



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 12, 2026 – 12:40 PM UTC

PDB ID : 1YFO / pdb_00001yfo
Title : RECEPTOR PROTEIN TYROSINE PHOSPHATASE ALPHA, DOMAIN 1
FROM MOUSE
Authors : Bilwes, A.M.; Noel, J.P.
Deposited on : 1996-12-11
Resolution : 2.25 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

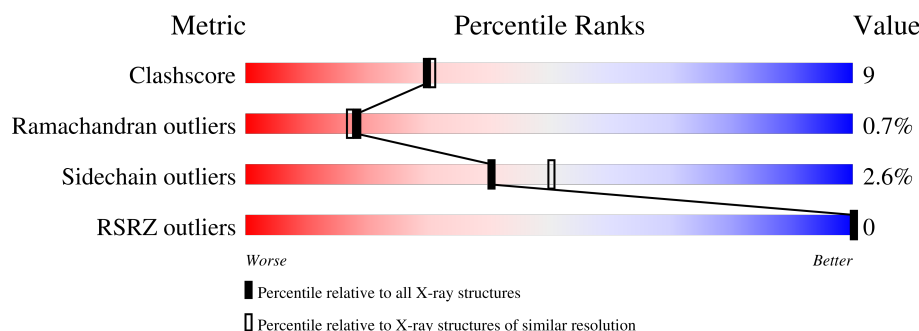
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.25 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))
Clashscore	190562	2005 (2.26-2.26)
Ramachandran outliers	187476	1965 (2.26-2.26)
Sidechain outliers	187428	1966 (2.26-2.26)
RSRZ outliers	180081	1898 (2.26-2.26)

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	302	
1	B	302	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4839 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 RECEPTOR PROTEIN TYROSINE PHOSPHATASE ALPHA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	279	Total	C	N	O	S	0	0	0
			2276	1454	389	415	18			
1	B	279	Total	C	N	O	S	0	0	0
			2276	1454	389	415	18			

There are 76 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	231	LEU	ILE	conflict	UNP P18052
A	?	-	PHE	deletion	UNP P18052
A	?	-	LEU	deletion	UNP P18052
A	?	-	SER	deletion	UNP P18052
A	?	-	LEU	deletion	UNP P18052
A	?	-	ALA	deletion	UNP P18052
A	?	-	VAL	deletion	UNP P18052
A	?	-	SER	deletion	UNP P18052
A	?	-	LYS	deletion	UNP P18052
A	?	-	ASP	deletion	UNP P18052
A	?	-	ALA	deletion	UNP P18052
A	?	-	VAL	deletion	UNP P18052
A	?	-	LYS	deletion	UNP P18052
A	?	-	ALA	deletion	UNP P18052
A	?	-	LEU	deletion	UNP P18052
A	?	-	ASN	deletion	UNP P18052
A	?	-	LYS	deletion	UNP P18052
A	?	-	THR	deletion	UNP P18052
A	?	-	THR	deletion	UNP P18052
A	?	-	PRO	deletion	UNP P18052
A	?	-	LEU	deletion	UNP P18052
A	?	-	LEU	deletion	UNP P18052
A	?	-	GLU	deletion	UNP P18052
A	?	-	ARG	deletion	UNP P18052

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Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	ARG	deletion	UNP P18052
A	?	-	PHE	deletion	UNP P18052
A	?	-	ILE	deletion	UNP P18052
A	?	-	GLY	deletion	UNP P18052
A	?	-	LYS	deletion	UNP P18052
A	?	-	SER	deletion	UNP P18052
A	?	-	ASN	deletion	UNP P18052
A	?	-	SER	deletion	UNP P18052
A	?	-	ARG	deletion	UNP P18052
A	?	-	GLY	deletion	UNP P18052
A	?	-	CYS	deletion	UNP P18052
A	?	-	LEU	deletion	UNP P18052
A	?	-	SER	deletion	UNP P18052
A	268	TYR	ASP	conflict	UNP P18052
B	231	LEU	ILE	conflict	UNP P18052
B	?	-	PHE	deletion	UNP P18052
B	?	-	LEU	deletion	UNP P18052
B	?	-	SER	deletion	UNP P18052
B	?	-	LEU	deletion	UNP P18052
B	?	-	ALA	deletion	UNP P18052
B	?	-	VAL	deletion	UNP P18052
B	?	-	SER	deletion	UNP P18052
B	?	-	LYS	deletion	UNP P18052
B	?	-	ASP	deletion	UNP P18052
B	?	-	ALA	deletion	UNP P18052
B	?	-	VAL	deletion	UNP P18052
B	?	-	LYS	deletion	UNP P18052
B	?	-	ALA	deletion	UNP P18052
B	?	-	LEU	deletion	UNP P18052
B	?	-	ASN	deletion	UNP P18052
B	?	-	LYS	deletion	UNP P18052
B	?	-	THR	deletion	UNP P18052
B	?	-	THR	deletion	UNP P18052
B	?	-	PRO	deletion	UNP P18052
B	?	-	LEU	deletion	UNP P18052
B	?	-	LEU	deletion	UNP P18052
B	?	-	GLU	deletion	UNP P18052
B	?	-	ARG	deletion	UNP P18052
B	?	-	ARG	deletion	UNP P18052
B	?	-	PHE	deletion	UNP P18052
B	?	-	ILE	deletion	UNP P18052
B	?	-	GLY	deletion	UNP P18052

