



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 08:45 AM UTC

PDB ID : 7ZUJ / pdb_00007zuj
Title : PENICILLIN-BINDING PROTEIN 1B (PBP-1B) in complex with lactone
6Az - Streptococcus pneumoniae R6
Authors : Flanders, P.L.; Contreras-Martel, C.; Martins, A.; Brown, N.W.; Shirley, J.D.;
Nauta, K.M.; Dessen, A.; Carlson, E.E.; Ambrose, E.A.
Deposited on : 2022-05-12
Resolution : 1.55 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
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
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

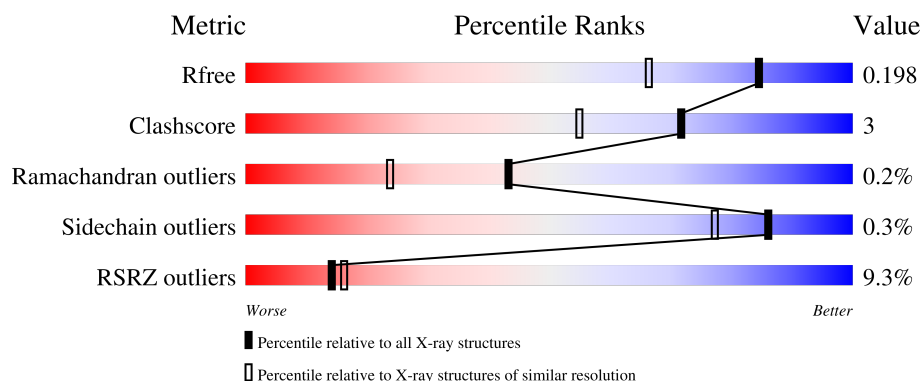
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.55 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	2145 (1.56-1.56)
Clashscore	190562	2189 (1.56-1.56)
Ramachandran outliers	187476	2153 (1.56-1.56)
Sidechain outliers	187428	2150 (1.56-1.56)
RSRZ outliers	180081	2146 (1.56-1.56)

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	AAA	821	5% 52% . 45%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	CL	AAA	926	-	-	X	-

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 4135 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.

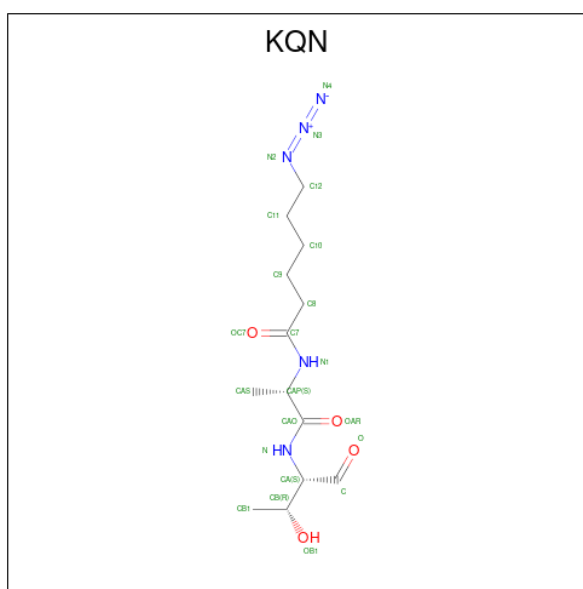
- Molecule 1 is a protein called Penicillin-binding protein 1b.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	AAA	454	Total	C	N	O	S	0	6	0
			3535	2215	603	702	15			

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
AAA	656	GLY	ASN	engineered mutation	UNP Q7CRA4
AAA	686	GLN	ARG	engineered mutation	UNP Q7CRA4
AAA	687	GLN	ARG	engineered mutation	UNP Q7CRA4

- Molecule 2 is 6-azido-N-[(2S)-1-oxidanylidene-1-[(2S,3R)-3-oxidanyl-1-oxidanylidene-butane-2-yl]amino]propan-2-yl]hexanamide (CCD ID: KQN) (formula: C₁₃H₂₃N₅O₄) (labeled as "Ligand of Interest" by depositor).

