# Integrative Structure Validation Report

## October 09, 2025 - 04:43 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 | 9A3E \| pdb_00009a3e |
| PDB-Dev ID | PDBDEV_00000199 |
| Structure Title | Structure of SH3 domain from chicken alpha spectrin determined using restraints from solid-state NMR |
| Structure Authors | Soeldner B; Grohe K; Neidig P; Auch J; Blach S; Klein A; Vasa S K; Schafer L V; Linser R |
| Deposited on | 2023-02-03 |

*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

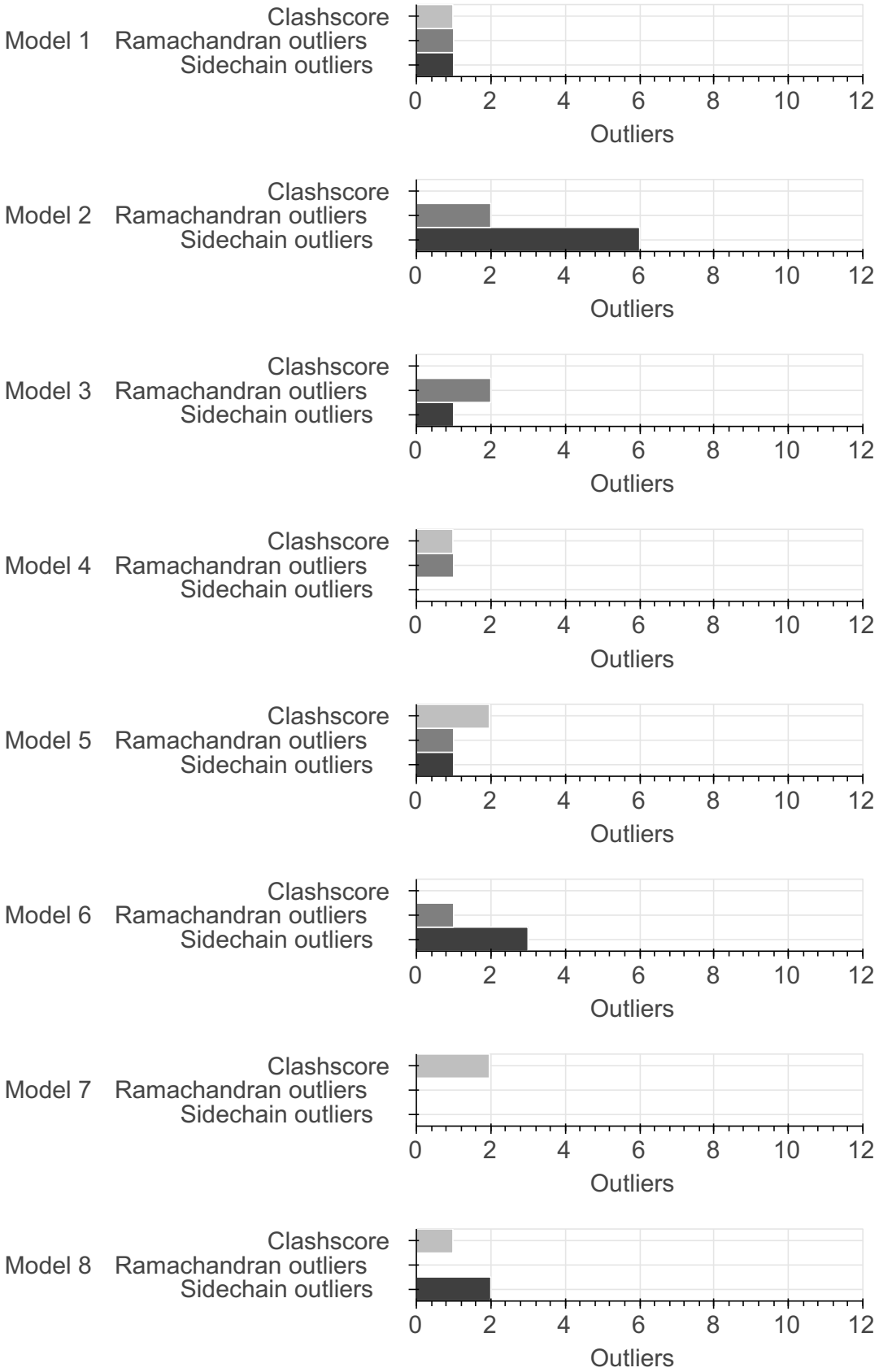
*This entry consists of 16 model(s). A total of 4 dataset(s) were used to build this entry.*

