



Full wwPDB X-ray Structure Validation Report ⓘ

Nov 7, 2023 – 02:22 AM EST

PDB ID : 6AT7
Title : Phenylalanine Ammonia-Lyase (PAL) from Sorghum bicolor
Authors : Jun, S.Y.; Kang, C.
Deposited on : 2017-08-28
Resolution : 2.49 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
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtrriage (Phenix) : 1.13
EDS : 2.36
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) : 2.36

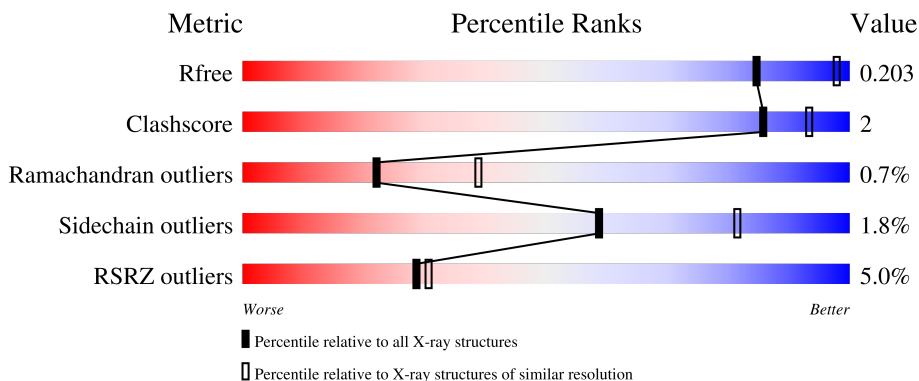
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

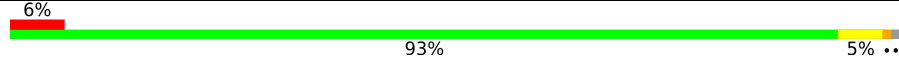
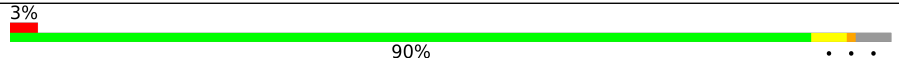
The reported resolution of this entry is 2.49 Å.

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	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)
RSRZ outliers	127900	4559 (2.50-2.50)

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	702	 6% 93% 5% ..
1	B	702	 3% 90% . . .

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 20689 atoms, of which 10059 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.

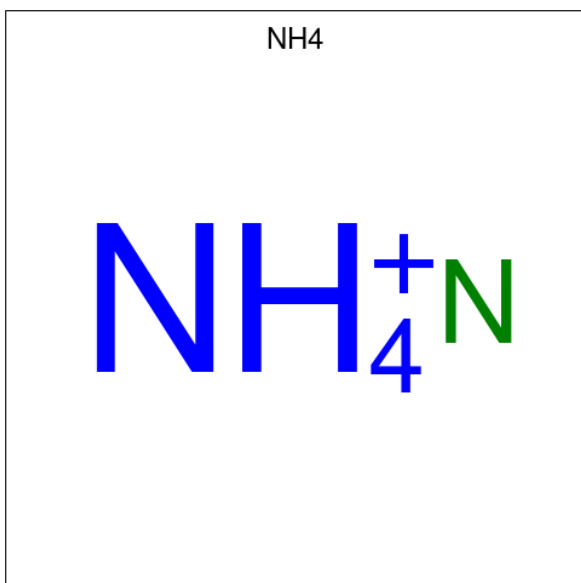
- Molecule 1 is a protein called Phenylalanine ammonia-lyase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
1	A	692	10273	3245	5109	907	992	20	0	0	0
1	B	672	9960	3152	4942	881	965	20	0	0	0

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	ALA	chromophore	UNP C5XXT8
A	?	-	SER	chromophore	UNP C5XXT8
A	190	MDO	GLY	chromophore	UNP C5XXT8
B	?	-	ALA	chromophore	UNP C5XXT8
B	?	-	SER	chromophore	UNP C5XXT8
B	190	MDO	GLY	chromophore	UNP C5XXT8

