Integrative Structure Validation Report

October 16, 2025 - 06:13 PM PDT

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

IHMValidation Version 3.0
Python-IHM Version 2.5
MolProbity Version 4.5.2

PDB ID	9AA3 | pdb_00009aa3
Structure Title	Integrative structure of Glutamate transporter homolog based in 3D localization AFM (3D-LAFM) density map
Structure Authors	Jiang, Y.; Wang, Z.; Scheuring, S.
Deposited on	2025-05-16

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

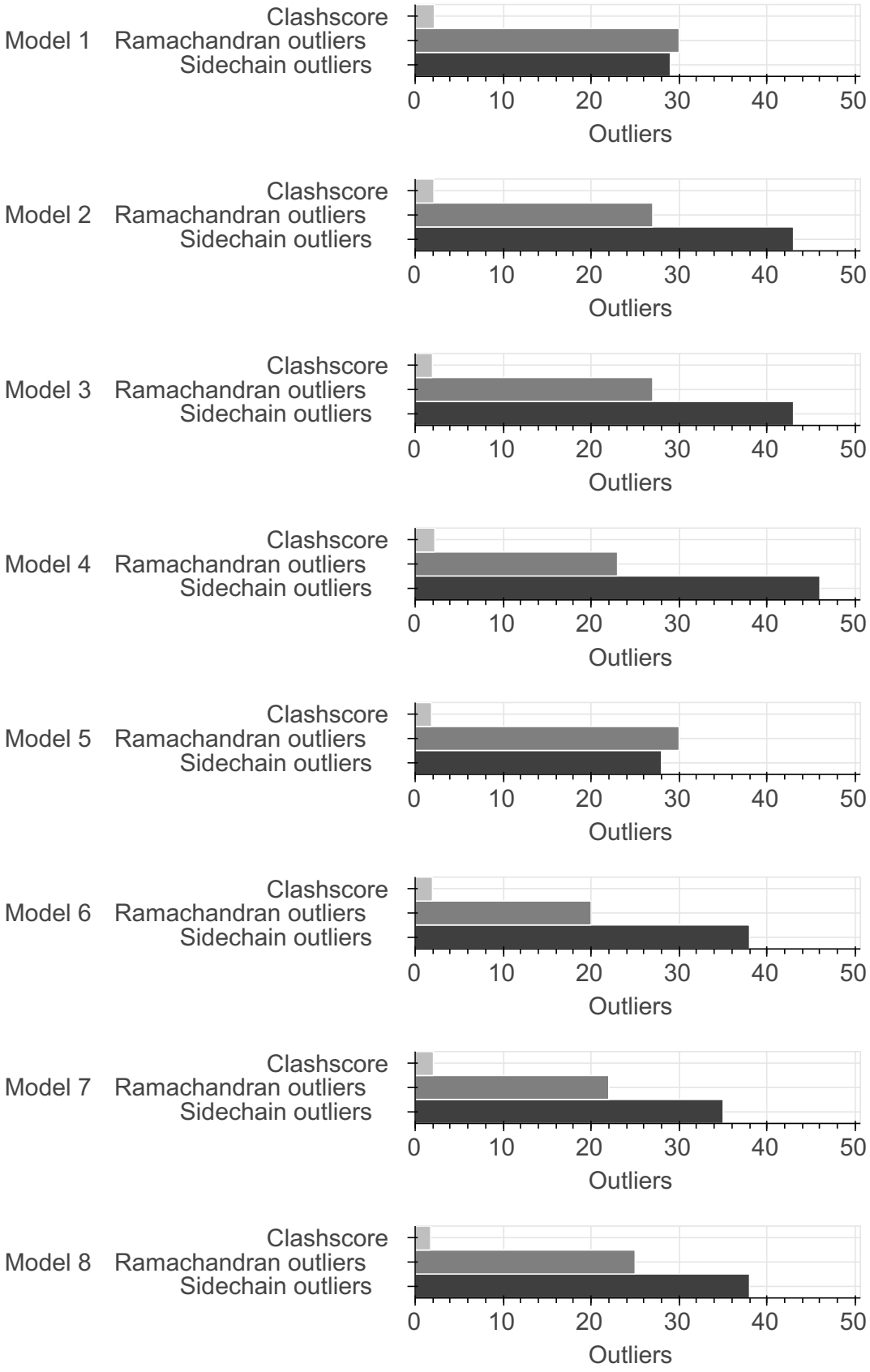
This entry consists of 10 model(s). A total of 2 dataset(s) were used to build this entry.

