



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 08:26 PM UTC

PDB ID : 3FWW / pdb_00003fww
Title : The crystal structure of the bifunctional N-acetylglucosamine-1-phosphate uridylyltransferase/glucosamine-1-phosphate acetyltransferase from *Yersinia pestis* CO92
Authors : Zhang, R.; Gu, M.; Stam, J.; Anderson, W.; Joachimiak, A.; Center for Structural Genomics of Infectious Diseases (CSGID)
Deposited on : 2009-01-19
Resolution : 2.50 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	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

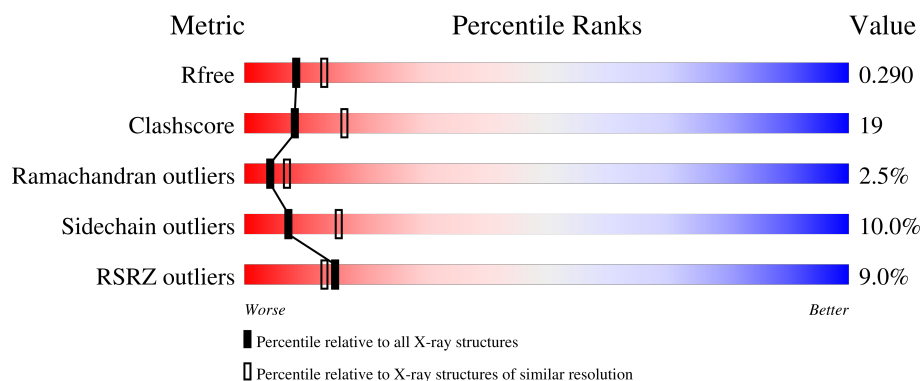
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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}	180053	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)

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	456	9% 62% 28% 7%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3355 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 Bifunctional protein glmU.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	445	Total	C	N	O	S	0	0	0
			3330	2089	594	637	10			

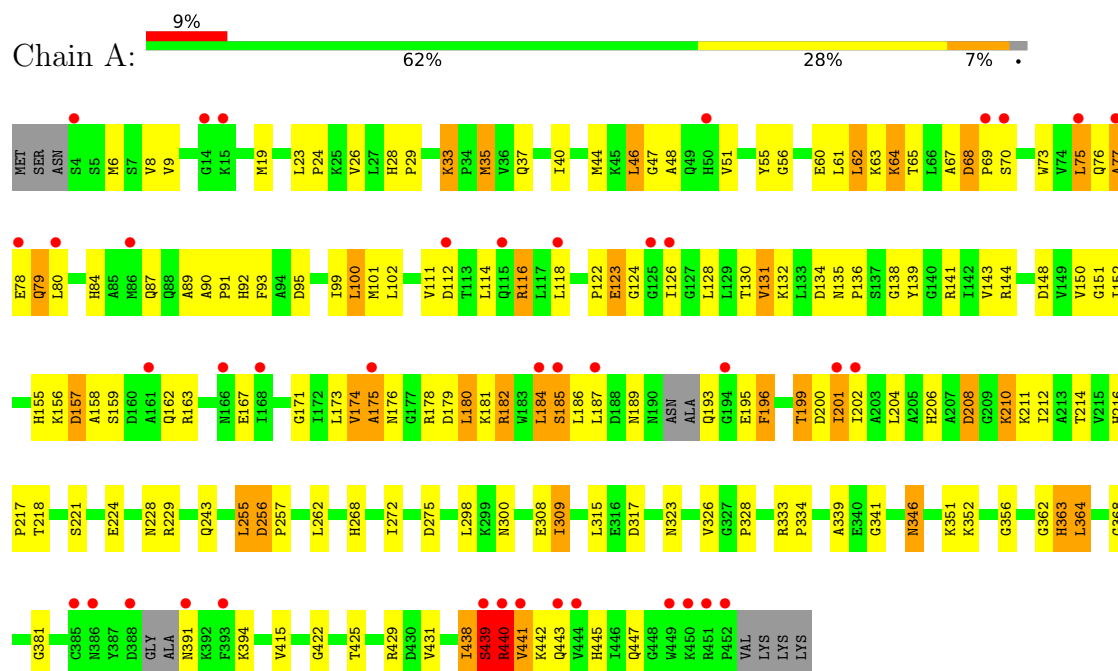
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	25	Total	O	0	0
			25	25		