- Molecule 2 is AMMONIUM ION (three-letter code: NH4) (formula: H₄N).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	H	N	0	0
			5	4	1		
2	B	1	Total	H	N	0	0
			5	4	1		

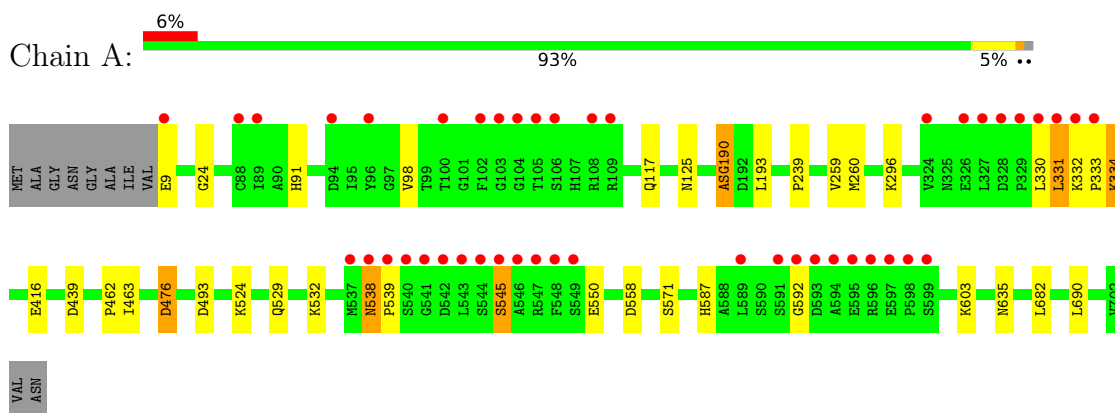
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	212	Total	O	0	0
			212	212		
3	B	234	Total	O	0	0
			234	234		

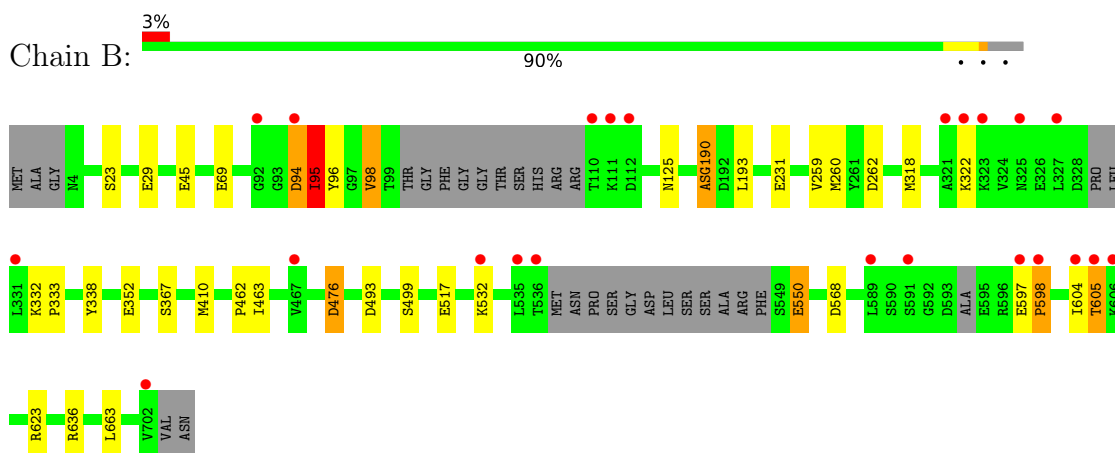
3 Residue-property plots

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: Phenylalanine ammonia-lyase



