Integrative Structure Validation Report

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The following software was used in the production of this report:

IHMValidation Version 3.2
Python-IHM Version 2.9
MolProbity Version 4.5.2
PrISM Version dbe5a41
PyMOL Version 2.5.0

PDB ID	9AAO | pdb_00009aao
Structure Title	Yeast Hsp90 open structural ensemble
Structure Authors	Hellenkamp, B.; Wortmann, P.; Kandzia, F.; Zacharias, M.; Hugel, T.
Deposited on	2026-01-13

This is a PDB-IHM Structure Validation Report.

We welcome your comments at helpdesk@pdb-ihm.org

A user guide is available at https://pdb-ihm.org/validation_help.html with specific help available everywhere you see the symbol.

List of references used to build this report is available here.

1. Overview

1.1. Summary

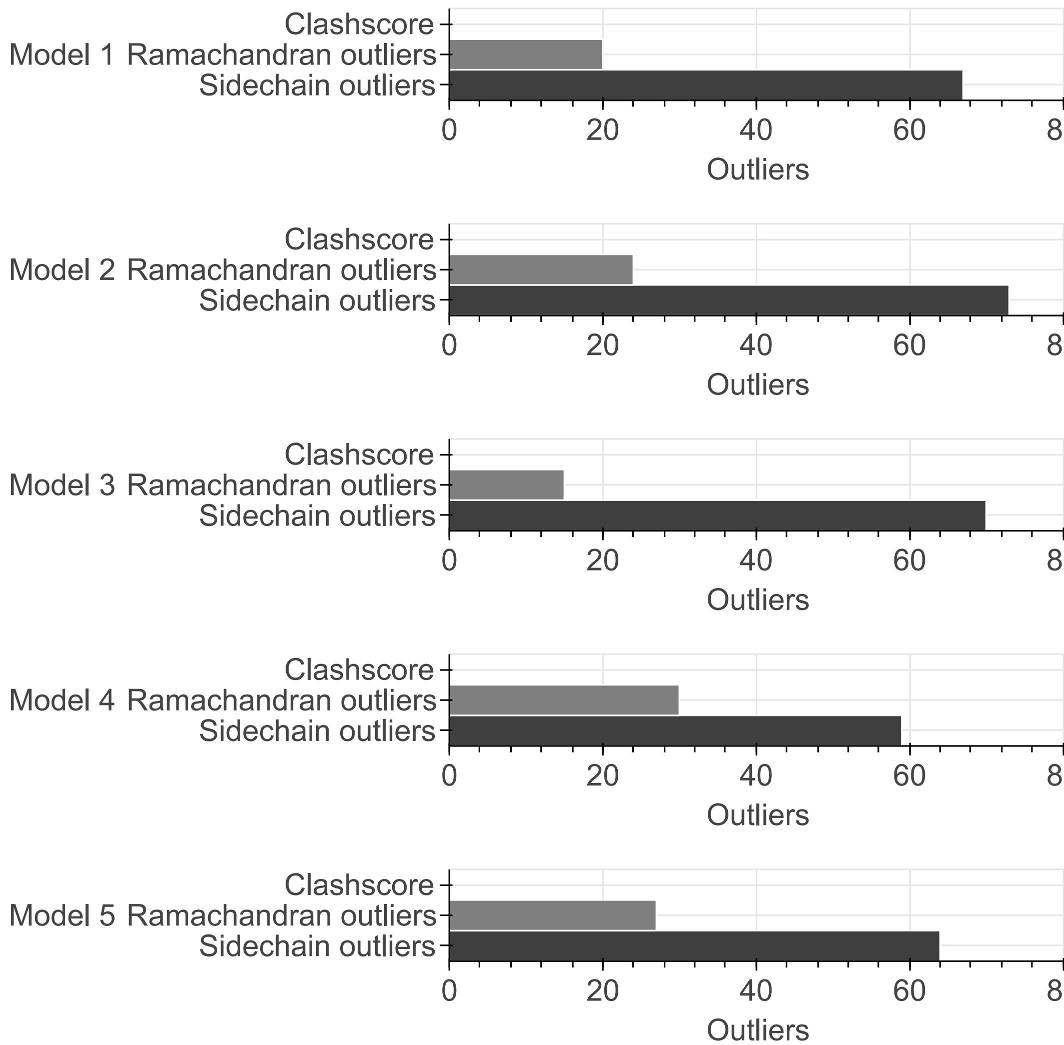
This entry consists of 5 model(s). A total of 2 dataset(s) were used to build this entry.