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: Bifunctional protein glmU



4 Data and refinement statistics

Property	Value	Source
Space group	P 63 2 2	Depositor
Cell constants a, b, c, α , β , γ	88.32Å 88.32Å 251.93Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	34.80 – 2.50 34.80 – 2.50	Depositor EDS
% Data completeness (in resolution range)	96.2 (34.80-2.50) 96.6 (34.80-2.50)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$	-	Xtriage
Refinement program	PHENIX (phenix.refine)	Depositor
R, R_{free}	0.214 , 0.277 0.238 , 0.290	Depositor DCC
R_{free} test set	1050 reflections (5.13%)	wwPDB-VP
Wilson B-factor (Å ²)	(Not available)	Xtriage
Anisotropy	(Not available)	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 57.1	EDS
L-test for twinning ¹	$\langle L \rangle =$ (Not available), $\langle L^2 \rangle =$ (Not available)	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	3355	wwPDB-VP
Average B, all atoms (Å ²)	79.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *(Not available)*

¹Theoretical 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	0.45	0/3379	0.85	5/4585 (0.1%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	116	ARG	N-CA-C	-7.46	104.03	113.43
1	A	256	ASP	CA-C-N	6.62	126.31	119.82
1	A	256	ASP	C-N-CA	6.62	126.31	119.82
1	A	445	HIS	N-CA-C	5.49	117.36	108.41
1	A	440	ARG	N-CA-C	5.24	117.27	108.73

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	3330	0	3345	128	0
2	A	25	0	0	0	0
All	All	3355	0	3345	128	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 19.

All (128) 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:44:MET:HE1	1:A:51:VAL:HG21	1.43	0.97
1:A:126:ILE:HB	1:A:212:ILE:HG23	1.54	0.89
1:A:75:LEU:N	1:A:75:LEU:HD12	1.89	0.88
1:A:441:VAL:HG12	1:A:442:LYS:H	1.39	0.88
1:A:75:LEU:H	1:A:75:LEU:CD1	1.88	0.87
1:A:56:GLY:HA3	1:A:79:GLN:NE2	1.90	0.86
1:A:75:LEU:N	1:A:75:LEU:CD1	2.43	0.80
1:A:100:LEU:HD11	1:A:114:LEU:HD22	1.65	0.79
1:A:62:LEU:HD23	1:A:73:TRP:HZ3	1.49	0.76
1:A:189:ASN:HB3	1:A:196:PHE:CZ	2.22	0.75
1:A:44:MET:HE1	1:A:51:VAL:CG2	2.16	0.74
1:A:128:LEU:HD12	1:A:173:LEU:HB3	1.72	0.71
1:A:193:GLN:HG2	1:A:195:GLU:HG3	1.71	0.71
1:A:440:ARG:HA	1:A:440:ARG:HE	1.53	0.71
1:A:152:ILE:HD13	1:A:202:ILE:HG13	1.71	0.71
1:A:351:LYS:O	1:A:368:GLY:HA2	1.93	0.69
1:A:112:ASP:O	1:A:116:ARG:HG3	1.92	0.69
1:A:100:LEU:HD21	1:A:102:LEU:HG	1.74	0.68
1:A:56:GLY:HA3	1:A:79:GLN:HE22	1.60	0.67
1:A:124:GLY:O	1:A:210:LYS:HG2	1.96	0.66
1:A:75:LEU:H	1:A:75:LEU:HD13	1.60	0.66
1:A:425:THR:HG23	1:A:439:SER:HB2	1.77	0.66
1:A:438:ILE:HG22	1:A:440:ARG:CZ	2.28	0.63
1:A:76:GLN:HE21	1:A:84:HIS:HD2	1.47	0.62
1:A:33:LYS:HD3	1:A:37:GLN:HB3	1.79	0.62
1:A:136:PRO:HB2	1:A:141:ARG:NH1	2.17	0.60
1:A:440:ARG:HA	1:A:440:ARG:NE	2.10	0.59
1:A:208:ASP:OD1	1:A:208:ASP:N	2.36	0.59
1:A:87:GLN:NE2	1:A:185:SER:HA	2.17	0.59
1:A:100:LEU:HD21	1:A:102:LEU:CG	2.32	0.58
1:A:150:VAL:HG23	1:A:206:HIS:CD2	2.39	0.58
1:A:61:LEU:HA	1:A:64:LYS:HB3	1.85	0.58
1:A:64:LYS:HD3	1:A:65:THR:N	2.18	0.58
1:A:422:GLY:HA3	1:A:438:ILE:HG23	1.84	0.58
1:A:425:THR:HA	1:A:439:SER:HB2	1.85	0.58
1:A:143:VAL:O	1:A:150:VAL:HG12	2.03	0.58
1:A:6:MET:HE1	1:A:46:LEU:HB3	1.85	0.58
1:A:124:GLY:HA2	1:A:179:ASP:OD2	2.04	0.58
1:A:187:LEU:HD21	1:A:204:LEU:HG	1.85	0.57
1:A:78:GLU:O	1:A:79:GLN:C	2.47	0.57
1:A:438:ILE:HG22	1:A:440:ARG:NH2	2.20	0.56
1:A:46:LEU:CD1	1:A:111:VAL:HG13	2.35	0.56

