



Full wwPDB X-ray Structure Validation Report ⓘ

Sep 2, 2023 – 11:48 AM EDT

PDB ID : 3QKI
Title : Crystal structure of Glucose-6-Phosphate Isomerase (PF14_0341) from Plasmodium falciparum 3D7
Authors : Gileadi, T.; Wernimont, A.K.; Hutchinson, A.; Weadge, J.; Cossar, D.; Lew, J.; Arrowsmith, C.H.; Edwards, A.M.; Bountra, C.; Weigelt, J.; Hui, R.; Hills, T.; Pizarro, J.C.; Structural Genomics Consortium (SGC)
Deposited on : 2011-02-01
Resolution : 1.92 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
Xtriage (Phenix) : 1.13
EDS : 2.35
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) : 2.35

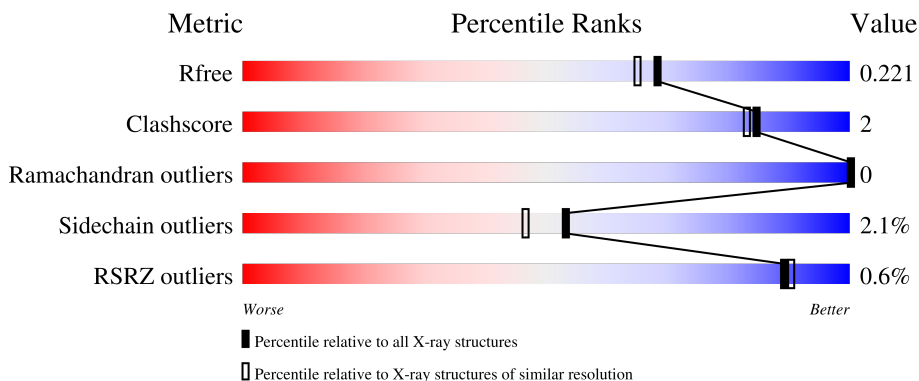
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.92 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	7937 (1.94-1.90)
Clashscore	141614	8644 (1.94-1.90)
Ramachandran outliers	138981	8530 (1.94-1.90)
Sidechain outliers	138945	8530 (1.94-1.90)
RSRZ outliers	127900	7793 (1.94-1.90)

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 $\leq 5\%$. 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	597	 90% 6%
1	B	597	 90% 7%
1	C	597	 89% 7%

2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 15823 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 Glucose-6-phosphate isomerase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	575	4745	3033	794	901	17	0	14	0
1	B	575	4738	3030	796	895	17	0	10	0
1	C	574	4714	3014	788	893	19	0	8	0

There are 54 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-17	MET	-	initiating methionine	UNP Q8ILA4
A	-16	HIS	-	expression tag	UNP Q8ILA4
A	-15	HIS	-	expression tag	UNP Q8ILA4
A	-14	HIS	-	expression tag	UNP Q8ILA4
A	-13	HIS	-	expression tag	UNP Q8ILA4
A	-12	HIS	-	expression tag	UNP Q8ILA4
A	-11	HIS	-	expression tag	UNP Q8ILA4
A	-10	SER	-	expression tag	UNP Q8ILA4
A	-9	SER	-	expression tag	UNP Q8ILA4
A	-8	GLY	-	expression tag	UNP Q8ILA4
A	-7	ARG	-	expression tag	UNP Q8ILA4
A	-6	GLU	-	expression tag	UNP Q8ILA4
A	-5	ASN	-	expression tag	UNP Q8ILA4
A	-4	LEU	-	expression tag	UNP Q8ILA4
A	-3	TYR	-	expression tag	UNP Q8ILA4
A	-2	PHE	-	expression tag	UNP Q8ILA4
A	-1	GLN	-	expression tag	UNP Q8ILA4
A	0	GLY	-	expression tag	UNP Q8ILA4
B	-17	MET	-	initiating methionine	UNP Q8ILA4
B	-16	HIS	-	expression tag	UNP Q8ILA4
B	-15	HIS	-	expression tag	UNP Q8ILA4
B	-14	HIS	-	expression tag	UNP Q8ILA4
B	-13	HIS	-	expression tag	UNP Q8ILA4