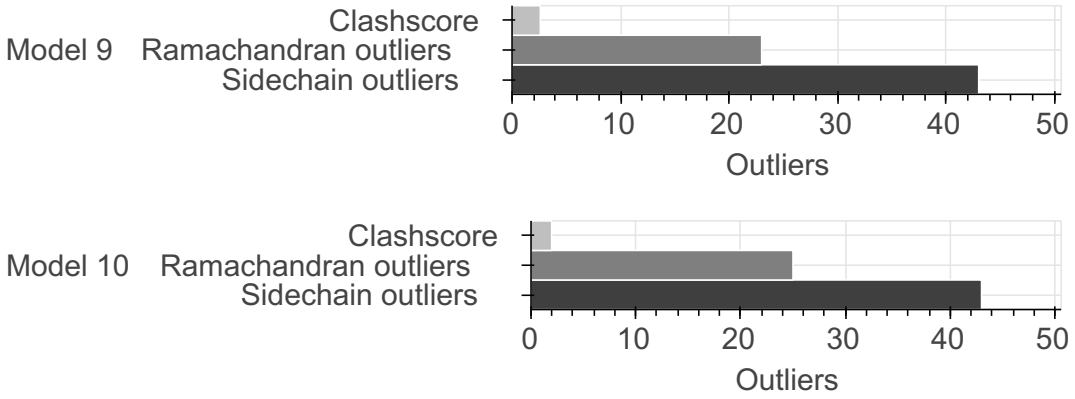
Name	Type	Count
Other	Experimental data	1
Experimental model	Starting model	1

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 0 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
1	1-10	1	Glutamate transporter homolog	A	415	-	1-415	100.00 / 100.00	Atomic
				B					
				C					

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	Other	Zenodo	10.5281/zenodo.14172248
2	Experimental model	PDB	pdb_00004p19

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	Not available	Not available	Not available	Not available	False	False

There are 2 software packages reported in this entry.

ID	Software name	Software version	Software classification	Software location
1	UCSF ChimeraX	Not available	model building	https://www.rbvi.ucsf.edu/chimerax/
2	Visual Molecular Dynamics (VMD)	Not available	model building	https://www.ks.uiuc.edu/Research/vmd/

3. Data quality

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 3777 bond length outliers in this entry (4.05% of 93250 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	32	HIS	ND1-CE1	11.38	1.43	1.32	4	8
A	327	HIS	ND1-CE1	10.89	1.43	1.32	7	5
A	327	HIS	CE1-NE2	10.71	1.21	1.32	2	3
B	35	HIS	ND1-CE1	10.65	1.43	1.32	1	4
A	32	HIS	ND1-CE1	10.60	1.43	1.32	4	3
A	218	HIS	ND1-CE1	10.46	1.43	1.32	4	3
A	120	HIS	ND1-CE1	10.39	1.42	1.32	4	8
C	327	HIS	ND1-CE1	10.16	1.42	1.32	9	8
A	75	ARG	NE-CZ	9.71	1.43	1.33	5	1
A	218	HIS	CE1-NE2	9.43	1.42	1.32	5	1
A	127	HIS	ND1-CE1	9.22	1.41	1.32	5	4
C	182	ILE	C-N	9.04	1.46	1.33	4	2
C	355	ALA	C-N	9.03	1.46	1.33	6	1
C	79	LYS	C-N	8.98	1.45	1.33	9	4
C	321	ALA	C-N	8.92	1.45	1.33	2	2
A	259	HIS	ND1-CE1	8.85	1.41	1.32	1	5
C	370	THR	C-N	8.83	1.45	1.33	1	1

