



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 12, 2017 – 11:32 pm GMT

PDB ID : 4APP
Title : Crystal Structure of the Human p21-Activated Kinase 4 in Complex with (S)-N-(5-(3-benzyl-1-methylpiperazine-4-carbonyl)-6,6-dimethyl-1,4,5, 6-tetrahydropyrrolo(3,4-c)pyrazol-3-yl)-3-phenoxybenzamide
Authors : Knighton, D.D.; Deng, Y.L.; Wang, C.; Guo, C.; Mcalpine, I.; Zhang, J.; Kephart, S.; Johnson, M.C.; Li, H.; Bouzida, D.; Yang, A.; Dong, L.; Marakovits, J.; Tikhe, J.; Richardson, P.; Guo, L.C.; Kania, R.; Edwards, M.P.; Kraynov, E.; Christensen, J.; Piraino, J.; Lee, J.; Dagostino, E.; Del-Carmen, C.; Smeal, T.; Murray, B.W.
Deposited on : 2012-04-04
Resolution : 2.20 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
Mogul	:	1.7.2 (RC1), CSD as538be (2017)
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

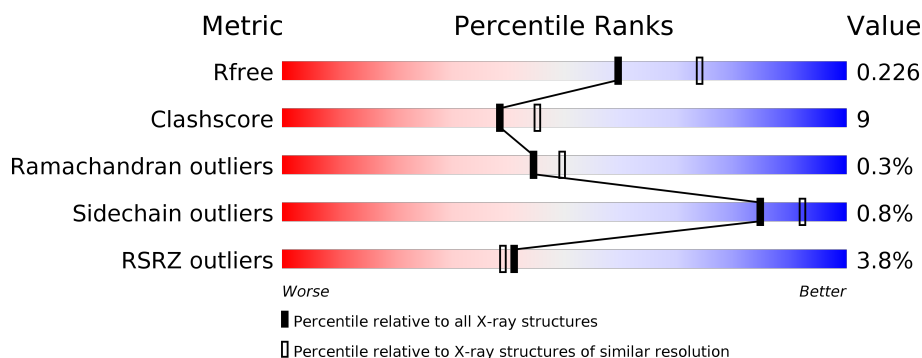
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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	4002 (2.20-2.20)
Clashscore	112137	4730 (2.20-2.20)
Ramachandran outliers	110173	4656 (2.20-2.20)
Sidechain outliers	110143	4657 (2.20-2.20)
RSRZ outliers	101464	4033 (2.20-2.20)

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	296	<div> <div>4%</div> <div>78%</div> <div>20%</div> <div>..</div> </div>

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 2542 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.

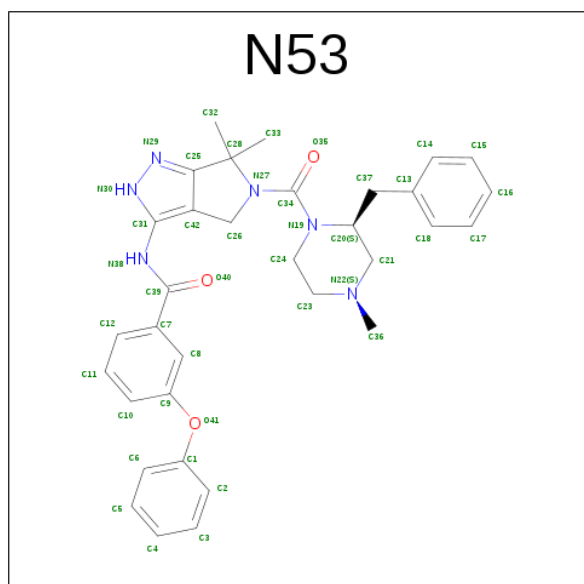
- Molecule 1 is a protein called SERINE/THREONINE-PROTEIN KINASE PAK 4.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	293	2312	1471	408	417	1	15	0	1	1

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	296	GLY	-	EXPRESSION TAG	UNP O96013
A	297	SER	-	EXPRESSION TAG	UNP O96013
A	298	HIS	-	EXPRESSION TAG	UNP O96013
A	299	MET	-	EXPRESSION TAG	UNP O96013

- Molecule 2 is N-[6,6-DIMETHYL-5-[(2S)-4-METHYL-2-(PHENYLMETHYL)PIPERAZIN-1-YL]CARBONYL-2,4-DIHYDROPYRROLO[3,4-C]PYRAZOL-3-YL]-3-PHENOXY-BENZAMIDE (three-letter code: N53) (formula: C₃₃H₃₆N₆O₃).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			42	33	6	3		

