



Full wwPDB X-ray Structure Validation Report ⓘ

Jul 13, 2022 – 10:15 am BST

PDB ID : 7OW5
Title : Crystal structure of a TCR in complex with HLA-A*11:01 bound to KRAS peptide (VVVGAGGVGK)
Authors : Karuppiah, V.; Robinson, R.A.
Deposited on : 2021-06-16
Resolution : 2.58 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 : 4.02b-467
Mogul : 1.8.4, CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.29
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0267
CCP4 : 7.1.010 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.29

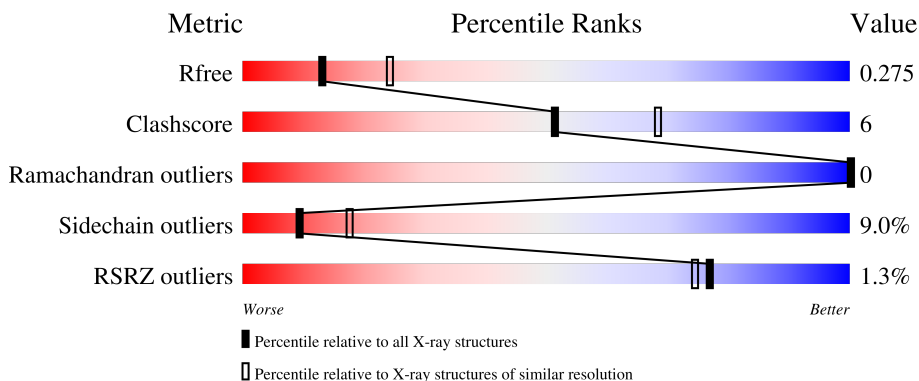
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.58 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	3676 (2.60-2.56)
Clashscore	141614	4049 (2.60-2.56)
Ramachandran outliers	138981	3979 (2.60-2.56)
Sidechain outliers	138945	3979 (2.60-2.56)
RSRZ outliers	127900	3614 (2.60-2.56)

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	276	 87% 10% 3% 2%
2	B	100	 81% 17% 2% 1%
3	C	10	 100%
4	D	203	 72% 19% 6% 2%
5	E	246	 78% 19% 3% 1%

2 Entry composition [i](#)

There are 7 unique types of molecules in this entry. The entry contains 6632 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 MHC class I antigen.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	275	2247	1397	408	433	9	0	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	276	PRO	-	expression tag	UNP A0A583ZB34

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	99	828	528	140	157	3	0	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	0	MET	-	initiating methionine	UNP P61769

- Molecule 3 is a protein called KRAS peptide (VVVGAGGVGK).

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
3	C	10	59	37	11	11	0	0	0

- Molecule 4 is a protein called TCR alpha.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
4	D	191	1516	959	246	303	8	0	0	0

- Molecule 5 is a protein called TCR beta.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
5	E	246	1950	1228	344	368	10	0	1	0

- Molecule 6 is SULFATE ION (three-letter code: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	S		
6	A	1	5	4	1	0	0
6	E	1	5	4	1	0	0
6	E	1	5	4	1	0	0

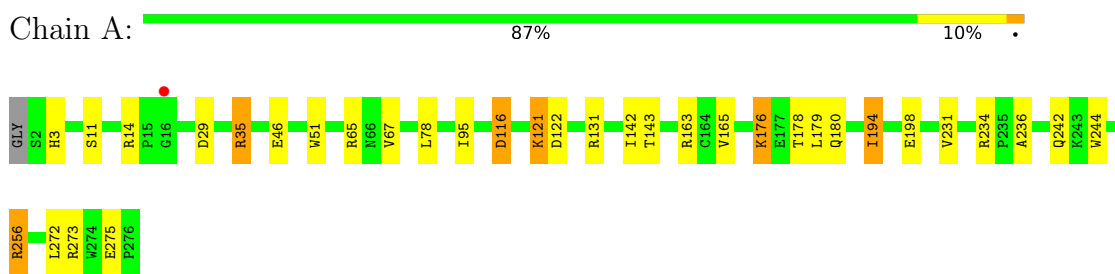
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
7	A	5	5	5	0	0
7	B	2	2	2	0	0
7	D	2	2	2	0	0
7	E	8	8	8	0	0