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
C	21	VAL	C-N	8.68	1.45	1.33	7	2
B	376	ALA	C-N	8.61	1.45	1.33	7	2
B	241	VAL	C-N	8.55	1.45	1.33	7	3
A	120	HIS	CB-CG	8.52	1.62	1.50	8	4
C	158	ILE	C-N	8.50	1.45	1.33	5	3
A	66	ALA	C-N	8.46	1.45	1.33	1	2
C	174	SER	C-N	8.42	1.45	1.33	6	2
C	129	LEU	C-N	8.39	1.45	1.33	4	3
C	32	HIS	ND1-CE1	8.34	1.40	1.32	1	5
B	363	HIS	ND1-CE1	8.33	1.40	1.32	3	6
C	270	THR	C-N	8.28	1.44	1.33	3	2
C	301	GLY	C-N	8.28	1.44	1.33	3	5
C	43	ASP	C-N	8.26	1.44	1.33	6	4
B	109	HIS	CB-CG	8.26	1.61	1.50	4	2
A	61	LEU	C-N	8.21	1.44	1.33	6	1
B	327	HIS	CE1-NE2	8.21	1.40	1.32	2	4
C	127	HIS	ND1-CE1	8.20	1.40	1.32	10	4
B	321	ALA	C-N	8.20	1.44	1.33	9	3
C	95	GLY	C-N	8.18	1.44	1.33	10	1
B	172	ARG	CD-NE	8.13	1.57	1.46	6	2
B	46	VAL	C-N	8.13	1.44	1.33	7	4
B	85	LEU	C-N	8.12	1.44	1.33	9	1
B	44	LEU	C-N	8.10	1.44	1.33	6	1
B	327	HIS	ND1-CE1	8.08	1.40	1.32	6	3
A	318	PHE	C-N	8.05	1.44	1.33	7	3
A	319	PHE	C-N	8.00	1.44	1.33	10	2
A	29	GLY	C-N	7.96	1.44	1.33	8	1
A	131	ASP	C-N	7.95	1.44	1.33	1	2
C	282	ARG	NE-CZ	7.94	1.41	1.33	1	5
B	100	ARG	NE-CZ	7.89	1.41	1.33	6	5
B	120	HIS	ND1-CE1	7.89	1.40	1.32	4	7
A	207	LEU	C-N	7.76	1.44	1.33	2	3
A	363	HIS	ND1-CE1	7.74	1.40	1.32	7	3
B	20	ILE	CB-CG1	7.73	1.68	1.53	5	3
A	208	ILE	C-N	7.73	1.44	1.33	9	6

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
B	380	MET	C-N	7.69	1.44	1.33	2	2
C	225	LYS	C-N	7.61	1.44	1.33	4	3
B	259	HIS	ND1-CE1	7.61	1.40	1.32	7	5
A	381	ILE	C-N	7.60	1.44	1.33	6	3
A	35	HIS	ND1-CE1	7.58	1.40	1.32	1	6
C	394	MET	C-N	7.56	1.43	1.33	3	2
C	199	TYR	C-N	7.55	1.43	1.33	10	2
C	180	ASP	CA-CB	7.54	1.68	1.53	2	1
B	352	GLY	C-N	7.52	1.43	1.33	8	4
C	42	GLY	C-N	7.52	1.43	1.33	10	3
A	47	ARG	CZ-NH2	7.51	1.43	1.33	2	1
B	47	ARG	NE-CZ	7.49	1.41	1.33	3	5
B	218	HIS	ND1-CE1	7.49	1.40	1.32	4	5
B	154	ILE	C-N	7.47	1.43	1.33	6	3
A	109	HIS	CG-CD2	7.47	1.44	1.35	2	2
C	47	ARG	NE-CZ	7.46	1.41	1.33	2	4
C	88	SER	C-N	7.46	1.43	1.33	3	2
C	384	ILE	C-N	7.45	1.43	1.33	2	2
C	47	ARG	C-N	7.45	1.43	1.33	6	3
A	375	ALA	C-N	7.44	1.43	1.33	9	2
C	75	ARG	C-N	7.42	1.43	1.33	8	1
B	190	TYR	C-N	7.41	1.43	1.33	5	3
C	207	LEU	CA-C	7.41	1.37	1.52	8	1
A	168	ASN	C-N	7.39	1.43	1.33	2	2
A	259	HIS	CB-CG	7.39	1.60	1.50	4	2
C	186	ALA	C-N	7.38	1.43	1.33	8	3
B	327	HIS	CG-CD2	7.38	1.44	1.35	7	1
A	109	HIS	ND1-CE1	7.37	1.39	1.32	3	1
B	394	MET	C-N	7.35	1.43	1.33	10	5
B	217	VAL	C-N	7.34	1.43	1.33	5	2
C	325	GLY	C-N	7.34	1.43	1.33	2	3
A	139	GLY	C-N	7.30	1.43	1.33	6	1
A	222	GLU	C-N	7.30	1.43	1.33	7	2
C	282	ARG	CD-NE	7.29	1.56	1.46	5	2
B	262	ASP	C-N	7.27	1.43	1.33	7	3

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
B	6	PRO	C-N	7.27	1.43	1.33	4	3
A	273	SER	C-N	7.26	1.43	1.33	7	3
C	160	ILE	C-N	7.26	1.43	1.33	5	1
B	82	VAL	C-N	7.25	1.43	1.33	2	3
A	371	ASP	C-N	7.25	1.22	1.34	4	1
C	364	SER	CA-CB	7.25	1.67	1.53	1	1
A	271	ARG	NE-CZ	7.25	1.41	1.33	4	5
B	191	LYS	C-N	7.24	1.43	1.33	2	3
C	153	ALA	C-N	7.23	1.43	1.33	8	3
B	392	ARG	NE-CZ	7.22	1.41	1.33	7	4
A	46	VAL	C-N	7.22	1.43	1.33	6	2
A	107	GLY	CA-C	7.21	1.39	1.52	7	3
A	100	ARG	CZ-NH1	7.21	1.42	1.32	6	2

