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Is there a "Living Pulse"in Microorganisms?

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A rhythmic pattern of motion due to breathing and circulation processes is observed within macroscopic organisms such as animals. The question is whether we could observe something like this –on a much smaller scale –also in microbial life forms. We know that there is motion within any type of cell from the myriad of internal processes and also at the cell boundaries when an organism interacts with its natural environment. Here we hypothesize that each microorganism has such a "living pulse", a rhythmic pattern that in principle can be detected by state-of-the-art technology (Walther-Antonio and Schulze-Makuch, 2023).
Experimental evidence that such a living pulse might exist comes from nanomechanical oscillators, which detect forces in the order of a piconewton and which were used to characterize living specimens and their metabolic cycles (Boisen et al. 2011). Cantilevers were used to investigate the activity of a cell's molecular motors and the particular vibrations of living *Saccharomyces cerevisiae* (Pelling et al. 2005). The measured force by nanomechanical oscillators in the order of a piconewton fares well with our theoretical considerations of the same order for the force required for one ion to go through a cellular membrane. If such a proposed "living pulse"exists, we suggest that it can be detected with state-of-the-art microscopy such as Stimulated Emission Depletion (STED) and Scanning Ion Conductance Microscopy (SICM), particularly if we compare dead cells as a control to living cells from the same species. One (of the many) challenges will be to distinguish the hypothetical "living pulse"from environmental noise. However, while environmental noise would travel from the outside of the cell to the inside, the opposite direction would be the case for the "living pulse". While we hypothesize that all living microbes will exhibit a living pulse, we expect the frequency and the magnitude to be different depending on the species just like it is the case for animals.
If the hypothesized "living pulse"can be detected, it would have far-reaching applications. It would be a universal biosignature independent of an organism´s specific biochemisty. It would be a tool to detect life in extreme environments on Earth and in extraterrestial locations, where we don´t know whether it exists. It would also help us to ensure that life is not present where sterilizing conditions are critical, such as for planetary protection purposes, in the food-processing industry, and during medical procedures.

References

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Pelling, A.E., et al. (2005) Time dependence of the frequency and amplitude of the local nanomechanical motion of yeast. Nanomedicine 1, 178-183.
Walther-Antonio, M. and Schulze-Makuch, D. (2023) The hypothesis of a living pulse in cells. Life 13(7), 1506; https://doi.org/10.3390/life13071506

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