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Shining Light on Mitochondria

670nm Light Induces Decrease in Complex IV Function (and more)

Introduction Photobiomodulation

- AKA Near-Infrared (NIR) therapy or Low-Level Light Therapy (LLLT).
- Illuminations with 600nm – 1,000nm from a laser or light emitting diode (LED) in non-thermal (“low”) intensity.
- Reportedly upregulates Complex IV activity, somehow leading to increase in ATP production and various beneficial clinical effects.



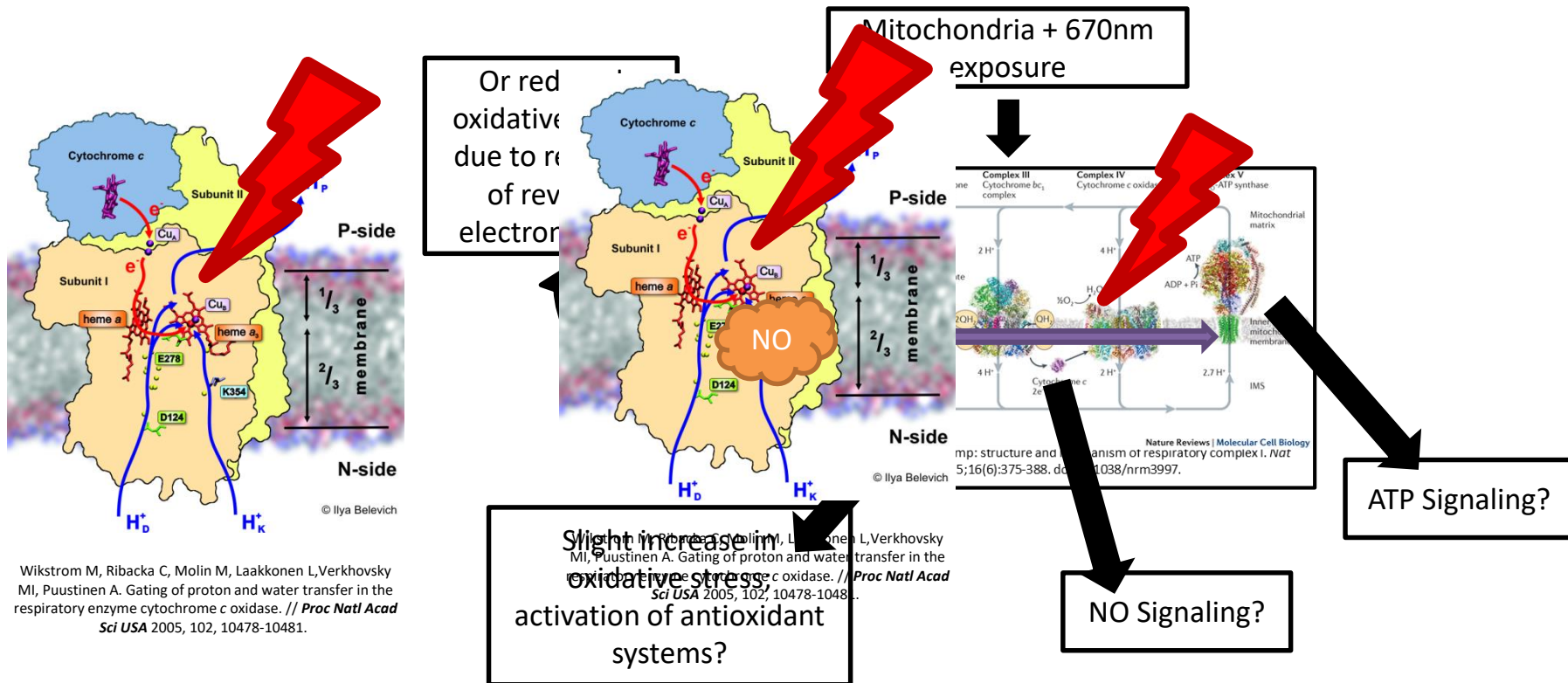
Introduction Limitations

- Though we are justified to be skeptical of these claims, scientific investigations are being conducted with many of them reporting empirical positive results.
- However, they are limited by:
 1. Poor understanding of biochemical mechanism induced by infrared light.
 2. No widely agreed “effective light parameter” used for therapeutic use.
 3. Research requires in-depth understanding of physical properties of light.



