



wwPDB X-ray Structure Validation Summary Report ⓘ

Nov 5, 2017 – 10:51 AM EST

PDB ID : 4EA3
Title : Structure of the N/OFQ Opioid Receptor in Complex with a Peptide Mimetic
Authors : Thompson, A.A.; Liu, W.; Chun, E.; Katritch, V.; Wu, H.; Vardy, E.; Huang, X.P.; Trapella, C.; Guerrini, R.; Calo, G.; Roth, B.L.; Cherezov, V.; Stevens, R.C.; GPCR Network (GPCR)
Deposited on : unknown
Resolution : 3.01 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 : rb-20030345
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) : rb-20030345

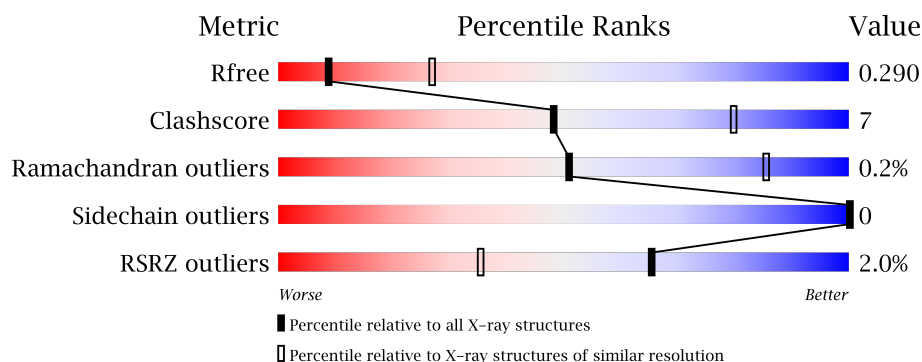
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.01 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	1924 (3.04-3.00)
Clashscore	112137	2279 (3.04-3.00)
Ramachandran outliers	110173	2207 (3.04-3.00)
Sidechain outliers	110143	2210 (3.04-3.00)
RSRZ outliers	101464	1948 (3.04-3.00)

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	434	<div> <div>2%</div> <div>56%</div> <div>8%</div> <div>36%</div> </div>
1	B	434	<div> <div>%</div> <div>77%</div> <div>9%</div> <div>13%</div> </div>

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	OLB	A	1502	-	-	-	X
4	OLA	A	1503	-	-	-	X

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 5130 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 Fusion protein of Nociceptin receptor and cytochrome b562.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	278	Total	C	N	O	S	0	0	0
			2113	1391	343	362	17			
1	B	376	Total	C	N	O	S	0	0	0
			2894	1887	475	513	19			

There are 68 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	991	ASP	-	EXPRESSION TAG	UNP P0ABE7
A	992	TYR	-	EXPRESSION TAG	UNP P0ABE7
A	993	LYS	-	EXPRESSION TAG	UNP P0ABE7
A	994	ASP	-	EXPRESSION TAG	UNP P0ABE7
A	995	ASP	-	EXPRESSION TAG	UNP P0ABE7
A	996	ASP	-	EXPRESSION TAG	UNP P0ABE7
A	997	ASP	-	EXPRESSION TAG	UNP P0ABE7
A	998	GLY	-	EXPRESSION TAG	UNP P0ABE7
A	999	ALA	-	EXPRESSION TAG	UNP P0ABE7
A	1000	PRO	-	EXPRESSION TAG	UNP P0ABE7
A	1007	TRP	MET	ENGINEERED MUTATION	UNP P0ABE7
A	1102	ILE	HIS	ENGINEERED MUTATION	UNP P0ABE7
A	1106	LEU	ARG	ENGINEERED MUTATION	UNP P0ABE7
A	340	GLY	-	EXPRESSION TAG	UNP P41146
A	341	ARG	-	EXPRESSION TAG	UNP P41146
A	342	PRO	-	EXPRESSION TAG	UNP P41146
A	343	LEU	-	EXPRESSION TAG	UNP P41146
A	344	GLU	-	EXPRESSION TAG	UNP P41146
A	345	VAL	-	EXPRESSION TAG	UNP P41146
A	346	LEU	-	EXPRESSION TAG	UNP P41146
A	347	PHE	-	EXPRESSION TAG	UNP P41146
A	348	GLN	-	EXPRESSION TAG	UNP P41146
A	349	GLY	-	EXPRESSION TAG	UNP P41146
A	350	PRO	-	EXPRESSION TAG	UNP P41146
A	351	HIS	-	EXPRESSION TAG	UNP P41146