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Chain	Residue	Modelled	Actual	Comment	Reference
B	?	-	LYS	deletion	UNP P18052
B	?	-	SER	deletion	UNP P18052
B	?	-	ASN	deletion	UNP P18052
B	?	-	SER	deletion	UNP P18052
B	?	-	ARG	deletion	UNP P18052
B	?	-	GLY	deletion	UNP P18052
B	?	-	CYS	deletion	UNP P18052
B	?	-	LEU	deletion	UNP P18052
B	?	-	SER	deletion	UNP P18052
B	268	TYR	ASP	conflict	UNP P18052

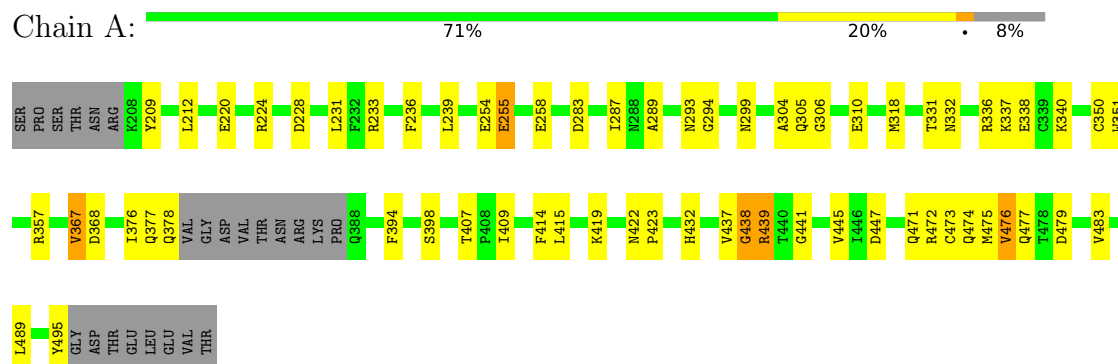
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	163	Total O 163 163	0	0
2	B	124	Total O 124 124	0	0

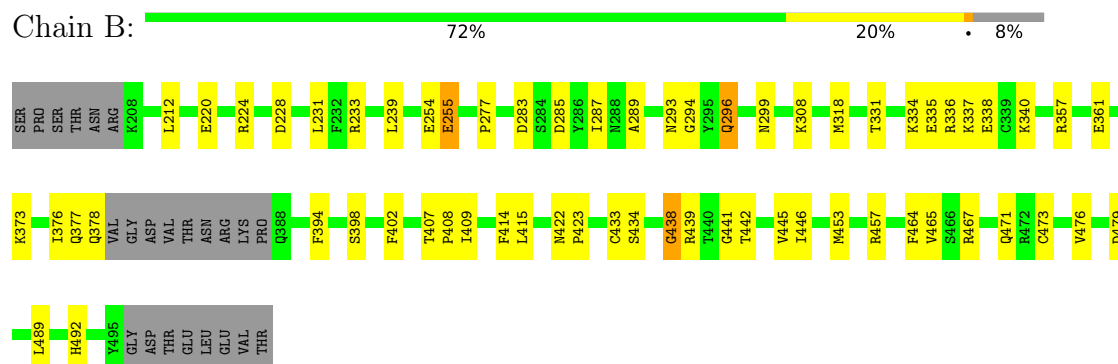
3 Residue-property plots

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: RECEPTOR PROTEIN TYROSINE PHOSPHATASE ALPHA



• Molecule 1: RECEPTOR PROTEIN TYROSINE PHOSPHATASE ALPHA



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	42.19Å 119.84Å 61.18Å 90.00° 110.08° 90.00°	Depositor
Resolution (Å)	20.00 – 2.25 20.00 – 2.25	Depositor EDS
% Data completeness (in resolution range)	82.4 (20.00-2.25) 81.8 (20.00-2.25)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.05	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.67 (at 2.26Å)	Xtriage
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.184 , 0.251 0.198 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	19.1	Xtriage
Anisotropy	0.153	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 24.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.257 for h,-k,-h-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	4839	wwPDB-VP
Average B, all atoms (Å ²)	21.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.65% 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	0.34	0/2332	0.87	8/3160 (0.3%)
1	B	0.33	0/2332	0.87	4/3160 (0.1%)
All	All	0.33	0/4664	0.87	12/6320 (0.2%)

There are no bond length outliers.

