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Noninvasive probes of mitochondrial molecular motors DHARMAKEERTHNA NAWARATHNA, DAVID WARMFLASH, JOHN MILLER, University of Houston, JAMES CLAYCOMB, Houston Baptist University — We report on a noninvasive method of probing mitochondrial molecular motors using nonlinear dielectric spectroscopy. It has been found previously that enzymes in the plasma membrane, particularly H+ ATPase, result in a strong low frequency (less than 100 Hz) nonlinear harmonic response. In this study, we find evidence that molecular motors located in the inner membranes of mitochondria cause the generation of harmonics at relatively high frequencies (1 - 30 kHz). In particular, we find that potassium cyanide (KCN), a respiratory inhibitor that binds to cytochrome c oxidase and thus prevents transport of protons across the mitochondrial inner membrane, suppresses the harmonic response. We observe this behavior in yeast (S. cerevisiae), a eucaryote that typically contains about 300 mitochondria, and B. indicas, a procaryote believed to be related to the ancient ancestor of mitochondria. Our current modeling efforts are focusing on a Brownian ratchet model of the F0 unit of ATP synthase, a remarkable molecular turbine driven by the proton gradient across the mitochondrial inner membrane.

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