

HSP90 INTERACTORS

Chaperones and relatives:

- Aha1 and its homolog Hch1
- Cdc37 (p50) and its relative Harc
- p23 (=Sba1)
- proteins with TPR motifs: Hop (=Sti1), FKBP52 (and high MW plant homologs), FKBP51, FKBP8 (=FKBP38), FKBP36 (=FKBP6), Plasmodium FKBP35, 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, GCUNC-45 (also UNC-45 and She4), DnaJC7 (=Tpr2=mDj11=CCRP), CRN, WISp39 (=FKBPL), Tah1 (=Spaghetti=RPAP3), NASP, Toc64, TPR1 (=Ttc1), SGT (=αSGT=SGTA), DYX1C1, AtTPR1, AtTPR2, AIPL1, Tom34
- CS-containing p23 relatives SGT1 (=SUGT1), RAR1, Siah-1-interacting protein (SIP), Chp1/Morgana, B-ind1, melusin, CHORDC1, NudC and NudCL2 (=Nudcd2)
- Hsp60
- Hsc70/Hsp70/Hsp72
- Human DnaJ homolog Hsj1b
- S100A1
- Sse1, Sse2
- valosin-containing protein (VCP)/p97
- Pih1 (=Nop17) (mostly through Tah1)
- Cullin5
- Tel2-Tti1-Tti2 complex
- Toxoplasma Sis1-like

Transcription factors:

- 12(S)-HETE receptor
- AF9/MLLT3
- all vertebrate steroid receptors (GR, MR, ER α , ER β , PR, AR)
- BCL-6
- CAR
- cytoplasmic v-erbA
- EcR
- PPAR α (PPAR β)
- PXR
- Hap1

- HSF-1
- IRF3
- Mal63
- p53
- PAS family members: Dioxin receptor (=AhR), Sim, HIF-1 α , HIF-2 α , HIF-3 α
- Sp1
- Stat3 (also in caveolin-1 complexes in rafts)
- Stat5
- TonEBP/OREBP
- Ure2
- VDR
- water mold *Achlya* steroid (antheridiol) receptor
- WT1

Kinases:

- Akt/PKB
- ALK1, ALK5
- AMPK α , AMPK γ
- ASK1
- Aurora B
- Bcr-Abl
- BTK
- c-Abl
- casein kinase II α catalytic subunit
- Cdc2 (=Cdk1)
- Cdc25c
- Cdk2, Cdk4, Cdk6, Cdk9, Cdk11
- Chk1
- Cot = Tpl-2
- Death-associated kinases DAPK, DAPK2, DAPK3
- death domain kinase RIP
- eEF-2 kinase
- eIF2- α kinases HRI, Gcn2, Perk, PKR
- Eml4-Alk
- EphA2
- ErbB2 (and mutant EGF receptor)
- ERK5
- FGFR3 and FGFR4
- FOP2-FGFR1
- Flt3
- Fused
- GRK2 and GRK6
- GSK3 β
- HER3

- I κ B kinases α , β , γ , ϵ
- Insulin receptor
- Insulin-like growth factor 1 receptor
- Integrin-linked kinase
- IP6K2
- IRAK-1
- Ire1 α
- JAK1
- JNK
- c-Kit
- KSR
- LATS1, LATS2
- Lkb1
- LRRK2
- MAPK6
- MEK
- MEKK1 and MEKK3
- Mik1
- MLK3
- MOK, MAK, MRK
- c-Mos
- mTOR
- NIK
- Nucleophosmin-Anaplastic Lymphoma Kinase
- p38
- p90RSK
- platelet-derived growth factor receptor α
- PDK1
- PI4KII β
- Pim-1
- Pink1
- PKC λ , PKC ϵ and other PKCs
- Plk1
- Pnck
- pp60v-src, c-src
- PRKD2
- src related tyrosine kinases: fer, fes, fgr, fps, lck, yes
- PRKDC
- Raf-1, B-Raf, Ste11
- RET
- RET/PTC1
- Ron
- Ryk
- SGK-1
- Slit2
- SRPK1
- SSCMK1
- SSTK (= Tssk6)
- TAK1
- TBK1
- TGF β receptors I and II
- TrkB
- TrkA1 and III
- Tyk2

- Ulk1
- VEGFR1, VEGFR2
- Wee1, Swe1
- ZAP-70

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| Others: |
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- α_{2C} adrenergic receptor
- AID
- Annexin II
- ANP receptor
- Apaf-1
- apoB
- Argonaute-1
- Argonaute-2 (= GERp95)
- ATG8 (GABARAP) proteins
- Axin 1
- Bcl-2
- Bcl-xL
- Beclin 1
- Bid
- BLM helicase
- Bms1
- BRCA2
- BRMS1
- calcineurin (Cna2; catalytic subunit)
- calmodulin
- calponin
- CARM1
- β -catenin
- CB2 cannabinoid receptor
- CD91
- Cdc13
- Cdk5 activator p35
- Clostridium toxin CDT
- CFTR (nascent and mutant polypeptide)
- Chronophin
- CIC-2 chloride channel
- Cineole synthase 1
- COG complex
- CTA1
- Ctf13/Skp1 component of CBF3
- Cup
- cyclin B
- cyclophilin D (mitochondrial)
- cytoskeletal proteins: actin, tubulin (including ciliary β 4-tubulin), myosin
- DEDD
- Diphtheria toxin
- Dengue virus protein E
- DNA polymerase α
- DNA polymerase η
- DNMT1

