



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 11, 2024 – 03:52 PM EST

PDB ID : 3C9H
Title : Crystal structure of the substrate binding protein of the ABC transporter from *Agrobacterium tumefaciens*
Authors : Zhang, R.; Xu, X.; Zheng, H.; Savchenko, A.; Edwards, A.M.; Joachimiak, A.; Midwest Center for Structural Genomics (MCSG)
Deposited on : 2008-02-15
Resolution : 1.90 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 : 1.8.5 (274361), 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

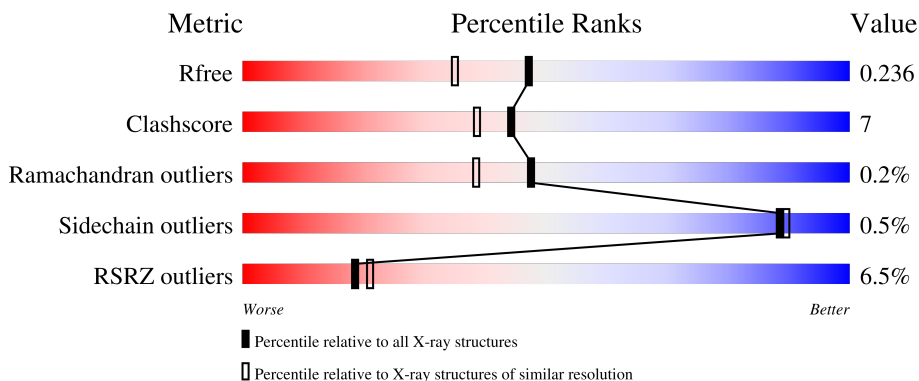
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.90 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	6207 (1.90-1.90)
Clashscore	141614	6847 (1.90-1.90)
Ramachandran outliers	138981	6760 (1.90-1.90)
Sidechain outliers	138945	6760 (1.90-1.90)
RSRZ outliers	127900	6082 (1.90-1.90)

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	355	 6% 81% 12% 6%
1	B	355	 6% 85% 10% 5%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 5726 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.

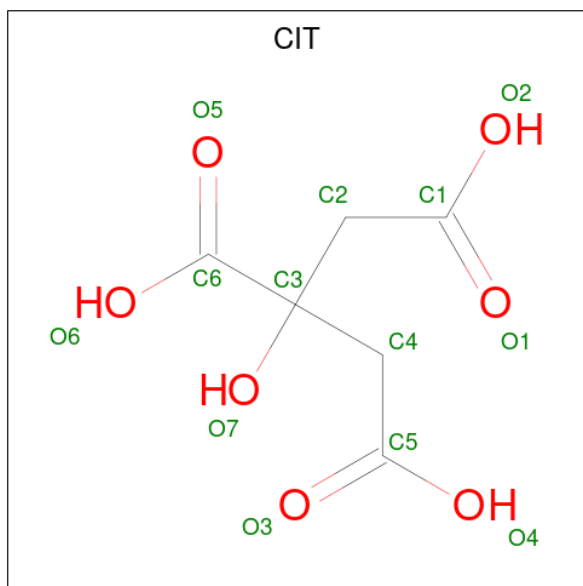
- Molecule 1 is a protein called ABC transporter, substrate binding protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	334	Total 2615	C 1667	N 450	O 487	S 11	0	0	0
1	B	339	Total 2650	C 1687	N 456	O 496	S 11	0	0	0

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total 1	Mg 1	0	0
2	B	1	Total 1	Mg 1	0	0

- Molecule 3 is CITRIC ACID (three-letter code: CIT) (formula: C₆H₈O₇).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			13	6	7		
3	B	1	Total	C	O	0	0
			13	6	7		

