SPECTRAL CHANGES CAUSED BY RADIOFREQUENCY ABLATION OF CARDIAC TISSUE

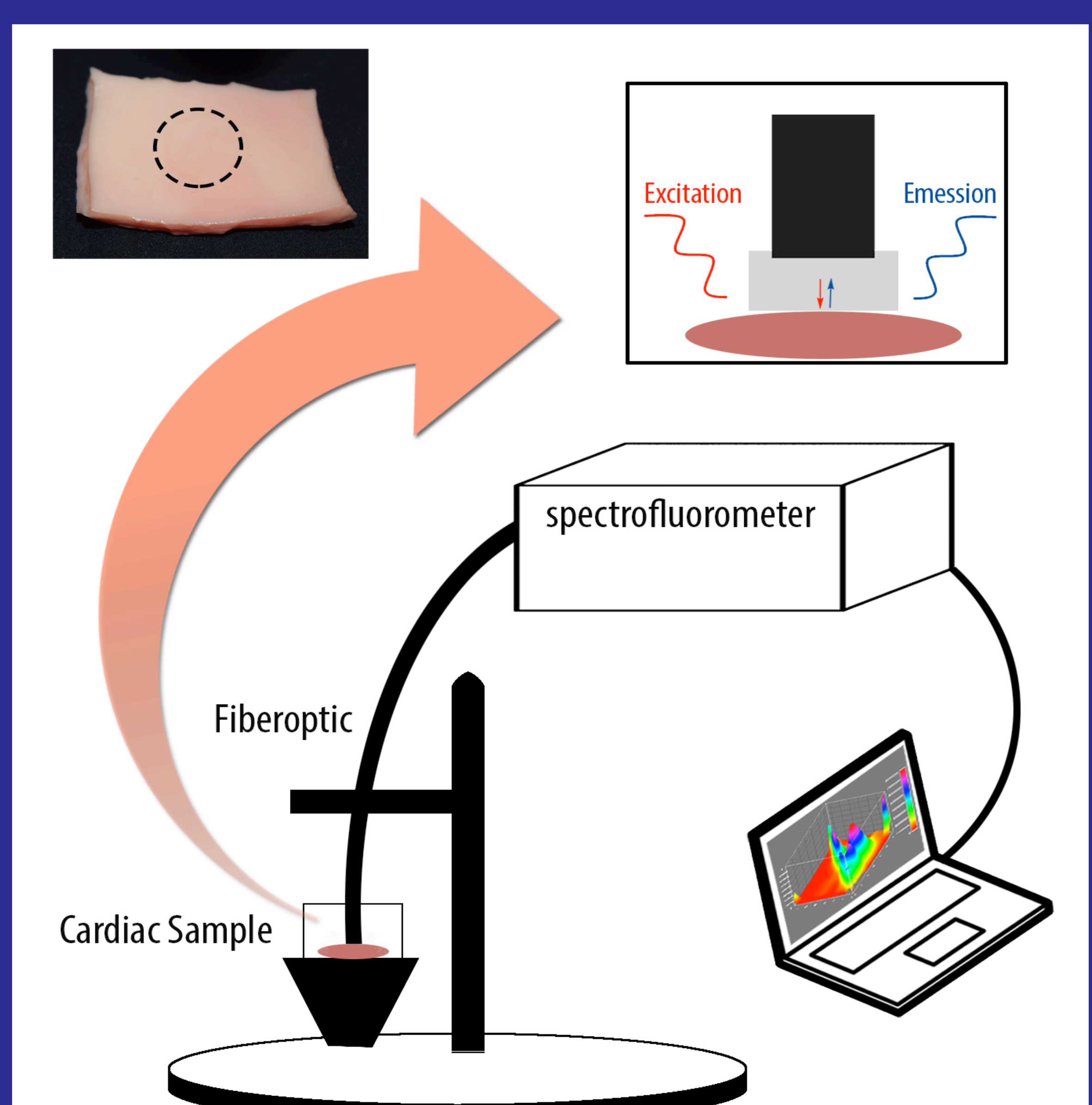
Mohammed Aljishi, Huda Asfour, Luther Swift, Narine Muselimyan, Marco Mercader, Narine Sarvazyan

Pharmacology and Physiology, The George Washington University, Washington, DC, USA

