



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 10:14 AM UTC

PDB ID : 3UD1 / pdb_00003ud1
Title : Crystal structure of ZU5A-ZU5B domains of human erythrocyte ankyrin
Authors : Yasunaga, M.; Ipsaro, J.J.; Mondragon, A.
Deposited on : 2011-10-27
Resolution : 2.00 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 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 : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

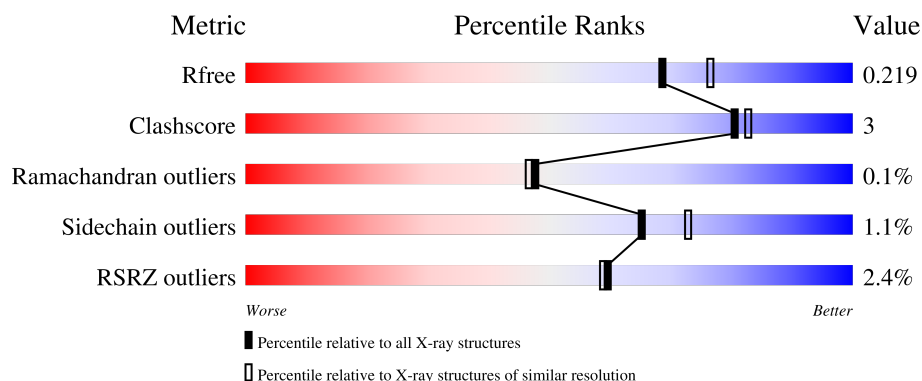
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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}	180053	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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	326	% 89% 9% .
1	B	326	5% 93% 5% .
1	C	326	% 93% 6% .

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
2	EOH	A	1	-	-	X	-
2	EOH	A	12	-	-	X	-
2	EOH	B	17	-	-	X	-

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 8547 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.

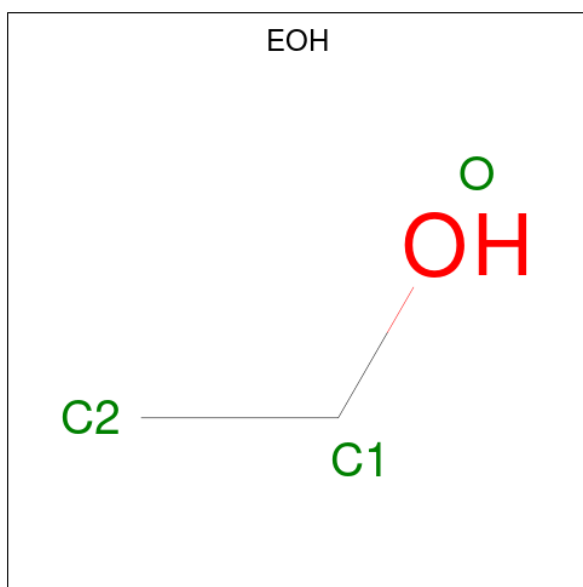
- Molecule 1 is a protein called Ankyrin-1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	322	Total	C	N	O	S	0	14	0
			2603	1647	463	479	14			
1	B	322	Total	C	N	O	S	0	14	0
			2609	1650	468	477	14			
1	C	322	Total	C	N	O	S	0	17	0
			2613	1652	466	482	13			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	908	SER	-	expression tag	UNP P16157
A	909	ASN	-	expression tag	UNP P16157
A	910	ALA	-	expression tag	UNP P16157
A	1075	ILE	THR	variant	UNP P16157
B	908	SER	-	expression tag	UNP P16157
B	909	ASN	-	expression tag	UNP P16157
B	910	ALA	-	expression tag	UNP P16157
B	1075	ILE	THR	variant	UNP P16157
C	908	SER	-	expression tag	UNP P16157
C	909	ASN	-	expression tag	UNP P16157
C	910	ALA	-	expression tag	UNP P16157
C	1075	ILE	THR	variant	UNP P16157

- Molecule 2 is ETHANOL (CCD ID: EOH) (formula: C₂H₆O).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			3	2	1		
2	A	1	Total	C	O	0	0
			3	2	1		
2	A	1	Total	C	O	0	0
			3	2	1		
2	A	1	Total	C	O	0	0
			3	2	1		
2	A	1	Total	C	O	0	0
			3	2	1		
2	B	1	Total	C	O	0	0
			3	2	1		
2	B	1	Total	C	O	0	0
			3	2	1		
2	B	1	Total	C	O	0	0
			3	2	1		
2	B	1	Total	C	O	0	0
			3	2	1		
2	C	1	Total	C	O	0	0
			3	2	1		
2	C	1	Total	C	O	0	0
			3	2	1		