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	473	CYS	N-CA-C	9.01	122.01	111.02
1	A	367	VAL	N-CA-C	6.15	116.62	110.23
1	A	477	GLN	N-CA-C	6.13	118.04	111.36
1	A	474	GLN	N-CA-C	5.77	119.52	111.90
1	A	294	GLY	N-CA-C	-5.77	103.47	112.58
1	A	398	SER	N-CA-C	5.74	119.98	113.15
1	B	294	GLY	N-CA-C	-5.35	104.13	112.58
1	A	209	TYR	CA-C-N	5.21	125.75	120.38
1	A	209	TYR	C-N-CA	5.21	125.75	120.38
1	B	398	SER	N-CA-C	5.07	119.11	113.02
1	B	308	LYS	N-CA-C	-5.01	103.04	110.46
1	A	332	ASN	N-CA-C	-5.01	102.36	110.32

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	2276	0	2230	38	0
1	B	2276	0	2230	39	0
2	A	163	0	0	3	0
2	B	124	0	0	4	0
All	All	4839	0	4460	77	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 9.

All (77) 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:B:287:ILE:HD13	1:B:318:MET:HE3	1.65	0.77
1:B:336:ARG:HH21	1:B:402:PHE:HE2	1.36	0.70
1:A:473:CYS:HA	2:A:606:HOH:O	1.92	0.69
1:B:340:LYS:HE3	1:B:434:SER:HB2	1.78	0.66
1:B:331:THR:OG1	1:B:433:CYS:HA	1.99	0.62
1:A:287:ILE:HD13	1:A:318:MET:HE3	1.82	0.61
1:B:340:LYS:HG3	1:B:434:SER:HB2	1.82	0.61
1:B:438:GLY:HA3	2:B:552:HOH:O	2.01	0.61
1:A:438:GLY:HA3	2:A:659:HOH:O	1.99	0.60
1:B:340:LYS:HE3	1:B:434:SER:CB	2.31	0.59
1:B:293:ASN:ND2	1:B:299:ASN:H	2.01	0.59
1:A:289:ALA:CB	1:A:318:MET:HE1	2.36	0.56
1:A:293:ASN:ND2	1:A:299:ASN:H	2.02	0.56
1:B:373:LYS:HE3	2:B:606:HOH:O	2.04	0.56
1:B:293:ASN:ND2	1:B:471:GLN:HE22	2.05	0.54
1:A:336:ARG:O	1:A:337:LYS:HB2	2.08	0.53
1:B:407:THR:CG2	1:B:409:ILE:HD13	2.38	0.53
1:A:287:ILE:HG21	1:A:318:MET:HE3	1.92	0.52
1:A:289:ALA:HB3	1:A:318:MET:HE1	1.91	0.52
1:A:338:GLU:HB2	1:A:340:LYS:HE2	1.92	0.50
1:A:212:LEU:HD21	1:A:224:ARG:NH2	2.27	0.50
1:A:305:GLN:HG2	1:A:306:GLY:O	2.12	0.49
1:B:239:LEU:HD21	1:B:465:VAL:HG11	1.93	0.49
1:A:228:ASP:O	1:A:233:ARG:NH2	2.46	0.49
1:A:437:VAL:HG12	1:A:472:ARG:HE	1.78	0.48
1:B:296:GLN:O	1:B:296:GLN:HG2	2.13	0.48
1:B:331:THR:CG2	1:B:340:LYS:HG2	2.43	0.48
1:A:419:LYS:HE2	1:A:447:ASP:OD1	2.14	0.48
1:B:334:LYS:HE2	1:B:337:LYS:HA	1.95	0.47
1:A:258:GLU:HB3	1:A:310:GLU:OE1	2.14	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:277:PRO:HG3	1:B:285:ASP:HB3	1.96	0.47
1:A:236:PHE:O	1:A:239:LEU:HB2	2.15	0.47
1:A:331:THR:HG22	1:A:439:ARG:NH1	2.30	0.47
1:A:407:THR:HB	1:A:409:ILE:HD13	1.97	0.47
1:B:394:PHE:HB3	1:B:414:PHE:CE1	2.50	0.46
1:B:336:ARG:C	1:B:338:GLU:H	2.22	0.46
2:A:564:HOH:O	1:B:340:LYS:HD2	2.16	0.45
1:B:228:ASP:O	1:B:233:ARG:NH2	2.49	0.45
1:A:255:GLU:H	1:A:255:GLU:CD	2.24	0.45
1:A:367:VAL:HG13	1:A:368:ASP:H	1.82	0.45
1:A:255:GLU:HG3	1:A:283:ASP:CG	2.42	0.45
1:A:293:ASN:HD22	1:A:299:ASN:H	1.65	0.45
1:A:293:ASN:ND2	1:A:471:GLN:HE22	2.15	0.45
1:A:409:ILE:HD12	1:A:409:ILE:H	1.81	0.45
1:A:357:ARG:O	1:A:376:ILE:HA	2.18	0.44
1:B:377:GLN:O	1:B:378:GLN:HB2	2.17	0.44
1:B:289:ALA:CB	1:B:318:MET:HE1	2.48	0.44
1:B:453:MET:O	1:B:457:ARG:HA	2.17	0.44
1:B:233:ARG:HD3	1:B:479:ASP:OD2	2.18	0.43
1:B:441:GLY:O	1:B:445:VAL:HG23	2.18	0.43
1:A:475:MET:O	1:A:476:VAL:HB	2.18	0.43
1:B:224:ARG:HA	1:B:231:LEU:HB2	2.00	0.43
1:A:304:ALA:O	1:A:432:HIS:HB2	2.19	0.43
1:A:233:ARG:HD3	1:A:479:ASP:OD2	2.19	0.43
1:B:357:ARG:O	1:B:376:ILE:HA	2.19	0.43
1:A:224:ARG:HA	1:A:231:LEU:HB2	2.01	0.42
1:B:407:THR:HA	1:B:408:PRO:HD3	1.90	0.42
1:B:407:THR:HG21	1:B:409:ILE:HD13	2.00	0.42
1:A:441:GLY:O	1:A:445:VAL:HG23	2.19	0.42
1:B:492:HIS:HD2	2:B:591:HOH:O	2.03	0.42
1:A:212:LEU:HD21	1:A:224:ARG:HH22	1.85	0.42
1:B:239:LEU:HD21	1:B:465:VAL:CG1	2.49	0.42
1:B:335:GLU:O	1:B:338:GLU:HB2	2.21	0.41
1:B:212:LEU:HD22	1:B:220:GLU:HG3	2.02	0.41
1:A:479:ASP:O	1:A:483:VAL:HG23	2.20	0.41
1:A:350:CYS:SG	1:A:357:ARG:HG2	2.61	0.41
1:B:442:THR:O	1:B:446:ILE:HG13	2.21	0.41
1:B:340:LYS:HG3	1:B:434:SER:CB	2.50	0.41
1:A:350:CYS:SG	1:A:351:TRP:N	2.94	0.41
1:B:422:ASN:HA	1:B:423:PRO:HD3	1.91	0.41
1:B:299:ASN:ND2	2:B:517:HOH:O	2.54	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:394:PHE:HB3	1:A:414:PHE:CE1	2.56	0.41
1:A:422:ASN:HA	1:A:423:PRO:HD3	1.93	0.41
1:B:255:GLU:HG3	1:B:283:ASP:OD2	2.22	0.40
1:B:464:PHE:O	1:B:467:ARG:HB3	2.21	0.40
1:A:220:GLU:O	1:A:224:ARG:HG3	2.21	0.40
1:A:377:GLN:O	1:A:378:GLN:HB2	2.22	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	275/302 (91%)	258 (94%)	15 (6%)	2 (1%)	18	17
1	B	275/302 (91%)	258 (94%)	15 (6%)	2 (1%)	18	17
All	All	550/604 (91%)	516 (94%)	30 (6%)	4 (1%)	18	17