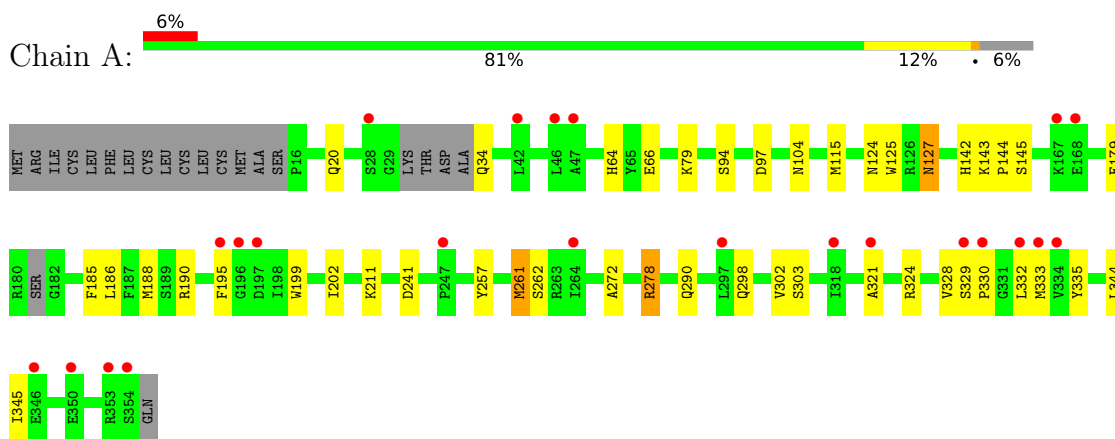
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	210	Total	O	0	0
			210	210		
4	B	223	Total	O	0	0
			223	223		

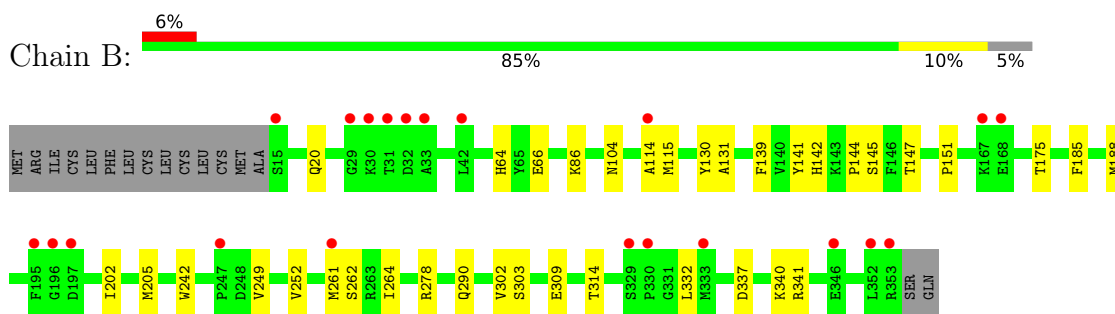
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

- Molecule 1: ABC transporter, substrate binding protein



- Molecule 1: ABC transporter, substrate binding protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	75.31Å 86.95Å 109.64Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	35.60 – 1.90 35.61 – 1.90	Depositor EDS
% Data completeness (in resolution range)	99.3 (35.60-1.90) 99.3 (35.61-1.90)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.43 (at 1.89Å)	Xtrriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.173 , 0.228 0.185 , 0.236	Depositor DCC
R_{free} test set	2906 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å ²)	25.8	Xtrriage
Anisotropy	0.473	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 54.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	5726	wwPDB-VP
Average B, all atoms (Å ²)	30.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 62.55 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.1068e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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: CIT, MG

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	0.64	0/2677	0.72	2/3634 (0.1%)
1	B	0.65	0/2714	0.71	2/3688 (0.1%)
All	All	0.64	0/5391	0.71	4/7322 (0.1%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	278	ARG	NE-CZ-NH2	-7.67	116.46	120.30
1	B	278	ARG	NE-CZ-NH1	6.52	123.56	120.30
1	A	278	ARG	NE-CZ-NH2	-5.04	117.78	120.30
1	A	278	ARG	NE-CZ-NH1	5.04	122.82	120.30

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	2615	0	2575	43	0
1	B	2650	0	2610	27	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	13	0	5	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	13	0	5	0	0
4	A	210	0	0	14	0
4	B	223	0	0	7	0
All	All	5726	0	5195	69	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 7.