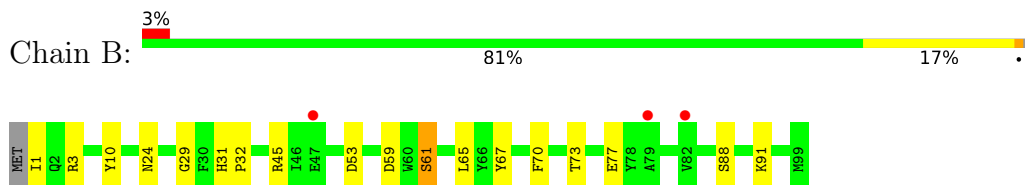
3 Residue-property plots

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: MHC class I antigen



- Molecule 2: Beta-2-microglobulin

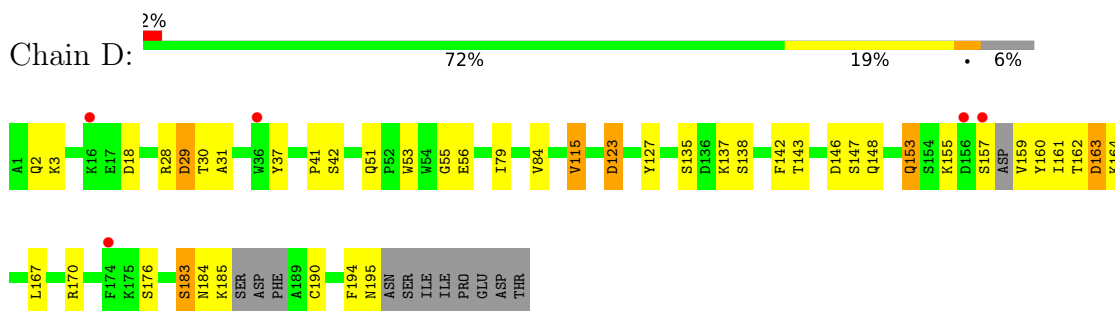


- Molecule 3: KRAS peptide (VVVGAGGVGK)

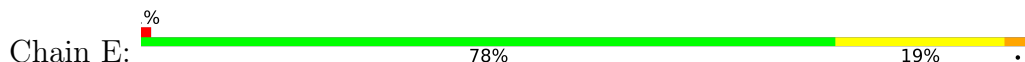


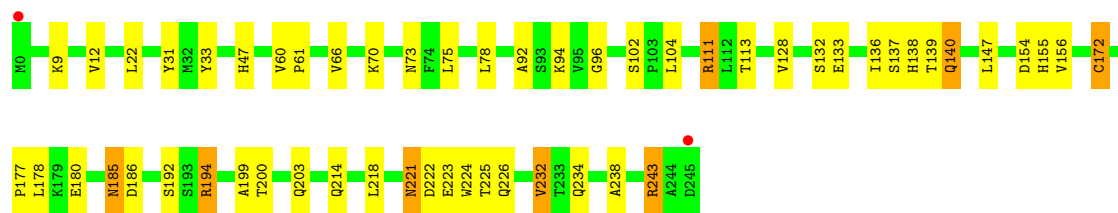
There are no outlier residues recorded for this chain.

