

Full wwPDB X-ray Structure Validation Report (i)

Sep 30, 2025 – 02:19 PM JST

PDB ID : 9KS9 / pdb 00009ks9

Title: Crystal structure of MerTK kinase domain in complex with compound 6

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Deposited on : 2024-11-29

Resolution : 2.80 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 (i) 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 (1)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0

Mogul : 1.8.5 (274361), CSD as541be (2020)

Xtriage (Phenix) : 2.0

EDS : 3.0

buster-report : 1.1.7 (2018)

Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)

CCP4 : 9.0.010 (Gargrove)

Density-Fitness : 1.0.12

Ideal geometry (proteins) : Engh & Huber (2001) Ideal geometry (DNA, RNA) : Parkinson et al. (1996)

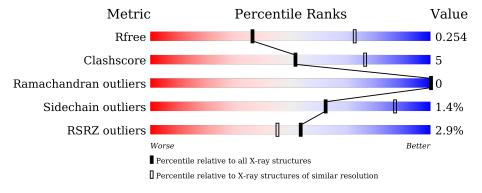
Validation Pipeline (wwPDB-VP) : 2.46

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure: $X\text{-}RAY\ DIFFRACTION$

The reported resolution of this entry is 2.80 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	Similar resolution
Metric	$(\# \mathrm{Entries})$	$(\# ext{Entries}, ext{ resolution range}(ext{Å}))$
R_{free}	164625	3657 (2.80-2.80)
Clashscore	180529	4123 (2.80-2.80)
Ramachandran outliers	177936	4071 (2.80-2.80)
Sidechain outliers	177891	4073 (2.80-2.80)
RSRZ outliers	164620	3659 (2.80-2.80)

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 <=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		
			2%		
1	A	294	78%	11%	11%
	_		3%		
1	В	294	77%	11%	12%



2 Entry composition (i)

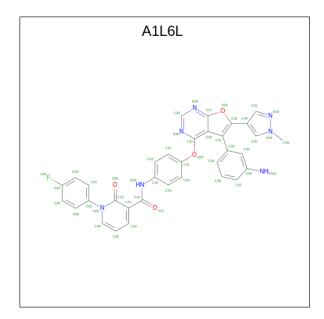
There are 3 unique types of molecules in this entry. The entry contains 4148 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Tyrosine-protein kinase Mer.

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace		
1	A	262	Total 2026	C 1304	N 338	O 364	S 20	0	0	0
1	В	259	Total 1974	C 1271	N 331	O 353	S 19	0	0	0

• Molecule 2 is $\{N\}$ -[4-[5-(3-aminophenyl)-6-(1-methylpyrazol-4-yl)furo[2,3-d]pyrimidin-4-yl] oxyphenyl]-1-(4-fluorophenyl)-2-oxidanylidene-pyridine-3-carboxamide (CCD ID: A1L6L) (formula: $C_{34}H_{24}FN_7O_4$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf			
2	٨	1	Total	С	F	N	О	0	0	
2	2 A	1	46	34	1	7	4	0		
2	D	1	Total	С	F	N	О	0	0	
	Б	1	46	34	1	7	4		U	

• Molecule 3 is water.



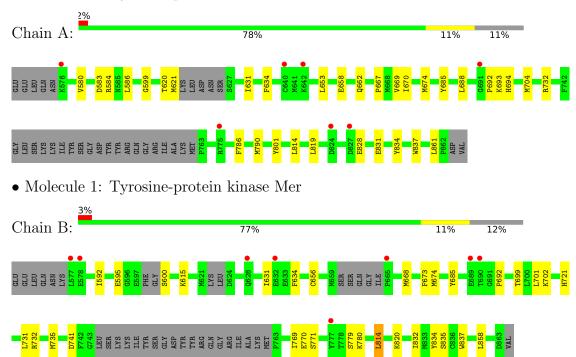
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	27	Total O 27 27	0	0
3	В	29	Total O 29 29	0	0



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: Tyrosine-protein kinase Mer





