Integrative Structure Validation Report

November 14, 2024 - 04:18 AM PST

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

Python-IHM Version 1.3
MolProbity Version 4.5.2
Integrative Modeling Validation Version 1.2

PDB ID	9A8X
Structure Title	Complex structure of holo-GmHO-1 and Ferredoxin III from maize root
Structure Authors	Tohd, R.; Yu, J.; Kurisu, G.

This is a PDB-Dev IM Structure Validation Report for a publicly released PDB-Dev entry.

We welcome your comments at pdb-dev@mail.wwpdb.org

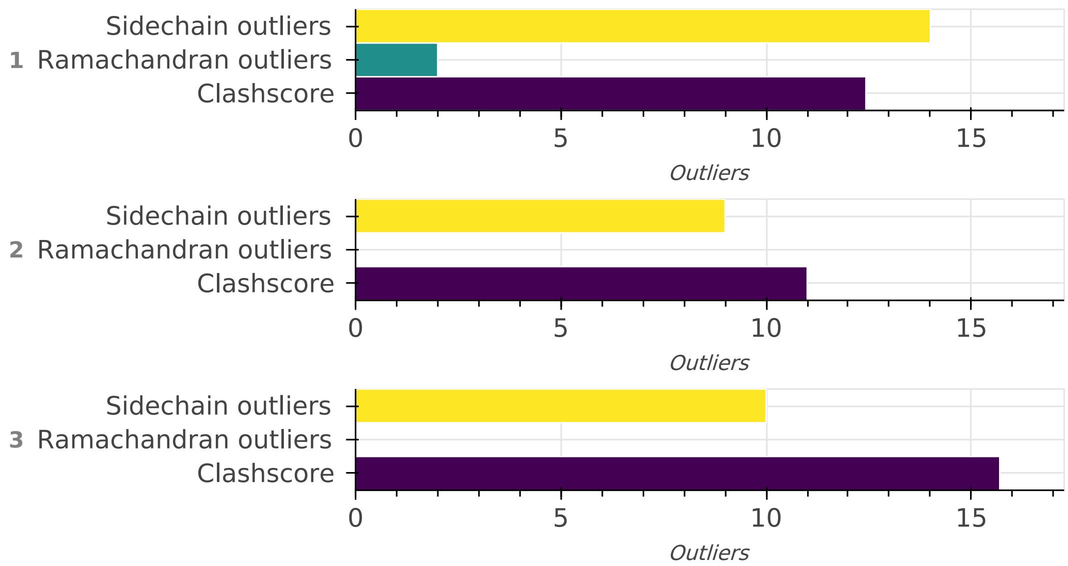
A user guide is available at https://pdb-dev.wwpdb.org/validation_help.html with specific help available everywhere you see the ? symbol.

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

Overall quality

This validation report contains model quality assessments for all structures, data quality assessment for SAS datasets and fit to model assessments for SAS 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



Ensemble information

This entry consists of 0 distinct ensemble(s).

Summary

This entry consists of 3 unique models, with 4 subunits in each model. A total of 3 datasets or restraints were used to build this entry. Each model is represented by 0 rigid bodies and 4 flexible or non-rigid units.

Entry composition

There are 3 unique types of models in this entry. These models are titled Model 1 of top cluster with a HADDOCK score of -57.0 +/- 2.2, Model 2 of top cluster with a HADDOCK score of -57.0 +/- 2.2, Model 3 of top cluster with a HADDOCK score of -57.0 +/- 2.2 respectively.

Model ID	Subunit number	Subunit ID	Subunit name	Chain ID	Chain ID [auth]	Total residues
1	1	1	Heme oxygenase (biliverdin-producing)	A	A	211
1	2	2	Ferredoxin-3, chloroplastic	B	B	97
1	3	3	FE2/S2 (INORGANIC) CLUSTER	C	C	Not available

Model ID	Subunit number	Subunit ID	Subunit name	Chain ID	Chain ID [auth]	Total residues
1	4	4	PROTOPORPHYRIN IX CONTAINING FE	D	D	Not available
2	1	1	Heme oxygenase (biliverdin-producing)	A	A	211
2	2	2	Ferredoxin-3, chloroplastic	B	B	97
2	3	3	FE2/S2 (INORGANIC) CLUSTER	C	C	Not available
2	4	4	PROTOPORPHYRIN IX CONTAINING FE	D	D	Not available
3	1	1	Heme oxygenase (biliverdin-producing)	A	A	211
3	2	2	Ferredoxin-3, chloroplastic	B	B	97
3	3	3	FE2/S2 (INORGANIC) CLUSTER	C	C	Not available
3	4	4	PROTOPORPHYRIN IX CONTAINING FE	D	D	Not available

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	NMR data	BMRB	26301
2	Experimental model	PDB	7CKA
3	Experimental model	PDB	5H57

Representation ?

