



wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 15, 2023 – 06:34 PM EDT

PDB ID : 1SZP
Title : A Crystal Structure of the Rad51 Filament
Authors : Conway, A.B.; Lynch, T.W.; Zhang, Y.; Fortin, G.S.; Symington, L.S.; Rice, P.A.
Deposited on : 2004-04-06
Resolution : 3.25 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.35
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) : 2.35

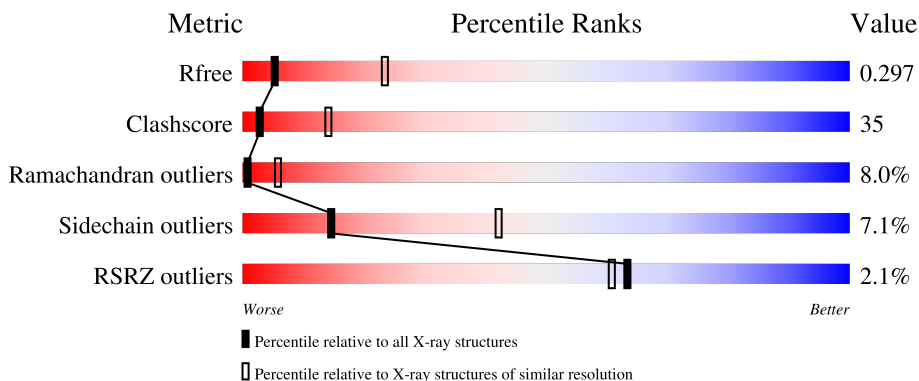
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.25 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	1191 (3.30-3.22)
Clashscore	141614	1251 (3.30-3.22)
Ramachandran outliers	138981	1229 (3.30-3.22)
Sidechain outliers	138945	1228 (3.30-3.22)
RSRZ outliers	127900	1154 (3.30-3.22)

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	321	
1	B	321	
1	C	321	
1	D	321	
1	E	321	

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Mol	Chain	Length	Quality of chain
1	F	321	

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	SO4	B	502	-	-	X	-
2	SO4	C	503	-	-	X	-
2	SO4	D	504	-	-	X	-
2	SO4	E	505	-	-	X	-

2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 12583 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 DNA repair protein RAD51.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	295	2148	1349	376	408	15	0	0	0
1	B	274	1985	1245	351	376	13	0	0	0
1	C	274	1995	1249	354	378	14	0	0	0
1	D	293	2143	1344	377	406	16	0	0	0
1	E	294	2147	1346	378	407	16	0	0	0
1	F	294	2135	1341	372	407	15	0	0	0

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	80	MET	-	initiating methionine	UNP P25454
A	345	THR	ILE	engineered mutation	UNP P25454
B	80	MET	-	initiating methionine	UNP P25454
B	345	THR	ILE	engineered mutation	UNP P25454
C	80	MET	-	initiating methionine	UNP P25454
C	345	THR	ILE	engineered mutation	UNP P25454
D	80	MET	-	initiating methionine	UNP P25454
D	345	THR	ILE	engineered mutation	UNP P25454
E	80	MET	-	initiating methionine	UNP P25454
E	345	THR	ILE	engineered mutation	UNP P25454
F	80	MET	-	initiating methionine	UNP P25454
F	345	THR	ILE	engineered mutation	UNP P25454

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O₄S).

