W O R L D W I D E

wwPDB

P R O T E I N   D A T A   B A N K

wwPDB X-ray Structure Validation Summary Report (i)

Sep 16, 2023 – 06:27 PM EDT

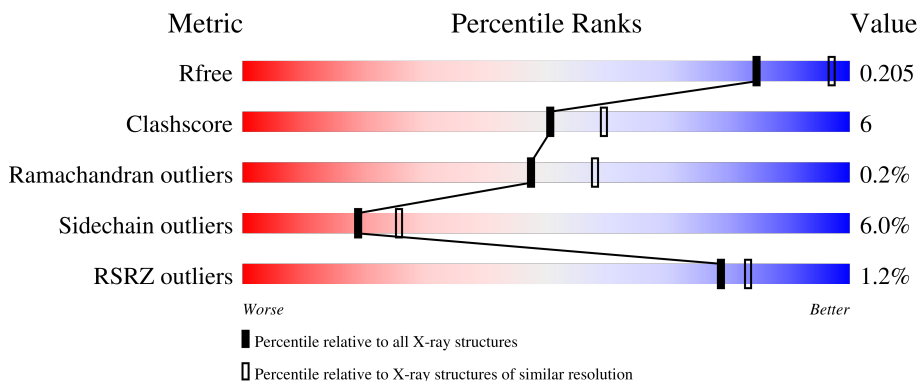|		
PDB ID	:	4PFM
Title	:	SHEWANELLA BENTHICA DHDPS WITH LYSINE AND PYRUVATE
Authors	:	Wubben, J.M.; Paxman, J.J.; Dogovski, C.; Panjikar, S.; Perugini, M.A.
Deposited on	:	2014-04-30
Resolution	:	2.33 Å(reported)

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 2.33 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	Percentile Ranks	Value
Rfree		0.205
Clashscore		6
Ramachandran outliers		0.2%
Sidechain outliers		6.0%
RSRZ outliers		1.2%

Worse   *Better*

▮ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	5974 (2.34-2.30)
Clashscore	141614	6604 (2.34-2.30)
Ramachandran outliers	138981	6523 (2.34-2.30)
Sidechain outliers	138945	6523 (2.34-2.30)
RSRZ outliers	127900	5855 (2.34-2.30)

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 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 <=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	295	86% 10% ··
1	B	295	85% 14% ·

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	GOL	B	303	-	-	-	X

2 Entry composition ⓘ

There are 6 unique types of molecules in this entry. The entry contains 4774 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 4-hydroxy-tetrahydrodipicolinate synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	295	Total	C	N	O	S	0	2	0
			2202	1395	368	429	10			
1	B	295	Total	C	N	O	S	0	2	0
			2200	1393	367	430	10			

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	68	SER	ALA	conflict	UNP A9DKW4
A	97	VAL	LEU	conflict	UNP A9DKW4
A	98	ALA	VAL	conflict	UNP A9DKW4
A	120	THR	LYS	conflict	UNP A9DKW4
A	167	VAL	LEU	conflict	UNP A9DKW4
A	168	ALA	ASP	conflict	UNP A9DKW4
A	175	ASP	GLU	conflict	UNP A9DKW4
A	209	ILE	LEU	conflict	UNP A9DKW4
B	68	SER	ALA	conflict	UNP A9DKW4
B	97	VAL	LEU	conflict	UNP A9DKW4
B	98	ALA	VAL	conflict	UNP A9DKW4
B	120	THR	LYS	conflict	UNP A9DKW4
B	167	VAL	LEU	conflict	UNP A9DKW4
B	168	ALA	ASP	conflict	UNP A9DKW4
B	175	ASP	GLU	conflict	UNP A9DKW4
B	209	ILE	LEU	conflict	UNP A9DKW4

- Molecule 2 is LYSINE (three-letter code: LYS) (formula: $C_6H_{15}N_2O_2$).

LYS

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total 10	C 6	N 2	O 2	0	0
2	A	1	Total 10	C 6	N 2	O 2	0	0
2	B	1	Total 10	C 6	N 2	O 2	0	0

- Molecule 3 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).

