



Full wwPDB X-ray Structure Validation Report

Dec 18, 2023 – 07:48 am GMT

PDB ID : 4D1D
Title : STRUCTURE OF MHP1, A NUCLEOBASE-CATION-SYMPORT-1 FAMILY TRANSPORTER with the inhibitor 5-(2-naphthylmethyl)-L-hydantoin
Authors : Weyand, S.; Brueckner, F.; Geng, T.; Drew, D.; Iwata, S.; Henderson, P.J.F.; Cameron, A.D.
Deposited on : 2014-05-01
Resolution : 3.70 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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 : 4.02b-467
Mogul : 1.8.4, CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.36
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36

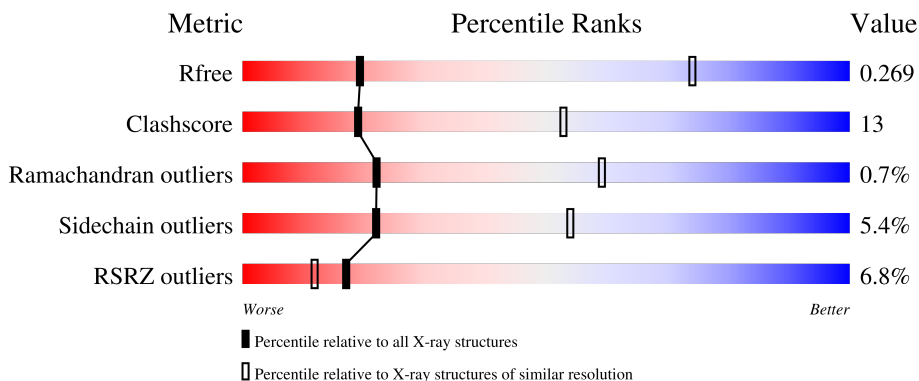
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.70 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}	130704	1049 (3.88-3.52)
Clashscore	141614	1027 (3.86-3.54)
Ramachandran outliers	138981	1069 (3.88-3.52)
Sidechain outliers	138945	1065 (3.88-3.52)
RSRZ outliers	127900	1578 (3.90-3.50)

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	495	

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3550 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.

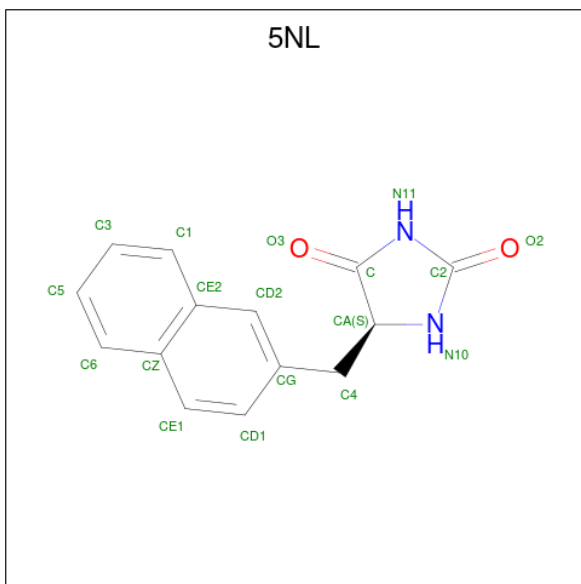
- Molecule 1 is a protein called HYDANTOIN TRANSPORT PROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	456	3513	2336	563	592	22	0	0	0

There are 8 discrepancies between the modelled and reference sequences:

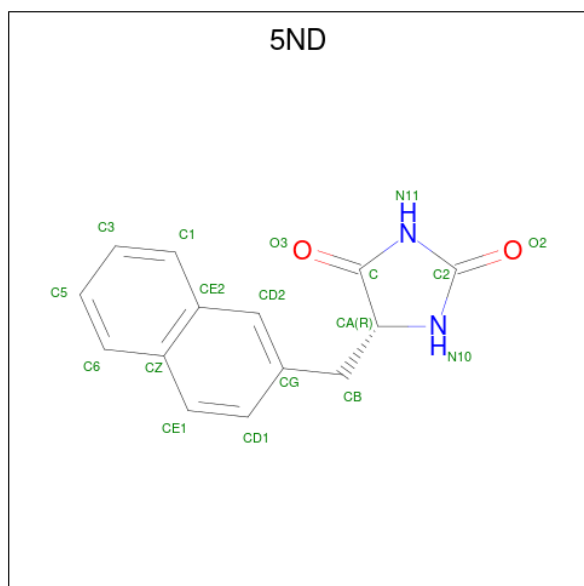
Chain	Residue	Modelled	Actual	Comment	Reference
A	488	GLY	-	expression tag	UNP D6R8X8
A	489	SER	-	expression tag	UNP D6R8X8
A	490	GLU	-	expression tag	UNP D6R8X8
A	491	ASN	-	expression tag	UNP D6R8X8
A	492	LEU	-	expression tag	UNP D6R8X8
A	493	TYR	-	expression tag	UNP D6R8X8
A	494	PHE	-	expression tag	UNP D6R8X8
A	495	GLN	-	expression tag	UNP D6R8X8

