



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 14, 2017 – 10:50 pm GMT

PDB ID : 1WMW
Title : Crystal structure of geranylgeranyl diphosphate synthase from *Thermus thermophilus*
Authors : Suto, K.; Nishio, K.; Nodake, Y.; Hamada, K.; Kawamoto, M.; Nakagawa, N.; Kuramitsu, S.; Miura, K.; RIKEN Structural Genomics/Proteomics Initiative (RSGI)
Deposited on : 2004-07-21
Resolution : 1.55 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.9-1692
EDS	:	trunk28620
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	recalc28949

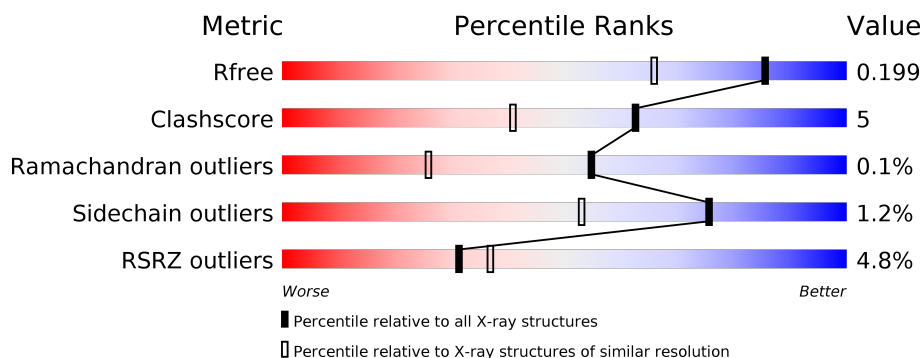
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.55 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}	100719	1088 (1.56-1.56)
Clashscore	112137	1132 (1.56-1.56)
Ramachandran outliers	110173	1110 (1.56-1.56)
Sidechain outliers	110143	1108 (1.56-1.56)
RSRZ outliers	101464	1089 (1.56-1.56)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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	330	<div> <div>2%</div> <div>91%</div> <div>8%</div> <div>•</div> </div>
1	B	330	<div> <div>11%</div> <div>86%</div> <div>10%</div> <div>• •</div> </div>
1	C	330	<div> <div>2%</div> <div>89%</div> <div>10%</div> <div>•</div> </div>
1	D	330	<div> <div>5%</div> <div>87%</div> <div>11%</div> <div>• •</div> </div>

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 11326 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 geranylgeranyl diphosphate synthetase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	328	Total	C	N	O	S	0	0	0
			2562	1637	460	459	6			
1	B	319	Total	C	N	O	S	0	0	0
			2488	1591	447	445	5			
1	C	328	Total	C	N	O	S	0	0	0
			2562	1637	460	459	6			
1	D	324	Total	C	N	O	S	0	0	0
			2527	1616	453	453	5			

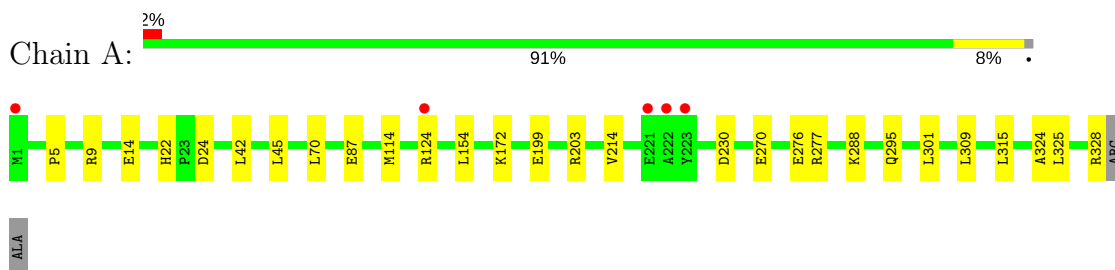
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	334	Total	O	0	0
			334	334		
2	B	237	Total	O	0	0
			237	237		
2	C	320	Total	O	0	0
			320	320		
2	D	296	Total	O	0	0
			296	296		