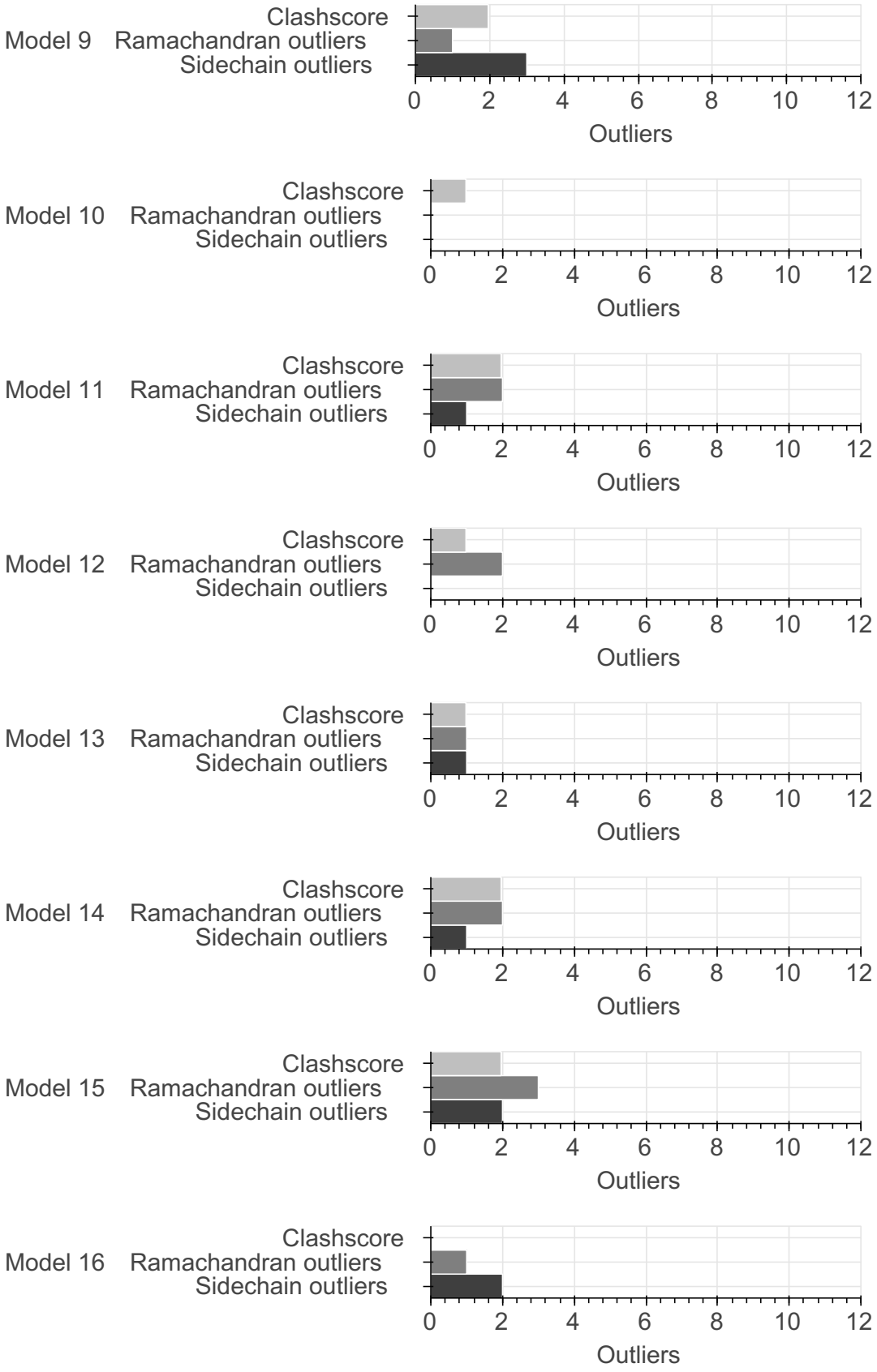
| Name | Type | Count |
|---|---|---|
| NMR data | Experimental data | 1 |
| Experimental model | Starting model | 3 |