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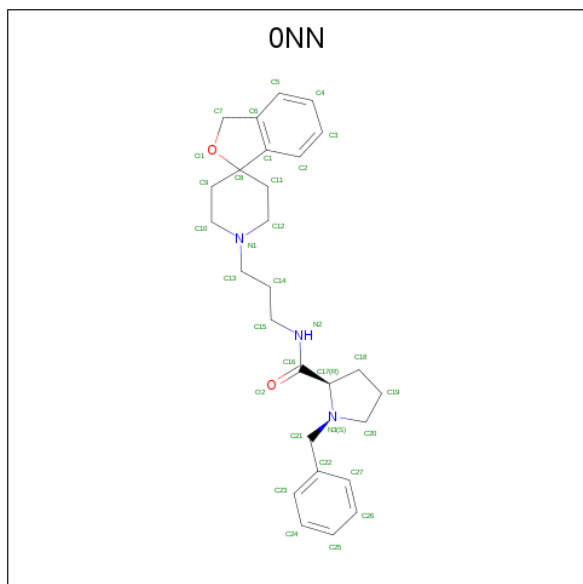
Chain	Residue	Modelled	Actual	Comment	Reference
A	352	HIS	-	EXPRESSION TAG	UNP P41146
A	353	HIS	-	EXPRESSION TAG	UNP P41146
A	354	HIS	-	EXPRESSION TAG	UNP P41146
A	355	HIS	-	EXPRESSION TAG	UNP P41146
A	356	HIS	-	EXPRESSION TAG	UNP P41146
A	357	HIS	-	EXPRESSION TAG	UNP P41146
A	358	HIS	-	EXPRESSION TAG	UNP P41146
A	359	HIS	-	EXPRESSION TAG	UNP P41146
A	360	HIS	-	EXPRESSION TAG	UNP P41146
B	991	ASP	-	EXPRESSION TAG	UNP P0ABE7
B	992	TYR	-	EXPRESSION TAG	UNP P0ABE7
B	993	LYS	-	EXPRESSION TAG	UNP P0ABE7
B	994	ASP	-	EXPRESSION TAG	UNP P0ABE7
B	995	ASP	-	EXPRESSION TAG	UNP P0ABE7
B	996	ASP	-	EXPRESSION TAG	UNP P0ABE7
B	997	ASP	-	EXPRESSION TAG	UNP P0ABE7
B	998	GLY	-	EXPRESSION TAG	UNP P0ABE7
B	999	ALA	-	EXPRESSION TAG	UNP P0ABE7
B	1000	PRO	-	EXPRESSION TAG	UNP P0ABE7
B	1007	TRP	MET	ENGINEERED MUTATION	UNP P0ABE7
B	1102	ILE	HIS	ENGINEERED MUTATION	UNP P0ABE7
B	1106	LEU	ARG	ENGINEERED MUTATION	UNP P0ABE7
B	340	GLY	-	EXPRESSION TAG	UNP P41146
B	341	ARG	-	EXPRESSION TAG	UNP P41146
B	342	PRO	-	EXPRESSION TAG	UNP P41146
B	343	LEU	-	EXPRESSION TAG	UNP P41146
B	344	GLU	-	EXPRESSION TAG	UNP P41146
B	345	VAL	-	EXPRESSION TAG	UNP P41146
B	346	LEU	-	EXPRESSION TAG	UNP P41146
B	347	PHE	-	EXPRESSION TAG	UNP P41146
B	348	GLN	-	EXPRESSION TAG	UNP P41146
B	349	GLY	-	EXPRESSION TAG	UNP P41146
B	350	PRO	-	EXPRESSION TAG	UNP P41146
B	351	HIS	-	EXPRESSION TAG	UNP P41146
B	352	HIS	-	EXPRESSION TAG	UNP P41146
B	353	HIS	-	EXPRESSION TAG	UNP P41146
B	354	HIS	-	EXPRESSION TAG	UNP P41146
B	355	HIS	-	EXPRESSION TAG	UNP P41146
B	356	HIS	-	EXPRESSION TAG	UNP P41146
B	357	HIS	-	EXPRESSION TAG	UNP P41146
B	358	HIS	-	EXPRESSION TAG	UNP P41146
B	359	HIS	-	EXPRESSION TAG	UNP P41146