- Molecule 3 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			6	3	3		

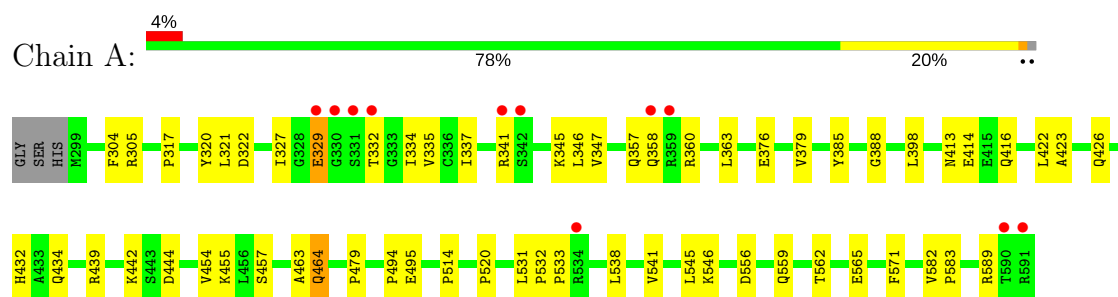
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	182	Total	O	0	0
			182	182		

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: SERINE/THREONINE-PROTEIN KINASE PAK 4



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	51.42Å 65.00Å 85.83Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	14.70 – 2.20 14.69 – 2.20	Depositor EDS
% Data completeness (in resolution range)	94.2 (14.70-2.20) 94.3 (14.69-2.20)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.22 (at 2.20Å)	Xtriage
Refinement program	CNX 2005	Depositor
R, R_{free}	0.188 , 0.229 0.186 , 0.226	Depositor DCC
R_{free} test set	433 reflections (3.13%)	DCC
Wilson B-factor (Å ²)	20.4	Xtriage
Anisotropy	0.372	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.40 , 58.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	2542	wwPDB-VP
Average B, all atoms (Å ²)	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.09% 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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: GOL, N53, SEP

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	0.49	0/2354	0.75	7/3187 (0.2%)

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	345	LYS	CA-CB-CG	6.23	127.10	113.40
1	A	589	ARG	CA-CB-CG	5.99	126.58	113.40
1	A	464	GLN	CA-CB-CG	5.86	126.28	113.40
1	A	546	LYS	CA-CB-CG	5.68	125.89	113.40
1	A	414	GLU	CA-CB-CG	-5.54	101.20	113.40
1	A	434	GLN	CA-CB-CG	5.45	125.38	113.40
1	A	329	GLU	CA-CB-CG	5.03	124.47	113.40

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	2312	0	2368	40	0
2	A	42	0	36	5	0
3	A	6	0	8	0	0
4	A	182	0	0	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	2542	0	2412	41	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 (41) 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:398:LEU:H	2:A:601:N53:H30	1.20	0.89
1:A:320:TYR:HA	1:A:341:ARG:HD3	1.63	0.80
1:A:322:ASP:OD2	1:A:341:ARG:HG2	1.82	0.79
1:A:332:THR:CG2	1:A:357:GLN:HE22	2.07	0.68
1:A:332:THR:HG21	1:A:357:GLN:HE22	1.61	0.65
1:A:379:VAL:HG21	1:A:457:SER:HB3	1.79	0.63
1:A:335:VAL:CG2	2:A:601:N53:H372	2.29	0.62
1:A:562:THR:OG1	1:A:565:GLU:HG3	1.99	0.61
1:A:464:GLN:HG2	4:A:2107:HOH:O	2.02	0.58
1:A:327:ILE:HD13	1:A:337:ILE:HG23	1.86	0.58
1:A:346:LEU:HD23	1:A:347:VAL:N	2.19	0.57
1:A:317:PRO:HB3	1:A:385:TYR:CE2	2.39	0.57
1:A:337:ILE:HB	1:A:346:LEU:HD21	1.89	0.55
1:A:304:PHE:CE1	1:A:360:ARG:HB2	2.42	0.54
1:A:398:LEU:N	2:A:601:N53:H30	2.01	0.50
1:A:422:LEU:O	1:A:426:GLN:HG3	2.12	0.50
1:A:423:ALA:CB	1:A:454:VAL:HB	2.43	0.49
1:A:317:PRO:HB2	1:A:321:LEU:HD12	1.94	0.49
1:A:376:GLU:HA	1:A:376:GLU:OE1	2.12	0.49
1:A:358:GLN:HE21	1:A:358:GLN:HA	1.79	0.47
1:A:538:LEU:O	1:A:541:VAL:HG22	2.14	0.47
1:A:376:GLU:O	1:A:455:LYS:HE2	2.16	0.46
1:A:329:GLU:HA	1:A:334:ILE:HA	1.97	0.46
1:A:413:ASN:OD1	1:A:416:GLN:HG3	2.15	0.46
1:A:582:VAL:HB	1:A:583:PRO:HD3	1.99	0.45
1:A:379:VAL:CG2	1:A:457:SER:HB3	2.47	0.45
1:A:304:PHE:CZ	1:A:360:ARG:HB2	2.52	0.45
1:A:335:VAL:HG22	2:A:601:N53:H372	1.98	0.44
1:A:514:PRO:HG2	1:A:533:PRO:HB2	2.01	0.43
1:A:556:ASP:OD2	1:A:559:GLN:HG2	2.19	0.42
1:A:457:SER:HB2	4:A:2104:HOH:O	2.19	0.42
1:A:442:LYS:HE3	1:A:444:ASP:HB2	2.00	0.42
1:A:305:ARG:NH1	1:A:388:GLY:O	2.53	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:545:LEU:HD13	1:A:571:PHE:CZ	2.55	0.41
1:A:514:PRO:HG2	1:A:533:PRO:CB	2.50	0.41
1:A:520:PRO:HG2	4:A:2138:HOH:O	2.20	0.41
1:A:531:LEU:HB3	1:A:532:PRO:HD2	2.03	0.41
2:A:601:N53:C26	2:A:601:N53:O40	2.68	0.41
1:A:358:GLN:NE2	1:A:358:GLN:HA	2.36	0.40
1:A:432:HIS:CG	1:A:494:PRO:HB3	2.56	0.40
1:A:439:ARG:NH2	1:A:463:ALA:HB2	2.36	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	291/296 (98%)	282 (97%)	8 (3%)	1 (0%)	44	49