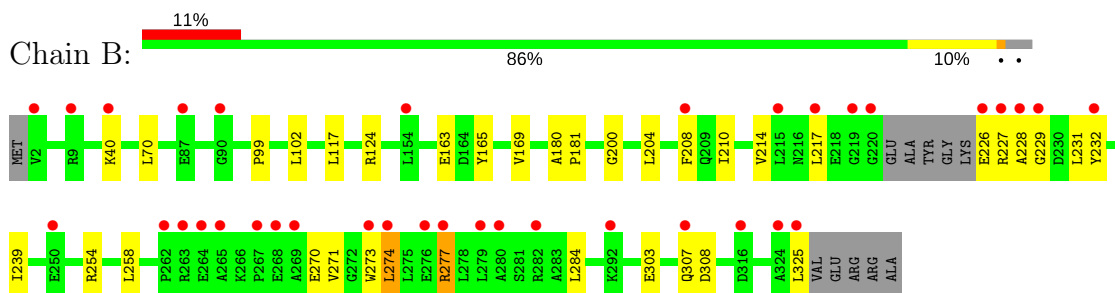
3 Residue-property plots

These plots are drawn for all protein, RNA and DNA 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.

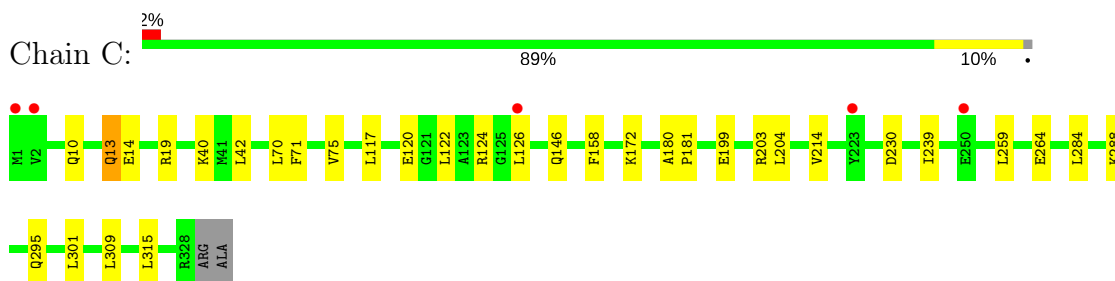
- Molecule 1: geranylgeranyl diphosphate synthetase



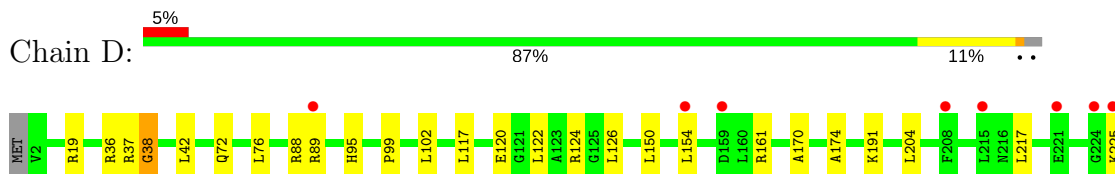
- Molecule 1: geranylgeranyl diphosphate synthetase

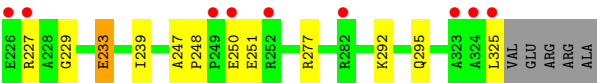


- Molecule 1: geranylgeranyl diphosphate synthetase



- Molecule 1: geranylgeranyl diphosphate synthetase





4 Data and refinement statistics

Property	Value	Source
Space group	P 43	Depositor
Cell constants a, b, c, α , β , γ	139.88Å 139.88Å 73.35Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.98 – 1.55 28.83 – 1.55	Depositor EDS
% Data completeness (in resolution range)	89.0 (19.98-1.55) 89.2 (28.83-1.55)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	9.26 (at 1.55Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.175 , 0.198 0.175 , 0.199	Depositor DCC
R_{free} test set	9157 reflections (5.01%)	DCC
Wilson B-factor (Å ²)	13.1	Xtriage
Anisotropy	0.204	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 52.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	0.025 for h,-k,-l	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	11326	wwPDB-VP
Average B, all atoms (Å ²)	18.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 27.50 % of the origin peak, indicating pseudo translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo translational symmetry is equal to 2.1731e-03.*

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](#)

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	0.34	0/2619	0.57	0/3554
1	B	0.31	0/2543	0.53	0/3452
1	C	0.33	0/2619	0.57	0/3554
1	D	0.32	0/2584	0.55	0/3508
All	All	0.33	0/10365	0.56	0/14068

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	2562	0	2587	22	0
1	B	2488	0	2510	25	0
1	C	2562	0	2587	27	0
1	D	2527	0	2547	29	0
2	A	334	0	0	10	0
2	B	237	0	0	2	0
2	C	320	0	0	3	0
2	D	296	0	0	4	0
All	All	11326	0	10231	102	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 5.

