



wwPDB X-ray Structure Validation Summary Report ⓘ

Apr 18, 2026 – 11:38 PM UTC

PDB ID : 5HKD / pdb_00005hkd
Title : Bacterial sodium channel neck 7G mutant
Authors : Rohaim, A.; Minor, D.L.
Deposited on : 2016-01-13
Resolution : 3.80 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

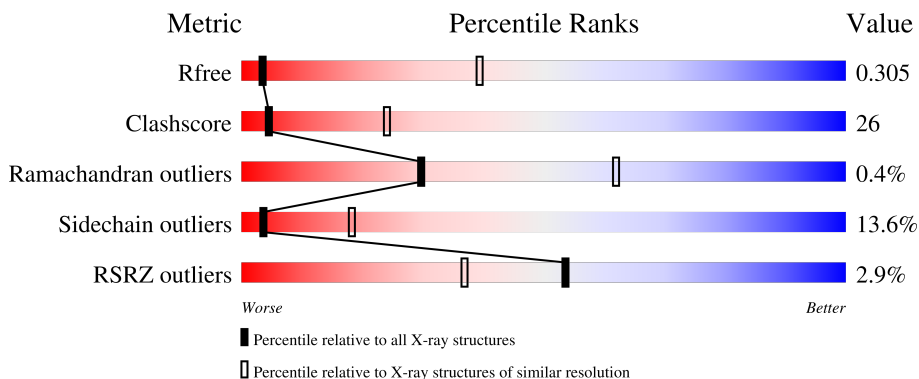
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.80 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	1065 (3.96-3.64)
Clashscore	190562	1012 (3.94-3.66)
Ramachandran outliers	187476	1048 (3.96-3.64)
Sidechain outliers	187428	1043 (3.96-3.64)
RSRZ outliers	180081	1064 (3.96-3.64)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	152	3% 40% 32% 7% 20%
1	B	152	2% 34% 34% 7% 24%
1	C	152	3% 45% 30% 6% 19%
1	D	152	2% 40% 33% 8% 19%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3697 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Ion transport protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	121	Total	C	N	O	S	0	0	0
			929	625	138	160	6			
1	B	116	Total	C	N	O	S	0	0	0
			913	617	137	153	6			
1	C	123	Total	C	N	O	S	0	0	0
			924	624	139	155	6			
1	D	123	Total	C	N	O	S	0	0	0
			928	629	140	153	6			

There are 52 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	137	GLY	-	expression tag	UNP Q0ABW0
A	138	PRO	-	expression tag	UNP Q0ABW0
A	139	SER	-	expression tag	UNP Q0ABW0
A	140	SER	-	expression tag	UNP Q0ABW0
A	141	PRO	-	expression tag	UNP Q0ABW0
A	142	SER	-	expression tag	UNP Q0ABW0
A	248	GLY	ALA	engineered mutation	UNP Q0ABW0
A	249	GLY	GLU	engineered mutation	UNP Q0ABW0
A	250	GLY	ASP	engineered mutation	UNP Q0ABW0
A	251	GLY	ALA	engineered mutation	UNP Q0ABW0
A	252	GLY	LYS	engineered mutation	UNP Q0ABW0
A	253	GLY	ARG	engineered mutation	UNP Q0ABW0
A	254	GLY	ILE	engineered mutation	UNP Q0ABW0
B	137	GLY	-	expression tag	UNP Q0ABW0
B	138	PRO	-	expression tag	UNP Q0ABW0
B	139	SER	-	expression tag	UNP Q0ABW0
B	140	SER	-	expression tag	UNP Q0ABW0
B	141	PRO	-	expression tag	UNP Q0ABW0
B	142	SER	-	expression tag	UNP Q0ABW0
B	248	GLY	ALA	engineered mutation	UNP Q0ABW0
B	249	GLY	GLU	engineered mutation	UNP Q0ABW0