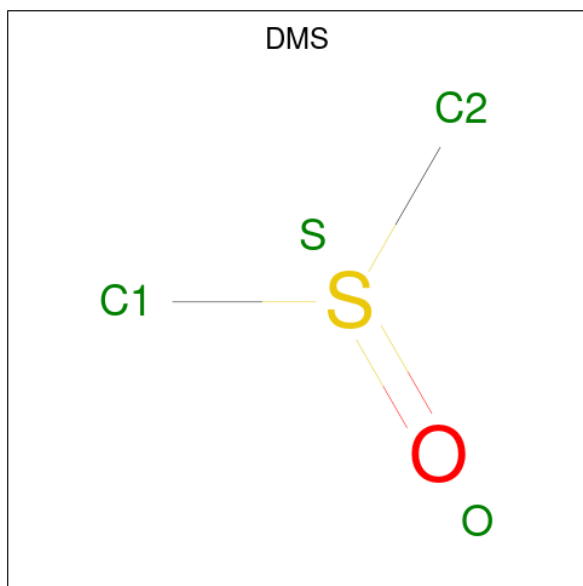


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	AAA	1	Total	C	N	O	0	0
			22	13	5	4		

- Molecule 3 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	AAA	25	Total	Cl	0	0
			25	25		

- Molecule 4 is DIMETHYL SULFOXIDE (CCD ID: DMS) (formula: C₂H₆OS).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	AAA	1	Total	C	O	S	0	0
			4	2	1	1		

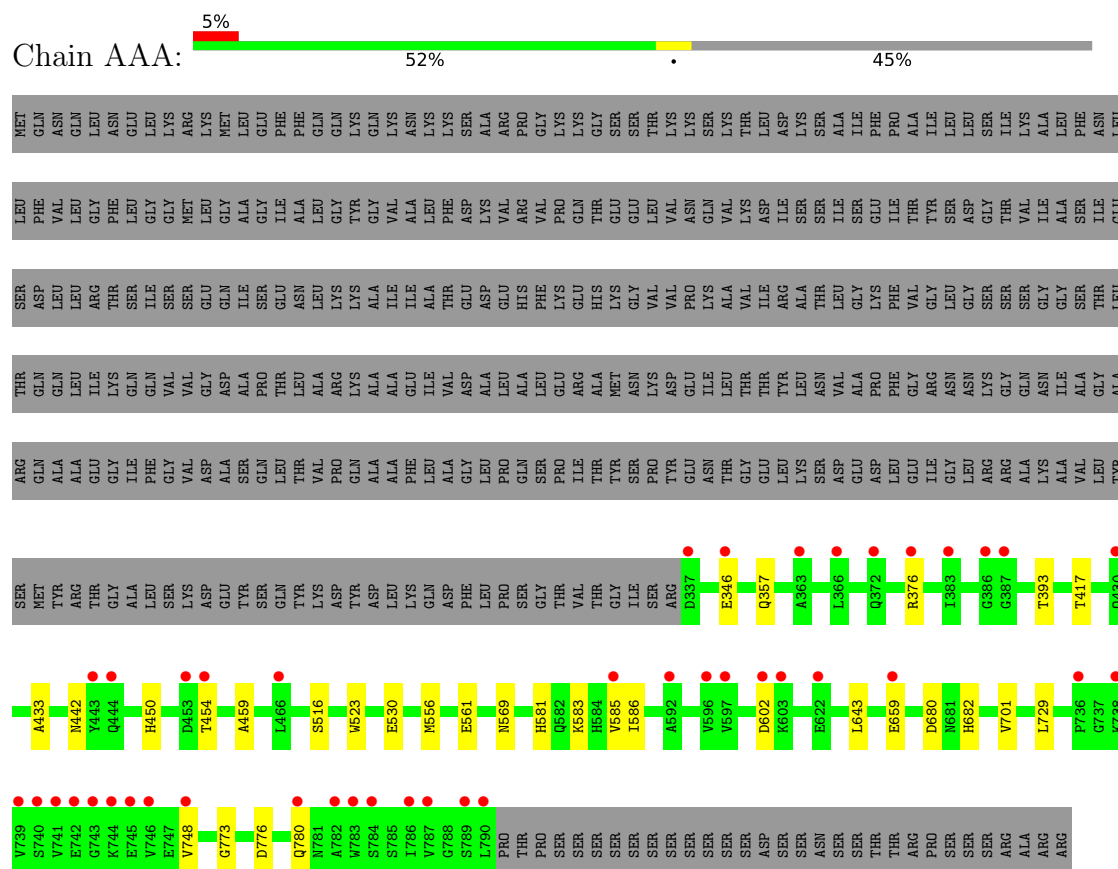
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	AAA	549	Total	O	0	0
			549	549		

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: Penicillin-binding protein 1b



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	96.31Å 149.05Å 98.83Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	44.16 – 1.55 44.16 – 1.55	Depositor EDS
% Data completeness (in resolution range)	99.4 (44.16-1.55) 99.4 (44.16-1.55)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.13	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.01 (at 1.55Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.165 , 0.190 0.172 , 0.198	Depositor DCC
R_{free} test set	2034 reflections (1.99%)	wwPDB-VP
Wilson B-factor (Å ²)	30.5	Xtriage
Anisotropy	0.286	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 50.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	4135	wwPDB-VP
Average B, all atoms (Å ²)	46.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.53% 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: CL, KQN, DMS