Name	Type	Count
Single molecule FRET data	Experimental data	1
Experimental model	Starting model	1

1.2. Overall quality

This validation report contains model quality assessments for all structures, data quality and fit to model assessments for SAS and crosslinking-MS datasets. Data quality and fit to model assessments for other datasets and model uncertainty are under development. Number of plots is limited to 256.

Model Quality: MolProbity Analysis



2. Model Details

2.1. Ensemble information

This entry consists of 1 distinct ensemble(s).

2.2. Representation

This entry has 1 representation(s).

ID	Model(s)	Entity ID	Molecule name	Chain(s) [auth]	Total residues	Rigid segments	Flexible segments	Model coverage/ Starting model coverage (%)	Scale

ID	Model(s)	Entity ID	Molecule name	Chain(s) [auth]	Total residues	Rigid segments	Flexible segments	Model coverage/ Starting model coverage (%)	Scale
1	1-5	1	ATP-dependent molecular chaperone HSP82	A	759	-	1-759	100.00 / 100.00	Atomic
				B					
		2	ADENOSINE-5'-DIPHOSPHATE	C [A]	Non-polymeric	-	-	Not available / Not available	Atomic
				E [B]					
		3	MAGNESIUM ION	D [A]	Non-polymeric	-	-	Not available / Not available	Atomic
				F [B]					

2.3. Datasets used for modeling

There are 2 unique datasets used to build the models in this entry.

ID	Dataset type	Database name	Data access code
1	Single molecule FRET data	Not available	10.1038/nmeth.4081
2	Experimental model	PDB	pdb_00002cg9

2.4. Methodology and software

This entry is a result of 1 distinct protocol(s).

Step number	Protocol ID	Method name	Method type	Method description	Number of computed models	Multi state modeling	Multi scale modeling
1	1	FPS-based docking	Not available	Not available	Not available	False	False
2	1	Optimization by the use of another crystal structure for only the N-Domain, namely 2WEP	Not available	Not available	Not available	False	False
3	1	MD refinement	Not available	Not available	Not available	False	False

There are 3 software packages reported in this entry.

ID	Software name	Software version	Software classification	Software location
1	FPS (FRET Positioning and Screening)	Not available	model validation	http://www.mpc.hhu.de/software/fps.html
2	MDA(Multi Domain Arrangement)	Not available	model building	http://www.singlemolecule.uni-freiburg.de/software
3	Amber14	Not available	model validation	https://ambermd.org/

3. Data quality

3.4. Single molecule FRET

Validation for this section is under development.

4. Model quality

For models with atomic structures, MolProbity analysis is performed. For models with coarse-grained or multi-scale structures, excluded volume analysis is performed.

4.1b. MolProbity Analysis

Excluded volume satisfaction for the models in the entry are listed below. The Analysed column shows the number of particle-partice or particle-atom pairs for which excluded volume was analysed.

Standard geometry: bond outliers

There are 10 bond length outliers in this entry (0.02% of 52189 assessed bonds). A summary is provided below.

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
E	1	ADP	C4-C5	5.91	1.37	1.49	4	5
C	1	ADP	C4-C5	5.90	1.37	1.49	3	5

Standard geometry: angle outliers

There are 226 bond angle outliers in this entry (0.32% of 70349 assessed bonds). A summary is provided below. The output is limited to 100 rows.

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
B	332	PHE	CA-CB-CG	10.33	124.13	113.80	2	5
A	332	PHE	CA-CB-CG	9.69	123.49	113.80	1	5
B	336	LYS	C-N-CA	8.21	136.48	121.70	2	2
B	331	LEU	C-N-CA	7.13	134.54	121.70	4	3
B	352	ASP	CA-CB-CG	7.02	119.62	112.60	1	3
B	337	LYS	N-CA-CB	6.98	122.37	110.50	2	2
A	46	ARG	CD-NE-CZ	6.55	133.57	124.40	2	2
B	50	LEU	C-CA-CB	6.45	122.35	110.10	3	1
E	1	ADP	PA-O3A-PB	6.39	139.67	120.50	5	5
A	375	PRO	C-N-CA	6.39	133.20	121.70	5	3
A	336	LYS	C-N-CA	6.27	132.98	121.70	2	2
A	352	ASP	CA-CB-CG	6.20	118.80	112.60	4	4
A	516	PHE	CA-CB-CG	6.15	119.95	113.80	2	1
A	532	GLU	C-N-CA	6.07	132.63	121.70	3	2
B	487	PHE	CA-CB-CG	6.06	119.86	113.80	5	1
B	211	LYS	C-N-CA	6.05	132.58	121.70	4	1