- Molecule 1: Phenylalanine ammonia-lyase



4 Data and refinement statistics

Property	Value	Source
Space group	I 41 2 2	Depositor
Cell constants a, b, c, α , β , γ	126.30Å 126.30Å 337.48Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	44.66 – 2.49 44.66 – 2.49	Depositor EDS
% Data completeness (in resolution range)	99.8 (44.66-2.49) 99.8 (44.66-2.49)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.78 (at 2.48Å)	Xtrriage
Refinement program	PHENIX (1.10.1_2155)	Depositor
R, R_{free}	0.160 , 0.202 0.161 , 0.203	Depositor DCC
R_{free} test set	2000 reflections (4.17%)	wwPDB-VP
Wilson B-factor (Å ²)	33.6	Xtrriage
Anisotropy	0.031	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 37.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	20689	wwPDB-VP
Average B, all atoms (Å ²)	41.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.14% 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: NH4, MDO

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	0.26	0/5236	0.44	1/7106 (0.0%)
1	B	0.26	0/5081	0.46	2/6890 (0.0%)
All	All	0.26	0/10317	0.45	3/13996 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	598	PRO	N-CA-CB	6.23	110.77	103.30
1	B	333	PRO	N-CA-CB	5.93	110.42	103.30
1	A	539	PRO	N-CA-CB	5.61	110.04	103.30

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	5164	5109	5124	24	0
1	B	5018	4942	4979	25	0
2	A	1	4	0	0	0
2	B	1	4	0	0	0
3	A	212	0	0	4	0
3	B	234	0	0	7	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	10630	10059	10103	44	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 2.

All (44) 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:95:ILE:HB	1:B:98:VAL:HG22	1.44	0.99
1:B:532:LYS:NZ	1:B:550:GLU:OE1	2.15	0.79
1:A:690:LEU:O	3:A:901:HOH:O	2.01	0.77
1:B:623:ARG:NH2	3:B:907:HOH:O	2.21	0.73
1:A:333:PRO:O	1:B:96:TYR:OH	2.03	0.70
1:A:190:MDO:O3	1:A:193:LEU:N	2.26	0.68
1:B:69:GLU:OE2	3:B:901:HOH:O	2.11	0.68
1:B:517:GLU:OE2	1:B:636:ARG:NH2	2.27	0.68
1:B:352:GLU:OE1	3:B:902:HOH:O	2.12	0.67
1:B:262:ASP:OD1	3:B:903:HOH:O	2.12	0.66
1:A:334:LYS:N	1:A:334:LYS:HD3	2.14	0.63
1:A:545:SER:O	1:A:587:HIS:NE2	2.33	0.62
1:B:190:MDO:O3	1:B:193:LEU:N	2.34	0.60
1:A:334:LYS:HD3	1:A:334:LYS:H	1.66	0.60
1:B:231:GLU:O	3:B:904:HOH:O	2.17	0.59
1:A:117:GLN:NE2	1:A:239:PRO:O	2.40	0.55
1:A:476:ASP:OD1	1:A:476:ASP:N	2.42	0.53
1:A:538:ASN:CB	1:A:603:LYS:HD3	2.39	0.52
1:A:332:LYS:HA	1:A:334:LYS:HE2	1.91	0.51
1:A:635:ASN:OD1	3:A:902:HOH:O	2.19	0.51
1:A:24:GLY:N	3:A:904:HOH:O	2.23	0.51
1:B:259:VAL:HG12	1:B:260:MET:HE2	1.94	0.50
1:A:259:VAL:HG12	1:A:260:MET:HE2	1.92	0.50
1:A:462:PRO:HD3	1:B:462:PRO:HD3	1.95	0.49
1:A:98:VAL:HG13	1:A:239:PRO:HB3	1.95	0.48
1:B:95:ILE:CB	1:B:98:VAL:HG22	2.31	0.48
1:B:29:GLU:OE2	3:B:905:HOH:O	2.20	0.47
1:B:95:ILE:H	1:B:95:ILE:HD13	1.78	0.47
1:B:95:ILE:H	1:B:95:ILE:CD1	2.29	0.46
1:A:532:LYS:NZ	1:A:550:GLU:OE2	2.49	0.46
1:A:330:LEU:O	1:A:331:LEU:CB	2.66	0.44
1:A:524:LYS:NZ	1:A:558:ASP:OD1	2.43	0.44
1:A:439:ASP:O	3:A:903:HOH:O	2.21	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:95:ILE:CG2	1:B:98:VAL:HG13	2.48	0.43
1:B:410:MET:HE1	1:B:499:SER:N	2.34	0.43
1:B:568:ASP:OD1	3:B:906:HOH:O	2.21	0.43
1:A:332:LYS:N	1:A:333:PRO:CD	2.82	0.43
1:A:9:GLU:OE1	1:A:9:GLU:HA	2.19	0.42
1:A:190:MDO:HB21	1:B:338:TYR:OH	2.20	0.42
1:B:604:ILE:HG23	1:B:605:THR:H	1.83	0.42
1:B:94:ASP:O	1:B:95:ILE:C	2.58	0.42
1:A:416:GLU:OE2	1:B:476:ASP:OD2	2.38	0.41
1:A:296:LYS:HA	1:B:367:SER:HB2	2.03	0.41
1:B:318:MET:O	1:B:322:LYS:HG2	2.20	0.41