GOL

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

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

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

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

- Molecule 5 is CITRATE ANION (three-letter code: FLC) (formula: $C_6H_5O_7$).
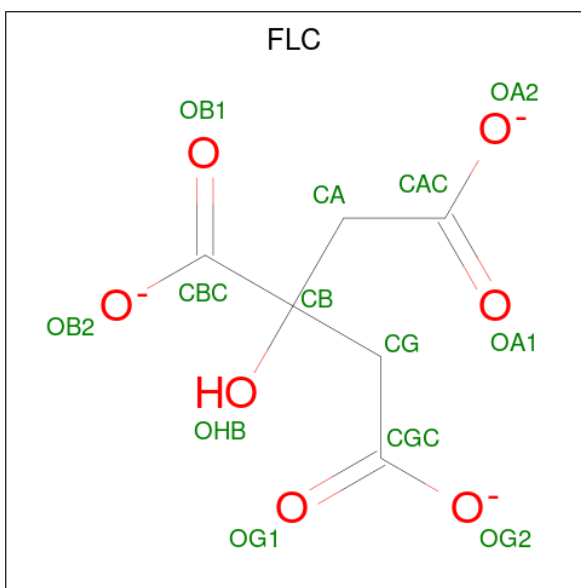
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	B	1	Total 13	C 6	O 7	0	0

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	156	Total 156	O 156	0	0
6	B	159	Total 159	O 159	0	0

3   Residue-property plots ⓘ

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: 4-hydroxy-tetrahydrodipicolinate synthase
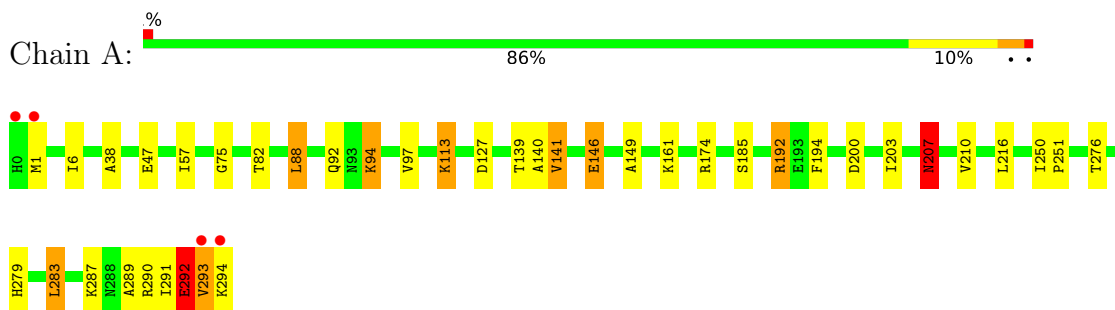
• Molecule 1: 4-hydroxy-tetrahydrodipicolinate synthase
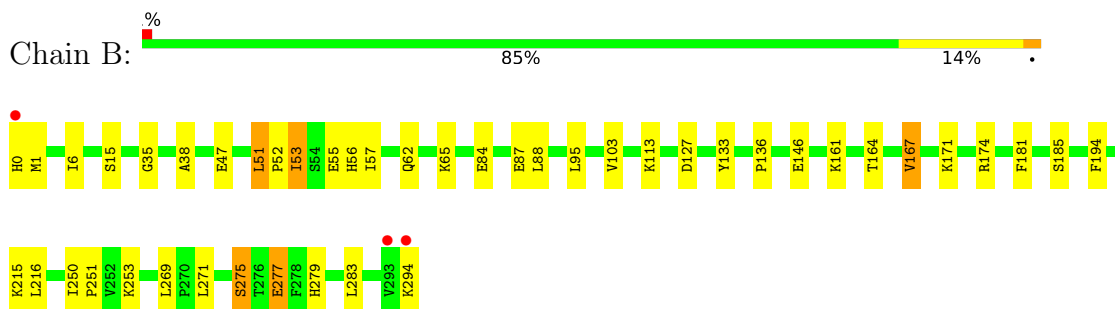
4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	74.27Å 83.93Å 143.87Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.96 – 2.33 44.00 – 2.33	Depositor EDS
% Data completeness (in resolution range)	99.5 (47.96-2.33) 99.5 (44.00-2.33)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.34 (at 2.32Å)	Xtriage
Refinement program	REFMAC 5.5.0110	Depositor
R, R_{free}	0.162 , 0.206 0.161 , 0.205	Depositor DCC
R_{free} test set	1963 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å^2)	44.2	Xtriage
Anisotropy	0.143	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 40.0	EDS
L-test for twinning[2]	$< |L| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	4774	wwPDB-VP
Average B, all atoms (Å^2)	47.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.98% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: NA, GOL, FLC, KPI

