



Full wwPDB X-ray Structure Validation Report ⓘ

May 16, 2020 – 12:39 am BST

PDB ID : 4WJ4
Title : Crystal structure of non-discriminating aspartyl-tRNA synthetase from *Pseudomonas aeruginosa* complexed with tRNA(Asn) and aspartic acid
Authors : Suzuki, T.; Nakamura, A.; Kato, K.; Tanaka, I.; Yao, M.
Deposited on : 2014-09-29
Resolution : 3.29 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Xtriage (Phenix) : 1.13
EDS : 2.11
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) : 2.11

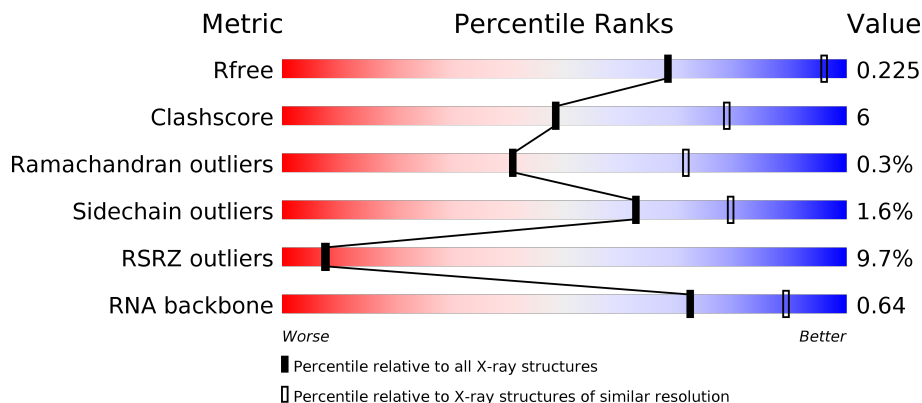
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.29 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	1149 (3.34-3.26)
Clashscore	141614	1205 (3.34-3.26)
Ramachandran outliers	138981	1183 (3.34-3.26)
Sidechain outliers	138945	1182 (3.34-3.26)
RSRZ outliers	127900	1115 (3.34-3.26)
RNA backbone	3102	1117 (3.70-2.90)

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 on 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	599	
2	B	76	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 6245 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 Aspartate--tRNA(Asp/Asn) ligase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	585	4614	2924	810	860	20	0	0	0

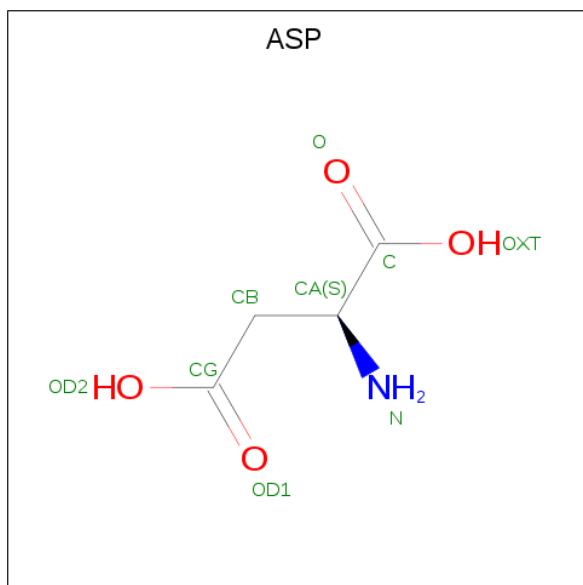
There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-7	MET	-	expression tag	UNP Q51422
A	-6	GLY	-	expression tag	UNP Q51422
A	-5	HIS	-	expression tag	UNP Q51422
A	-4	HIS	-	expression tag	UNP Q51422
A	-3	HIS	-	expression tag	UNP Q51422
A	-2	HIS	-	expression tag	UNP Q51422
A	-1	HIS	-	expression tag	UNP Q51422
A	0	HIS	-	expression tag	UNP Q51422

- Molecule 2 is a RNA chain called 76mer-tRNA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	B	76	1622	723	288	535	76	0	0	0

- Molecule 3 is ASPARTIC ACID (three-letter code: ASP) (formula: C₄H₇NO₄).