This entry has only one representation and includes 0 rigid bodies and 4 flexible units.

Chain ID	Rigid bodies	Non-rigid segments
B	-	1-97
A	-	1-211
C	-	None-None
D	-	None-None

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

Step number	Protocol ID	Method name	Method type	Method description	Number of computed models	Multi state modeling	Multi scale modeling
1	1	None	docking	A docking simulation was performed with holo-GmHO-1 (Protein Data Bank [PDB] ID:7CKA) and maize Fd (Protein Data Bank [PDB] ID: 5h57) using the HADDOCK server based on NMR chemical shift perturbation experiments of apo-GmHO-1. Ten HADDOCK models were successfully obtained, from which the top cluster of models with a HADDOCK score of -57.0 +/- 2.2 were adopted.	None	False	False

There is 1 software package reported in this entry.

ID	Software name	Software version	Software classification	Software location
1	HADDOCK	2.4	model building	https://rascar.science.uu.nl/haddock2.4/

Data quality

NMR

Validation for this section is under development.

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.

Standard geometry: bond outliers

There are 1299 bond outliers in this entry. A summary is provided below, and a detailed list of outliers can be found here.

Bond type	Observed distance (Å)	Ideal distance (Å)	Number of outliers
N--H	0.97	0.86	22
NE2--HE21	0.97	0.86	3
NE2--HE22	0.97	0.86	1
N--H	0.98	0.86	581
NE2--HE22	0.98	0.86	20
ND2--HD22	0.98	0.86	18
OG1--HG1	0.96	0.84	11
NE--HE	0.98	0.86	11
NE2--HE21	0.98	0.86	17
ND2--HD21	0.98	0.86	16
NE1--HE1	0.98	0.86	12
OH--HH	0.96	0.84	25

Bond type	Observed distance (Å)	Ideal distance (Å)	Number of outliers
OG--HG	0.96	0.84	20
ND1--HD1	0.98	0.86	5
NE2--HE2	0.98	0.86	5
SG--HG	1.33	1.20	11
N--H	0.99	0.86	89
NE2--HE2	0.99	0.86	10
ND1--HD1	0.99	0.86	1
NE--HE	0.99	0.86	17
OG--HG	0.97	0.84	20
OH--HH	0.97	0.84	6
ND2--HD21	0.99	0.86	2
OG1--HG1	0.97	0.84	14
NE2--HE21	0.99	0.86	4
NE--HE	1.00	0.86	6
OH--HH	0.98	0.84	2
OG--HG	0.98	0.84	7
NE2--HE22	1.00	0.86	3
NZ--HZ2	1.03	0.89	3
NZ--HZ1	1.03	0.89	1
NZ--HZ3	1.03	0.89	1
NZ--HZ3	1.04	0.89	53
NZ--HZ1	1.04	0.89	56
NZ--HZ2	1.04	0.89	57

Bond type	Observed distance (Å)	Ideal distance (Å)	Number of outliers
NZ--HZ1	1.05	0.89	11
NZ--HZ2	1.05	0.89	7
NZ--HZ3	1.05	0.89	11
NZ--HZ3	1.06	0.89	3
NZ--HZ2	1.06	0.89	1
NH1--HH11	1.03	0.86	2
NH1--HH12	1.03	0.86	3
NH2--HH21	1.03	0.86	2
NH2--HH21	1.04	0.86	13
NH2--HH22	1.04	0.86	23
NH1--HH12	1.04	0.86	19
NH1--HH11	1.04	0.86	24
NH2--HH22	1.05	0.86	7
NH1--HH11	1.05	0.86	4
NH2--HH21	1.05	0.86	12
NH1--HH12	1.05	0.86	8
NH2--HH21	1.06	0.86	7
NH1--HH11	1.06	0.86	4
NH2--HH22	1.06	0.86	4
NH1--HH12	1.06	0.86	4

Standard geometry: angle outliers

There are 3 angle outliers in this entry. A summary is provided below, and a detailed list of outliers can be found here.

