



Full wwPDB X-ray Structure Validation Report ⓘ

May 16, 2020 – 02:14 am BST

PDB ID : 2R5V
Title : Hydroxymandelate Synthase Crystal Structure
Authors : Brownlee, J.M.; He, P.; Moran, G.R.; Harrison, D.H.T.
Deposited on : 2007-09-04
Resolution : 2.30 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 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 : 2.11
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) : 2.11

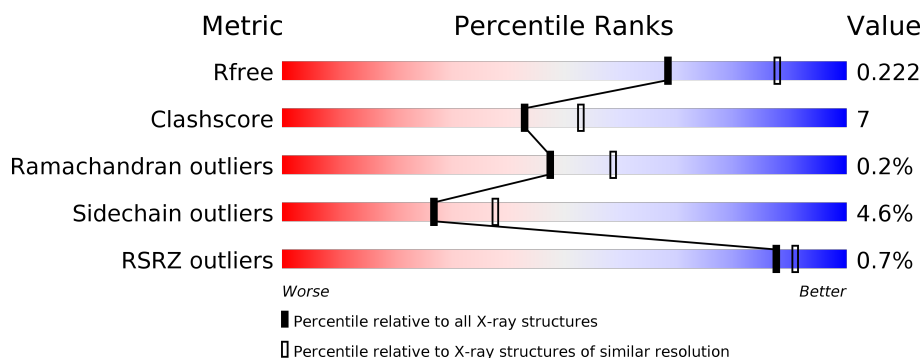
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	5042 (2.30-2.30)
Clashscore	141614	5643 (2.30-2.30)
Ramachandran outliers	138981	5575 (2.30-2.30)
Sidechain outliers	138945	5575 (2.30-2.30)
RSRZ outliers	127900	4938 (2.30-2.30)

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 on 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	357	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, orange, yellow, green, grey);"></div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> % 83% 11% • • </div> </div>
1	B	357	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, orange, yellow, green, grey);"></div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> % 77% 13% • 8% </div> </div>

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 5295 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.

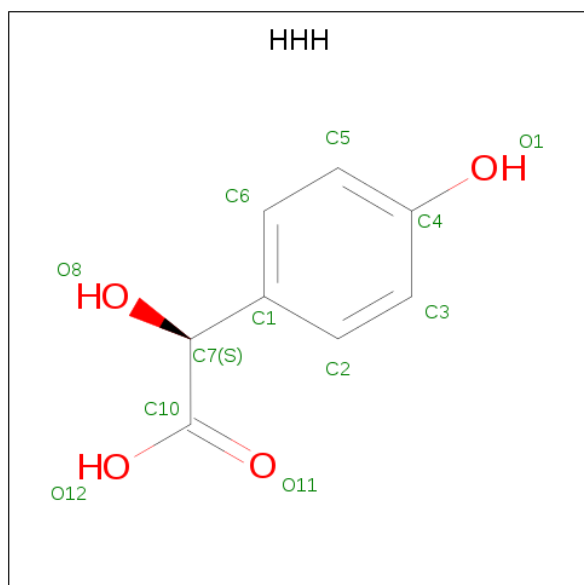
- Molecule 1 is a protein called PCZA361.1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	346	Total	C	N	O	S	0	0	0
			2585	1619	449	512	5			
1	B	330	Total	C	N	O	S	0	0	0
			2462	1553	423	481	5			

- Molecule 2 is COBALT (II) ION (three-letter code: CO) (formula: Co).

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

- Molecule 3 is (2S)-hydroxy(4-hydroxyphenyl)ethanoic acid (three-letter code: HHH) (formula: C₈H₈O₄).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			12	8	4		
3	B	1	Total	C	O	0	0
			12	8	4		

- Molecule 4 is PHOSPHATE ION (three-letter code: PO4) (formula: O₄P).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	B	1	Total	O	P	0	0
			5	4	1		

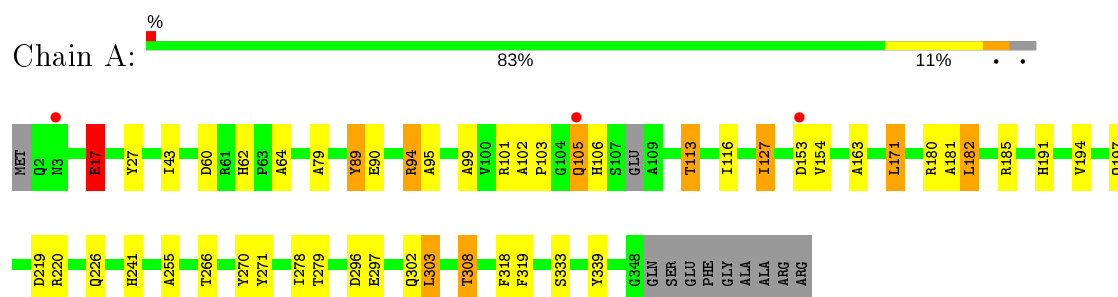
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	112	Total	O	0	0
			112	112		
5	B	105	Total	O	0	0
			105	105		