Standard geometry: angle outliers

There are 5652 bond angle outliers in this entry (4.44% of 127260 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	180	ASP	CA-CB-CG	13.44	126.04	112.60	10	7
B	389	ASP	CA-CB-CG	12.36	124.96	112.60	5	6
C	41	PHE	CA-CB-CG	11.69	102.11	113.80	2	4
C	138	PHE	CA-CB-CG	11.17	102.63	113.80	7	2
C	118	GLN	OE1-CD-NE2	11.12	133.72	122.60	7	3
C	9	GLN	OE1-CD-NE2	10.95	133.55	122.60	8	2
A	373	ASN	CA-CB-CG	10.87	101.73	112.60	1	1
A	256	PHE	CA-CB-CG	10.66	124.46	113.80	3	5
A	259	HIS	CA-CB-CG	10.56	124.36	113.80	2	4
B	259	HIS	CA-CB-CG	10.54	124.34	113.80	9	3
C	200	ALA	CA-C-N	10.50	132.65	116.90	5	9
B	305	ASN	CA-CB-CG	10.28	122.88	112.60	5	4
B	123	PRO	CA-C-N	10.23	132.24	116.90	3	4
A	298	LEU	CA-C-N	10.22	132.24	116.90	6	9
A	39	LYS	CA-C-N	10.18	132.17	116.90	2	7
A	32	HIS	CA-CB-CG	10.17	103.63	113.80	6	4
C	168	ASN	CA-CB-CG	9.96	122.56	112.60	4	3

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
A	200	ALA	CA-C-N	9.96	131.83	116.90	8	8
B	127	HIS	CA-CB-CG	9.88	103.92	113.80	9	4
C	385	ASP	CA-CB-CG	9.75	122.35	112.60	10	3
C	102	PHE	CA-CB-CG	9.71	104.09	113.80	6	6
A	41	PHE	CA-CB-CG	9.66	104.14	113.80	2	6
A	102	PHE	CA-CB-CG	9.62	104.18	113.80	9	3
C	268	PHE	CA-CB-CG	9.59	123.39	113.80	8	6
C	5	TYR	CA-C-N	9.50	131.16	116.90	5	5
B	326	SER	N-CA-CB	9.45	126.56	110.50	9	2
C	109	HIS	CD2-NE2-CE1	9.39	99.61	109.00	3	9
A	237	GLN	OE1-CD-NE2	9.34	113.26	122.60	10	2
A	72	ARG	NE-CZ-NH1	9.33	112.17	121.50	1	3
B	45	PHE	CA-CB-CG	9.33	123.13	113.80	5	3
C	188	ALA	C-CA-CB	9.31	96.54	110.50	1	6
A	327	HIS	CD2-NE2-CE1	9.29	99.71	109.00	3	4
A	127	HIS	CA-CB-CG	9.20	123.00	113.80	7	3
B	200	ALA	CA-C-N	9.18	130.67	116.90	9	8
C	298	LEU	CA-C-N	9.17	130.65	116.90	7	9
C	43	ASP	CA-CB-CG	9.14	121.74	112.60	3	1
B	252	ASP	CA-C-N	9.07	130.50	116.90	1	6
B	168	ASN	N-CA-CB	9.03	125.84	110.50	3	8
B	133	VAL	CA-C-N	9.02	130.43	116.90	4	4
B	194	ASN	CA-CB-CG	8.96	121.56	112.60	8	2
B	327	HIS	ND1-CE1-NE2	8.93	117.33	108.40	7	4
A	27	HIS	CB-CG-CD2	8.89	119.64	131.20	1	2
B	5	TYR	CA-C-N	8.80	130.09	116.90	9	5
A	389	ASP	CA-CB-CG	8.79	103.81	112.60	4	5
C	218	HIS	CB-CG-CD2	8.77	119.79	131.20	9	2
C	392	ARG	NE-CZ-NH2	8.73	127.05	119.20	2	3
C	109	HIS	CA-CB-CG	8.68	105.12	113.80	1	3
C	282	ARG	NE-CZ-NH1	8.68	130.18	121.50	4	1
C	103	ASN	CA-CB-CG	8.65	121.25	112.60	10	4
B	252	ASP	CA-CB-CG	8.65	121.25	112.60	3	6
B	327	HIS	CD2-NE2-CE1	8.63	100.37	109.00	3	8
A	27	HIS	CD2-NE2-CE1	8.60	100.40	109.00	1	4

