



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 9, 2017 – 01:49 PM EDT

PDB ID : 2HM1
Title : Crystal Structure of human beta-secretase (BACE) in the presence of an inhibitor (2)
Authors : Benson, T.E.; Prince, D.B.; Tomasselli, A.G.; Emmons, T.L.; Paddock, D.J.
Deposited on : unknown
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 : 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

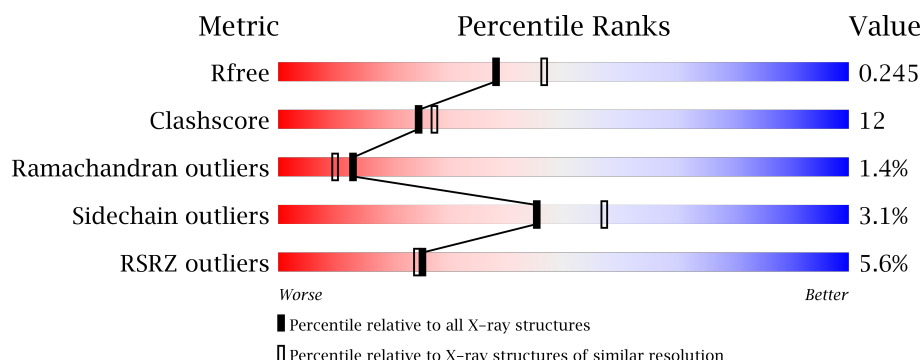
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 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	406	<div> <div>5%</div> <div>69%</div> <div>21%</div> <div>8%</div> </div>

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3165 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.

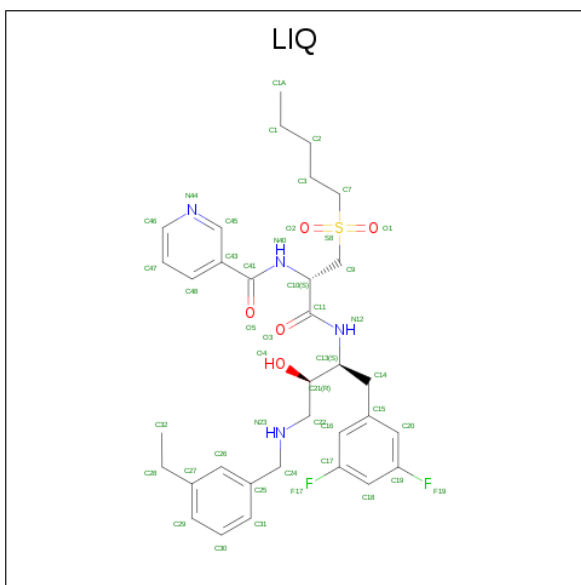
- Molecule 1 is a protein called Beta-secretase 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	375	2952	1894	490	554	14	0	0	0

There are 9 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	58P	MET	-	CLONING ARTIFACT	UNP P56817
A	393	ARG	-	CLONING ARTIFACT	UNP P56817
A	394	SER	-	CLONING ARTIFACT	UNP P56817
A	395	HIS	-	EXPRESSION TAG	UNP P56817
A	396	HIS	-	EXPRESSION TAG	UNP P56817
A	397	HIS	-	EXPRESSION TAG	UNP P56817
A	398	HIS	-	EXPRESSION TAG	UNP P56817
A	399	HIS	-	EXPRESSION TAG	UNP P56817
A	400	HIS	-	EXPRESSION TAG	UNP P56817

- Molecule 2 is N-{(1S)-2-({(1S,2R)-1-(3,5-DIFLUOROBENZYL)-3-[(3-ETHYLBENZYL)AMINO]-2-HYDROXYPROPYL}AMINO)-2-OXO-1-[(PENTYLSULFONYL)METHYL]ETHYL}NICOTINAMIDE (three-letter code: LIQ) (formula: C₃₃H₄₂F₂N₄O₅S).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
2	A	1	Total	C	F	N	O	S	0	0
			45	33	2	4	5	1		

