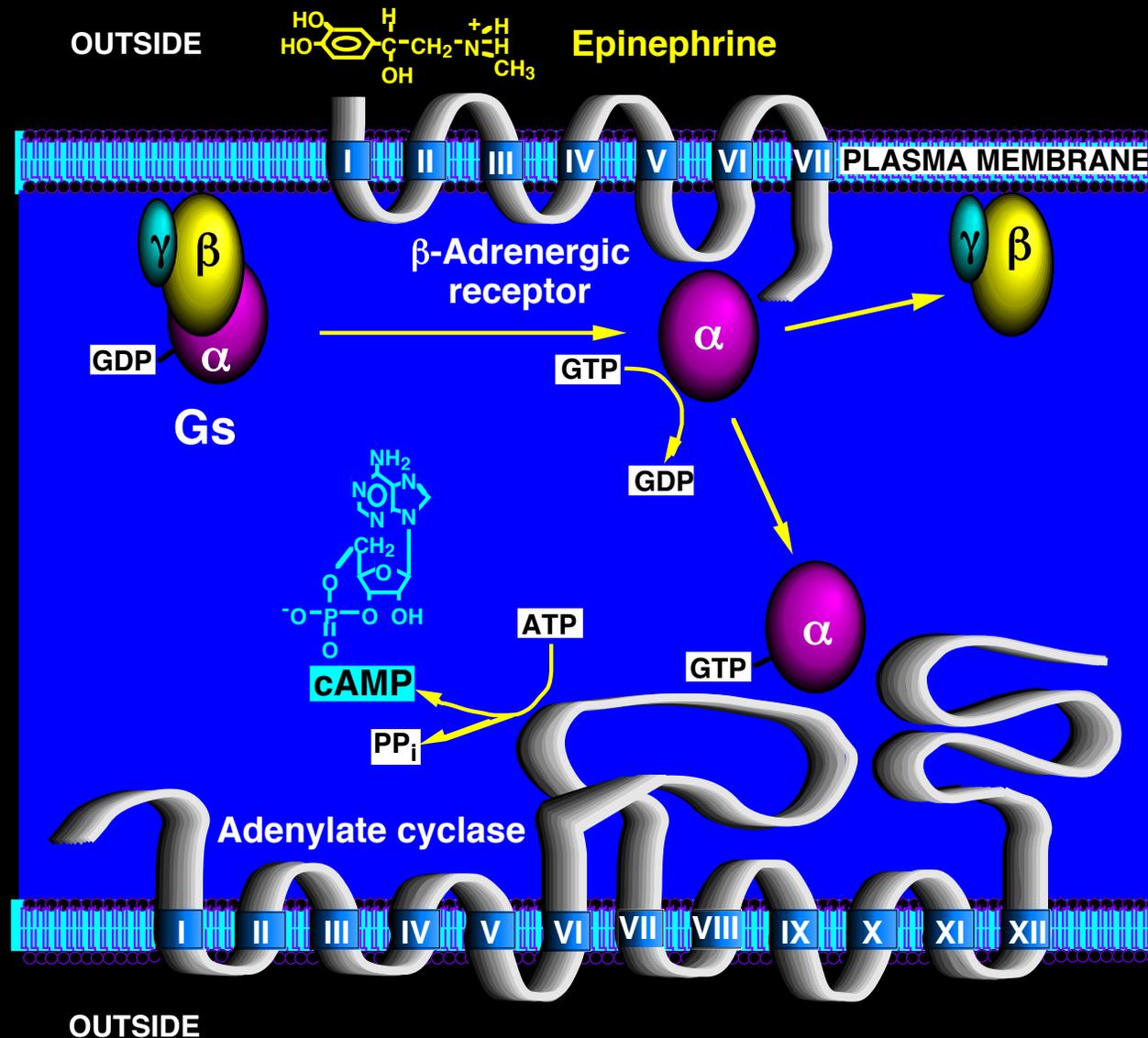