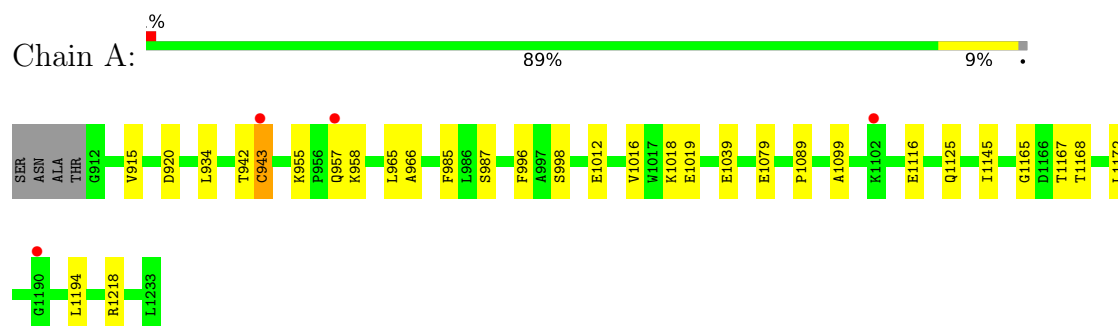
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	223	Total 223	O 223	0	0
3	B	198	Total 198	O 198	0	0
3	C	265	Total 265	O 265	0	0

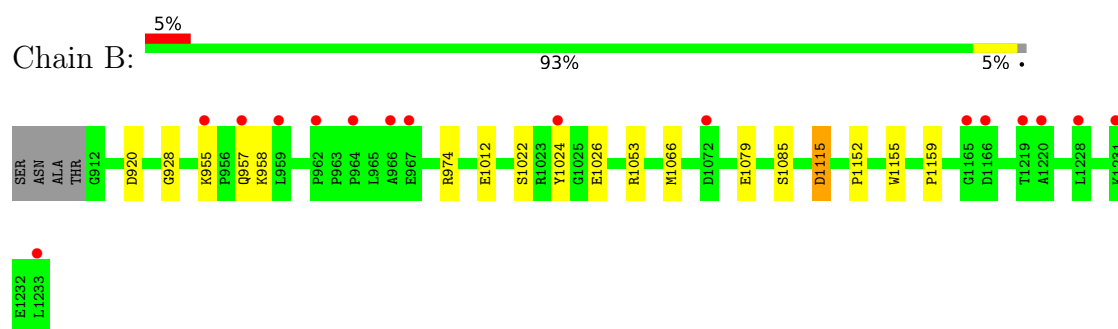
3 Residue-property plots [i](#)

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.

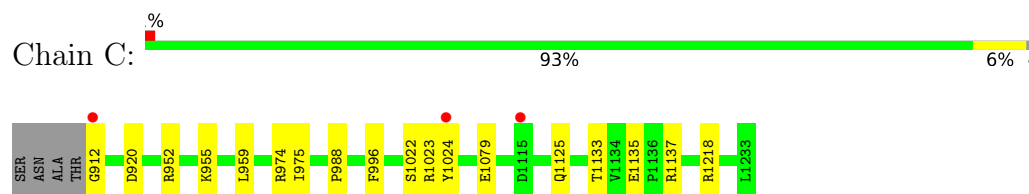
• Molecule 1: Ankyrin-1



• Molecule 1: Ankyrin-1



• Molecule 1: Ankyrin-1



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	160.12Å 40.49Å 178.10Å 90.00° 112.68° 90.00°	Depositor
Resolution (Å)	29.68 – 2.00 29.68 – 2.00	Depositor EDS
% Data completeness (in resolution range)	(Not available) (29.68-2.00) 99.3 (29.68-2.00)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	0.09	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.50 (at 2.00Å)	Xtriage
Refinement program	BUSTER 2.8.0	Depositor
R, R_{free}	0.171 , 0.206 0.187 , 0.219	Depositor DCC
R_{free} test set	3623 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å ²)	21.4	Xtriage
Anisotropy	0.345	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 47.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	8547	wwPDB-VP
Average B, all atoms (Å ²)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 49.39 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 7.5123e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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: EOH

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	0.82	0/2682	1.01	3/3638 (0.1%)
1	B	0.79	1/2688 (0.0%)	1.03	3/3645 (0.1%)
1	C	0.82	0/2704	1.00	2/3668 (0.1%)
All	All	0.81	1/8074 (0.0%)	1.02	8/10951 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	1152	PRO	CA-C	5.17	1.54	1.51