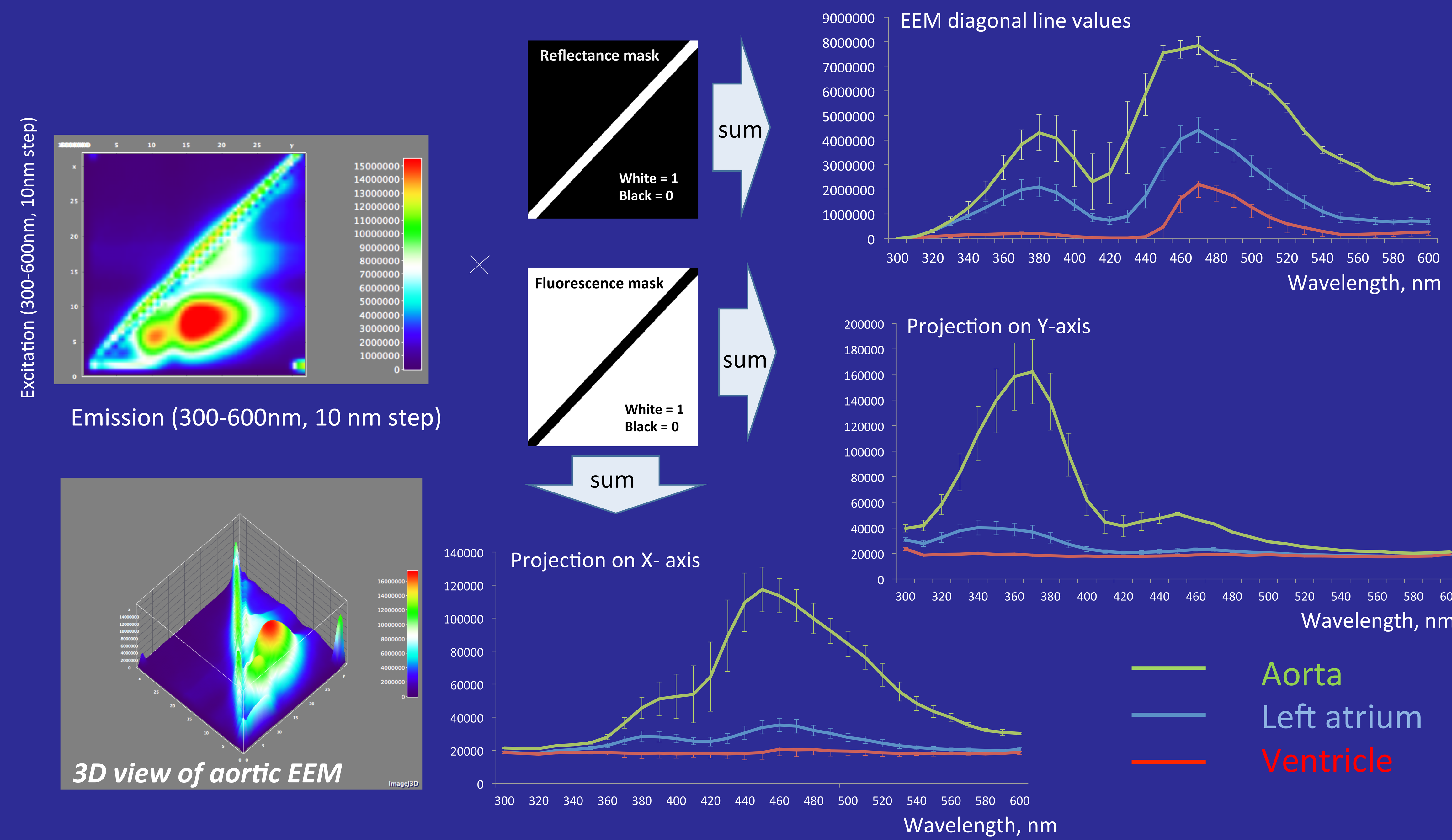
OBJECTIVE: To improve existing tools for surgical treatment of cardiac arrhythmias. We aim to develop new generation of diagnostic/treatment catheters that deliver and acquire light through fiberoptic bundle within body of ablation catheter. This information can be then used for a real time feedback guidance.