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	1.07	4/2222 (0.2%)	0.95	2/3025 (0.1%)
1	B	1.01	1/2220 (0.0%)	0.91	2/3023 (0.1%)
All	All	1.04	5/4442 (0.1%)	0.93	4/6048 (0.1%)

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	A	0	1

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	47	GLU	CG-CD	6.26	1.61	1.51
1	B	146	GLU	CG-CD	6.07	1.61	1.51
1	A	141	VAL	CB-CG1	-5.65	1.41	1.52
1	A	207	ASN	CB-CG	-5.05	1.39	1.51
1	A	292	GLU	CG-CD	5.02	1.59	1.51

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	88	LEU	CA-CB-CG	6.86	131.09	115.30
1	B	51	LEU	CA-CB-CG	6.05	129.22	115.30
1	A	200	ASP	CB-CG-OD1	-5.90	112.99	118.30
1	B	167	VAL	CG1-CB-CG2	5.81	120.20	110.90

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	203	ILE	Peptide

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	2202	0	2235	27	0
1	B	2200	0	2228	24	0
2	A	20	0	24	3	0
2	B	10	0	12	2	0
3	A	6	0	8	0	0
3	B	6	0	8	0	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
5	B	13	0	5	1	0
6	A	156	0	0	1	0
6	B	159	0	0	4	0
All	All	4774	0	4520	51	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 6.

The worst 5 of 51 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:146[A]:GLU:N	1:A:146[A]:GLU:OE1	1.86	1.05
1:A:293:VAL:HG11	6:A:535:HOH:O	1.60	1.01
2:B:301:LYS:O	2:B:301:LYS:HD2	1.84	0.77
1:B:84:GLU:HB2	2:B:301:LYS:HA	1.71	0.72
1:A:94:LYS:HD2	1:A:94:LYS:H	1.57	0.68

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	A	294/295 (100%)	285 (97%)	8 (3%)	1 (0%)	41	50
1	B	294/295 (100%)	288 (98%)	6 (2%)	0	100	100
All	All	588/590 (100%)	573 (97%)	14 (2%)	1 (0%)	47	58

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	293	VAL

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	233/231 (101%)	218 (94%)	15 (6%)	17	23
1	B	233/231 (101%)	220 (94%)	13 (6%)	21	29
All	All	466/462 (101%)	438 (94%)	28 (6%)	19	26

5 of 28 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	292	GLU
1	B	294	LYS
1	B	51	LEU
1	B	275	SER
1	B	1	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	92	GLN
1	A	207	ASN
1	B	56	HIS
1	B	62	GLN
1	B	150	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

2 non-standard protein/DNA/RNA residues are modelled in this entry.