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	479	PRO

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	255/257 (99%)	253 (99%)	2 (1%)	85	92

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	363	LEU
1	A	495	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	357	GLN
1	A	358	GLN
1	A	434	GLN
1	A	464	GLN
1	A	537	ASN
1	A	559	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

1 non-standard protein/DNA/RNA residue is modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the chemical component dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
1	SEP	A	474	1	9,9,10	0.81	0	9,12,14	1.39	2 (22%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means

no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	SEP	A	474	1	-	0/5/8/10	0/0/0/0

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	474	SEP	O2P-P-O1P	2.18	119.01	110.50
1	A	474	SEP	OG-CB-CA	2.76	110.89	108.17

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

2 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the chemical component dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
2	N53	A	601	-	44,47,47	2.13	24 (54%)	48,68,68	1.42	7 (14%)
3	GOL	A	602	-	5,5,5	0.58	0	5,5,5	0.20	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	N53	A	601	-	-	0/20/53/53	0/6/6/6
3	GOL	A	602	-	-	0/4/4/4	0/0/0/0

All (24) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	601	N53	C11-C10	2.00	1.42	1.38
2	A	601	N53	C5-C6	2.01	1.42	1.38
2	A	601	N53	C5-C4	2.10	1.43	1.38
2	A	601	N53	C3-C2	2.19	1.43	1.38
2	A	601	N53	C16-C15	2.21	1.43	1.38
2	A	601	N53	C4-C3	2.22	1.43	1.38
2	A	601	N53	C15-C14	2.27	1.43	1.38
2	A	601	N53	C8-C7	2.30	1.42	1.39
2	A	601	N53	C18-C13	2.33	1.43	1.38
2	A	601	N53	C11-C12	2.34	1.43	1.38
2	A	601	N53	C2-C1	2.36	1.43	1.38
2	A	601	N53	C17-C16	2.39	1.43	1.38
2	A	601	N53	C17-C18	2.43	1.43	1.38
2	A	601	N53	C14-C13	2.46	1.44	1.38
2	A	601	N53	C8-C9	2.48	1.43	1.38
2	A	601	N53	O41-C1	2.59	1.45	1.39
2	A	601	N53	C12-C7	2.64	1.43	1.39
2	A	601	N53	C26-N27	2.65	1.50	1.47
2	A	601	N53	C10-C9	2.71	1.44	1.38
2	A	601	N53	C21-C20	2.73	1.57	1.51
2	A	601	N53	C6-C1	2.83	1.44	1.38
2	A	601	N53	O41-C9	3.12	1.46	1.39
2	A	601	N53	C31-N38	4.74	1.49	1.39
2	A	601	N53	C34-N19	4.81	1.48	1.38

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	601	N53	C31-C42-C25	-3.36	103.24	106.48
2	A	601	N53	C24-N19-C34	-3.24	105.80	120.53
2	A	601	N53	O35-C34-N19	-3.02	119.79	122.60
2	A	601	N53	N19-C34-N27	2.08	119.22	115.14
2	A	601	N53	C13-C37-C20	2.17	117.31	113.26
2	A	601	N53	C9-O41-C1	2.99	125.97	118.78
2	A	601	N53	C32-C28-C25	3.18	113.19	108.01

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	601	N53	5	0

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	292/296 (98%)	-0.25	11 (3%) 41 39	11, 21, 46, 61	0

All (11) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	359	ARG	4.5
1	A	331	SER	4.1
1	A	590	THR	3.4
1	A	591	ARG	3.3
1	A	329	GLU	3.0
1	A	358	GLN	2.9
1	A	332	THR	2.8
1	A	330	GLY	2.8
1	A	534	ARG	2.8
1	A	341	ARG	2.7
1	A	342	SER	2.3

6.2 Non-standard residues in protein, DNA, RNA chains [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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å ²)	Q<0.9
1	SEP	A	474	10/11	0.97	0.08	-	18,20,22,22	0

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(\AA^2)	Q<0.9
2	N53	A	601	42/42	0.90	0.14	-0.05	13,24,37,40	0
3	GOL	A	602	6/6	0.89	0.13	-0.25	27,29,30,30	0

6.5 Other polymers [i](#)

There are no such residues in this entry.