



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 19, 2016 – 07:52 PM GMT

PDB ID : 4U31
Title : Sco GlgEI-V279S in Complex with maltose-C-phosphonate
Authors : Ronning, D.R.; Lindenberger, J.J.
Deposited on : 2014-07-18
Resolution : 1.85 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
<http://wwpdb.org/validation/2016/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 : 1.7.1 (RC1), CSD as537be (2016)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20026982
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20026982

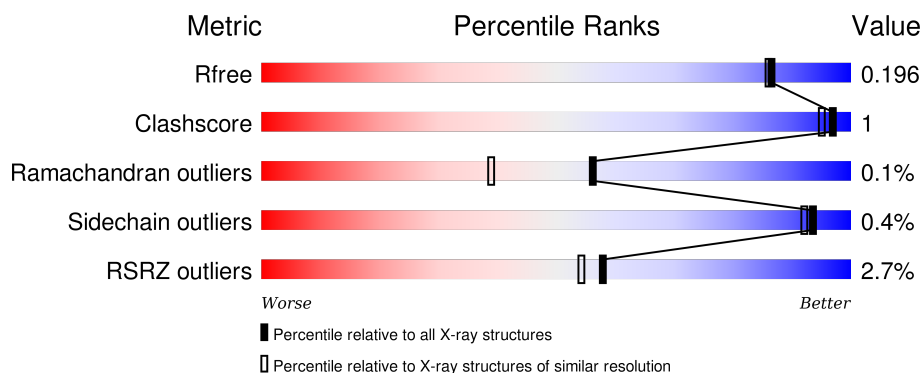
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.85 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}	91344	2634 (1.86-1.82)
Clashscore	102246	2862 (1.86-1.82)
Ramachandran outliers	100387	2831 (1.86-1.82)
Sidechain outliers	100360	2832 (1.86-1.82)
RSRZ outliers	91569	2639 (1.86-1.82)

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. 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	683	<div> <div>3%</div> <div>91%</div> <div>5%</div> </div>
1	B	683	<div> <div>2%</div> <div>92%</div> <div>5%</div> </div>

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
4	EDO	A	703	-	-	-	X
4	EDO	A	704	-	-	-	X
4	EDO	A	706	-	-	-	X
4	EDO	B	703	-	-	-	X

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 11906 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.

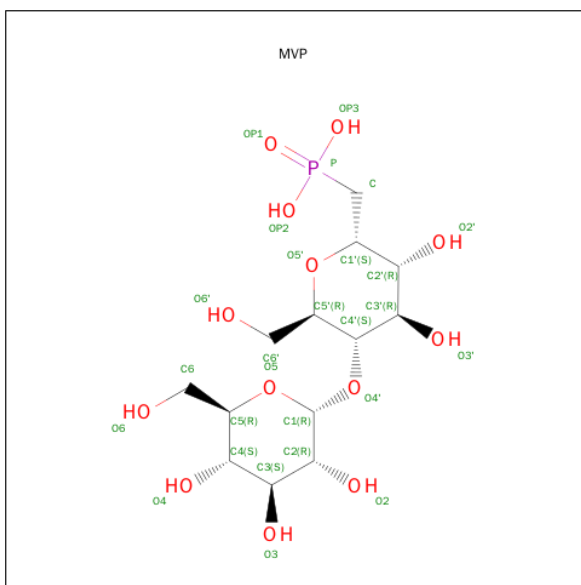
- Molecule 1 is a protein called Alpha-1,4-glucan:maltose-1-phosphate maltosyltransferase 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	649	Total	C	N	O	S	1	6	0
			5207	3281	959	957	10			
1	B	649	Total	C	N	O	S	0	2	0
			5152	3252	939	949	12			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	279	SER	VAL	engineered mutation	UNP Q9L1K2
A	676	ALA	-	expression tag	UNP Q9L1K2
A	677	LEU	-	expression tag	UNP Q9L1K2
A	678	HIS	-	expression tag	UNP Q9L1K2
A	679	HIS	-	expression tag	UNP Q9L1K2
A	680	HIS	-	expression tag	UNP Q9L1K2
A	681	HIS	-	expression tag	UNP Q9L1K2
A	682	HIS	-	expression tag	UNP Q9L1K2
A	683	HIS	-	expression tag	UNP Q9L1K2
B	279	SER	VAL	engineered mutation	UNP Q9L1K2
B	676	ALA	-	expression tag	UNP Q9L1K2
B	677	LEU	-	expression tag	UNP Q9L1K2
B	678	HIS	-	expression tag	UNP Q9L1K2
B	679	HIS	-	expression tag	UNP Q9L1K2
B	680	HIS	-	expression tag	UNP Q9L1K2
B	681	HIS	-	expression tag	UNP Q9L1K2
B	682	HIS	-	expression tag	UNP Q9L1K2
B	683	HIS	-	expression tag	UNP Q9L1K2