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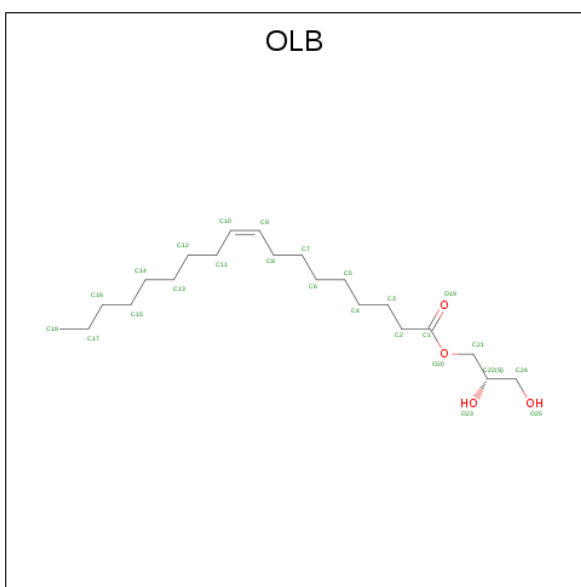
Chain	Residue	Modelled	Actual	Comment	Reference
B	360	HIS	-	EXPRESSION TAG	UNP P41146

- Molecule 2 is 1-benzyl-N-[3-(1'H,3H-spiro[2-benzofuran-1,4'-piperidin]-1'-yl)propyl]-D-prolin amide (three-letter code: ONN) (formula: C₂₇H₃₅N₃O₂).



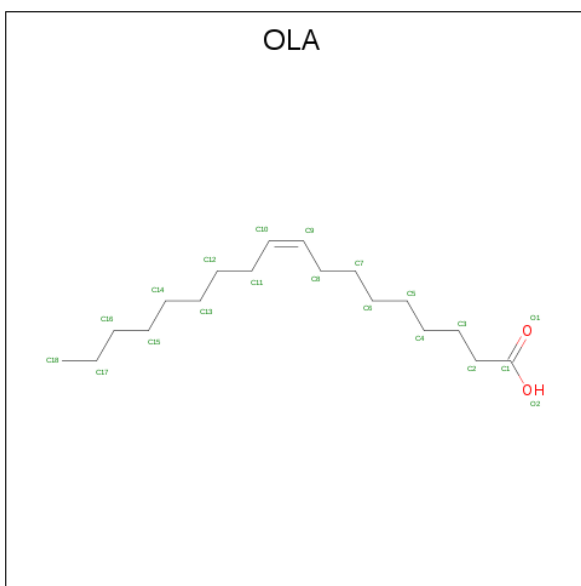
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			32	27	3	2		
2	B	1	Total	C	N	O	0	0
			32	27	3	2		

- Molecule 3 is (2S)-2,3-dihydroxypropyl (9Z)-octadec-9-enoate (three-letter code: OLB) (formula: C₂₁H₄₀O₄).



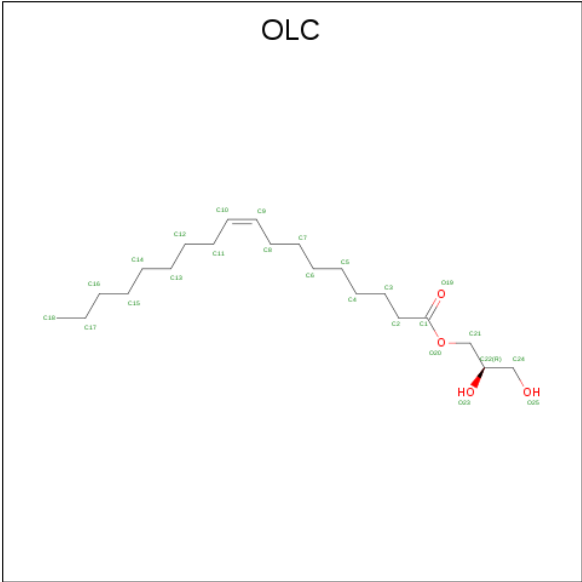
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			15	11	4		

- Molecule 4 is OLEIC ACID (three-letter code: OLA) (formula: $C_{18}H_{34}O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			20	18	2		

- Molecule 5 is (2R)-2,3-dihydroxypropyl (9Z)-octadec-9-enoate (three-letter code: OLC) (formula: $C_{21}H_{40}O_4$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	B	1	Total	C	O	0	0
			16	12	4		