All (69) 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:B:139:PHE:HB2	1:B:252:VAL:HG22	1.51	0.91
1:A:188:MET:HE3	4:A:477:HOH:O	1.81	0.80
1:A:290:GLN:HE22	1:A:302:VAL:H	1.35	0.72
1:A:188:MET:CE	4:A:477:HOH:O	2.37	0.72
1:A:64:HIS:HD2	4:A:476:HOH:O	1.74	0.69
1:A:34:GLN:N	4:A:518:HOH:O	2.27	0.68
1:B:64:HIS:HE1	1:B:66:GLU:OE2	1.77	0.67
1:B:290:GLN:HE22	1:B:302:VAL:H	1.43	0.65
1:B:242:TRP:CD1	1:B:249:VAL:HG21	2.32	0.65
1:A:124:ASN:HD21	1:A:127:ASN:ND2	1.97	0.63
1:A:278:ARG:NE	4:A:601:HOH:O	2.23	0.59
1:A:188:MET:HE2	1:A:188:MET:HA	1.86	0.58
1:A:321:ALA:O	1:A:324:ARG:NH1	2.37	0.58
1:A:94:SER:HA	1:A:261:MET:HE1	1.86	0.57
1:B:188:MET:HE1	1:B:202:ILE:HD11	1.87	0.56
1:A:124:ASN:HD21	1:A:127:ASN:HD22	1.52	0.56
1:A:79:LYS:HG3	4:A:498:HOH:O	2.06	0.55
1:B:290:GLN:NE2	1:B:303:SER:H	2.05	0.54
1:B:175:THR:HB	1:B:205:MET:HE1	1.90	0.54
1:B:188:MET:CE	4:B:492:HOH:O	2.56	0.54
1:B:20:GLN:HG2	4:B:483:HOH:O	2.07	0.53
1:A:34:GLN:N	4:A:529:HOH:O	2.41	0.53
1:A:330:PRO:O	1:A:333:MET:HE3	2.09	0.53
1:A:195:PHE:CD2	1:A:257:TYR:HE2	2.27	0.52
1:A:290:GLN:NE2	1:A:303:SER:H	2.08	0.52
1:A:179:GLU:HG2	1:A:345:ILE:CG2	2.41	0.51
1:A:179:GLU:HG2	1:A:345:ILE:HG21	1.92	0.51
1:A:261:MET:HE2	1:A:262:SER:N	2.27	0.50
1:B:188:MET:HE3	4:B:492:HOH:O	2.12	0.50
1:A:298:GLN:HB2	4:A:522:HOH:O	2.11	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:86:LYS:NZ	4:B:591:HOH:O	2.31	0.50
1:B:139:PHE:HB2	1:B:252:VAL:CG2	2.34	0.50
1:A:330:PRO:CB	1:A:333:MET:HE3	2.42	0.49
1:B:290:GLN:HE21	1:B:303:SER:H	1.61	0.49
1:A:97:ASP:HB3	1:A:335:TYR:CD2	2.49	0.48
1:A:142:HIS:HD2	1:A:145:SER:OG	1.96	0.48
1:A:64:HIS:HE1	1:A:66:GLU:OE2	1.97	0.47
1:A:115:MET:HE1	4:A:591:HOH:O	2.14	0.47
1:A:211:LYS:NZ	4:A:588:HOH:O	2.47	0.47
1:B:142:HIS:HE1	4:B:512:HOH:O	1.97	0.47
1:A:125:TRP:HB2	1:A:328:VAL:HG12	1.97	0.47
1:A:241:ASP:HB2	4:A:522:HOH:O	2.14	0.47
1:B:309:GLU:HA	1:B:314:THR:HG21	1.97	0.47
1:A:143:LYS:HB2	1:A:144:PRO:HD3	1.98	0.45
1:B:115:MET:HA	4:B:462:HOH:O	2.17	0.45
1:B:337:ASP:OD2	1:B:340:LYS:NZ	2.31	0.44
1:A:290:GLN:NE2	1:A:302:VAL:H	2.09	0.44
1:A:199:TRP:HB2	4:A:516:HOH:O	2.18	0.44
1:A:290:GLN:HE21	1:A:303:SER:H	1.66	0.44
1:A:330:PRO:O	1:A:333:MET:CE	2.66	0.44
1:A:94:SER:HA	1:A:261:MET:CE	2.48	0.43
1:B:144:PRO:O	1:B:147:THR:HG23	2.19	0.43
1:B:104:ASN:HB3	1:B:332:LEU:HD22	2.00	0.42
1:B:188:MET:HA	1:B:188:MET:HE2	2.01	0.42
1:A:20:GLN:HE22	1:B:20:GLN:HE21	1.67	0.42
1:A:188:MET:HE1	1:A:202:ILE:HD11	2.01	0.42
1:A:261:MET:CE	1:A:262:SER:C	2.88	0.42
1:B:130:TYR:O	1:B:264:ILE:HA	2.19	0.42
1:B:141:TYR:CZ	1:B:151:PRO:HG3	2.55	0.42
1:A:104:ASN:CB	1:A:332:LEU:HD22	2.51	0.41
1:B:131:ALA:HB1	1:B:262:SER:HB3	2.02	0.41
1:A:186:LEU:O	1:A:190:ARG:HG2	2.20	0.41
1:A:329:SER:N	1:A:330:PRO:CD	2.84	0.41
1:B:142:HIS:HD2	1:B:145:SER:OG	2.04	0.41
1:A:272:ALA:HB3	4:A:452:HOH:O	2.20	0.41
1:A:185:PHE:CE1	1:A:344:LEU:HD23	2.56	0.40
1:A:79:LYS:NZ	4:A:596:HOH:O	2.42	0.40
1:B:185:PHE:CZ	1:B:341:ARG:HG3	2.55	0.40
1:B:20:GLN:HG3	4:B:592:HOH:O	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	328/355 (92%)	325 (99%)	3 (1%)	0	100	100
1	B	337/355 (95%)	334 (99%)	2 (1%)	1 (0%)	41	31
All	All	665/710 (94%)	659 (99%)	5 (1%)	1 (0%)	47	38