- Molecule 4: TCR alpha



- Molecule 5: TCR beta





4 Data and refinement statistics

Property	Value	Source
Space group	P 41 2 2	Depositor
Cell constants a, b, c, α , β , γ	145.55Å 145.55Å 120.60Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	65.09 – 2.58 65.09 – 2.58	Depositor EDS
% Data completeness (in resolution range)	100.0 (65.09-2.58) 99.3 (65.09-2.58)	Depositor EDS
R_{merge}	0.15	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	0.96 (at 2.58Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.206 , 0.274 0.216 , 0.275	Depositor DCC
R_{free} test set	2115 reflections (5.14%)	wwPDB-VP
Wilson B-factor (Å ²)	87.8	Xtriage
Anisotropy	0.180	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	(Not available) , (Not available)	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	6632	wwPDB-VP
Average B, all atoms (Å ²)	94.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.27% 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: SO4

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	0.71	0/2309	0.94	0/3136
2	B	0.74	0/851	0.91	0/1152
3	C	0.95	0/58	1.12	0/75
4	D	0.73	0/1551	0.93	0/2104
5	E	0.75	0/2006	0.94	0/2728
All	All	0.73	0/6775	0.94	0/9195

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 [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	2092	20	0
2	B	828	0	794	8	0
3	C	59	0	68	0	0
4	D	1516	0	1433	21	0
5	E	1950	0	1872	33	0
6	A	5	0	0	0	0
6	E	10	0	0	0	0
7	A	5	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
7	B	2	0	0	0	0
7	D	2	0	0	0	0
7	E	8	0	0	0	0
All	All	6632	0	6259	72	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.