All (102) 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:C:40:LYS:HA	1:C:40:LYS:HE2	1.45	0.96
1:B:217:LEU:HD21	1:B:231:LEU:HD11	1.56	0.88
1:D:19:ARG:HH22	1:D:120:GLU:CD	1.78	0.87
1:A:172:LYS:HE3	2:A:480:HOH:O	1.77	0.83
1:C:239:ILE:HG13	2:C:364:HOH:O	1.86	0.74
1:C:13:GLN:HE21	1:C:13:GLN:HA	1.54	0.72
1:A:22:HIS:HD2	1:A:24:ASP:H	1.38	0.72
1:B:303:GLU:HG3	1:B:307:GLN:HE21	1.56	0.70
1:B:124:ARG:HG3	2:B:515:HOH:O	1.91	0.68
1:D:247:ALA:HB1	1:D:251:GLU:HG3	1.75	0.68
1:A:124:ARG:HG3	2:A:617:HOH:O	1.96	0.65
1:B:217:LEU:HD21	1:B:231:LEU:CD1	2.27	0.63
1:D:191:LYS:HE2	2:D:510:HOH:O	1.97	0.63
1:A:22:HIS:CD2	1:A:24:ASP:H	2.18	0.61
1:C:214:VAL:HG13	1:C:284:LEU:HD11	1.81	0.60
1:D:124:ARG:HG2	2:D:620:HOH:O	2.02	0.59
1:B:277:ARG:HG2	1:B:277:ARG:HH11	1.67	0.58
1:D:229:GLY:O	1:D:233:GLU:HB2	2.04	0.58
1:B:40:LYS:N	1:B:40:LYS:HD2	2.19	0.57
1:D:227:ARG:HH11	1:D:227:ARG:HG3	1.71	0.56
1:D:89:ARG:HH11	1:D:89:ARG:HA	1.70	0.56
1:C:40:LYS:CA	1:C:40:LYS:HE2	2.26	0.56
1:B:226:GLU:OE1	1:B:229:GLY:HA2	2.05	0.56
1:A:199:GLU:HG2	1:A:301:LEU:HD13	1.88	0.55
1:B:228:ALA:HB1	1:B:231:LEU:HD13	1.88	0.55
1:C:309:LEU:HD12	1:C:315:LEU:HD13	1.88	0.55
1:A:276:GLU:OE2	1:A:277:ARG:HD2	2.06	0.55
1:A:214:VAL:HG11	1:A:288:LYS:HE2	1.89	0.55
1:B:210:ILE:O	1:B:214:VAL:HG23	2.07	0.55
1:B:165:TYR:CZ	1:B:169:VAL:HG11	2.43	0.54
1:C:146:GLN:OE1	1:C:172:LYS:HE2	2.07	0.54
1:B:254:ARG:HD3	1:B:273:TRP:CZ2	2.44	0.53
1:A:199:GLU:O	1:A:203:ARG:HD3	2.08	0.53
1:C:117:LEU:HD22	2:C:637:HOH:O	2.09	0.53
1:D:36:ARG:C	1:D:38:GLY:H	2.12	0.53
1:D:19:ARG:NH2	1:D:120:GLU:CD	2.57	0.53
1:C:124:ARG:HB2	1:C:126:LEU:HD12	1.91	0.52
1:D:225:LYS:HD2	1:D:225:LYS:N	2.24	0.52
2:A:640:HOH:O	1:D:37:ARG:HA	2.09	0.52
1:B:163:GLU:HG3	2:B:521:HOH:O	2.10	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:117:LEU:C	1:D:117:LEU:HD23	2.31	0.51
1:D:99:PRO:HD2	1:D:102:LEU:HD12	1.92	0.51
1:B:99:PRO:HD2	1:B:102:LEU:HD12	1.92	0.51
1:D:76:LEU:HG	1:D:88:ARG:NH2	2.26	0.51
1:B:117:LEU:HD23	1:B:117:LEU:C	2.30	0.51
1:C:214:VAL:HG22	1:C:239:ILE:HD11	1.91	0.51
1:B:284:LEU:HD13	1:B:284:LEU:C	2.31	0.50
1:D:76:LEU:HG	1:D:88:ARG:CZ	2.41	0.50
1:C:214:VAL:HG11	1:C:288:LYS:HE2	1.95	0.49
1:A:70:LEU:HD23	1:A:114:MET:HA	1.95	0.48
1:C:117:LEU:HD13	1:C:117:LEU:C	2.33	0.48
1:B:40:LYS:H	1:B:40:LYS:HD2	1.77	0.48
1:C:13:GLN:NE2	1:C:13:GLN:HA	2.26	0.48