Introduction

Currently Accepted Mechanism



Method Respirometer Protocols

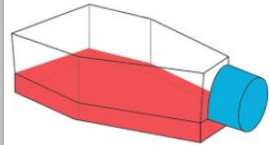
“Real-Time”
HEK293T



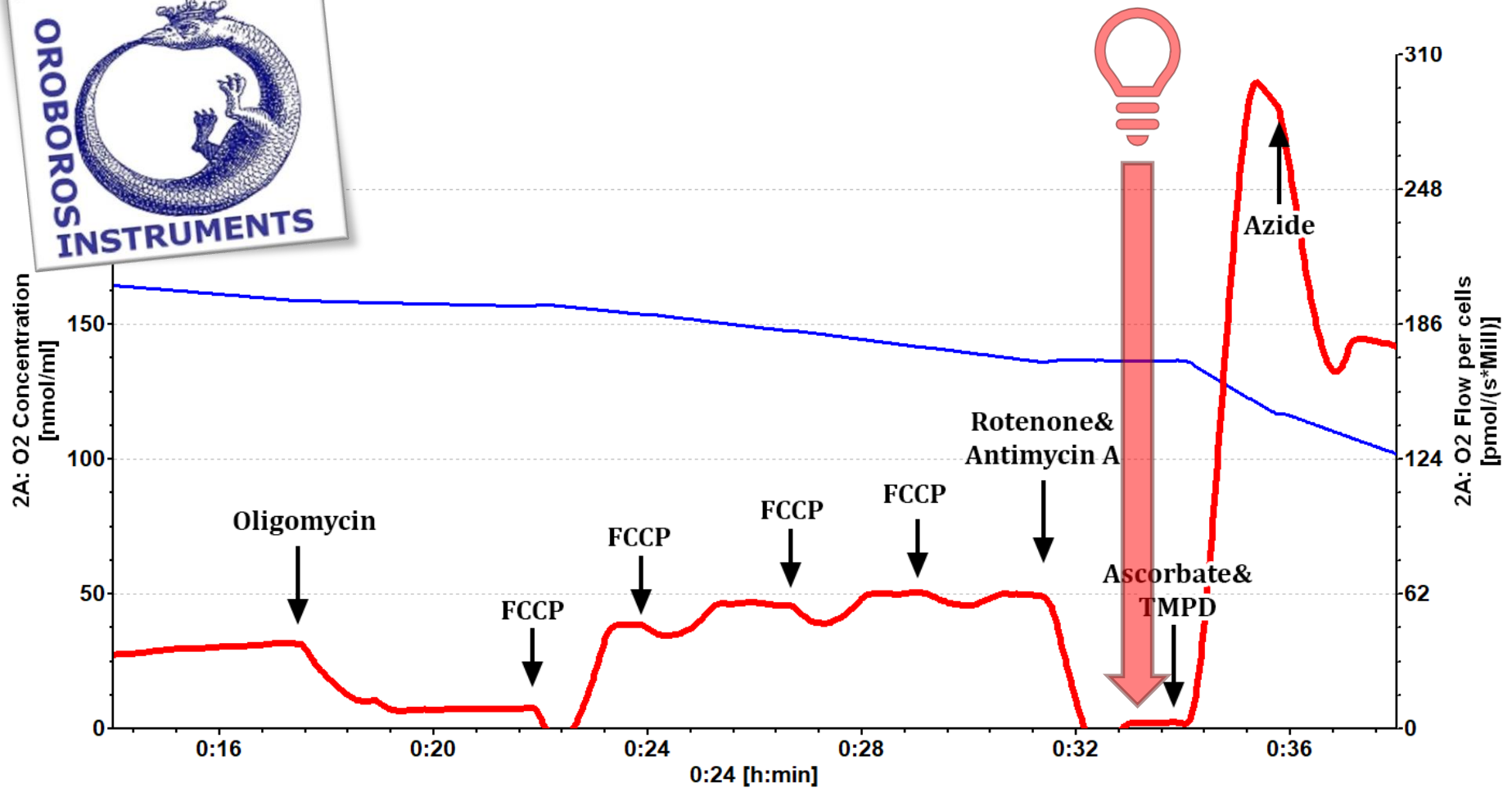
670nm light applied through O2K's
window.



