

HSP90 INTERACTORS

Chaperones and relatives

- Aha1 and its homolog Hch1
- Cdc37 (p50) and its relative Hsc70 (= Cdc37L1)
- p23 (=Sba1)
- proteins with TPR motifs: Hop (=Sti1), FKBP52 (=FKBP4; and high MW plant homologs), FKBP51 (=FKBP5), FKBP8 (=FKBP38), FKBP36 (=FKBP6), *Plasmodium* FKBP35, plant TWD1, cyclophilin-40 (Cpr6 and Cpr7), PP5 (and yeast Ppt1), Tom70, probably also related Tom71=Tom72, XAP-2 (=AIP=ARA9), Cns1 and its *Drosophila* and human relatives Dpit47 and TTC4, CHIP, UNC45A (GC-UNC45) and UNC45B, She4, DnaJC7 (=Tpr2=mDj11=CCRP), CRN, WISp39 (=FKBPL), Tah1 (=Spaghetti=RPAP3), Spag1, NASP, Toc64 and OM64, TPR1 (=Ttc1), SGT (=αSGT=SGTA), DYX1C1, AtTPR1, AtTPR2, AtTPR7, AIPL1, Tom34, *Tetrahymena* Coi12p
- CS-containing p23 relatives AARSD1, SGT1 (=SUGT1), RAR1, Siah-1-interacting protein (SIP), Chp1/CHORDC1/Morgana, B-ind1, melusin, NudC and NudCL2 (=Nudcd2)
- Cereblon
- FNIP1, FNIP2
- GIGANTEA
- Hsc70/Hsp70/Hsp72/DnaK
- Hsp60
- Human DnaJ homolog Hsj1b, cyanobacterial DnaJ2
- Ids2
- mtHsp70/Grp75/mortalin
- PhLP2A
- Pih1 (=Nop17) (mostly through Tah1)
- Prefoldin 4 and 6
- S100A1

- Sse1, Sse2
- Tel2-Tti1-Tti2 complex
- TIMP2
- TPR15, TPR16
- *Toxoplasma* Sis1-like
- Tsc1
- USP19
- valosin-containing protein (VCP)/p97
- ZMYND10

Transcription factors

- 12(S)-HETE receptor
- AF9/MLLT3
- all vertebrate steroid receptors (GR, MR, ERα, ERβ, PR, AR)
- AGL24
- ATF3
- BBX
- BCL-6
- Bclaf1
- BES1
- BrZ7
- BZR1
- C20orf194
- CAR
- C/EBPβ
- CEBPE (C/EBPε)
- Cwt1
- CXXC1
- cytoplasmic v-erbA
- DLX6
- DMRTA1
- E1A
- E2F1 and E2F2
- EcR
- FOXD4L6
- FOXM1
- FOXP2
- GTF2IRD2
- Hap1
- HCFC1
- HMGA1, HMGA2
- HNF4A
- HP1BP3
- HSF1
- HSF2
- HsfA1, HsfA2, HsfB1
- IRF2
- IRF3
- ISX

- LFY
- MAFG
- Mal63
- MalR
- MAX
- Met1
- MeSRS1
- MeWRKY20
- MKX
- mod(mdg4)
- c-Myc
- Nanog
- NFIC
- NFRKB
- Notch1 (ICN1)
- NR1H3
- NR1I2
- Nrf2
- Oct4
- p53
- p73
- PAS family members: Dioxin receptor (=AhR), Sim, HIF-1α, HIF-2α, HIF-3α
- PCGF6
- POGK
- PPARα, PPARβ, PPARγ, PPARδ
- PRDM1
- PREB
- PXR
- REST
- REV-ERBα
- RlmA (of *Aspergillus*)
- SETDB1
- SIM2
- SLFN11
- SOC1
- SOX11
- Sp1
- SREBF1
- SREBP1
- SREBP2
- STAT1
- STAT2
- STAT3 (also in caveolin-1 complexes in rafts)
- STAT5
- SUP
- TADA2A
- TBX22
- TCF25
- TDP-43
- TEAD2