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-12	HIS	-	expression tag	UNP Q8ILA4
B	-11	HIS	-	expression tag	UNP Q8ILA4
B	-10	SER	-	expression tag	UNP Q8ILA4
B	-9	SER	-	expression tag	UNP Q8ILA4
B	-8	GLY	-	expression tag	UNP Q8ILA4
B	-7	ARG	-	expression tag	UNP Q8ILA4
B	-6	GLU	-	expression tag	UNP Q8ILA4
B	-5	ASN	-	expression tag	UNP Q8ILA4
B	-4	LEU	-	expression tag	UNP Q8ILA4
B	-3	TYR	-	expression tag	UNP Q8ILA4
B	-2	PHE	-	expression tag	UNP Q8ILA4
B	-1	GLN	-	expression tag	UNP Q8ILA4
B	0	GLY	-	expression tag	UNP Q8ILA4
C	-17	MET	-	initiating methionine	UNP Q8ILA4
C	-16	HIS	-	expression tag	UNP Q8ILA4
C	-15	HIS	-	expression tag	UNP Q8ILA4
C	-14	HIS	-	expression tag	UNP Q8ILA4
C	-13	HIS	-	expression tag	UNP Q8ILA4
C	-12	HIS	-	expression tag	UNP Q8ILA4
C	-11	HIS	-	expression tag	UNP Q8ILA4
C	-10	SER	-	expression tag	UNP Q8ILA4
C	-9	SER	-	expression tag	UNP Q8ILA4
C	-8	GLY	-	expression tag	UNP Q8ILA4
C	-7	ARG	-	expression tag	UNP Q8ILA4
C	-6	GLU	-	expression tag	UNP Q8ILA4
C	-5	ASN	-	expression tag	UNP Q8ILA4
C	-4	LEU	-	expression tag	UNP Q8ILA4
C	-3	TYR	-	expression tag	UNP Q8ILA4
C	-2	PHE	-	expression tag	UNP Q8ILA4
C	-1	GLN	-	expression tag	UNP Q8ILA4
C	0	GLY	-	expression tag	UNP Q8ILA4

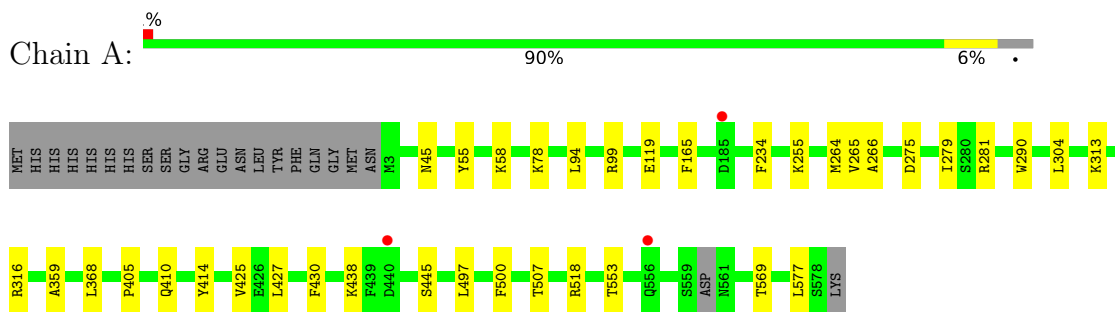
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	554	Total O 554 554	0	0
2	B	547	Total O 547 547	0	0
2	C	525	Total O 525 525	0	0

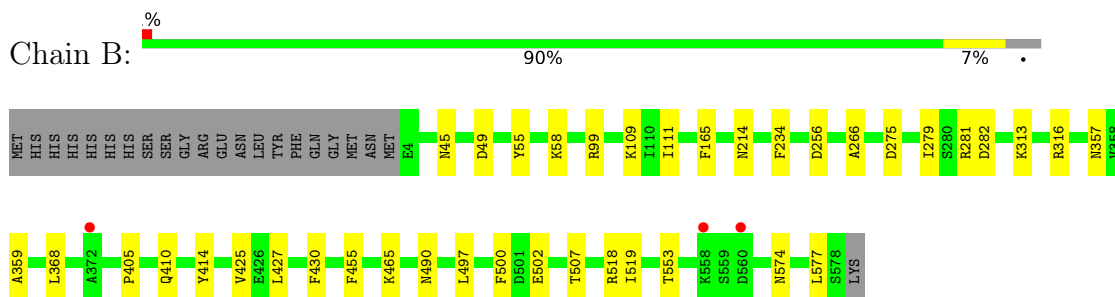
3 Residue-property plots [i](#)

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.

