Endocytosis and signaling: competition of Rab proteins

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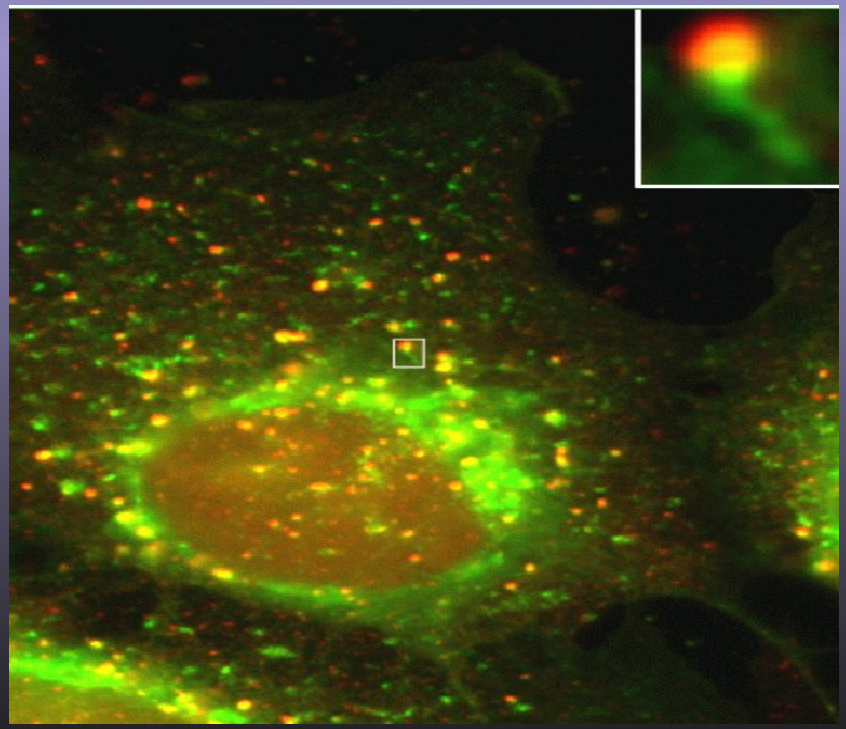
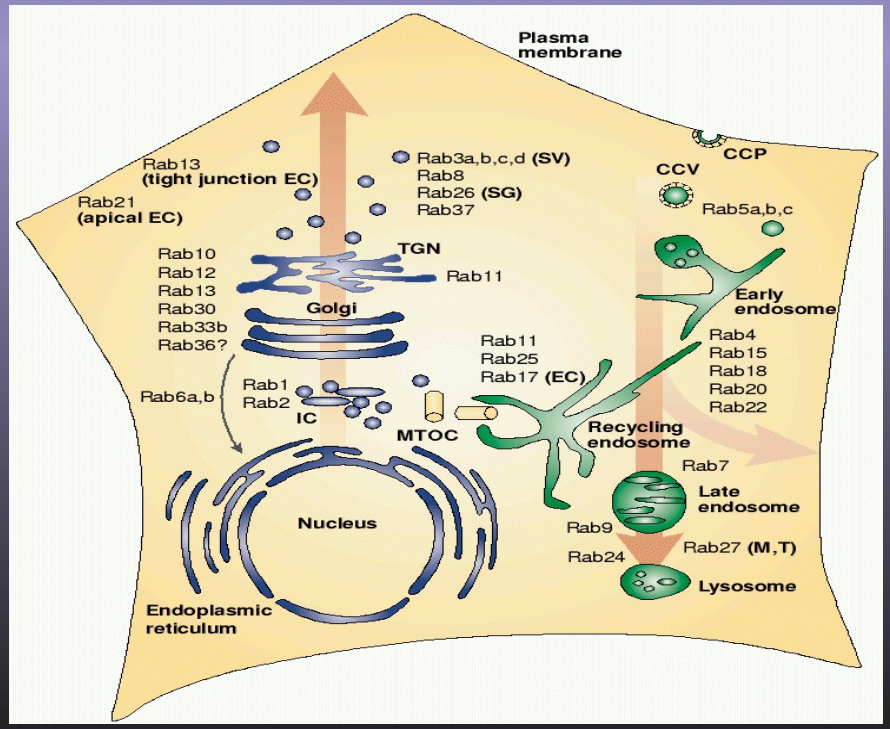
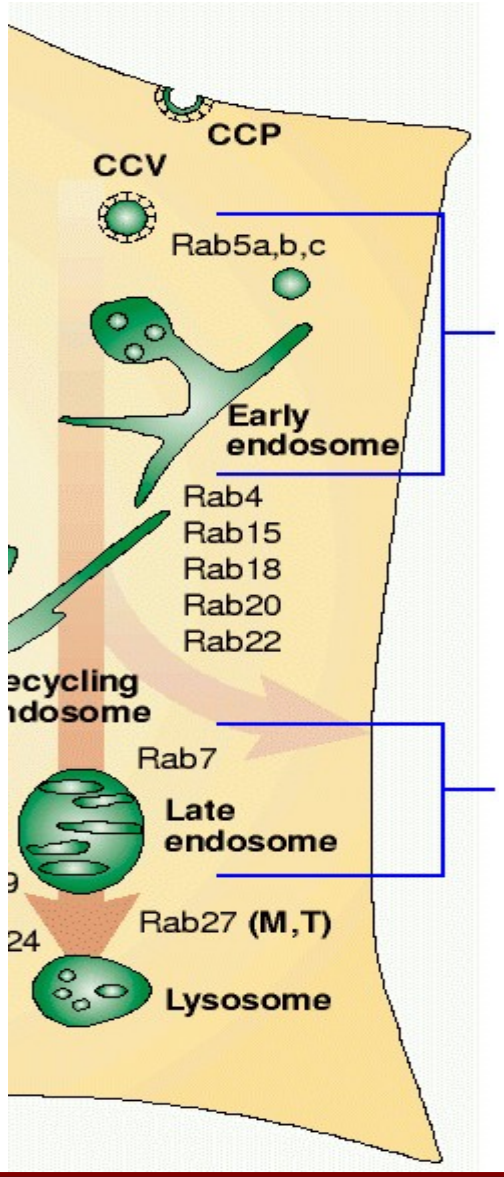