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Chain	Residue	Modelled	Actual	Comment	Reference
B	250	GLY	ASP	engineered mutation	UNP Q0ABW0
B	251	GLY	ALA	engineered mutation	UNP Q0ABW0
B	252	GLY	LYS	engineered mutation	UNP Q0ABW0
B	253	GLY	ARG	engineered mutation	UNP Q0ABW0
B	254	GLY	ILE	engineered mutation	UNP Q0ABW0
C	137	GLY	-	expression tag	UNP Q0ABW0
C	138	PRO	-	expression tag	UNP Q0ABW0
C	139	SER	-	expression tag	UNP Q0ABW0
C	140	SER	-	expression tag	UNP Q0ABW0
C	141	PRO	-	expression tag	UNP Q0ABW0
C	142	SER	-	expression tag	UNP Q0ABW0
C	248	GLY	ALA	engineered mutation	UNP Q0ABW0
C	249	GLY	GLU	engineered mutation	UNP Q0ABW0
C	250	GLY	ASP	engineered mutation	UNP Q0ABW0
C	251	GLY	ALA	engineered mutation	UNP Q0ABW0
C	252	GLY	LYS	engineered mutation	UNP Q0ABW0
C	253	GLY	ARG	engineered mutation	UNP Q0ABW0
C	254	GLY	ILE	engineered mutation	UNP Q0ABW0
D	137	GLY	-	expression tag	UNP Q0ABW0
D	138	PRO	-	expression tag	UNP Q0ABW0
D	139	SER	-	expression tag	UNP Q0ABW0
D	140	SER	-	expression tag	UNP Q0ABW0
D	141	PRO	-	expression tag	UNP Q0ABW0
D	142	SER	-	expression tag	UNP Q0ABW0
D	248	GLY	ALA	engineered mutation	UNP Q0ABW0
D	249	GLY	GLU	engineered mutation	UNP Q0ABW0
D	250	GLY	ASP	engineered mutation	UNP Q0ABW0
D	251	GLY	ALA	engineered mutation	UNP Q0ABW0
D	252	GLY	LYS	engineered mutation	UNP Q0ABW0
D	253	GLY	ARG	engineered mutation	UNP Q0ABW0
D	254	GLY	ILE	engineered mutation	UNP Q0ABW0

- Molecule 2 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	B	1	Total Ca 1 1	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	2	Total	O	0	0
			2	2		

ARG	GLY
I208	PRO
P212	SER
W213	SER
A214	PRO
W216	SER
I216	LEU
	LEU
W219	ARG
S220	ALA
F221	TLE
	PRO
	GLY
L230	I150
N231	A154
L232	L157
F233	L158
L234	V159
G235	I160
I236	F161
I237	V162
	V163
M241	I166
Q242	M167
SER	
ALA	
HIS	L171
TRP	F172
GLU	A173
GLY	Q174
GLY	S175
GLY	F176
GLY	P177
GLU	
GLN	F180
E257	G181
	T182
	L183
A260	
E263	S186
E266	M187
M267	Y188
L268	
	F191
	Q192
S275	T195
S276	L196
L277	E197
V278	S198
D279	G199
R280	W199
L281	S200
E282	
R283	L203
R284	A204
S285	R205
G286	P206
L286	V207

4 Data and refinement statistics

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, α , β , γ	137.10Å 137.99Å 173.16Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	15.00 – 3.80 15.00 – 3.80	Depositor EDS
% Data completeness (in resolution range)	96.0 (15.00-3.80) 96.0 (15.00-3.80)	Depositor EDS
R_{merge}	0.66	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.23 (at 3.77Å)	Xtriage
Refinement program	REFMAC 5.8.0071	Depositor
R, R_{free}	0.273 , 0.312 0.270 , 0.305	Depositor DCC
R_{free} test set	795 reflections (4.90%)	wwPDB-VP
Wilson B-factor (Å ²)	129.7	Xtriage
Anisotropy	0.153	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.23 , 159.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.39$, $\langle L^2 \rangle = 0.22$	Xtriage
Estimated twinning fraction	0.100 for -k,-h,-l	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	3697	wwPDB-VP
Average B, all atoms (Å ²)	169.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.99% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CA