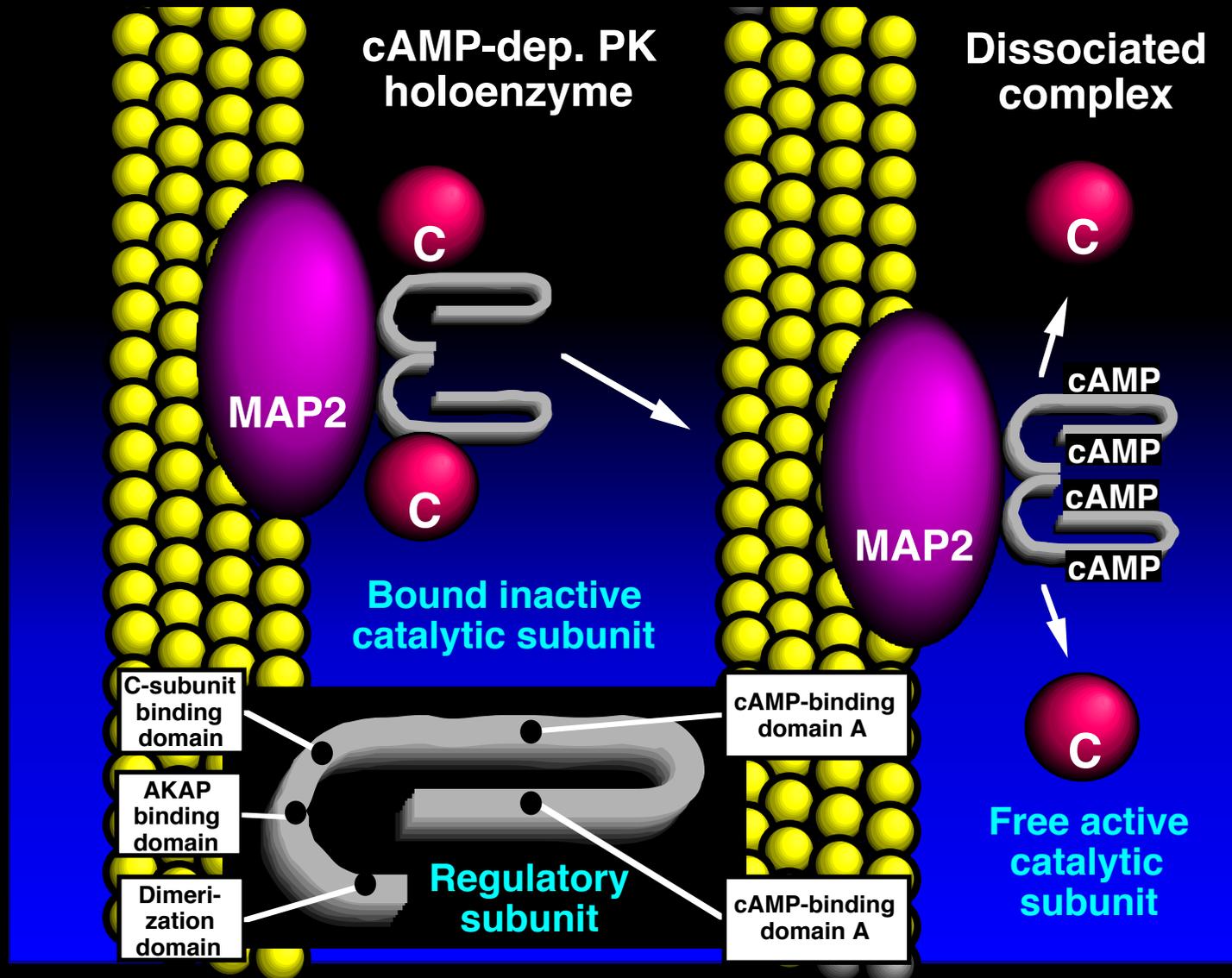