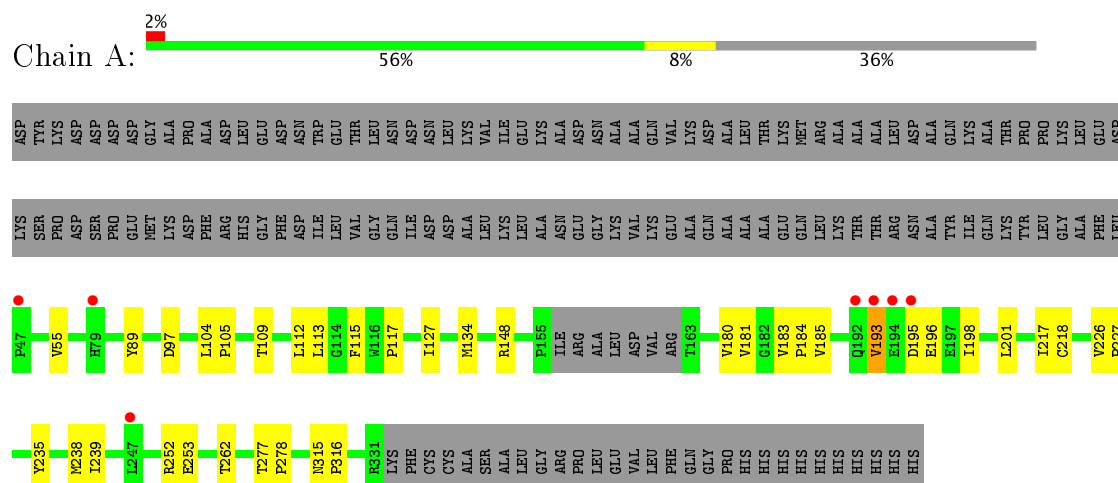
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	6	Total	O	0	0
			6	6		
6	B	2	Total	O	0	0
			2	2		

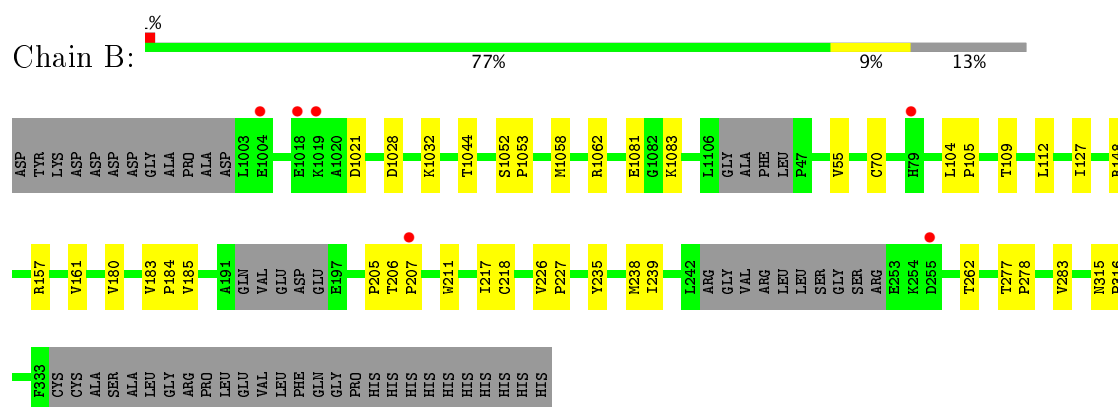
3 Residue-property plots [i](#)

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: Fusion protein of Nociceptin receptor and cytochrome b562



- Molecule 1: Fusion protein of Nociceptin receptor and cytochrome b562



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	42.11Å 170.94Å 65.35Å 90.00° 103.14° 90.00°	Depositor
Resolution (Å)	32.02 – 3.01 32.02 – 3.01	Depositor EDS
% Data completeness (in resolution range)	93.1 (32.02-3.01) 93.2 (32.02-3.01)	Depositor EDS
R_{merge}	0.19	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.11 (at 3.00Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.7.3_928)	Depositor
R, R_{free}	0.248 , 0.288 0.244 , 0.290	Depositor DCC
R_{free} test set	845 reflections (5.12%)	DCC
Wilson B-factor (Å ²)	58.8	Xtriage
Anisotropy	0.244	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 66.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	5130	wwPDB-VP
Average B, all atoms (Å ²)	71.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.42% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: OLA, OLB, OLC, 0NN

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	0.22	0/2159	0.39	0/2950
1	B	0.21	0/2950	0.38	0/4015
All	All	0.22	0/5109	0.38	0/6965

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

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	2113	0	2167	36	0
1	B	2894	0	2978	30	0
2	A	32	0	35	3	0
2	B	32	0	35	5	0
3	A	15	0	19	1	0
4	A	20	0	33	8	0
5	B	16	0	21	0	0
6	A	6	0	0	1	0
6	B	2	0	0	0	0
All	All	5130	0	5288	72	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 7.