Angle type	Observed angle (°)	Ideal angle (°)	Number of outliers

Angle type	Observed angle (°)	Ideal angle (°)	Number of outliers
C3B-CAB-CBB	120.00	132.82	2
C3B-CAB-CBB	120.00	132.80	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 the models in this entry.

Model ID	Clash score	Number of clashes
1	12.43	61
2	11.00	54
3	15.69	77

All 192 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Model ID	Atom-1	Atom-2	Clash overlap (Å)
1	B:43:GLY:HA2	C:1:FES:S1	1.291
1	B:43:GLY:CA	C:1:FES:S1	1.047
1	B:45:CYS:SG	C:1:FES:FE2	0.935
1	B:45:CYS:HG	C:1:FES:FE2	0.929
1	B:41:ARG:HA	B:78:CYS:HB2	0.791
1	B:42:ALA:HB2	D:1:HEM:CGA	0.784
1	B:42:ALA:HB2	D:1:HEM:O1A	0.750
1	A:21:ARG:HD2	A:22:GLU:HG3	0.698
1	A:61:LYS:HE2	A:65:GLU:OE2	0.698
1	B:40:CYS:HA	D:1:HEM:O2D	0.667
1	B:52:ILE:HD13	B:88:ILE:HG12	0.631
1	B:24:TYR:CD2	B:79:VAL:HA	0.628

Model ID	Atom-1	Atom-2	Clash overlap (Å)
1	B:42:ALA:CB	D:1:HEM:O1A	0.621
1	B:44:ALA:N	C:1:FES:S1	0.616
1	A:16:THR:HG21	A:32:GLU:HB3	0.599
1	B:45:CYS:SG	C:1:FES:S2	0.597
1	A:144:LYS:O	A:148:GLU:HG3	0.584
1	A:165:LEU:HB3	A:166:PRO:HD3	0.581
1	A:8:ARG:NE	D:1:HEM:HAD1	0.573
1	A:91:TRP:O	A:95:GLN:HG2	0.570
1	B:24:TYR:HD2	B:79:VAL:HA	0.564
1	A:123:ALA:HB1	A:194:GLU:HG2	0.563
1	B:37:PRO:HB2	B:47:THR:HG22	0.554
1	B:66:ASP:O	B:70:GLN:HG3	0.554
1	A:29:GLN:NE2	A:31:GLU:HB3	0.552
1	A:151:LEU:HB3	A:154:LYS:HB3	0.550
1	B:41:ARG:O	B:79:VAL:HG13	0.521
1	A:8:ARG:HG3	D:1:HEM:HAD2	0.513
1	B:43:GLY:C	C:1:FES:S1	0.511
1	B:39:SER:HB3	B:45:CYS:SG	0.498
1	A:173:ARG:NH2	B:40:CYS:HB3	0.497
1	B:46:SER:HB2	B:93:GLU:HG3	0.494
1	A:40:PRO:HB3	A:209:ILE:HG22	0.492
1	B:9:GLY:HA3	B:13:GLU:CD	0.489
1	B:24:TYR:HB2	B:27:ASP:OD1	0.488

Model ID	Atom-1	Atom-2	Clash overlap (Å)
1	B:40:CYS:O	D:1:HEM:O2A	0.488
1	A:8:ARG:HE	D:1:HEM:HAD1	0.481
1	A:125:ILE:HD12	A:183:TRP:CZ2	0.477
1	A:125:ILE:HD12	A:183:TRP:HZ2	0.467
1	A:35:VAL:HA	A:38:TRP:CD1	0.456
1	A:71:TYR:OH	A:121:PRO:HA	0.456
1	A:147:ALA:HA	A:151:LEU:HB2	0.454
1	A:29:GLN:HE22	A:31:GLU:HB3	0.453
1	A:152:ASN:O	A:153:ASN:HB2	0.451
1	A:104:SER:HB3	A:105:PRO:HD3	0.440
1	A:143:GLY:HA3	A:159:TYR:CZ	0.439
1	A:126:CYS:HB2	A:191:CYS:SG	0.435
1	B:58:ASP:HB2	B:83:LYS:HD2	0.430
1	B:65:LEU:HD21	B:96:LEU:HD13	0.429
1	A:10:VAL:O	A:14:LEU:HG	0.424
1	B:41:ARG:HA	B:78:CYS:CB	0.424
1	B:26:LEU:HD23	B:41:ARG:HD2	0.423
1	B:58:ASP:HB3	B:81:TYR:HB2	0.423
1	B:43:GLY:N	C:1:FES:S1	0.422
1	A:101:GLU:H	A:101:GLU:HG2	0.421
1	A:29:GLN:HG3	A:32:GLU:CD	0.417
1	A:88:ASP:CG	A:156:LEU:HB3	0.416
1	A:53:LYS:HA	A:85:LEU:HD13	0.415