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:268:HIS:HB2	1:A:272:ILE:HD12	1.87	0.56
1:A:44:MET:CE	1:A:51:VAL:HG21	2.28	0.56
1:A:100:LEU:CD2	1:A:102:LEU:HG	2.35	0.56
1:A:55:TYR:OH	1:A:75:LEU:HG	2.08	0.54
1:A:176:ASN:O	1:A:180:LEU:HB2	2.07	0.54
1:A:132:LYS:HA	1:A:167:GLU:HA	1.89	0.54
1:A:158:ALA:HB3	1:A:163:ARG:HH21	1.73	0.54
1:A:40:ILE:HG23	1:A:44:MET:HE3	1.91	0.53
1:A:101:MET:HE3	1:A:171:GLY:O	2.08	0.53
1:A:268:HIS:HB2	1:A:272:ILE:CD1	2.39	0.53
1:A:441:VAL:HG12	1:A:442:LYS:N	2.18	0.53
1:A:76:GLN:O	1:A:77:ALA:C	2.52	0.52
1:A:179:ASP:O	1:A:182:ARG:HB3	2.09	0.52
1:A:151:GLY:HA2	1:A:202:ILE:CG2	2.40	0.52
1:A:95:ASP:HB3	1:A:178:ARG:HB2	1.92	0.52
1:A:429:ARG:CZ	1:A:429:ARG:HA	2.40	0.52
1:A:8:VAL:HG11	1:A:102:LEU:HD12	1.92	0.51
1:A:44:MET:N	1:A:44:MET:HE2	2.25	0.51
1:A:189:ASN:HB3	1:A:196:PHE:CE1	2.45	0.51
1:A:114:LEU:O	1:A:118:LEU:HG	2.11	0.51
1:A:298:LEU:HG	1:A:315:LEU:HD13	1.91	0.51
1:A:144:ARG:HA	1:A:148:ASP:O	2.10	0.50
1:A:429:ARG:HA	1:A:429:ARG:NH1	2.27	0.50
1:A:62:LEU:HD23	1:A:73:TRP:CZ3	2.39	0.50
1:A:351:LYS:O	1:A:352:LYS:C	2.55	0.50
1:A:78:GLU:O	1:A:79:GLN:O	2.31	0.49
1:A:176:ASN:OD1	1:A:178:ARG:HB3	2.12	0.49
1:A:6:MET:CE	1:A:46:LEU:HB3	2.43	0.48
1:A:184:LEU:C	1:A:186:LEU:H	2.20	0.48
1:A:100:LEU:C	1:A:100:LEU:HD23	2.38	0.48
1:A:184:LEU:O	1:A:186:LEU:N	2.46	0.47
1:A:68:ASP:OD1	1:A:68:ASP:N	2.47	0.47
1:A:90:ALA:N	1:A:91:PRO:HD2	2.29	0.47
1:A:122:PRO:HG2	1:A:211:LYS:O	2.13	0.47
1:A:19:MET:SD	1:A:228:ASN:HA	2.55	0.47
1:A:328:PRO:O	1:A:346:ASN:HA	2.13	0.47
1:A:8:VAL:HG22	1:A:100:LEU:HD22	1.97	0.47
1:A:174:VAL:HG12	1:A:175:ALA:H	1.79	0.47
1:A:23:LEU:HD12	1:A:24:PRO:HD2	1.97	0.46
1:A:136:PRO:O	1:A:141:ARG:NH2	2.48	0.46
1:A:447:GLN:HA	1:A:447:GLN:NE2	2.30	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:99:ILE:HB	1:A:180:LEU:HD12	1.97	0.46
1:A:91:PRO:HA	1:A:181:LYS:HE2	1.97	0.45
1:A:8:VAL:HG12	1:A:9:VAL:N	2.31	0.45
