Full wwPDB X-ray Structure Validation Report

Feb 5, 2024 – 08:06 AM EST

PDB ID	:	8EZC
Title	:	X-ray crystal structure of salmonella typhimurium Tryptophan synthase internal aldimine
Authors	:	Drago, V.N.; Mueser, T.C.
Deposited on	:	2022-10-31
Resolution	:	1.60 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:

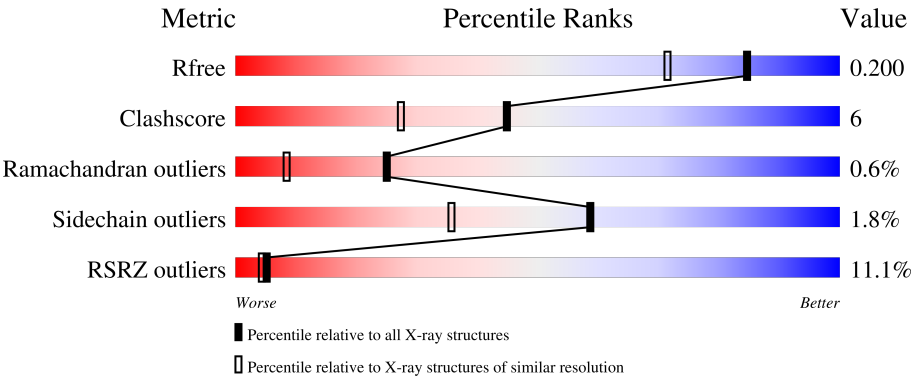
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.60 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	3398 (1.60-1.60)
Clashscore	141614	3665 (1.60-1.60)
Ramachandran outliers	138981	3564 (1.60-1.60)
Sidechain outliers	138945	3563 (1.60-1.60)
RSRZ outliers	127900	3321 (1.60-1.60)

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	268	15% 82% 12% • 5%
2	B	397	8% 88% 11% ••

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 5371 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 Tryptophan synthase alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	255	1934	1234	332	360	8	0	1	0

- Molecule 2 is a protein called Tryptophan synthase beta chain.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
2	B	395	3014	1893	527	574	1	19	0	2	0

- Molecule 3 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Na		
3	B	1	1	1	0	0

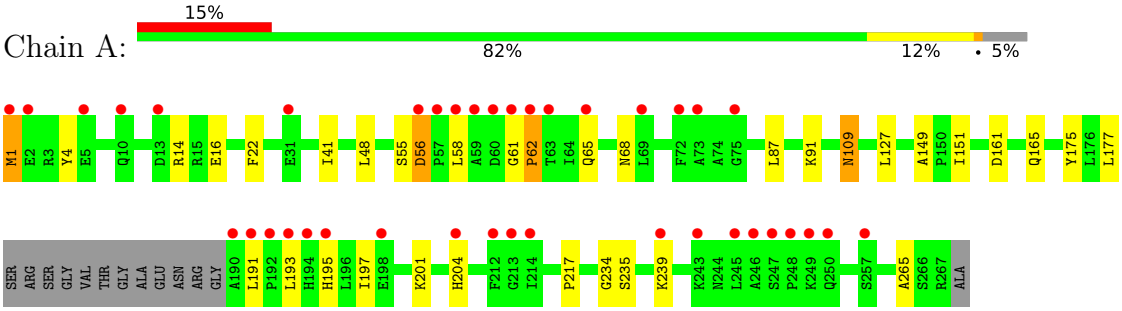
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	A	114	114	114	0	0
4	B	308	Total	O	0	0
			308	308		

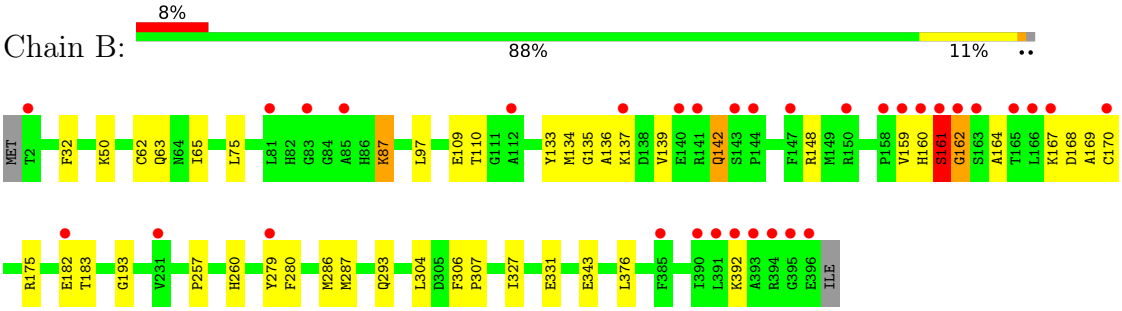
3 Residue-property plots (i)

