wwPDB X-ray Structure Validation Summary Report (i)

Jun 12, 2024 – 04:26 AM EDT

PDB ID	:	2ODF
Title	:	The crystal structure of gene product Atu2144 from Agrobacterium tumefaciens
Authors	:	Zhang, R.; Xu, X.; Zheng, H.; Savchenko, A.; Edwards, A.; Joachimiak, A.; Midwest Center for Structural Genomics (MCSG)
Deposited on	:	2006-12-22
Resolution	:	1.90 Å(reported)

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

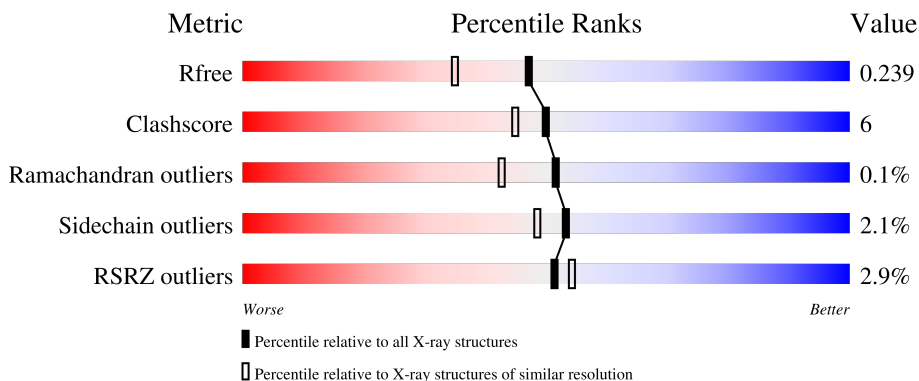|		
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	2.36.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

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 1.90 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.
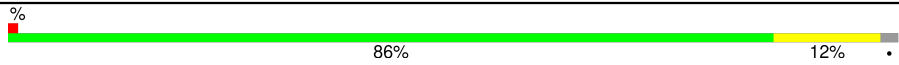
Metric	Percentile Ranks	Value
Rfree		0.239
Clashscore		6
Ramachandran outliers		0.1%
Sidechain outliers		2.1%
RSRZ outliers		2.9%

Worse   *Better*

▮ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	6207 (1.90-1.90)
Clashscore	141614	6847 (1.90-1.90)
Ramachandran outliers	138981	6760 (1.90-1.90)
Sidechain outliers	138945	6760 (1.90-1.90)
RSRZ outliers	127900	6082 (1.90-1.90)

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 <=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	257	88% 9% ··
1	B	257	2% 87% 10% ··
1	C	257	% 84% 11% · ·
1	D	257	% 87% 10% ·
1	E	257	3% 89% 8% ·

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Mol	Chain	Length	Quality of chain
1	F	257	% ![bar] 86% 12% •
1	G	257	7% ![bar] 79% 16% • •
1	H	257	8% ![bar] 83% 13% • •

2 Entry composition ⓘ

There are 3 unique types of molecules in this entry. The entry contains 17054 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 Hypothetical protein Atu2144.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	252	Total	C	N	O	S	0	0	0
			1937	1219	343	369	6			
1	B	252	Total	C	N	O	S	0	0	0
			1928	1215	338	369	6			
1	C	249	Total	C	N	O	S	0	0	0
			1908	1203	337	362	6			
1	D	250	Total	C	N	O	S	0	0	0
			1917	1208	338	365	6			
1	E	251	Total	C	N	O	S	0	0	0
			1928	1214	342	366	6			
1	F	251	Total	C	N	O	S	0	0	0
			1928	1214	342	366	6			
1	G	250	Total	C	N	O	S	0	0	0
			1917	1208	338	365	6			
1	H	251	Total	C	N	O	S	0	0	0
			1928	1214	342	366	6			

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O_4S).

SO4

O1

O3 O⁻ — S — O⁻ O4

S

O2

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

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	326	Total 326	O 326	0	0
3	B	174	Total 174	O 174	0	0