G Protein Activation of Adenylate Cyclase

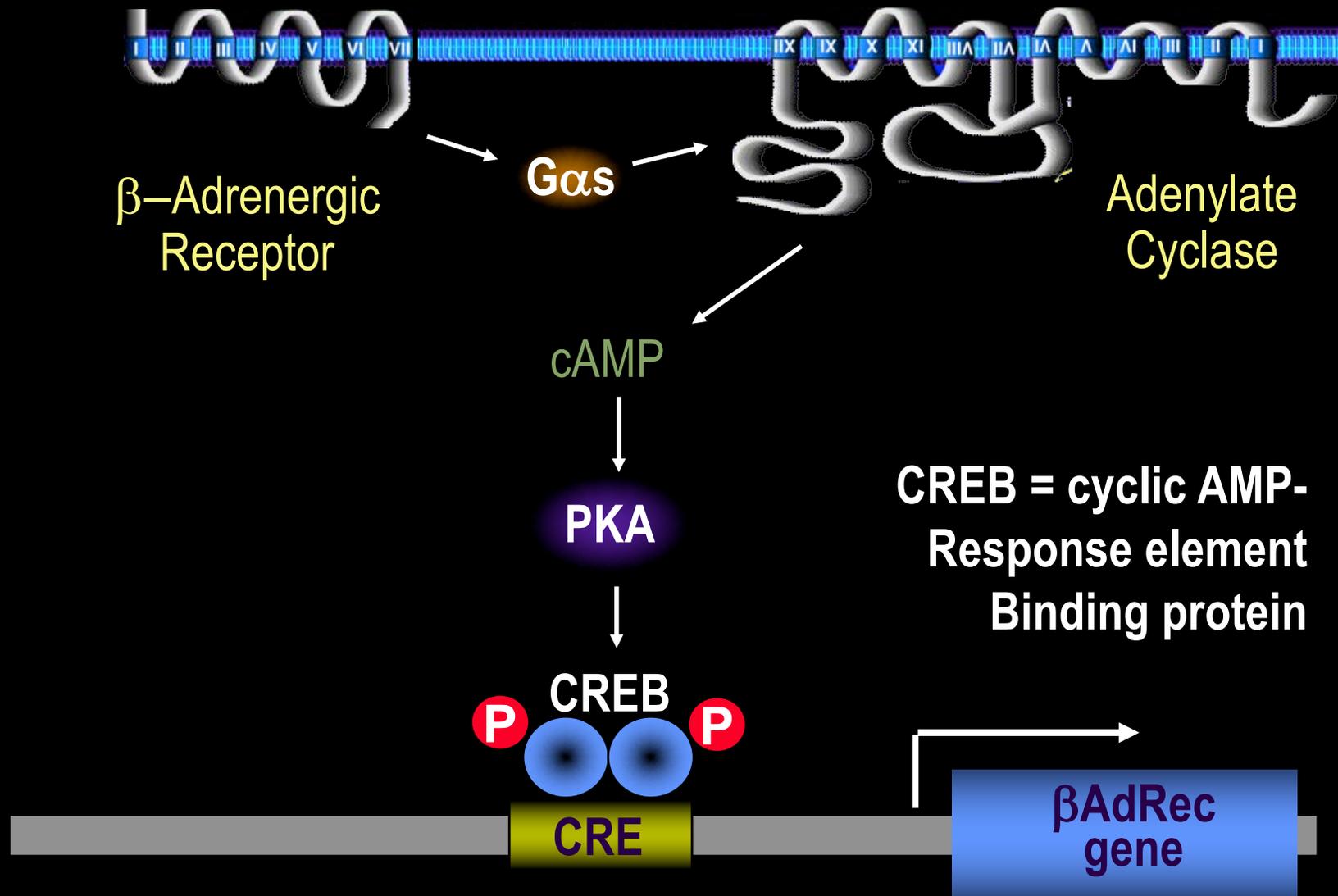


$G\alpha$ is coupled to adenylate cyclase

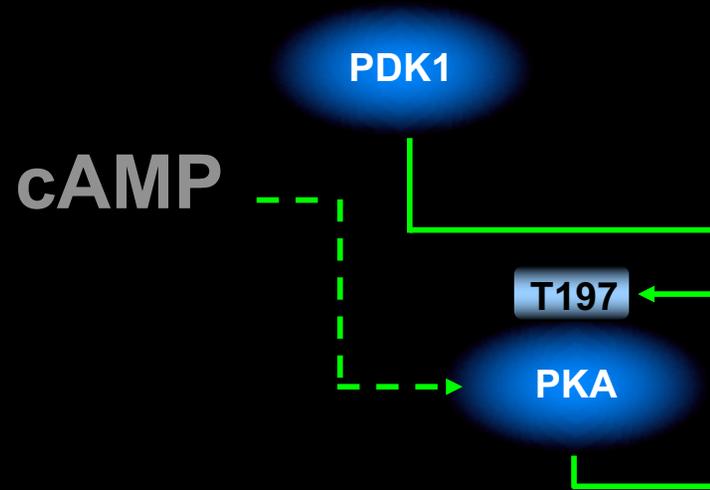
Activation of cAMP-dependent Protein Kinase (PKA)