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: Tryptophan synthase alpha chain



• Molecule 2: Tryptophan synthase beta chain



4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	184.55Å 58.82Å 67.29Å 90.00° 94.81° 90.00°	Depositor
Resolution (Å)	36.84 – 1.60 36.84 – 1.60	Depositor EDS
% Data completeness (in resolution range)	99.2 (36.84-1.60) 99.7 (36.84-1.60)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.84 (at 1.60Å)	Xtriage
Refinement program	PHENIX 1.19.2_4158	Depositor
R, R_{free}	0.195 , 0.203 0.191 , 0.200	Depositor DCC
R_{free} test set	2734 reflections (2.89%)	wwPDB-VP
Wilson B-factor (Å^2)	16.8	Xtriage
Anisotropy	0.751	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 51.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	5371	wwPDB-VP
Average B, all atoms (Å^2)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.85% of the height of the origin peak. No significant pseudotranslation is detected.*

[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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: LLP, NA

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	0.43	0/1979	0.59	0/2689
2	B	0.45	0/3053	0.67	1/4122 (0.0%)
All	All	0.44	0/5032	0.64	1/6811 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	162	GLY	N-CA-C	-5.42	99.56	113.10

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	1934	0	1942	27	0
2	B	3014	0	2988	45	0
3	B	1	0	0	0	0
4	A	114	0	0	1	0
4	B	308	0	0	6	1
All	All	5371	0	4930	64	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 6.