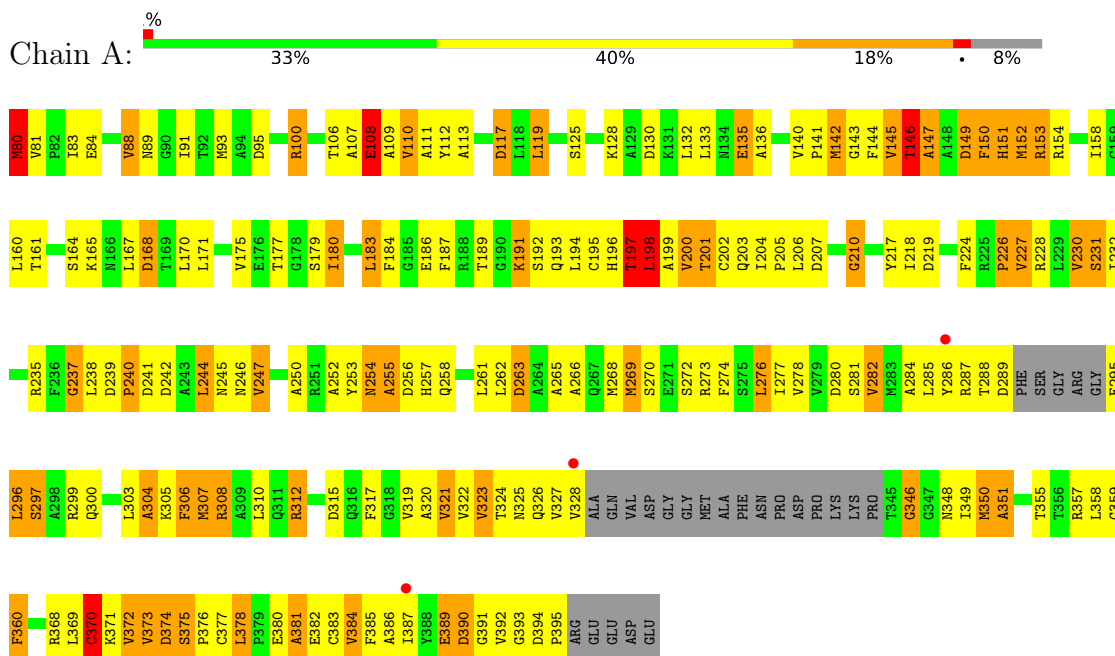


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		
2	B	1	Total	O	S	0	0
			5	4	1		
2	C	1	Total	O	S	0	0
			5	4	1		
2	D	1	Total	O	S	0	0
			5	4	1		
2	E	1	Total	O	S	0	0
			5	4	1		
2	F	1	Total	O	S	0	0
			5	4	1		

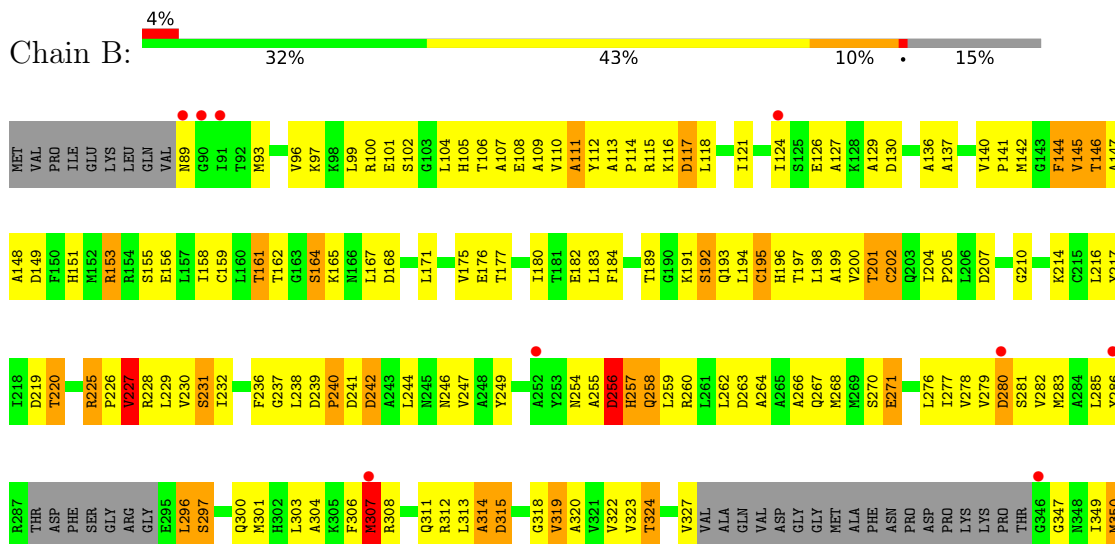
3 Residue-property plots [i](#)

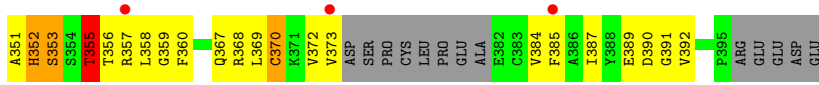
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: DNA repair protein RAD51