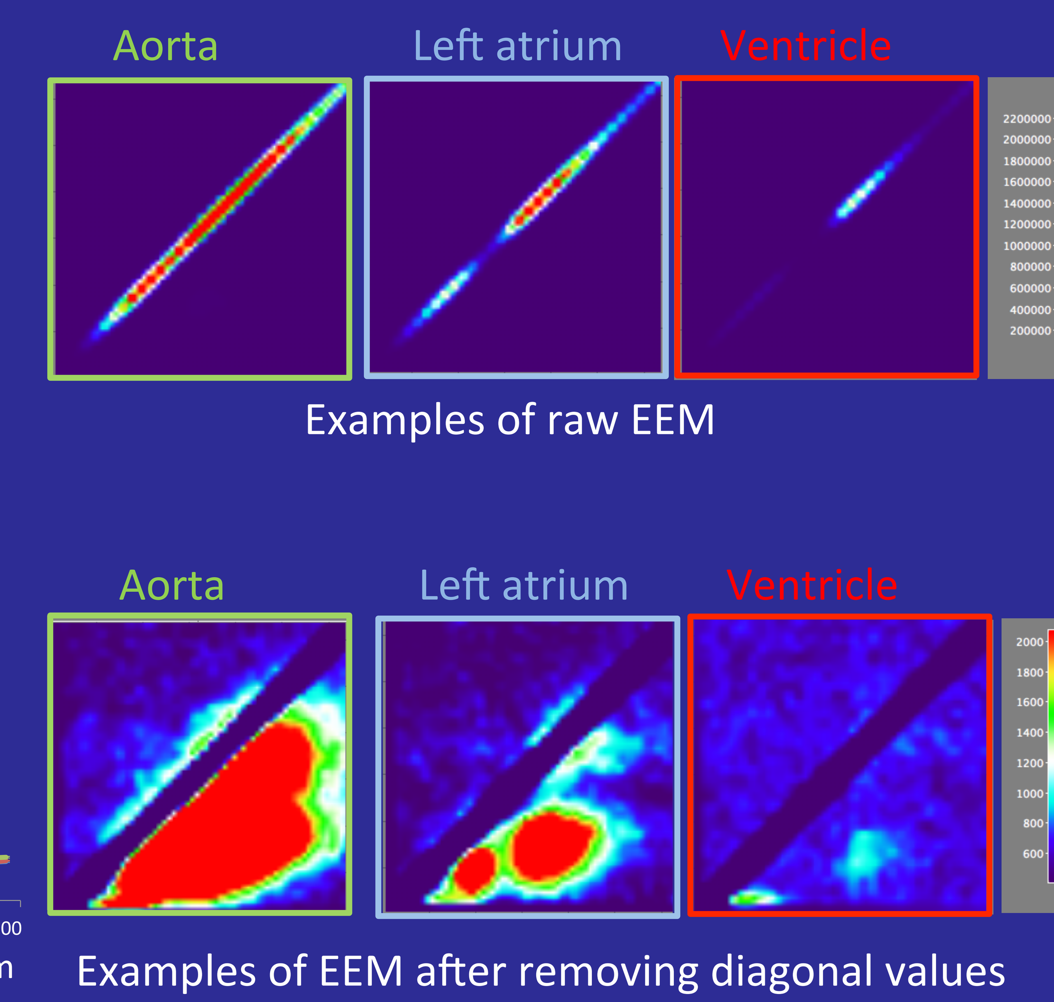
SPECIFIC AIM: To determine the most sensitive optical ranges for characterizing thermal injury by comparing spectral information from different areas of the heart before and after radiofrequency (RF) ablation.

METHODS: Light was delivered and acquired through a fiberoptic bundle pressed against excised pieces of porcine heart using FluoroMax 3 spectrofluorometer. Excitation emission matrices (EEMs) from ventricular muscle, endocardial surface of left atria, and aorta were acquired from 300-600 nm range. Values from different pieces of porcine tissue were averaged to reveal the differences with $p<0.05$ considered significant.