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	C	216	Total 216	O 216	0	0
3	D	275	Total 275	O 275	0	0
3	E	166	Total 166	O 166	0	0
3	F	171	Total 171	O 171	0	0
3	G	126	Total 126	O 126	0	0
3	H	159	Total 159	O 159	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.
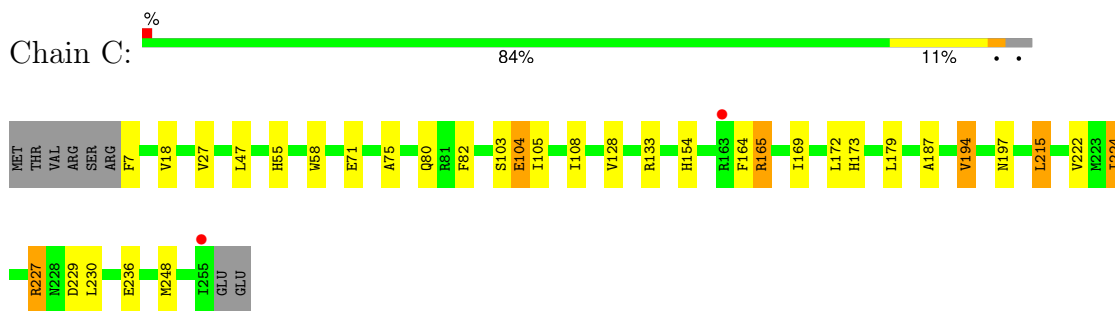
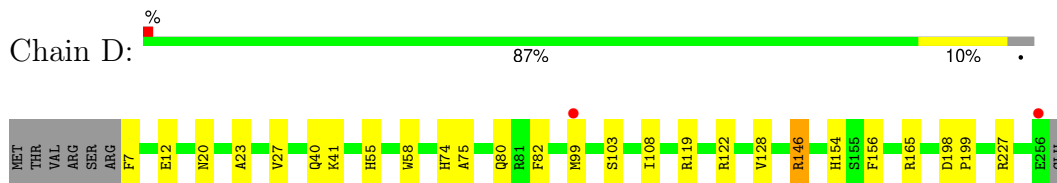• Molecule 1: Hypothetical protein Atu2144
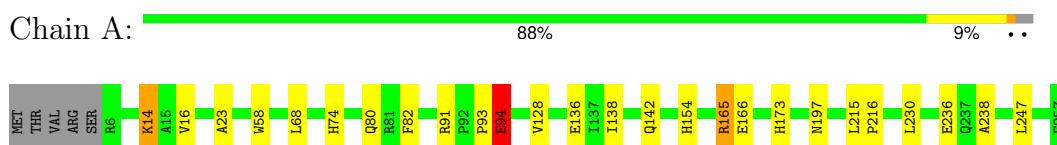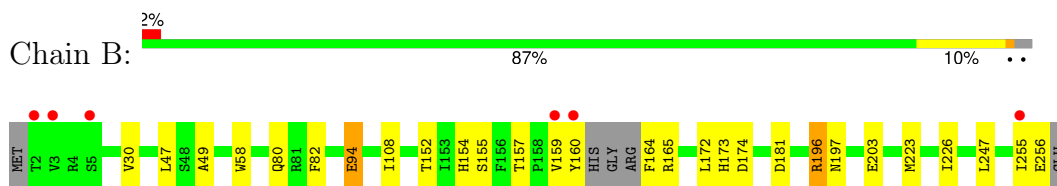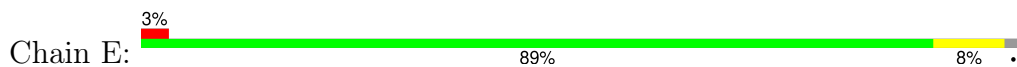
Chain A:

• Molecule 1: Hypothetical protein Atu2144

Chain B:

• Molecule 1: Hypothetical protein Atu2144

Chain C:

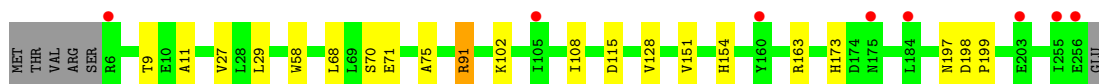• Molecule 1: Hypothetical protein Atu2144

Chain D:

• Molecule 1: Hypothetical protein Atu2144

Chain E:

• Molecule 1: Hypothetical protein Atu2144
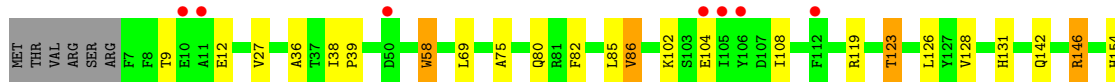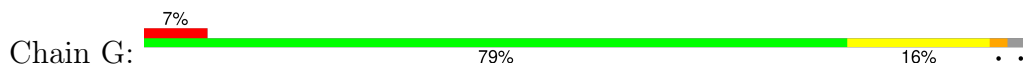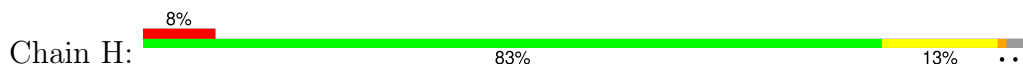
Chain F:

• Molecule 1: Hypothetical protein Atu2144

Chain G:

• Molecule 1: Hypothetical protein Atu2144

Chain H:
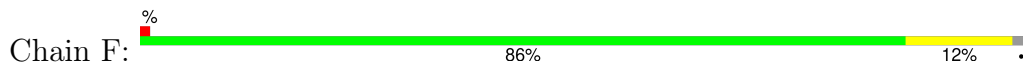
4   Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	110.52Å 89.77Å 120.36Å 90.00° 91.35° 90.00°	Depositor
Resolution (Å)	120.00 – 1.90 45.21 – 1.90	Depositor EDS
% Data completeness (in resolution range)	99.0 (120.00-1.90) 98.9 (45.21-1.90)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.85 (at 1.91Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.189 , 0.234 0.194 , 0.239	Depositor DCC
R_{free} test set	9148 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å^2)	25.8	Xtriage
Anisotropy	0.500	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 57.9	EDS
L-test for twinning[2]	$< \|L\| > = 0.48, < L^2 > = 0.31$	Xtriage
Estimated twinning fraction	0.026 for h,-k,-l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	17054	wwPDB-VP
Average B, all atoms (Å^2)	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.10% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< \|L\| >$, $< L^2 >$ 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	0.76	1/1977 (0.1%)	0.75	3/2684 (0.1%)
1	B	0.61	0/1966	0.69	2/2670 (0.1%)
1	C	0.66	0/1948	0.72	4/2646 (0.2%)
1	D	0.67	0/1957	0.72	2/2658 (0.1%)
1	E	0.55	0/1968	0.67	2/2672 (0.1%)
1	F	0.58	0/1968	0.66	0/2672
1	G	0.55	0/1957	0.65	2/2658 (0.1%)
1	H	0.57	0/1968	0.69	2/2672 (0.1%)
All	All	0.62	1/15709 (0.0%)	0.70	17/21332 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	94	GLU	CB-CG	5.88	1.63	1.52

The worst 5 of 17 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	C	165	ARG	NE-CZ-NH1	7.92	124.26	120.30
1	E	91	ARG	NE-CZ-NH2	-6.60	117.00	120.30
1	C	227	ARG	NE-CZ-NH2	-6.44	117.08	120.30
1	C	165	ARG	NE-CZ-NH2	-6.42	117.09	120.30
1	D	165	ARG	NE-CZ-NH2	-6.31	117.15	120.30

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	1937	0	1902	17	0
1	B	1928	0	1895	21	0
1	C	1908	0	1877	38	0
1	D	1917	0	1883	17	0
1	E	1928	0	1896	14	0
1	F	1928	0	1896	20	0
1	G	1917	0	1883	31	0
1	H	1928	0	1896	23	0
2	A	5	0	0	0	0
2	B	5	0	0	0	0
2	C	10	0	0	1	0
2	D	10	0	0	0	0
2	F	10	0	0	0	0
2	G	5	0	0	0	0
2	H	5	0	0	1	0
3	A	326	0	0	6	0
3	B	174	0	0	5	0
3	C	216	0	0	6	0
3	D	275	0	0	7	0
3	E	166	0	0	5	0
3	F	171	0	0	7	0
3	G	126	0	0	6	0
3	H	159	0	0	3	0
All	All	17054	0	15128	176	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.

The worst 5 of 176 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:136:GLU:OE1	3:A:539:HOH:O	1.75	1.02
1:F:205:GLY:O	3:F:479:HOH:O	1.76	1.01
1:G:224:ILE:HD11	1:G:248:MET:CE	1.96	0.96
1:C:227:ARG:HD2	1:C:229:ASP:OD1	1.69	0.92

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W O R L D W I D E
wwPDB
PROTEIN DATA BANK

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:154:HIS:HD2	3:B:303:HOH:O	1.51	0.91

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	250/257 (97%)	245 (98%)	5 (2%)	0	100	100
1	B	248/257 (96%)	244 (98%)	4 (2%)	0	100	100
1	C	247/257 (96%)	239 (97%)	7 (3%)	1 (0%)	34	24
1	D	248/257 (96%)	243 (98%)	5 (2%)	0	100	100
1	E	249/257 (97%)	243 (98%)	6 (2%)	0	100	100
1	F	249/257 (97%)	238 (96%)	10 (4%)	1 (0%)	34	24
1	G	248/257 (96%)	241 (97%)	7 (3%)	0	100	100
1	H	249/257 (97%)	244 (98%)	5 (2%)	0	100	100
All	All	1988/2056 (97%)	1937 (97%)	49 (2%)	2 (0%)	51	42