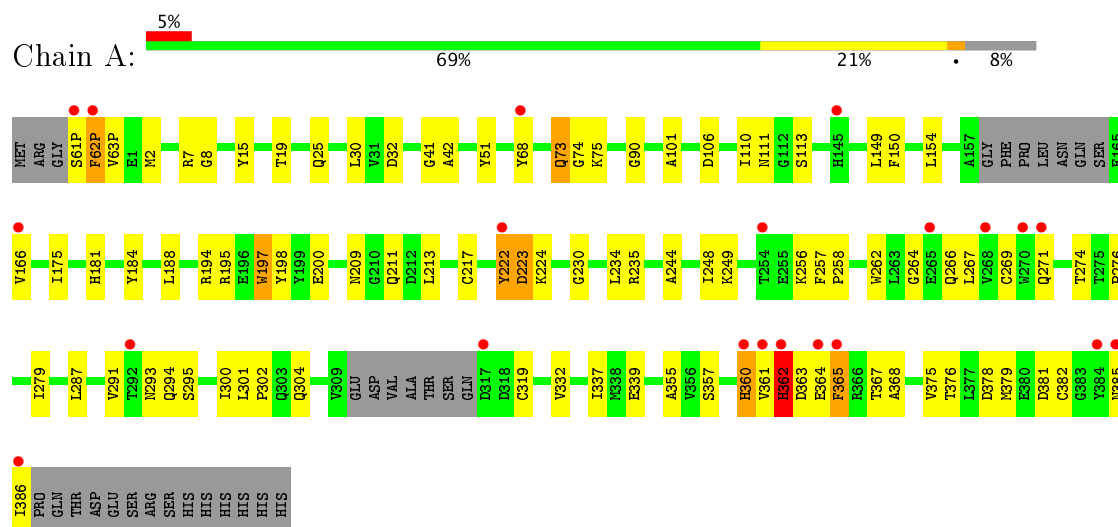
- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	168	Total O 168 168	0	0

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: Beta-secretase 1



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	72.99 Å 104.88 Å 50.06 Å 90.00° 94.99° 90.00°	Depositor
Resolution (Å)	20.00 – 2.20 39.71 – 2.19	Depositor EDS
% Data completeness (in resolution range)	91.9 (20.00-2.20) 91.4 (39.71-2.19)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.43 (at 2.20 Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.204 , 0.251 0.200 , 0.245	Depositor DCC
R_{free} test set	1712 reflections (10.84%)	DCC
Wilson B-factor (Å ²)	23.6	Xtriage
Anisotropy	0.813	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 50.4	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	0.94	EDS
Total number of atoms	3165	wwPDB-VP
Average B, all atoms (Å ²)	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.55% 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: LIQ

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	0.35	0/3026	0.65	0/4111

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	2952	0	2878	69	0
2	A	45	0	42	3	0
3	A	168	0	0	5	0
All	All	3165	0	2920	70	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 12.

All (70) 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:62(P):PHE:HD2	1:A:63(P):VAL:H	1.26	0.83