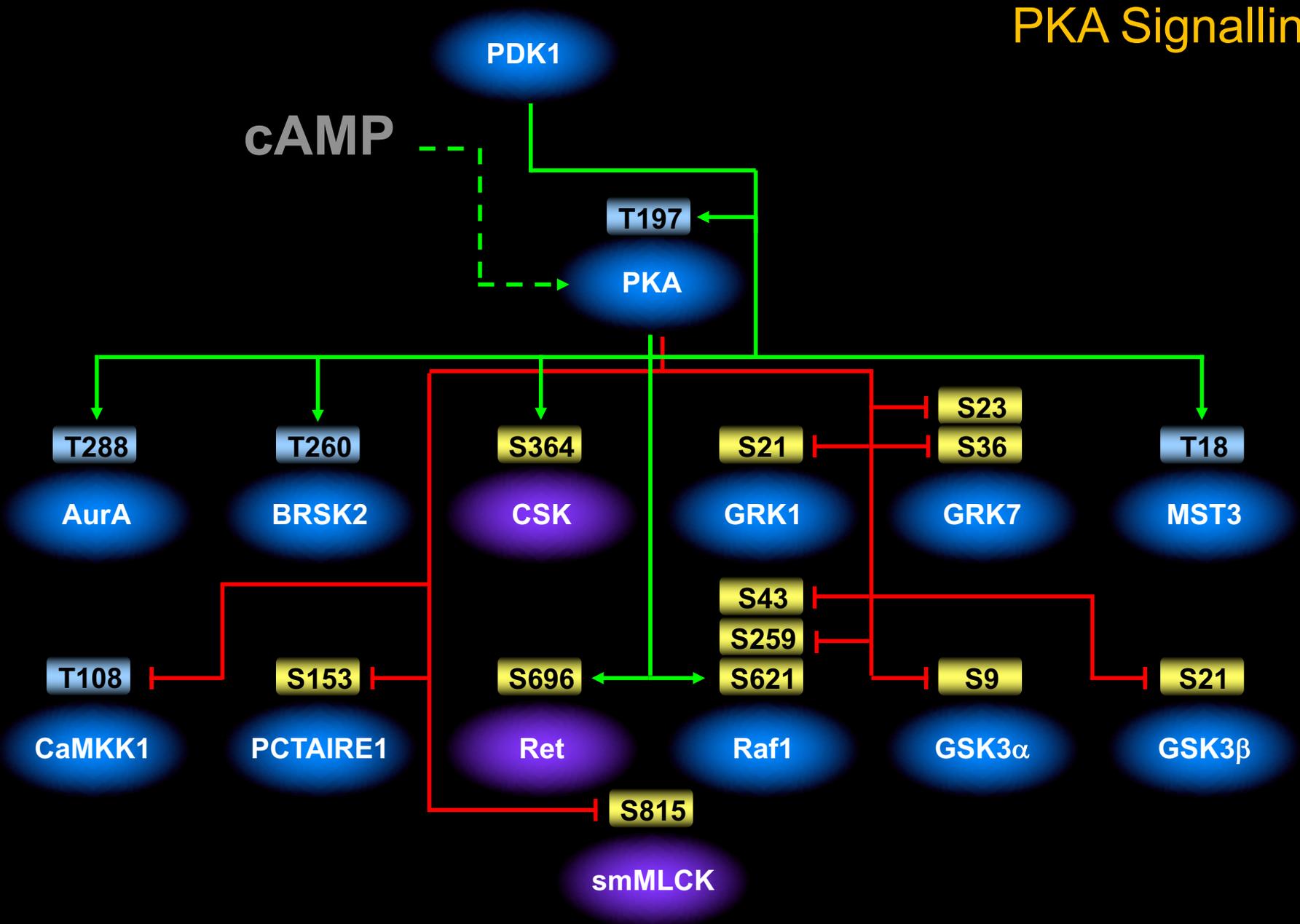
β -adrenergic Receptor Activation of Gene Expression