Model ID	Atom-1	Atom-2	Clash overlap (Å)
1	A:91:TRP:CH2	A:154:LYS:HG2	0.413
1	A:35:VAL:HA	A:38:TRP:CG	0.402
1	A:197:LYS:HE3	A:201:LEU:HD11	0.402
2	B:42:ALA:CB	D:1:HEM:O1A	1.442
2	B:42:ALA:HB2	D:1:HEM:CGA	1.305
2	A:21:ARG:NH1	B:24:TYR:CD2	1.297
2	A:21:ARG:NH1	B:24:TYR:HD2	1.126
2	B:42:ALA:HB1	D:1:HEM:O1A	1.107
2	B:42:ALA:HB2	D:1:HEM:O1A	1.092
2	A:8:ARG:NH1	B:41:ARG:HD3	1.026
2	A:21:ARG:HD2	B:27:ASP:OD2	0.948
2	A:8:ARG:CZ	B:41:ARG:HB2	0.928
2	B:42:ALA:HB2	D:1:HEM:O2A	0.910
2	A:21:ARG:NH1	B:24:TYR:CE2	0.838
2	A:166:PRO:HA	B:44:ALA:HB1	0.787
2	A:173:ARG:NH2	B:40:CYS:HB2	0.770
2	B:42:ALA:CB	D:1:HEM:CGA	0.746
2	A:8:ARG:HH12	B:41:ARG:HD3	0.689
2	A:123:ALA:HB1	A:194:GLU:HG2	0.673
2	A:61:LYS:HE2	A:65:GLU:OE2	0.671
2	A:170:GLN:OE1	B:45:CYS:HB2	0.664
2	A:16:THR:HG21	A:32:GLU:HB3	0.655
2	B:52:ILE:HD13	B:88:ILE:HG12	0.634

Model ID	Atom-1	Atom-2	Clash overlap (Å)
2	A:8:ARG:NE	B:40:CYS:O	0.625
2	A:173:ARG:CZ	B:40:CYS:HB3	0.610
2	A:144:LYS:O	A:148:GLU:HG3	0.595
2	A:29:GLN:NE2	A:31:GLU:HB3	0.578
2	B:40:CYS:O	D:1:HEM:O2D	0.569
2	A:91:TRP:O	A:95:GLN:HG2	0.568
2	A:173:ARG:CZ	B:40:CYS:CB	0.567
2	A:8:ARG:HG3	D:1:HEM:HAD2	0.563
2	A:151:LEU:HB3	A:154:LYS:HB3	0.553
2	A:165:LEU:HB3	A:166:PRO:HD3	0.543
2	A:8:ARG:NE	D:1:HEM:HAD1	0.517
2	A:21:ARG:HH11	B:24:TYR:HD2	0.491
2	A:173:ARG:NH2	B:40:CYS:CB	0.487
2	A:71:TYR:OH	A:121:PRO:HA	0.473
2	A:173:ARG:CZ	B:40:CYS:HB2	0.469
2	A:147:ALA:HA	A:151:LEU:HB2	0.466
2	A:125:ILE:HD12	A:183:TRP:CZ2	0.460
2	A:35:VAL:HA	A:38:TRP:CD1	0.458
2	B:59:GLN:NE2	B:76:LEU:H	0.458
2	A:104:SER:HB3	A:105:PRO:HD3	0.448
2	A:152:ASN:O	A:153:ASN:HB2	0.447
2	A:8:ARG:NH2	B:41:ARG:HB2	0.443
2	A:143:GLY:HA3	A:159:TYR:CZ	0.441

