



wwPDB X-ray Structure Validation Summary Report

Feb 28, 2014 – 11:51 AM GMT

PDB ID : 1KBY
Title : Structure of Photosynthetic Reaction Center with bacteriochlorophyll-bacteriopheophytinheterodimer
Authors : Camara-Artigas, A.; Magee, C.; Goetsch, A.; Allen, J.P.
Deposited on : 2001-11-07
Resolution : 2.50 Å(reported)

This is a wwPDB validation summary report for a publicly released PDB entry.

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

A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

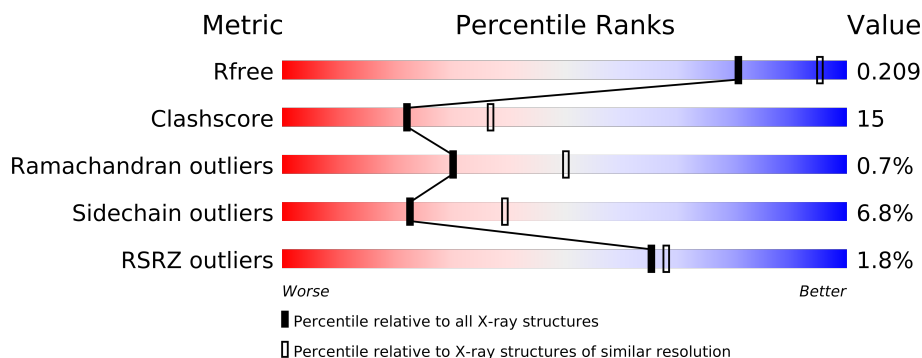
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	1.15 2013
Xtriage (Phenix)	:	dev-1323
EDS	:	stable22639
Percentile statistics	:	21963
Refmac	:	5.8.0049
CCP4	:	6.3.0 (Settle)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP)	:	stable22683

1 Overall quality at a glance

The reported resolution of this entry is 2.50 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}	66092	2784 (2.50-2.50)
Clashscore	79885	3562 (2.50-2.50)
Ramachandran outliers	78287	3480 (2.50-2.50)
Sidechain outliers	78261	3482 (2.50-2.50)
RSRZ outliers	66119	2785 (2.50-2.50)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	L	281	
2	M	307	
3	H	260	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
5	CL	M	6000	-	X
6	BCL	L	850	-	X
6	BCL	L	851	-	X
7	BPH	L	854	-	X
7	BPH	M	852	-	X
9	SPO	M	859	-	X

2 Entry composition

There are 11 unique types of molecules in this entry. The entry contains 7220 atoms, of which 0 are hydrogen and 0 are deuterium.

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 PHOTOSYNTHETIC REACTION CENTER PROTEIN L CHAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	L	281	Total	C	N	O	S	0	0	0
			2232	1507	355	362	8			

- Molecule 2 is a protein called PHOTOSYNTHETIC REACTION CENTER PROTEIN M CHAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	M	302	Total	C	N	O	S	0	0	0
			2406	1607	392	397	10			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
M	202	LEU	HIS	ENGINEERED	UNP P02953

- Molecule 3 is a protein called PHOTOSYNTHETIC REACTION CENTER PROTEIN H CHAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	H	236	Total	C	N	O	S	0	0	0
			1794	1148	305	332	9			

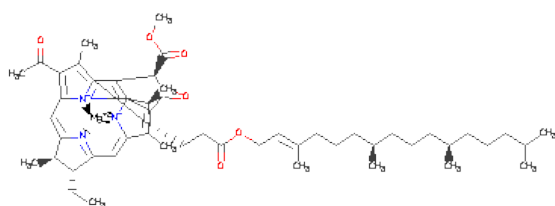
- Molecule 4 is FE (III) ION (three-letter code: FE) (formula: Fe).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	M	1	Total	Fe	0	0
			1	1		

- Molecule 5 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

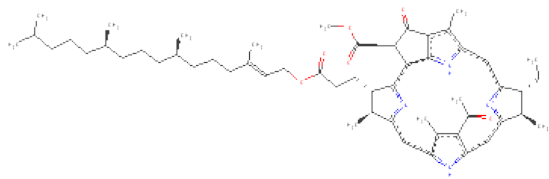
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	M	1	Total	Cl	0	0
			1	1		

- Molecule 6 is BACTERIOCHLOROPHYLL A (three-letter code: BCL) (formula: $C_{55}H_{74}MgN_4O_6$).