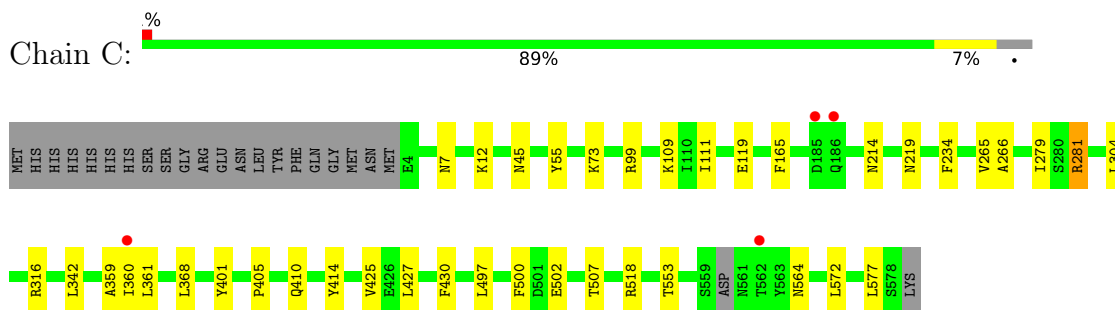
- Molecule 1: Glucose-6-phosphate isomerase



- Molecule 1: Glucose-6-phosphate isomerase



- Molecule 1: Glucose-6-phosphate isomerase



4 Data and refinement statistics i

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	138.44Å 233.00Å 72.79Å 90.00° 91.40° 90.00°	Depositor
Resolution (Å)	39.66 – 1.92 38.85 – 1.92	Depositor EDS
% Data completeness (in resolution range)	(Not available) (39.66-1.92) 91.2 (38.85-1.92)	Depositor EDS
R_{merge}	0.17	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.74 (at 1.92Å)	Xtrriage
Refinement program	BUSTER-TNT BUSTER 2.8.0, BUSTER 2.8.0	Depositor
R, R_{free}	0.174 , 0.207 0.187 , 0.221	Depositor DCC
R_{free} test set	7981 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å ²)	17.3	Xtrriage
Anisotropy	0.495	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 61.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.012 for -1/2*h+1/2*k,3/2*h+1/2*k,-l 0.010 for -1/2*h-1/2*k,-3/2*h+1/2*k,-l 0.022 for 1/2*h+1/2*k,3/2*h-1/2*k,-l 0.059 for 1/2*h-1/2*k,-3/2*h-1/2*k,-l 0.027 for -h,-k,l	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	15823	wwPDB-VP
Average B, all atoms (Å ²)	23.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.26% 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	0.50	0/4883	0.65	0/6597
1	B	0.54	0/4865	0.66	0/6568
1	C	0.50	0/4834	0.65	0/6528
All	All	0.51	0/14582	0.65	0/19693

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	4745	0	4659	17	0
1	B	4738	0	4664	24	0
1	C	4714	0	4627	26	0
2	A	554	0	0	2	1
2	B	547	0	0	6	1
2	C	525	0	0	7	0
All	All	15823	0	13950	66	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 2.