## 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 | 1-16 | 1 | spectrin alpha chain | A | 62 | - | 1-6, 7-61, 62 | 100.00 / 100.00 | Atomic |

## 2.3. Datasets used for modeling

*There are 4 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 | 34785 |
| 4 | Experimental model | PDB | pdb_00008cf4 |

## 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 | 256000 | 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-partice or particle-atom pairs for which excluded volume was analysed.*

### Standard geometry: bond outliers

*There are no bond length outliers.*

### Standard geometry: angle outliers

*There are 537 bond angle outliers in this entry (4.81% of 11168 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 | 16 | GLN | OE1-CD-NE2 | 10.91 | 111.69 | 122.60 | 5 | 11 |
| A | 47 | ASN | CA-CB-CG | 10.76 | 101.84 | 112.60 | 9 | 7 |
| A | 49 | ARG | NE-CZ-NH2 | 9.64 | 127.87 | 119.20 | 4 | 6 |
| A | 62 | ASP | CA-CB-CG | 9.03 | 121.63 | 112.60 | 7 | 7 |
| A | 29 | ASP | CA-CB-CG | 8.51 | 121.11 | 112.60 | 6 | 6 |
| A | 50 | GLN | OE1-CD-NE2 | 8.42 | 114.18 | 122.60 | 9 | 10 |
| A | 14 | ASP | CA-CB-CG | 8.32 | 120.92 | 112.60 | 3 | 3 |
| A | 47 | ASN | OD1-CG-ND2 | 8.26 | 114.34 | 122.60 | 10 | 9 |
| A | 52 | PHE | CA-CB-CG | 8.01 | 121.81 | 113.80 | 1 | 3 |
| A | 2 | ASP | CA-CB-CG | 7.76 | 120.36 | 112.60 | 16 | 6 |
| A | 41 | TRP | CE2-CD2-CE3 | 7.59 | 111.21 | 118.80 | 5 | 4 |
| A | 40 | ASP | CA-CB-CG | 7.52 | 120.12 | 112.60 | 13 | 3 |
| A | 56 | ALA | C-N-CA | 7.51 | 135.23 | 121.70 | 15 | 2 |
| A | 21 | ARG | NH1-CZ-NH2 | 7.42 | 109.65 | 119.30 | 2 | 2 |
| A | 47 | ASN | C-N-CA | 7.23 | 134.72 | 121.70 | 14 | 4 |
| A | 22 | GLU | C-N-CA | 7.15 | 134.57 | 121.70 | 10 | 1 |
| A | 58 | VAL | CA-CB-CG2 | 7.10 | 122.47 | 110.40 | 6 | 4 |
| A | 9 | VAL | CA-CB-CG2 | 7.08 | 122.43 | 110.40 | 16 | 6 |
| A | 24 | THR | OG1-CB-CG2 | 7.08 | 95.14 | 109.30 | 8 | 1 |
| A | 55 | ALA | N-CA-CB | 7.04 | 99.84 | 110.40 | 12 | 3 |
| A | 49 | ARG | NE-CZ-NH1 | 7.04 | 128.54 | 121.50 | 6 | 4 |
| A | 26 | LYS | C-N-CA | 7.01 | 134.32 | 121.70 | 12 | 3 |
| A | 4 | THR | C-N-CA | 6.82 | 133.98 | 121.70 | 8 | 2 |
| A | 38 | ASN | OD1-CG-ND2 | 6.79 | 115.81 | 122.60 | 7 | 8 |
| A | 53 | VAL | CA-CB-CG2 | 6.67 | 121.73 | 110.40 | 7 | 5 |
| A | 24 | THR | CA-CB-OG1 | 6.51 | 99.84 | 109.60 | 15 | 2 |
| A | 23 | VAL | CA-CB-CG1 | 6.50 | 121.45 | 110.40 | 1 | 2 |
| A | 48 | ASP | CA-CB-CG | 6.41 | 119.01 | 112.60 | 11 | 8 |