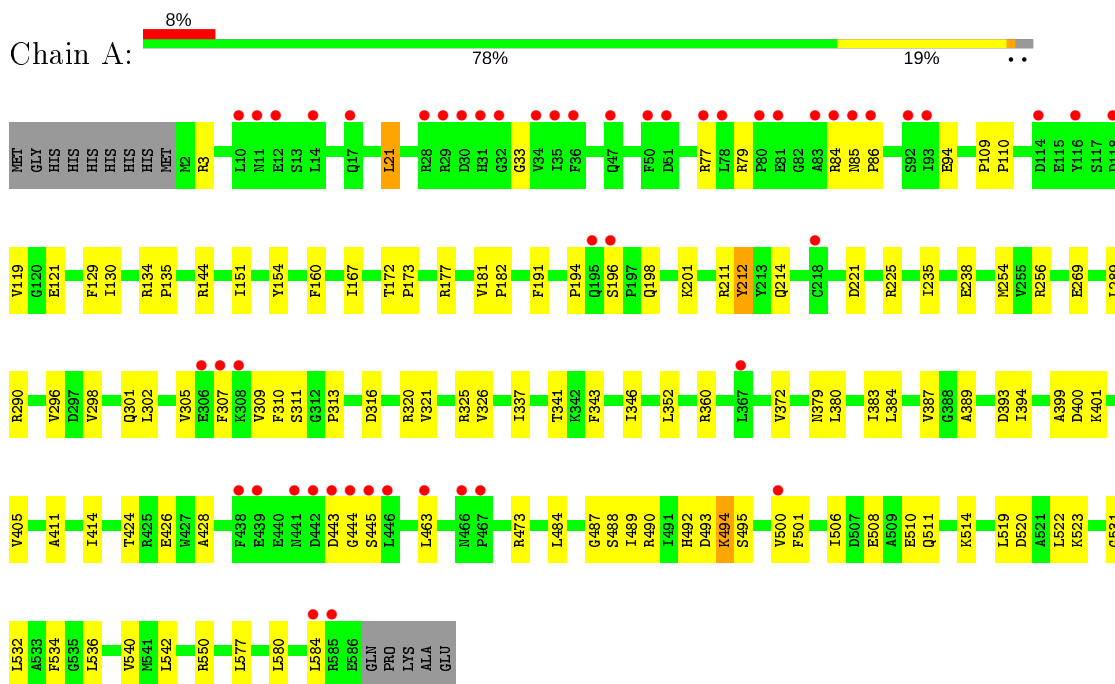


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
3	A	1	9	4	1	4	0	0

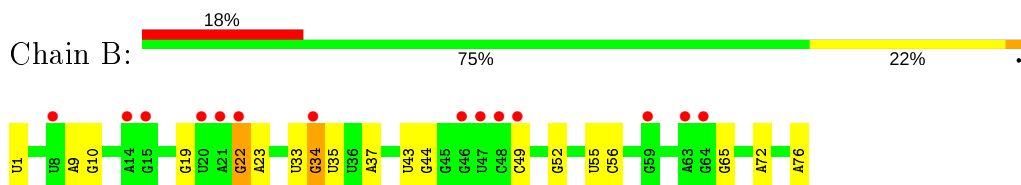
3 Residue-property plots i

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: Aspartate--tRNA(Asp/Asn) ligase



- Molecule 2: 76mer-tRNA



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 2 2	Depositor
Cell constants a, b, c, α , β , γ	157.91Å 157.91Å 146.26Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	39.48 – 3.29 47.26 – 3.29	Depositor EDS
% Data completeness (in resolution range)	99.9 (39.48-3.29) 99.9 (47.26-3.29)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.79 (at 3.33Å)	Xtrriage
Refinement program	PHENIX (phenix.refine: 1.9_1692)	Depositor
R, R_{free}	0.189 , 0.224 0.198 , 0.225	Depositor DCC
R_{free} test set	1425 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å ²)	113.0	Xtrriage
Anisotropy	0.165	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 74.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	6245	wwPDB-VP
Average B, all atoms (Å ²)	112.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.89% 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](#)

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	0.23	0/4712	0.41	0/6368
2	B	0.31	1/1812 (0.1%)	0.69	0/2821
All	All	0.25	1/6524 (0.0%)	0.51	0/9189