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	476	VAL
1	A	438	GLY
1	B	438	GLY
1	B	476	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	249/270 (92%)	243 (98%)	6 (2%)	43	54
1	B	249/270 (92%)	242 (97%)	7 (3%)	38	48
All	All	498/540 (92%)	485 (97%)	13 (3%)	40	50

All (13) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	254	GLU
1	A	255	GLU
1	A	415	LEU
1	A	439	ARG
1	A	489	LEU
1	A	495	TYR
1	B	254	GLU
1	B	255	GLU
1	B	296	GLN
1	B	361	GLU
1	B	415	LEU
1	B	439	ARG
1	B	489	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (19) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	229	ASN
1	A	293	ASN
1	A	299	ASN
1	A	323	ASN
1	A	332	ASN
1	A	422	ASN
1	A	424	GLN
1	A	474	GLN
1	A	492	HIS
1	B	229	ASN
1	B	293	ASN
1	B	299	ASN
1	B	313	ASN
1	B	322	GLN
1	B	323	ASN

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Mol	Chain	Res	Type
1	B	388	GLN
1	B	422	ASN
1	B	424	GLN
1	B	492	HIS

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 [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	279/302 (92%)	-1.72	0 100 100	4, 16, 42, 73	0
1	B	279/302 (92%)	-1.67	0 100 100	6, 17, 48, 83	0
All	All	558/604 (92%)	-1.69	0 100 100	4, 17, 45, 83	0

There are no RSRZ outliers to report.

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.