Modular organisation



Mechanism for activity progression?

Rab5 module on early endosome:

cargo sorting

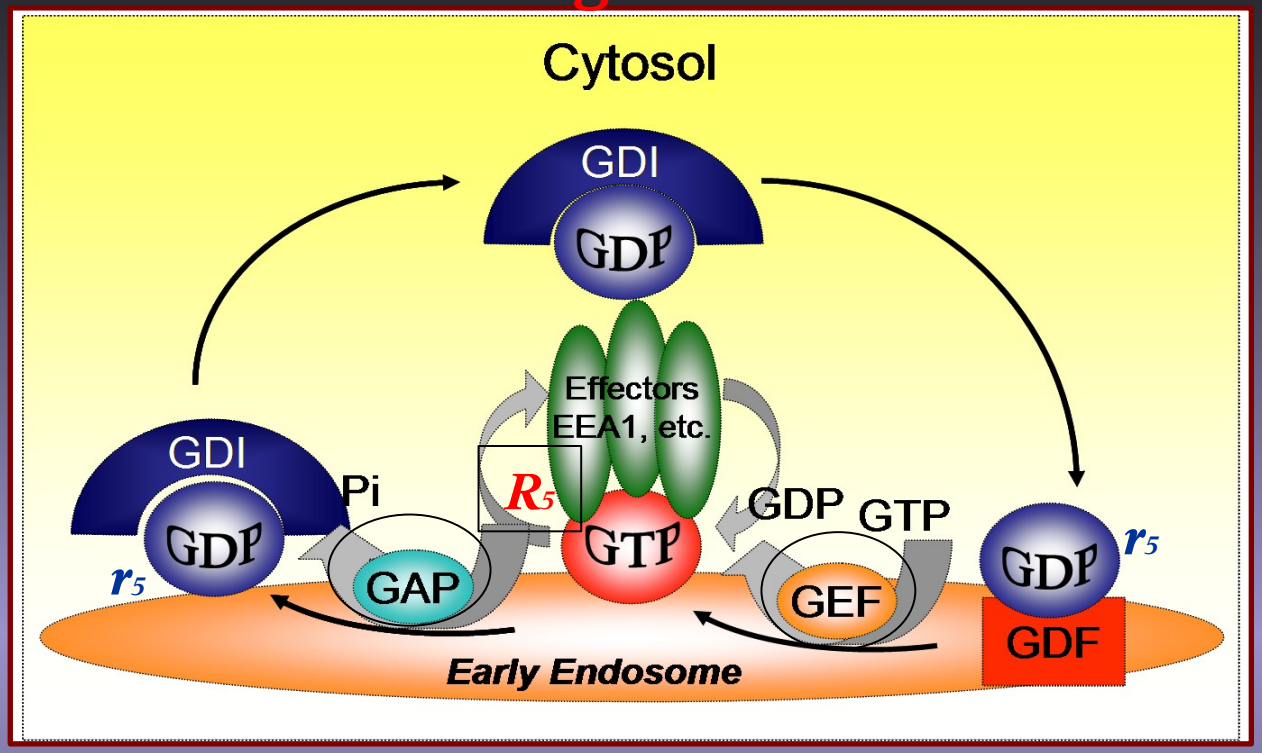
Rab7 module on late endosome:

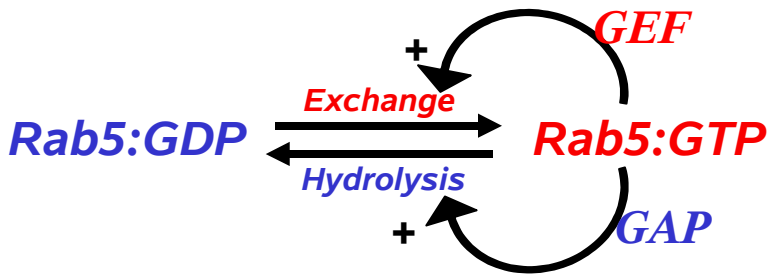
cargo degradation

Hierarchical organisation of modularity

[Barabasi et al., 2002] not applicable

Model of single Rab module

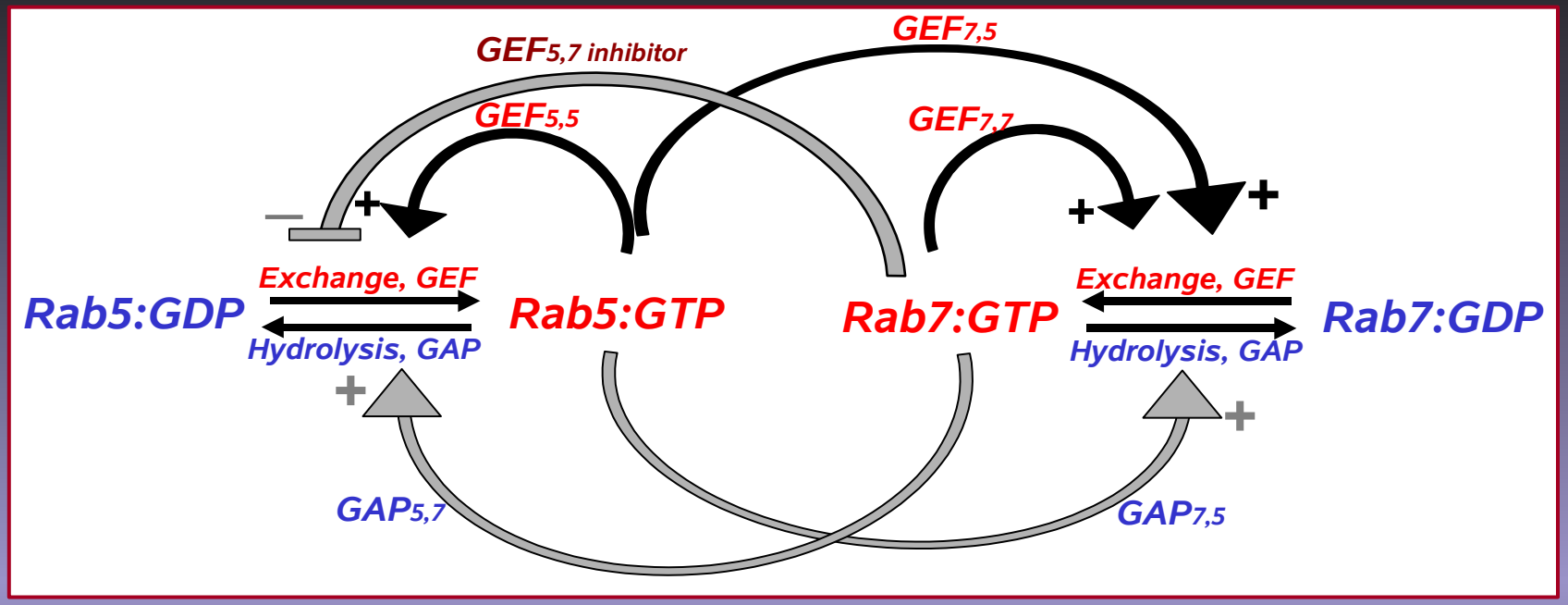




$$\frac{dr_5}{dt} = K_1 - (k_{-1} + GEF(R_5))r_5(t) + GAP_5 \cdot R_5(t)$$

$$\frac{dR_5}{dt} = GEF(R_5)r_5(t) - GAP_5 \cdot R_5(t)$$

Rab5-Rab7 interaction circuits