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	1115	ASP	CA-CB-CG	6.14	118.74	112.60
1	B	920	ASP	CA-CB-CG	5.51	118.11	112.60
1	A	965	LEU	N-CA-C	5.50	118.21	109.96
1	A	1089	PRO	N-CA-C	5.44	121.10	113.53
1	B	928	GLY	N-CA-C	-5.31	104.51	112.63
1	C	920	ASP	CA-CB-CG	5.13	117.73	112.60
1	A	920	ASP	CA-CB-CG	5.11	117.71	112.60
1	C	988	PRO	N-CA-C	5.05	119.25	111.21

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	2603	0	2656	20	0
1	B	2609	0	2665	12	0
1	C	2613	0	2671	12	0
2	A	15	0	30	8	0
2	B	15	0	30	5	0
2	C	6	0	12	0	0
3	A	223	0	0	2	0
3	B	198	0	0	0	0
3	C	265	0	0	0	0
All	All	8547	0	8064	41	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 3.

All (41) 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:B:1066:MET:HE1	2:B:9:EOH:H23	1.63	0.81
1:B:1026:GLU:OE2	1:B:1053[B]:ARG:HD2	1.80	0.81
1:B:955:LYS:HE3	1:B:957:GLN:HB2	1.67	0.77
1:A:957:GLN:HG2	3:A:447:HOH:O	1.90	0.71
1:C:1022:SER:O	1:C:1024[B]:TYR:N	2.23	0.71
1:A:1012:GLU:H	2:A:12:EOH:H21	1.57	0.68
1:B:1022:SER:O	1:B:1024[A]:TYR:N	2.21	0.67
1:B:955:LYS:HE2	1:B:958:LYS:HG3	1.80	0.62
1:A:1019[A]:GLU:HG3	3:A:318:HOH:O	2.02	0.60
1:A:998:SER:HB3	2:A:1:EOH:H21	1.85	0.59
1:C:1133:THR:CG2	1:C:1137:ARG:HD2	2.34	0.58
1:C:959:LEU:HD11	1:C:975:ILE:HD13	1.85	0.58
1:A:943[A]:CYS:SG	1:A:985:PHE:HE2	2.29	0.56
1:A:1016:VAL:HB	2:A:12:EOH:H22	1.91	0.53
1:A:1099:ALA:HB1	1:A:1145:ILE:HD11	1.91	0.52
1:A:1012:GLU:H	2:A:12:EOH:C2	2.24	0.51
1:C:912:GLY:HA3	1:C:952:ARG:HA	1.94	0.49
2:A:1:EOH:H23	1:C:974:ARG:HE	1.77	0.49
1:A:955[A]:LYS:HE2	1:A:958:LYS:HG3	1.95	0.49
1:A:943[A]:CYS:HG	1:A:985:PHE:HE2	1.55	0.49
1:B:974:ARG:CG	2:B:17:EOH:H22	2.42	0.49
1:A:943[A]:CYS:SG	1:A:985:PHE:CE2	3.05	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:974:ARG:HE	2:B:17:EOH:H22	1.79	0.48
1:C:1133:THR:HG21	1:C:1137:ARG:HD2	1.96	0.46
1:B:974:ARG:HE	2:B:17:EOH:C2	2.28	0.46
1:A:996[B]:PHE:CD2	1:C:996:PHE:CE2	3.04	0.46
1:B:974:ARG:HG3	2:B:17:EOH:H22	1.96	0.46
1:A:966:ALA:O	1:C:955:LYS:NZ	2.48	0.46
2:A:1:EOH:C2	1:C:974:ARG:HE	2.29	0.45
1:C:1135:GLU:OE1	1:C:1137:ARG:HD3	2.16	0.45
1:C:1125[A]:GLN:OE1	1:C:1218:ARG:NH1	2.50	0.45
1:A:1125[A]:GLN:OE1	1:A:1218:ARG:NH1	2.51	0.44
1:B:1155:TRP:CE2	1:B:1159:PRO:HB3	2.53	0.43
1:A:1018:LYS:NZ	2:A:7:EOH:H22	2.34	0.43
1:B:1022:SER:C	1:B:1024[A]:TYR:N	2.77	0.42
1:A:942:THR:HG22	1:A:987:SER:OG	2.20	0.42
1:B:1012:GLU:HG3	1:C:1024[A]:TYR:HE1	1.84	0.42
1:A:1012:GLU:HG2	2:A:12:EOH:H12	2.02	0.42
1:A:915:VAL:HG13	1:A:934:LEU:HD23	2.02	0.41
1:A:1172:LEU:HD22	1:A:1194:LEU:HD11	2.03	0.40
1:A:1165:GLY:O	1:A:1168:THR:HG22	2.21	0.40

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	334/326 (102%)	329 (98%)	5 (2%)	0	100	100
1	B	334/326 (102%)	326 (98%)	8 (2%)	0	100	100
1	C	337/326 (103%)	330 (98%)	5 (2%)	2 (1%)	21	17
All	All	1005/978 (103%)	985 (98%)	18 (2%)	2 (0%)	48	42