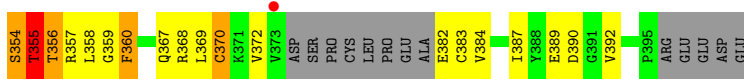
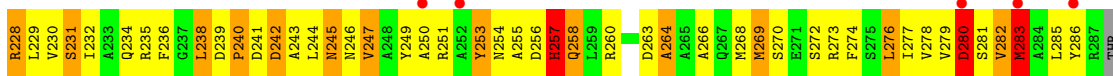
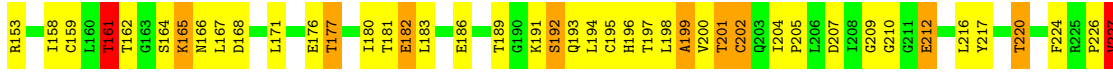
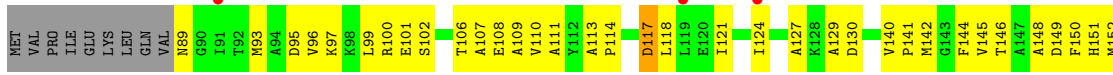


• Molecule 1: DNA repair protein RAD51





- Molecule 1: DNA repair protein RAD51

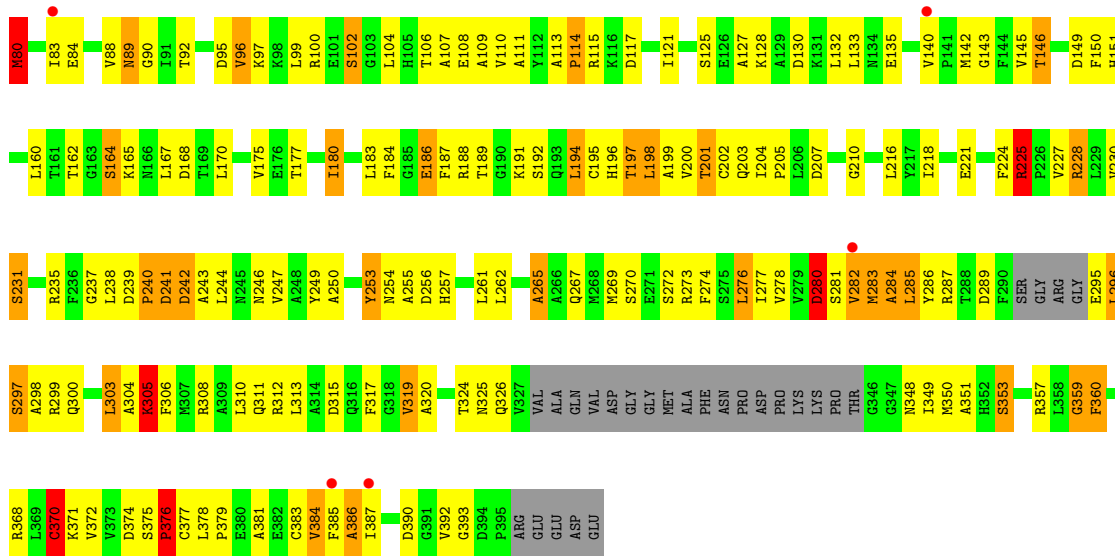


- Molecule 1: DNA repair protein RAD51

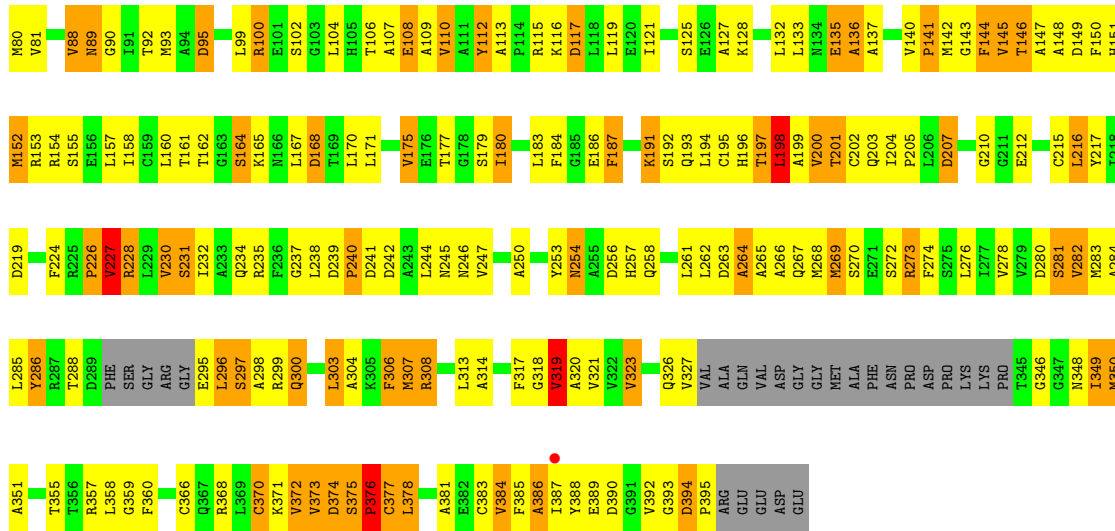
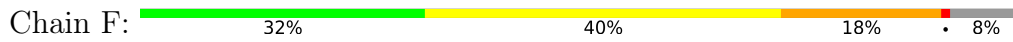