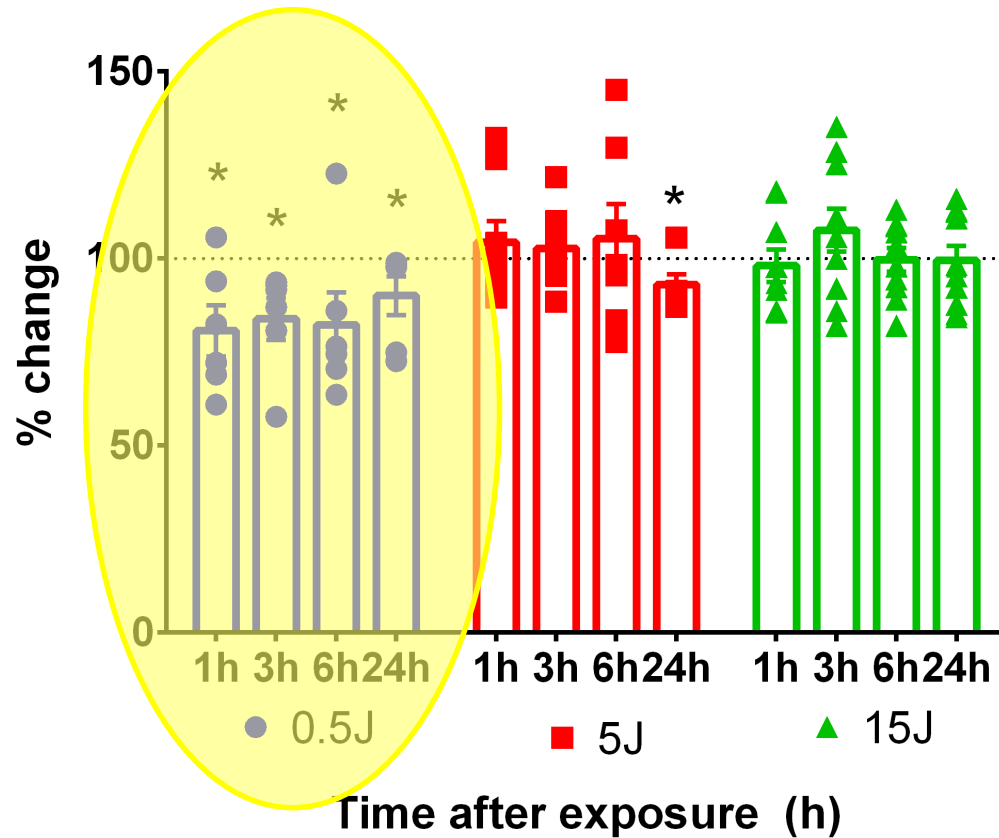
Measured **immediate** effect of NIR
light.



