



Full wwPDB X-ray Structure Validation Report ⓘ

Aug 18, 2022 – 01:44 AM EDT

PDB ID : 4Q0U
Title : Crystal structure of Acinetobacter sp. DL28 L-ribose isomerase mutant E204Q
in complex with L-ribose
Authors : Yoshida, H.; Yoshihara, A.; Teraoka, M.; Izumori, K.; Kamitori, S.
Deposited on : 2014-04-02
Resolution : 1.98 Å(reported)

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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 : 2.29
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) : 2.29

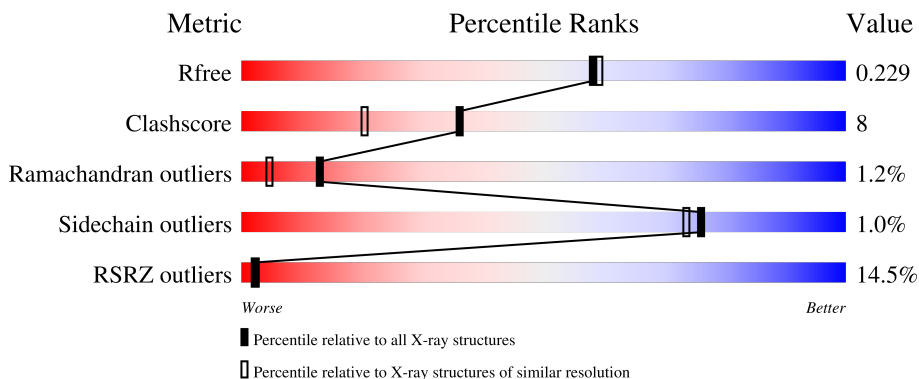
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.98 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	11647 (2.00-1.96)
Clashscore	141614	1014 (1.98-1.98)
Ramachandran outliers	138981	1006 (1.98-1.98)
Sidechain outliers	138945	1006 (1.98-1.98)
RSRZ outliers	127900	11410 (2.00-1.96)

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	260	

2 Entry composition [i](#)

There are 7 unique types of molecules in this entry. The entry contains 2116 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 L-Ribose isomerase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	249	1930	1220	332	367	11	0	0	0

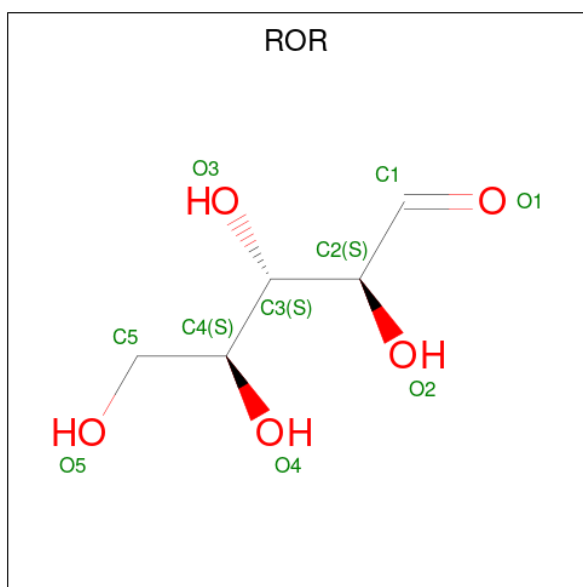
There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-10	MET	-	expression tag	UNP Q93UQ5
A	-9	ARG	-	expression tag	UNP Q93UQ5
A	-8	GLY	-	expression tag	UNP Q93UQ5
A	-7	SER	-	expression tag	UNP Q93UQ5
A	-6	HIS	-	expression tag	UNP Q93UQ5
A	-5	HIS	-	expression tag	UNP Q93UQ5
A	-4	HIS	-	expression tag	UNP Q93UQ5
A	-3	HIS	-	expression tag	UNP Q93UQ5
A	-2	HIS	-	expression tag	UNP Q93UQ5
A	-1	HIS	-	expression tag	UNP Q93UQ5
A	0	GLY	-	expression tag	UNP Q93UQ5
A	1	SER	-	expression tag	UNP Q93UQ5
A	2	ALA	-	expression tag	UNP Q93UQ5
A	204	GLN	GLU	engineered mutation	UNP Q93UQ5

