Physical limits to spatiotemporal cellular signaling

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ABSTRACT

Cells need to respond to spatiotemporal signals. Physical limits on the detection of such signals are poorly understood. Here we study the detection of spatiotemporal Ca^{2+}-signals by the conventional Protein Kinase C-α (PKC-α). Protein kinases C are ubiquitously expressed and, together with Calmodulin, form the basic read-out module for Ca^{2+} -signals. In order to activate PKC-α, it needs to simultaneously bind to Ca^{2+} and to Diacylglycerol (DAG) on the plasma membrane. On the membrane, PKC-α forms clusters. We explore the consequences of cluster formation for signal transduction. In particular we show that PKC-α acts as a low pass filter and determines the accuracy of the readout. Our study highlights the possible role of collective effects for cellular signal transduction.