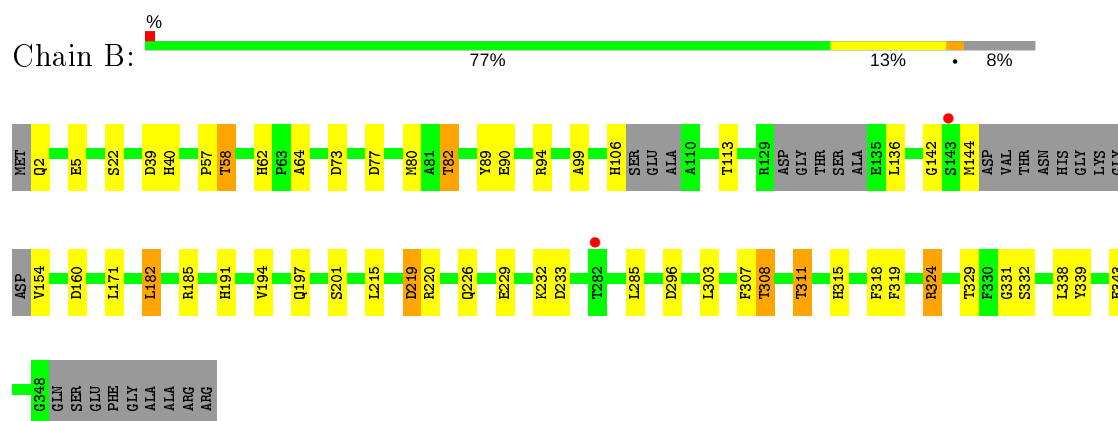
3 Residue-property plots

These plots are drawn for all protein, RNA and DNA 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 ($\text{RSRZ} > 2$). 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: PCZA361.1



• Molecule 1: PCZA361.1



4 Data and refinement statistics

Property	Value	Source
Space group	P 41	Depositor
Cell constants a, b, c, α , β , γ	106.37Å 106.37Å 75.95Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.57 – 2.30 47.57 – 2.30	Depositor EDS
% Data completeness (in resolution range)	99.8 (47.57-2.30) 99.9 (47.57-2.30)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	7.04 (at 2.29Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.174 , 0.227 0.173 , 0.222	Depositor DCC
R_{free} test set	1898 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	40.8	Xtriage
Anisotropy	0.048	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 44.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.029 for h,-k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	5295	wwPDB-VP
Average B, all atoms (Å ²)	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.69% 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: PO4, HHH, CO

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	1.12	4/2635 (0.2%)	0.97	6/3586 (0.2%)
1	B	1.09	0/2509	1.01	10/3415 (0.3%)
All	All	1.10	4/5144 (0.1%)	0.99	16/7001 (0.2%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	17	GLU	CB-CG	11.15	1.73	1.52
1	A	27	TYR	CD1-CE1	6.22	1.48	1.39
1	A	89	TYR	CE1-CZ	5.30	1.45	1.38
1	A	270	TYR	CD1-CE1	5.11	1.47	1.39

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	324	ARG	NE-CZ-NH2	-16.14	112.23	120.30
1	B	324	ARG	NE-CZ-NH1	15.23	127.91	120.30
1	A	185	ARG	NE-CZ-NH2	-10.12	115.24	120.30
1	A	185	ARG	NE-CZ-NH1	9.23	124.92	120.30
1	B	324	ARG	CD-NE-CZ	6.79	133.10	123.60
1	B	185	ARG	NE-CZ-NH1	6.44	123.52	120.30
1	A	94	ARG	NE-CZ-NH1	-6.25	117.18	120.30
1	B	182	LEU	CA-CB-CG	6.10	129.33	115.30
1	B	220	ARG	NE-CZ-NH2	-5.99	117.30	120.30
1	B	324	ARG	CG-CD-NE	-5.50	100.24	111.80
1	A	303	LEU	CB-CG-CD1	-5.38	101.86	111.00
1	B	73	ASP	CB-CG-OD1	5.31	123.08	118.30
1	B	219	ASP	CB-CG-OD1	5.27	123.04	118.30
1	A	171	LEU	CA-CB-CG	5.25	127.37	115.30
1	A	127	ILE	CG1-CB-CG2	-5.06	100.27	111.40

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	77	ASP	CB-CG-OD1	5.06	122.85	118.30