All (64) 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:56:ASP:HB3	2:B:279:TYR:OH	1.89	0.73
2:B:135:GLY:HA2	2:B:159:VAL:HG22	1.72	0.70
1:A:22:PHE:HB3	1:A:234:GLY:HA2	1.77	0.67
1:A:56:ASP:HB3	2:B:279:TYR:CZ	2.33	0.63
1:A:56:ASP:HB3	2:B:279:TYR:CE2	2.34	0.63
2:B:182:GLU:HG2	2:B:183:THR:HG23	1.82	0.62
1:A:197:ILE:O	1:A:201:LYS:HG3	2.01	0.60
1:A:61:GLY:O	1:A:65:GLN:HB2	2.02	0.59
2:B:279:TYR:HD1	2:B:280:PHE:CD2	2.20	0.58
2:B:87:LLP:NZ	2:B:87:LLP:O3	2.30	0.58
1:A:56:ASP:OD2	2:B:167:LYS:HD2	2.04	0.58
2:B:50:LYS:HG3	4:B:585:HOH:O	2.04	0.57
2:B:135:GLY:HA2	2:B:159:VAL:CG2	2.34	0.57
2:B:279:TYR:HE1	2:B:280:PHE:CE1	2.23	0.57
2:B:136:ALA:HA	2:B:139:VAL:CG2	2.36	0.55
1:A:235:SER:O	1:A:239:LYS:HG3	2.09	0.53
2:B:63:GLN:NE2	4:B:506:HOH:O	2.42	0.53
1:A:55:SER:HB3	2:B:293:GLN:HB3	1.91	0.52
2:B:87:LLP:HE2	4:B:535:HOH:O	2.08	0.52
2:B:170:CYS:SG	4:B:779:HOH:O	2.39	0.52
2:B:279:TYR:CE1	2:B:280:PHE:CE1	2.98	0.52
2:B:65:ILE:HG12	2:B:343:GLU:OE2	2.11	0.51
2:B:137:LYS:HG3	2:B:164:ALA:HB3	1.93	0.50
1:A:56:ASP:CB	2:B:279:TYR:OH	2.59	0.50
2:B:136:ALA:HA	2:B:139:VAL:HG23	1.93	0.50
2:B:279:TYR:HD1	2:B:280:PHE:CG	2.30	0.50
1:A:191:LEU:HG	1:A:195:HIS:ND1	2.27	0.50
1:A:161:ASP:O	1:A:165:GLN:HG3	2.12	0.49
1:A:1:MET:O	1:A:4:TYR:N	2.40	0.49
1:A:193:LEU:HG	1:A:197:ILE:HD11	1.97	0.47
2:B:160:HIS:O	2:B:161:SER:C	2.53	0.47
2:B:257:PRO:HG3	2:B:304:LEU:HB3	1.97	0.47
1:A:191:LEU:HG	1:A:195:HIS:CE1	2.50	0.46
2:B:392:LYS:HB3	2:B:392:LYS:HE2	1.74	0.46
2:B:260:HIS:HD2	4:B:764:HOH:O	1.98	0.45
1:A:14:ARG:NH1	1:A:16:GLU:OE2	2.48	0.45
2:B:161:SER:HB3	2:B:168:ASP:OD2	2.16	0.45
1:A:61:GLY:HA3	1:A:62:PRO:HD3	1.89	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:109:ASN:HB2	4:A:312:HOH:O	2.16	0.44
2:B:62:CYS:SG	2:B:75:LEU:HG	2.57	0.44
2:B:279:TYR:CD1	2:B:280:PHE:N	2.85	0.44
1:A:175:TYR:HE1	1:A:177:LEU:HD13	1.81	0.44
2:B:109:GLU:HA	2:B:133:TYR:O	2.17	0.44
2:B:110:THR:O	2:B:134:MET:HG3	2.18	0.44
1:A:127:LEU:HB2	1:A:151:ILE:HB	2.00	0.43
2:B:148:ARG:NE	4:B:513:HOH:O	2.52	0.43
2:B:135:GLY:CA	2:B:159:VAL:HG22	2.47	0.42
2:B:286:MET:HB3	2:B:286:MET:HE3	1.31	0.42
2:B:327:ILE:HG23	2:B:331:GLU:HB2	2.01	0.42
1:A:177:LEU:HD12	1:A:177:LEU:HA	1.77	0.42
1:A:217:PRO:HB3	1:A:265:ALA:HB2	2.00	0.42
2:B:142:GLN:HE21	2:B:142:GLN:HB3	1.53	0.42
2:B:32:PHE:HA	2:B:97:LEU:HD11	2.01	0.42
2:B:376:LEU:HD12	2:B:376:LEU:HA	1.91	0.42
1:A:87:LEU:HG	1:A:91:LYS:HE2	2.02	0.41
2:B:136:ALA:O	2:B:139:VAL:HB	2.20	0.41
2:B:109:GLU:HB2	2:B:169:ALA:HB1	2.01	0.41
1:A:41:ILE:HD11	1:A:48:LEU:HD11	2.03	0.41
2:B:134:MET:CE	2:B:139:VAL:HG22	2.51	0.41
1:A:56:ASP:HB3	2:B:279:TYR:HH	1.85	0.41
2:B:193:GLY:HA2	2:B:280:PHE:O	2.20	0.41
2:B:306:PHE:CD1	2:B:307:PRO:HD2	2.56	0.40
1:A:56:ASP:CG	2:B:279:TYR:OH	2.60	0.40
1:A:1:MET:HB3	1:A:149:ALA:HB2	2.04	0.40

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)
4:B:502:HOH:O	4:B:502:HOH:O[2_655]	2.08	0.12

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	252/268 (94%)	243 (96%)	7 (3%)	2 (1%)	19 6
2	B	394/397 (99%)	383 (97%)	9 (2%)	2 (0%)	29 11
All	All	646/665 (97%)	626 (97%)	16 (2%)	4 (1%)	25 8

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	58	LEU
2	B	162	GLY
1	A	62	PRO
2	B	161	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	201/208 (97%)	196 (98%)	5 (2%)	47 22
2	B	310/310 (100%)	306 (99%)	4 (1%)	69 50
All	All	511/518 (99%)	502 (98%)	9 (2%)	59 36

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	56	ASP
1	A	68	ASN
1	A	109	ASN
1	A	204	HIS
2	B	142	GLN
2	B	161	SER
2	B	175	ARG
2	B	287	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	68	ASN
2	B	63	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)

1 non-standard protein/DNA/RNA residue is 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	LLP	B	87	2	23,24,25	2.50	7 (30%)	25,32,34	1.62	5 (20%)

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
2	LLP	B	87	2	-	4/16/17/19	0/1/1/1