- TFDP3
- THAP4
- TonEBP/OREBP
- TR β
- TRIM32
- Tup1
- Twist1
- Upc2
- Ure2
- USP1
- VDR
- VP16
- water mold *Achlya* steroid (antheridiol) receptor
- WT1
- ZBED4
- ZBTB7A
- ZBTB17
- ZBTB20
- ZC3H7B
- ZNF215
- ZNF509
- ZNF74

Kinases

- ACVR1B
- ACVR1C
- ACVR2B
- Akt/PKB
- AKT2
- ALK
- ALK1, ALK5
- ALPK1
- AMHR2
- AMPK α , AMPK γ
- ARAF
- ASK1
- ATM
- AURKC
- Aurora B
- AXL
- Bcr-Abl
- BCR-FGFR1
- BGLF4 of EBV
- BLK
- BMPR1A
- BMX
- BTK
- c-Abl
- c-Kit
- c-Mos
- CAMK1G
- CAMK2A
- CAMK2B
- CAMK2D
- CAMK2G
- CAMK4

- CAMKK1
- CAMKK2
- CAMKV
- casein kinase II α catalytic subunit
- Cdc2 (=Cdk1)
- CDK11B
- CDK14
- CDK15
- CDK18
- Cdk2, Cdk4, Cdk6, Cdk9, Cdk11
- CDK3
- CheA (E. coli)
- Chk1
- Cla4
- CLK2
- CLK3
- Cot = Tpl-2
- CSF1R
- CSNK1A1
- DCLK2
- DDR1
- DDR2
- Death-associated kinases DAPK, DAPK2, DAPK3
- DLK
- DMPK
- DYRK1B
- DYRK2
- DYRK3
- DYRK4
- eEF-2 kinase
- EGF receptor (mutant and wt)
- eIF2- α kinases HRI, Gcn2, Perk, PKR
- Eml4-Alk
- EPHA1
- EphA2
- EPHA4
- EPHB1
- EPHB6
- ErbB2
- ERBB3
- ERBB4
- ERK5
- FASTK
- FGFR1
- FGFR3-TACC3
- FGFR3 and FGFR4
- Flt3
- FLT4
- FOP2-FGFR1
- FRK
- Fused
- FYN
- Gal1
- GRK2 and GRK6

- GRK4
- GRK7
- GSK3A
- GSK3 β
- HCK
- HER3
- HIPK2
- HIPK4
- HopBF1 effectors
- ICK
- INSRR
- Insulin receptor
- Insulin-like growth factor 1 receptor
- Integrin-linked kinase
- IP6K2
- IRAK-1
- IRAK2
- IRAK3
- Irf1 α
- ITK
- I κ B kinases (IKK) α , β , γ , ϵ
- JAK1
- JNK
- KSR
- LATS1, LATS2
- LCK
- LIMK1
- LIMK2
- Lkb1
- LMTK3
- LRRK2
- LYN
- MAP2K5
- MAP2K7
- MAP3K12
- MAP3K15
- MAP3K2
- MAP3K6
- MAP3K9
- MAP4K1
- MAP4K2
- MAP4K4
- MAPKKK (MEKK) YODA
- MAPK15
- MAPK4
- MAPK6
- MAPK7
- MAST1
- MAST2
- MATK
- MEK
- MEKK1 and MEKK3
- MERTK
- MET
- Mik1
- MINK1
- MLK3
- MLKL

- MOK, MAK, MRK
- MpkA (of Aspergillus)
- Mps1 (=TTK)
- mTOR
- MUSK
- MYLK2
- MYLK3
- MYLK4
- NEK11
- NEK8
- NEK9
- NIK
- NPM-Aik
- NPR2
- NTRK1
- NTRK2
- NTRK3
- NUAK2
- Nucleophosmin-Anaplastic Lymphoma Kinase
- p38
- p90RSK
- PAK6
- PASK
- Pbs2
- PDGFRB
- PDIK1L
- PDK1
- PGK1
- PI4K2A
- PI4KII β
- Pim-1
- PIM2
- PIM3
- Pink1
- PKC λ , PKC ϵ and other PKCs
- PKM2
- PKN1
- PKN2
- platelet-derived growth factor receptor α
- Plk1
- Plk3
- Pnck
- pp60v-src, c-src
- PRKAA2
- PRKACB
- PRKCA
- PRKCB
- PRKCG
- PRKCH
- PRKCI
- PRKCCQ
- PRKCCZ
- PRKD1
- PRKD2
- PRKD3 (PKD3)
- PRKDC
- PRKG2