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
B	506	ASP	CA-CB-CG	5.96	118.56	112.60	1	5
B	570	LYS	C-N-CA	5.92	132.36	121.70	3	2
A	338	LYS	C-CA-CB	5.83	121.17	110.10	1	3
B	477	GLU	N-CA-CB	5.82	100.60	110.50	5	1
A	636	ASP	C-N-CA	5.81	132.15	121.70	1	3
A	330	ASP	C-N-CA	5.74	132.03	121.70	1	1
B	375	PRO	C-N-CA	5.70	131.96	121.70	5	3
B	477	GLU	C-N-CA	5.69	131.95	121.70	5	1
A	313	GLY	C-N-CA	5.68	131.92	121.70	3	1
B	286	GLN	C-N-CA	5.62	131.82	121.70	2	1
A	573	ASP	CA-CB-CG	5.61	118.21	112.60	2	1
A	337	LYS	C-CA-CB	5.60	120.74	110.10	3	1
B	338	LYS	C-CA-CB	5.57	120.69	110.10	1	1
B	313	GLY	C-N-CA	5.56	131.72	121.70	3	2
C	1	ADP	PA-O3A-PB	5.55	137.14	120.50	5	5
A	286	GLN	C-N-CA	5.54	131.68	121.70	2	3
A	570	LYS	C-N-CA	5.53	131.65	121.70	3	2
A	523	ASP	C-CA-CB	5.46	120.48	110.10	5	2
A	506	ASP	CA-CB-CG	5.34	117.94	112.60	1	4
B	197	HIS	CB-CG-CD2	5.33	124.27	131.20	1	4
B	143	ASP	CA-CB-CG	5.30	117.90	112.60	1	4
B	280	ASN	CA-CB-CG	5.29	117.89	112.60	5	1
A	477	GLU	C-N-CA	5.26	131.16	121.70	5	1
A	143	ASP	CA-CB-CG	5.20	117.80	112.60	2	5
A	331	LEU	C-N-CA	5.20	131.05	121.70	3	3
A	673	SER	C-N-CA	5.19	131.05	121.70	5	2
B	467	HIS	CB-CG-CD2	5.19	124.45	131.20	5	5
B	330	ASP	C-N-CA	5.14	130.95	121.70	1	1
B	532	GLU	C-N-CA	5.08	130.85	121.70	3	2
A	70	PRO	C-N-CA	5.08	130.84	121.70	2	1
B	337	LYS	C-N-CA	5.08	130.84	121.70	3	2
B	283	ASP	CA-CB-CG	5.07	117.67	112.60	2	1
A	467	HIS	CB-CG-CD2	5.05	124.63	131.20	5	5
B	613	PHE	CA-CB-CG	5.05	118.85	113.80	4	5
B	339	ASN	C-N-CA	5.03	130.76	121.70	1	1

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
A	487	PHE	CA-CB-CG	4.99	118.79	113.80	5	1
B	271	ASN	C-N-CA	4.95	130.60	121.70	1	1
A	330	ASP	C-CA-CB	4.91	119.42	110.10	2	2
B	331	LEU	CA-C-N	4.90	126.01	116.20	4	1
A	267	ILE	C-N-CA	4.90	130.52	121.70	2	5
A	383	LEU	C-N-CA	4.88	130.48	121.70	5	3
B	636	ASP	C-N-CA	4.87	130.47	121.70	4	2
A	276	LEU	N-CA-CB	4.87	102.22	110.50	4	1
B	639	VAL	CA-CB-CG1	4.83	118.61	110.40	2	4
A	213	VAL	CA-CB-CG1	4.81	118.58	110.40	2	1
B	332	PHE	C-N-CA	4.80	130.34	121.70	4	1
A	430	HIS	CB-CG-CD2	4.77	125.00	131.20	1	5
A	531	GLU	C-N-CA	4.75	130.24	121.70	1	1
B	380	ARG	CB-CG-CD	4.74	122.19	111.30	5	1
A	332	PHE	C-N-CA	4.70	130.16	121.70	3	1
A	296	ILE	CA-CB-CG1	4.69	118.38	110.40	4	1
B	530	LEU	C-N-CA	4.69	130.14	121.70	2	1
B	414	PHE	CA-CB-CG	4.67	118.47	113.80	3	1
B	267	ILE	C-N-CA	4.65	130.08	121.70	3	2
B	308	HIS	CA-CB-CG	4.63	118.43	113.80	3	2
A	197	HIS	CB-CG-CD2	4.63	125.18	131.20	4	5
B	330	ASP	C-CA-CB	4.62	118.89	110.10	4	1
B	46	ARG	CD-NE-CZ	4.55	130.76	124.40	1	1
A	47	TYR	CA-CB-CG	4.55	122.08	113.90	4	3
A	474	ILE	C-N-CA	4.51	129.81	121.70	4	2
B	178	LYS	C-N-CA	4.49	129.79	121.70	2	1
A	664	PHE	CA-CB-CG	4.49	118.29	113.80	1	1
B	673	SER	C-N-CA	4.47	129.74	121.70	5	1
A	308	HIS	CB-CG-CD2	4.45	125.42	131.20	2	1
A	637	LYS	N-CA-CB	4.45	102.94	110.50	2	1
B	335	LYS	C-N-CA	4.43	129.68	121.70	2	1
A	336	LYS	CA-CB-CG	4.43	122.96	114.10	2	1
B	430	HIS	CB-CG-CD2	4.43	125.45	131.20	5	4
A	270	LEU	C-N-CA	4.42	129.66	121.70	2	2
A	500	PHE	CA-CB-CG	4.40	118.20	113.80	4	1