- Molecule 2 is (1S)-1,5-anhydro-4-O-alpha-D-glucopyranosyl-1-(phosphonomethyl)-D-glucitol (three-letter code: MVP) (formula: C₁₃H₂₅O₁₃P).



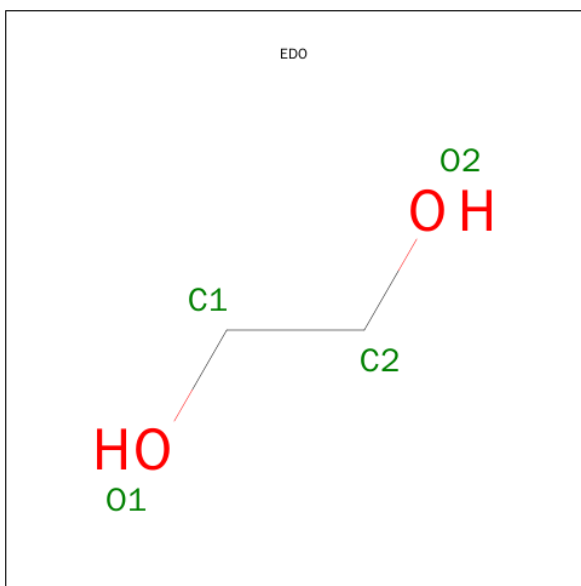
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	O	P	0	0
			27	13	13	1		
2	B	1	Total	C	O	P	0	0
			27	13	13	1		

- Molecule 3 is CITRIC ACID (three-letter code: CIT) (formula: $C_6H_8O_7$).



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 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	B	1	Total	C	O	0	0
			4	2	2		

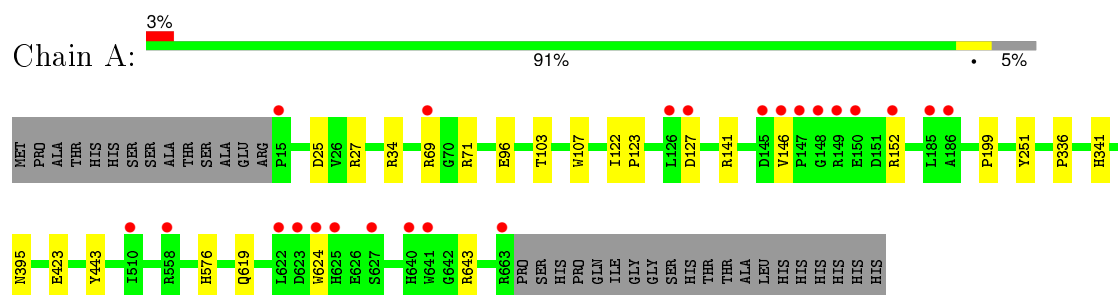
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	710	Total	O	0	0
			710	710		
5	B	737	Total	O	0	0
			737	737		