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts ⓘ

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	2585	0	2456	38	0
1	B	2462	0	2339	30	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	12	0	7	0	0
3	B	12	0	6	0	0
4	B	5	0	0	0	0
5	A	112	0	0	2	0
5	B	105	0	0	6	0
All	All	5295	0	4808	67	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 (67) 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:62:HIS:HD2	1:A:64:ALA:H	1.22	0.88
1:A:90:GLU:OE2	1:A:94:ARG:NH1	2.11	0.84
1:A:101:ARG:NH2	1:A:113:THR:HG23	1.95	0.80
1:A:191:HIS:HE1	1:A:219:ASP:OD2	1.68	0.77
1:A:308:THR:HG22	1:A:319:PHE:H	1.50	0.77
1:A:105:GLN:O	5:A:4216:HOH:O	2.08	0.71
1:A:278:ILE:HD11	1:A:302:GLN:HE21	1.56	0.71
1:A:79:ALA:HB1	1:A:127:ILE:HD11	1.73	0.70
1:A:62:HIS:CD2	1:A:64:ALA:H	2.08	0.69
1:B:142:GLY:HA2	5:B:4287:HOH:O	1.91	0.69

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:101:ARG:NH2	1:A:113:THR:CG2	2.56	0.69
1:A:105:GLN:O	1:A:106:HIS:HB2	1.91	0.68
1:B:62:HIS:HD2	1:B:64:ALA:H	1.42	0.68
1:A:297:GLU:HG3	1:A:302:GLN:HG2	1.77	0.66
1:A:101:ARG:HH22	1:A:113:THR:HG23	1.61	0.65
1:B:160:ASP:OD1	1:B:324:ARG:HD2	1.98	0.63
1:A:308:THR:CG2	1:A:319:PHE:H	2.12	0.63
1:B:62:HIS:CD2	1:B:64:ALA:H	2.18	0.61
1:B:39:ASP:HA	1:B:58:THR:HG22	1.83	0.61
1:B:58:THR:HG21	5:B:4231:HOH:O	1.99	0.60
1:B:308:THR:HG22	1:B:319:PHE:H	1.67	0.59
1:B:106:HIS:HE1	5:B:4264:HOH:O	1.85	0.57
1:B:191:HIS:HE1	1:B:219:ASP:OD2	1.88	0.57
1:A:79:ALA:HB1	1:A:127:ILE:CD1	2.37	0.55
1:A:153:ASP:HB3	1:A:255:ALA:HB2	1.90	0.53
1:B:308:THR:HG22	1:B:318:PHE:HB2	1.92	0.52
1:B:194:VAL:O	1:B:197:GLN:HG2	2.10	0.51
1:A:308:THR:HG22	1:A:318:PHE:HB2	1.94	0.50
1:B:2:GLN:CB	1:B:82:THR:OG1	2.61	0.49
1:A:278:ILE:HD11	1:A:302:GLN:NE2	2.26	0.49
1:B:324:ARG:NH2	1:B:329:THR:O	2.40	0.49
1:A:163:ALA:CB	1:A:241:HIS:CE1	2.98	0.46
1:A:266:THR:HG22	1:A:271:TYR:CE2	2.51	0.46
1:B:226:GLN:HE22	1:B:339:TYR:HD2	1.64	0.46
1:A:226:GLN:HE22	1:A:339:TYR:HD2	1.64	0.46
1:B:201:SER:HA	1:B:215:LEU:O	2.16	0.45
1:A:105:GLN:O	1:A:106:HIS:CB	2.61	0.45
1:A:296:ASP:OD2	1:A:333:SER:HB3	2.17	0.45
1:A:220:ARG:HB2	1:A:220:ARG:HE	1.65	0.45
1:A:89:TYR:OH	1:A:99:ALA:HB1	2.16	0.45
1:B:89:TYR:OH	1:B:99:ALA:HB1	2.17	0.44
1:B:308:THR:HG23	5:B:4193:HOH:O	2.17	0.43
1:B:229:GLU:OE1	1:B:233:ASP:OD2	2.36	0.43
1:B:57:PRO:HB3	1:B:64:ALA:HB3	2.00	0.43
1:A:95:ALA:HB3	1:A:181:ALA:HA	2.00	0.43
1:A:308:THR:HG23	5:A:4121:HOH:O	2.17	0.43
1:A:116:ILE:HD11	1:A:182:LEU:HD11	2.00	0.43
1:A:226:GLN:NE2	1:A:339:TYR:HD2	2.17	0.42
1:B:90:GLU:CG	1:B:94:ARG:NH1	2.82	0.42
1:A:103:PRO:HA	1:A:113:THR:O	2.19	0.42
1:A:278:ILE:CD1	1:A:297:GLU:OE1	2.67	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:39:ASP:OD1	1:B:40:HIS:HD2	2.02	0.42
1:A:194:VAL:O	1:A:197:GLN:HG2	2.19	0.42
1:B:296:ASP:OD2	1:B:331:GLY:HA3	2.20	0.42
1:B:343:GLU:OE1	1:B:343:GLU:HA	2.19	0.42
1:B:315:HIS:ND1	5:B:4260:HOH:O	2.36	0.42
1:B:308:THR:CG2	1:B:319:PHE:H	2.32	0.42
1:A:278:ILE:HD13	1:A:297:GLU:OE1	2.19	0.41
1:A:43:ILE:HG21	1:A:43:ILE:HD13	1.71	0.41
1:A:17:GLU:H	1:A:17:GLU:HG3	1.48	0.41
1:B:311:THR:CG2	5:B:4285:HOH:O	2.69	0.41
1:A:303:LEU:HD12	1:A:303:LEU:HA	1.36	0.41
1:B:307:PHE:CE2	1:B:338:LEU:HB3	2.56	0.41
1:A:180:ARG:HH12	1:B:58:THR:HG23	1.85	0.41
1:B:90:GLU:O	1:B:94:ARG:HB2	2.21	0.41
1:B:5:GLU:O	1:B:80:MET:HA	2.22	0.40
1:A:102:ALA:HA	1:A:103:PRO:HD3	1.94	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	342/357 (96%)	331 (97%)	10 (3%)	1 (0%)	41	50
1	B	322/357 (90%)	306 (95%)	16 (5%)	0	100	100
All	All	664/714 (93%)	637 (96%)	26 (4%)	1 (0%)	47	58