| Chain | Res | Type | Atoms | \|Z\| | Observed (Å) | Ideal (Å) | Model ID (Worst) | Models (Total) |
|---|---|---|---|---|---|---|---|---|
| A | 32 | THR | CA-CB-OG1 | 6.38 | 100.04 | 109.60 | 9 | 4 |
| A | 47 | ASN | C-CA-CB | 6.37 | 122.20 | 110.10 | 13 | 4 |
| A | 51 | GLY | O-C-N | 6.35 | 112.84 | 123.00 | 6 | 1 |
| A | 46 | VAL | C-N-CA | 6.34 | 133.12 | 121.70 | 8 | 4 |
| A | 24 | THR | CA-CB-CG2 | 6.33 | 121.25 | 110.50 | 4 | 4 |
| A | 46 | VAL | O-C-N | 6.22 | 113.05 | 123.00 | 4 | 1 |
| A | 7 | GLU | C-CA-CB | 6.16 | 121.81 | 110.10 | 2 | 1 |
| A | 24 | THR | N-CA-CB | 6.16 | 101.03 | 111.50 | 2 | 1 |
| A | 4 | THR | O-C-N | 6.13 | 113.20 | 123.00 | 2 | 2 |
| A | 7 | GLU | N-CA-CB | 6.07 | 100.18 | 110.50 | 3 | 1 |
| A | 20 | PRO | N-CA-CB | 6.06 | 109.66 | 103.00 | 4 | 4 |
| A | 33 | LEU | C-N-CA | 6.02 | 132.54 | 121.70 | 2 | 3 |
| A | 35 | ASN | OD1-CG-ND2 | 6.00 | 116.60 | 122.60 | 12 | 6 |
| A | 54 | PRO | N-CA-CB | 5.99 | 109.59 | 103.00 | 12 | 3 |
| A | 21 | ARG | CD-NE-CZ | 5.94 | 132.72 | 124.40 | 11 | 2 |
| A | 31 | LEU | N-CA-CB | 5.93 | 100.43 | 110.50 | 5 | 1 |
| A | 30 | ILE | C-N-CA | 5.92 | 132.35 | 121.70 | 6 | 2 |
| A | 25 | MET | CA-CB-CG | 5.90 | 125.91 | 114.10 | 13 | 2 |
| A | 18 | LYS | C-N-CA | 5.90 | 132.32 | 121.70 | 8 | 4 |
| A | 11 | ALA | N-CA-CB | 5.89 | 101.57 | 110.40 | 4 | 2 |
| A | 55 | ALA | C-CA-CB | 5.88 | 119.32 | 110.50 | 3 | 2 |
| A | 35 | ASN | C-N-CA | 5.87 | 132.27 | 121.70 | 8 | 3 |
| A | 43 | LYS | C-N-CA | 5.87 | 132.27 | 121.70 | 2 | 3 |
| A | 19 | SER | CA-C-N | 5.86 | 125.69 | 116.90 | 7 | 6 |
| A | 41 | TRP | CD2-CE3-CZ3 | 5.85 | 126.21 | 118.60 | 5 | 1 |
| A | 10 | LEU | C-CA-CB | 5.84 | 121.20 | 110.10 | 16 | 2 |
| A | 56 | ALA | N-CA-C | 5.78 | 127.18 | 111.00 | 5 | 1 |
| A | 25 | MET | C-CA-CB | 5.78 | 121.07 | 110.10 | 14 | 1 |
| A | 38 | ASN | CA-CB-CG | 5.77 | 118.37 | 112.60 | 5 | 1 |
| A | 8 | LEU | C-N-CA | 5.75 | 132.04 | 121.70 | 7 | 4 |
| A | 60 | LYS | O-C-N | 5.64 | 113.98 | 123.00 | 8 | 1 |
| A | 2 | ASP | C-N-CA | 5.59 | 131.77 | 121.70 | 7 | 5 |
| A | 56 | ALA | N-CA-CB | 5.59 | 102.01 | 110.40 | 14 | 2 |
| A | 15 | TYR | C-N-CA | 5.52 | 131.63 | 121.70 | 11 | 4 |
| A | 37 | THR | CA-CB-OG1 | 5.48 | 117.83 | 109.60 | 11 | 2 |