1:A:42:LEU:CD2	1:A:325:LEU:HD23	2.43	0.47
1:B:232:TYR:CE1	1:B:271:VAL:HG11	2.49	0.47
1:A:9:ARG:HG2	1:A:45:LEU:HD11	1.95	0.47
1:C:19:ARG:NE	1:C:117:LEU:HD23	2.29	0.47
1:A:5:PRO:HG2	2:A:507:HOH:O	2.15	0.46
1:A:270:GLU:OE2	1:A:270:GLU:HA	2.17	0.45
1:C:230:ASP:HB2	2:C:518:HOH:O	2.15	0.45
1:D:150:LEU:O	1:D:154:LEU:HD13	2.16	0.45
1:C:158:PHE:CZ	1:C:259:LEU:HG	2.52	0.45
1:B:200:GLY:O	1:B:204:LEU:HG	2.16	0.45
1:C:180:ALA:HB3	1:C:181:PRO:HD3	1.99	0.45
1:B:258:LEU:HD23	1:B:274:LEU:HD12	1.99	0.44
1:C:122:LEU:HD22	1:D:122:LEU:HD21	1.97	0.44
1:B:270:GLU:OE2	1:B:270:GLU:HA	2.17	0.44
1:A:42:LEU:HD21	1:A:325:LEU:HD23	1.99	0.44
1:B:217:LEU:HD12	1:B:239:ILE:HD13	1.98	0.44
1:A:154:LEU:HD21	2:A:580:HOH:O	2.18	0.44
1:D:277:ARG:HA	1:D:277:ARG:NE	2.33	0.44
1:B:208:PHE:CD1	1:B:325:LEU:HB3	2.53	0.43
1:D:124:ARG:NH2	1:D:126:LEU:HD22	2.34	0.43
1:A:309:LEU:HD12	1:A:315:LEU:HD13	2.01	0.43
1:C:10:GLN:O	1:C:14:GLU:HG3	2.17	0.43
1:A:295:GLN:HB3	2:A:583:HOH:O	2.19	0.43
1:A:324:ALA:O	1:A:328:ARG:HD3	2.19	0.43
1:D:227:ARG:NH1	1:D:227:ARG:HG3	2.34	0.43
1:A:328:ARG:HA	2:A:545:HOH:O	2.17	0.43
1:C:214:VAL:CG2	1:C:239:ILE:HD11	2.48	0.43
1:D:248:PRO:HD2	1:D:251:GLU:OE1	2.18	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:292:LYS:HD2	2:D:516:HOH:O	2.18	0.43
1:D:72:GLN:O	1:D:76:LEU:HD13	2.19	0.43
1:A:87:GLU:HG2	2:A:459:HOH:O	2.19	0.42
1:D:42:LEU:HD21	1:D:325:LEU:CD1	2.48	0.42
1:A:14:GLU:HG3	2:A:536:HOH:O	2.19	0.42
1:C:264:GLU:HA	1:C:264:GLU:OE2	2.20	0.42
1:C:199:GLU:HG2	1:C:203:ARG:NH1	2.34	0.42
1:A:230:ASP:HB2	2:A:481:HOH:O	2.21	0.41
1:D:247:ALA:HB1	1:D:251:GLU:CG	2.49	0.41
1:B:40:LYS:H	1:B:40:LYS:CD	2.33	0.41
1:C:71:PHE:CZ	1:C:75:VAL:HG21	2.56	0.41
1:D:95:HIS:CD2	1:D:95:HIS:H	2.39	0.41
1:B:180:ALA:HB3	1:B:181:PRO:HD3	2.03	0.40
1:D:217:LEU:HD12	1:D:239:ILE:HD13	2.03	0.40
1:C:204:LEU:HD23	1:C:295:GLN:HA	2.02	0.40
1:C:203:ARG:NH1	1:C:301:LEU:HD11	2.36	0.40
1:B:227:ARG:O	1:B:227:ARG:HG3	2.22	0.40
1:C:120:GLU:HB3	1:C:124:ARG:HH12	1.87	0.40
1:C:199:GLU:HG2	1:C:203:ARG:HH11	1.86	0.40
1:D:95:HIS:HE1	2:D:581:HOH:O	2.03	0.40
1:D:170:ALA:HA	1:D:174:ALA:HB3	2.03	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	326/330 (99%)	323 (99%)	3 (1%)	0	100	100
1	B	315/330 (96%)	311 (99%)	4 (1%)	0	100	100
1	C	326/330 (99%)	323 (99%)	3 (1%)	0	100	100
1	D	322/330 (98%)	316 (98%)	5 (2%)	1 (0%)	44	19