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants	51.56Å 91.35Å 69.84Å	Donositor
a, b, c, α , β , γ	90.00° 101.00° 90.00°	Depositor
Resolution (Å)	34.28 - 2.80	Depositor
rtesolution (A)	34.28 - 2.80	EDS
% Data completeness	92.6 (34.28-2.80)	Depositor
(in resolution range)	92.5 (34.28-2.80)	EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) > 1$	6.05 (at 2.81Å)	Xtriage
Refinement program	PHENIX (1.20.1_4487: ???)	Depositor
D D.	0.206 , 0.260	Depositor
R, R_{free}	0.205 , 0.254	DCC
R_{free} test set	1462 reflections (9.28%)	wwPDB-VP
Wilson B-factor (Å ²)	41.0	Xtriage
Anisotropy	0.739	Xtriage
Bulk solvent $k_{sol}(e/Å^3)$, $B_{sol}(Å^2)$	0.34, 51.4	EDS
L-test for twinning ²	$ < L >=0.50, < L^2>=0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	4148	wwPDB-VP
Average B, all atoms (Å ²)	42.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: The largest off-origin peak in the Patterson function is 8.06% of the height of the origin peak. No significant pseudotranslation is detected.

²Theoretical values of <|L|>, $<L^2>$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.



¹Intensities estimated from amplitudes.

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: A1L6L

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		
Mol Chain		RMSZ	# Z > 5	RMSZ	# Z > 5	
1	A	0.10	0/2070	0.34	0/2809	
1	В	0.11	0/2015	0.35	0/2735	
All	All	0.11	0/4085	0.35	0/5544	

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	2026	0	1985	19	0
1	В	1974	0	1905	20	0
2	A	46	0	0	1	0
2	В	46	0	0	1	0
3	A	27	0	0	0	0
3	В	29	0	0	0	0
All	All	4148	0	3890	40	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 5.

All (40) close contacts within the same asymmetric unit are listed below, sorted by their clash



magnitude.

Atom 1	Atom-2	Interatomic	Clash
Atom-1			overlap (Å)
1:B:674:MET:HE1	1:B:732:ARG:HG3	1.79	0.65
1:B:631:ILE:HA	1:B:634:PHE:HB3	1.78	0.65
1:A:685:TYR:HB3	1:A:692:PRO:HD2	1.80	0.61
1:B:731:LEU:HD22	1:B:735:MET:HE3	1.84	0.59
1:A:674:MET:HE2	1:A:732:ARG:HA	1.86	0.58
1:A:828:GLU:HA	1:A:831:GLU:HG3	1.88	0.55
1:B:595:GLU:HA	1:B:600:SER:HA	1.91	0.53
1:A:688:LEU:HD13	1:B:820:LYS:HB2	1.91	0.53
1:A:704:MET:HE2	1:A:790:MET:HB3	1.91	0.52
1:A:693:LYS:HG3	1:A:694:HIS:N	2.24	0.52
1:A:620:THR:HG22	1:A:621:MET:H	1.76	0.51
2:B:901:A1L6L:O16	2:B:901:A1L6L:N14	2.44	0.51
1:A:786:PHE:O	1:A:790:MET:HG3	2.12	0.49
1:B:674:MET:CE	1:B:732:ARG:HG3	2.42	0.49
1:B:685:TYR:HB3	1:B:692:PRO:HD2	1.95	0.49
1:B:702:LYS:HE3	1:B:858:LEU:HD21	1.95	0.48
1:A:653:LEU:HB2	1:A:670:ILE:HG22	1.95	0.47
1:B:656:CYS:HB3	1:B:668:MET:HE2	1.97	0.47
2:A:1001:A1L6L:O16	2:A:1001:A1L6L:N14	2.48	0.47
1:A:634:PHE:CE2	1:A:669:VAL:HG23	2.51	0.45
1:A:599:GLY:HA2	1:A:621:MET:HA	1.98	0.45
1:B:699:THR:HA	1:B:702:LYS:HD2	1.97	0.45
1:A:621:MET:HE1	1:A:631:ILE:HA	1.98	0.45
1:A:801:TYR:CZ	1:A:819:LEU:HG	2.51	0.45
1:B:769:ILE:HD11	1:B:814:LEU:HD12	1.98	0.45
1:A:814:LEU:O	1:A:814:LEU:HD13	2.17	0.44
1:B:834:TYR:HA	1:B:837:TRP:CE3	2.53	0.44
1:B:721:HIS:HE1	1:B:741:ASP:HB2	1.83	0.43
1:B:832:ILE:O	1:B:835:SER:OG	2.34	0.43
1:B:770:GLU:HG2	1:B:771:SER:N	2.33	0.43
1:A:621:MET:HE3	1:A:667:PRO:HD2	2.00	0.43
1:A:599:GLY:CA	1:A:621:MET:HA	2.49	0.43
1:B:780:LYS:HA	1:B:780:LYS:HD2	1.73	0.43
1:B:721:HIS:CE1	1:B:741:ASP:HB2	2.54	0.43
1:B:701:LEU:HB2	1:B:858:LEU:HD13	2.01	0.42
1:B:615:LYS:HB3	1:B:673:PHE:HB3	2.00	0.42
1:B:702:LYS:HE3	1:B:858:LEU:HD11	2.02	0.42
1:A:584:ARG:HE	1:A:658:GLU:HG3	1.86	0.41
1:A:583:ASP:HB2	1:A:586:LEU:HD13	2.03	0.41
1:A:834:TYR:HA	1:A:837:TRP:CE3	2.56	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	Perce	ntiles
1	A	$256/294\ (87\%)$	256 (100%)	0	0	100	100
1	В	249/294~(85%)	249 (100%)	0	0	100	100
All	All	505/588~(86%)	505 (100%)	0	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	216/264 (82%)	213 (99%)	3 (1%)	62 87
1	В	204/264 (77%)	201 (98%)	3 (2%)	60 86
All	All	420/528 (80%)	414 (99%)	6 (1%)	62 87