PKA Signalling



PKA Signalling



PKA Signalling

cAMP

PDK1

T197

PKA

T288

AurA

T260

BRSK2

S364

CSK

S21

GRK1

S23

S36

GRK7

T18

MST3

T108

CaMKK1

S153

PCTAIRE1

S696

Ret

S43

S259

S621

Raf1

S9

GSK3 α

S21

GSK3 β

S815

smMLCK

T38

PPP1R14A

T75

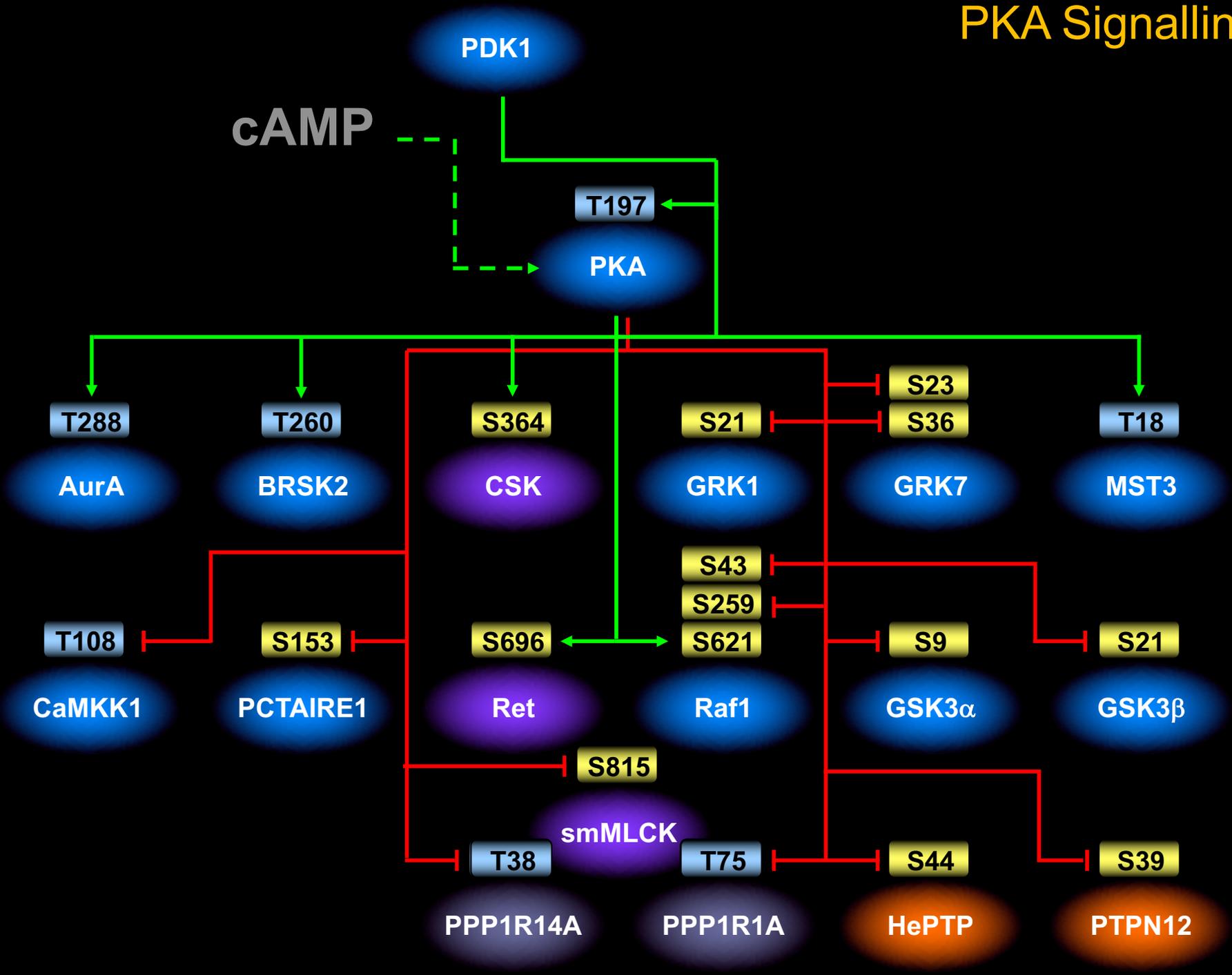
PPP1R1A

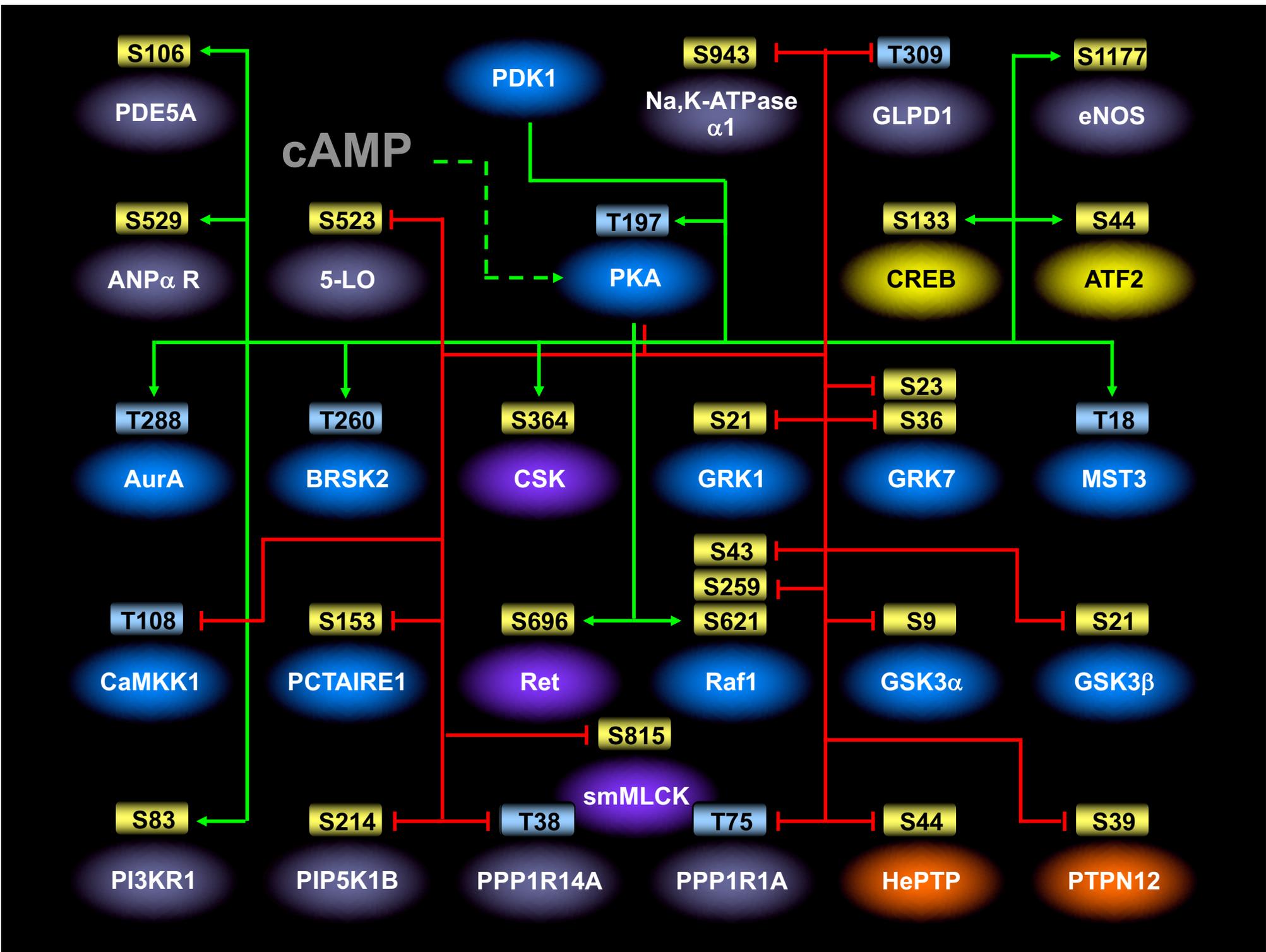
S44

HePTP

S39

PTPN12





PKA Signalling

Substrate Short Name	Substrate Full Name	ProteinType	Substrate Swissprot	Phospho-site	Effect of Phosphorylation	Kinase Affecting	All Kinases Affecting	Phosphatase Affecting
5-LO	Aarachidonate 5-lipoxygenase	Enzyme	P09917	S523	Phosphorylation inhibits 5-LO activity	PKACa	PKACa	
ANP-alpha R	Atrial natriuretic peptide type receptor	A- Guanylyl cyclase; Protein kinase serine kinase (receptor, RGC group, RGC family)	P16066	S529	Phosphorylation activates guanylate cyclase activity.	PKACa	PKACa	
ATF2	Activating transcription factor-2	Transcription protein	P15336	S44	Phosphorylation activates transcriptional activity.	PKACa	VRK1 (human vaccinia virus-related kinase 1), PKACa	
Aurora-A	Aurora-family kinase 1	Protein-serine kinase Other group, AUR family	O14965	T288	Phosphorylation increases phosphotransferase activity.	PKACa	PAK1, PKACa, AurA	PPP1CA
BRSK2	BR serine/threonine-protein kinase 2	Protein-serine kinase CAMK group, CAMKL family, BRSK subfamily	Q8IWQ3	T260	Phosphorylation increases phosphotransferase activity.	PKACa	PKACa	