- Molecule 2 is 5-(2-NAPHTHYLMETHYL)-L-HYDANTOIN (three-letter code: 5NL)
(formula: C₁₄H₁₂N₂O₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	18	14	2	2	0	0

- Molecule 3 is 5-(2-NAPHTHYLMETHYL)-D-HYDANTOIN (three-letter code: 5ND) (formula: $C_{14}H_{12}N_2O_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
3	A	1	18	14	2	2	0	0

- Molecule 4 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Na		
4	A	1	1	1	0	0

4 Data and refinement statistics i

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	87.60Å 106.90Å 106.80Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	37.78 – 3.70 37.78 – 3.70	Depositor EDS
% Data completeness (in resolution range)	88.9 (37.78-3.70) 95.6 (37.78-3.70)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.13 (at 3.66Å)	Xtrriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, R_{free}	0.256 , 0.308 0.272 , 0.269	Depositor DCC
R_{free} test set	1074 reflections (10.02%)	wwPDB-VP
Wilson B-factor (Å ²)	130.0	Xtrriage
Anisotropy	0.714	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.21 , 66.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.38$, $\langle L^2 \rangle = 0.21$	Xtrriage
Estimated twinning fraction	0.048 for -h,l,k	Xtrriage
F_o, F_c correlation	0.89	EDS
Total number of atoms	3550	wwPDB-VP
Average B, all atoms (Å ²)	194.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.46% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 5NL, NA, 5ND

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	0.34	0/3610	0.60	0/4936

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

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	3513	0	3604	93	0
2	A	18	0	3	0	0
3	A	18	0	2	0	0
4	A	1	0	0	0	0
All	All	3550	0	3609	93	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 13.