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

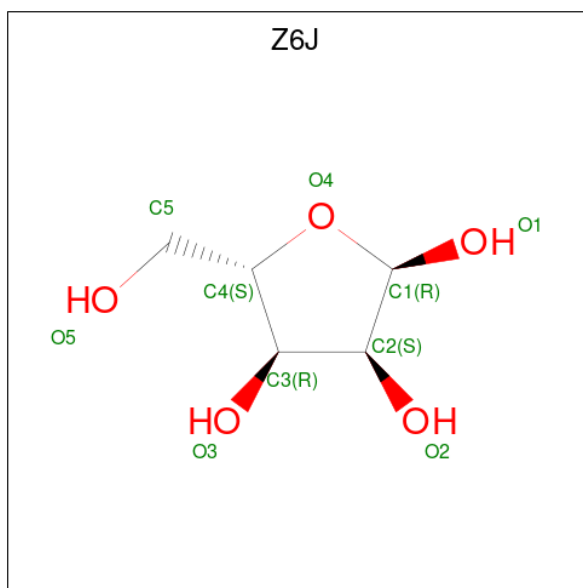
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Co	0	0
			1	1		

- Molecule 3 is L-ribose (three-letter code: ROR) (formula: C₅H₁₀O₅).



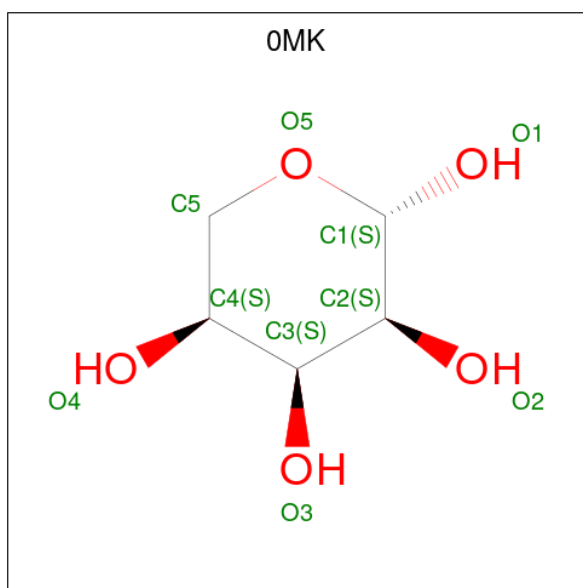
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			10	5	5		

- Molecule 4 is alpha-L-ribofuranose (three-letter code: Z6J) (formula: C₅H₁₀O₅).



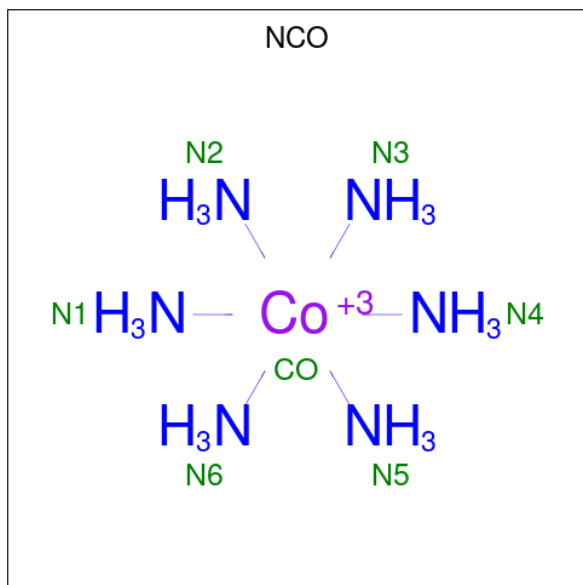
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			10	5	5		
4	A	1	Total	C	O	0	0
			10	5	5		
4	A	1	Total	C	O	0	0
			10	5	5		

- Molecule 5 is beta-L-ribofuranose (three-letter code: 0MK) (formula: $C_5H_{10}O_5$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			10	5	5		

- Molecule 6 is COBALT HEXAMMINE(III) (three-letter code: NCO) (formula: $CoH_{18}N_6$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total	Co	N	0	0
			7	1	6		

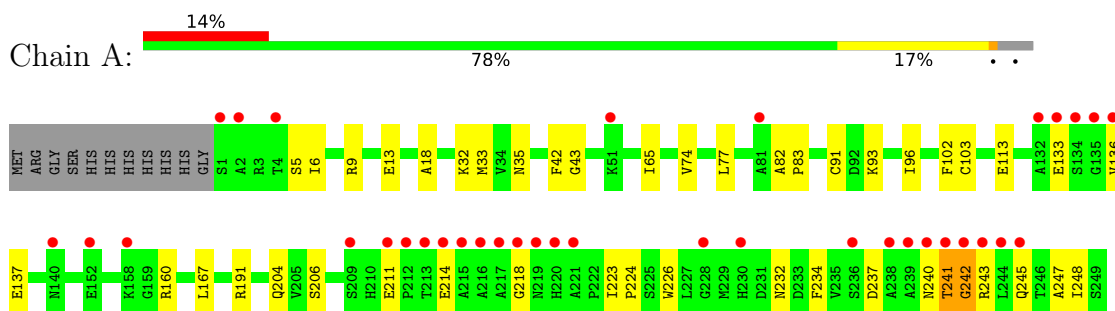
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	128	Total 128	O 128	0	0