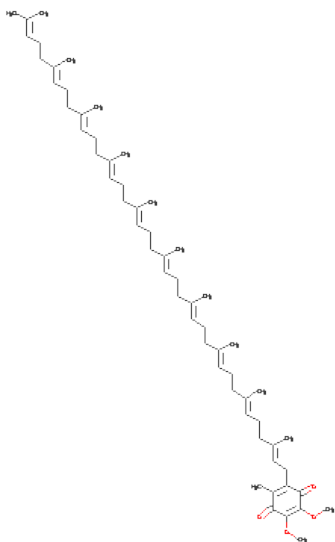
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
6	L	1	Total	C	Mg	N	O	0	0
			66	55	1	4	6		
6	L	1	Total	C	Mg	N	O	0	0
			66	55	1	4	6		
6	L	1	Total	C	Mg	N	O	0	0
			66	55	1	4	6		

- Molecule 7 is BACTERIOPHEOPHYTIN A (three-letter code: BPH) (formula: $C_{55}H_{76}N_4O_6$).



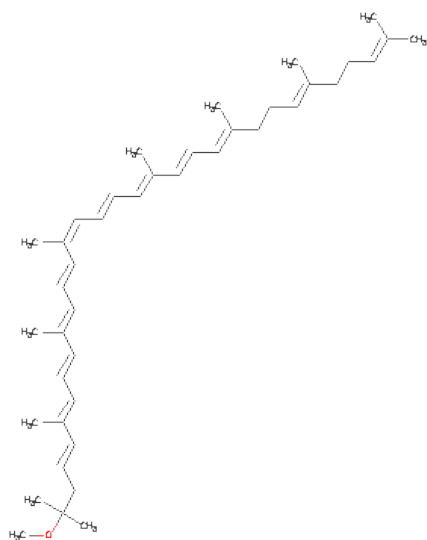
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
7	M	1	Total	C	N	O	0	0
			65	55	4	6		
7	L	1	Total	C	N	O	0	0
			65	55	4	6		
7	L	1	Total	C	N	O	0	0
			65	55	4	6		

- Molecule 8 is UBIQUINONE-10 (three-letter code: U10) (formula: C₅₉H₉₀O₄).



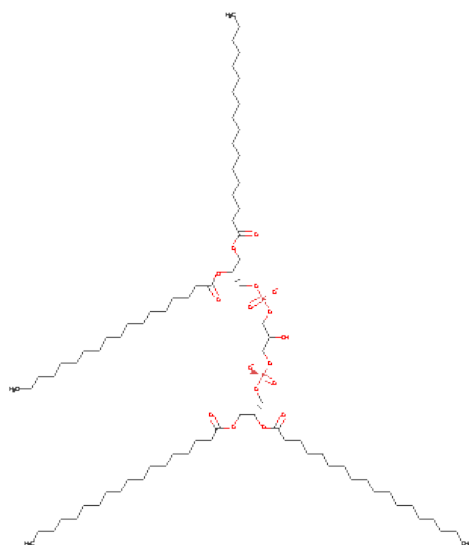
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
8	M	1	Total	C	O	0	0
			48	44	4		

- Molecule 9 is SPHEROIDENE (three-letter code: SPO) (formula: $C_{41}H_{60}O$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
9	M	1	Total	C	O	0	0
			42	41	1		

- Molecule 10 is CARDIOLIPIN (three-letter code: CDL) (formula: $C_{81}H_{156}O_{17}P_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
10	M	1	Total	C	O	P	0	0
			81	62	17	2		

- Molecule 11 is water.