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
B	383	LEU	C-N-CA	4.38	129.58	121.70	1	2
B	531	GLU	C-N-CA	4.32	129.47	121.70	5	1
A	298	ASN	C-N-CA	4.31	129.46	121.70	4	1
A	150	SER	C-N-CA	4.28	129.40	121.70	5	2
B	156	PHE	CA-CB-CG	4.27	118.07	113.80	1	1
A	331	LEU	CA-C-N	4.27	124.73	116.20	3	2
A	435	ASN	C-N-CA	4.26	129.38	121.70	1	2
B	47	TYR	CA-CB-CG	4.25	121.55	113.90	4	1
A	308	HIS	CA-CB-CG	4.23	118.03	113.80	3	1
A	523	ASP	CA-CB-CG	4.23	116.83	112.60	5	1
B	315	LEU	C-N-CA	4.23	129.31	121.70	2	1
A	262	GLU	C-N-CA	4.22	129.29	121.70	1	1
B	404	PHE	CA-CB-CG	4.21	118.01	113.80	1	2
B	348	VAL	CA-CB-CG2	4.21	117.55	110.40	1	1

Too-close contacts ?

The following all-atom clashscore is based on a MolProbity analysis. All-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The table below contains clashscores for all atomic models in this entry.

Model ID	Clash score	Number of clashes
1	0.00	0
2	0.00	0
3	0.00	0
4	0.00	0
5	0.00	0

There are no too-close contacts.

Torsion angles: Protein backbone ?

In the following table, Ramachandran outliers are listed. The Analysed column shows the number of residues for which the backbone conformation was analysed.

Model ID	Analysed	Favored	Allowed	Outliers
1	1254	1129	105	20
2	1254	1117	113	24
3	1254	1128	111	15
4	1254	1131	93	30
5	1254	1109	118	27

There are 72 unique backbone outliers. Detailed list of outliers are tabulated below.

Chain	Res	Type	Models (Total)
A	268	GLU	5
A	337	LYS	5
B	268	GLU	5
B	338	LYS	4
A	314	GLN	3
B	263	GLU	3
B	336	LYS	3
B	337	LYS	3
B	674	LEU	3
A	212	GLU	2
A	263	GLU	2
A	335	LYS	2
A	376	LEU	2
A	379	SER	2
A	380	ARG	2
A	562	VAL	2
A	563	GLU	2
A	571	LEU	2
A	660	GLU	2
A	674	LEU	2
B	272	LYS	2
B	314	GLN	2
B	333	GLU	2
B	340	ASN	2
B	376	LEU	2
B	524	ILE	2
B	531	GLU	2
B	571	LEU	2
A	23	VAL	1
A	71	GLU	1
A	213	VAL	1
A	269	GLU	1
A	271	ASN	1
A	315	LEU	1
A	316	GLU	1

Chain	Res	Type	Models (Total)
A	332	PHE	1
A	333	GLU	1
A	377	ASN	1
A	412	GLU	1
A	451	VAL	1
A	478	SER	1
A	516	PHE	1
A	524	ILE	1
A	533	THR	1
A	575	PRO	1
A	596	GLN	1
B	3	SER	1
B	94	GLY	1
B	161	ASP	1
B	163	VAL	1
B	179	ASP	1
B	199	GLU	1
B	212	GLU	1
B	271	ASN	1
B	274	LYS	1
B	287	GLU	1
B	315	LEU	1
B	331	LEU	1
B	332	PHE	1
B	335	LYS	1
B	377	ASN	1
B	478	SER	1
B	495	ASN	1
B	533	THR	1
B	540	ARG	1
B	562	VAL	1
B	563	GLU	1
B	575	PRO	1
B	596	GLN	1
B	632	GLY	1

Chain	Res	Type	Models (Total)
B	638	THR	1
B	660	GLU	1

Torsion angles : Protein sidechains

In the following table, sidechain rotameric outliers are listed. The Analysed column shows the number of residues for which the sidechain conformation was analysed.