CaMKK1	Calcium/calmodulin-dependent protein kinase 1 alpha	Protein-serine kinase Other group, CAMKK family, Meta subfamily	Q8N5S9	T108	Phosphorylation inhibits phosphotransferase activity.	PKACa	PKACa, CaMK1	
CREB	cAMP response element-binding protein	Transcription protein	P16220	S133	Phosphorylation increases transcriptional activity.	PKACa	PKACa, RSK1, RSK2, RSK3, MSK1, CaMK1-alpha, CaMK2-alpha, CaMK4	
Csk	C-terminus of Src kinase	Protein-tyrosine kinase, TK group, Csk family	P41240	S364	Phosphorylation increases phosphotransferase activity via SH3 domain of Csk.	PKACa	PKACa	
eNOS	Endothelial nitric oxide synthetase	Synthetase	P29474	S1177	Phosphorylation increases enzymatic activity of eNOS.	PKACa	PKACa, PKBa/Akt1, PKG1	
ER81 ETS transcription factor	ETS translocation variant 1	Transcription protein	P50549	S191	Phosphorylation activates transcriptional activity.	PKACa	RSK1, PKACa	
ER81 ETS transcription factor	ETS translocation variant 1	Transcription protein	P50549	S216	Phosphorylation activates transcriptional activity.	PKACa	RSK1, PKACa	

PKA Signalling

Substrate Short Name	Substrate Full Name	ProteinType	Substrate Swissprot	Phospho-site	Effect of Phosphorylation	Kinase Affecting	All Kinases Affecting	Phosphatase Affecting
GPLD1	Phosphatidylinositol-glycan-specific phospholipase D	Phospholipase	P80108	T309	Phosphorylation inhibits enzymatic activity.	PKACa	PKACa	
GRK1	G protein-coupled receptor kinase 1	Protein-serine kinase, AGC group, GRK family, GRK subfamily	Q15835	S21	Phosphorylation inhibits phosphotransferase activity.	PKACa	PKACa	