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	687/702 (98%)	661 (96%)	22 (3%)	4 (1%)	25	43
1	B	659/702 (94%)	640 (97%)	13 (2%)	6 (1%)	17	31
All	All	1346/1404 (96%)	1301 (97%)	35 (3%)	10 (1%)	22	39

All (10) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	598	PRO
1	A	592	GLY
1	B	95	ILE
1	B	94	ASP
1	B	605	THR
1	A	538	ASN
1	A	331	LEU

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Mol	Chain	Res	Type
1	A	545	SER
1	B	332	LYS
1	B	597	GLU

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	538/569 (95%)	529 (98%)	9 (2%)	60	82
1	B	524/569 (92%)	514 (98%)	10 (2%)	57	80
All	All	1062/1138 (93%)	1043 (98%)	19 (2%)	59	81

All (19) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	91	HIS
1	A	125	ASN
1	A	334	LYS
1	A	463	ILE
1	A	476	ASP
1	A	493	ASP
1	A	529	GLN
1	A	571	SER
1	A	682	LEU
1	B	23	SER
1	B	45	GLU
1	B	95	ILE
1	B	98	VAL
1	B	125	ASN
1	B	463	ILE
1	B	476	ASP
1	B	493	ASP
1	B	550	GLU
1	B	663	LEU

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

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

2 non-standard protein/DNA/RNA residues 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
1	MDO	A	190	1	12,13,14	3.34	6 (50%)	15,18,20	3.10	6 (40%)
1	MDO	B	190	1	12,13,14	3.50	7 (58%)	15,18,20	3.32	5 (33%)

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	MDO	A	190	1	-	0/4/23/24	0/1/1/1
1	MDO	B	190	1	-	0/4/23/24	0/1/1/1

All (13) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	190	MDO	C1-N2	7.44	1.43	1.32
1	A	190	MDO	C1-N2	7.03	1.42	1.32
1	B	190	MDO	CA2-C2	5.50	1.54	1.43
1	A	190	MDO	CA2-C2	5.42	1.54	1.43
1	B	190	MDO	C1-N3	5.27	1.46	1.37
1	A	190	MDO	C1-N3	5.22	1.46	1.37
1	B	190	MDO	C2-N3	3.31	1.47	1.39

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	190	MDO	C2-N3	3.15	1.47	1.39
1	B	190	MDO	CA2-N2	2.52	1.43	1.39
1	B	190	MDO	O2-C2	-2.27	1.18	1.23
1	B	190	MDO	CA1-C1	2.26	1.54	1.51
1	A	190	MDO	O2-C2	-2.25	1.18	1.23
1	A	190	MDO	CA2-N2	2.19	1.43	1.39