| Chain | Res | Type | Atoms | \|Z\| | Observed (Å) | Ideal (Å) | Model ID (Worst) | Models (Total) |
|---|---|---|---|---|---|---|---|---|
| A | 21 | ARG | NE-CZ-NH1 | 5.47 | 126.97 | 121.50 | 2 | 3 |
| A | 6 | LYS | C-N-CA | 5.46 | 131.52 | 121.70 | 6 | 1 |
| A | 42 | TRP | CG-CD2-CE3 | 5.44 | 139.34 | 133.90 | 14 | 2 |
| A | 39 | LYS | CG-CD-CE | 5.43 | 123.78 | 111.30 | 9 | 1 |
| A | 3 | GLU | CA-CB-CG | 5.42 | 124.95 | 114.10 | 7 | 2 |
| A | 27 | LYS | CG-CD-CE | 5.40 | 123.73 | 111.30 | 2 | 2 |
| A | 47 | ASN | CB-CG-ND2 | 5.40 | 124.50 | 116.40 | 2 | 5 |
| A | 14 | ASP | C-N-CA | 5.39 | 131.40 | 121.70 | 1 | 2 |
| A | 49 | ARG | NH1-CZ-NH2 | 5.34 | 112.36 | 119.30 | 6 | 6 |
| A | 59 | LYS | CA-C-O | 5.34 | 111.72 | 120.80 | 10 | 1 |
| A | 52 | PHE | C-N-CA | 5.34 | 131.31 | 121.70 | 1 | 4 |
| A | 59 | LYS | C-N-CA | 5.30 | 131.23 | 121.70 | 16 | 2 |
| A | 25 | MET | C-N-CA | 5.27 | 131.18 | 121.70 | 9 | 2 |
| A | 42 | TRP | CD2-CE2-NE1 | 5.27 | 100.55 | 107.40 | 11 | 5 |
| A | 52 | PHE | C-CA-CB | 5.26 | 120.10 | 110.10 | 1 | 2 |
| A | 3 | GLU | N-CA-CB | 5.25 | 101.58 | 110.50 | 4 | 3 |
| A | 18 | LYS | CB-CG-CD | 5.24 | 123.34 | 111.30 | 12 | 1 |
| A | 23 | VAL | O-C-N | 5.23 | 114.63 | 123.00 | 12 | 1 |
| A | 35 | ASN | CA-CB-CG | 5.21 | 117.81 | 112.60 | 16 | 1 |
| A | 56 | ALA | C-CA-CB | 5.20 | 102.70 | 110.50 | 15 | 1 |
| A | 27 | LYS | N-CA-CB | 5.19 | 101.68 | 110.50 | 1 | 2 |
| A | 27 | LYS | C-N-CA | 5.18 | 131.02 | 121.70 | 2 | 2 |
| A | 56 | ALA | O-C-N | 5.17 | 114.72 | 123.00 | 15 | 1 |
| A | 40 | ASP | CA-C-O | 5.17 | 112.01 | 120.80 | 6 | 2 |
| A | 19 | SER | CA-CB-OG | 5.12 | 121.35 | 111.10 | 1 | 1 |
| A | 49 | ARG | CD-NE-CZ | 5.12 | 131.56 | 124.40 | 7 | 2 |
| A | 50 | GLN | CG-CD-NE2 | 5.11 | 124.06 | 116.40 | 5 | 1 |
| A | 42 | TRP | CB-CG-CD2 | 5.10 | 133.94 | 126.80 | 1 | 2 |
| A | 29 | ASP | C-CA-CB | 5.10 | 119.78 | 110.10 | 16 | 2 |
| A | 39 | LYS | CA-C-O | 5.08 | 112.16 | 120.80 | 8 | 1 |
| A | 12 | LEU | C-N-CA | 5.07 | 130.83 | 121.70 | 7 | 2 |
| A | 42 | TRP | CE2-CD2-CE3 | 5.04 | 113.76 | 118.80 | 14 | 4 |
| A | 19 | SER | CA-C-O | 5.03 | 112.24 | 120.80 | 1 | 2 |
| A | 60 | LYS | C-N-CA | 5.03 | 130.75 | 121.70 | 8 | 3 |
| A | 21 | ARG | NE-CZ-NH2 | 5.03 | 123.73 | 119.20 | 10 | 3 |