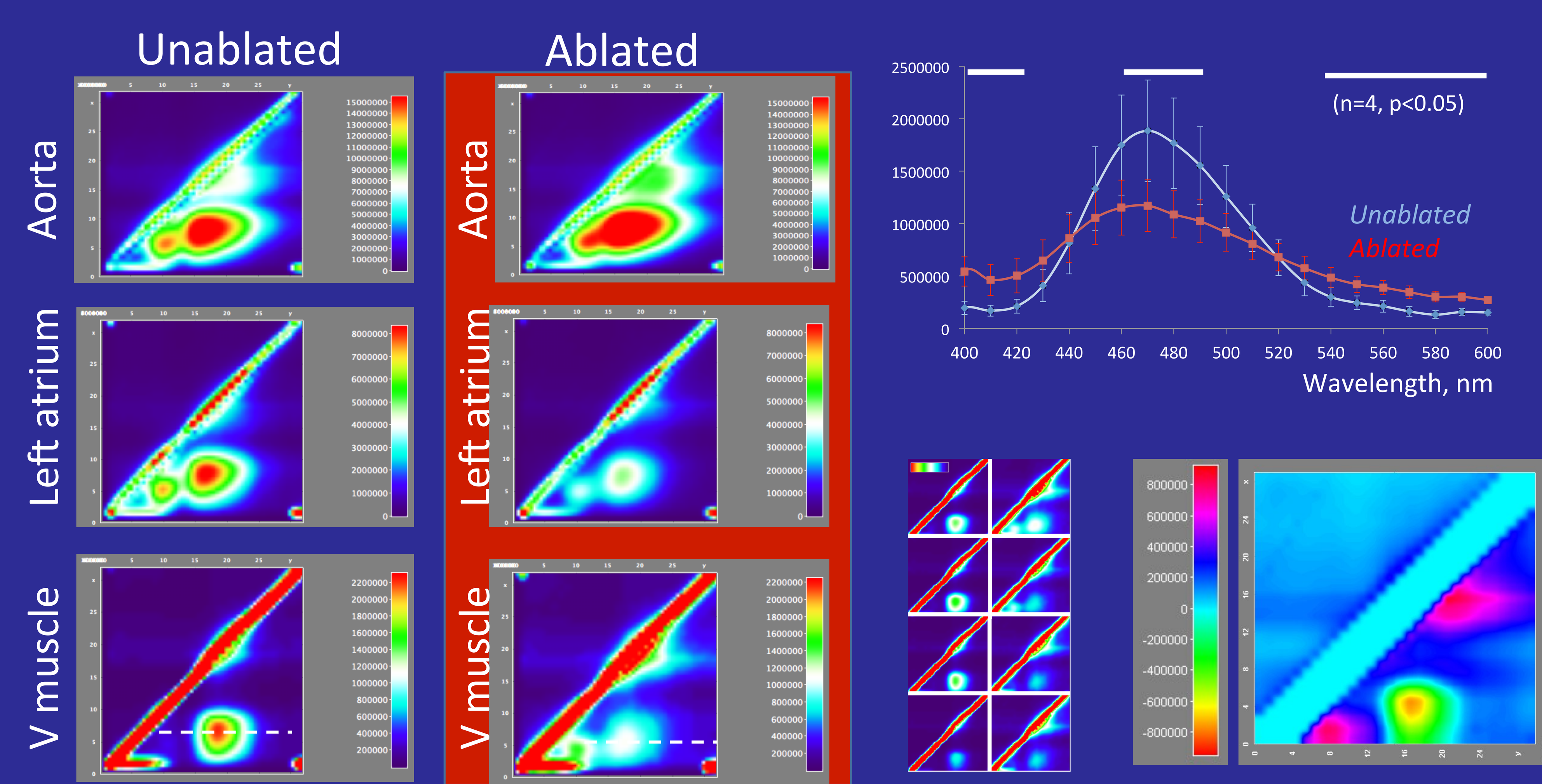
Analysis of Excitation-Emission Matrices analysis for three types of cardiac tissue





Each type of tissue exhibited distinct EEMs with reproducible changes in fluorescence and diffuse reflectance as shown in the graphs and corresponding figures (n=7).

Effect of RFA ablation on three tissue types



Each type of tissue exhibited distinct EEMs that underwent reproducible changes in fluorescence and diffuse reflectance upon RF ablation (left panel shows representative EEMS, n=3-4). Specifically, RF resulted in a reduction of the NADH fluorescence peak in ventricular muscle EEMs (360/460nm excitation/emission maxima, graph corresponds to the white dotted line on the bottom sets of EEMs). It also led to a broadening of collagen fluorescence peaks in the aorta. RF led to an increase in diffuse reflectance (seen as increased width of the EEM diagonal line) in all three tissue types. Thermal coagulation of heme-containing proteins, including different forms of myoglobin, led to a weaker absorption in the Soret band range (410-430nm). The latter was particularly noticeable in ventricular tissue but was also significant in the left atrial tissue. The major changes caused by RF ablation of ventricular tissue are shown on the bottom right. After deriving an average EEM values from 4 unablated and 4 ablated sites of the ventricular tissue, fluorescence mask was applied and difference EEM was then plotted (note different LUT scale with blue being no change)

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