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:269:CYS:HG	1:A:319:CYS:HG	1.02	0.83
1:A:361:VAL:HB	1:A:368:ALA:HB2	1.58	0.83
1:A:30:LEU:HD11	2:A:801:LIQ:H1A1	1.59	0.83
1:A:293:ASN:HA	1:A:376:THR:O	1.80	0.81
1:A:222:TYR:O	1:A:223:ASP:HB3	1.91	0.69
1:A:378:ASP:HB3	1:A:381:ASP:OD2	1.92	0.69
1:A:301:LEU:HD12	1:A:361:VAL:HG12	1.75	0.66
1:A:61(P):SER:HA	1:A:175:ILE:CG2	2.27	0.65
1:A:365:PHE:N	1:A:365:PHE:CD2	2.67	0.63
1:A:62(P):PHE:HD2	1:A:63(P):VAL:N	1.94	0.63
1:A:361:VAL:CB	1:A:368:ALA:HB2	2.28	0.60
1:A:258:PRO:HG3	1:A:266:GLN:NE2	2.17	0.58
1:A:234:LEU:HB2	1:A:337:ILE:HD11	1.85	0.58
1:A:271:GLN:HB3	1:A:274:THR:OG1	2.04	0.58
1:A:68:TYR:HE1	1:A:75:LYS:HD2	1.70	0.57
1:A:361:VAL:HB	1:A:368:ALA:CB	2.30	0.56
1:A:276:PRO:O	1:A:279:ILE:HG12	2.06	0.56
1:A:235:ARG:HG3	1:A:332:VAL:HB	1.86	0.56
1:A:291:VAL:HB	1:A:294:GLN:HE21	1.70	0.56
1:A:73:GLN:HA	1:A:73:GLN:HE21	1.71	0.55
1:A:304:GLN:CD	1:A:361:VAL:HG21	2.26	0.55
1:A:357:SER:O	1:A:360:HIS:HB3	2.06	0.55
1:A:149:LEU:C	1:A:149:LEU:HD23	2.27	0.55
1:A:294:GLN:H	1:A:379:MET:HE1	1.72	0.55
1:A:7:ARG:HG2	1:A:8:GLY:N	2.20	0.54
1:A:62(P):PHE:CD2	1:A:63(P):VAL:N	2.73	0.54
1:A:2:MET:HG2	1:A:90:GLY:HA2	1.90	0.53
1:A:300:ILE:N	1:A:300:ILE:HD12	2.24	0.53
1:A:222:TYR:O	1:A:223:ASP:CB	2.57	0.52
1:A:269:CYS:HG	1:A:319:CYS:CB	2.22	0.52
1:A:149:LEU:HD23	1:A:150:PHE:N	2.24	0.52
1:A:304:GLN:OE1	1:A:361:VAL:HG21	2.11	0.51
1:A:42:ALA:CB	1:A:101:ALA:HB1	2.40	0.51
1:A:194:ARG:HD3	1:A:200:GLU:OE2	2.10	0.51
1:A:264:GLY:HA2	3:A:924:HOH:O	2.09	0.51
1:A:361:VAL:CG2	1:A:368:ALA:HB2	2.42	0.50
1:A:287:LEU:O	1:A:295:SER:HB2	2.13	0.49
1:A:32:ASP:OD1	1:A:230:GLY:HA3	2.12	0.49
1:A:110:ILE:HB	1:A:113:SER:HB3	1.94	0.49
1:A:217:CYS:CB	1:A:382:CYS:HG	2.19	0.49
1:A:291:VAL:HB	1:A:294:GLN:NE2	2.30	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:74:GLY:HA2	1:A:106:ASP:O	2.16	0.46
1:A:197:TRP:CG	1:A:198:TYR:N	2.83	0.46
1:A:293:ASN:O	1:A:375:VAL:HA	2.16	0.46
1:A:198:TYR:CE2	1:A:224:LYS:HE3	2.51	0.46
1:A:301:LEU:HD11	1:A:367:THR:HA	1.96	0.45
1:A:362:HIS:HB2	1:A:363:ASP:H	1.56	0.45
1:A:30:LEU:CD1	2:A:801:LIQ:H1A1	2.40	0.44
1:A:301:LEU:HB3	1:A:302:PRO:HD2	2.00	0.43
1:A:235:ARG:CG	1:A:332:VAL:HB	2.48	0.43
1:A:61(P):SER:HA	1:A:175:ILE:HG23	1.99	0.42
1:A:364:GLU:OE2	1:A:365:PHE:HE2	2.02	0.42
1:A:41:GLY:O	1:A:51:TYR:HB2	2.20	0.42
1:A:195:ARG:HD3	3:A:929:HOH:O	2.18	0.42
1:A:8:GLY:HA2	1:A:15:TYR:CE2	2.55	0.42
1:A:244:ALA:O	1:A:248:ILE:HG13	2.20	0.42
2:A:801:LIQ:H1A3	3:A:1065:HOH:O	2.20	0.42
1:A:385:ASN:O	1:A:386:ILE:C	2.57	0.42
1:A:362:HIS:HA	3:A:988:HOH:O	2.18	0.41
1:A:294:GLN:HG2	3:A:984:HOH:O	2.20	0.41
1:A:188:LEU:HD23	1:A:355:ALA:HB2	2.01	0.41
1:A:249:LYS:HG2	1:A:262:TRP:CE2	2.56	0.41
1:A:19:THR:HA	1:A:25:GLN:O	2.21	0.41
1:A:256:LYS:HA	1:A:256:LYS:HD3	1.89	0.41
1:A:7:ARG:HG2	1:A:8:GLY:H	1.84	0.41
1:A:257:PHE:CD1	1:A:257:PHE:N	2.89	0.40
1:A:154:LEU:O	1:A:339:GLU:HA	2.21	0.40
1:A:181:HIS:HA	1:A:184:TYR:CE1	2.56	0.40
1:A:365:PHE:N	1:A:365:PHE:HD2	2.15	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	369/406 (91%)	348 (94%)	16 (4%)	5 (1%)	13 10

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	166	VAL
1	A	223	ASP
1	A	362	HIS
1	A	360	HIS
1	A	222	TYR

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	A	320/348 (92%)	310 (97%)	10 (3%)	45 57

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	62(P)	PHE
1	A	73	GLN
1	A	111	ASN
1	A	197	TRP
1	A	209	ASN
1	A	211	GLN
1	A	213	LEU
1	A	267	LEU
1	A	362	HIS
1	A	365	PHE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	98	ASN

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Mol	Chain	Res	Type
1	A	111	ASN
1	A	266	GLN
1	A	271	GLN
1	A	326	GLN