All (72) 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)
5:E:111[A]:ARG:HH11	5:E:111[A]:ARG:HG3	1.11	1.14
5:E:111[A]:ARG:HG3	5:E:111[A]:ARG:NH1	1.84	0.87
4:D:159:VAL:HG22	4:D:183:SER:HB2	1.63	0.78
1:A:231:VAL:HG13	1:A:244:TRP:CZ2	2.31	0.66
5:E:185:ASN:HD22	5:E:185:ASN:C	1.99	0.65
5:E:47:HIS:HB2	5:E:66:VAL:HG11	1.80	0.64
4:D:123:ASP:OD1	5:E:138:HIS:NE2	2.32	0.63
4:D:161:ILE:HD12	4:D:161:ILE:O	1.99	0.63
1:A:194:ILE:HD11	1:A:198:GLU:HB3	1.81	0.62
4:D:84:VAL:HA	4:D:115:VAL:HB	1.81	0.62
4:D:163:ASP:OD1	4:D:163:ASP:N	2.34	0.61
1:A:78:LEU:HG	1:A:95:ILE:HD12	1.81	0.60
2:B:29:GLY:HA2	2:B:61:SER:HB2	1.83	0.60
4:D:142:PHE:HB2	4:D:194:PHE:CE2	2.37	0.60
2:B:24:ASN:HB3	2:B:65:LEU:HD11	1.85	0.58
5:E:12:VAL:HA	5:E:113:THR:O	2.03	0.58
1:A:272:LEU:HD12	1:A:272:LEU:N	2.19	0.57
1:A:234:ARG:HE	1:A:242:GLN:HE21	1.53	0.57
5:E:185:ASN:HD22	5:E:186:ASP:N	2.04	0.56
5:E:128:VAL:HG23	5:E:238:ALA:HB3	1.88	0.55
1:A:35:ARG:NH1	1:A:46:GLU:OE1	2.40	0.54
4:D:51:GLN:HE21	4:D:55:GLY:HA3	1.73	0.54
5:E:218:LEU:HB3	5:E:222:ASP:OD2	2.07	0.53
5:E:156:VAL:HA	5:E:214:GLN:O	2.09	0.53
1:A:3:HIS:HD2	1:A:29:ASP:OD2	1.92	0.52
2:B:59:ASP:OD1	2:B:61:SER:OG	2.27	0.52
1:A:231:VAL:CG1	1:A:244:TRP:CZ2	2.93	0.51
1:A:51:TRP:CZ2	1:A:179:LEU:HD11	2.46	0.51
5:E:94:LYS:HE2	5:E:102:SER:O	2.11	0.50
4:D:51:GLN:NE2	4:D:56:GLU:O	2.45	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:E:221:ASN:N	5:E:221:ASN:OD1	2.45	0.49
1:A:35:ARG:HD3	2:B:53:ASP:OD1	2.13	0.49
5:E:136:ILE:HG23	5:E:199:ALA:HB1	1.96	0.48
4:D:184:ASN:O	4:D:185:LYS:C	2.51	0.48
5:E:31:TYR:CZ	5:E:96:GLY:HA2	2.49	0.48
4:D:159:VAL:HG22	4:D:183:SER:CB	2.37	0.48
5:E:60:VAL:N	5:E:61:PRO:CD	2.77	0.47
5:E:33:TYR:HB2	5:E:92:ALA:HB3	1.95	0.47
5:E:223:GLU:HG2	5:E:224:TRP:N	2.29	0.47
2:B:31:HIS:ND1	2:B:32:PRO:HA	2.31	0.46
5:E:139:THR:O	5:E:140:GLN:HB2	2.16	0.45
1:A:121:LYS:HE3	1:A:121:LYS:HB2	1.68	0.45
1:A:121:LYS:O	1:A:122:ASP:C	2.55	0.45
4:D:31:ALA:HA	4:D:53:TRP:CD2	2.51	0.45
5:E:111[A]:ARG:HG2	5:E:155:HIS:CD2	2.52	0.45
1:A:142:ILE:O	1:A:143:THR:C	2.56	0.44
5:E:224:TRP:CE2	5:E:226:GLN:HB2	2.52	0.44
1:A:116:ASP:N	1:A:116:ASP:OD1	2.50	0.44
4:D:146:ASP:OD1	4:D:148:GLN:HB2	2.18	0.43
1:A:65:ARG:NH1	4:D:29:ASP:OD2	2.42	0.43
2:B:10:TYR:CD1	2:B:10:TYR:N	2.86	0.43
4:D:160:TYR:HE1	5:E:180:GLU:O	2.00	0.43
4:D:162:THR:HG21	5:E:192:SER:OG	2.18	0.43
4:D:153:GLN:NE2	4:D:161:ILE:HD11	2.33	0.43
5:E:154:ASP:HB2	5:E:177:PRO:HG2	2.00	0.43
5:E:218:LEU:O	5:E:232:VAL:HG12	2.18	0.43
1:A:163:ARG:NH1	4:D:30:THR:HG21	2.34	0.42
4:D:127:TYR:HB3	5:E:132:SER:CB	2.50	0.42
5:E:203:GLN:HA	5:E:243:ARG:O	2.20	0.42
5:E:78:LEU:HD12	5:E:78:LEU:N	2.34	0.42
1:A:236:ALA:O	2:B:24:ASN:ND2	2.49	0.41
5:E:172:CYS:HB3	5:E:194:ARG:HD2	2.01	0.41
4:D:37:TYR:OH	5:E:104:LEU:N	2.54	0.41
4:D:135:SER:HB2	4:D:137:LYS:H	1.84	0.41
1:A:176:LYS:HA	1:A:180:GLN:HG3	2.03	0.41
4:D:18:ASP:HA	4:D:79:ILE:O	2.20	0.41
5:E:66:VAL:HA	5:E:75:LEU:O	2.21	0.41
1:A:256:ARG:H	1:A:256:ARG:HG3	1.77	0.41
5:E:111[A]:ARG:NH1	5:E:111[A]:ARG:CG	2.65	0.40
1:A:242:GLN:NE2	2:B:10:TYR:CD2	2.89	0.40
5:E:185:ASN:C	5:E:185:ASN:ND2	2.71	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:E:147:LEU:HD12	5:E:147:LEU:HA	1.96	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	273/276 (99%)	258 (94%)	15 (6%)	0	100	100
2	B	97/100 (97%)	88 (91%)	9 (9%)	0	100	100
3	C	8/10 (80%)	8 (100%)	0	0	100	100
4	D	185/203 (91%)	171 (92%)	14 (8%)	0	100	100
5	E	245/246 (100%)	228 (93%)	17 (7%)	0	100	100
All	All	808/835 (97%)	753 (93%)	55 (7%)	0	100	100

There are no Ramachandran outliers to report.