All (66) 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:360:ILE:HD11	1:C:401:TYR:HD1	1.14	1.13
1:C:281[A]:ARG:HA	1:C:281[A]:ARG:HE	1.13	1.04
1:B:281[B]:ARG:HH11	1:B:281[B]:ARG:HG2	1.15	1.04
1:C:360:ILE:HD11	1:C:401:TYR:CD1	2.04	0.93
1:C:281[A]:ARG:HA	1:C:281[A]:ARG:NE	1.86	0.88
1:C:360:ILE:HG13	2:C:783:HOH:O	1.76	0.83
1:B:490:ASN:HB2	2:B:1584:HOH:O	1.80	0.82
1:C:281[A]:ARG:HE	1:C:281[A]:ARG:CA	1.93	0.80
1:A:119:GLU:HG3	2:A:1471:HOH:O	1.80	0.80
1:B:281[B]:ARG:HG2	1:B:281[B]:ARG:NH1	1.96	0.76
1:C:360:ILE:CG1	2:C:783:HOH:O	2.34	0.73
1:A:264:MET:SD	2:A:1530:HOH:O	2.50	0.69
1:B:281[B]:ARG:HH11	1:B:281[B]:ARG:CG	2.01	0.64
1:B:282:ASP:O	2:B:1558:HOH:O	2.17	0.60
1:B:357:ASN:ND2	2:B:1455:HOH:O	2.35	0.59
1:C:361:LEU:HB2	1:C:427[A]:LEU:HD23	1.87	0.56
1:B:553:THR:HG21	1:B:577:LEU:HD13	1.89	0.52
1:C:360:ILE:HD13	2:C:1571:HOH:O	2.08	0.52
1:A:553:THR:HG21	1:A:577:LEU:HD13	1.90	0.51
1:C:73:LYS:HD3	2:C:1484:HOH:O	2.10	0.51
1:A:500:PHE:CD1	1:A:507[A]:THR:HG23	2.46	0.51
1:C:553:THR:HG21	1:C:577:LEU:HD13	1.91	0.51
1:A:313:LYS:HG2	1:A:316[A]:ARG:HH21	1.76	0.51
1:A:430:PHE:CD2	1:A:500:PHE:HB2	2.48	0.49
1:C:430:PHE:CD2	1:C:500:PHE:HB2	2.48	0.49
1:B:359:ALA:HB3	1:B:425:VAL:HG12	1.95	0.49
1:B:465:LYS:HE3	2:C:1051:HOH:O	2.13	0.49
1:B:430:PHE:CD2	1:B:500:PHE:HB2	2.49	0.48
1:C:359:ALA:HB3	1:C:425:VAL:HG12	1.95	0.48
1:B:266:ALA:HB2	1:B:279:ILE:HD13	1.94	0.48
1:B:313:LYS:HG2	1:B:316[A]:ARG:NH2	2.28	0.47
1:C:316:ARG:HG3	2:C:581:HOH:O	2.14	0.46
1:A:427:LEU:HB2	1:A:497:LEU:HD23	1.97	0.46
1:A:266:ALA:HB2	1:A:279:ILE:HD13	1.96	0.46
1:C:266:ALA:HB2	1:C:279:ILE:HD13	1.98	0.45
1:A:359:ALA:HB3	1:A:425:VAL:HG12	1.99	0.45
1:C:427[A]:LEU:HB2	1:C:497:LEU:HD23	1.98	0.45
1:B:410:GLN:HA	1:B:414:TYR:CG	2.52	0.44
1:A:438:LYS:HD3	1:A:445:SER:HB3	1.99	0.44
1:B:502:GLU:O	1:B:507:THR:HG21	2.18	0.44
1:B:455:PHE:HE1	1:C:572:LEU:HB3	1.83	0.44
1:C:502:GLU:O	1:C:507:THR:HG21	2.17	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:519:ILE:HD12	2:B:1570:HOH:O	2.18	0.43
1:C:410:GLN:HA	1:C:414:TYR:CG	2.54	0.43
1:A:313:LYS:HG2	1:A:316[A]:ARG:NH2	2.33	0.42
1:A:410:GLN:HA	1:A:414:TYR:CG	2.54	0.42
1:B:368:LEU:HA	1:B:405:PRO:HG3	2.01	0.42
1:B:427:LEU:HB2	1:B:497:LEU:HD23	2.00	0.42
1:A:368[A]:LEU:HA	1:A:405:PRO:HG3	2.01	0.42
1:B:574:ASN:HB3	2:B:1528:HOH:O	2.19	0.42
1:B:410:GLN:HA	1:B:414:TYR:CD1	2.55	0.42
1:C:7:ASN:HA	1:C:12:LYS:HE3	2.02	0.42
1:C:368:LEU:HA	1:C:405:PRO:HG3	2.02	0.42
1:A:368[B]:LEU:HA	1:A:405:PRO:HG3	2.01	0.42
1:B:256:ASP:CB	2:B:671:HOH:O	2.67	0.41
1:C:500:PHE:CD1	1:C:507:THR:HG23	2.56	0.41
1:C:119:GLU:HG3	2:C:1538:HOH:O	2.19	0.41
1:A:265:VAL:HG21	1:A:304:LEU:HD21	2.01	0.41
1:B:49:ASP:HB3	1:B:497:LEU:HB2	2.03	0.41
1:C:410:GLN:HA	1:C:414:TYR:CD1	2.55	0.41
1:A:410:GLN:HA	1:A:414:TYR:CD1	2.56	0.41
1:C:109:LYS:HD2	1:C:111:ILE:HD11	2.02	0.40
1:B:109:LYS:HD2	1:B:111:ILE:HD11	2.03	0.40
1:B:500:PHE:CD1	1:B:507:THR:HG23	2.56	0.40
1:C:265:VAL:HG21	1:C:304:LEU:HD21	2.03	0.40
1:A:94:LEU:HB2	1:A:290:TRP:CE3	2.57	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)
2:A:840:HOH:O	2:B:750:HOH:O[1_556]	2.16	0.04