GRK7	G protein-coupled receptor kinase 7	Protein-serine kinase, AGC group, GRK family, GRK subfamily	Q8WTQ7	S23	Phosphorylation inhibits phosphotransferase activity.	PKACa	PKACa	
GRK7	G protein-coupled receptor kinase 7	Protein-serine kinase, AGC group, GRK family, GRK subfamily	Q8WTQ7	S36	Phosphorylation inhibits phosphotransferase activity.	PKACa	PKACa	
GSK3-alpha	Glycogen synthase kinase-3 alpha	Protein-serine kinase, CMGC group, GSK family	P49840	S21	Phosphorylation inhibits phosphotransferase activity.	PKACa	PKBa/Akt1, PKACa, PKCa, PKCb, PKCd, PKCg, PKCh, PKCz, RSK2	
GSK3-beta	Glycogen synthase kinase-3 beta	Protein-serine kinase, CMGC group, GSK family	P49841	S9	Phosphorylation inhibits phosphotransferase activity.	PKACa	PKBa/Akt1, KHS1, p70S6K, PKACa, PKCa, PKCb, PKCd, PKCg, PKCh, PKCz, RSK1, RSK2	PPP1CA
HePTP	Hematopoietic protein-tyrosine phosphatase	Protein-tyrosine phosphatase	P35236	S44	Phosphorylation inhibits interaction with ERK2.	PKACa	PKACa	PPP1CA
hnRNP-A1		RNA binding protein	P09651	S199	Phosphorylation inhibits hnRNP A1 activity.	PKACa	CK2-A1, PKACa, PKBa/Akt1	
MST3	Mammalian STE20-like protein kinase 3	Protein-serine kinase, STE group, STE20 family, YSK subfamily	Q9Y6E0	T18	Phosphorylation increases phosphotransferase activity.	PKACa	PKACa	
Na,K-ATPase alpha(1) subunit		Enzyme, hydrolase	P05023	S943	Phosphorylation inhibits its enzyme activity.	PKACa	PKACa	
PCTAIRE1	PCTAIRE-motif protein kinase 1	Protein-serine kinase, CMGC group, CDK family, TAIRE subfamily	Q00536	S153	Phosphorylation inhibits phosphotransferase activity.	PKACa	PKACa	