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
C	327	HIS	CD2-NE2-CE1	8.59	100.41	109.00	7	6
B	54	MET	CA-C-N	8.59	129.78	116.90	6	7
A	367	LEU	CA-C-N	8.56	129.74	116.90	10	4
A	90	PHE	CA-CB-CG	8.55	105.25	113.80	5	5
C	194	ASN	CA-CB-CG	8.55	104.05	112.60	10	3
B	102	PHE	CA-CB-CG	8.53	105.27	113.80	9	6
A	120	HIS	CA-CB-CG	8.52	105.28	113.80	10	2
B	147	LEU	CA-C-N	8.51	129.66	116.90	1	6
A	35	HIS	CB-CG-CD2	8.50	120.15	131.20	8	1
C	168	ASN	OD1-CG-ND2	8.50	131.10	122.60	6	3
A	405	ALA	C-CA-CB	8.49	97.77	110.50	9	5
B	120	HIS	CD2-NE2-CE1	8.48	100.52	109.00	3	6
B	120	HIS	ND1-CE1-NE2	8.48	116.88	108.40	8	4
B	168	ASN	CA-CB-CG	8.47	121.07	112.60	3	4
A	109	HIS	CG-CD2-NE2	8.47	115.67	107.20	3	2
A	138	PHE	CA-CB-CG	8.45	105.35	113.80	8	3
C	131	ASP	CA-CB-CG	8.42	121.02	112.60	8	5
C	307	ASP	CA-CB-CG	8.41	104.19	112.60	7	1
A	103	ASN	CA-CB-CG	8.39	120.99	112.60	7	3
C	35	HIS	CD2-NE2-CE1	8.39	100.61	109.00	3	3
B	205	PHE	CA-CB-CG	8.39	122.19	113.80	4	8
C	32	HIS	CG-CD2-NE2	8.35	115.55	107.20	1	7
B	242	TYR	CB-CG-CD1	8.33	133.30	120.80	9	2
C	263	ALA	N-CA-CB	8.29	122.84	110.40	3	2
A	127	HIS	CG-CD2-NE2	8.28	115.48	107.20	4	4
C	117	PHE	CA-CB-CG	8.26	105.54	113.80	2	3
C	75	ARG	NE-CZ-NH1	8.23	129.73	121.50	10	4
A	259	HIS	CD2-NE2-CE1	8.23	100.77	109.00	9	5
B	194	ASN	OD1-CG-ND2	8.20	130.80	122.60	4	1
B	337	VAL	CA-CB-CG2	8.19	96.47	110.40	7	3
C	327	HIS	CG-CD2-NE2	8.19	115.39	107.20	7	5
A	51	MET	C-N-CA	8.18	136.43	121.70	5	4
A	127	HIS	CD2-NE2-CE1	8.18	100.82	109.00	4	8
C	350	VAL	N-CA-CB	8.16	125.37	111.50	2	8
A	282	ARG	NE-CZ-NH2	8.14	111.87	119.20	6	4

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
C	100	ARG	NE-CZ-NH1	8.14	129.64	121.50	10	2
A	168	ASN	CA-CB-CG	8.08	104.52	112.60	7	4
B	162	TYR	N-CA-CB	8.08	124.23	110.50	9	3
A	35	HIS	ND1-CE1-NE2	8.07	116.47	108.40	3	3
B	348	ALA	N-CA-CB	8.07	122.50	110.40	7	7
A	165	ASN	CA-CB-CG	8.05	104.55	112.60	6	4
B	173	LYS	N-CA-CB	8.05	124.18	110.50	5	5
B	127	HIS	CB-CG-CD2	8.02	120.77	131.20	2	3
B	364	SER	N-CA-CB	8.02	124.13	110.50	3	2
C	349	GLY	C-N-CA	7.97	136.05	121.70	8	9
A	327	HIS	ND1-CE1-NE2	7.97	116.37	108.40	3	6
C	65	ALA	N-CA-CB	7.93	122.29	110.40	1	4
B	271	ARG	NE-CZ-NH1	7.92	129.42	121.50	3	3

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	2.18	41
2	2.13	40
3	1.97	37
4	2.23	42
5	1.86	35
6	1.97	37
7	2.07	39
8	1.76	33
9	2.61	49
10	1.97	37

There are 390 clashes. The table below contains the detailed list of all clashes based on a MolProbity analysis. Bad clashes are >= 0.4 Angstrom. The output is limited to 100 rows.