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: L-Ribose isomerase



4 Data and refinement statistics

Property	Value	Source
Space group	F 2 2 2	Depositor
Cell constants a, b, c, α , β , γ	96.73Å 107.06Å 118.89Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	61.45 – 1.98 61.44 – 1.98	Depositor EDS
% Data completeness (in resolution range)	98.9 (61.45-1.98) 99.0 (61.44-1.98)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.22 (at 1.98Å)	Xtrriage
Refinement program	CNS 1.3	Depositor
R, R_{free}	0.221 , 0.237 0.207 , 0.229	Depositor DCC
R_{free} test set	2135 reflections (9.95%)	wwPDB-VP
Wilson B-factor (Å ²)	29.4	Xtrriage
Anisotropy	0.306	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 52.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	2116	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.87% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 0MK, Z6J, NCO, ROR, 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	0.33	0/1988	0.61	1/2704 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	103	CYS	N-CA-C	-7.46	90.87	111.00

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	1930	0	1847	29	0
2	A	1	0	0	0	0
3	A	10	0	8	2	0
4	A	30	0	24	1	0
5	A	10	0	10	0	0
6	A	7	0	0	0	0
7	A	128	0	0	1	0
All	All	2116	0	1889	31	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 8.

All (31) 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:502:ROR:H2	3:A:502:ROR:H10	1.64	0.79
1:A:241:THR:HG23	1:A:242:GLY:H	1.52	0.73
1:A:35:ASN:HA	4:A:503:Z6J:H21	1.69	0.73
1:A:211:GLU:HG2	1:A:232:ASN:HD21	1.52	0.73
1:A:243:ARG:O	1:A:243:ARG:HD3	1.90	0.72
1:A:91:CYS:SG	1:A:93:LYS:HE3	2.32	0.70
1:A:237:ASP:HA	1:A:240:ASN:HD22	1.59	0.66
1:A:237:ASP:HA	1:A:240:ASN:ND2	2.14	0.61
1:A:18:ALA:HB1	1:A:96:ILE:HD12	1.84	0.59
1:A:167:LEU:HD12	1:A:167:LEU:N	2.24	0.53
1:A:9:ARG:O	1:A:13:GLU:HG3	2.08	0.53
3:A:502:ROR:H2	3:A:502:ROR:C5	2.37	0.53
1:A:223:ILE:HB	1:A:226:TRP:CD1	2.46	0.51
1:A:113:GLU:HG2	1:A:204:GLN:NE2	2.26	0.50
1:A:234:PHE:CE2	1:A:243:ARG:HG3	2.48	0.49
1:A:43:GLY:HA3	1:A:160:ARG:HH22	1.77	0.49
1:A:5:SER:HB2	1:A:247:ALA:O	2.13	0.48
1:A:133:GLU:OE1	1:A:136:VAL:HG11	2.14	0.47
1:A:82:ALA:N	1:A:83:PRO:HD2	2.29	0.47
1:A:74:VAL:HA	1:A:77:LEU:HD12	1.98	0.45
1:A:245:GLN:N	1:A:245:GLN:OE1	2.50	0.44
1:A:204:GLN:HE21	1:A:206:SER:HB3	1.82	0.44
1:A:6:ILE:O	1:A:248:ILE:HA	2.18	0.44
1:A:65:ILE:HG21	1:A:93:LYS:HD3	1.99	0.44
1:A:42:PHE:CE2	1:A:243:ARG:HG2	2.53	0.43
1:A:204:GLN:NE2	7:A:650:HOH:O	2.51	0.42
1:A:32:LYS:HG3	1:A:33:MET:N	2.34	0.42
1:A:241:THR:HG23	1:A:242:GLY:N	2.29	0.41
1:A:102:PHE:CD2	1:A:191:ARG:HB3	2.56	0.41
1:A:245:GLN:O	1:A:245:GLN:HG2	2.20	0.41
1:A:223:ILE:HG23	1:A:224:PRO:HD2	2.03	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	247/260 (95%)	232 (94%)	12 (5%)	3 (1%)	13 4

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	218	GLY
1	A	241	THR
1	A	242	GLY

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	205/214 (96%)	203 (99%)	2 (1%)	76 73

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	137	GLU
1	A	214	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	204	GLN

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Mol	Chain	Res	Type
1	A	220	HIS
1	A	232	ASN
1	A	240	ASN