- PRKX
- PRKY
- PSKH1
- PSKH2
- PTK2
- PTK2B
- PTK6
- PTK6
- Raf-1, B-Raf, Ste11
- RET
- RET/PTC1
- RIP1
- RIP3
- Ron
- ROR1
- ROR2
- RPS6KA1
- RPS6KA2
- RPS6KA3
- RPS6KA5
- RPS6KA6
- RPS6KB1
- RPS6KC1
- RPS6KL1
- Ryk
- SGK-1
- SGK2
- SGK223
- SGK3
- Sit2
- src related tyrosine kinases: fer, fes, fgr, fps, lck, yes
- SRPK1
- SRPK3
- SSCMK1
- STK32B
- STK32C
- STK33
- STK38
- STK38L
- STYK1
- SYK
- TAK1
- TAOK3
- TBK1
- TESK1
- TESK2
- TGF β receptors I and II
- TIE1
- TNK1
- TNK2
- TNNI3K
- TP53RK
- TrkA1 and III
- TrkB
- TSSK1B
- TSSK2
- TSSK3
- TSSK4

- TSSK6
- Tyk2
- TYRO3
- Uik1
- VEGFR1, VEGFR2
- Wee1, Swe1
- WNK4
- ZAP-70

Others

- 2Q2
- Act1 (=TRAF3IP2)
- Acs14
- Adenosine A_{2A} receptor
- α_{2C} adrenergic receptor
- Ago3
- AHH1
- AID
- AIP56
- Aldo-keto reductase 1B10
- ANAPC2
- Anillin
- ANKMY2
- Annexin A2
- ANP receptor
- ANP32C/D
- Apaf-1
- APEX2
- APH1
- Apn2
- apoB
- APOBEC-3B, -3C, -3G
- Arb1
- ARD1
- Argonaute-1 (Ago1)
- Argonaute-2 (=Ago2=GERp95)
- Argonaute-4 (Ago4)
- ARMC5
- ArtAB
- ASB17
- ASB2
- ASB3
- ASB4
- ASB6
- ASL
- ASS1
- ATG8 (GABARAP) proteins
- ATG8b, ATG8c, ATG8e, ATG12
- Atp3
- Axin 1
- BAK1
- BALF5 of EBV
- BCAP (PIK3AP1)
- Bcl-2
- Bcl-xL
- Beclin 1

