wwPDB X-ray Structure Validation Summary Report (i)

Aug 15, 2023 – 03:20 PM EDT

PDB ID	:	1XVG
Title	:	soluble methane monooxygenase hydroxylase: bromoethanol soaked structure
Authors	:	Sazinsky, M.H.; Lippard, S.J.
Deposited on	:	2004-10-27
Resolution	:	1.96 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
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:

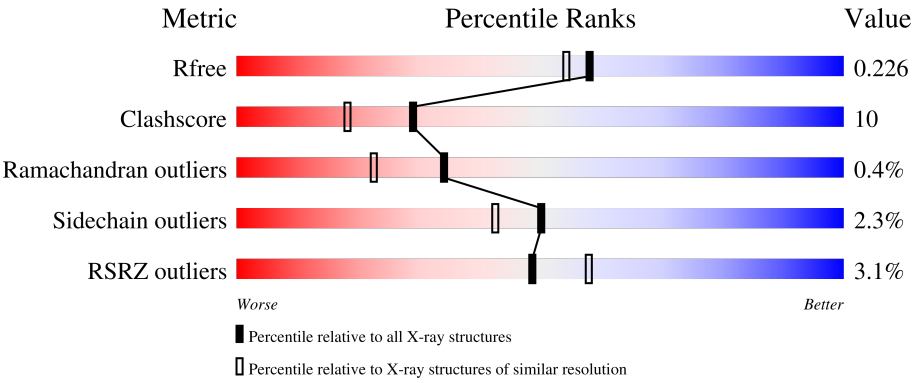
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.96 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	2580 (1.96-1.96)
Clashscore	141614	2705 (1.96-1.96)
Ramachandran outliers	138981	2678 (1.96-1.96)
Sidechain outliers	138945	2678 (1.96-1.96)
RSRZ outliers	127900	2539 (1.96-1.96)

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
1	A	527	75% 20%
1	B	527	76% 20%
2	C	389	85% 15%
2	D	389	5% 77% 23%
3	E	170	82% 15%

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Mol	Chain	Length	Quality of chain
3	F	170	

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
6	BRJ	B	3802	-	-	-	X

2 Entry composition (i)

There are 7 unique types of molecules in this entry. The entry contains 18633 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 Methane monooxygenase component A alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	510	Total	C	N	O	S	0	0	0
			4148	2655	713	762	18			
1	B	510	Total	C	N	O	S	0	0	0
			4137	2646	711	762	18			

- Molecule 2 is a protein called Methane monooxygenase component A beta chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	388	Total	C	N	O	S	0	0	0
			3163	2036	545	574	8			
2	D	388	Total	C	N	O	S	0	0	0
			3151	2028	543	572	8			

- Molecule 3 is a protein called Methane monooxygenase component A gamma chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	E	166	Total	C	N	O	S	0	0	0
			1364	864	245	250	5			
3	F	166	Total	C	N	O	S	0	0	0
			1358	860	243	250	5			

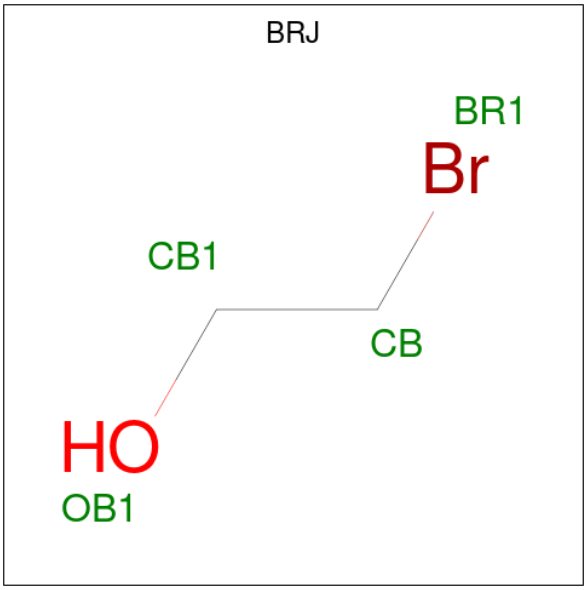
- Molecule 4 is FE (III) ION (three-letter code: FE) (formula: Fe).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	2	Total	Fe	0	0
			2	2		
4	B	2	Total	Fe	0	0
			2	2		

- Molecule 5 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total Ca 1 1	0	0
5	C	3	Total Ca 3 3	0	0