Model equations

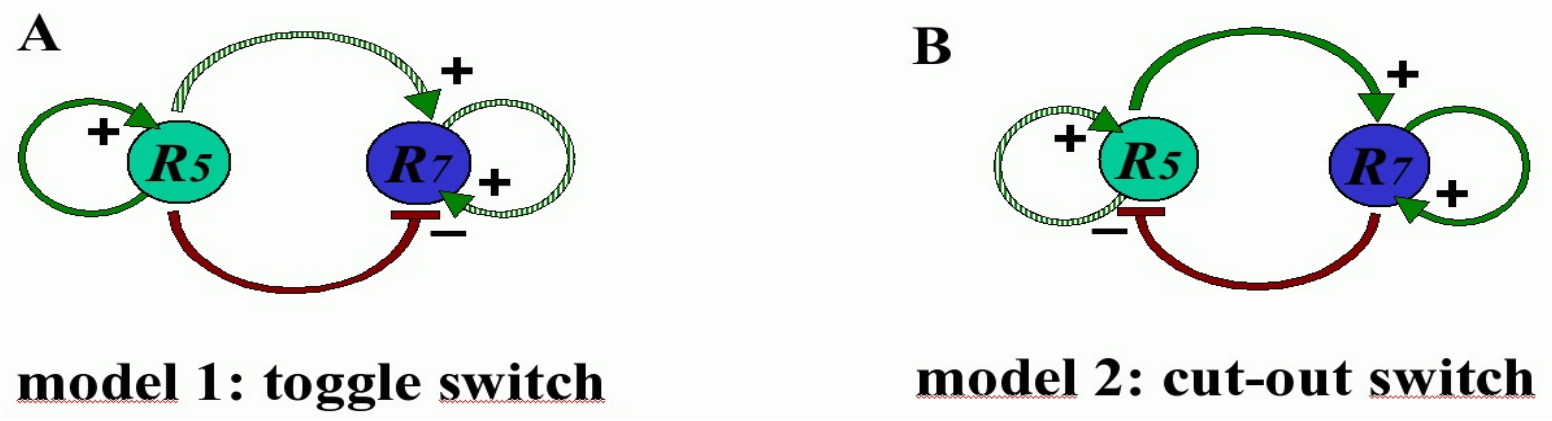
$$\frac{dr_5}{dt} = K_1 - (k_{-1} + GEF_{5,5}(R_5))r_5(t) + GAP_{5,7}(R_7)R_5(t)$$

$$\frac{dR_5}{dt} = (GEF_{5,5}(R_5))r_5(t) - GAP_{5,7}(R_7)R_5(t)$$

$$\frac{dr_7}{dt} = K_2 - (k_{-2} + GEF_{7,7}(R_7) + GEF_{7,5}(R_5))r_7(t) + GAP_{7,5}(R_5)R_7(t)$$

$$\frac{dR_7}{dt} = (GEF_{7,7}(R_7) + GEF_{7,5}(R_5))r_7(t) - GAP_{7,5}(R_5)R_7(t)$$