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	233/233 (100%)	219 (94%)	14 (6%)	19	37
2	B	94/95 (99%)	84 (89%)	10 (11%)	6	12
3	C	5/5 (100%)	5 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
4	D	172/184 (94%)	150 (87%)	22 (13%)	4	7
5	E	212/211 (100%)	193 (91%)	19 (9%)	9	17
All	All	716/728 (98%)	651 (91%)	65 (9%)	9	17

All (65) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	11	SER
1	A	14	ARG
1	A	35	ARG
1	A	67	VAL
1	A	116	ASP
1	A	121	LYS
1	A	131	ARG
1	A	165	VAL
1	A	176	LYS
1	A	178	THR
1	A	194	ILE
1	A	256	ARG
1	A	273	ARG
1	A	275	GLU
2	B	1	ILE
2	B	3	ARG
2	B	45	ARG
2	B	61	SER
2	B	67	TYR
2	B	70	PHE
2	B	73	THR
2	B	77	GLU
2	B	88	SER
2	B	91	LYS
4	D	2	GLN
4	D	3	LYS
4	D	28	ARG
4	D	29	ASP
4	D	41	PRO
4	D	42	SER
4	D	115	VAL
4	D	123	ASP
4	D	138	SER
4	D	143	THR

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Mol	Chain	Res	Type
4	D	147	SER
4	D	153	GLN
4	D	155	LYS
4	D	157	SER
4	D	163	ASP
4	D	164	LYS
4	D	167	LEU
4	D	170	ARG
4	D	176	SER
4	D	183	SER
4	D	190	CYS
4	D	195	ASN
5	E	9	LYS
5	E	22	LEU
5	E	70	LYS
5	E	73	ASN
5	E	111[A]	ARG
5	E	111[B]	ARG
5	E	133	GLU
5	E	137	SER
5	E	140	GLN
5	E	172	CYS
5	E	178	LEU
5	E	185	ASN
5	E	194	ARG
5	E	200	THR
5	E	221	ASN
5	E	225	THR
5	E	232	VAL
5	E	234	GLN
5	E	243	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	3	HIS
1	A	62	GLN
1	A	115	GLN
1	A	242	GLN
4	D	2	GLN
4	D	58	ASN
4	D	153	GLN

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Mol	Chain	Res	Type
5	E	108	ASN
5	E	185	ASN
5	E	234	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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

3 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	SO4	E	302	-	4,4,4	0.30	0	6,6,6	0.11	0
6	SO4	E	301	-	4,4,4	0.31	0	6,6,6	0.15	0
6	SO4	A	301	-	4,4,4	0.31	0	6,6,6	0.09	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.

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, 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	275/276 (99%)	0.18	1 (0%) 92 92	68, 86, 112, 138	0
2	B	99/100 (99%)	0.23	3 (3%) 50 46	76, 103, 134, 141	0
3	C	10/10 (100%)	0.27	0 100 100	73, 77, 83, 87	0
4	D	191/203 (94%)	0.19	5 (2%) 56 52	64, 106, 146, 167	0
5	E	246/246 (100%)	0.18	2 (0%) 86 85	65, 84, 113, 137	0
All	All	821/835 (98%)	0.19	11 (1%) 77 74	64, 90, 132, 167	0

All (11) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	D	16	LYS	4.1
2	B	47	GLU	2.6
5	E	0	MET	2.6
4	D	156	ASP	2.5
4	D	157	SER	2.4
1	A	16	GLY	2.4
4	D	174	PHE	2.3
2	B	82	VAL	2.1
5	E	245	ASP	2.1
2	B	79	ALA	2.0
4	D	36	TRP	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
6	SO4	E	302	5/5	0.78	0.15	108,135,150,150	0
6	SO4	E	301	5/5	0.84	0.22	112,128,142,146	0
6	SO4	A	301	5/5	0.88	0.15	105,122,135,135	0

6.5 Other polymers [i](#)

There are no such residues in this entry.