| Chain | Res | Type | Atoms | \|Z\| | Observed (Å) | Ideal (Å) | Model ID (Worst) | Models (Total) |
|---|---|---|---|---|---|---|---|---|
| A | 49 | ARG | C-N-CA | 5.02 | 130.74 | 121.70 | 11 | 2 |
| A | 50 | GLN | CB-CG-CD | 5.02 | 121.13 | 112.60 | 12 | 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 | 0.00 | 0 |
| 3 | 0.00 | 0 |
| 4 | 0.98 | 1 |
| 5 | 1.96 | 2 |
| 6 | 0.00 | 0 |
| 7 | 1.96 | 2 |
| 8 | 0.98 | 1 |
| 9 | 1.96 | 2 |
| 10 | 0.98 | 1 |
| 11 | 1.96 | 2 |
| 12 | 0.98 | 1 |
| 13 | 0.98 | 1 |
| 14 | 1.96 | 2 |
| 15 | 1.96 | 2 |
| 16 | 0.00 | 0 |

*There are 18 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:42:TRP:CH2 | A:60:LYS:HE3 | 0.58 | 13 | 1 |
| A:33:LEU:CD2 | A:60:LYS:HE2 | 0.57 | 11 | 2 |
| A:39:LYS:HE3 | A:40:ASP:OD2 | 0.54 | 10 | 1 |
| A:23:VAL:HG12 | A:49:ARG:CZ | 0.51 | 8 | 1 |
| A:41:TRP:CZ3 | A:54:PRO:HD3 | 0.49 | 12 | 1 |
| A:25:MET:HE1 | A:58:VAL:HG13 | 0.45 | 5 | 1 |
| A:30:ILE:N | A:30:ILE:HD12 | 0.44 | 4 | 1 |
| A:3:GLU:O | A:6:LYS:HE3 | 0.43 | 1 | 1 |
| A:33:LEU:CD2 | A:60:LYS:HE3 | 0.43 | 15 | 1 |