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	AAA	0.93	2/3626 (0.1%)	1.14	0/4920

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	AAA	780	GLN	C-O	7.02	1.32	1.24
1	AAA	776	ASP	C-O	5.05	1.29	1.24

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	AAA	3535	0	3430	23	0
2	AAA	22	0	0	0	0
3	AAA	25	0	0	2	0
4	AAA	4	0	6	1	0
5	AAA	549	0	0	4	1
All	All	4135	0	3436	23	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 3.

All (23) 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:AAA:659:GLU:HG3	3:AAA:926:CL:CL	2.19	0.79
1:AAA:680:ASP:OD1	1:AAA:682:HIS:HD2	1.69	0.76
1:AAA:417:THR:O	1:AAA:682:HIS:HE1	1.71	0.72
1:AAA:561:GLU:OE1	5:AAA:1002:HOH:O	2.09	0.70
1:AAA:581:HIS:HD2	1:AAA:602:ASP:OD1	1.74	0.70
1:AAA:346:GLU:HB3	1:AAA:586:ILE:HD12	1.76	0.67
1:AAA:569:ASN:HD21	1:AAA:583:LYS:H	1.41	0.66
1:AAA:569:ASN:ND2	1:AAA:583:LYS:H	1.95	0.64
1:AAA:659:GLU:CG	3:AAA:926:CL:CL	2.89	0.57
1:AAA:680:ASP:OD1	1:AAA:682:HIS:CD2	2.56	0.56
1:AAA:376[A]:ARG:NH2	5:AAA:1005:HOH:O	2.37	0.54
1:AAA:581:HIS:HE1	5:AAA:1324:HOH:O	1.89	0.53
1:AAA:450:HIS:HA	1:AAA:454:THR:OG1	2.09	0.53
1:AAA:393:THR:HB	1:AAA:433:ALA:HB1	1.93	0.49
1:AAA:585[B]:VAL:HG22	4:AAA:927:DMS:H21	1.95	0.49
1:AAA:417:THR:O	1:AAA:682:HIS:CE1	2.61	0.48
1:AAA:643:LEU:HD21	1:AAA:701:VAL:HG12	1.96	0.46
1:AAA:729:LEU:HD13	1:AAA:748:VAL:HG12	2.00	0.43
1:AAA:459:ALA:HA	1:AAA:556:MET:O	2.19	0.42
1:AAA:357:GLN:HG2	5:AAA:1132:HOH:O	2.20	0.41
1:AAA:346:GLU:HB3	1:AAA:586:ILE:CD1	2.47	0.41
1:AAA:523:TRP:CG	1:AAA:773:GLY:HA3	2.56	0.41

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)
5:AAA:1284:HOH:O	5:AAA:1413:HOH:O[8_545]	1.92	0.28

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	AAA	458/821 (56%)	448 (98%)	9 (2%)	1 (0%)	43 24

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	AAA	442	ASN

5.3.2 Protein sidechains ⓘ

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	AAA	378/679 (56%)	377 (100%)	1 (0%)	86 77

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	AAA	516	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry

Of 27 ligands modelled in this entry, 25 are monoatomic - leaving 2 for Mogul analysis.

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
4	DMS	AAA	927	-	3,3,3	0.25	0	3,3,3	0.15	0
2	KQN	AAA	901	1	20,21,21	1.19	2 (10%)	24,25,25	0.49	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	KQN	AAA	901	1	-	7/25/26/26	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	AAA	901	KQN	N4-N3	-4.49	1.14	1.23
2	AAA	901	KQN	N3-N2	2.60	1.29	1.23

There are no bond angle outliers.

There are no chirality outliers.

All (7) torsion outliers are listed below:

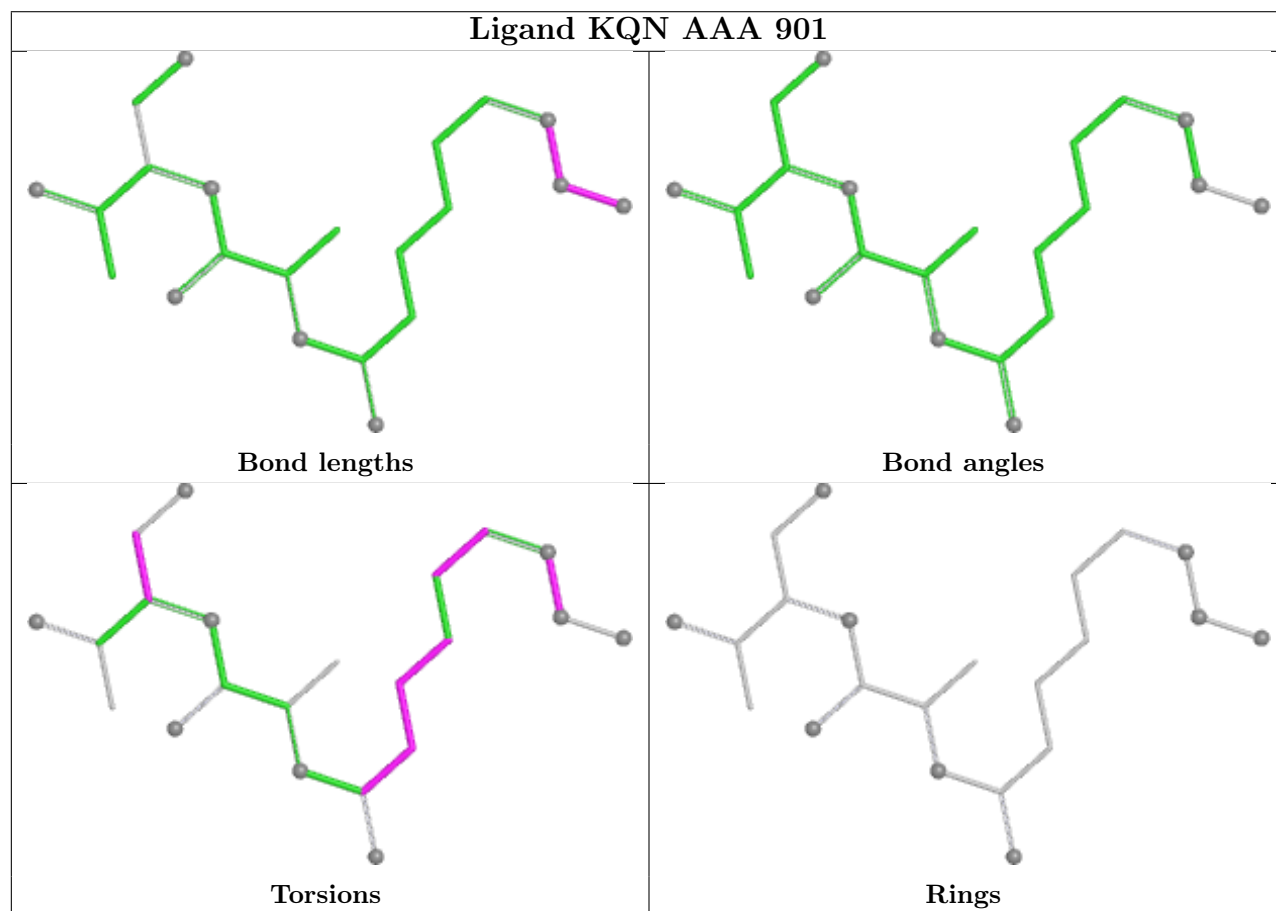
Mol	Chain	Res	Type	Atoms
2	AAA	901	KQN	O-C-CA-CB
2	AAA	901	KQN	C10-C11-C12-N2
2	AAA	901	KQN	C7-C8-C9-C10
2	AAA	901	KQN	C11-C10-C9-C8
2	AAA	901	KQN	C12-N2-N3-N4
2	AAA	901	KQN	OC7-C7-C8-C9
2	AAA	901	KQN	N1-C7-C8-C9

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	AAA	927	DMS	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 than 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.

5.8 Polymer linkage issues [i](#)

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	AAA	454/821 (55%)	0.84	42 (9%) 14 16	23, 40, 72, 120	6 (1%)

All (42) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	AAA	366	LEU	5.4
1	AAA	790	LEU	5.4
1	AAA	363	ALA	5.0
1	AAA	782	ALA	3.7
1	AAA	780	GLN	3.5
1	AAA	597	VAL	3.3
1	AAA	783	TRP	3.3
1	AAA	383	ILE	3.3
1	AAA	386	GLY	3.2
1	AAA	430	GLN	3.2
1	AAA	596	VAL	3.2
1	AAA	739	VAL	3.1
1	AAA	337	ASP	3.1
1	AAA	746	VAL	2.9
1	AAA	738	LYS	2.8
1	AAA	748	VAL	2.7
1	AAA	622	GLU	2.6
1	AAA	787	VAL	2.6
1	AAA	453	ASP	2.5
1	AAA	744	LYS	2.5
1	AAA	743	GLY	2.5
1	AAA	603	LYS	2.5
1	AAA	454	THR	2.4
1	AAA	745	GLU	2.4
1	AAA	736	PRO	2.4
1	AAA	387	GLY	2.3
1	AAA	592	ALA	2.3