The worst 5 of 72 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:157:ARG:O	1:B:161:VAL:HG23	1.77	0.83
1:A:193:VAL:O	1:A:193:VAL:HG13	1.87	0.74
1:B:1028:ASP:OD2	1:B:1032:LYS:NZ	2.31	0.63
1:A:201:LEU:HA	2:A:1501:0NN:H30	1.81	0.62
1:A:113:LEU:HD12	1:A:117:PRO:HG3	1.86	0.58

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	274/434 (63%)	261 (95%)	12 (4%)	1 (0%)	38	76
1	B	368/434 (85%)	354 (96%)	14 (4%)	0	100	100
All	All	642/868 (74%)	615 (96%)	26 (4%)	1 (0%)	51	85

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	193	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	228/365 (62%)	228 (100%)	0	100	100
1	B	312/365 (86%)	312 (100%)	0	100	100
All	All	540/730 (74%)	540 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Some 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 carbohydrates in this entry.

5.6 Ligand geometry ⓘ

5 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	0NN	A	1501	-	34,36,36	3.14	9 (26%)	43,50,50	1.14	5 (11%)
3	OLB	A	1502	-	14,14,24	1.21	1 (7%)	15,15,25	1.01	1 (6%)
4	OLA	A	1503	-	16,19,19	0.22	0	15,19,19	0.60	0
2	0NN	B	1501	-	34,36,36	3.17	11 (32%)	43,50,50	1.12	4 (9%)
5	OLC	B	1502	-	15,15,24	1.15	1 (6%)	16,16,25	1.02	1 (6%)

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	0NN	A	1501	-	-	0/15/49/49	0/5/5/5
3	OLB	A	1502	-	-	0/14/14/24	0/0/0/0
4	OLA	A	1503	-	-	0/15/17/17	0/0/0/0
2	0NN	B	1501	-	-	0/15/49/49	0/5/5/5
5	OLC	B	1502	-	-	0/15/15/24	0/0/0/0

The worst 5 of 22 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1501	0NN	O1-C7	-2.56	1.39	1.43
2	A	1501	0NN	O1-C7	-2.49	1.40	1.43
2	B	1501	0NN	C11-C8	-2.44	1.50	1.53
2	A	1501	0NN	C18-C17	-2.38	1.48	1.53
2	B	1501	0NN	C18-C17	-2.24	1.48	1.53

The worst 5 of 11 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1501	0NN	C7-C6-C1	-2.29	107.64	108.83
2	B	1501	0NN	C10-C9-C8	2.16	113.62	111.94
2	A	1501	0NN	C12-C11-C8	2.20	113.64	111.94
2	A	1501	0NN	C16-C17-N3	2.28	115.37	112.36
2	A	1501	0NN	C17-C16-N2	2.57	121.12	116.05

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

4 monomers are involved in 17 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1501	0NN	3	0
3	A	1502	OLB	1	0
4	A	1503	OLA	8	0
2	B	1501	0NN	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	278/434 (64%)	-0.35	7 (2%) 58 28	39, 59, 141, 174	0
1	B	376/434 (86%)	-0.24	6 (1%) 72 43	31, 69, 113, 156	0
All	All	654/868 (75%)	-0.29	13 (1%) 65 35	31, 63, 124, 174	0

The worst 5 of 13 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	193	VAL	5.1
1	A	194	GLU	3.5
1	B	1004	GLU	3.5
1	B	79	HIS	3.4
1	A	195	ASP	2.7

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 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
3	OLB	A	1502	15/25	0.81	0.32	5.09	76,91,96,96	0
4	OLA	A	1503	20/20	0.79	0.34	3.45	46,69,91,94	0
2	0NN	A	1501	32/32	0.95	0.20	1.71	50,61,79,81	0
2	0NN	B	1501	32/32	0.93	0.21	0.68	50,60,70,71	0
5	OLC	B	1502	16/25	0.89	0.21	0.62	48,59,62,63	0

6.5 Other polymers [i](#)

There are no such residues in this entry.