Model ID	Atom-1	Atom-2	Clash overlap (Å)
2	A:40:PRO:HB3	A:209:ILE:HG22	0.435
2	A:173:ARG:HA	A:176:LEU:HD12	0.425
2	A:91:TRP:CH2	A:154:LYS:HG2	0.423
2	A:10:VAL:O	A:14:LEU:HG	0.416
2	A:88:ASP:CG	A:156:LEU:HB3	0.413
2	A:53:LYS:HA	A:85:LEU:HD13	0.408
2	A:125:ILE:HD12	A:183:TRP:HZ2	0.407
2	A:101:GLU:H	A:101:GLU:HG2	0.407
2	A:35:VAL:HA	A:38:TRP:CG	0.406
2	A:67:PRO:HD2	A:71:TYR:HD2	0.402
2	B:40:CYS:HA	D:1:HEM:O2D	0.402
3	A:5:GLU:CG	B:38:TYR:O	1.316
3	B:42:ALA:HB2	D:1:HEM:CGA	1.311
3	A:5:GLU:HG2	B:38:TYR:O	1.279
3	B:42:ALA:HB2	D:1:HEM:O2A	1.266
3	B:42:ALA:CB	D:1:HEM:CGA	1.169
3	A:170:GLN:OE1	B:45:CYS:HB2	1.071
3	B:42:ALA:HB1	D:1:HEM:O1A	1.057
3	B:42:ALA:CB	D:1:HEM:O1A	1.044
3	A:5:GLU:CD	B:38:TYR:O	1.031
3	A:170:GLN:OE1	B:45:CYS:CB	0.789
3	A:5:GLU:OE1	B:38:TYR:O	0.764
3	A:8:ARG:HH21	D:1:HEM:HAA2	0.758

Model ID	Atom-1	Atom-2	Clash overlap (Å)
3	A:5:GLU:HG2	B:38:TYR:C	0.750
3	A:4:VAL:HB	B:39:SER:OG	0.735
3	A:123:ALA:HB1	A:194:GLU:HG2	0.729
3	A:173:ARG:CZ	B:40:CYS:HB3	0.715
3	A:8:ARG:NH2	D:1:HEM:HAA2	0.707
3	A:8:ARG:HH11	B:41:ARG:HD3	0.686
3	A:21:ARG:NH1	B:27:ASP:OD2	0.678
3	A:8:ARG:CZ	B:41:ARG:HB2	0.676
3	A:16:THR:HG21	A:32:GLU:HB3	0.669
3	A:61:LYS:HE2	A:65:GLU:OE2	0.669
3	B:42:ALA:CB	D:1:HEM:O2A	0.660
3	A:173:ARG:CZ	B:40:CYS:CB	0.649
3	B:52:ILE:HD13	B:88:ILE:HG12	0.637
3	A:4:VAL:HG11	A:173:ARG:HD3	0.632
3	B:42:ALA:HB1	D:1:HEM:CGA	0.623
3	A:5:GLU:HG2	B:39:SER:HA	0.621
3	A:144:LYS:O	A:148:GLU:HG3	0.605
3	A:21:ARG:NH2	B:27:ASP:OD2	0.601
3	A:8:ARG:HD2	B:41:ARG:HB2	0.587
3	A:173:ARG:NH2	B:40:CYS:HB2	0.583
3	A:8:ARG:NE	B:41:ARG:HB2	0.574
3	A:91:TRP:O	A:95:GLN:HG2	0.562
3	A:29:GLN:NE2	A:31:GLU:HB3	0.561

Model ID	Atom-1	Atom-2	Clash overlap (Å)
3	B:40:CYS:O	D:1:HEM:O2D	0.554
3	A:151:LEU:HB3	A:154:LYS:HB3	0.545
3	A:8:ARG:HG2	D:1:HEM:CAD	0.540
3	A:8:ARG:HG2	D:1:HEM:HAD2	0.535
3	A:173:ARG:NE	B:40:CYS:HB3	0.534
3	A:8:ARG:CD	B:41:ARG:HB2	0.533
3	A:21:ARG:CZ	B:27:ASP:OD2	0.523
3	A:71:TYR:OH	A:121:PRO:HA	0.504
3	A:165:LEU:HB3	A:166:PRO:HD3	0.502
3	A:29:GLN:HE22	A:31:GLU:HB3	0.492
3	A:8:ARG:CZ	B:41:ARG:CB	0.489
3	A:152:ASN:O	A:153:ASN:HB2	0.482
3	A:8:ARG:NH1	B:41:ARG:CB	0.481
3	A:125:ILE:HD12	A:183:TRP:CZ2	0.480
3	A:173:ARG:HA	A:176:LEU:HD12	0.471
3	A:147:ALA:HA	A:151:LEU:HB2	0.470
3	A:142:ILE:HD11	D:1:HEM:CBB	0.462
3	A:40:PRO:HB3	A:209:ILE:HG22	0.458
3	B:59:GLN:NE2	B:76:LEU:H	0.457
3	A:8:ARG:NH1	A:12:MET:HG3	0.456
3	A:133:PHE:HB3	D:1:HEM:HBD1	0.455
3	A:143:GLY:HA3	A:159:TYR:CZ	0.446
3	A:104:SER:HB3	A:105:PRO:HD3	0.444