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	105	GLN

5.3.2 Protein sidechains ⓘ

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	260/276 (94%)	252 (97%)	8 (3%)	40	55
1	B	245/276 (89%)	230 (94%)	15 (6%)	18	25
All	All	505/552 (92%)	482 (95%)	23 (5%)	27	38

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	17	GLU
1	A	60	ASP
1	A	113	THR
1	A	154	VAL
1	A	171	LEU
1	A	182	LEU
1	A	279	THR
1	A	308	THR
1	B	22	SER
1	B	58	THR
1	B	82	THR
1	B	113	THR
1	B	136	LEU
1	B	144	MET
1	B	154	VAL
1	B	171	LEU
1	B	182	LEU
1	B	232	LYS
1	B	285	LEU
1	B	303	LEU
1	B	308	THR
1	B	311	THR
1	B	332	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	62	HIS
1	A	191	HIS
1	A	200	ASN
1	A	226	GLN
1	A	302	GLN
1	B	40	HIS
1	B	62	HIS
1	B	200	ASN
1	B	226	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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 5 ligands modelled in this entry, 2 are monoatomic - leaving 3 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	HHH	B	4116	2	9,12,12	1.17	0	11,16,16	1.06	0
3	HHH	A	4114	2	9,12,12	1.21	1 (11%)	11,16,16	0.96	0
4	PO4	B	4115	-	4,4,4	0.75	0	6,6,6	1.25	1 (16%)

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	HHH	B	4116	2	-	2/4/8/8	0/1/1/1
3	HHH	A	4114	2	-	2/4/8/8	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	4114	HHH	C5-C4	2.94	1.44	1.38

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	B	4115	PO4	O3-P-O2	2.25	115.20	107.97

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	4116	HHH	C6-C1-C7-O8
3	B	4116	HHH	C2-C1-C7-O8
3	A	4114	HHH	C6-C1-C7-O8
3	A	4114	HHH	C2-C1-C7-O8

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	346/357 (96%)	-0.34	3 (0%) 84 88	24, 36, 58, 80	0
1	B	330/357 (92%)	-0.21	2 (0%) 89 92	23, 38, 57, 72	0
All	All	676/714 (94%)	-0.28	5 (0%) 87 91	23, 37, 58, 80	0

All (5) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	143	SER	2.9
1	A	3	ASN	2.6
1	A	153	ASP	2.5
1	B	282	THR	2.1
1	A	105	GLN	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 carbohydrates 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(\AA^2)	Q<0.9
3	HHH	B	4116	12/12	0.97	0.09	27,32,36,38	0
4	PO4	B	4115	5/5	0.97	0.11	48,49,54,55	0
3	HHH	A	4114	12/12	0.98	0.10	28,32,39,43	0
2	CO	B	4114	1/1	0.99	0.11	37,37,37,37	0
2	CO	A	4113	1/1	1.00	0.10	39,39,39,39	0

6.5 Other polymers [i](#)

There are no such residues in this entry.