



# Full wwPDB X-ray Structure Validation Report ⓘ

Oct 29, 2024 – 01:33 PM EDT

PDB ID : 4FTV  
Title : The complex between the high affinity version of A6 TCR (A6c134) and human Class I MHC HLA-A2 with the bound TAX nonameric peptide  
Authors : Borbulevych, O.Y.; Baker, B.M.  
Deposited on : 2012-06-28  
Resolution : 2.74 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](mailto: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>.

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

MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.003 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.39

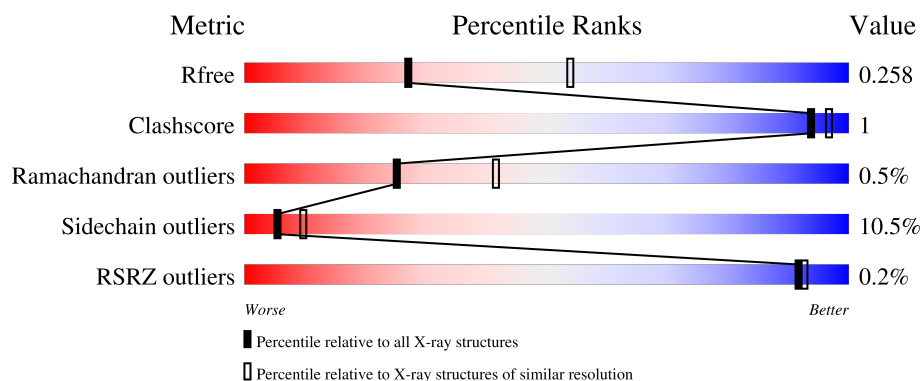
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.74 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))
$R_{free}$	164625	1649 (2.76-2.72)
Clashscore	180529	1744 (2.76-2.72)
Ramachandran outliers	177936	1710 (2.76-2.72)
Sidechain outliers	177891	1711 (2.76-2.72)
RSRZ outliers	164620	1649 (2.76-2.72)

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  $\geq 3$ , 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	275	
2	B	100	
3	C	9	
4	D	200	
5	E	245	

## 2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 6740 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 HLA class I histocompatibility antigen, A-2 alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	275	Total	C	N	O	S	0	0	0
			2247	1403	409	426	9			

- Molecule 2 is a protein called Beta-2-microglobulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	100	Total	C	N	O	S	0	1	0
			842	536	141	161	4			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	0	MET	-	expression tag	UNP P61769

- Molecule 3 is a protein called Protein Tax-1.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	C	9	Total	C	N	O	0	0	0
			77	56	9	12			

- Molecule 4 is a protein called A6 alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	200	Total	C	N	O	S	0	0	0
			1552	965	255	325	7			

- Molecule 5 is a protein called A6 beta chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	E	245	Total	C	N	O	S	0	1	0
			1937	1215	337	376	9			

- Molecule 6 is GLYCEROL (three-letter code: GOL) (formula:  $C_3H_8O_3$ ).



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

- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	9	Total	O	0	0
			9	9		

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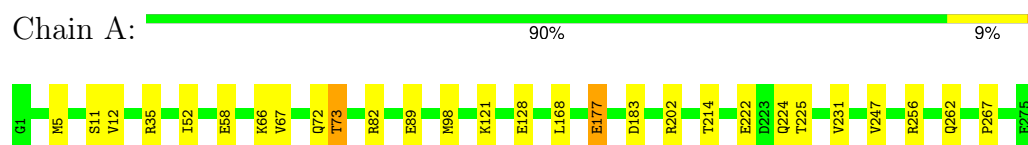
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	B	11	Total 11	O 11	0	0
7	D	1	Total 1	O 1	0	0
7	E	4	Total 4	O 4	0	0

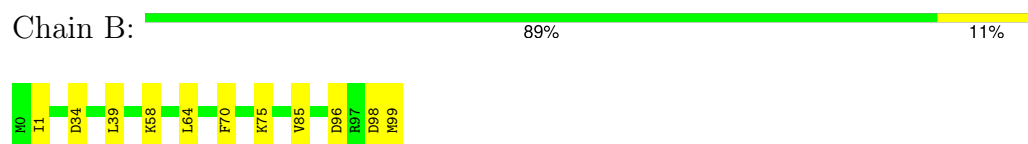
### 3 Residue-property plots [i](#)

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.

