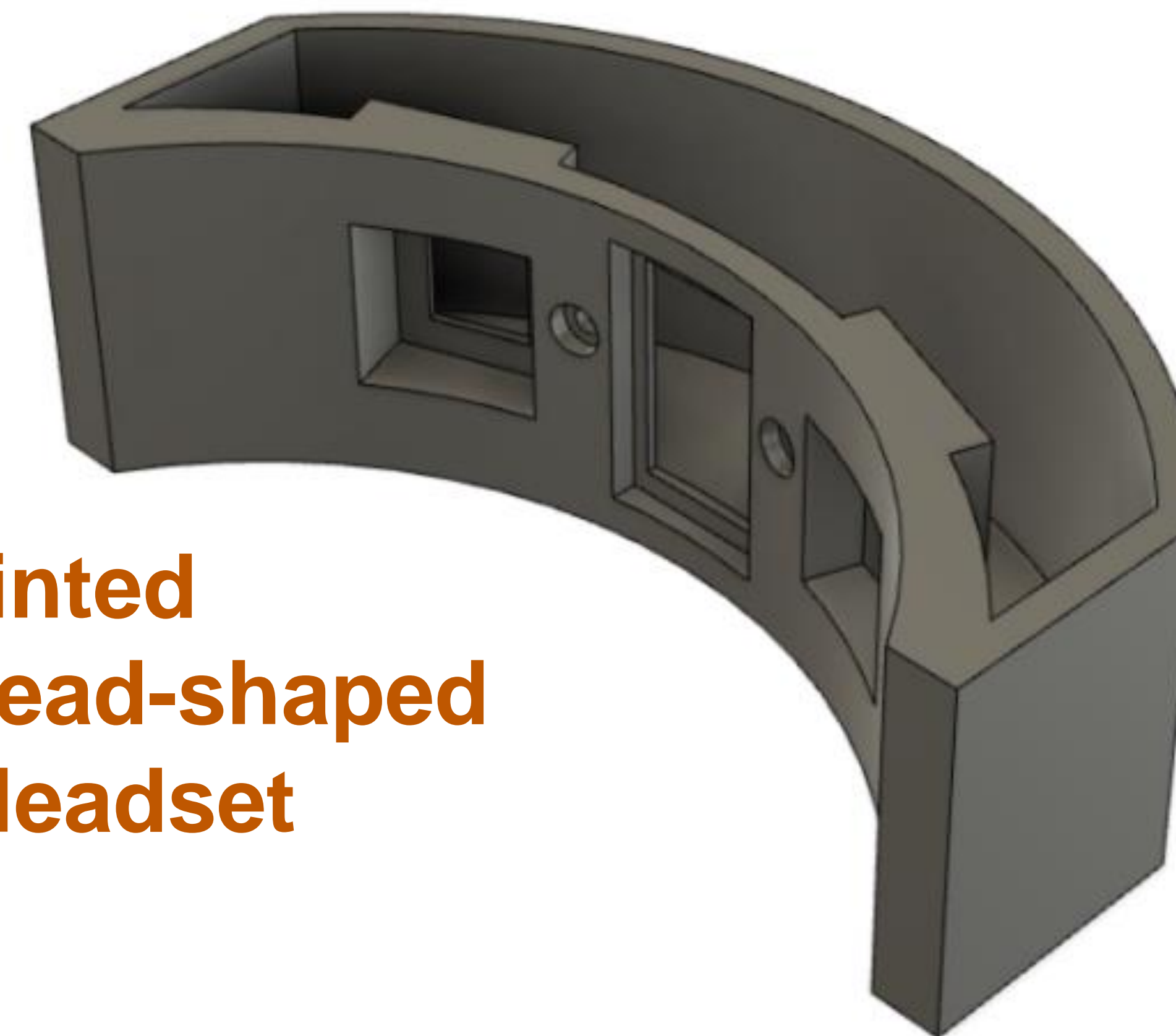
1064 nm 1030-1070 nm
250 mW/cm² 750 mW per LED
Collimated light Divergent light

PILOT DESIGN

LED wearable headband

- 2 LED arrays
- a microcontroller
- ambient light sensors
- temperature detection
- pulse oximeter sensor
- mobile software interface

3D-Printed
Forehead-shaped
LED Headset



RESULTS

- Average power density of array: 87 mW/cm²
- Microcontroller firmware functioned properly
- Ambient light and temperature sensors provided accurate data of external conditions
- Pulse oximeter did not provide accurate data of SpO₂ levels in the prefrontal cortex (*proof of concept*)