Method Respirometer Protocols



Decreased CIV Activity

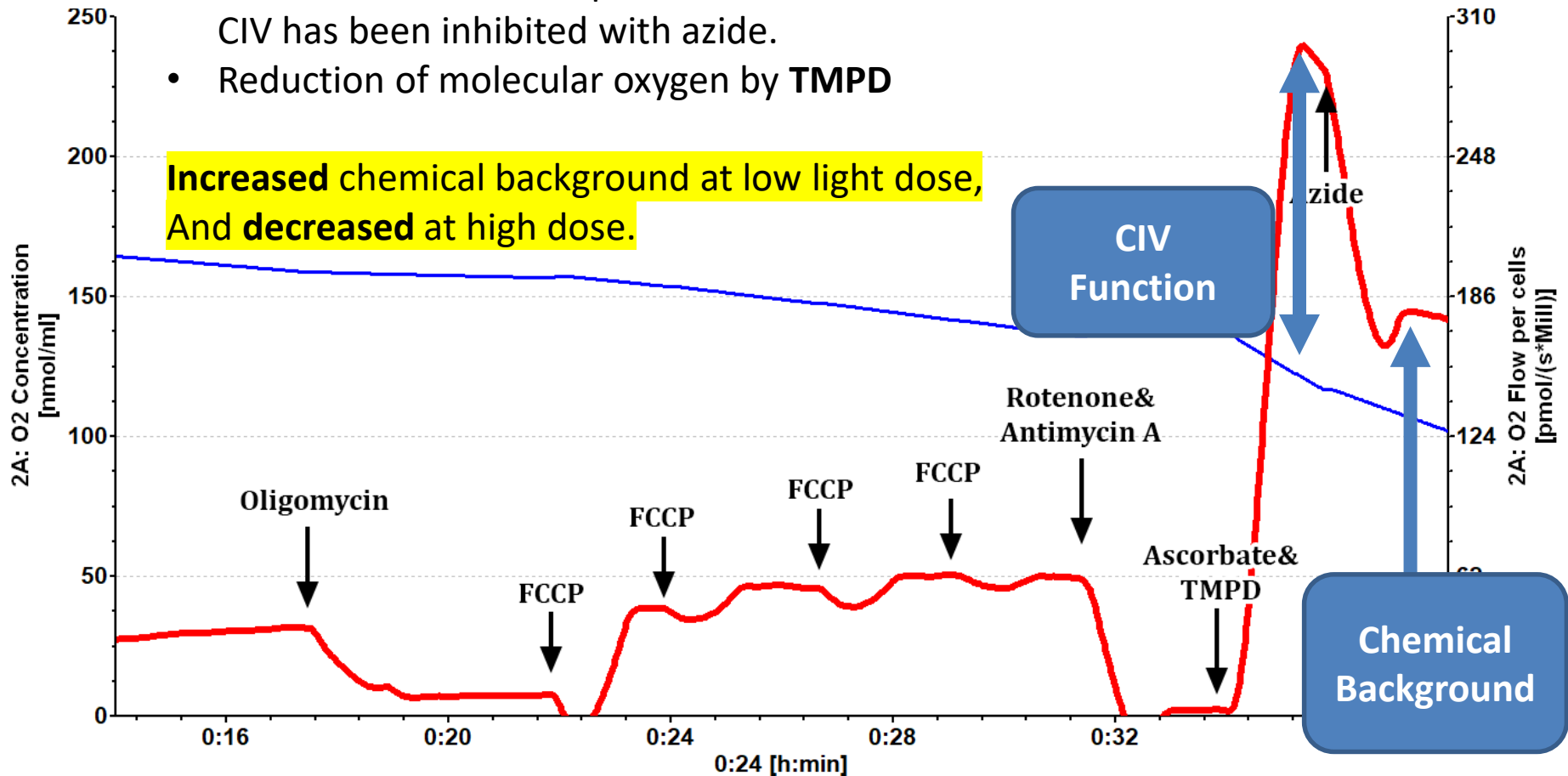


But wait there's more

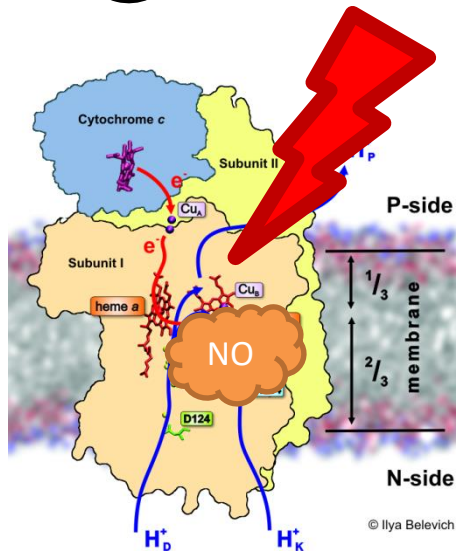
Chemical Background:

- Non-mitochondrial respiration that remains after CIV has been inhibited with azide.
- Reduction of molecular oxygen by **TMPD**

Increased chemical background at low light dose,
And decreased at high dose.



Proposed Mechanisms



Wikstrom M, Ribacka C, Molin M, Laakkonen L, Verkhovsky MI, Puustinen A. Gating of proton and water transfer in the respiratory enzyme cytochrome c oxidase. // *Proc Natl Acad Sci USA* 2005, 102, 10478-10481.

Three effects of NIR light observed:

1. CIV function decreased

- Increased NO dissociation.

2. Chemical background increased

- Increased CIV's azide resistance

3. Chemical background decreased

- Decreased activity of non-mitochondrial oxygen consumers; NADPH oxidase (NOX)



THANK YOU!