

Integrative Structure Validation Report

October 09, 2025 - 04:38 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	9A0A pdb_00009a0a
PDB-Dev ID	PDBDEV_00000046
Structure Title	Protein motional details and dynamics of spectrin alpha chain
Structure Authors	Grohe K; Patel S; Hebrank C; Schafer LV; Linser R
Deposited on	2020-04-11

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

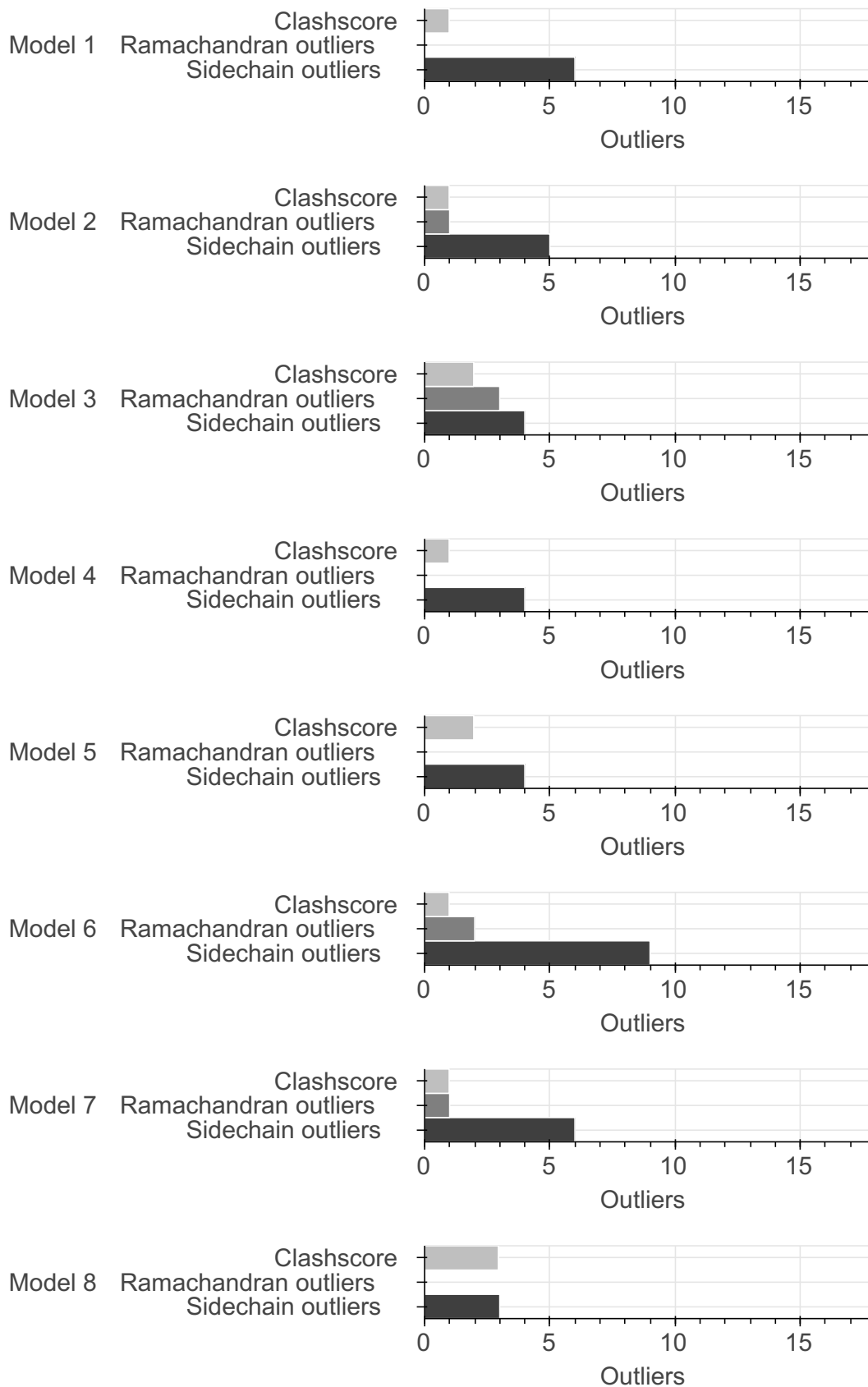
This entry consists of 20 model(s). A total of 3 dataset(s) were used to build this entry.