All (93) 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:A:59:TRP:HB3	1:A:198:MET:HG3	1.73	0.71
1:A:32:LEU:HA	1:A:35:ILE:HD12	1.70	0.71
1:A:436:ALA:O	1:A:440:LEU:HG	1.97	0.63
1:A:13:LEU:HD12	1:A:14:ASN:N	2.13	0.63
1:A:324:TYR:O	1:A:328:SER:HB3	2.00	0.62
1:A:131:GLU:HB3	1:A:303:GLN:HG2	1.82	0.61
1:A:155:VAL:HA	1:A:158:PHE:CD2	2.37	0.59
1:A:48:ALA:O	1:A:52:MET:HG2	2.04	0.57
1:A:283:PRO:HG2	1:A:302:PHE:HZ	1.67	0.57
1:A:154:VAL:HG13	1:A:340:VAL:HG12	1.86	0.57
1:A:96:MET:HB2	1:A:97:PRO:HD3	1.87	0.56
1:A:369:ALA:O	1:A:415:TYR:OH	2.14	0.56
1:A:442:ILE:HB	1:A:443:PRO:HD3	1.87	0.55
1:A:385:ARG:NH2	1:A:403:TYR:OH	2.40	0.55
1:A:257:TRP:CE2	1:A:261:VAL:HG21	2.42	0.54
1:A:221:ILE:HG21	1:A:367:ALA:HB1	1.90	0.54
1:A:95:ARG:HG2	1:A:100:ILE:HA	1.89	0.54
1:A:131:GLU:O	1:A:135:LEU:HG	2.08	0.54
1:A:165:ARG:O	1:A:169:VAL:HG23	2.08	0.53
1:A:426:PRO:HA	1:A:429:MET:HG3	1.91	0.53
1:A:110:LYS:HD3	1:A:110:LYS:C	2.29	0.53
1:A:97:PRO:O	1:A:408:ASN:ND2	2.41	0.53
1:A:302:PHE:O	1:A:305:PHE:HB3	2.09	0.52
1:A:461:ARG:O	1:A:464:ASP:HB2	2.10	0.52
1:A:302:PHE:O	1:A:302:PHE:HD1	1.92	0.52
1:A:327:CYS:HA	1:A:334:PHE:HB2	1.92	0.52
1:A:22:TYR:OH	1:A:85:ARG:NH1	2.44	0.51
1:A:14:ASN:ND2	1:A:331:PRO:O	2.34	0.51
1:A:21:ARG:NH1	1:A:464:ASP:O	2.43	0.51
1:A:31:SER:O	1:A:35:ILE:HG13	2.10	0.51
1:A:34:ALA:O	1:A:168:ASN:HB3	2.11	0.50
1:A:157:THR:HG21	1:A:319:LEU:HD23	1.93	0.50
1:A:25:ARG:HD2	1:A:234:CYS:O	2.12	0.50
1:A:284:VAL:HA	1:A:302:PHE:CE2	2.46	0.50
1:A:388:ARG:NH1	1:A:459:GLU:OE2	2.45	0.49
1:A:256:GLN:O	1:A:260:MET:HG2	2.12	0.49
1:A:174:VAL:O	1:A:178:MET:HG3	2.13	0.48
1:A:178:MET:CE	1:A:305:PHE:HB2	2.43	0.48
1:A:52:MET:HE1	1:A:212:ALA:HB1	1.96	0.48
1:A:13:LEU:O	1:A:332:ARG:NH2	2.46	0.48
1:A:128:ALA:HA	1:A:303:GLN:HG3	1.96	0.48
1:A:76:LEU:O	1:A:80:GLN:HG2	2.14	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:37:PHE:CE1	1:A:41:ILE:HD11	2.49	0.47
1:A:142:LEU:HB3	1:A:143:PRO:HD3	1.95	0.47
1:A:37:PHE:HA	1:A:259:GLY:O	2.15	0.47
1:A:274:SER:HB3	1:A:280:GLU:O	2.15	0.47
1:A:106:PRO:HB2	1:A:373:LEU:HD13	1.97	0.47
1:A:54:SER:O	1:A:204:ASN:HB3	2.16	0.46
1:A:122:THR:HG21	1:A:348:LEU:HD21	1.97	0.46
1:A:352:PRO:HD2	1:A:353:TRP:CZ3	2.50	0.46
1:A:178:MET:HE2	1:A:305:PHE:HB2	1.97	0.46
1:A:89:ASN:HB3	1:A:92:VAL:H	1.81	0.45
1:A:129:LEU:HG	1:A:307:LEU:HD13	1.98	0.45
1:A:85:ARG:HD2	1:A:86:TRP:CE2	2.51	0.45
1:A:25:ARG:NH1	1:A:84:ILE:O	2.44	0.45
1:A:99:GLY:HA3	1:A:407:VAL:HA	1.98	0.45
1:A:129:LEU:O	1:A:133:THR:HG23	2.17	0.45
1:A:218:GLY:HA2	1:A:221:ILE:HB	1.99	0.45
1:A:225:VAL:HG23	1:A:374:ALA:HB2	1.99	0.45
1:A:151:ALA:O	1:A:155:VAL:HG23	2.17	0.44
1:A:118:PHE:HA	1:A:314:ASN:OD1	2.18	0.44
1:A:391:LEU:HA	1:A:394:LEU:HD12	1.99	0.44
1:A:153:GLN:O	1:A:157:THR:N	2.48	0.44
1:A:400:ILE:HD13	1:A:456:SER:HB2	2.00	0.43
1:A:404:TRP:CE2	1:A:452:PHE:HE2	2.36	0.43
1:A:73:VAL:HA	1:A:76:LEU:HD12	2.01	0.43
1:A:110:LYS:HD3	1:A:110:LYS:O	2.18	0.43
1:A:47:ILE:HG12	1:A:281:TRP:CE2	2.53	0.43
1:A:89:ASN:HB2	1:A:92:VAL:HB	2.00	0.43
1:A:22:TYR:CZ	1:A:238:PRO:HB3	2.53	0.43
1:A:132:ILE:CG1	1:A:303:GLN:HB3	2.49	0.43
1:A:144:LEU:HG	1:A:148:ILE:HD12	2.01	0.42
1:A:158:PHE:HZ	1:A:341:ILE:HD11	1.84	0.42
1:A:376:ILE:HG13	1:A:437:ALA:HB1	2.00	0.42
1:A:115:LEU:HD23	1:A:115:LEU:HA	1.84	0.42
1:A:282:ASN:HA	1:A:283:PRO:HD2	1.90	0.42
1:A:243:GLU:O	1:A:247:LYS:HG2	2.19	0.42
1:A:141:ASN:OD1	1:A:143:PRO:HD2	2.19	0.42
1:A:391:LEU:HD12	1:A:465:TYR:HB2	2.01	0.42
1:A:120:PHE:O	1:A:123:TRP:HB3	2.20	0.41
1:A:381:TYR:CE2	1:A:387:ARG:HG2	2.54	0.41
1:A:94:ALA:O	1:A:97:PRO:HD2	2.19	0.41
1:A:319:LEU:HD21	1:A:340:VAL:HG13	2.02	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:56:PHE:HB3	1:A:60:GLN:OE1	2.20	0.41
1:A:320:LEU:HD23	1:A:320:LEU:HA	1.82	0.41
1:A:91:THR:HG23	1:A:107:ILE:HD13	2.03	0.41
1:A:116:PHE:CE2	1:A:363:LEU:HD11	2.55	0.41
1:A:128:ALA:O	1:A:132:ILE:HG13	2.20	0.41
1:A:41:ILE:HD13	1:A:175:LEU:HB3	2.02	0.41
1:A:90:PHE:HB2	1:A:228:HIS:HB2	2.03	0.41
1:A:197:VAL:HA	1:A:200:MET:HG3	2.02	0.41
1:A:137:THR:C	1:A:139:PHE:H	2.24	0.41
1:A:440:LEU:O	1:A:443:PRO:HD2	2.22	0.40