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	1289/1320 (98%)	1273 (99%)	15 (1%)	1 (0%)	55 26

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	38	GLY

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	249/250 (100%)	249 (100%)	0	100	100
1	B	242/250 (97%)	238 (98%)	4 (2%)	66	36
1	C	249/250 (100%)	246 (99%)	3 (1%)	75	53
1	D	245/250 (98%)	240 (98%)	5 (2%)	60	29
All	All	985/1000 (98%)	973 (99%)	12 (1%)	75	53

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	70	LEU
1	B	274	LEU
1	B	277	ARG
1	B	308	ASP
1	C	13	GLN
1	C	42	LEU
1	C	70	LEU
1	D	161	ARG
1	D	204	LEU
1	D	233	GLU
1	D	250	GLU
1	D	295	GLN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such

sidechains are listed below:

Mol	Chain	Res	Type
1	A	22	HIS
1	B	209	GLN
1	B	295	GLN
1	B	307	GLN
1	C	10	GLN
1	C	13	GLN
1	C	72	GLN
1	D	72	GLN
1	D	95	HIS
1	D	307	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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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, 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	328/330 (99%)	-0.16	5 (1%) 74 79	8, 13, 23, 40	0
1	B	319/330 (96%)	0.49	36 (11%) 6 6	8, 18, 42, 51	0
1	C	328/330 (99%)	-0.16	5 (1%) 74 79	9, 14, 24, 40	0
1	D	324/330 (98%)	0.05	17 (5%) 28 32	8, 16, 31, 44	0
All	All	1299/1320 (98%)	0.05	63 (4%) 31 37	8, 15, 32, 51	0

All (63) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	220	GLY	15.1
1	C	1	MET	9.6
1	B	325	LEU	8.5
1	B	227	ARG	8.4
1	B	228	ALA	7.4
1	B	226	GLU	6.9
1	A	1	MET	6.0
1	D	324	ALA	5.7
1	B	219	GLY	5.3
1	B	264	GLU	5.3
1	B	263	ARG	4.9
1	D	225	LYS	4.8
1	B	279	LEU	4.7
1	B	217	LEU	4.6
1	B	268	GLU	4.6
1	B	324	ALA	4.5
1	D	226	GLU	4.3
1	D	323	ALA	4.3
1	D	208	PHE	4.2
1	B	229	GLY	4.1
1	B	215	LEU	4.1

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Mol	Chain	Res	Type	RSRZ
1	B	208	PHE	3.9
1	D	325	LEU	3.9
1	D	250	GLU	3.7
1	B	267	PRO	3.7
1	A	222	ALA	3.7
1	A	223	TYR	3.6
1	B	273	TRP	3.6
1	B	307	GLN	3.5
1	D	89	ARG	3.3
1	B	277	ARG	3.3
1	B	269	ALA	3.1
1	B	90	GLY	3.1
1	B	232	TYR	3.0
1	D	227	ARG	3.0
1	B	282	ARG	2.9
1	D	282	ARG	2.9
1	B	87	GLU	2.6
1	D	154	LEU	2.6
1	A	124	ARG	2.6
1	D	249	PRO	2.5
1	B	262	PRO	2.5
1	A	221	GLU	2.5
1	B	280	ALA	2.4
1	B	40	LYS	2.4
1	D	224	GLY	2.4
1	B	154	LEU	2.4
1	D	215	LEU	2.4
1	B	2	VAL	2.4
1	D	252	ARG	2.4
1	B	316	ASP	2.4
1	D	159	ASP	2.4
1	C	250	GLU	2.4
1	D	221	GLU	2.3
1	C	2	VAL	2.3
1	C	223	TYR	2.2
1	B	274	LEU	2.2
1	B	292	LYS	2.2
1	B	265	ALA	2.1
1	C	126	LEU	2.1
1	B	250	GLU	2.1
1	B	9	ARG	2.1
1	B	276	GLU	2.1

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 carbohydrates in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.