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	580	VAL
1	A	662	GLN
1	A	861	LEU
1	В	592	ILE
1	В	779	SER

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			- 0
Mol	Chain	Res	Type
1	В	814	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	853	GLN
1	В	605	ASN
1	В	680	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)

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 Lin		Link Bond lengths			Bond angles		
MIOI	Type	Chain	nes	5 LIIIK	Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	A1L6L	A	1001	-	45,52,52	1.80	12 (26%)	57,75,75	1.74	10 (17%)
2	A1L6L	В	901	-	45,52,52	1.78	11 (24%)	57,75,75	1.79	12 (21%)

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	A1L6L	A	1001	-	-	2/20/24/24	0/7/7/7
2	A1L6L	В	901	-	-	3/20/24/24	0/7/7/7

All (23) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	\mathbf{Z}	Observed(A)	$Ideal(\AA)$
2	В	901	A1L6L	C13-N14	5.14	1.46	1.35
2	A	1001	A1L6L	C13-N14	5.13	1.46	1.35
2	A	1001	A1L6L	C40-C32	4.27	1.53	1.46
2	В	901	A1L6L	C45-N44	-4.22	1.31	1.35
2	A	1001	A1L6L	C45-N44	-4.22	1.31	1.35
2	В	901	A1L6L	C40-C32	4.13	1.53	1.46
2	В	901	A1L6L	C12-N07	-3.28	1.33	1.41
2	В	901	A1L6L	O24-C25	3.18	1.41	1.36
2	A	1001	A1L6L	C12-N07	-3.17	1.33	1.41
2	A	1001	A1L6L	C31-C26	3.09	1.47	1.42
2	A	1001	A1L6L	O24-C25	2.93	1.40	1.36
2	В	901	A1L6L	C31-C26	2.76	1.47	1.42
2	A	1001	A1L6L	C31-C34	2.74	1.53	1.49
2	A	1001	A1L6L	C15-N14	2.56	1.46	1.41
2	A	1001	A1L6L	C08-N07	-2.51	1.32	1.38
2	В	901	A1L6L	C31-C34	2.51	1.53	1.49
2	A	1001	A1L6L	O17-C13	-2.49	1.18	1.23
2	В	901	A1L6L	C15-N14	2.49	1.46	1.41
2	В	901	A1L6L	C08-N07	-2.48	1.32	1.38
2	В	901	A1L6L	O17-C13	-2.47	1.18	1.23
2	В	901	A1L6L	C11-C12	-2.12	1.40	1.45
2	A	1001	A1L6L	C11-C12	-2.07	1.40	1.45
2	A	1001	A1L6L	C38-N41	2.01	1.45	1.38

