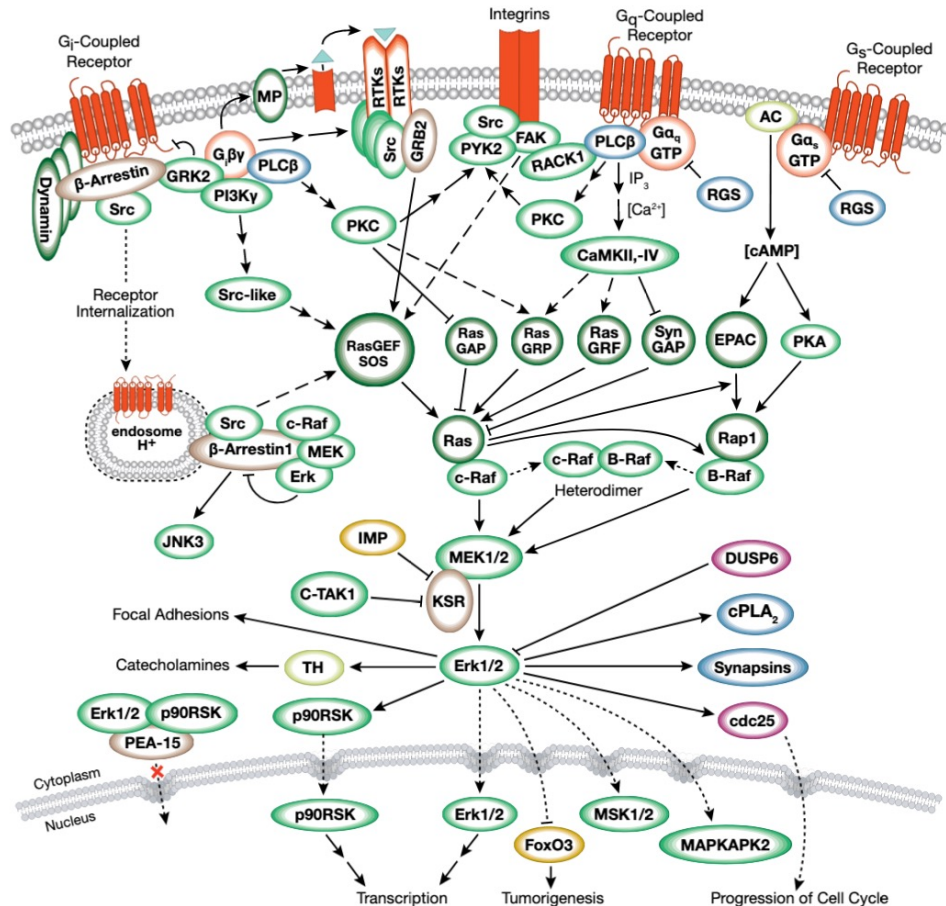


# #39: Tracking Chemical Reaction Networks Driven Time-Periodically from the Viewpoint of Condensed Matter Physics

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Master equation

$$\frac{d}{dt}P(\alpha, t) = \sum_{\beta} [W(\alpha|\beta)P(\beta, t) - W(\beta|\alpha)P(\alpha, t)]$$



2<sup>nd</sup> quantization

M. Doi, J. Phys. A: Math. Gen. **9**, 1465 (1976).  
 L. Peliti, J. Phys. France. **46**, 1469-83 (1985).

Schrödinger equation (imaginary time) of open quantum system

$$\frac{d}{dt}|\psi(t)\rangle = -\hat{H}|\psi(t)\rangle, \quad |\psi(t)\rangle = \sum_{\alpha} P(\alpha, t)|\alpha\rangle,$$

$$\hat{H} = \hat{H}_{\text{reaction}} + \hat{H}_{\text{diffusion}}$$

S. B. Nicholson and T. R. Gingrich (2023)

Chemical Reaction Network  
 = Open Quantum System

Example of a chemical reaction network (Signaling from G protein-coupled receptors to MAPK/Erk) 2023 © Cell Signaling Technology.

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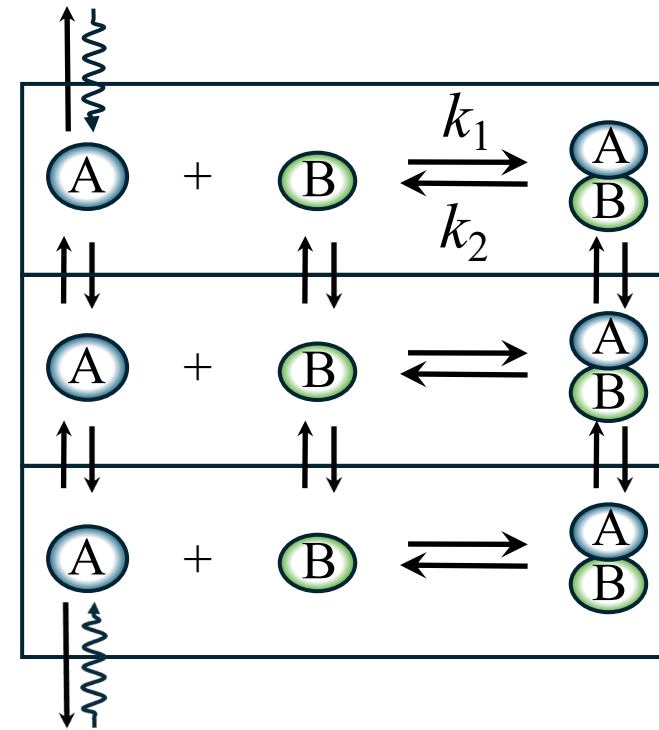
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Chemical Reaction Network  
= Open Quantum System (OQS)

Can the state within a living organism  
be controlled?

II

Can the state of OQS be controlled?  
→ Floquet Engineering of OQS



The Result for simple association-dissociation reaction + diffusion