- Bid
 - BIN2
 - BLM helicase
 - Bms1
 - BPIFB4
 - BRAT1
 - BRCA1
 - BRCA2
 - BRD4
 - BRI1
 - BRMS1
 - BTRC
 - c-IAP1
 - calcineurin (Cna2; catalytic subunit)
 - calmodulin
 - calmodulin methyltransferase
 - calpain-1
 - calponin
 - CARM1
 - Caspase-8
 - β -catenin
 - CB2 cannabinoid receptor
 - Ccp1
 - CCDC117
 - CD38 type III
 - CD79a
 - CD80 (B7-1)
 - CD147 (Basigin)
 - Cdc13
 - Cdc14
 - Cdc25a and Cdc25c
 - Cdk5 activator p35
 - CFTR (nascent and mutant polypeptide)
 - ChAT
 - CheZ (*E. coli*)
 - Chl1
 - Chronophin
 - Cineole synthase 1
 - Clathrin heavy chain
 - CLC-1 chloride channel
 - CLC-2 chloride channel
 - Clostridium toxin CDT
 - Clostridium toxin iota
 - Clusterin
 - CND1 (*Arabidopsis* gene *At1g32730*)
 - COG complex
 - COI1
 - Complement C9
 - COX-2
 - CPEB1, CPEB2, CPEB3
 - Cry1 prototoxins
 - CTA1 = CtxA1
 - Ctf13/Skp1 component of CBF3
 - CTNNA1
- CUL1
 - CUL2
 - CUL3
 - CUL4A
 - CUL4B
 - Cup
 - Cx43
 - cyclin B
 - cyclophilin D (mitochondrial)
 - Cyr1
 - cytoskeletal proteins: actin, tubulin (including ciliary β 4-tubulin), myosin (including Myo3B)
 - DBC2
 - DDX5
 - DEDD
 - Dengue virus protein E
 - Dengue virus proteins NS1/2B/3/4B/5
 - DET1
 - Dicer 1
 - Diphtheria toxin A
 - DNA helicase Ssl2
 - DNA polymerase α
 - DNA polymerase λ
 - DNA polymerase η
 - DnaA (*E. coli*)
 - DNMT1
 - Drp1
 - Dsn1
 - DTX4
 - E6^AE7
 - EBAX-1
 - EEF1A2
 - Emc2
 - ENC1
 - eNOS, nNOS (?)
 - EPRS
 - ether-a-gogo-related potassium channel (ERG = HERG = KCNH2)
 - EZH2
 - F1F0-ATP synthase
 - FANCA
 - FBXL12
 - FBXL13
 - FBXL14
 - FBXL15
 - FBXL18
 - FBXL2
 - FBXL3
 - FBXL6
 - FBXL8
 - FBXL10
 - FBXL17
 - FBXL18
 - FBXL24
- FBXO25
 - FBXO27
 - FBXO28
 - FBXO3
 - FBXO34
 - FBXO38
 - FBXO4
 - FBXO40
 - FBXO6
 - FBXO9
 - FBXW11
 - FBXW2
 - FBXW5
 - FBXW7
 - FGAMS
 - FHIT
 - Fibronectin
 - Filamin A
 - FliN, FilI (*E. coli*)
 - FLIP_S and FLIP_L
 - Folliculin
 - free $\beta\gamma$ subunit of G protein
 - FtsZ
 - G2E3
 - GAN
 - GBP1
 - GF14-4
 - Gln1
 - GLT-1
 - GluR1
 - glutathione S-transferase subunit 3 (KS type)
 - GPX4
 - Guanylate cyclase, soluble
 - G α_0 , G α_{12}
 - Glucocerebrosidase
 - GREB1
 - HAX-1
 - HDAC1
 - HDAC6
 - HECTD3
 - Hepatitis B virus core protein
 - Hepatitis C virus protein NS3
 - Hepatitis E virus capsid protein
 - HERC4
 - HERC6
 - Histones H1, H2A, H2B, H3 and H4
 - HMGCR
 - Hsp27
 - Humanin
 - Huntingtin
 - IDH1
 - IDO1
 - Importin 4 (IPO4)
 - Importin β 1