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 ⓘ

1 ligand 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	$\# Z > 2$
2	LIQ	A	801	-	45,47,47	4.49	25 (55%)	57,63,63	2.28	18 (31%)

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	LIQ	A	801	-	-	1/43/43/43	0/3/3/3

All (25) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	801	LIQ	C22-C21	-5.77	1.45	1.52
2	A	801	LIQ	F17-C17	-3.58	1.27	1.36
2	A	801	LIQ	F19-C19	-2.42	1.30	1.36
2	A	801	LIQ	C45-N44	2.03	1.38	1.34
2	A	801	LIQ	C47-C46	2.13	1.44	1.37
2	A	801	LIQ	C14-C13	2.55	1.59	1.53
2	A	801	LIQ	C22-N23	2.61	1.51	1.47
2	A	801	LIQ	C14-C15	2.79	1.58	1.51
2	A	801	LIQ	C41-N40	3.09	1.41	1.34
2	A	801	LIQ	C29-C27	3.21	1.45	1.38
2	A	801	LIQ	C46-N44	3.30	1.43	1.33
2	A	801	LIQ	C47-C48	3.35	1.45	1.38
2	A	801	LIQ	C48-C43	4.00	1.45	1.39
2	A	801	LIQ	C26-C27	4.03	1.46	1.39
2	A	801	LIQ	C16-C15	5.64	1.49	1.39
2	A	801	LIQ	C31-C25	7.04	1.53	1.38
2	A	801	LIQ	C18-C19	7.50	1.50	1.37
2	A	801	LIQ	C16-C17	7.58	1.50	1.37
2	A	801	LIQ	C20-C19	7.63	1.50	1.37
2	A	801	LIQ	C7-S8	7.67	1.87	1.78
2	A	801	LIQ	C30-C29	7.88	1.54	1.38
2	A	801	LIQ	C30-C31	8.00	1.54	1.38
2	A	801	LIQ	C18-C17	9.05	1.53	1.37
2	A	801	LIQ	C20-C15	9.52	1.56	1.39
2	A	801	LIQ	C26-C25	11.27	1.59	1.39

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	801	LIQ	C14-C13-N12	-6.44	102.62	110.17
2	A	801	LIQ	O2-S8-O1	-4.70	110.03	117.37
2	A	801	LIQ	O1-S8-C9	-4.35	103.17	108.22
2	A	801	LIQ	C30-C29-C27	-3.41	115.44	120.64
2	A	801	LIQ	C2-C3-C7	-2.98	103.55	112.73
2	A	801	LIQ	C27-C26-C25	-2.65	117.91	121.26
2	A	801	LIQ	C18-C19-C20	-2.60	120.23	123.53
2	A	801	LIQ	C43-C45-N44	-2.57	119.53	123.45
2	A	801	LIQ	C28-C27-C29	-2.29	115.69	121.29
2	A	801	LIQ	C28-C27-C26	-2.17	116.21	121.00
2	A	801	LIQ	C15-C14-C13	-2.09	109.56	113.36
2	A	801	LIQ	C15-C16-C17	2.11	120.57	118.84
2	A	801	LIQ	C15-C20-C19	2.51	120.91	118.84

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	801	LIQ	C48-C43-C45	2.67	120.72	117.66
2	A	801	LIQ	C21-C22-N23	3.99	117.44	111.97
2	A	801	LIQ	C46-N44-C45	4.01	123.86	116.83
2	A	801	LIQ	C13-N12-C11	4.31	130.88	123.16
2	A	801	LIQ	C29-C27-C26	6.69	128.09	118.53

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	801	LIQ	C3-C7-S8-C9

There are no ring outliers.

1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	801	LIQ	3	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	375/406 (92%)	0.15	21 (5%) 25 24	15, 28, 51, 63	0

All (21) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	362	HIS	7.5
1	A	61(P)	SER	4.3
1	A	365	PHE	4.2
1	A	361	VAL	3.9
1	A	62(P)	PHE	3.9
1	A	292	THR	3.8
1	A	384	TYR	3.5
1	A	145	HIS	3.0
1	A	271	GLN	3.0
1	A	386	ILE	2.9
1	A	317	ASP	2.8
1	A	166	VAL	2.8
1	A	270	TRP	2.8
1	A	265	GLU	2.6
1	A	254	THR	2.5
1	A	222	TYR	2.4
1	A	268	VAL	2.3
1	A	364	GLU	2.3
1	A	68	TYR	2.2
1	A	385	ASN	2.1
1	A	360	HIS	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 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	LIQ	A	801	45/45	0.93	0.19	1.74	25,28,34,36	0

6.5 Other polymers [i](#)

There are no such residues in this entry.