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	87	LLP	C4-C4'	8.00	1.61	1.46
2	B	87	LLP	C4'-NZ	5.59	1.46	1.27
2	B	87	LLP	C2'-C2	3.01	1.55	1.50
2	B	87	LLP	C6-N1	2.46	1.39	1.34
2	B	87	LLP	C4-C5	-2.41	1.38	1.42
2	B	87	LLP	C5'-C5	2.33	1.57	1.50

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	87	LLP	P-OP2	-2.01	1.47	1.54

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	87	LLP	C4-C4'-NZ	-4.19	105.08	124.31
2	B	87	LLP	C5'-C5-C6	-3.07	114.32	119.37
2	B	87	LLP	C3-C4-C4'	-2.93	114.94	120.41
2	B	87	LLP	OP4-C5'-C5	2.63	114.37	109.35
2	B	87	LLP	C5-C4-C4'	2.53	125.72	121.56

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	87	LLP	C4-C4'-NZ-CE
2	B	87	LLP	O-C-CA-CB
2	B	87	LLP	CG-CD-CE-NZ
2	B	87	LLP	CD-CE-NZ-C4'

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	87	LLP	2	0

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 1 ligands modelled in this entry, 1 is monoatomic - leaving 0 for Mogul analysis.

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

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, 95^{th} 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	255/268 (95%)	0.83	39 (15%)	2	1	15, 31, 55, 70	0
2	B	394/397 (99%)	0.42	33 (8%)	11	9	11, 18, 48, 66	0
All	All	649/665 (97%)	0.58	72 (11%)	5	4	11, 23, 52, 70	0

All (72) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	191	LEU	8.4
1	A	212	PHE	7.2
1	A	194	HIS	7.1
1	A	246	ALA	6.5
1	A	190	ALA	6.4
2	B	162	GLY	6.3
1	A	195	HIS	6.3
2	B	2	THR	5.5
2	B	161	SER	5.4
2	B	396	GLU	5.3
1	A	73	ALA	5.0
2	B	395	GLY	5.0
2	B	159	VAL	4.9
2	B	141	ARG	4.6
2	B	279	TYR	4.5
1	A	247	SER	4.2
2	B	163	SER	4.2
1	A	193	LEU	4.1
2	B	392	LYS	4.1
2	B	160	HIS	4.0
1	A	59	ALA	3.9
2	B	170	CYS	3.8
2	B	393	ALA	3.6
2	B	112	ALA	3.6

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Mol	Chain	Res	Type	RSRZ
1	A	204	HIS	3.6
2	B	143	SER	3.6
2	B	166	LEU	3.5
1	A	69	LEU	3.5
2	B	137	LYS	3.4
1	A	250	GLN	3.3
1	A	214	ILE	3.3
1	A	192	PRO	3.2
1	A	249	LYS	3.2
1	A	13	ASP	3.1
2	B	140	GLU	3.1
2	B	144	PRO	3.0
1	A	213	GLY	3.0
2	B	158	PRO	3.0
2	B	394	ARG	3.0
1	A	243	LYS	3.0
2	B	165	THR	3.0
2	B	385	PHE	2.9
2	B	167	LYS	2.9
1	A	62	PRO	2.8
1	A	198	GLU	2.8
1	A	31	GLU	2.8
1	A	257	SER	2.7
2	B	391	LEU	2.7
1	A	1	MET	2.7
1	A	239	LYS	2.7
1	A	75	GLY	2.6
1	A	63	THR	2.6
2	B	147	PHE	2.6
2	B	81	LEU	2.6
1	A	248	PRO	2.6
1	A	56	ASP	2.6
1	A	60	ASP	2.6
2	B	390	ILE	2.5
2	B	83	GLY	2.4
1	A	72	PHE	2.3
1	A	5	GLU	2.3
1	A	245	LEU	2.3
1	A	57	PRO	2.3
1	A	61	GLY	2.3
2	B	85	ALA	2.2
2	B	182	GLU	2.2

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Mol	Chain	Res	Type	RSRZ
2	B	231	VAL	2.1
1	A	2	GLU	2.1
1	A	58	LEU	2.1
1	A	10	GLN	2.0
2	B	150	ARG	2.0
1	A	65	GLN	2.0

6.2 Non-standard residues in protein, DNA, RNA chains (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^{th} 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	LLP	B	87	24/25	0.97	0.14	11,16,24,26	0

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^{th} 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
3	NA	B	401	1/1	0.99	0.09	19,19,19,19	0

6.5 Other polymers (i)

There are no such residues in this entry.