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	$\#|Z| > 2$
1	KPI	B	161	1	11,13,14	1.12	0	10,15,17	2.65	4 (40%)
1	KPI	A	161	1	11,13,14	1.36	3 (27%)	10,15,17	2.26	5 (50%)

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
1	KPI	B	161	1	-	0/13/14/16	-
1	KPI	A	161	1	-	0/13/14/16	-

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	161	KPI	C1-CX1	2.70	1.55	1.49

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	161	KPI	O2-CX2	2.05	1.28	1.22
1	A	161	KPI	CX2-CX1	-2.02	1.47	1.49

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	161	KPI	C1-CX1-CX2	4.97	123.00	118.17
1	A	161	KPI	C1-CX1-CX2	4.68	122.71	118.17
1	B	161	KPI	O2-CX2-CX1	-4.47	115.67	121.38
1	B	161	KPI	O1-CX2-CX1	3.38	123.69	116.35
1	B	161	KPI	CE-NZ-CX1	3.27	130.62	121.70

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates ⓘ

There are no monosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 8 ligands modelled in this entry, 2 are monoatomic - leaving 6 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	GOL	B	303	-	5,5,5	0.43	0	5,5,5	0.47	0
5	FLC	B	302	-	12,12,12	1.23	0	17,17,17	1.78	4 (23%)
2	LYS	B	301	-	8,9,9	1.35	1 (12%)	9,10,10	0.92	0
2	LYS	A	301	-	8,9,9	0.72	0	9,10,10	1.64	2 (22%)
3	GOL	A	303	-	5,5,5	0.49	0	5,5,5	0.30	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	#$\|Z\| > 2$	Counts	RMSZ	#$\|Z\| > 2$
2	LYS	A	302	-	8,9,9	1.08	1 (12%)	9,10,10	1.45	2 (22%)

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	GOL	B	303	-	-	2/4/4/4	-
5	FLC	B	302	-	-	6/16/16/16	-
2	LYS	B	301	-	-	3/9/9/9	-
2	LYS	A	301	-	-	1/9/9/9	-
3	GOL	A	303	-	-	2/4/4/4	-
2	LYS	A	302	-	-	1/9/9/9	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	302	LYS	OXT-C	-2.43	1.22	1.30
2	B	301	LYS	O-C	2.36	1.29	1.22

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	B	302	FLC	OB2-CBC-CB	4.39	120.67	113.05
2	A	301	LYS	OXT-C-CA	3.52	125.38	113.38
2	A	302	LYS	OXT-C-O	-3.27	116.67	124.09
5	B	302	FLC	CB-CG-CGC	2.83	120.67	113.81
2	A	301	LYS	OXT-C-O	-2.70	117.95	124.09

There are no chirality outliers.

5 of 15 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	303	GOL	C1-C2-C3-O3
3	A	303	GOL	O2-C2-C3-O3
3	B	303	GOL	O1-C1-C2-O2
3	B	303	GOL	O1-C1-C2-C3
5	B	302	FLC	CAC-CA-CB-CBC

There are no ring outliers.

3 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	B	302	FLC	1	0
2	B	301	LYS	2	0
2	A	302	LYS	3	0

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	A	294/295 (99%)	-0.21	4 (1%)	75	80	34, 44, 61, 97	0
1	B	294/295 (99%)	-0.11	3 (1%)	82	86	32, 44, 61, 105	0
All	All	588/590 (99%)	-0.16	7 (1%)	79	83	32, 44, 61, 105	0

The worst 5 of 7 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	0	HIS	6.7
1	B	294	LYS	4.2
1	A	294	LYS	3.9
1	B	293	VAL	3.1
1	A	0	HIS	3.0

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

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
1	KPI	A	161	14/15	0.95	0.12	33,37,47,47	0
1	KPI	B	161	14/15	0.96	0.21	36,37,50,50	0

6.3   Carbohydrates ⓘ

There are no monosaccharides 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. 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
5	FLC	B	302	13/13	0.50	0.38	136,139,139,139	0
3	GOL	B	303	6/6	0.71	0.97	58,60,61,61	6
3	GOL	A	303	6/6	0.82	0.32	84,91,93,94	0
2	LYS	B	301	10/10	0.86	0.20	58,60,61,61	0
4	NA	A	304	1/1	0.90	0.11	60,60,60,60	0
4	NA	B	304	1/1	0.95	0.12	63,63,63,63	0
2	LYS	A	302	10/10	0.95	0.19	35,42,45,45	0
2	LYS	A	301	10/10	0.97	0.19	33,41,44,45	0

6.5 Other polymers ⓘ

There are no such residues in this entry.