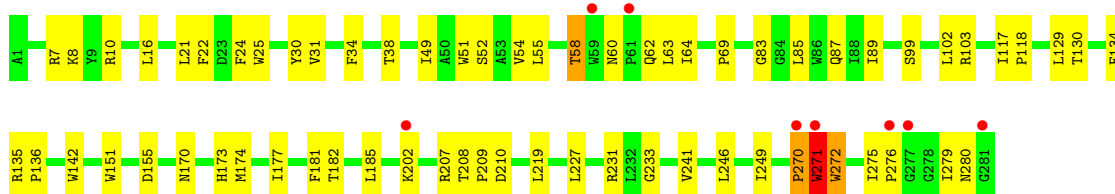
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
11	H	77	Total 77	O 77	0	0
11	L	74	Total 74	O 74	0	0
11	M	71	Total 71	O 71	0	0

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 errors 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.

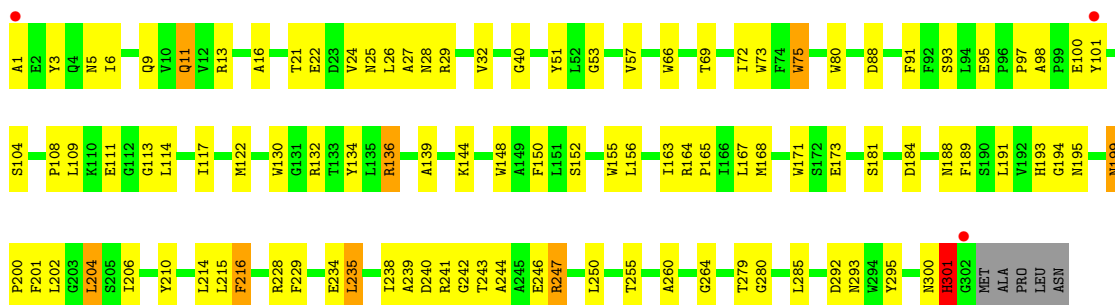
- Molecule 1: PHOTOSYNTHETIC REACTION CENTER PROTEIN L CHAIN

Chain L: 



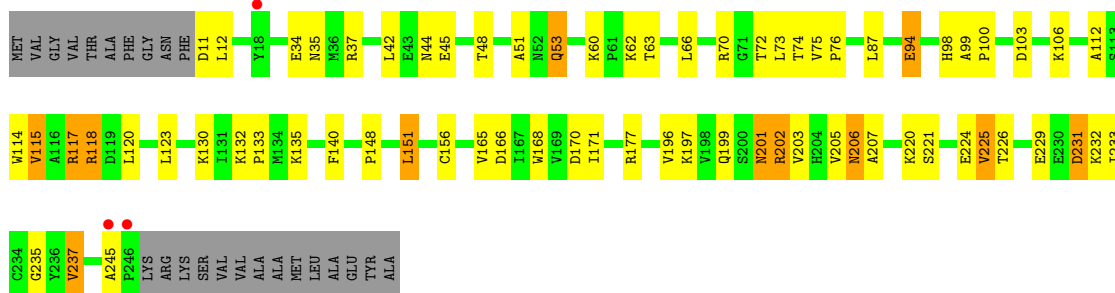
- Molecule 2: PHOTOSYNTHETIC REACTION CENTER PROTEIN M CHAIN

Chain M: 