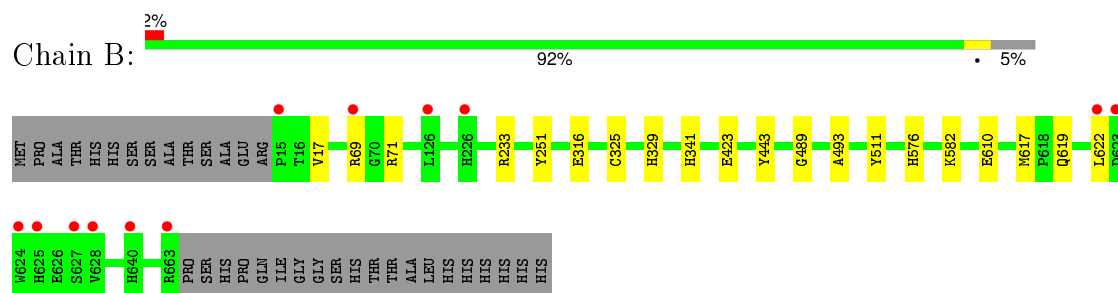
3 Residue-property plots [i](#)

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 ($\text{RSRZ} > 2$). 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: Alpha-1,4-glucan:maltose-1-phosphate maltosyltransferase 1



- Molecule 1: Alpha-1,4-glucan:maltose-1-phosphate maltosyltransferase 1



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	113.56Å 113.56Å 315.14Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	42.69 – 1.85 42.68 – 1.85	Depositor EDS
% Data completeness (in resolution range)	100.0 (42.69-1.85) 97.5 (42.68-1.85)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.38 (at 1.86Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.9_1692)	Depositor
R, R_{free}	0.164 , 0.194 0.172 , 0.196	Depositor DCC
R_{free} test set	2000 reflections (1.18%)	DCC
Wilson B-factor (Å ²)	21.2	Xtriage
Anisotropy	0.153	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 41.9	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	0 of 176074 reflections	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	11906	wwPDB-VP
Average B, all atoms (Å ²)	24.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 10.30% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: MVP, EDO, CIT

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	0.35	0/5359	0.51	0/7324
1	B	0.36	0/5304	0.52	0/7251
All	All	0.36	0/10663	0.51	0/14575

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

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	5207	0	5050	13	0
1	B	5152	0	4992	11	0
2	A	27	0	23	1	0
2	B	27	0	23	0	0
3	A	13	0	2	2	0
3	B	13	0	7	2	0
4	A	16	0	24	0	0
4	B	4	0	6	0	0
5	A	710	0	0	1	2
5	B	737	0	0	3	2
All	All	11906	0	10127	27	2

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 1.

All (27) 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)
3:A:702:CIT:C1	3:A:702:CIT:O1	1.66	1.42
3:B:702:CIT:C1	3:B:702:CIT:O2	1.71	1.37
1:A:25[B]:ASP:OD2	1:A:27[B]:ARG:NH1	2.16	0.79
1:A:69:ARG:NH2	1:A:96:GLU:OE2	2.16	0.78
3:A:702:CIT:C2	3:A:702:CIT:O1	2.35	0.74
1:B:316:GLU:OE1	5:B:1166:HOH:O	2.11	0.68
1:A:146:VAL:O	1:A:152:ARG:NH2	2.33	0.62
1:A:624:TRP:HB3	1:A:643:ARG:HH21	1.64	0.62
1:A:34:ARG:HE	1:B:17:VAL:HG13	1.74	0.52
1:B:576:HIS:CG	1:B:619:GLN:HG2	2.47	0.48
1:A:576:HIS:CG	1:A:619:GLN:HG2	2.49	0.48
1:A:336:PRO:O	1:A:341:HIS:HE1	1.97	0.47
1:B:489:GLY:HA3	1:B:493:ALA:HB2	1.97	0.47
1:A:141:ARG:NH1	5:A:801:HOH:O	2.43	0.45
1:B:582:LYS:HG3	1:B:610:GLU:O	2.18	0.43
1:A:423:GLU:HA	1:A:443:TYR:CD1	2.54	0.43
1:A:122:ILE:HB	1:A:123:PRO:HD3	2.01	0.42
1:A:69:ARG:HE	1:A:71:ARG:NH2	2.17	0.42
1:B:233:ARG:HG2	5:B:1066:HOH:O	2.20	0.42
1:B:341:HIS:HE1	5:B:822:HOH:O	2.03	0.42
3:B:702:CIT:HO2	3:B:702:CIT:C1	2.14	0.41
1:B:617:MET:HE3	1:B:622:LEU:HB2	2.03	0.41
1:B:69:ARG:HB2	1:B:71:ARG:HD3	2.03	0.41
1:B:325[B]:CYS:HB2	1:B:329:HIS:HB2	2.02	0.41
1:B:423:GLU:HA	1:B:443:TYR:CD1	2.56	0.41
1:A:395:ASN:OD1	2:A:701:MVP:OP3	2.39	0.40
1:A:103:THR:HG22	1:A:199:PRO:HA	2.03	0.40