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	190	MDO	CA2-C2-N3	8.39	107.34	103.37
1	A	190	MDO	CA2-C2-N3	7.69	107.01	103.37
1	B	190	MDO	O2-C2-CA2	-5.70	127.76	130.96
1	A	190	MDO	O2-C2-CA2	-5.47	127.89	130.96
1	B	190	MDO	CA2-N2-C1	4.84	109.78	105.40
1	A	190	MDO	CA2-N2-C1	4.52	109.49	105.40
1	B	190	MDO	C2-CA2-N2	-4.22	105.97	108.93
1	A	190	MDO	C2-CA2-N2	-3.62	106.39	108.93
1	A	190	MDO	C2-N3-C1	-3.33	106.28	107.97
1	B	190	MDO	C2-N3-C1	-3.24	106.33	107.97
1	A	190	MDO	CA3-N3-C1	2.44	130.09	127.16

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	190	MDO	2	0
1	B	190	MDO	1	0

5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 2 ligands modelled in this entry, 2 are modelled with single atom - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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	A	691/702 (98%)	-0.09	45 (6%) 18 19	18, 34, 102, 165	0
1	B	671/702 (95%)	-0.19	23 (3%) 45 48	18, 32, 78, 124	0
All	All	1362/1404 (97%)	-0.14	68 (4%) 28 30	18, 33, 89, 165	0

All (68) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	541	GLY	10.5
1	A	543	LEU	8.7
1	B	605	THR	7.4
1	A	542	ASP	7.3
1	A	544	SER	7.2
1	A	332	LYS	6.6
1	B	536	THR	6.5
1	A	539	PRO	6.2
1	A	547	ARG	5.9
1	B	110	THR	5.8
1	A	329	PRO	5.8
1	A	540	SER	5.8
1	A	105	THR	5.7
1	A	538	ASN	5.7
1	A	104	GLY	5.3
1	B	327	LEU	4.6
1	B	331	LEU	4.6
1	A	596	ARG	4.6
1	A	333	PRO	4.4
1	A	598	PRO	4.4
1	A	594	ALA	4.3
1	A	9	GLU	4.2
1	A	595	GLU	4.1
1	A	327	LEU	3.9

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Mol	Chain	Res	Type	RSRZ
1	B	323	LYS	3.9
1	A	331	LEU	3.8
1	A	106	SER	3.8
1	B	321	ALA	3.7
1	A	548	PHE	3.6
1	B	322	LYS	3.6
1	B	606	LYS	3.5
1	A	599	SER	3.5
1	A	589	LEU	3.5
1	A	330	LEU	3.3
1	A	593	ASP	3.3
1	B	597	GLU	3.2
1	A	597	GLU	3.2
1	A	537	MET	3.1
1	B	589	LEU	3.1
1	A	100	THR	3.1
1	A	546	ALA	3.1
1	A	89	ILE	3.1
1	B	604	ILE	3.0
1	A	591	SER	2.9
1	A	88	CYS	2.9
1	B	92	GLY	2.8
1	A	326	GLU	2.8
1	B	535	LEU	2.8
1	A	96	TYR	2.6
1	A	545	SER	2.6
1	A	549	SER	2.6
1	A	102	PHE	2.6
1	B	111	LYS	2.5
1	B	598	PRO	2.5
1	B	591	SER	2.5
1	B	702	VAL	2.5
1	A	103	GLY	2.5
1	A	328	ASP	2.4
1	B	94	ASP	2.4
1	B	467	VAL	2.2
1	B	325	ASN	2.2
1	A	324	VAL	2.2
1	A	94	ASP	2.1
1	A	592	GLY	2.1
1	B	112	ASP	2.0
1	A	109	ARG	2.0

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Mol	Chain	Res	Type	RSRZ
1	B	532	LYS	2.0
1	A	108	ARG	2.0

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. 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
1	MDO	B	190	13/14	0.89	0.23	24,30,33,37	0
1	MDO	A	190	13/14	0.92	0.19	24,31,37,42	0

6.3 Carbohydrates [i](#)

There are no monosaccharides 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
2	NH4	B	801	1/1	0.86	0.49	46,55,55,55	0
2	NH4	A	801	1/1	0.88	0.51	52,62,62,62	0

6.5 Other polymers [i](#)

There are no such residues in this entry.