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Mol	Chain	Res	Type	RSRZ
1	AAA	376[A]	ARG	2.3
1	AAA	585[A]	VAL	2.3
1	AAA	789	SER	2.3
1	AAA	443	TYR	2.3
1	AAA	602	ASP	2.2
1	AAA	741	VAL	2.2
1	AAA	346	GLU	2.2
1	AAA	466	LEU	2.2
1	AAA	786	ILE	2.1
1	AAA	372	GLN	2.1
1	AAA	659	GLU	2.1
1	AAA	444	GLN	2.0
1	AAA	742	GLU	2.0
1	AAA	740	SER	2.0
1	AAA	784	SER	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, 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	B-factors(Å ²)	Q<0.9
3	CL	AAA	925	1/1	0.88	0.18	62,62,62,62	0
3	CL	AAA	908	1/1	0.90	0.20	60,60,60,60	0
3	CL	AAA	926	1/1	0.90	0.19	57,57,57,57	0
3	CL	AAA	906	1/1	0.91	0.20	68,68,68,68	0
3	CL	AAA	909	1/1	0.91	0.16	63,63,63,63	0
2	KQN	AAA	901	22/22	0.92	0.17	34,43,134,171	0
4	DMS	AAA	927	4/4	0.92	0.20	50,52,52,57	0
3	CL	AAA	907	1/1	0.93	0.16	62,62,62,62	0

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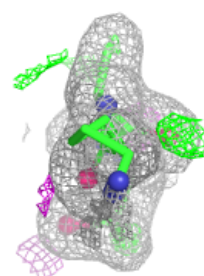
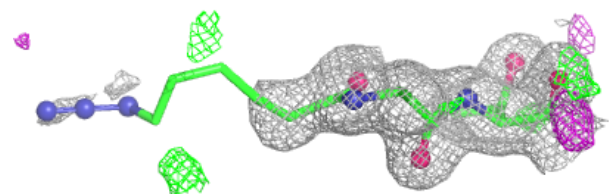
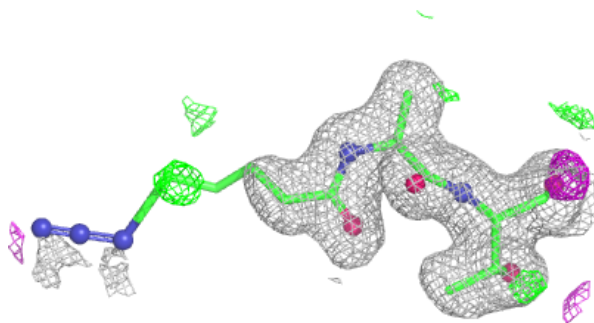
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
3	CL	AAA	902	1/1	0.93	0.20	47,47,47,47	0
3	CL	AAA	922	1/1	0.94	0.15	58,58,58,58	0
3	CL	AAA	918	1/1	0.94	0.14	65,65,65,65	0
3	CL	AAA	915	1/1	0.95	0.14	50,50,50,50	0
3	CL	AAA	917	1/1	0.95	0.17	52,52,52,52	0
3	CL	AAA	910	1/1	0.95	0.13	49,49,49,49	0
3	CL	AAA	920	1/1	0.95	0.19	54,54,54,54	0
3	CL	AAA	921	1/1	0.96	0.17	53,53,53,53	0
3	CL	AAA	905	1/1	0.96	0.12	51,51,51,51	0
3	CL	AAA	924	1/1	0.96	0.25	59,59,59,59	0
3	CL	AAA	914	1/1	0.97	0.20	50,50,50,50	0
3	CL	AAA	904	1/1	0.97	0.22	52,52,52,52	0
3	CL	AAA	919	1/1	0.97	0.12	59,59,59,59	0
3	CL	AAA	923	1/1	0.97	0.11	61,61,61,61	0
3	CL	AAA	913	1/1	0.98	0.11	47,47,47,47	0
3	CL	AAA	912	1/1	0.98	0.13	43,43,43,43	0
3	CL	AAA	916	1/1	0.99	0.06	37,37,37,37	1
3	CL	AAA	903	1/1	0.99	0.06	42,42,42,42	0
3	CL	AAA	911	1/1	0.99	0.06	42,42,42,42	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.

Electron density around KQN AAA 901:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



6.5 Other polymers [i](#)

There are no such residues in this entry.