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1	U	OP3-P	-10.53	1.48	1.61

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	4614	0	4585	64	0
2	B	1622	0	819	11	0
3	A	9	0	3	1	0
All	All	6245	0	5407	70	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 (70) 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:341:THR:HG22	1:A:352:LEU:HB3	1.66	0.74
1:A:520:ASP:HA	1:A:523:LYS:HE3	1.71	0.71
1:A:33:GLY:H	2:B:33:U:H5'	1.58	0.69
1:A:201:LYS:HE2	1:A:238:GLU:HB2	1.78	0.66
1:A:325:ARG:NH1	1:A:393:ASP:OD2	2.28	0.65
1:A:121:GLU:OE1	1:A:550:ARG:NH1	2.29	0.64
1:A:302:LEU:HD23	1:A:310:PHE:HB3	1.80	0.63
1:A:325:ARG:HH11	1:A:389:ALA:HA	1.65	0.61
1:A:172:THR:HG22	1:A:514:LYS:HD2	1.83	0.60
1:A:144:ARG:HG3	1:A:540:VAL:HG21	1.86	0.57
1:A:301:GLN:HG3	1:A:379:ASN:HD22	1.71	0.56
1:A:313:PRO:HA	1:A:316:ASP:HB3	1.87	0.56
1:A:225:ARG:NH2	2:B:72:A:N7	2.54	0.56
1:A:77:ARG:NH1	2:B:34:G:O6	2.38	0.55
1:A:508:GLU:HA	1:A:511:GLN:HB2	1.87	0.55
1:A:305:VAL:HG12	1:A:311:SER:HB3	1.89	0.55
1:A:94:GLU:OE2	2:B:34:G:N2	2.40	0.55
1:A:493:ASP:O	1:A:495:SER:N	2.39	0.53
1:A:289:LEU:HB2	1:A:428:ALA:HB1	1.91	0.53
1:A:79:ARG:HD2	1:A:84:ARG:HA	1.91	0.53
1:A:360:ARG:HE	1:A:384:LEU:HD23	1.73	0.52
1:A:212:TYR:OH	1:A:214:GLN:NE2	2.42	0.52
1:A:167:ILE:O	1:A:194:PRO:HD3	2.11	0.51
1:A:256:ARG:HH22	1:A:269:GLU:HA	1.75	0.51
1:A:492:HIS:HA	1:A:522:LEU:HD22	1.91	0.51
1:A:196:SER:HG	3:A:600:ASP:N	2.08	0.51
1:A:235:ILE:HB	1:A:534:PHE:HB2	1.91	0.51
1:A:235:ILE:HD11	1:A:536:LEU:HD13	1.92	0.51
1:A:411:ALA:O	1:A:414:ILE:HG13	2.12	0.50
1:A:343:PHE:O	1:A:346:ILE:HG22	2.12	0.50
2:B:49:C:H42	2:B:65:G:H1	1.59	0.49
2:B:22:G:H2'	2:B:23:A:H8	1.78	0.49
1:A:302:LEU:HD11	1:A:383:ILE:HD11	1.94	0.49
1:A:487:GLY:HA3	1:A:532:LEU:HA	1.96	0.48
1:A:463:LEU:HD21	1:A:500:VAL:HG13	1.94	0.48
1:A:181:VAL:HB	1:A:191:PHE:HB2	1.96	0.48
1:A:401:LYS:O	1:A:405:VAL:HG12	2.14	0.47
1:A:198:GLN:O	1:A:201:LYS:HG2	2.14	0.47
1:A:3:ARG:HG3	1:A:21:LEU:HA	1.96	0.47
1:A:151:ILE:HD13	1:A:235:ILE:HD13	1.96	0.47
1:A:372:VAL:HG23	1:A:380:LEU:HD21	1.96	0.47
1:A:320:ARG:HG3	1:A:405:VAL:HG11	1.97	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:182:PRO:HB2	1:A:580:LEU:HD23	1.97	0.47
1:A:290:ARG:O	1:A:424:THR:HG22	2.14	0.47
1:A:443:ASP:OD2	1:A:444:GLY:N	2.48	0.46
1:A:129:PHE:CD2	1:A:130:ILE:HG23	2.51	0.46
1:A:484:LEU:HD21	1:A:542:LEU:HD12	1.97	0.46
1:A:506:ILE:HG23	1:A:510:GLU:HB2	1.97	0.46
1:A:337:ILE:O	1:A:341:THR:HG23	2.17	0.45
1:A:109:PRO:HA	1:A:110:PRO:HD2	1.76	0.45
1:A:400:ASP:OD1	1:A:401:LYS:N	2.42	0.45
2:B:9:A:O2'	2:B:10:G:N7	2.49	0.45
1:A:33:GLY:N	2:B:33:U:H5'	2.29	0.45
2:B:22:G:H2'	2:B:23:A:C8	2.51	0.44
1:A:85:ASN:HA	1:A:86:PRO:HD3	1.88	0.44
1:A:296:VAL:HG11	1:A:387:VAL:HG23	2.01	0.43
1:A:238:GLU:OE1	1:A:531:GLY:HA3	2.19	0.43
1:A:160:PHE:CD2	1:A:211:ARG:HB3	2.54	0.43
1:A:577:LEU:HD21	1:A:584:LEU:HG	2.00	0.43
1:A:321:VAL:HG13	1:A:399:ALA:HB2	2.01	0.42
1:A:326:VAL:HG13	1:A:394:ILE:HG23	2.02	0.42
1:A:177:ARG:HB3	1:A:221:ASP:HB3	2.00	0.42
1:A:488:SER:O	1:A:490:ARG:NH1	2.53	0.42
1:A:134:ARG:HA	1:A:135:PRO:HD3	1.92	0.41
1:A:298:VAL:HG21	1:A:383:ILE:HG23	2.02	0.41
2:B:43:U:H2'	2:B:44:G:H8	1.85	0.41
1:A:154:TYR:CE2	1:A:254:MET:HB2	2.56	0.41
1:A:494:LYS:HE3	1:A:519:LEU:HB3	2.03	0.40
2:B:55:U:H5'	2:B:56:C:OP2	2.21	0.40
1:A:473:ARG:HG2	1:A:489:ILE:HB	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	583/599 (97%)	543 (93%)	38 (6%)	2 (0%)	41 71