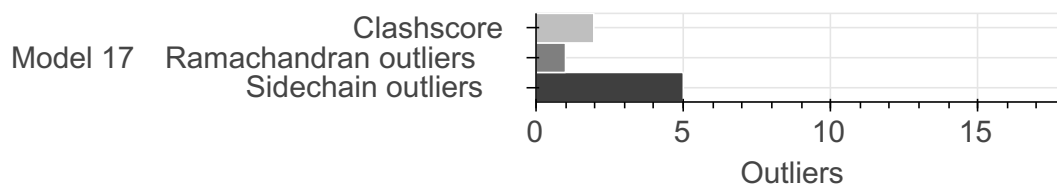
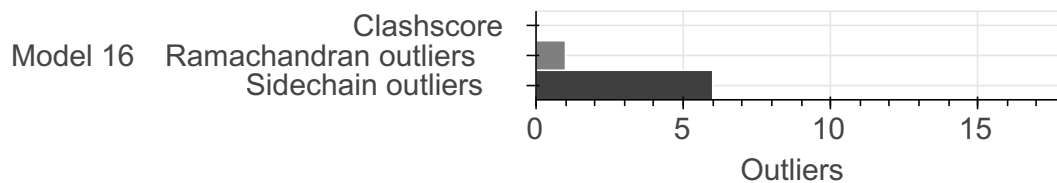
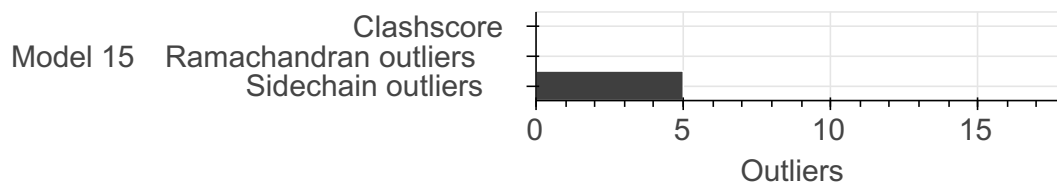
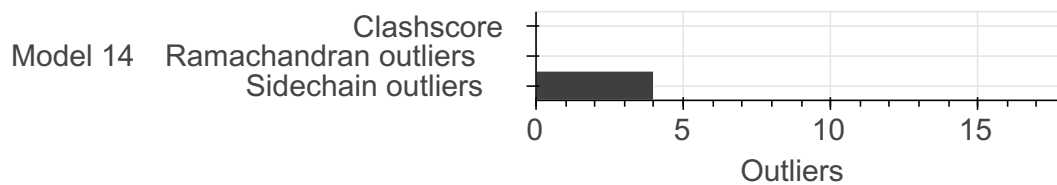
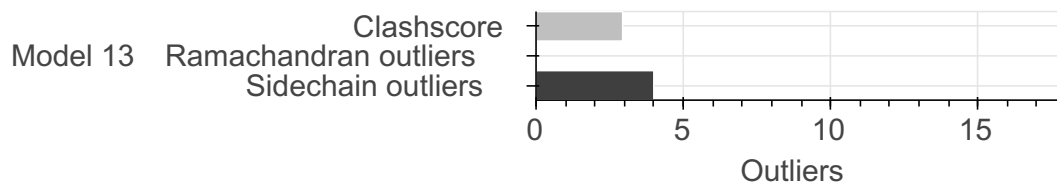
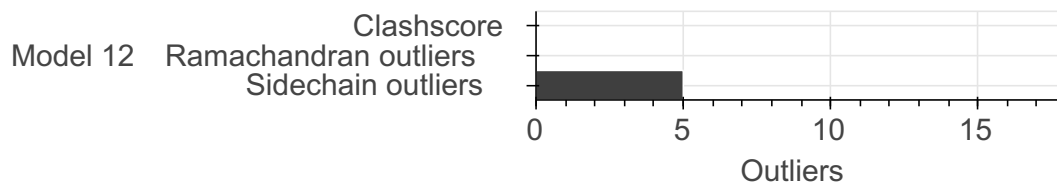
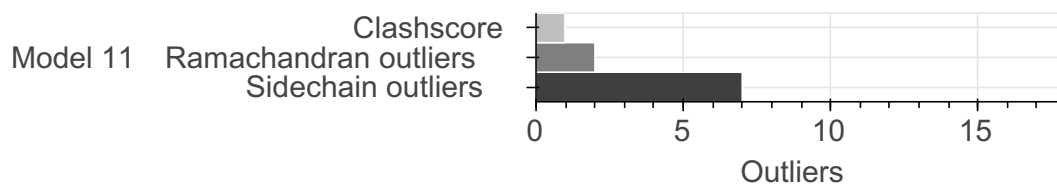
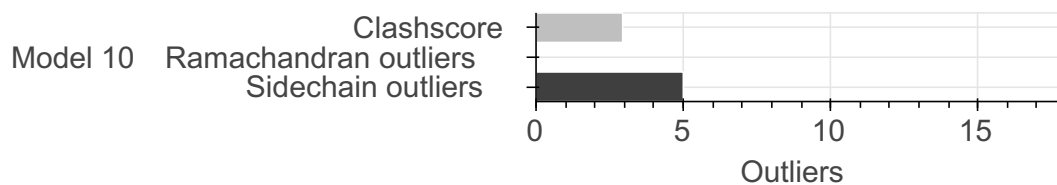
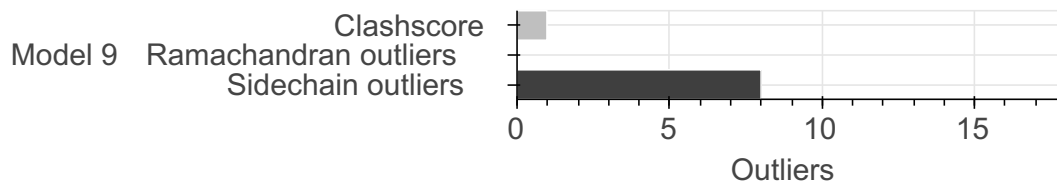
Name	Type	Count
NMR data	Experimental data	1
Experimental model	Starting model	2