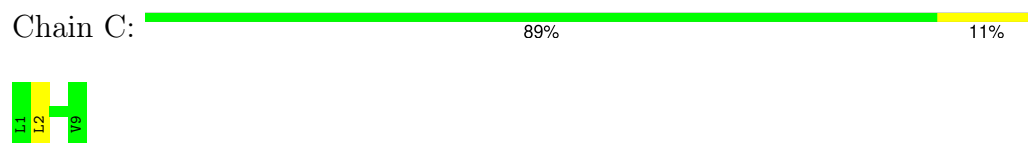
- Molecule 1: HLA class I histocompatibility antigen, A-2 alpha chain



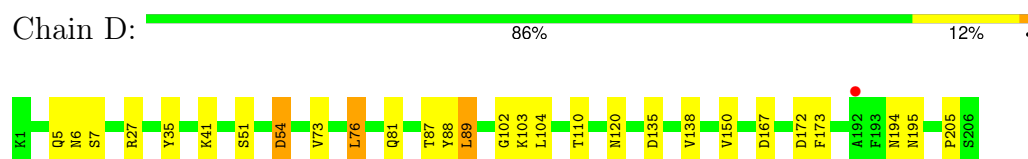
- Molecule 2: Beta-2-microglobulin



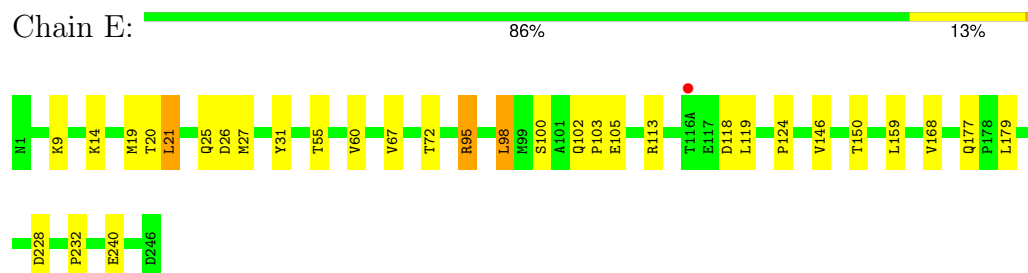
- Molecule 3: Protein Tax-1



- Molecule 4: A6 alpha chain



- Molecule 5: A6 beta chain



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	224.23Å 48.95Å 94.40Å 90.00° 89.62° 90.00°	Depositor
Resolution (Å)	20.00 – 2.74 20.00 – 2.74	Depositor EDS
% Data completeness (in resolution range)	97.6 (20.00-2.74) 97.3 (20.00-2.74)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.70 (at 2.75Å)	Xtriage
Refinement program	REFMAC	Depositor
R, $R_{free}$	0.216 , 0.260 0.214 , 0.258	Depositor DCC
$R_{free}$ test set	1370 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	71.4	Xtriage
Anisotropy	0.207	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 58.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.018 for -h,-k,l	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	6740	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	91.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.35% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: GOL

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	0.49	0/2312	0.68	0/3137
2	B	0.48	0/868	0.69	0/1173
3	C	0.58	0/80	0.83	0/108
4	D	0.43	0/1585	0.65	2/2150 (0.1%)
5	E	0.44	0/1993	0.67	1/2716 (0.0%)
All	All	0.46	0/6838	0.67	3/9284 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
5	E	21	LEU	CA-CB-CG	5.87	128.81	115.30
4	D	76	LEU	CA-CB-CG	5.48	127.90	115.30
4	D	89	LEU	CA-CB-CG	5.34	127.59	115.30

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	2247	0	2096	6	0
2	B	842	0	807	3	0
3	C	77	0	79	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	D	1552	0	1461	6	0
5	E	1937	0	1839	6	0
6	A	36	0	48	0	0
6	B	12	0	16	0	0
6	D	6	0	8	0	0
6	E	6	0	8	0	0
7	A	9	0	0	0	0
7	B	11	0	0	0	0
7	D	1	0	0	0	0
7	E	4	0	0	0	0
All	All	6740	0	6362	17	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 1.