1:A:221:SER:HA	1:A:224:GLU:HG3	1.97	0.45
1:A:415:VAL:HG13	1:A:431:VAL:HB	1.97	0.45
1:A:309:ILE:HG23	1:A:326:VAL:HG13	1.99	0.45
1:A:323:ASN:O	1:A:341:GLY:HA2	2.17	0.45
1:A:196:PHE:N	1:A:196:PHE:CD2	2.84	0.44
1:A:255:LEU:HB2	1:A:275:ASP:HA	1.99	0.44
1:A:47:GLY:O	1:A:48:ALA:C	2.61	0.44
1:A:174:VAL:O	1:A:175:ALA:HB2	2.18	0.44
1:A:364:LEU:O	1:A:381:GLY:HA2	2.18	0.44
1:A:128:LEU:O	1:A:214:THR:HA	2.18	0.43
1:A:128:LEU:CD1	1:A:173:LEU:HB3	2.45	0.43
1:A:175:ALA:HB3	1:A:180:LEU:HG	2.00	0.43
1:A:339:ALA:HB3	1:A:356:GLY:C	2.44	0.43
1:A:201:ILE:HA	1:A:204:LEU:HB2	2.00	0.43
1:A:221:SER:HA	1:A:224:GLU:CG	2.48	0.43
1:A:256:ASP:HA	1:A:257:PRO:HD2	1.78	0.43
1:A:152:ILE:HB	1:A:199:THR:HG23	2.01	0.43
1:A:26:VAL:HA	1:A:35:MET:HE2	2.00	0.43
1:A:68:ASP:C	1:A:70:SER:H	2.26	0.43
1:A:63:LYS:HA	1:A:73:TRP:CZ2	2.54	0.43
1:A:333:ARG:HB3	1:A:334:PRO:HD2	2.01	0.43
1:A:6:MET:HE3	1:A:6:MET:HB3	1.88	0.42
1:A:89:ALA:O	1:A:92:HIS:HB2	2.19	0.42
1:A:68:ASP:N	1:A:69:PRO:HD3	2.35	0.42
1:A:425:THR:HA	1:A:439:SER:CB	2.49	0.42
1:A:19:MET:O	1:A:229:ARG:NH1	2.52	0.42
1:A:90:ALA:HA	1:A:93:PHE:CE1	2.54	0.42
1:A:200:ASP:C	1:A:202:ILE:H	2.28	0.42
1:A:362:GLY:C	1:A:363:HIS:CG	2.98	0.42
1:A:28:HIS:HA	1:A:29:PRO:HD3	1.81	0.42
1:A:141:ARG:NH2	1:A:155:HIS:ND1	2.67	0.42
1:A:139:TYR:CD1	1:A:139:TYR:N	2.88	0.41
1:A:126:ILE:HG23	1:A:174:VAL:O	2.21	0.41
1:A:130:THR:OG1	1:A:216:HIS:CE1	2.72	0.41
1:A:187:LEU:HD11	1:A:201:ILE:HG22	2.03	0.41
1:A:122:PRO:O	1:A:123:GLU:C	2.64	0.41
1:A:159:SER:OG	1:A:162:GLN:HG3	2.21	0.41
1:A:157:ASP:OD1	1:A:157:ASP:N	2.36	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:300:ASN:O	1:A:317:ASP:HA	2.20	0.41
1:A:8:VAL:CG1	1:A:9:VAL:N	2.83	0.40
1:A:243:GLN:NE2	1:A:262:LEU:HB3	2.36	0.40
1:A:131:VAL:HG13	1:A:217:PRO:CD	2.51	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	439/456 (96%)	399 (91%)	29 (7%)	11 (2%)	4 7