- Importin- α 6 (KPNA5)
- Ino80
- Inositol 1,4,5-trisphosphate receptor 3
- Integrin α 2
- Integrin α 4
- Integrin α L
- Integrin α M β 2
- IL-1 β
- IRS-2
- Japanese encephalitis virus E protein
- JlpA
- KAP1
- KAT5
- KAT8
- KBTBD4
- KBTBD7
- KCBP
- KCNA5
- KCNA6
- KCNG1
- KCNS3
- KCNQ4
- KCTD8
- KDM3A/JMJD1A
- KDM4B/JMJD2B
- KEAP1
- KIAA0317
- Kir6.2
- KLHL1
- KLHL10
- KLHL13
- KLHL14
- KLHL15
- KLHL22
- KLHL23
- KLHL25
- KLHL26
- KLHL29
- KLHL32
- KLHL34
- KLHL36
- KLHL38
- KLHL6
- knob complexes (in the membrane of Plasmodium-infected erythrocytes)
- KSHV K1
- KSR1
- KSR2
- L protein of HRSV
- L protein of SHVV
- Lamin A/C
- LAMP-2A
- LANA of KS-HSV
- LAP
- LARP4B
- Legumain
- LGALS3BP
- LIS1
- LNX1
- LOC440248
- LOX1 (OLR1)
- LOXL2
- Lpl1 (*S. aureus*)
- LRP1 (=CD91)
- LRP5
- LRSAM1
- LSD1
- LSM8
- macromolecular aminoacyl-tRNA synthetase complex
- Macrophage scavenger receptor
- MAP1B
- MAP4
- MARCH9
- Mdm2
- MDM4
- MeCatalase1
- Mg²⁺-dependent phosphatidate phosphohydrolase
- MIF
- misfolded VHL
- MMP2, MMP3, MMP9
- μ -opioid receptor
- MRE11/Rad50/NBS1 (MRN) complex
- MRP1
- Msps/XMAP215/ch-TOG
- MTA1
- MTG8
- MUC1
- Myoglobin
- N-myc downstream-regulated gene 1 (NRDG1)
- N-WASP
- Na⁺-K⁺-Cl⁻ cotransporter 1
- NadA
- NAP1
- NB-LRR proteins: RPM1 and RPS2, Nod1, Nod2, NALP2, NALP3, NALP4, NALP12, IPAF, RPP4
- NBR1
- NCC
- NCT
- NDRG1
- NDRG2
- NELF-E
- Nervous necrosis virus capsid protein
- Neuraminidase
- Neuropeptide Y
- NHE1
- NHLRC1
- Nibrin
- NleH1 and NleH2
- NMNAT2
- Norovirus capsid protein VP1
- Nox1, Nox2, Nox3, Nox5
- NS1
- Nsl1
- nsP3 and nsP4 of Chikungunya virus
- Nucleoprotein (NP) of MERS-CoV
- Nup62
- Nwd1
- OGT
- OsCERK1
- P protein (rabies virus)
- P1 (picornaviral capsid precursor protein P1)
- P2X₇ purinergic receptor
- p14ARF
- p17 (Avian reovirus)
- p300
- P450 CYP2E1
- PARK2
- PARK7 (DJ-1)
- PB1 and PB2 subunits of influenza RNA pol.
- PBD2
- PCGF1
- PCGF3
- PCNA
- Peli1
- perilipin
- PfCRT
- PIDD
- Piwi
- PIWIL2
- PLC γ
- PLN
- polysomal ribonuclease 1 (PMR1)
- PPAT
- PRDM14
- PRMT5
- pro-Dcp1
- prolactin receptor
- prostacyclin synthase
- proteasome
- PRPF8
- PRPF19
- PsbO
- PTPN22
- Ptx
- PUS7
- R-protein I-2
- R2TP complex through Pih1
- Rab- α GDI
- Rab3a

- | | | |
|--|---|--|
| - Rab11a | - SLC6A14 | - UCH-L1 |
| - RAB40A | - SMURF1 | - UHRF1 |
| - Rac/Rop GTPase Rac1 (rice) | - SMYD1, SMYD2, SMYD3 | - UL42 (of HSV-1) |
| - Rac1 | - snoRNP complexes | - Ulp1 |
| - Rad51 | - SNRNP200 | - uPA |
| - Rad52 | - SOCS6 | - Ura2 |
| - RAG1 | - SPSB1 | - URI complex |
| - Ral-binding protein 1 (RalBP1) | - SPSB3 | - Uroporphyrinogen decarboxylase (HemE) [in cyanobacteria] |
| - RanBP9 | - SREC-1 | - Us11 (of HSV-1) |
| - Rapsyn | - STING | - Utp21 |
| - Raptor | - SUR1 (subunit of β -cell ATP-sensitive potassium channel) | - Vaccinia core protein 4a |
| - RCBTB1 | - survivin | - vFLIP (of KSHV) |
| - RCBTB2 | - SUV39H1 | - Vimentin |
| - RCP | - SV40 large T-antigen | - VIP1 |
| - Reovirus protein σ 1 | - Swr1 | - VP5 of pseudorabies virus |
| - REV1 | - α -synuclein | - VP5, VP7, VP35 of grass carp reovirus |
| - reverse transcriptase of hepatitis B virus | - Tab2/3 | - VPS18 |
| - RFWD3 | - Tas3 | - VPS41 |
| - RGS11 | - Tau protein | - WASF3 |
| - RGS6 | - Tax | - WSB2 |
| - RGS7 | - TCL1A | - WTAP |
| - RGS9 | - telomerase | - WWP1 |
| - RhoB | - TFR1 | - XPO1 |
| - RHOBTB1 | - thiopurine S-methyltransferase | - XPORT |
| - ribosomal protein L2 (E. coli) | - thrombin receptor (PAR-1) | - XRCC1 |
| - ribosomal proteins S3 and S6 | - thromboxane synthase | - ZEITLUPE |
| - ricin catalytic A chain | - TiIS | |
| - RIG-I | - TIR1 | |
| - RNA-dep. RNA polymerase (of Bamboo mosaic virus) | - Tissue plasminogen activator (tPA) | |
| - RNF10 | - Titin | |
| - RNF111 | - TLR4/MD-2 complex | |
| - RNF19B | - TLR7 | |
| - RNF40 | - TLR9 | |
| - RNGTT | - Tm-2 ² | |
| - Rnr4 | - TNFAIP3 (=A20) | |
| - Rpb1 | - TOM40 | |
| - RPN6 | - TRIM10 | |
| - SA- β -galactosidase (GLB1) | - TRIM17 | |
| - SARS-CoV-2 proteins N, M, Orf3, Orf7a, and Orf7b | - TRIM2 | |
| - SCAP | - TRIM36 | |
| - SDF2 | - TRIM37 | |
| - SENP3 | - TRIM41 | |
| - SERCA2a | - TRIM49 | |
| - SERT (SLC6A4) | - TRIM56 | |
| - SF3B3 | - TRIM7 | |
| - SH3RF2 | - TRIM73 | |
| - Sicily | - TRIM74 | |
| - SIR2 (SIR2RP1 in Leishmania) | - TRIM8 | |
| - SIRT1 | - Triosephosphate isomerase | |
| - SIRT2 | - Trithorax (and ortholog MLL) | |
| - SKP2 | - Trx1 | |
| - SKP2 complexes | - TrxR | |
| | - TSG101 | |
| | - Tyrosine hydroxylase | |
| | - UBA52 | |