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	104	GLU
1	F	113	ASP

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	202/207 (98%)	199 (98%)	3 (2%)	65	62
1	B	202/207 (98%)	199 (98%)	3 (2%)	65	62
1	C	199/207 (96%)	194 (98%)	5 (2%)	47	41
1	D	200/207 (97%)	198 (99%)	2 (1%)	76	76
1	E	201/207 (97%)	199 (99%)	2 (1%)	76	76
1	F	201/207 (97%)	199 (99%)	2 (1%)	76	76
1	G	200/207 (97%)	191 (96%)	9 (4%)	27	18
1	H	201/207 (97%)	194 (96%)	7 (4%)	36	27
All	All	1606/1656 (97%)	1573 (98%)	33 (2%)	53	48

5 of 33 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	H	84	ARG
1	H	146	ARG
1	H	215	LEU
1	D	58	TRP
1	D	20	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 40 such sidechains are listed below:

Mol	Chain	Res	Type
1	F	175	ASN
1	H	20	ASN
1	F	197	ASN
1	G	197	ASN
1	H	154	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no monosaccharides in this entry.

5.6 Ligand geometry ⓘ

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
2	SO4	B	302	-	4,4,4	0.18	0	6,6,6	0.34	0
2	SO4	D	305	-	4,4,4	0.26	0	6,6,6	0.33	0
2	SO4	F	307	-	4,4,4	0.23	0	6,6,6	0.22	0
2	SO4	D	306	-	4,4,4	0.22	0	6,6,6	0.53	0
2	SO4	H	310	-	4,4,4	0.31	0	6,6,6	0.44	0
2	SO4	F	308	-	4,4,4	0.25	0	6,6,6	0.70	0
2	SO4	C	304	-	4,4,4	0.19	0	6,6,6	0.16	0
2	SO4	C	303	-	4,4,4	0.18	0	6,6,6	0.31	0
2	SO4	G	309	-	4,4,4	0.25	0	6,6,6	0.11	0
2	SO4	A	301	-	4,4,4	1.69	1 (25%)	6,6,6	0.89	0

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	301	SO4	O2-S	-2.10	1.32	1.44

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	H	310	SO4	1	0

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Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	303	SO4	1	0

5.7   Other polymers ⓘ

There are no such residues in this entry.

5.8   Polymer linkage issues ⓘ

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(Å²)	Q<0.9
1	A	252/257 (98%)	-0.16	0	100	100	15, 20, 32, 44	0
1	B	252/257 (98%)	0.07	6 (2%)	59	62	18, 28, 43, 57	0
1	C	249/257 (96%)	-0.02	2 (0%)	86	87	18, 27, 36, 46	0
1	D	250/257 (97%)	-0.07	2 (0%)	86	87	15, 24, 33, 48	0
1	E	251/257 (97%)	0.12	8 (3%)	47	50	20, 31, 44, 50	0
1	F	251/257 (97%)	-0.01	2 (0%)	86	87	18, 29, 40, 51	0
1	G	250/257 (97%)	0.46	19 (7%)	13	15	21, 33, 53, 63	0
1	H	251/257 (97%)	0.49	20 (7%)	12	13	17, 33, 56, 68	0
All	All	2006/2056 (97%)	0.11	59 (2%)	51	54	15, 28, 47, 68	0

The worst 5 of 59 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	G	105	ILE	8.0
1	G	106	TYR	7.3
1	G	160	TYR	5.6
1	H	164	PHE	5.2
1	E	105	ILE	5.1

6.2   Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

6.3   Carbohydrates ⓘ

There are no monosaccharides in this entry.

6.4 Ligands ⓘ

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	G	309	5/5	0.95	0.14	61,61,61,62	0
2	SO4	F	307	5/5	0.97	0.11	52,54,54,55	0
2	SO4	C	304	5/5	0.98	0.10	45,46,46,48	0
2	SO4	A	301	5/5	0.98	0.16	20,20,20,20	0
2	SO4	F	308	5/5	0.98	0.12	39,41,45,45	0
2	SO4	B	302	5/5	0.98	0.08	42,44,46,47	0
2	SO4	H	310	5/5	0.98	0.09	45,46,46,48	0
2	SO4	D	305	5/5	0.99	0.07	37,41,42,42	0
2	SO4	D	306	5/5	0.99	0.10	23,27,29,32	0
2	SO4	C	303	5/5	0.99	0.07	33,34,37,37	0

6.5 Other polymers ⓘ

There are no such residues in this entry.