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
B:15:LEU:HD22	B:387:ILE:HD11	0.72	10	1
C:387:ILE:H	C:387:ILE:HD12	0.70	9	2
B:172:ARG:O	B:175:ALA:HB3	0.69	7	7
C:110:LEU:HD21	C:376:ALA:HB3	0.69	4	1

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
A:289:ILE:H	A:289:ILE:HD12	0.68	9	1
B:102:PHE:HB2	B:229:ALA:HB2	0.66	7	1
C:70:PRO:HA	C:72:ARG:H	0.64	6	4
A:184:GLY:HA2	B:170:LYS:HB3	0.64	10	2
A:147:LEU:HD21	A:343:ALA:HB1	0.63	3	1
A:147:LEU:H	A:147:LEU:HD12	0.62	1	1
B:306:MET:HG3	B:347:THR:HG21	0.62	6	1
A:234:LEU:HD22	A:395:VAL:HG21	0.62	1	1
B:47:ARG:HA	B:47:ARG:HE	0.61	10	2
B:324:LEU:HD21	B:374:VAL:HA	0.61	7	1
B:188:ALA:HB2	C:171:VAL:HG13	0.60	8	3
A:313:GLN:HE21	A:361:VAL:HG11	0.60	2	1
B:267:ALA:CB	B:276:THR:HG21	0.60	8	1
B:215:GLN:HG3	B:380:MET:HE2	0.59	4	3
B:223:LEU:HD22	B:384:ILE:HD13	0.58	4	1
A:171:VAL:HG13	C:188:ALA:HB2	0.58	5	2
C:91:ALA:HB1	C:310:ALA:HB3	0.58	4	1
B:46:VAL:HG21	B:382:LEU:HD21	0.58	5	1
C:289:ILE:HD13	C:404:THR:OG1	0.58	8	1
C:249:TYR:CD2	C:406:ILE:HG23	0.58	4	1
A:103:ASN:HD22	A:105:GLY:H	0.58	9	1
C:226:VAL:HG21	C:319:PHE:CD2	0.58	10	1
C:350:VAL:H	C:393:THR:HG23	0.57	1	5
C:251:ILE:HD11	C:406:ILE:HG13	0.57	9	1
A:362:LEU:HD22	A:367:LEU:HD23	0.57	5	1
B:251:ILE:HD11	B:405:ALA:HB3	0.56	6	1
C:352:GLY:H	C:389:ASP:HB3	0.56	1	1
A:96:ILE:HD12	A:333:GLN:HB3	0.56	7	1
B:163:LEU:O	B:171:VAL:HG12	0.55	2	1
B:121:GLN:H	B:336:ILE:HG22	0.55	7	1
A:208:ILE:HD11	A:212:MET:HE2	0.55	9	1
A:242:TYR:CD1	A:402:THR:HG21	0.55	4	1
A:291:GLU:HA	A:294:TYR:CD1	0.55	6	1
A:125:LEU:H	A:125:LEU:HD22	0.55	4	1
C:99:ALA:HB2	C:315:VAL:HA	0.55	4	1

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
C:68:ILE:HG21	C:300:LEU:HD22	0.54	5	1
B:47:ARG:HA	B:47:ARG:NE	0.54	10	1
A:99:ALA:HB2	A:315:VAL:HG22	0.54	3	1
B:164:MET:HE2	B:179:LEU:HD22	0.54	8	1
B:56:ILE:HG13	B:189:MET:HG3	0.53	4	1
B:246:LEU:HA	B:251:ILE:HD13	0.53	10	3
C:284:ALA:HB1	C:289:ILE:HD12	0.53	5	2
B:34:VAL:HG11	B:210:TYR:HA	0.53	9	1
C:281:MET:HB3	C:294:TYR:CE1	0.53	6	2
B:54:MET:HA	B:54:MET:HE2	0.53	6	2
C:7:VAL:HB	C:271:ARG:HH21	0.53	1	1
B:289:ILE:HG12	B:405:ALA:HA	0.53	9	1
B:163:LEU:CB	B:175:ALA:HB2	0.52	10	1
A:7:VAL:HG12	A:269:VAL:HA	0.52	2	1
C:403:GLY:O	C:407:VAL:HG23	0.52	1	4
B:259:HIS:CE1	B:283:VAL:HG22	0.52	4	1
B:75:ARG:HE	B:411:GLU:HB3	0.52	10	1
B:163:LEU:HD22	B:171:VAL:HG13	0.52	7	1
A:291:GLU:HA	A:294:TYR:CE1	0.52	6	3
A:289:ILE:HD13	A:404:THR:CG2	0.52	7	1
C:84:TYR:CE1	C:305:ASN:HA	0.52	6	1
B:163:LEU:HA	B:171:VAL:HG12	0.51	4	4
C:258:LYS:HA	C:258:LYS:HE3	0.51	7	1
A:279:VAL:O	A:283:VAL:HG23	0.51	6	3
A:392:ARG:HG2	A:396:ASN:HD21	0.51	6	1
B:5:TYR:CE1	B:266:THR:HA	0.51	8	1
C:274:SER:O	C:278:PRO:HD2	0.51	1	1
C:291:GLU:HA	C:294:TYR:CE1	0.51	4	3
A:166:SER:HB2	A:171:VAL:HG11	0.51	6	1
A:182:ILE:HA	A:185:LEU:HB2	0.51	4	1
A:382:LEU:HA	A:385:ASP:HB2	0.51	5	1
A:226:VAL:HG21	A:319:PHE:CD2	0.50	3	1
B:362:LEU:HD23	B:367:LEU:H	0.50	5	1
C:23:LEU:HD22	C:217:VAL:HG12	0.50	7	1
A:405:ALA:HA	A:414:LEU:HD23	0.50	2	2