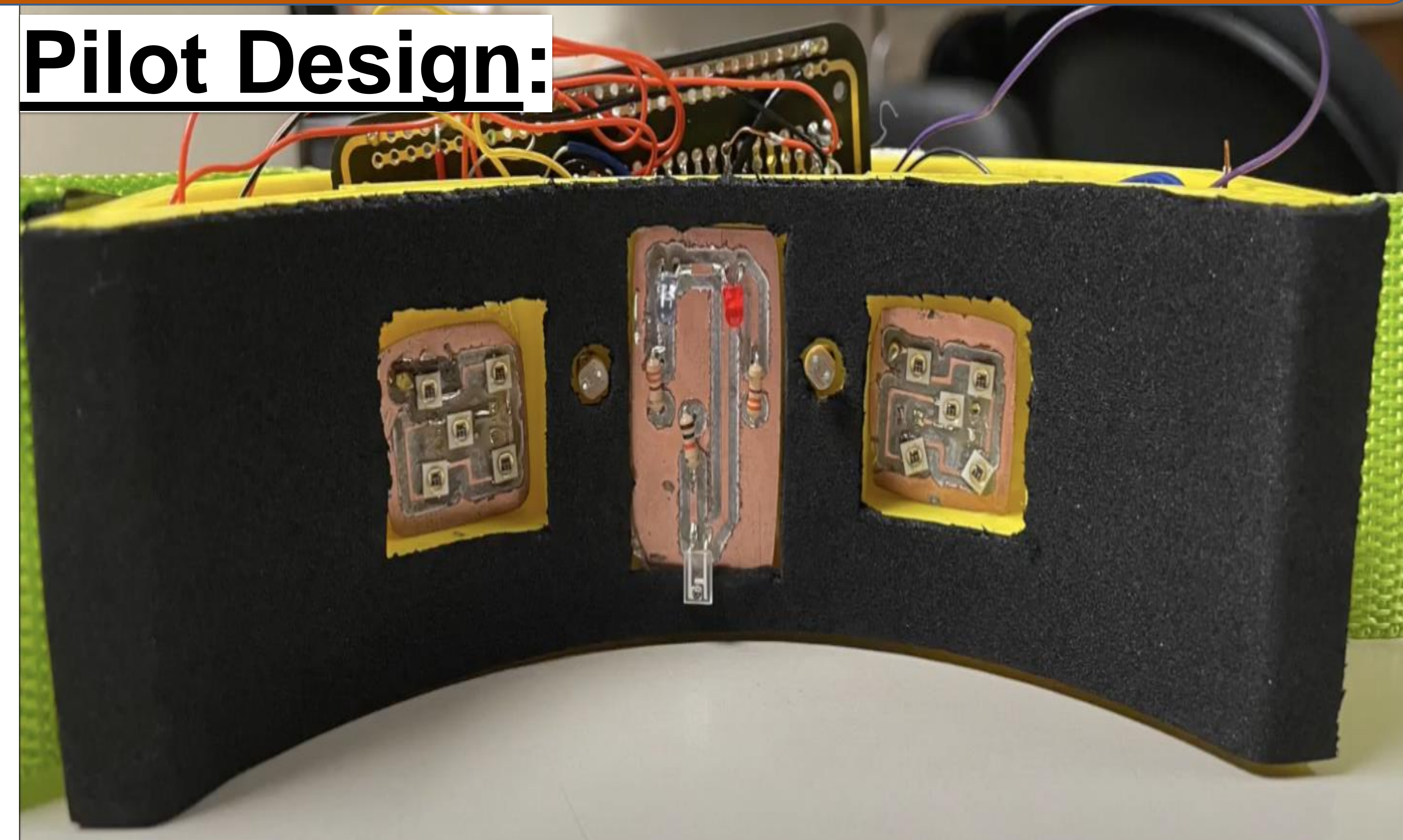


Inefficient thermal
dissipation prevents
LEDs from achieving the
desired power output