PKA Signalling

Substrate Short Name	Substrate Full Name	ProteinType	Substrate Swissprot	Phospho-site	Effect of Phosphorylation	Kinase Affecting	All Kinases Affecting	Phosphatase Affecting
PDE5A	cGMP phosphodiesterase 5	Phosphodiesterase	O76074	S106	Phosphorylation increases phosphodiesterase activity.	PKACa	PKACa, PKG1	PPP1CA
PIK3R1	Phosphatidylinositol 3-kinase regulatory alpha subunit	Regulator, inositol phosphate metabolism	P27986	S83	Phosphorylation increases enzymatic activity and interaction with ER-alpha, H-Ras-1 and PKAR2B.	PKACa	PKACa	
PIP5K1B	Phosphatidylinositol-4-phosphate 5-kinase, type I, beta	Kinase, lipid, inositol phosphate metabolism	O14986	S214	Phosphorylation inhibits phosphotransferase activity.	PKACa	PKACa	PPP1CA
PKACalpha	cAMP-dependent protein kinase alpha catalytic subunit	Protein-serine kinase, AGC group, PKA family	P17612	T197	Phosphorylation increases phosphotransferase activity.	PKACa	PDK1, PKACa	
PPP1R14A	Protein phosphatase 1, regulatory (inhibitor) subunit 14A	Protein-serine phosphatase inhibitor	Q96A00	T38	Phosphorylation inhibits phosphotransferase activity.	PKACa	ILK, PKACa, PKCa, PKCd, PKCe, PKCz, PKD1, ROCK2, PAK, PKN, CaMK2	PPP2CA
PPP1R1A	Protein phosphatase inhibitor 1	Protein phosphatase inhibitor protein	Q13522	T75	Phosphorylation induces activation of the inhibitory activity of this protein towards PPP1CA.	PKACa	PKACa, PKCA	
PTPN12	Protein-tyrosine phosphatase, non-receptor type 12	Protein-tyrosine phosphatase	Q05209	S39	Phosphorylation inhibits phosphotransferase activity.	PKACa	PKACa, PKCa	
Raf1	Raf proto-oncogene serine/threonine-protein kinase	Protein-serine kinase, TKL group, Raf family	P04049	S259	Phosphorylation inhibits phosphotransferase activity, reduces H-Ras-1 and PPP2CB binding, and induces binding of 14-3-3-beta and zeta. It appears to necessary for PKC-alpha activation of Raf1.	PKACa	PKACa	PPP2CB

PKA Signalling

Substrate Short Name	Substrate Full Name	ProteinType	Substrate Swissprot	Phospho-site	Effect of Phosphorylation	Kinase Affecting	All Kinases Affecting	Phosphatase Affecting
Raf1	Raf proto-oncogene serine/threonine-protein kinase	Protein-serine kinase, TKL group, Raf family	P04049	S621	Phosphorylation increases phosphotransferase activity and induces interaction with 14-3-3-zeta.	PKACa	PKACa, Raf1	
Raf1	Raf proto-oncogene serine/threonine-protein kinase	Protein-serine kinase, TKL group, Raf family	P04049	S43	Phosphorylation inhibits phosphotransferase activity, inhibits interaction with H-Ras-1 and induces binding of 14-3-3-beta.	PKACa	PKCa, PKACa	
Ret	Proto-oncogene ret receptor-tyrosine kinase for GDNF	Protein-tyrosine kinase (receptor), TK group, Ret family	P07949	S696	Phosphorylation increases phosphotransferase activity. Phosphorylation promotes lamellipodia formation of neuronal cells.	PKACa	PKACa	
smMLCK	Myosin light chain kinase, smooth muscle and non-muscle isozymes	Protein-serine kinase, CAMK group, MLCK family	Q15746	S815	Phosphorylation inhibits the calmodulin-dependent activity due to a decrease in the affinity for calmodulin	PKACa	CaMK2, PKACa, smMLCK	

Epac Signalling