- Molecule 3: PHOTOSYNTHETIC REACTION CENTER PROTEIN H CHAIN

Chain H: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	142.31Å 142.31Å 187.59Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	27.07 – 2.50 27.07 – 2.56	Depositor EDS
% Data completeness (in resolution range)	81.4 (27.07-2.50) 83.8 (27.07-2.56)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	0.12	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.62 (at 2.57Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.195 , 0.224 0.193 , 0.209	Depositor DCC
R_{free} test set	6034 reflections (11.28%)	DCC
Wilson B-factor (Å ²)	46.9	Xtriage
Anisotropy	0.124	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 60.0	EDS
Estimated twinning fraction	0.021 for -h,-k,l	Xtriage
L-test for twinning	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	0 of 59548 reflections	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	7220	wwPDB-VP
Average B, all atoms (Å ²)	46.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.78% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: BCL, CL, CDL, BPH, FE, SPO, U10

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	L	0.43	0/2320	0.61	0/3175
2	M	0.43	0/2497	0.60	0/3409
3	H	0.39	0/1842	0.66	0/2509
All	All	0.42	0/6659	0.62	0/9093

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	L	2232	0	2187	60	0
2	M	2406	0	2325	78	0
3	H	1794	0	1792	64	0
4	M	1	0	0	0	0
5	M	1	0	0	0	0
6	L	198	0	222	16	0
7	L	130	0	152	17	0
7	M	65	0	76	9	0
8	M	48	0	63	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
9	M	42	0	60	1	0
10	M	81	0	106	1	0
11	H	77	0	0	1	0
11	L	74	0	0	2	0
11	M	71	0	0	3	0
All	All	7220	0	6983	210	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 15.

The worst 5 of 210 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:L:272:TRP:HA	1:L:275:ILE:HD13	1.42	1.00
7:M:852:BPH:HBD	7:M:852:BPH:HAA2	1.47	0.96
2:M:21:THR:HG23	2:M:26:LEU:HD11	1.45	0.95
1:L:34:PHE:O	1:L:38:THR:HG23	1.74	0.88
6:L:850:BCL:H93	7:M:852:BPH:H203	1.56	0.87

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone ⓘ

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	L	279/281 (99%)	262 (94%)	15 (5%)	2 (1%)	30	50
2	M	300/307 (98%)	286 (95%)	13 (4%)	1 (0%)	50	73
3	H	234/260 (90%)	222 (95%)	9 (4%)	3 (1%)	18	29
All	All	813/848 (96%)	770 (95%)	37 (5%)	6 (1%)	30	50

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	M	301	HIS

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Mol	Chain	Res	Type
3	H	220	LYS
3	H	51	ALA
1	L	270	PRO
1	L	271	TRP

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	L	220/220 (100%)	209 (95%)	11 (5%)	34	58
2	M	236/240 (98%)	218 (92%)	18 (8%)	19	33
3	H	191/208 (92%)	176 (92%)	15 (8%)	18	31
All	All	647/668 (97%)	603 (93%)	44 (7%)	22	39

5 of 44 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	M	204	LEU
2	M	247	ARG
3	H	206	ASN
2	M	214	LEU
2	M	216	PHE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 12 such sidechains are listed below:

Mol	Chain	Res	Type
2	M	193	HIS
2	M	199	ASN
3	H	98	HIS
2	M	28	ASN
3	H	44	ASN

5.3.3 RNA ⓘ

There are no RNA chains 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 ⓘ

There are no carbohydrates in this entry.

5.6 Ligand geometry ⓘ

Of 11 ligands modelled in this entry, 2 are monoatomic - leaving 9 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$
6	BCL	L	850	-	74,74,74	2.29	14 (18%)	97,115,115	5.14	29 (29%)
6	BCL	L	851	-	74,74,74	1.49	11 (14%)	97,115,115	1.91	23 (23%)
6	BCL	L	853	-	74,74,74	1.55	14 (18%)	97,115,115	2.15	27 (27%)
7	BPH	L	854	-	70,70,70	1.57	8 (11%)	94,101,101	1.98	21 (22%)
7	BPH	L	855	-	70,70,70	1.44	10 (14%)	94,101,101	2.06	22 (23%)
10	CDL	M	5000	-	80,80,99	1.23	5 (6%)	92,92,111	1.04	7 (7%)
7	BPH	M	852	-	70,70,70	1.61	11 (15%)	94,101,101	2.63	26 (27%)
8	U10	M	857	-	48,48,63	2.30	14 (29%)	59,61,79	2.35	24 (40%)
9	SPO	M	859	-	41,41,41	3.53	27 (65%)	50,50,50	2.87	17 (34%)