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	1023[A]	ARG
1	C	1023[B]	ARG

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	292/281 (104%)	285 (98%)	7 (2%)	43	47
1	B	291/281 (104%)	288 (99%)	3 (1%)	68	75
1	C	294/281 (105%)	293 (100%)	1 (0%)	86	91
All	All	877/843 (104%)	866 (99%)	11 (1%)	65	68

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	943[A]	CYS
1	A	943[B]	CYS
1	A	1039	GLU
1	A	1079	GLU
1	A	1116	GLU
1	A	1167[B]	THR
1	A	1167[C]	THR
1	B	1079	GLU
1	B	1085	SER
1	B	1115	ASP
1	C	1079	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	1206	ASN
1	B	957	GLN
1	B	1031	GLN
1	C	1071	GLN
1	C	1202	ASN

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Mol	Chain	Res	Type
1	C	1206	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

12 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	EOH	A	18	-	2,2,2	0.44	0	1,1,1	0.08	0
2	EOH	B	5	-	2,2,2	0.48	0	1,1,1	0.00	0
2	EOH	A	12	-	2,2,2	0.44	0	1,1,1	0.31	0
2	EOH	B	3	-	2,2,2	0.52	0	1,1,1	0.06	0
2	EOH	C	2	-	2,2,2	0.50	0	1,1,1	0.03	0
2	EOH	A	4	-	2,2,2	0.43	0	1,1,1	0.28	0
2	EOH	B	17	-	2,2,2	0.43	0	1,1,1	0.41	0
2	EOH	C	6	-	2,2,2	0.50	0	1,1,1	0.20	0
2	EOH	A	7	-	2,2,2	0.41	0	1,1,1	0.38	0
2	EOH	A	1	-	2,2,2	0.40	0	1,1,1	0.20	0
2	EOH	B	9	-	2,2,2	0.46	0	1,1,1	0.22	0
2	EOH	B	11	-	2,2,2	0.47	0	1,1,1	0.16	0

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5 monomers are involved in 13 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	12	EOH	4	0
2	B	17	EOH	4	0
2	A	7	EOH	1	0
2	A	1	EOH	3	0
2	B	9	EOH	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	322/326 (98%)	-0.04	4 (1%) 76 76	7, 24, 45, 64	14 (4%)
1	B	322/326 (98%)	0.16	16 (4%) 34 33	10, 25, 54, 75	14 (4%)
1	C	322/326 (98%)	-0.28	3 (0%) 81 80	10, 20, 42, 55	17 (5%)
All	All	966/978 (98%)	-0.05	23 (2%) 59 59	7, 23, 48, 75	45 (4%)

All (23) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	1024[A]	TYR	4.9
1	B	1024[A]	TYR	3.7
1	B	1233	LEU	3.3
1	B	967	GLU	3.2
1	B	1231	LYS	3.1
1	B	955	LYS	2.7
1	B	1219	THR	2.6
1	A	943[A]	CYS	2.5
1	B	1165	GLY	2.5
1	B	966	ALA	2.4
1	B	1166	ASP	2.4
1	B	1220	ALA	2.4
1	B	962	PRO	2.4
1	A	1190	GLY	2.4
1	B	1072[A]	ASP	2.3
1	B	957	GLN	2.2
1	C	912	GLY	2.2
1	B	964	PRO	2.2
1	A	1102	LYS	2.1
1	B	959	LEU	2.1
1	B	1228	LEU	2.1
1	A	957	GLN	2.0
1	C	1115	ASP	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 oligosaccharides 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($\text{\AA}^2$)	Q<0.9
2	EOH	B	3	3/3	0.60	0.32	38,38,42,45	0
2	EOH	C	2	3/3	0.66	0.24	40,40,41,42	0
2	EOH	A	4	3/3	0.71	0.14	25,25,34,40	0
2	EOH	B	9	3/3	0.72	0.21	49,49,49,50	0
2	EOH	B	17	3/3	0.74	0.18	32,32,36,41	0
2	EOH	A	1	3/3	0.78	0.23	26,26,36,42	0
2	EOH	A	7	3/3	0.78	0.19	38,38,40,43	0
2	EOH	C	6	3/3	0.80	0.18	24,24,28,30	0
2	EOH	B	11	3/3	0.85	0.15	43,43,43,44	0
2	EOH	A	12	3/3	0.86	0.16	25,25,34,40	0
2	EOH	A	18	3/3	0.89	0.14	29,29,31,33	0
2	EOH	B	5	3/3	0.91	0.10	26,26,31,32	0

6.5 Other polymers [i](#)

There are no such residues in this entry.