All (22) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	$Observed(^o)$	$\mathbf{Ideal}(^{o})$
2	В	901	A1L6L	C42-N43-N44	6.24	110.73	104.23
2	A	1001	A1L6L	C42-N43-N44	6.19	110.68	104.23
2	A	1001	A1L6L	N28-C29-N30	-4.73	121.29	128.68
2	В	901	A1L6L	N28-C29-N30	-4.66	121.39	128.68
2	A	1001	A1L6L	C46-N44-N43	3.84	125.02	120.50
2	В	901	A1L6L	C46-N44-N43	3.82	125.00	120.50

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Mol	Chain	Res	Type	Atoms	\mathbf{Z}	$Observed(^o)$	$\operatorname{Ideal}({}^{o})$
2	В	901	A1L6L	C21-O24-C25	-3.45	111.36	118.16
2	В	901	A1L6L	C26-C27-N28	-3.41	119.32	124.89
2	В	901	A1L6L	C31-C26-C27	-3.41	104.82	107.54
2	A	1001	A1L6L	C31-C26-C27	-3.39	104.83	107.54
2	A	1001	A1L6L	C26-C27-N28	-3.28	119.54	124.89
2	A	1001	A1L6L	C29-N28-C27	3.27	121.10	113.45
2	В	901	A1L6L	C29-N28-C27	3.22	121.00	113.45
2	В	901	A1L6L	C29-N30-C25	3.11	120.81	115.88
2	A	1001	A1L6L	C29-N30-C25	3.03	120.69	115.88
2	A	1001	A1L6L	C32-C31-C26	-2.81	104.83	109.16
2	A	1001	A1L6L	O16-C12-C11	-2.68	119.12	124.95
2	В	901	A1L6L	O16-C12-C11	-2.67	119.14	124.95
2	В	901	A1L6L	C32-C31-C26	-2.66	105.05	109.16
2	A	1001	A1L6L	C21-O24-C25	-2.56	113.11	118.16
2	В	901	A1L6L	C12-C11-C13	-2.22	118.98	121.53
2	В	901	A1L6L	C05-C04-C03	-2.04	120.12	122.83

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	В	901	A1L6L	C26-C31-C34-C35
2	В	901	A1L6L	C26-C31-C34-C39
2	A	1001	A1L6L	C26-C31-C34-C35
2	A	1001	A1L6L	C26-C31-C34-C39
2	В	901	A1L6L	C32-C31-C34-C35

There are no ring outliers.

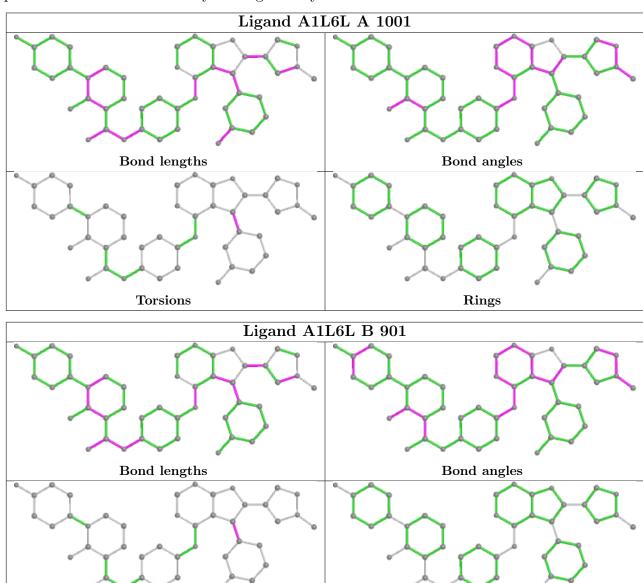
2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1001	A1L6L	1	0
2	В	901	A1L6L	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the



average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.