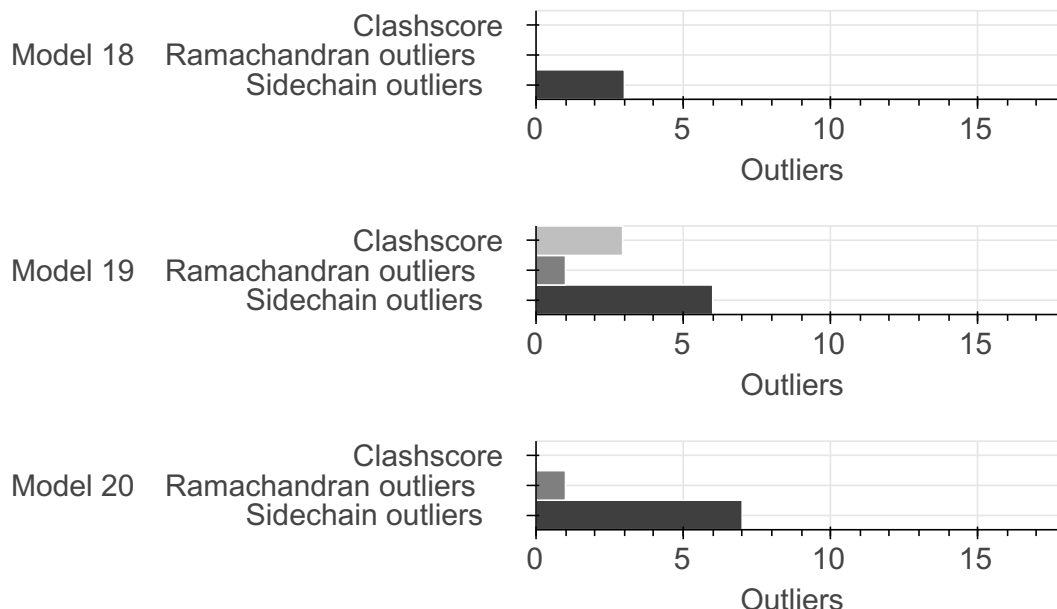
1.2. Overall quality

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	1-20	1	spectrin alpha chain	A	62	-	1-6, 7-61, 62	100.00 / 100.00	Atomic

2.3. Datasets used for modeling ?

There are 3 unique datasets used to build the models in this entry.

