Cell polarity controled by light

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Abstract

Cell polarity is characterized by spatial asymmetry of cellular shape, molecules distribution, and signaling activities. This polarity is critical for many biological processes such as division, migration, or the development of an embryo.

Cellular polarization occurs along a complex and orchestrated sequence of events. Initiation of cell polarity requires intrinsic or extrinsic signals which will be selectively integrated and amplified to generate a stable axis of polarity. Next, spatial asymmetry has to be maintained thanks to polarity effectors. The study of cell polarity consists in understanding the molecular mechanisms that control the initiation, amplification, and maintenance of the polarized state as well as the feedback regulations which coordinate these events in space and in time.

To control cell polarity, we used a novel optogenetic tool developped in Chandra Tucker's Lab[1]. This light inducible and genetically encoded tool permit us to localy recruit proteins of interest to the membrane and to generate a polarized state. Thanks to its diffusion and disassociation characterics, it seems to be an efficient mean to dissect the dynamic of signaling pathways.

Using this optogenic tool, we will dynamically perturbate two different signaling circuits, namely gtpase signaling pathway involved in cytoskelton rearrangements and the determinant of polarity atypical Protein Kinase C(aPKC) involved in asymetric cell division.

Contrary to the usual perturbations which affect the whole cells and often drive them to an abnormal state, this pertubation preserves cellular integrity and may be used to understand dynamic properties -as amplification or filtering characteristics- of special signaling pathways.

[1] Kennedy, M.J., et al., Rapid blue-light-mediated induction of protein interactions in living cells. Nat Meth, 2010. 7(12): p. 973-975.