Model ID	Analysed	Favored	Allowed	Outliers
1	1138	966	105	67
2	1138	946	119	73
3	1138	964	104	70
4	1138	975	104	59
5	1137	960	113	64

There are 205 unique sidechain outliers. Detailed list of outliers are tabulated below. The output is limited to 100 rows.

Chain	Res	Type	Models (Total)
A	315	LEU	5
A	390	LYS	5
A	497	GLU	5
A	515	GLU	5
B	315	LEU	5
B	335	LYS	5
B	497	GLU	5
A	144	GLU	4
A	318	ARG	4
A	332	PHE	4
B	144	GLU	4
B	263	GLU	4
B	332	PHE	4
A	186	GLU	3
A	263	GLU	3
A	265	GLN	3
A	325	LYS	3
A	336	LYS	3
A	382	MET	3
A	541	GLU	3
A	622	ILE	3

Chain	Res	Type	Models (Total)
A	627	LYS	3
A	660	GLU	3
B	18	LEU	3
B	22	THR	3
B	159	THR	3
B	325	LYS	3
B	380	ARG	3
B	515	GLU	3
B	556	GLU	3
B	570	LYS	3
B	660	GLU	3
A	34	LEU	2
A	43	ASP	2
A	45	ILE	2
A	46	ARG	2
A	47	TYR	2
A	73	LYS	2
A	134	VAL	2
A	188	LYS	2
A	215	LYS	2
A	299	ASP	2
A	329	PHE	2
A	331	LEU	2
A	335	LYS	2
A	337	LYS	2
A	380	ARG	2
A	489	ASP	2
A	494	LYS	2
A	564	LYS	2
A	566	VAL	2
A	572	LEU	2
A	629	VAL	2
A	677	ASN	2
B	47	TYR	2
B	54	LYS	2

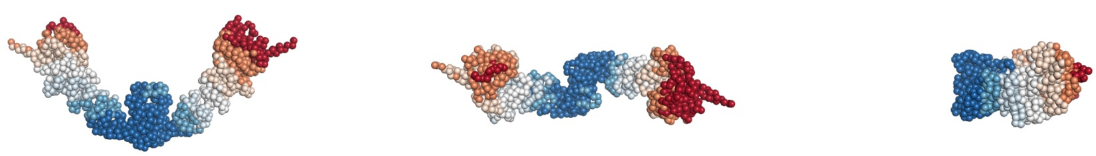
Chain	Res	Type	Models (Total)
B	116	MET	2
B	189	ARG	2
B	198	SER	2
B	199	GLU	2
B	214	GLU	2
B	215	LYS	2
B	299	ASP	2
B	314	GLN	2
B	316	GLU	2
B	331	LEU	2
B	469	LYS	2
B	494	LYS	2
B	498	VAL	2
B	537	LYS	2
B	562	VAL	2
B	564	LYS	2
B	594	LYS	2
B	602	SER	2
B	622	ILE	2
B	627	LYS	2
A	23	VAL	1
A	36	SER	1
A	74	VAL	1
A	77	ILE	1
A	119	GLN	1
A	157	THR	1
A	165	GLU	1
A	187	GLU	1
A	199	GLU	1
A	200	PHE	1
A	209	VAL	1
A	212	GLU	1
A	213	VAL	1
A	214	GLU	1
A	274	LYS	1

Chain	Res	Type	Models (Total)
A	276	LEU	1
A	278	THR	1
A	280	ASN	1
A	283	ASP	1
A	286	GLN	1
A	310	SER	1
A	316	GLU	1
A	323	ILE	1
A	333	GLU	1

4.2. PrISM Precision Analysis

*Regions of **low** **high** precision, defined as the variability among the models that satisfy the input data and calculated as the density-weighted root mean-square fluctuation (RMSF) from the bead/atom center of density, annotated and visualized using PrISM. The per-bead precision is computed from the deposited ensemble of superposed integrative models. High- and low-precision regions are then determined by clustering beads of similar precision based on their proximity in the structure. Only coarse-grained beads (or CA atoms for atomic models) of deposited models are used for assessment and visualization, and three projections for each representative model are generated.*

PrISM analysis for Ensemble 1 (models deposited/total: 5/5).



5. Fit to Data Used for Modeling Assessment

5.4. Single molecule FRET

Validation for this section is under development.

6. Fit to Data Used for Validation Assessment

Validation for this section is under development.

Acknowledgments

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