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	173	PRO
1	A	494	LYS

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	490/502 (98%)	482 (98%)	8 (2%)	62 79

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	21	LEU
1	A	119	VAL
1	A	212	TYR
1	A	307	PHE
1	A	309	VAL
1	A	426	GLU
1	A	445	SER
1	A	501	PHE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	214	GLN

5.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	B	75/76 (98%)	7 (9%)	0

All (7) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	B	19	G
2	B	22	G
2	B	34	G
2	B	35	U
2	B	37	A
2	B	52	G
2	B	76	A

There are no RNA pucker outliers to report.

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](#)

1 ligand is modelled in this entry.

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

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	585/599 (97%)	0.55	50 (8%) 10 10	75, 99, 143, 171	0
2	B	76/76 (100%)	0.89	14 (18%) 1 1	97, 137, 161, 164	0
All	All	661/675 (97%)	0.59	64 (9%) 7 8	75, 102, 148, 171	0

All (64) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	442	ASP	6.7
1	A	30	ASP	5.0
1	A	36	PHE	4.9
1	A	34	VAL	4.7
1	A	446	LEU	4.2
1	A	10	LEU	4.1
1	A	80	PRO	4.0
1	A	83	ALA	3.9
1	A	463	LEU	3.9
1	A	78	LEU	3.5
1	A	116	TYR	3.5
1	A	92	SER	3.5
1	A	50	PHE	3.5
1	A	445	SER	3.4
1	A	84	ARG	3.3
1	A	14	LEU	3.3
1	A	466	ASN	3.2
1	A	81	GLU	3.2
2	B	21	A	3.2
1	A	438	PHE	3.2
1	A	86	PRO	3.1
1	A	47	GLN	3.1
1	A	114	ASP	3.1
2	B	34	G	3.0

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Mol	Chain	Res	Type	RSRZ
1	A	439	GLU	2.9
2	B	20	U	2.8
1	A	77	ARG	2.7
1	A	441	ASN	2.7
1	A	11	ASN	2.7
1	A	28	ARG	2.7
1	A	306	GLU	2.7
1	A	31	HIS	2.7
1	A	51	ASP	2.7
2	B	22	G	2.7
1	A	93	ILE	2.6
1	A	12	GLU	2.6
1	A	35	ILE	2.6
2	B	48	C	2.6
1	A	32	GLY	2.5
2	B	47	U	2.5
1	A	29	ARG	2.5
2	B	8	U	2.5
1	A	443	ASP	2.4
1	A	585	ARG	2.4
2	B	63	A	2.4
1	A	500	VAL	2.4
1	A	367	LEU	2.4
1	A	118	ASP	2.3
1	A	584	LEU	2.2
1	A	196	SER	2.2
1	A	17	GLN	2.2
2	B	14	A	2.1
1	A	195	GLN	2.1
1	A	308	LYS	2.1
2	B	64	G	2.1
1	A	467	PRO	2.1
2	B	46	G	2.0
1	A	85	ASN	2.0
1	A	444	GLY	2.0
2	B	49	C	2.0
2	B	15	G	2.0
1	A	307	PHE	2.0
2	B	59	G	2.0
1	A	218	CYS	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 carbohydrates 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(\AA^2)	Q<0.9
3	ASP	A	600	9/9	0.81	0.38	96,107,121,124	0

6.5 Other polymers [i](#)

There are no such residues in this entry.