ID	Dataset type	Database name	Data access code
1	Experimental model	PDB	pdb_00002nuz
2	Experimental model	PDB	pdb_00006scw
3	NMR data	BMRB	34420

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	modeling	Restrained Molecular Dynamics Simulation	Not available	200000	False	False

There is 1 software package reported in this entry.

ID	Software name	Software version	Software classification	Software location
1	GROMACS	2019.20	model building	http://www.gromacs.org

3. Data quality ?

3.4. NMR ?

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-particle or particle-atom pairs for which excluded volume was analysed.

Standard geometry: bond outliers ?

There are 118 bond length outliers in this entry (1.14% of 10340 assessed bonds). A summary is provided below.

Chain	Res	Type	Atoms	Z	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
A	45	GLU	CD-OE1	9.37	1.37	1.19	13	11
A	29	ASP	CG-OD1	9.36	1.37	1.19	17	5
A	2	ASP	CG-OD1	9.35	1.37	1.19	5	8
A	3	GLU	CD-OE1	9.23	1.37	1.19	11	7
A	22	GLU	CD-OE1	9.22	1.37	1.19	10	3
A	7	GLU	CD-OE1	9.17	1.37	1.19	7	7
A	14	ASP	CG-OD1	9.14	1.37	1.19	10	2
A	62	ASP	CG-OD1	9.14	1.37	1.19	13	6
A	40	ASP	CG-OD1	9.11	1.37	1.19	4	4
A	17	GLU	CD-OE1	9.09	1.37	1.19	16	5
A	48	ASP	CG-OD1	9.05	1.37	1.19	18	1
A	17	GLU	CD-OE2	5.47	1.22	1.33	14	5
A	7	GLU	CD-OE2	5.46	1.22	1.33	6	7

Chain	Res	Type	Atoms	Z	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
A	3	GLU	CD-OE2	5.33	1.22	1.33	13	7
A	29	ASP	CG-OD2	5.31	1.22	1.33	13	5
A	40	ASP	CG-OD2	5.28	1.22	1.33	16	4
A	62	ASP	CG-OD2	5.27	1.22	1.33	6	6
A	48	ASP	CG-OD2	5.20	1.23	1.33	18	1
A	45	GLU	CD-OE2	5.19	1.23	1.33	8	11
A	22	GLU	CD-OE2	5.19	1.23	1.33	10	3
A	2	ASP	CG-OD2	5.17	1.23	1.33	5	8
A	14	ASP	CG-OD2	4.88	1.23	1.33	10	2

Standard geometry: angle outliers ?

There are 606 bond angle outliers in this entry (4.34% of 13960 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)
A	21	ARG	NE-CZ-NH1	11.94	133.44	121.50	15	6
A	50	GLN	OE1-CD-NE2	9.94	112.66	122.60	6	9
A	35	ASN	CA-CB-CG	9.94	122.54	112.60	18	3
A	21	ARG	NE-CZ-NH2	9.42	110.72	119.20	15	8
A	16	GLN	OE1-CD-NE2	8.50	114.10	122.60	8	6
A	14	ASP	CA-CB-CG	8.39	120.99	112.60	18	4
A	47	ASN	CA-CB-CG	8.25	120.85	112.60	11	11
A	47	ASN	OD1-CG-ND2	8.12	114.48	122.60	11	7
A	52	PHE	CA-CB-CG	7.99	121.79	113.80	3	6
A	40	ASP	CA-CB-CG	7.94	120.54	112.60	6	6
A	35	ASN	OD1-CG-ND2	7.70	114.90	122.60	6	7
A	29	ASP	CA-CB-CG	7.57	120.17	112.60	17	5
A	49	ARG	NE-CZ-NH1	7.56	129.06	121.50	11	5
A	49	ARG	NE-CZ-NH2	7.51	112.44	119.20	18	6
A	62	ASP	CA-CB-CG	7.48	120.08	112.60	17	7
A	20	PRO	N-CA-CB	7.47	111.22	103.00	8	6
A	24	THR	CA-CB-OG1	7.10	120.25	109.60	9	1
A	17	GLU	CB-CG-CD	6.96	124.43	112.60	14	2
A	23	VAL	CA-CB-CG1	6.88	122.10	110.40	16	4
A	46	VAL	CA-CB-CG2	6.85	122.04	110.40	9	8
A	18	LYS	CA-CB-CG	6.76	127.62	114.10	11	1