Model ID	Atom-1	Atom-2	Clash overlap (Å)
3	A:4:VAL:CB	B:39:SER:OG	0.444
3	A:173:ARG:CZ	B:40:CYS:HB2	0.442
3	A:35:VAL:HA	A:38:TRP:CD1	0.439
3	B:40:CYS:HA	D:1:HEM:O2D	0.438
3	A:8:ARG:NH1	B:41:ARG:HB3	0.438
3	A:173:ARG:HH22	B:44:ALA:HB3	0.435
3	A:126:CYS:HB2	A:191:CYS:SG	0.431
3	A:5:GLU:HG2	B:39:SER:CA	0.423
3	A:46:LEU:O	A:50:VAL:HG23	0.421
3	A:67:PRO:HD2	A:71:TYR:HD2	0.417
3	A:91:TRP:CH2	A:154:LYS:HG2	0.417
3	A:180:ALA:O	A:188:LYS:HE2	0.416
3	A:53:LYS:HA	A:85:LEU:HD13	0.415
3	A:110:ALA:O	A:114:LYS:HG3	0.414
3	A:35:VAL:HA	A:38:TRP:CG	0.409
3	A:175:LYS:O	A:179:VAL:HG23	0.409
3	A:173:ARG:NH1	B:45:CYS:HB3	0.409
3	A:18:ASP:OD1	A:37:LYS:NZ	0.408
3	A:186:GLU:CD	A:186:GLU:H	0.404

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	Analyzed	Favored	Allowed	Outliers
1	304	284	18	2

Model ID	Analyzed	Favored	Allowed	Outliers
2	304	293	11	0
3	304	293	11	0

Detailed list of outliers are tabulated below.

Torsion angles: Protein sidechains

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

Model ID	Analyzed	Favored	Allowed	Outliers
1	265	234	17	14
2	265	243	13	9
3	265	243	12	10

Detailed list of outliers are tabulated below.

Model ID	Chain	Residue ID	Residue type
1	A	19	GLN
1	A	21	ARG
1	A	29	GLN
1	A	31	GLU
1	A	36	THR
1	A	43	GLU
1	A	70	SER
1	A	84	SER
1	A	136	SER
1	A	150	LEU
1	B	35	GLU
1	B	41	ARG
1	B	47	THR

Model ID	Chain	Residue ID	Residue type
1	B	79	VAL
2	A	22	GLU
2	A	29	GLN
2	A	31	GLU
2	A	36	THR
2	A	43	GLU
2	A	70	SER
2	A	84	SER
2	A	136	SER
2	A	150	LEU
3	A	22	GLU
3	A	29	GLN
3	A	31	GLU
3	A	36	THR
3	A	43	GLU
3	A	70	SER
3	A	84	SER
3	A	136	SER
3	A	150	LEU
3	A	167	ARG

Fit of model to data used for modeling ?

NMR

Validation for this section is under development.

Fit of model to data used for validation

Validation for this section is under development.

Acknowledgements

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 ABI awards (DBI-1756248, DBI-2112966, DBI-2112967, DBI-2112968, and DBI-1756250). The PDB-Dev team and members of Sali labcontributed model validation metrics and software packages.

Implementation of validation methods for SAS data and SAS-based models are funded by RCSB PDB (grant number DBI-1832184). Dr. Stephen Burley, Dr. John Westbrook, and Dr. Jasmine Young from RCSB PDB, Dr. Jill Trewhella, Dr. Dina Schneidman, and members of the SASBDB repository are acknowledged for their advice and support in implementing SAS validation methods.

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