- Molecule 1: DNA repair protein RAD51





• Molecule 1: DNA repair protein RAD51



4 Data and refinement statistics i

Property	Value	Source
Space group	P 31	Depositor
Cell constants a, b, c, α , β , γ	135.26Å 135.26Å 128.89Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	40.00 – 3.25 36.26 – 3.25	Depositor EDS
% Data completeness (in resolution range)	88.4 (40.00-3.25) 99.1 (36.26-3.25)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.40 (at 3.25Å)	Xtrriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.268 , 0.320 0.250 , 0.297	Depositor DCC
R_{free} test set	4063 reflections (9.90%)	wwPDB-VP
Wilson B-factor (Å ²)	85.8	Xtrriage
Anisotropy	0.273	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 44.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	0.408 for -h,-k,l 0.046 for h,-h-k,-l 0.045 for -k,-h,-l	Xtrriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	12583	wwPDB-VP
Average B, all atoms (Å ²)	51.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 19.12% 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	2.15	72/2177 (3.3%)	1.55	23/2951 (0.8%)
1	B	1.81	25/2009 (1.2%)	1.48	23/2719 (0.8%)
1	C	1.85	38/2019 (1.9%)	1.45	23/2730 (0.8%)
1	D	1.90	43/2172 (2.0%)	1.50	23/2942 (0.8%)
1	E	1.87	40/2176 (1.8%)	1.49	20/2947 (0.7%)
1	F	2.14	72/2164 (3.3%)	1.55	22/2934 (0.7%)
All	All	1.96	290/12717 (2.3%)	1.50	134/17223 (0.8%)

The worst 5 of 290 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	F	308	ARG	CG-CD	12.86	1.84	1.51
1	F	386	ALA	CA-CB	-11.61	1.28	1.52
1	B	227	VAL	CB-CG2	10.88	1.75	1.52
1	C	227	VAL	CB-CG2	10.04	1.74	1.52
1	C	202	CYS	CB-SG	-9.82	1.65	1.82

The worst 5 of 134 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	225	ARG	NE-CZ-NH1	13.12	126.86	120.30
1	D	225	ARG	NE-CZ-NH2	-12.32	114.14	120.30
1	E	225	ARG	NE-CZ-NH1	11.60	126.10	120.30
1	F	308	ARG	NE-CZ-NH1	-11.07	114.77	120.30
1	E	117	ASP	CB-CG-OD2	10.90	128.11	118.30

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	2148	0	2095	152	0
1	B	1985	0	1931	162	0
1	C	1995	0	1944	152	0
1	D	2143	0	2094	144	0
1	E	2147	0	2095	131	1
1	F	2135	0	2075	163	1
2	A	5	0	0	1	0
2	B	5	0	0	2	0
2	C	5	0	0	2	0
2	D	5	0	0	2	0
2	E	5	0	0	2	0
2	F	5	0	0	0	0
All	All	12583	0	12234	876	1

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 35.