- Dsn1
- eNOS, nNOS (?)
- ether-a-gogo-related cardiac potassium channel
- F1F0-ATP synthase
- FLIP_S and FLIP_L
- G α_0 , G α_{12}
- free $\beta\gamma$ subunit of G protein
- glutathione S-transferase subunit 3 (KS type)
- HDAC6
- Hepatitis B virus core protein
- Hepatitis C virus protein NS3
- Hepatitis E virus capsid protein
- HERG
- Histones H1, H2A, H2B, H3 and H4
- Huntingtin
- c-IAP1
- Importin β 1
- Importin 4 (IPO4)
- Importin- α 6 (KPNA5)
- Inositol 1,4,5-trisphosphate receptor 3
- INrf2 (=Keap1)
- Clostridium toxin iota
- IRS-2
- Japanese encephalitis virus E protein
- JlpA
- KSHV K1
- Kir6.2
- knob complexes (in the membrane of Plasmodium-infected erythrocytes)
- LAMP-2A
- LAP
- LIS1
- macromolecular aminoacyl-tRNA synthetase complex
- Macrophage scavenger receptor
- Mdm2
- MMP2, MMP9
- MRE11/Rad50/NBS1 (MRN) complex
- Msps/XMAP215/ch-TOG
- MTG8
- MUC1
- NadA
- Na⁺-K⁺-Cl⁻ cotransporter 1
- NB-LRR proteins: RPM1 and RPS2, Nod1, Nod2, NALP2, NALP3, NALP4, NALP12, IPAF
- Neuropeptide Y
- N-myc downstream-regulated gene 1 (NRDG1)
- Nox1, Nox2, Nox3, Nox5
- Nsl1
- NS1
- NSP3
- Nup62
- N-WASP
- OsCERK1
- P1 (picornaviral capsid precursor protein P1)
- p300
- P450 CYP2E1
- P2X₇ purinergic receptor
- PARK7 (DJ-1)
- PB1 and PB2 subunits of influenza RNA pol.
- PCNA
- perilipin
- PIDD
- Piwi
- Mg²⁺-dependent phosphatidate phosphohydrolase
- polysomal ribonuclease 1 (PMR1)
- PRMT5
- prolactin receptor
- prostacyclin synthase
- proteasome
- R2TP complex through Pih1
- Rab- α GDI
- Rab11a
- Rac/Rop GTPase Rac1 (rice)
- Rac1
- Ral-binding protein 1 (RalBP1)
- Rapsyn
- Raptor
- reovirus protein σ 1
- REV1
- reverse transcriptase of hepatitis B virus
- ribosomal proteins S3 and S6
- ribosomal protein L2 (E. coli)
- ricin catalytic A chain
- RIG-I
- Rpb1
- R-protein I-2
- SENP3
- SIR2 (SIR2RP1 in Leishmania)
- SKP2 complexes
- SMYD1, SMYD2, SMYD3
- snoRNP complexes
- SREC-I
- DNA helicase Ssl2
- SUR1 (subunit of β -cell ATP-sensitive potassium channel)
- survivin
- SV40 large T-antigen
- α -synuclein
- Tab2/3
- Tau protein
- telomerase
- thiopurine S-methyltransferase
- thrombin receptor (PAR-1)
- thromboxane synthase

- **Tissue plasminogen activator (tPA)**
- **Titin**
- **TLR4/MD-2 complex**
- **TOM40**
- **TRIM8**
- **Triosephosphate isomerase**
- **Trithorax (and ortholog MLL)**
- **Tyrosine hydroxylase**
- **UCH-L1**
- **URI complex**
- **Uroporphyrinogen decarboxylase (HemE) [in cyanobacteria]**
- **Vaccinia core protein 4a**
- **misfolded VHL**
- **Vimentin**
- **WASF3**
- **XPO1**
- **XPORT**
- **ZEITLUPE**

Notes:

- Only the cytosolic form of Hsp90 was considered.
- Only proteins are listed for which biochemical evidence for an interaction is available (i.e. geldanamycin effects alone were not considered 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), 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), and in a pharmacological survey of kinases (Citri et al. [2006] J. Biol. Chem. 281, 14361).
- **See [Hsp90Int.db](http://www.picard.ch/Hsp90Int) for the comprehensive 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 <http://www.picard.ch/Hsp90Int>).**
- **Looking for references? See <http://www.picard.ch/downloads/Hsp90facts.pdf>.**