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:A:892:HOH:O	5:B:1299:HOH:O[6_446]	2.12	0.08
5:A:892:HOH:O	5:B:863:HOH:O[6_446]	2.14	0.06

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	654/683 (96%)	640 (98%)	13 (2%)	1 (0%)	52	35
1	B	649/683 (95%)	636 (98%)	13 (2%)	0	100	100
All	All	1303/1366 (95%)	1276 (98%)	26 (2%)	1 (0%)	56	39

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	127	ASP

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	544/565 (96%)	542 (100%)	2 (0%)	93	92
1	B	539/565 (95%)	537 (100%)	2 (0%)	93	92
All	All	1083/1130 (96%)	1079 (100%)	4 (0%)	93	92

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	107	TRP
1	A	251	TYR
1	B	251	TYR
1	B	511	TYR

Some 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 ⓘ

There are no carbohydrates in this entry.

5.6 Ligand geometry ⓘ

9 ligands 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
2	MVP	A	701	-	27,28,28	1.43	3 (11%)	39,42,42	1.10	3 (7%)
3	CIT	A	702	3	3,12,12	3.97	1 (33%)	3,17,17	14.44	3 (100%)
4	EDO	A	703	-	3,3,3	0.53	0	2,2,2	0.39	0
4	EDO	A	704	-	3,3,3	0.48	0	2,2,2	0.60	0
4	EDO	A	705	-	3,3,3	0.46	0	2,2,2	0.47	0
4	EDO	A	706	-	3,3,3	0.53	0	2,2,2	0.40	0
2	MVP	B	701	-	27,28,28	1.40	4 (14%)	39,42,42	1.07	3 (7%)
3	CIT	B	702	3	3,12,12	6.24	2 (66%)	3,17,17	12.33	2 (66%)
4	EDO	B	703	-	3,3,3	0.51	0	2,2,2	0.21	0

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
2	MVP	A	701	-	-	0/13/53/53	0/2/2/2
3	CIT	A	702	3	-	0/6/16/16	0/0/0/0
4	EDO	A	703	-	-	0/1/1/1	0/0/0/0
4	EDO	A	704	-	-	0/1/1/1	0/0/0/0
4	EDO	A	705	-	-	0/1/1/1	0/0/0/0
4	EDO	A	706	-	-	0/1/1/1	0/0/0/0
2	MVP	B	701	-	-	0/13/53/53	0/2/2/2
3	CIT	B	702	3	-	0/6/16/16	0/0/0/0
4	EDO	B	703	-	-	0/1/1/1	0/0/0/0

All (10) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	702	CIT	O7-C3	-6.64	1.32	1.43
2	B	701	MVP	C2'-C3'	-3.19	1.43	1.52
2	A	701	MVP	C2'-C3'	-3.05	1.44	1.52
2	B	701	MVP	P-OP2	-2.02	1.49	1.54
2	A	701	MVP	P-OP1	2.15	1.55	1.50
2	B	701	MVP	P-OP1	2.50	1.55	1.50
2	B	701	MVP	P-C	3.96	1.82	1.78
2	A	701	MVP	P-C	4.82	1.83	1.78
3	B	702	CIT	O7-C3	6.60	1.53	1.43
3	B	702	CIT	C4-C3	8.45	1.67	1.54