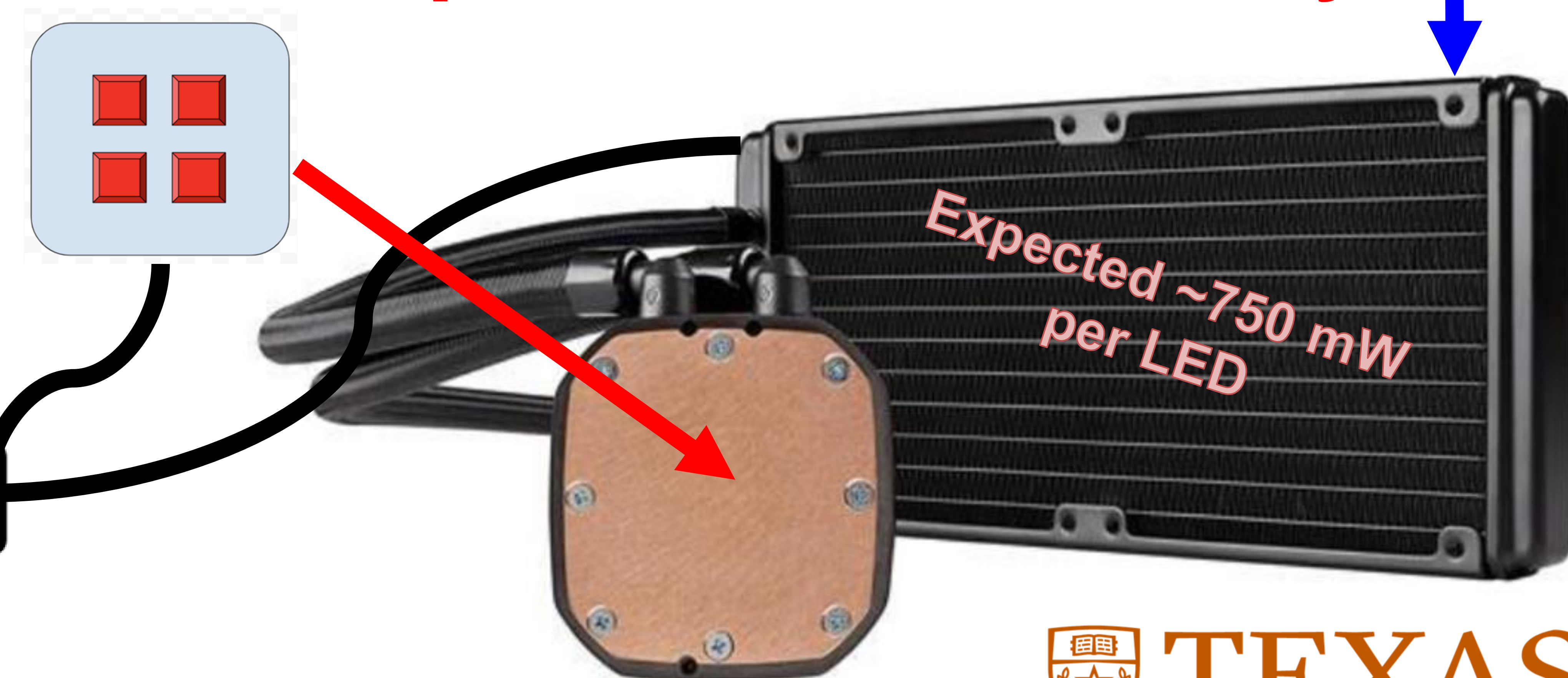
Power Supply

USB-C
SATA Power
Constant Current

Pilot Design:



New Design: Integrated Cooler
Dissipates 3W  Heat  from
New Simplified LED Array



REFERENCES

1. Rojas, J. C., & Gonzalez-Lima, F. (2011). Low-level light therapy of the eye and brain. *Eye Brain*, 3, 49-67.
2. Karu, T. I., Pyatibrat, L. V., Kolyakov, S. F., & Afanasyeva, N. I. (2005). Absorption measurements of a cell monolayer relevant to phototherapy: reduction of cytochrome c oxidase under near IR radiation. *Journal of Photochemistry and Photobiology B: Biology*, 81, 98-106.
3. Wong-Riley, M. T., Liang, H. L., Eells, J. T., Chance, B., Henry, M. M., Buchmann, E., Kane, M., & Whelan, H. T. (2005). Photobiomodulation directly benefits primary neurons functionally inactivated by toxins: role of cytochrome c oxidase. *The Journal of Biological Chemistry*, 280, 4761-4771.
4. Rojas, J. C., & Gonzalez-Lima, F. (2013). Neurological and psychological applications of transcranial lasers and LEDs. *Biochemical Pharmacology*, 86, 447-457. doi:10.1016/j.bcp.2013.06.012.

PILOT DESIGN VIDEO



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