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	585/597 (98%)	567 (97%)	18 (3%)	0	100	100
1	B	582/597 (98%)	562 (97%)	20 (3%)	0	100	100
1	C	578/597 (97%)	557 (96%)	21 (4%)	0	100	100
All	All	1745/1791 (97%)	1686 (97%)	59 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	532/550 (97%)	518 (97%)	14 (3%)	46	37
1	B	529/550 (96%)	519 (98%)	10 (2%)	57	51
1	C	527/550 (96%)	514 (98%)	13 (2%)	47	39
All	All	1588/1650 (96%)	1551 (98%)	37 (2%)	53	43

All (37) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	45[A]	ASN
1	A	45[B]	ASN
1	A	55	TYR
1	A	58	LYS
1	A	78	LYS
1	A	99	ARG
1	A	165	PHE
1	A	234	PHE
1	A	255	LYS
1	A	275	ASP
1	A	281	ARG
1	A	518	ARG
1	A	569[A]	THR
1	A	569[B]	THR

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Mol	Chain	Res	Type
1	B	45	ASN
1	B	55	TYR
1	B	58	LYS
1	B	99	ARG
1	B	165	PHE
1	B	214	ASN
1	B	234	PHE
1	B	275[A]	ASP
1	B	275[B]	ASP
1	B	518	ARG
1	C	45	ASN
1	C	55	TYR
1	C	99	ARG
1	C	165	PHE
1	C	214	ASN
1	C	219	ASN
1	C	234	PHE
1	C	281[A]	ARG
1	C	281[B]	ARG
1	C	342	LEU
1	C	518	ARG
1	C	564[A]	ASN
1	C	564[B]	ASN

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

Mol	Chain	Res	Type
1	C	490	ASN

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 monosaccharides 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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	575/597 (96%)	-0.23	3 (0%) 91 92	11, 19, 40, 60	1 (0%)
1	B	575/597 (96%)	-0.23	3 (0%) 91 92	10, 19, 40, 51	2 (0%)
1	C	574/597 (96%)	-0.20	4 (0%) 87 89	11, 19, 41, 57	0
All	All	1724/1791 (96%)	-0.22	10 (0%) 89 90	10, 19, 41, 60	3 (0%)

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	185[A]	ASP	4.1
1	A	556	GLN	3.2
1	B	560	ASP	3.0
1	A	440[A]	ASP	2.8
1	C	185	ASP	2.5
1	C	562	THR	2.2
1	B	558	LYS	2.2
1	C	186	GLN	2.1
1	B	372	ALA	2.1
1	C	360	ILE	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 monosaccharides in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.