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
A:133:VAL:HG22	A:151:PHE:CE2	0.50	8	1
B:328:LEU:HD12	B:333:GLN:HE21	0.50	9	1
A:62:VAL:HG11	A:182:ILE:HG21	0.49	1	3
A:70:PRO:CB	A:71:ALA:HA	0.49	7	1
B:354:GLY:H	B:389:ASP:HB3	0.49	1	1
A:378:TYR:CE2	A:382:LEU:HD11	0.49	1	1
A:70:PRO:HB3	A:71:ALA:HA	0.49	7	2
C:283:VAL:HG22	C:286:GLU:OE1	0.49	9	1
A:174:SER:HA	C:181:ALA:HA	0.49	3	3
B:188:ALA:CB	C:171:VAL:HG13	0.49	8	1
A:59:ALA:HB2	A:185:LEU:HD23	0.49	6	2
C:80:ILE:HA	C:407:VAL:HG21	0.49	5	1
B:105:GLY:HA2	B:322:ASN:HB3	0.49	2	1
B:75:ARG:HH21	B:411:GLU:HA	0.49	9	1
B:164:MET:SD	B:175:ALA:HB1	0.48	8	1
C:147:LEU:O	C:151:PHE:CD2	0.48	9	1
A:238:ILE:HG22	A:243:PHE:CE1	0.48	1	1
C:277:LEU:HB3	C:278:PRO:HD3	0.48	9	1
B:184:GLY:CA	C:170:LYS:HB3	0.48	4	2
C:281:MET:HB3	C:282:ARG:HH21	0.48	9	1
A:289:ILE:CD1	A:289:ILE:H	0.48	9	1
B:246:LEU:HD22	B:251:ILE:HG21	0.48	10	2
A:378:TYR:CZ	A:382:LEU:HD11	0.48	1	1
C:166:SER:CB	C:171:VAL:HG11	0.48	6	1
C:7:VAL:HG21	C:198:GLN:HE22	0.48	9	1
A:184:GLY:HA2	B:170:LYS:O	0.48	9	3

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	1229	1127	72	30
2	1229	1133	69	27
3	1229	1135	67	27
4	1229	1132	74	23

Model ID	Analysed	Favored	Allowed	Outliers
5	1229	1135	64	30
6	1229	1147	62	20
7	1229	1140	67	22
8	1229	1128	76	25
9	1229	1140	66	23
10	1229	1133	71	25

There are 67 unique backbone outliers. Detailed list of outliers are tabulated below.

Chain	Res	Type	Models (Total)
A	168	ASN	10
A	412	GLY	10
B	168	ASN	10
B	305	ASN	10
B	350	VAL	10
B	365	VAL	10
C	69	SER	10
C	350	VAL	10
C	371	ASP	10
A	69	SER	8
B	69	SER	8
C	4	GLU	7
C	326	SER	7
A	348	ALA	6
B	124	PRO	6
B	271	ARG	6
B	348	ALA	6
C	121	GLN	6
C	348	ALA	6
B	111	ALA	5
C	5	TYR	5
C	111	ALA	5
A	106	ALA	4
A	146	VAL	4
B	326	SER	4
A	111	ALA	3

Chain	Res	Type	Models (Total)
A	345	ILE	3
A	411	GLU	3
B	73	LEU	3
B	104	PRO	3
B	106	ALA	3
C	304	ILE	3
A	104	PRO	2
A	112	VAL	2
A	114	GLY	2
A	271	ARG	2
A	326	SER	2
B	6	PRO	2
B	114	GLY	2
B	166	SER	2
B	167	GLU	2
C	70	PRO	2
C	106	ALA	2
C	168	ASN	2
C	273	SER	2
A	3	ILE	1
A	6	PRO	1
A	124	PRO	1
A	134	PRO	1
A	136	ASN	1
A	252	ASP	1
A	346	GLY	1
A	351	PRO	1
B	70	PRO	1
B	105	GLY	1
B	113	GLY	1
B	325	GLY	1
B	347	THR	1
C	72	ARG	1
C	104	PRO	1
C	114	GLY	1