Notes:

- Only the cytosolic form(s) of Hsp90 is considered.
- Clients from different species are all mixed together and the protein names are typically those of the original publication (i.e. not necessarily the official protein name).
- Only proteins are listed for which biochemical evidence for an interaction is available (i.e. geldanamycin effects alone are not considered as sufficient).
- more candidate interactors can be found in reports about proteomic approaches (Falsone et al. [2005] FEBS Lett. 579, 6350; Te et al. [2007] J. Proteome Res. 6, 1963; Caldas-Lopes et al. [2009] PNAS 106, 8368; Tsaytler et al. [2009] Cell Stress Chaperones 14, 629; Gong et al. [2009] Mol. Syst. Biol. 5, 275; Gano and Simon [2010] Mol. Cell. Proteomics 9, 255; Behrends et al. [2010] Nature 466, 68; Wang et al. [2010] Cancer Invest. 28, 635; Garcia-Descalzo et al. [2011] Cell Stress Chaperones 16, 203; Skarra et al. [2011] Proteomics 11, 1508, Moulik et al. [2011] Nat. Chem. Biol. 7, 818; Wu et al. [2012] Mol. Cell. Proteomics 11, M111 016675; Taipale et al. [2012] Cell 150, 987; Buljan et al. [2020] Mol. Cell 79, 504; Taipale et al. [2014] Cell 158, 434; Truman et al. [2015] J. Proteomics 112, 285; Savitsky et al. [2018] Cell 173, 260; Zhao et al. [2021] Mol. Cell 81, 2914; Liu et al. [2022] Nucleic Acids Res. 50, 6990), global analyses (e.g. Zhao et al. [2005] Cell 120, 715; Millson et al. [2005] Euk. Cell 4, 849; McClellan et al. [2007] Cell 131, 121; Franzosa et al. [2011] PLoS One 6, e28211; Sharma et al. [2012] Mol. Cell. Proteomics 11, M111 014654; Rizzolo et al. [2017] Cell Rep. 20, 2735; Miao et al. [2018] Anal. Chem. 90, 11751); O'Meara et al. [2019] PLoS Biol. 17, e3000358; Tsvetkov et al. (2020) Cell Rep. 32, 108001; Yan et al. [2023] Plant Cell Environ. 46, 1935; and in a pharmacological survey of kinases (Citri et al. [2006] J. Biol. Chem. 281, 14361; Haupt et al. [2012] BMC Cancer 12, 38).
- See **Hsp90Int.db** for the comprehensive (notably human) interactome built with data from public protein-protein interaction databases and the literature (Echeverría et al. [2011] PLoS One 6, e26044; and its associated database at <https://www.picard.ch/Hsp90Int>). Hsp90Int.db also uses exclusively the official NCBI names.
- Looking for references? See <https://www.picard.ch/downloads/Hsp90facts.pdf>.