The worst 5 of 876 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:227:VAL:CB	1:B:227:VAL:CG2	1.75	1.62
1:F:308:ARG:CD	1:F:308:ARG:CG	1.84	1.55
1:A:308:ARG:CD	1:A:308:ARG:CG	1.76	1.52
1:A:93:MET:CE	1:A:93:MET:SD	2.02	1.45
1:F:93:MET:CE	1:F:93:MET:SD	2.05	1.44

All (1) 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)
1:E:305:LYS:NZ	1:F:288:THR:OG1[2_545]	2.07	0.13

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	289/321 (90%)	206 (71%)	55 (19%)	28 (10%)	0	4
1	B	266/321 (83%)	187 (70%)	58 (22%)	21 (8%)	1	6
1	C	266/321 (83%)	189 (71%)	57 (21%)	20 (8%)	1	7
1	D	287/321 (89%)	195 (68%)	73 (25%)	19 (7%)	1	9
1	E	288/321 (90%)	200 (69%)	66 (23%)	22 (8%)	1	6
1	F	288/321 (90%)	206 (72%)	57 (20%)	25 (9%)	1	5
All	All	1684/1926 (87%)	1183 (70%)	366 (22%)	135 (8%)	1	6

5 of 135 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	142	MET
1	A	153	ARG
1	A	257	HIS
1	A	296	LEU
1	A	297	SER

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	217/260 (84%)	202 (93%)	15 (7%)	15	43
1	B	197/260 (76%)	186 (94%)	11 (6%)	21	52
1	C	199/260 (76%)	186 (94%)	13 (6%)	17	46

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	D	217/260 (84%)	200 (92%)	17 (8%)	12	38
1	E	217/260 (84%)	198 (91%)	19 (9%)	10	33
1	F	215/260 (83%)	200 (93%)	15 (7%)	15	43
All	All	1262/1560 (81%)	1172 (93%)	90 (7%)	14	42

5 of 90 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	89	ASN
1	E	370	CYS
1	E	146	THR
1	E	231	SER
1	F	80	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 21 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	87	GLN
1	F	89	ASN
1	F	325	ASN
1	F	166	ASN
1	E	325	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

6 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	SO4	E	505	-	4,4,4	1.40	1 (25%)	6,6,6	1.65	1 (16%)
2	SO4	C	503	-	4,4,4	0.58	0	6,6,6	1.81	2 (33%)
2	SO4	A	501	-	4,4,4	0.97	0	6,6,6	1.24	1 (16%)
2	SO4	F	506	-	4,4,4	0.42	0	6,6,6	0.97	0
2	SO4	B	502	-	4,4,4	0.59	0	6,6,6	1.84	2 (33%)
2	SO4	D	504	-	4,4,4	0.97	0	6,6,6	2.14	3 (50%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	E	505	SO4	O1-S	-2.45	1.32	1.46

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	503	SO4	O4-S-O3	3.34	123.31	109.06
2	D	504	SO4	O3-S-O2	3.31	126.57	109.31
2	B	502	SO4	O4-S-O1	3.00	124.97	109.31
2	D	504	SO4	O2-S-O1	-2.93	87.78	109.43
2	E	505	SO4	O4-S-O3	2.87	121.30	109.06

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	E	505	SO4	2	0

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Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	503	SO4	2	0
2	A	501	SO4	1	0
2	B	502	SO4	2	0
2	D	504	SO4	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 [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	295/321 (91%)	-0.01	3 (1%) 82 82	6, 36, 69, 98	0
1	B	274/321 (85%)	0.22	12 (4%) 34 32	23, 64, 98, 128	0
1	C	274/321 (85%)	0.21	9 (3%) 46 43	22, 63, 99, 121	0
1	D	293/321 (91%)	0.04	6 (2%) 65 63	12, 51, 81, 112	0
1	E	294/321 (91%)	0.05	5 (1%) 70 67	15, 53, 82, 112	0
1	F	294/321 (91%)	-0.01	1 (0%) 94 94	5, 35, 72, 93	0
All	All	1724/1926 (89%)	0.08	36 (2%) 63 61	5, 49, 93, 128	0

The worst 5 of 36 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	346	GLY	5.8
1	C	286	TYR	4.7
1	C	373	VAL	4.3
1	B	90	GLY	3.9
1	B	124	ILE	3.7

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
2	SO4	B	502	5/5	0.92	0.13	55,58,62,69	0
2	SO4	C	503	5/5	0.92	0.13	49,52,62,65	0
2	SO4	D	504	5/5	0.96	0.14	33,36,42,43	0
2	SO4	E	505	5/5	0.97	0.16	32,35,35,39	0
2	SO4	A	501	5/5	0.98	0.14	37,40,47,48	0
2	SO4	F	506	5/5	0.98	0.12	36,41,44,49	0

6.5 Other polymers [i](#)

There are no such residues in this entry.