

Title: Following long-term calcium signaling dynamics with smart photonic DR1 approach

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- Calcium Signaling Dynamics
- Disperse Red 1 (DR1) system
- MDCK: Madin Darby-Canine Kidney Cells.

Abstract

Ca²⁺ ion is a key messenger in many critical intracellular processes, allowing cells to adapt to new environmental conditions. However, it remains unclear how cells adapt Ca²⁺ transient kinetics upon these external changes.

We present the smart photonic Disperse Red 1 (DR1) system [(Fedele et al., 2020; Kirby et al., 2014; Peussa et al., 2023)], which enables the application of reproducible and repeatable mechanical stimuli to cells, with fully controllable spacing, timing and intensity of microscope laser.

By combining the DR1 system with live imaging of Madin-Darby Canine Kidney (MDCK) cells, we are able to repeatedly stimulate and induce Ca²⁺ transients in the same cell patches, up to 40 iterations. The Ca²⁺ responses triggered by DR1 system suggest that Ca²⁺ response system is compartmentalized and contains short-term memory (order of minutes). This is previously not possible in single-response or steady-state studies of Ca²⁺ dynamics.

Citations:

Fedele, C., M.äntylä, E., Belardi, B., Hamkins-Indik, T., Cavalli, S., Netti, P.A., Fletcher, D.A., Nymark, S., Priimägi, A., Ihalainen, T.O 2020. Sci. Rep. 10, 15329.

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