Rab5-Rab7 interaction circuits



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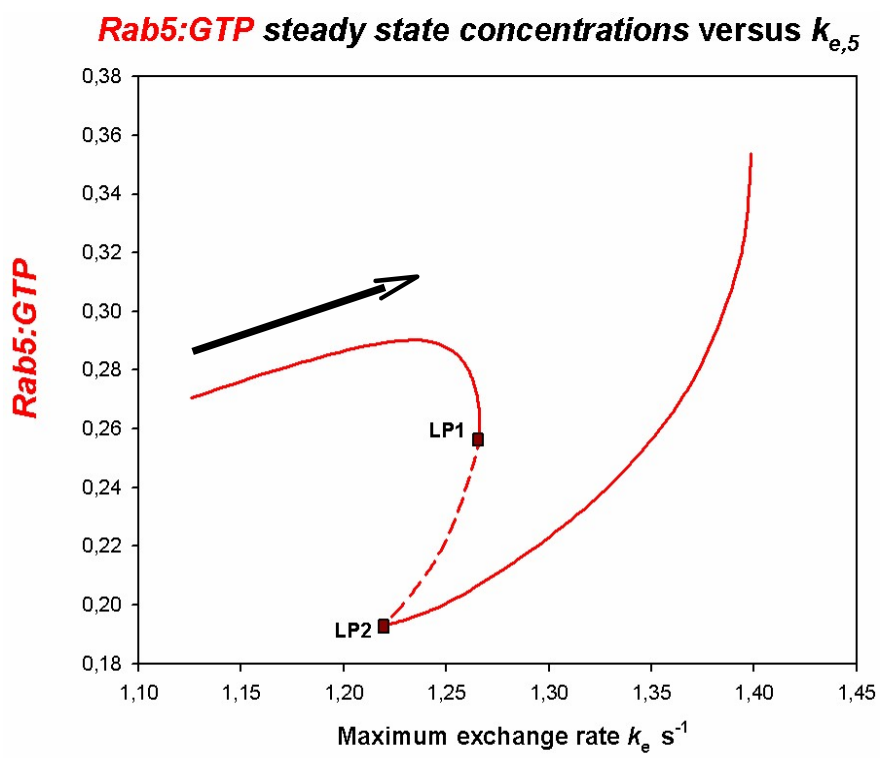
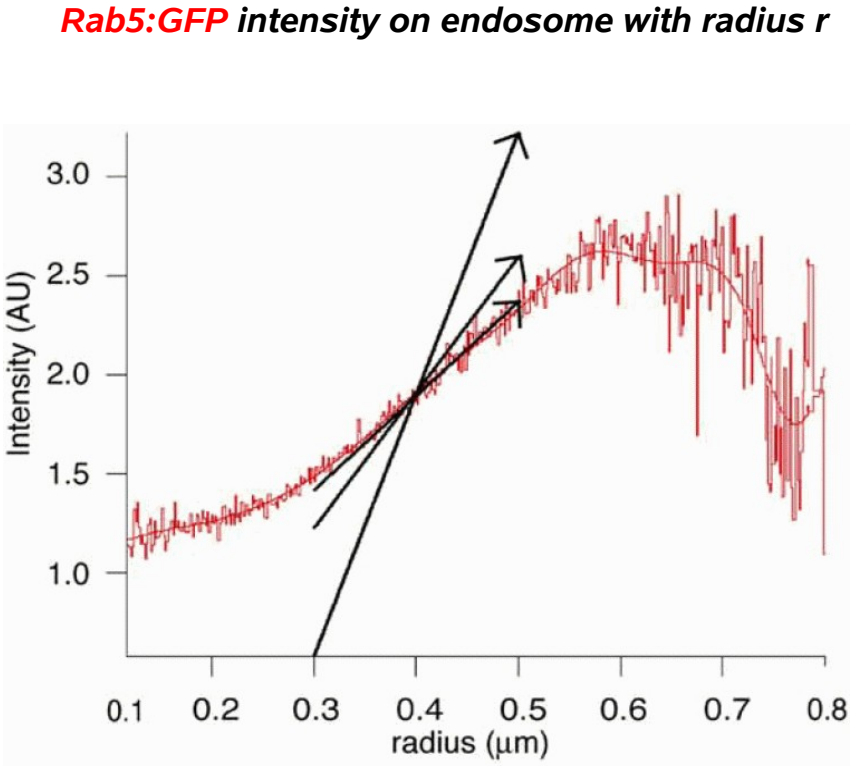
Cut-out switch:
Rab5 density increases towards threshold, then switches off





[Rink et al., 2005]