Chain	Res	Type	Atoms	Z	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
A	21	ARG	CD-NE-CZ	6.72	133.80	124.40	3	2
A	42	TRP	CE2-CD2-CE3	6.65	112.15	118.80	9	5
A	46	VAL	C-CA-CB	6.65	124.03	111.40	17	2
A	49	ARG	CA-CB-CG	6.60	127.29	114.10	7	1
A	42	TRP	CB-CG-CD2	6.53	135.94	126.80	6	5
A	4	THR	CA-CB-OG1	6.51	119.37	109.60	9	5
A	53	VAL	CA-CB-CG2	6.47	121.40	110.40	18	6
A	26	LYS	CA-CB-CG	6.46	127.01	114.10	20	1
A	14	ASP	CB-CG-OD1	6.42	133.17	118.40	20	4
A	21	ARG	NH1-CZ-NH2	6.40	110.99	119.30	20	5
A	49	ARG	CD-NE-CZ	6.39	133.35	124.40	10	7
A	21	ARG	C-N-CA	6.38	133.19	121.70	15	1
A	14	ASP	CB-CG-OD2	6.29	103.93	118.40	20	4
A	30	ILE	CA-CB-CG2	6.28	121.17	110.50	19	2
A	59	LYS	N-CA-CB	6.26	99.85	110.50	13	2
A	38	ASN	OD1-CG-ND2	6.24	116.36	122.60	6	7
A	16	GLN	CB-CG-CD	6.24	123.20	112.60	2	2
A	27	LYS	C-CA-CB	6.24	121.95	110.10	14	1
A	9	VAL	C-N-CA	6.22	132.90	121.70	9	2
A	49	ARG	C-N-CA	6.18	132.82	121.70	13	3
A	58	VAL	C-N-CA	6.13	132.74	121.70	1	2
A	6	LYS	CA-CB-CG	6.11	126.32	114.10	4	3
A	41	TRP	CD2-CE3-CZ3	6.02	126.43	118.60	1	2
A	60	LYS	C-CA-CB	6.02	121.53	110.10	15	2
A	56	ALA	C-CA-CB	6.01	101.48	110.50	9	2
A	48	ASP	CA-CB-CG	6.01	118.61	112.60	3	3
A	47	ASN	C-CA-CB	6.01	121.51	110.10	4	3
A	58	VAL	CA-CB-CG2	6.00	120.60	110.40	8	3
A	39	LYS	C-N-CA	5.92	132.35	121.70	17	1
A	32	THR	CA-CB-CG2	5.91	120.54	110.50	20	2
A	22	GLU	CG-CD-OE2	5.91	104.81	118.40	17	2
A	41	TRP	CE2-CD2-CE3	5.87	112.93	118.80	10	4
A	19	SER	CA-C-N	5.84	125.66	116.90	11	2
A	16	GLN	C-CA-CB	5.81	121.14	110.10	15	4
A	26	LYS	CB-CG-CD	5.80	124.65	111.30	6	2