Chain	Res	Type	Models (Total)
C	115	GLN	1
C	123	PRO	1
C	124	PRO	1
C	250	GLY	1
C	271	ARG	1
C	305	ASN	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	963	840	94	29
2	963	854	66	43
3	963	826	94	43
4	963	859	58	46
5	963	837	98	28
6	963	842	83	38
7	963	838	90	35
8	963	837	88	38
9	963	839	81	43
10	963	840	80	43

There are 228 unique sidechain outliers. Detailed list of outliers are tabulated below. The output is limited to 100 rows.

Chain	Res	Type	Models (Total)
C	72	ARG	9
C	251	ILE	9
A	269	VAL	7
A	282	ARG	7
A	404	THR	7
B	286	GLU	6
A	278	PRO	5
A	347	THR	5
C	116	GLN	5
C	173	LYS	5
A	170	LYS	4
A	174	SER	4

Chain	Res	Type	Models (Total)
A	406	ILE	4
B	182	ILE	4
B	277	LEU	4
B	398	THR	4
C	40	PRO	4
A	72	ARG	3
A	76	VAL	3
A	210	TYR	3
A	303	THR	3
A	413	THR	3
A	414	LEU	3
B	40	PRO	3
B	72	ARG	3
B	123	PRO	3
B	135	THR	3
B	170	LYS	3
B	234	LEU	3
B	282	ARG	3
B	350	VAL	3
B	407	VAL	3
C	70	PRO	3
C	93	THR	3
C	258	LYS	3
C	277	LEU	3
A	55	PRO	2
A	61	LEU	2
A	87	THR	2
A	119	PRO	2
A	125	LEU	2
A	148	PRO	2
A	168	ASN	2
A	219	VAL	2
A	270	THR	2
A	285	LYS	2
A	294	TYR	2

Chain	Res	Type	Models (Total)
A	300	LEU	2
A	411	GLU	2
B	15	LEU	2
B	55	PRO	2
B	70	PRO	2
B	82	VAL	2
B	93	THR	2
B	116	GLN	2
B	130	LEU	2
B	174	SER	2
B	190	TYR	2
B	191	LYS	2
B	219	VAL	2
B	269	VAL	2
B	278	PRO	2
B	289	ILE	2
B	296	PHE	2
B	303	THR	2
B	332	GLN	2
B	370	THR	2
B	409	LYS	2
C	10	LYS	2
C	76	VAL	2
C	127	HIS	2
C	163	LEU	2
C	268	PHE	2
C	278	PRO	2
C	282	ARG	2
C	300	LEU	2
C	329	THR	2
C	347	THR	2
C	370	THR	2
C	372	PRO	2
A	2	TYR	1
A	4	GLU	1

Chain	Res	Type	Models (Total)
A	6	PRO	1
A	8	LEU	1
A	11	ILE	1
A	28	TYR	1
A	36	THR	1
A	73	LEU	1
A	79	LYS	1
A	103	ASN	1
A	115	GLN	1
A	116	GLN	1
A	126	VAL	1
A	128	ILE	1
A	132	ILE	1
A	147	LEU	1
A	149	THR	1
A	155	ILE	1
A	164	MET	1
A	171	VAL	1

5. Fit to Data Used for Modeling Assessment

6. Fit to Data Used for Validation Assessment

Validation for this section is under development.

Acknowledgments

The development of integrative model validation metrics, implementation of a model validation pipeline, and creation of a validation report for integrative structures are funded by NSF awards to the PDB-IHM team (DBI-1756248, DBI-2112966, DBI-2112967, DBI-2112968, and DBI-1756250) and awards from NSF, NIH, and DOE to the RCSB PDB (DBI-2321666, R01GM157729, and DE-SC0019749). The PDB-IHM team and members of the Sali lab contributed model validation metrics and software packages.

Dr. Jill Trewhella, Dr. Dina Schneidman, and members of the SASBDB repository are acknowledged for their advice and support in implementing SAS validation methods. Team members from the labs of Dr. Juri Rappsilber, Dr. Alexander Leitner, Dr. Andrea Graziadei, and members of PRIDE database are acknowledged for their advice and

support in implementing crosslinking-MS validation methods. We are grateful to Dr. Shruthi Viswanath for discussions about uncertainty assessment of integrative structural models.

Members of the wwPDB Integrative/Hybrid Methods Task Force provided recommendations and community support for the project.