- Molecule 6 is 2-BROMOETHANOL (three-letter code: BRJ) (formula: C_2H_5BrO).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	1	Total Br C O 4 1 2 1	0	0
6	A	1	Total Br C O 4 1 2 1	0	0
6	A	1	Total Br C O 4 1 2 1	0	0
6	A	1	Total Br C O 4 1 2 1	0	0
6	B	1	Total Br C O 4 1 2 1	0	0
6	B	1	Total Br C O 4 1 2 1	0	0
6	B	1	Total Br C O 4 1 2 1	0	0
6	B	1	Total Br C O 4 1 2 1	0	0
6	C	1	Total Br C O 4 1 2 1	0	0
6	C	1	Total Br C O 4 1 2 1	0	0

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	C	1	Total	Br	C	O	0	0
			4	1	2	1		
6	C	1	Total	Br	C	O	0	0
			4	1	2	1		

- Molecule 7 is water.

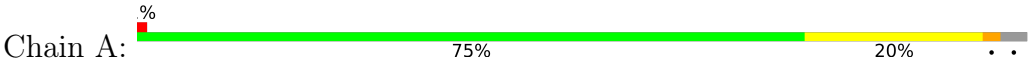
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	313	Total	O	0	0
			313	313		
7	B	278	Total	O	0	0
			278	278		
7	C	280	Total	O	0	0
			280	280		
7	D	167	Total	O	0	0
			167	167		
7	E	153	Total	O	0	0
			153	153		
7	F	65	Total	O	0	0
			65	65		

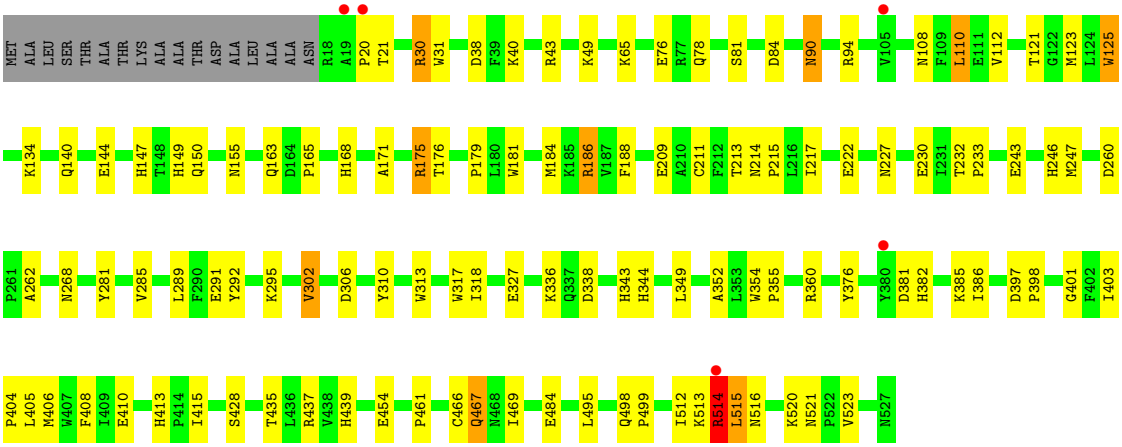
3 Residue-property plots (i)

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: Methane monooxygenase component A alpha chain

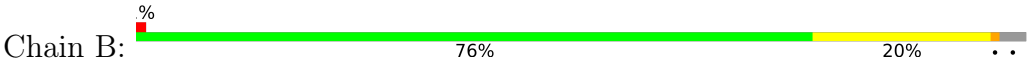
Chain A:

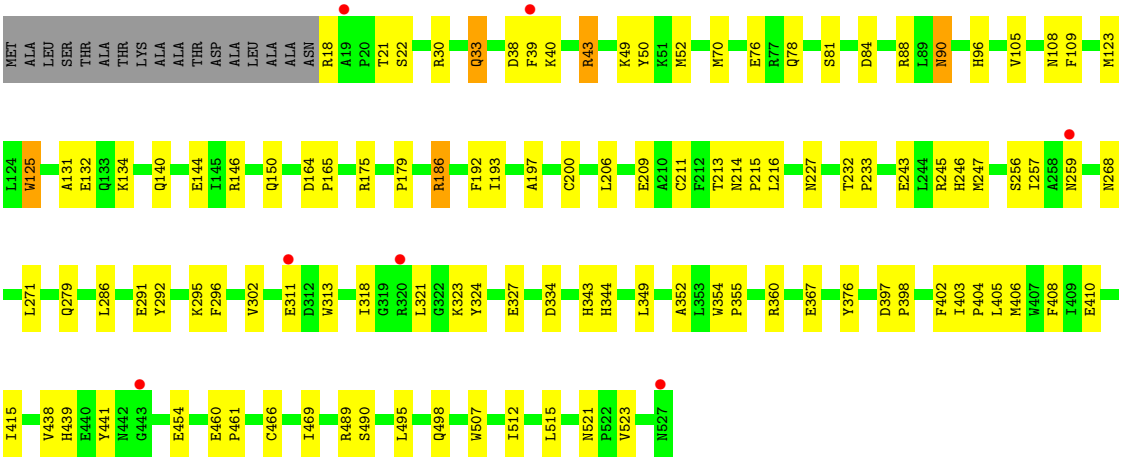




• Molecule 1: Methane monooxygenase component A alpha chain

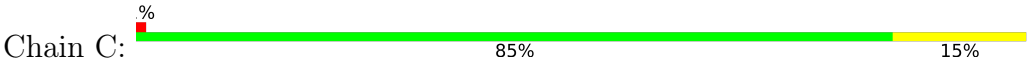
Chain B:

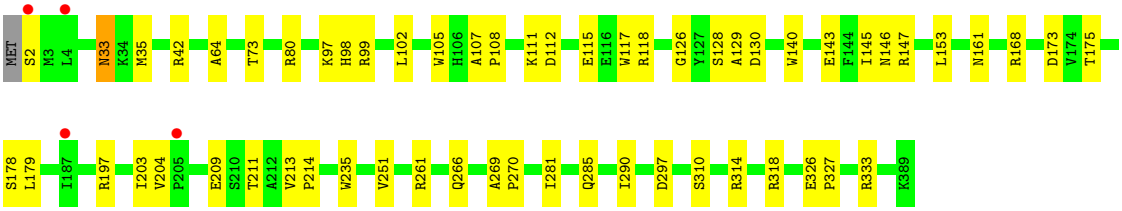




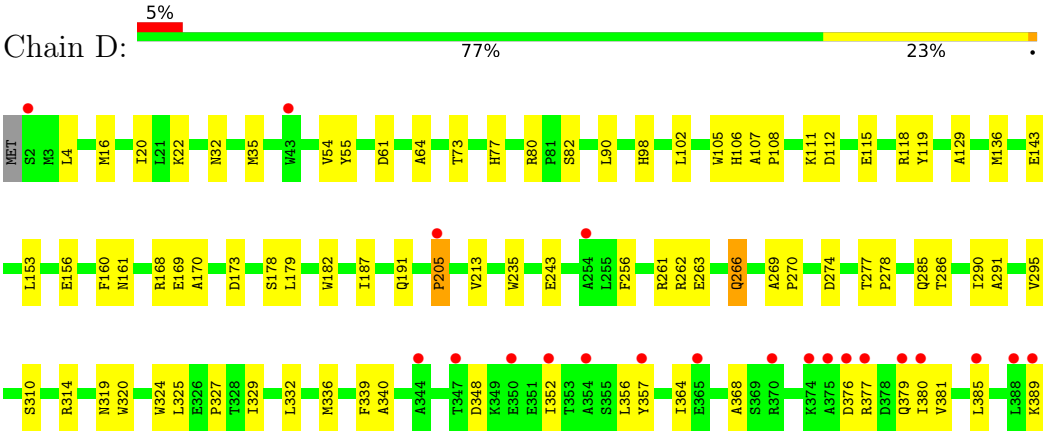
• Molecule 2: Methane monooxygenase component A beta chain

Chain C:

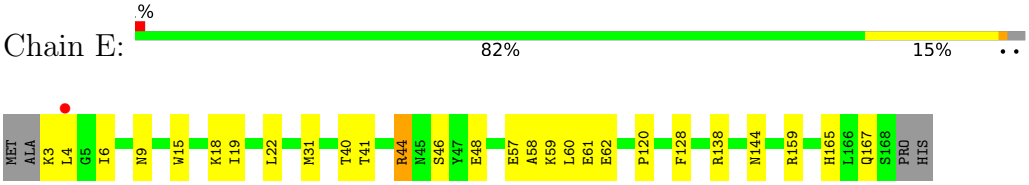




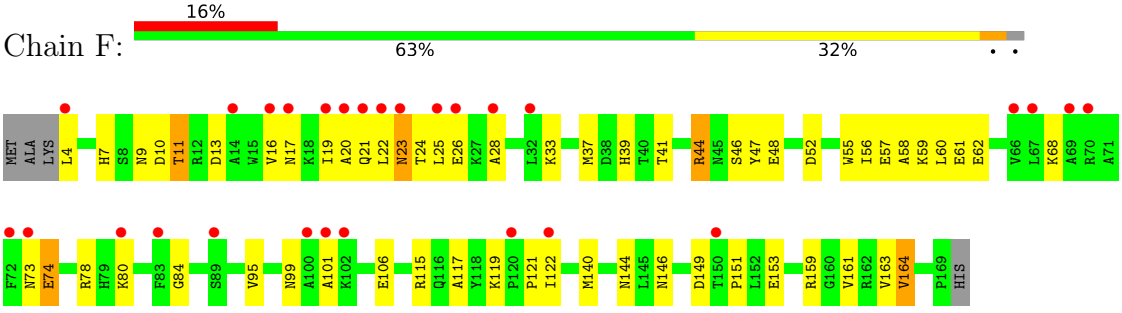
• Molecule 2: Methane monooxygenase component A beta chain



• Molecule 3: Methane monooxygenase component A gamma chain



• Molecule 3: Methane monooxygenase component A gamma chain



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	71.28Å 171.54Å 221.42Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.97 – 1.96 29.97 – 1.95	Depositor EDS
% Data completeness (in resolution range)	93.1 (29.97-1.96) 92.9 (29.97-1.95)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	0.08	Depositor
$< I/\sigma(I) >$ [1]	3.44 (at 1.95Å)	Xtriage
Refinement program	CNS 1.0	Depositor
R, R_{free}	0.198 , 0.230 0.194 , 0.226	Depositor DCC
R_{free} test set	9060 reflections (4.59%)	wwPDB-VP
Wilson B-factor (Å^2)	20.9	Xtriage
Anisotropy	0.172	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 55.6	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	18633	wwPDB-VP
Average B, all atoms (Å^2)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.52% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical 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.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CA, BRJ, FE

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	0.36	0/4273	0.61	3/5808 (0.1%)
1	B	0.33	0/4262	0.56	0/5796
2	C	0.36	0/3259	0.57	0/4430
2	D	0.32	0/3247	0.53	0/4417
3	E	0.33	0/1392	0.58	0/1876
3	F	0.29	0/1387	0.51	0/1873
All	All	0.34	0/17820	0.56	3/24200 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	516	ASN	O-C-N	-6.44	112.40	122.70
1	A	515	LEU	CA-CB-CG	5.91	128.88	115.30
1	A	516	ASN	CA-C-O	5.62	131.91	120.10

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	4148	0	3919	92	0
1	B	4137	0	3888	97	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	C	3163	0	2986	46	0
2	D	3151	0	2960	69	0
3	E	1364	0	1352	19	0
3	F	1358	0	1335	45	0
4	A	2	0	0	0	0
4	B	2	0	0	0	0
5	A	1	0	0	0	0
5	C	3	0	0	0	0
6	A	16	0	11	1	0
6	B	16	0	11	0	0
6	C	16	0	12	2	0
7	A	313	0	0	6	0
7	B	278	0	0	9	0
7	C	280	0	0	5	0
7	D	167	0	0	4	0
7	E	153	0	0	1	0
7	F	65	0	0	1	0
All	All	18633	0	16474	326	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 10.

The worst 5 of 326 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)
2:C:270:PRO:HB3	2:D:270:PRO:HB3	1.38	1.03
3:F:80:LYS:HE2	3:F:84:GLY:HA2	1.40	1.00
1:B:78:GLN:HE22	1:B:150:GLN:HE21	1.11	0.94
1:A:78:GLN:HE22	1:A:150:GLN:HE21	1.09	0.92
3:F:41:THR:O	3:F:44:ARG:HD2	1.76	0.86

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	508/527 (96%)	485 (96%)	21 (4%)	2 (0%)	34 22
1	B	508/527 (96%)	487 (96%)	20 (4%)	1 (0%)	47 38
2	C	386/389 (99%)	376 (97%)	8 (2%)	2 (0%)	29 17
2	D	386/389 (99%)	368 (95%)	16 (4%)	2 (0%)	29 17
3	E	164/170 (96%)	162 (99%)	2 (1%)	0	100 100
3	F	164/170 (96%)	156 (95%)	6 (4%)	2 (1%)	13 4
All	All	2116/2172 (97%)	2034 (96%)	73 (3%)	9 (0%)	34 22