Chain	Res	Type	Atoms	Z	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
A	2	ASP	CA-CB-CG	5.77	118.37	112.60	17	3
A	24	THR	N-CA-CB	5.75	101.73	111.50	19	2
A	51	GLY	O-C-N	5.73	132.17	123.00	6	1
A	37	THR	CA-CB-OG1	5.71	118.16	109.60	20	1
A	49	ARG	NH1-CZ-NH2	5.69	111.91	119.30	11	4
A	21	ARG	CA-CB-CG	5.65	125.41	114.10	19	1
A	39	LYS	C-CA-CB	5.65	120.84	110.10	15	2
A	7	GLU	O-C-N	5.63	132.01	123.00	12	3
A	54	PRO	C-CA-CB	5.63	120.80	110.10	2	1
A	24	THR	CA-CB-CG2	5.62	120.05	110.50	10	1
A	17	GLU	N-CA-CB	5.60	100.98	110.50	20	1
A	9	VAL	CA-CB-CG2	5.59	119.91	110.40	2	2
A	44	VAL	C-N-CA	5.58	131.74	121.70	17	4
A	22	GLU	CG-CD-OE1	5.57	131.20	118.40	5	2
A	31	LEU	CA-C-O	5.52	130.18	120.80	19	1
A	41	TRP	CE2-CZ2-CH2	5.51	124.66	117.50	18	3
A	42	TRP	CD2-CE3-CZ3	5.50	125.75	118.60	17	5
A	62	ASP	CB-CG-OD1	5.48	131.01	118.40	3	3
A	17	GLU	CA-C-O	5.47	130.10	120.80	9	1
A	44	VAL	CA-CB-CG2	5.45	119.66	110.40	15	1
A	31	LEU	C-CA-CB	5.44	99.76	110.10	18	1
A	37	THR	N-CA-CB	5.44	102.26	111.50	15	1
A	18	LYS	C-CA-CB	5.44	120.43	110.10	16	2
A	45	GLU	CG-CD-OE2	5.40	130.81	118.40	13	4
A	43	LYS	C-CA-CB	5.39	120.35	110.10	3	4
A	46	VAL	C-N-CA	5.38	131.39	121.70	8	5
A	57	TYR	C-N-CA	5.37	131.37	121.70	11	3
A	45	GLU	CA-CB-CG	5.35	124.81	114.10	5	1
A	45	GLU	C-N-CA	5.35	131.33	121.70	4	3
A	41	TRP	CZ2-CH2-CZ3	5.34	114.56	121.50	2	4
A	9	VAL	CA-CB-CG1	5.33	119.46	110.40	14	2
A	49	ARG	CA-C-N	5.31	105.57	116.20	3	1
A	25	MET	CG-SD-CE	5.30	89.24	100.90	11	2
A	62	ASP	OD1-CG-OD2	5.30	110.19	122.90	3	1
A	41	TRP	CA-CB-CG	5.26	123.60	113.60	13	3

Chain	Res	Type	Atoms	Z	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
A	60	LYS	CB-CG-CD	5.26	123.40	111.30	6	3
A	55	ALA	C-N-CA	5.24	131.14	121.70	16	1
A	50	GLN	CG-CD-NE2	5.23	124.25	116.40	14	2
A	53	VAL	N-CA-CB	5.22	120.37	111.50	1	2
A	38	ASN	CA-CB-CG	5.21	117.81	112.60	18	3
A	15	TYR	N-CA-CB	5.21	101.64	110.50	7	2
A	22	GLU	CB-CG-CD	5.20	121.44	112.60	6	2
A	37	THR	OG1-CB-CG2	5.20	98.91	109.30	16	3
A	40	ASP	C-N-CA	5.18	131.03	121.70	7	2

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	0.98	1
2	0.98	1
3	1.96	2
4	0.98	1
5	1.96	2
6	0.98	1
7	0.98	1
8	2.94	3
9	0.98	1
10	2.94	3
11	0.98	1
12	0.00	0
13	2.94	3
14	0.00	0
15	0.00	0
16	0.00	0
17	1.96	2
18	0.00	0
19	2.94	3
20	0.00	0

There are 25 clashes. The table below contains the detailed list of all clashes based on a MolProbity analysis. Bad clashes are ≥ 0.4 Angstrom.