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	454/495 (92%)	403 (89%)	48 (11%)	3 (1%)	22 59

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	228	HIS
1	A	137	THR
1	A	138	GLY

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	367/399 (92%)	347 (95%)	20 (5%)	22 54

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	13	LEU
1	A	31	SER
1	A	42	GLN
1	A	85	ARG
1	A	114	SER
1	A	144	LEU
1	A	161	ILE
1	A	167	MET
1	A	241	SER
1	A	243	GLU
1	A	276	VAL
1	A	295	SER
1	A	302	PHE
1	A	311	TRP
1	A	312	SER
1	A	332	ARG
1	A	364	ASN
1	A	365	LEU
1	A	405	ARG
1	A	446	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains

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

5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 3 ligands modelled in this entry, 1 is monoatomic - leaving 2 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	5ND	A	1468	-	20,20,20	2.63	4 (20%)	26,28,28	1.24	2 (7%)
2	5NL	A	1467	-	20,20,20	2.62	5 (25%)	26,28,28	1.08	1 (3%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	5ND	A	1468	-	-	4/4/16/16	0/3/3/3
2	5NL	A	1467	-	-	0/4/16/16	0/3/3/3

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	1468	5ND	CA-C	-7.47	1.47	1.52
2	A	1467	5NL	CA-C	-7.07	1.47	1.52
2	A	1467	5NL	C2-N10	6.19	1.45	1.35
3	A	1468	5ND	C2-N10	6.12	1.45	1.35
2	A	1467	5NL	C-N11	4.29	1.43	1.37
3	A	1468	5ND	C-N11	3.87	1.42	1.37
2	A	1467	5NL	C2-N11	3.56	1.46	1.39
3	A	1468	5ND	C2-N11	3.40	1.45	1.39
2	A	1467	5NL	CE1-CD1	2.04	1.40	1.36

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	1468	5ND	C-N11-C2	-4.07	108.03	111.60
2	A	1467	5NL	C-N11-C2	-3.95	108.14	111.60
3	A	1468	5ND	CB-CA-N10	-3.47	109.92	113.95

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	1468	5ND	CA-CB-CG-CD1
3	A	1468	5ND	CA-CB-CG-CD2
3	A	1468	5ND	C-CA-CB-CG
3	A	1468	5ND	N10-CA-CB-CG

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

6.1 Protein, DNA and RNA chains

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	456/495 (92%)	0.00	31 (6%) 17 12	102, 185, 281, 399	0

All (31) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	293	GLY	6.7
1	A	294	VAL	6.6
1	A	196	GLU	6.5
1	A	456	SER	5.3
1	A	295	SER	4.1
1	A	194	LEU	3.9
1	A	239	ASN	3.6
1	A	197	VAL	3.4
1	A	203	GLU	3.3
1	A	200	MET	3.2
1	A	195	GLY	3.1
1	A	184	TYR	3.1
1	A	185	LEU	3.0
1	A	457	GLU	3.0
1	A	388	ARG	3.0
1	A	208	PRO	3.0
1	A	458	ALA	2.9
1	A	461	ARG	2.7
1	A	455	PHE	2.6
1	A	361	THR	2.5
1	A	384	VAL	2.5
1	A	297	PRO	2.4
1	A	201	GLY	2.4
1	A	450	LYS	2.3
1	A	427	ASP	2.3
1	A	454	LEU	2.2
1	A	241	SER	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	169	VAL	2.2
1	A	424	LEU	2.1
1	A	381	TYR	2.0
1	A	186	MET	2.0

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 monosaccharides 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(Å ²)	Q<0.9
2	5NL	A	1467	18/18	0.83	0.33	142,154,170,171	18
3	5ND	A	1468	18/18	0.83	0.35	140,151,167,169	18
4	NA	A	1471	1/1	0.89	0.21	115,115,115,115	0

6.5 Other polymers [i](#)

There are no such residues in this entry.