5.7 Other polymers (i)

There are no such residues in this entry.

Torsions

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.



Rings

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, 95^{th} 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	$\langle { m RSRZ} \rangle$	$\# \mathrm{RSRZ}{>}2$	$OWAB(A^2)$	Q<0.9
1	A	262/294 (89%)	0.15	7 (2%) 56 47	21, 39, 79, 92	0
1	В	259/294~(88%)	0.14	8 (3%) 51 43	21, 38, 80, 99	0
All	All	521/588 (88%)	0.15	15 (2%) 54 45	21, 39, 80, 99	0

All (15) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	В	690	THR	4.4
1	В	577	LEU	4.0
1	В	578	GLU	3.7
1	В	628	GLN	3.5
1	A	775	ARG	3.2
1	В	632	GLU	3.2
1	A	691	GLY	3.1
1	В	665	PRO	2.9
1	A	640	CYS	2.8
1	В	689	GLU	2.7
1	A	824	ASP	2.7
1	В	777	TYR	2.2
1	A	642	LYS	2.1
1	A	576	LYS	2.1
1	A	827	ASP	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 oligosaccharides in this entry.

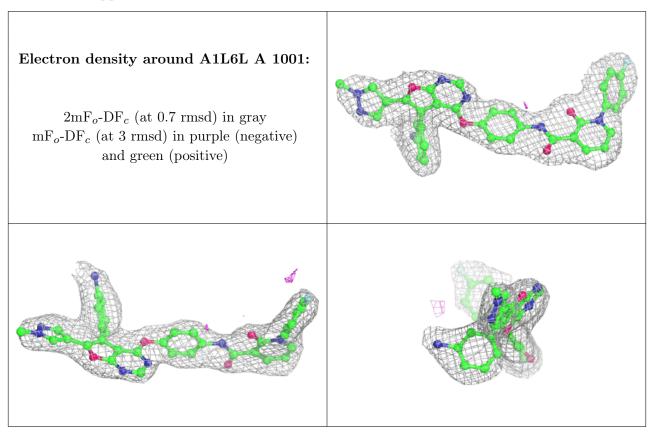


6.4 Ligands (i)

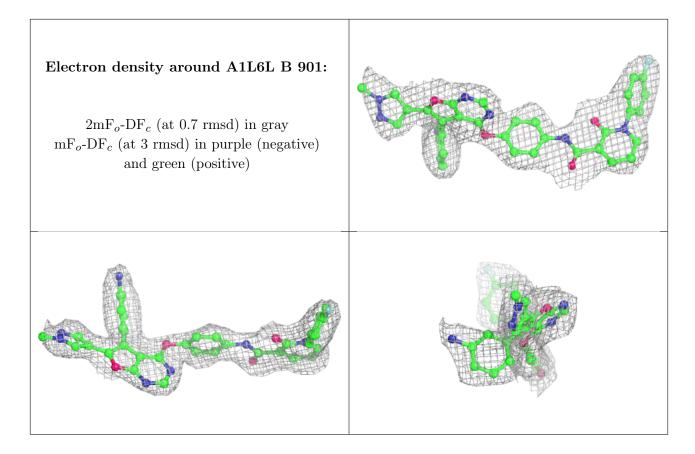
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	$\mathbf{B} ext{-}\mathbf{factors}(\mathbf{\mathring{A}}^2)$	Q < 0.9
2	A1L6L	A	1001	46/46	0.94	0.09	19,30,41,47	0
2	A1L6L	В	901	46/46	0.94	0.09	19,32,41,54	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.







6.5 Other polymers (i)

There are no such residues in this entry.