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	114	ALA

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	273/292 (94%)	271 (99%)	2 (1%)	84	84
1	B	277/292 (95%)	276 (100%)	1 (0%)	91	91
All	All	550/584 (94%)	547 (100%)	3 (0%)	88	89

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	127	ASN
1	A	261	MET
1	B	261	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (14)

such sidechains are listed below:

Mol	Chain	Res	Type
1	A	64	HIS
1	A	127	ASN
1	A	142	HIS
1	A	233	ASN
1	A	290	GLN
1	A	310	ASN
1	A	322	GLN
1	A	338	GLN
1	B	20	GLN
1	B	64	HIS
1	B	142	HIS
1	B	290	GLN
1	B	322	GLN
1	B	338	GLN

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 2 are 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	CIT	A	402	2	12,12,12	1.27	0	17,17,17	1.36	2 (11%)
3	CIT	B	402	2	12,12,12	1.10	1 (8%)	17,17,17	1.52	2 (11%)

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	CIT	A	402	2	-	2/16/16/16	-
3	CIT	B	402	2	-	0/16/16/16	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	402	CIT	O2-C1	-2.29	1.23	1.30

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	402	CIT	O6-C6-C3	4.35	120.61	113.05
3	B	402	CIT	O6-C6-C3	3.86	119.75	113.05
3	B	402	CIT	O2-C1-O1	-2.71	116.55	123.30
3	A	402	CIT	O6-C6-O5	-2.09	117.16	123.82

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	402	CIT	O1-C1-C2-C3
3	A	402	CIT	C3-C4-C5-O3

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

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	334/355 (94%)	0.41	23 (6%) 16 19	17, 28, 46, 55	0
1	B	339/355 (95%)	0.38	21 (6%) 20 23	17, 28, 45, 56	0
All	All	673/710 (94%)	0.39	44 (6%) 18 21	17, 28, 45, 56	0

All (44) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	31	THR	7.0
1	A	330	PRO	6.2
1	B	114	ALA	6.2
1	B	196	GLY	6.1
1	A	195	PHE	5.9
1	A	333	MET	5.3
1	A	353	ARG	5.3
1	B	195	PHE	4.7
1	A	318	ILE	4.7
1	B	32	ASP	4.3
1	A	321	ALA	4.1
1	A	354	SER	4.1
1	B	333	MET	3.9
1	A	168	GLU	3.8
1	B	30	LYS	3.7
1	A	332	LEU	3.5
1	B	15	SER	3.5
1	A	196	GLY	3.4
1	A	167	LYS	3.3
1	B	33	ALA	3.2
1	B	42	LEU	3.0
1	B	197	ASP	3.0
1	B	353	ARG	2.9
1	A	329	SER	2.8

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Mol	Chain	Res	Type	RSRZ
1	A	42	LEU	2.8
1	B	167	LYS	2.8
1	B	330	PRO	2.7
1	B	329	SER	2.6
1	B	168	GLU	2.5
1	A	297	LEU	2.3
1	B	29	GLY	2.2
1	B	346	GLU	2.2
1	B	261	MET	2.1
1	B	247	PRO	2.1
1	A	46	LEU	2.1
1	A	247	PRO	2.1
1	A	346	GLU	2.1
1	A	28	SER	2.1
1	A	197	ASP	2.1
1	A	350	GLU	2.1
1	B	352	LEU	2.1
1	A	47	ALA	2.0
1	A	264	ILE	2.0
1	A	334	VAL	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
3	CIT	A	402	13/13	0.98	0.10	16,17,19,19	0
3	CIT	B	402	13/13	0.98	0.09	15,17,20,20	0
2	MG	B	401	1/1	0.99	0.10	22,22,22,22	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
2	MG	A	401	1/1	1.00	0.10	22,22,22,22	0

6.5 Other polymers [i](#)

There are no such residues in this entry.