All (11) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	67	ALA
1	A	79	GLN
1	A	156	LYS
1	A	77	ALA
1	A	138	GLY
1	A	182	ARG
1	A	185	SER
1	A	175	ALA
1	A	184	LEU
1	A	439	SER
1	A	441	VAL

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	351/365 (96%)	316 (90%)	35 (10%)	7 15

All (35) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	33	LYS
1	A	35	MET
1	A	46	LEU
1	A	60	GLU
1	A	62	LEU
1	A	64	LYS
1	A	68	ASP
1	A	75	LEU
1	A	80	LEU
1	A	100	LEU
1	A	123	GLU
1	A	131	VAL
1	A	134	ASP
1	A	135	ASN
1	A	157	ASP
1	A	174	VAL
1	A	180	LEU
1	A	196	PHE
1	A	199	THR
1	A	201	ILE
1	A	208	ASP
1	A	210	LYS
1	A	218	THR
1	A	255	LEU
1	A	308	GLU
1	A	309	ILE
1	A	346	ASN
1	A	363	HIS
1	A	364	LEU
1	A	391	ASN
1	A	394	LYS
1	A	438	ILE
1	A	439	SER
1	A	440	ARG

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Mol	Chain	Res	Type
1	A	443	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	76	GLN
1	A	79	GLN
1	A	84	HIS
1	A	135	ASN
1	A	193	GLN
1	A	216	HIS
1	A	227	ASN
1	A	243	GLN
1	A	363	HIS
1	A	391	ASN
1	A	443	GLN
1	A	447	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 oligosaccharides 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 ⓘ

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	445/456 (97%)	0.37	40 (8%) 15 13	29, 67, 140, 189	0

All (40) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	166	ASN	5.9
1	A	450	LYS	5.9
1	A	112	ASP	5.3
1	A	451	ARG	4.5
1	A	80	LEU	4.0
1	A	452	PRO	3.7
1	A	443	GLN	3.5
1	A	444	VAL	3.3
1	A	439	SER	3.3
1	A	86	MET	3.1
1	A	75	LEU	3.1
1	A	184	LEU	3.0
1	A	440	ARG	2.8
1	A	78	GLU	2.8
1	A	386	ASN	2.7
1	A	118	LEU	2.7
1	A	115	GLN	2.7
1	A	187	LEU	2.7
1	A	388	ASP	2.7
1	A	4	SER	2.7
1	A	77	ALA	2.7
1	A	175	ALA	2.7
1	A	185	SER	2.6
1	A	201	ILE	2.6
1	A	161	ALA	2.6
1	A	126	ILE	2.5
1	A	168	ILE	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	15	LYS	2.4
1	A	69	PRO	2.3
1	A	393	PHE	2.3
1	A	14	GLY	2.3
1	A	194	GLY	2.3
1	A	50	HIS	2.2
1	A	70	SER	2.2
1	A	385	CYS	2.2
1	A	441	VAL	2.1
1	A	125	GLY	2.1
1	A	449	TRP	2.1
1	A	391	ASN	2.1
1	A	202	ILE	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 oligosaccharides 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.