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	0.85	0/953	1.19	10/1301 (0.8%)
1	B	0.84	3/939 (0.3%)	1.30	7/1281 (0.5%)
1	C	0.84	0/948	1.39	8/1295 (0.6%)
1	D	0.84	2/954 (0.2%)	1.38	9/1305 (0.7%)
All	All	0.84	5/3794 (0.1%)	1.32	34/5182 (0.7%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	B	0	3
1	C	0	2
1	D	0	3
All	All	0	8

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	278	VAL	CA-C	8.18	1.62	1.52
1	B	277	LYS	CA-C	7.04	1.61	1.53
1	D	277	LYS	N-CA	5.56	1.52	1.46
1	D	285	SER	CA-C	5.25	1.59	1.52
1	B	277	LYS	C-O	5.10	1.29	1.23

The worst 5 of 34 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	173	ALA	CB-CA-C	-19.37	71.88	110.42

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	173	ALA	CB-CA-C	-18.83	72.95	110.42
1	D	173	ALA	CB-CA-C	-18.46	73.68	110.42
1	D	173	ALA	CA-C-N	13.59	143.10	122.17
1	D	173	ALA	C-N-CA	13.59	143.10	122.17

There are no chirality outliers.

5 of 8 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	173	ALA	Peptide
1	B	276	SER	Peptide
1	B	278	VAL	Peptide
1	C	173	ALA	Peptide
1	C	281	LEU	Peptide

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	929	0	891	63	0
1	B	913	0	889	62	0
1	C	924	0	882	46	0
1	D	928	0	884	53	0
2	B	1	0	0	0	0
3	A	2	0	0	0	0
All	All	3697	0	3546	190	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 26.

The worst 5 of 190 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:281:LEU:HD22	1:D:282:GLU:HA	1.64	0.80
1:D:205:ARG:HB2	1:D:206:PRO:HD3	1.66	0.78

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:267:MET:HB2	1:B:268:LEU:HD21	1.66	0.77
1:B:205:ARG:HB2	1:B:206:PRO:HD3	1.68	0.76
1:B:260:ALA:O	1:B:263:GLU:HG2	1.85	0.74

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	117/152 (77%)	97 (83%)	19 (16%)	1 (1%)	14	45
1	B	112/152 (74%)	91 (81%)	20 (18%)	1 (1%)	14	45
1	C	119/152 (78%)	94 (79%)	25 (21%)	0	100	100
1	D	119/152 (78%)	97 (82%)	22 (18%)	0	100	100
All	All	467/608 (77%)	379 (81%)	86 (18%)	2 (0%)	30	62

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	173	ALA
1	B	258	GLN

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	92/126 (73%)	79 (86%)	13 (14%)	3	18
1	B	92/126 (73%)	78 (85%)	14 (15%)	3	16
1	C	88/126 (70%)	77 (88%)	11 (12%)	4	21
1	D	88/126 (70%)	77 (88%)	11 (12%)	4	21
All	All	360/504 (71%)	311 (86%)	49 (14%)	3	18

5 of 49 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	161	PHE
1	C	266	GLU
1	C	166	VAL
1	C	215	TRP
1	C	278	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	192	GLN
1	C	192	GLN
1	D	192	GLN
1	D	261	HIS

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 1 ligands modelled in this entry, 1 is monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data [i](#)

6.1 Protein, DNA and RNA chains [i](#)

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ > 2			OWAB(Å ²)	Q < 0.9
1	A	121/152 (79%)	-0.32	4 (3%)	49	34	84, 151, 249, 285	0
1	B	116/152 (76%)	-0.15	3 (2%)	57	39	93, 162, 262, 296	0
1	C	123/152 (80%)	-0.29	4 (3%)	49	34	78, 160, 259, 321	0
1	D	123/152 (80%)	-0.26	3 (2%)	59	41	87, 168, 268, 371	0
All	All	483/608 (79%)	-0.26	14 (2%)	53	37	78, 163, 266, 371	0

The worst 5 of 14 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	173	ALA	5.4
1	B	173	ALA	4.0
1	A	181	GLY	3.6
1	A	242	GLN	3.1
1	D	173	ALA	2.7

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q < 0.9’ lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	CA	B	301	1/1	0.90	0.28	30,30,30,30	0

6.5 Other polymers [i](#)

There are no such residues in this entry.