All (17) 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:66:LYS:HE3	3:C:2:LEU:HB2	1.85	0.58
4:D:54:ASP:N	4:D:54:ASP:OD1	2.45	0.49
4:D:5:GLN:NE2	4:D:88:TYR:O	2.47	0.48
2:B:96:ASP:HB3	2:B:99:MET:HB2	1.95	0.48
5:E:124:PRO:HD3	5:E:232:PRO:HB3	1.96	0.48
5:E:14:LYS:HB3	5:E:119:LEU:HD13	1.95	0.48
1:A:202:ARG:NH1	2:B:99:MET:SD	2.88	0.46
1:A:177:GLU:H	1:A:177:GLU:HG2	1.55	0.45
1:A:5:MET:HB2	1:A:168:LEU:HD13	1.97	0.45
1:A:214:THR:HB	1:A:262:GLN:HB2	1.99	0.45
4:D:102:GLY:O	5:E:95:ARG:NH1	2.50	0.44
2:B:39:LEU:HA	2:B:39:LEU:HD23	1.85	0.42
4:D:138:VAL:HG11	5:E:146:VAL:HG21	2.01	0.42
5:E:102:GLN:HA	5:E:103:PRO:HD3	1.78	0.41
1:A:73:THR:HG22	5:E:98:LEU:HG	2.03	0.41
4:D:41:LYS:HB3	4:D:41:LYS:HE2	1.83	0.40
4:D:35:TYR:HB2	4:D:89:LEU:HB2	2.02	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	273/275 (99%)	257 (94%)	15 (6%)	1 (0%)	30	48
2	B	99/100 (99%)	96 (97%)	3 (3%)	0	100	100
3	C	7/9 (78%)	6 (86%)	1 (14%)	0	100	100
4	D	198/200 (99%)	177 (89%)	19 (10%)	2 (1%)	13	23
5	E	244/245 (100%)	229 (94%)	14 (6%)	1 (0%)	30	48
All	All	821/829 (99%)	765 (93%)	52 (6%)	4 (0%)	25	41

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
4	D	172	ASP
4	D	205	PRO
5	E	222	ASN
1	A	267	PRO

### 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	231/231 (100%)	210 (91%)	21 (9%)	7	14
2	B	96/95 (101%)	87 (91%)	9 (9%)	7	13
3	C	8/8 (100%)	8 (100%)	0	100	100
4	D	178/178 (100%)	159 (89%)	19 (11%)	5	9

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
5	E	212/211 (100%)	184 (87%)	28 (13%)	3	5
All	All	725/723 (100%)	648 (89%)	77 (11%)	5	9

All (77) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	11	SER
1	A	12	VAL
1	A	35	ARG
1	A	52	ILE
1	A	58	GLU
1	A	67	VAL
1	A	72	GLN
1	A	73	THR
1	A	82	ARG
1	A	89	GLU
1	A	98	MET
1	A	121	LYS
1	A	128	GLU
1	A	177	GLU
1	A	183	ASP
1	A	222	GLU
1	A	224	GLN
1	A	225	THR
1	A	231	VAL
1	A	247	VAL
1	A	256	ARG
2	B	1	ILE
2	B	34[A]	ASP
2	B	34[B]	ASP
2	B	58	LYS
2	B	64	LEU
2	B	70	PHE
2	B	75	LYS
2	B	85	VAL
2	B	98	ASP
4	D	6	ASN
4	D	7	SER
4	D	27	ARG
4	D	51	SER
4	D	54	ASP
4	D	73	VAL

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Mol	Chain	Res	Type
4	D	76	LEU
4	D	81	GLN
4	D	87	THR
4	D	103	LYS
4	D	104	LEU
4	D	110	THR
4	D	120	ASN
4	D	135	ASP
4	D	150	VAL
4	D	167	ASP
4	D	173	PHE
4	D	194	ASN
4	D	195	ASN
5	E	9	LYS
5	E	19	MET
5	E	20	THR
5	E	21	LEU
5	E	25	GLN
5	E	26	ASP
5	E	27	MET
5	E	31	TYR
5	E	55	THR
5	E	60	VAL
5	E	67	VAL
5	E	72	THR
5	E	95	ARG
5	E	98	LEU
5	E	100	SER
5	E	105	GLU
5	E	113	ARG
5	E	118	ASP
5	E	150	THR
5	E	159	LEU
5	E	168	VAL
5	E	177	GLN
5	E	179	LEU
5	E	198	VAL
5	E	213	GLN
5	E	222	ASN
5	E	228	ASP
5	E	240	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such

sidechains are listed below:

Mol	Chain	Res	Type
4	D	105	GLN
5	E	22	GLN
5	E	57	GLN

### 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](#)

10 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	$\# Z  > 2$
6	GOL	A	305	-	5,5,5	0.37	0	5,5,5	0.45	0
6	GOL	A	303	-	5,5,5	0.37	0	5,5,5	0.80	0
6	GOL	A	306	-	5,5,5	0.35	0	5,5,5	0.49	0
6	GOL	A	301	-	5,5,5	0.42	0	5,5,5	0.24	0
6	GOL	A	302	-	5,5,5	0.34	0	5,5,5	0.39	0
6	GOL	E	301	-	5,5,5	0.35	0	5,5,5	0.55	0
6	GOL	B	102	-	5,5,5	0.38	0	5,5,5	0.38	0
6	GOL	D	301	-	5,5,5	0.41	0	5,5,5	0.38	0
6	GOL	A	304	-	5,5,5	0.41	0	5,5,5	0.62	0
6	GOL	B	101	-	5,5,5	0.43	0	5,5,5	0.28	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
6	GOL	A	305	-	-	3/4/4/4	-
6	GOL	A	303	-	-	3/4/4/4	-
6	GOL	A	306	-	-	2/4/4/4	-
6	GOL	A	301	-	-	1/4/4/4	-
6	GOL	A	302	-	-	2/4/4/4	-
6	GOL	E	301	-	-	2/4/4/4	-
6	GOL	B	102	-	-	0/4/4/4	-
6	GOL	D	301	-	-	4/4/4/4	-
6	GOL	A	304	-	-	2/4/4/4	-
6	GOL	B	101	-	-	2/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (21) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	A	302	GOL	O1-C1-C2-C3
6	A	304	GOL	C1-C2-C3-O3
6	A	305	GOL	C1-C2-C3-O3
6	D	301	GOL	O1-C1-C2-C3
6	E	301	GOL	O1-C1-C2-C3
6	A	305	GOL	O2-C2-C3-O3
6	A	303	GOL	O1-C1-C2-C3
6	A	306	GOL	C1-C2-C3-O3
6	B	101	GOL	O1-C1-C2-C3
6	D	301	GOL	C1-C2-C3-O3
6	D	301	GOL	O1-C1-C2-O2
6	D	301	GOL	O2-C2-C3-O3
6	E	301	GOL	O1-C1-C2-O2
6	A	303	GOL	O1-C1-C2-O2
6	A	304	GOL	O2-C2-C3-O3
6	A	301	GOL	O2-C2-C3-O3
6	A	302	GOL	O1-C1-C2-O2
6	A	303	GOL	O2-C2-C3-O3

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Mol	Chain	Res	Type	Atoms
6	A	306	GOL	O2-C2-C3-O3
6	B	101	GOL	O1-C1-C2-O2
6	A	305	GOL	O1-C1-C2-O2

There are no ring outliers.

No monomer is involved in short contacts.

## 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 [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	275/275 (100%)	-0.40	0 <a href="#">100</a> <a href="#">100</a>	43, 67, 159, 195	0
2	B	100/100 (100%)	-0.55	0 <a href="#">100</a> <a href="#">100</a>	34, 61, 105, 118	1 (1%)
3	C	9/9 (100%)	-0.72	0 <a href="#">100</a> <a href="#">100</a>	51, 53, 59, 60	0
4	D	200/200 (100%)	0.15	1 (0%) <a href="#">87</a> <a href="#">88</a>	51, 108, 186, 201	0
5	E	245/245 (100%)	-0.21	1 (0%) <a href="#">89</a> <a href="#">90</a>	30, 87, 143, 168	1 (0%)
All	All	829/829 (100%)	-0.24	2 (0%) <a href="#">92</a> <a href="#">92</a>	30, 82, 169, 201	2 (0%)

All (2) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
5	E	116(A)	THR	3.2
4	D	192	ALA	3.2

### 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, 95<sup>th</sup> 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
6	GOL	A	302	6/6	0.49	0.34	60,61,62,62	6
6	GOL	B	102	6/6	0.52	0.34	62,62,64,65	6
6	GOL	A	305	6/6	0.71	0.15	89,90,91,92	0
6	GOL	A	304	6/6	0.80	0.12	82,83,84,84	0
6	GOL	D	301	6/6	0.82	0.10	96,98,98,98	0
6	GOL	B	101	6/6	0.83	0.11	82,83,83,84	0
6	GOL	E	301	6/6	0.85	0.13	86,86,87,87	0
6	GOL	A	303	6/6	0.86	0.10	59,61,61,64	0
6	GOL	A	306	6/6	0.87	0.09	89,90,91,91	0
6	GOL	A	301	6/6	0.90	0.10	71,73,73,73	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.