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
A:36:SER:HG	A:42:TRP:CG	0.66	5	2
A:17:GLU:C	A:17:GLU:CD	0.50	13	1
A:42:TRP:CZ2	A:60:LYS:HE3	0.48	3	1
A:43:LYS:HE2	A:52:PHE:CE2	0.48	8	1
A:11:ALA:HB2	A:25:MET:HG3	0.47	9	1
A:54:PRO:HG2	A:57:TYR:CD1	0.47	17	1
A:34:LEU:HD12	A:45:GLU:HB2	0.47	17	1
A:43:LYS:HE3	A:52:PHE:CZ	0.47	8	1
A:34:LEU:HD13	A:45:GLU:HB2	0.46	19	1
A:43:LYS:HE3	A:52:PHE:CD1	0.45	19	1
A:25:MET:HE1	A:58:VAL:HG13	0.45	6	1
A:22:GLU:HA	A:52:PHE:O	0.44	2	1
A:21:ARG:C	A:22:GLU:HG3	0.44	1	1
A:9:VAL:HG22	A:58:VAL:HG12	0.43	4	1
A:9:VAL:HG21	A:33:LEU:HG	0.43	5	1
A:8:LEU:HD21	A:32:THR:HG22	0.42	7	1
A:43:LYS:CE	A:52:PHE:CZ	0.42	8	1
A:42:TRP:CH2	A:60:LYS:HE3	0.41	3	1
A:31:LEU:HD22	A:44:VAL:HG21	0.41	13	1
A:23:VAL:CG1	A:46:VAL:HG22	0.41	19	1
A:45:GLU:C	A:45:GLU:CD	0.41	10	1
A:42:TRP:CD1	A:55:ALA:HB2	0.41	11	1
A:5:GLY:HA3	A:32:THR:HG23	0.40	10	1
A:36:SER:HA	A:42:TRP:CD1	0.40	13	1

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	60	55	5	0
2	60	54	5	1
3	60	54	3	3
4	60	56	4	0
5	60	58	2	0
6	60	54	4	2
7	60	55	4	1

Model ID	Analysed	Favored	Allowed	Outliers
8	60	53	7	0
9	60	54	6	0
10	60	52	8	0
11	60	56	2	2
12	60	54	6	0
13	60	56	4	0
14	60	56	4	0
15	60	55	5	0
16	60	51	8	1
17	60	53	6	1
18	60	56	4	0
19	60	55	4	1
20	60	53	6	1

There are 11 unique backbone outliers. Detailed list of outliers are tabulated below.

Chain	Res	Type	Models (Total)
A	47	ASN	3
A	2	ASP	1
A	3	GLU	1
A	6	LYS	1
A	7	GLU	1
A	35	ASN	1
A	36	SER	1
A	40	ASP	1
A	46	VAL	1
A	48	ASP	1
A	56	ALA	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	56	42	8	6
2	56	44	7	5
3	56	50	2	4
4	56	46	6	4

Model ID	Analysed	Favored	Allowed	Outliers
5	56	43	9	4
6	56	41	6	9
7	56	43	7	6
8	56	49	4	3
9	56	44	4	8
10	56	44	7	5
11	56	44	5	7
12	56	45	6	5
13	56	41	11	4
14	56	41	11	4
15	56	45	6	5
16	56	42	8	6
17	56	42	9	5
18	56	45	8	3
19	56	44	6	6
20	56	46	3	7

There are 30 unique sidechain outliers. Detailed list of outliers are tabulated below.

Chain	Res	Type	Models (Total)
A	1	MET	10
A	43	LYS	9
A	6	LYS	7
A	27	LYS	7
A	17	GLU	6
A	18	LYS	6
A	59	LYS	6
A	31	LEU	5
A	39	LYS	5
A	23	VAL	4
A	26	LYS	4
A	45	GLU	4
A	60	LYS	4
A	16	GLN	3
A	21	ARG	3
A	37	THR	3

Chain	Res	Type	Models (Total)
A	3	GLU	2
A	25	MET	2
A	30	ILE	2
A	47	ASN	2
A	50	GLN	2
A	62	ASP	2
A	4	THR	1
A	20	PRO	1
A	33	LEU	1
A	40	ASP	1
A	42	TRP	1
A	46	VAL	1
A	49	ARG	1
A	58	VAL	1

5. Fit to Data Used for Modeling Assessment ?

5.4. NMR ?

Validation for this section is under development.

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.

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