| Atom 1 | Atom 2 | Clash(Å) | Model ID (Worst) | Models (Total) |
|---|---|---|---|---|
| A:33:LEU:HD23 | A:60:LYS:HE2 | 0.42 | 7 | 1 |
| A:9:VAL:HG23 | A:31:LEU:HB2 | 0.42 | 14 | 1 |
| A:33:LEU:HD22 | A:60:LYS:HE2 | 0.42 | 11 | 1 |
| A:8:LEU:HD23 | A:32:THR:HA | 0.41 | 15 | 1 |
| A:43:LYS:HE2 | A:50:GLN:HB3 | 0.41 | 5 | 1 |
| A:13:TYR:CG | A:14:ASP:N | 0.41 | 9 | 1 |
| A:22:GLU:HA | A:52:PHE:O | 0.41 | 14 | 1 |
| A:10:LEU:HB2 | A:61:LEU:HD21 | 0.40 | 9 | 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 | 4 | 1 |
| 2 | 60 | 56 | 2 | 2 |
| 3 | 60 | 57 | 1 | 2 |
| 4 | 60 | 55 | 4 | 1 |
| 5 | 60 | 56 | 3 | 1 |
| 6 | 60 | 56 | 3 | 1 |
| 7 | 60 | 56 | 4 | 0 |
| 8 | 60 | 57 | 3 | 0 |
| 9 | 60 | 55 | 4 | 1 |
| 10 | 60 | 55 | 5 | 0 |
| 11 | 60 | 54 | 4 | 2 |
| 12 | 60 | 54 | 4 | 2 |
| 13 | 60 | 54 | 5 | 1 |
| 14 | 60 | 54 | 4 | 2 |
| 15 | 60 | 53 | 4 | 3 |
| 16 | 60 | 59 | 0 | 1 |

*There are 5 unique backbone outliers. Detailed list of outliers are tabulated below.*

| Chain | Res | Type | Models (Total) |
|---|---|---|---|
| A | 47 | ASN | 11 |
| A | 20 | PRO | 3 |
| A | 14 | ASP | 2 |
| A | 48 | ASP | 2 |

| Chain | Res | Type | Models (Total) |
|---|---|---|---|
| A | 56 | ALA | 2 |

## 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 | 51 | 4 | 1 |
| 2 | 56 | 49 | 1 | 6 |
| 3 | 56 | 50 | 5 | 1 |
| 4 | 56 | 51 | 5 | 0 |
| 5 | 56 | 50 | 5 | 1 |
| 6 | 56 | 48 | 5 | 3 |
| 7 | 56 | 53 | 3 | 0 |
| 8 | 56 | 49 | 5 | 2 |
| 9 | 56 | 53 | 0 | 3 |
| 10 | 56 | 54 | 2 | 0 |
| 11 | 56 | 54 | 1 | 1 |
| 12 | 56 | 53 | 3 | 0 |
| 13 | 56 | 50 | 5 | 1 |
| 14 | 56 | 51 | 4 | 1 |
| 15 | 56 | 51 | 3 | 2 |
| 16 | 56 | 49 | 5 | 2 |

*There are 17 unique sidechain outliers. Detailed list of outliers are tabulated below.*

| Chain | Res | Type | Models (Total) |
|---|---|---|---|
| A | 3 | GLU | 3 |
| A | 58 | VAL | 3 |
| A | 1 | MET | 2 |
| A | 32 | THR | 2 |
| A | 37 | THR | 2 |
| A | 2 | ASP | 1 |
| A | 4 | THR | 1 |
| A | 14 | ASP | 1 |
| A | 23 | VAL | 1 |
| A | 25 | MET | 1 |
| A | 27 | LYS | 1 |

| Chain | Res | Type | Models (Total) |
|---|---|---|---|
| A | 30 | ILE | 1 |
| A | 31 | LEU | 1 |
| A | 38 | ASN | 1 |
| A | 40 | ASP | 1 |
| A | 46 | VAL | 1 |
| A | 48 | ASP | 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.*

*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.*