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
6	BCL	L	850	-	-	0/41/137/137	0/0/9/9
6	BCL	L	851	-	-	0/41/137/137	0/0/9/9
6	BCL	L	853	-	-	0/41/137/137	0/0/9/9
7	BPH	L	854	-	2/2/18/22	0/49/105/105	0/0/6/6

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
7	BPH	L	855	-	2/2/18/22	0/49/105/105	0/0/6/6
10	CDL	M	5000	-	1/1/9/9	0/91/91/110	0/0/0/0
7	BPH	M	852	-	2/2/18/22	0/49/105/105	0/0/6/6
8	U10	M	857	-	-	0/45/69/87	0/1/1/1
9	SPO	M	859	-	-	0/47/47/47	0/0/0/0

The worst 5 of 114 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	L	850	BCL	C3B-C4B	11.36	1.58	1.40
6	L	850	BCL	C1B-NB	-8.91	1.24	1.34
9	M	859	SPO	C15-C16	8.90	1.58	1.34
8	M	857	U10	C6-C1	7.59	1.54	1.35
9	M	859	SPO	C10-C11	6.93	1.53	1.34

The worst 5 of 196 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	L	850	BCL	OBB-CAB-C3B	28.58	162.96	120.07
6	L	850	BCL	C4B-C3B-C2B	-23.38	78.68	106.97
6	L	850	BCL	C3B-C4B-NB	18.30	126.43	108.64
6	L	850	BCL	OBB-CAB-CBB	-16.90	78.14	120.13
6	L	850	BCL	CBB-CAB-C3B	-12.14	84.83	120.30

5 of 7 chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
7	L	855	BPH	C8
7	L	855	BPH	C13
10	M	5000	CDL	CA4
7	M	852	BPH	C8
7	M	852	BPH	C13

There are no torsion outliers.

There are no ring outliers.

5.7 Other polymers ⓘ

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	L	281/281 (100%)	-0.49	8 (2%)	50	53	24, 39, 73, 82	0
2	M	302/307 (98%)	-0.47	3 (0%)	79	81	23, 45, 74, 89	0
3	H	236/260 (90%)	-0.51	3 (1%)	74	76	28, 45, 65, 85	0
All	All	819/848 (96%)	-0.49	14 (1%)	65	69	23, 44, 72, 89	0

The worst 5 of 14 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	M	1	ALA	5.5
1	L	59	TRP	4.5
3	H	245	ALA	3.2
2	M	302	GLY	3.0
3	H	246	PRO	2.7

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

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

6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

6.4 Ligands ⓘ

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	RSR	LLDF	B-factors(\AA^2)	Q<0.9
5	CL	M	6000	1/1	0.45	6.88	100,100,100,100	0
6	BCL	L	850	66/66	0.22	3.21	35,46,96,98	0
9	SPO	M	859	42/42	0.25	2.90	47,62,74,75	0
7	BPH	M	852	65/65	0.18	2.88	33,37,66,76	0
7	BPH	L	854	65/65	0.19	2.71	39,44,95,98	0
6	BCL	L	851	66/66	0.16	2.02	30,37,47,60	0
8	U10	M	857	48/63	0.16	1.64	41,51,69,70	0
10	CDL	M	5000	81/100	0.20	1.36	59,76,86,90	0
7	BPH	L	855	65/65	0.14	1.35	26,35,46,53	0
6	BCL	L	853	66/66	0.14	0.87	24,30,60,66	0
4	FE	M	856	1/1	0.08	-1.32	28,28,28,28	0

6.5 Other polymers ⓘ

There are no such residues in this entry.