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 7 ligands modelled in this entry, 1 is 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	$\# Z > 2$
6	NCO	A	507	-	6,6,6	4.52	6 (100%)	-		
4	Z6J	A	504	-	10,10,10	0.44	0	13,14,14	1.42	3 (23%)
3	ROR	A	502	2	8,9,9	0.51	0	10,11,11	0.42	0
4	Z6J	A	503	-	10,10,10	0.49	0	13,14,14	1.50	3 (23%)
5	OMK	A	505	-	10,10,10	0.69	0	14,14,14	0.45	0
4	Z6J	A	506	-	10,10,10	0.43	0	13,14,14	1.53	3 (23%)

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
4	Z6J	A	504	-	-	2/2/18/18	0/1/1/1
3	ROR	A	502	2	-	4/10/12/12	-
4	Z6J	A	503	-	-	0/2/18/18	0/1/1/1
5	OMK	A	505	-	-	-	0/1/1/1
4	Z6J	A	506	-	-	2/2/18/18	0/1/1/1

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	507	NCO	CO-N1	-4.60	1.80	1.96
6	A	507	NCO	CO-N4	-4.55	1.81	1.96
6	A	507	NCO	CO-N5	-4.54	1.81	1.96
6	A	507	NCO	CO-N6	-4.52	1.81	1.96
6	A	507	NCO	CO-N2	-4.47	1.81	1.96
6	A	507	NCO	CO-N3	-4.43	1.81	1.96

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	503	Z6J	C1-C2-C3	3.06	106.13	102.30
4	A	506	Z6J	C1-C2-C3	2.99	106.04	102.30
4	A	504	Z6J	C1-C2-C3	2.83	105.84	102.30
4	A	506	Z6J	O4-C1-C2	2.70	107.79	104.46
4	A	503	Z6J	O4-C1-C2	2.59	107.65	104.46
4	A	506	Z6J	O1-C1-O4	-2.49	107.94	111.13
4	A	503	Z6J	O1-C1-O4	-2.29	108.20	111.13
4	A	504	Z6J	O1-C1-O4	-2.26	108.23	111.13
4	A	504	Z6J	O4-C1-C2	2.26	107.24	104.46

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	502	ROR	O2-C2-C3-C4
3	A	502	ROR	C1-C2-C3-C4
3	A	502	ROR	O2-C2-C3-O3
4	A	504	Z6J	C3-C4-C5-O5
4	A	504	Z6J	O4-C4-C5-O5
4	A	506	Z6J	O4-C4-C5-O5
4	A	506	Z6J	C3-C4-C5-O5

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Mol	Chain	Res	Type	Atoms
3	A	502	ROR	C1-C2-C3-O3

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	502	ROR	2	0
4	A	503	Z6J	1	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	249/260 (95%)	1.41	36 (14%) 2 2	17, 27, 68, 94	0

All (36) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	218	GLY	16.5
1	A	216	ALA	16.2
1	A	213	THR	15.7
1	A	219	ASN	14.7
1	A	217	ALA	10.7
1	A	215	ALA	10.1
1	A	244	LEU	9.5
1	A	1	SER	8.6
1	A	214	GLU	6.9
1	A	212	PRO	6.7
1	A	242	GLY	6.2
1	A	240	ASN	6.2
1	A	136	VAL	5.6
1	A	134	SER	5.4
1	A	241	THR	4.7
1	A	220	HIS	4.4
1	A	211	GLU	4.0
1	A	133	GLU	3.8
1	A	230	HIS	3.1
1	A	158	LYS	3.0
1	A	135	GLY	2.9
1	A	245	GLN	2.9
1	A	238	ALA	2.8
1	A	228	GLY	2.8
1	A	140	ASN	2.8
1	A	132	ALA	2.7
1	A	221	ALA	2.7

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Mol	Chain	Res	Type	RSRZ
1	A	81	ALA	2.5
1	A	51	LYS	2.4
1	A	4	THR	2.4
1	A	152	GLU	2.3
1	A	2	ALA	2.3
1	A	243	ARG	2.2
1	A	239	ALA	2.2
1	A	236	SER	2.0
1	A	209	SER	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
4	Z6J	A	504	10/10	0.68	0.33	68,69,70,70	0
4	Z6J	A	503	10/10	0.70	0.21	58,60,60,61	0
4	Z6J	A	506	10/10	0.74	0.37	66,70,71,72	0
5	0MK	A	505	10/10	0.81	0.18	52,52,54,54	0
3	ROR	A	502	10/10	0.82	0.32	27,40,48,50	0
6	NCO	A	507	7/7	0.88	0.30	48,49,49,50	0
2	CO	A	501	1/1	0.99	0.09	28,28,28,28	0

6.5 Other polymers [\(i\)](#)

There are no such residues in this entry.