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	702	CIT	C4-C3-C2	-4.44	98.84	109.85
2	A	701	MVP	O4'-C4'-C5'	-2.69	102.18	109.33
2	B	701	MVP	O4'-C4'-C5'	-2.39	102.97	109.33
2	A	701	MVP	O3'-C3'-C2'	-2.17	105.46	110.36
2	B	701	MVP	O3'-C3'-C2'	-2.16	105.50	110.36
2	A	701	MVP	O5'-C5'-C4'	3.05	116.28	109.78
2	B	701	MVP	O5'-C5'-C4'	3.34	116.90	109.78
3	A	702	CIT	C4-C3-C2	5.83	124.31	109.85
3	A	702	CIT	C3-C2-C1	17.03	141.56	114.95
3	A	702	CIT	C3-C4-C5	17.36	142.07	114.95
3	B	702	CIT	C3-C4-C5	20.85	147.53	114.95

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	701	MVP	1	0
3	A	702	CIT	2	0
3	B	702	CIT	2	0

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	649/683 (95%)	-0.12	23 (3%)	48 44	13, 20, 44, 66	1 (0%)
1	B	649/683 (95%)	-0.17	12 (1%)	71 69	13, 21, 39, 65	5 (0%)
All	All	1298/1366 (95%)	-0.15	35 (2%)	58 54	13, 21, 42, 66	6 (0%)

All (35) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	126	LEU	7.5
1	B	625	HIS	4.1
1	A	625	HIS	3.8
1	B	226	HIS	3.6
1	A	146	VAL	3.6
1	B	663	ARG	3.4
1	B	15	PRO	3.3
1	A	149	ARG	3.1
1	B	627	SER	3.1
1	A	145	ASP	3.0
1	A	623	ASP	3.0
1	A	627	SER	3.0
1	A	558[A]	ARG	3.0
1	A	150	GLU	2.9
1	A	663	ARG	2.9
1	A	624	TRP	2.7
1	A	147	PRO	2.6
1	A	152	ARG	2.6
1	A	15	PRO	2.5
1	B	624	TRP	2.5
1	A	622	LEU	2.5
1	A	640	HIS	2.5
1	B	628	VAL	2.5
1	B	622	LEU	2.5

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Mol	Chain	Res	Type	RSRZ
1	B	640	HIS	2.4
1	A	69	ARG	2.4
1	B	69	ARG	2.4
1	A	185	LEU	2.3
1	A	127	ASP	2.2
1	A	641	TRP	2.2
1	A	186	ALA	2.2
1	B	623	ASP	2.2
1	A	510	ILE	2.2
1	B	126	LEU	2.2
1	A	148	GLY	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. 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	RSCC	RSR	LLDF	B-factors(Å ²)	Q<0.9
4	EDO	A	706	4/4	0.84	0.21	7.94	25,26,28,30	4
4	EDO	A	704	4/4	0.71	0.20	6.35	31,34,34,39	4
4	EDO	B	703	4/4	0.85	0.19	3.82	25,29,33,36	0
4	EDO	A	703	4/4	0.91	0.16	3.61	22,23,24,27	4
4	EDO	A	705	4/4	0.93	0.20	1.95	32,45,46,48	0
3	CIT	B	702	13/13	0.87	0.15	0.39	28,33,37,38	13
3	CIT	A	702	13/13	0.88	0.14	0.29	28,33,36,38	13
2	MVP	A	701	27/27	0.97	0.08	-0.64	14,17,21,22	0
2	MVP	B	701	27/27	0.97	0.09	-0.70	12,17,21,22	0

6.5 Other polymers [i](#)

There are no such residues in this entry.