5 of 9 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	40	LYS
2	D	205	PRO
1	A	94	ARG
1	A	514	ARG
2	C	64	ALA

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	425/442 (96%)	411 (97%)	14 (3%)	38 26
1	B	422/442 (96%)	413 (98%)	9 (2%)	53 46
2	C	315/323 (98%)	311 (99%)	4 (1%)	69 65
2	D	312/323 (97%)	304 (97%)	8 (3%)	46 36
3	E	143/147 (97%)	141 (99%)	2 (1%)	67 62
3	F	142/147 (97%)	138 (97%)	4 (3%)	43 33
All	All	1759/1824 (96%)	1718 (98%)	41 (2%)	50 42

5 of 41 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	D	35	MET
3	E	44	ARG
2	D	80	ARG
2	D	205	PRO
3	F	11	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 63 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	268	ASN
3	E	165	HIS
1	B	413	HIS
3	E	144	ASN
3	F	39	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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 20 ligands modelled in this entry, 8 are monoatomic - leaving 12 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	$\#\|Z\|>2$
6	BRJ	B	3809	-	3,3,3	0.57	0	2,2,2	0.21	0
6	BRJ	A	3805	-	3,3,3	0.64	0	2,2,2	0.51	0
6	BRJ	A	3806	-	3,3,3	0.66	0	2,2,2	0.19	0
6	BRJ	A	3803	4	3,3,3	0.54	0	2,2,2	0.22	0
6	BRJ	B	3801	-	3,3,3	0.53	0	2,2,2	0.31	0
6	BRJ	B	3802	-	3,3,3	0.44	0	2,2,2	0.43	0
6	BRJ	C	3807	-	3,3,3	0.51	0	2,2,2	0.32	0
6	BRJ	C	3811	-	3,3,3	0.59	0	2,2,2	0.16	0
6	BRJ	C	3808	-	3,3,3	0.59	0	2,2,2	0.23	0
6	BRJ	C	3810	-	3,3,3	0.57	0	2,2,2	0.22	0
6	BRJ	B	3800	4	3,3,3	0.55	0	2,2,2	0.25	0
6	BRJ	A	3804	-	3,3,3	0.51	0	2,2,2	0.26	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
6	BRJ	B	3809	-	-	0/1/1/1	-
6	BRJ	A	3805	-	-	1/1/1/1	-
6	BRJ	A	3806	-	-	0/1/1/1	-
6	BRJ	A	3803	4	-	0/1/1/1	-
6	BRJ	B	3801	-	-	1/1/1/1	-
6	BRJ	B	3802	-	-	1/1/1/1	-
6	BRJ	C	3807	-	-	0/1/1/1	-
6	BRJ	C	3811	-	-	0/1/1/1	-
6	BRJ	C	3808	-	-	0/1/1/1	-
6	BRJ	C	3810	-	-	0/1/1/1	-
6	BRJ	B	3800	4	-	0/1/1/1	-
6	BRJ	A	3804	-	-	1/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	A	3805	BRJ	BR1-CB-CB1-OB1
6	B	3802	BRJ	BR1-CB-CB1-OB1
6	A	3804	BRJ	BR1-CB-CB1-OB1

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Mol	Chain	Res	Type	Atoms
6	B	3801	BRJ	BR1-CB-CB1-OB1

There are no ring outliers.

3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	3805	BRJ	1	0
6	C	3807	BRJ	1	0
6	C	3808	BRJ	1	0

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

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, 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	<RSRZ>	#RSRZ>2	OWAB(Å^2)	Q<0.9
1	A	510/527 (96%)	-0.02	5 (0%) 82 87	13, 22, 43, 71	0
1	B	510/527 (96%)	-0.04	7 (1%) 75 82	14, 23, 41, 73	0
2	C	388/389 (99%)	-0.24	4 (1%) 82 87	11, 18, 40, 66	0
2	D	388/389 (99%)	0.45	21 (5%) 25 34	16, 31, 55, 83	0
3	E	166/170 (97%)	-0.19	1 (0%) 89 93	12, 20, 38, 67	0
3	F	166/170 (97%)	1.09	28 (16%) 1 2	24, 42, 64, 81	0
All	All	2128/2172 (97%)	0.09	66 (3%) 49 58	11, 24, 50, 83	0

The worst 5 of 66 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	E	4	LEU	4.8
2	C	2	SER	4.4
2	D	389	LYS	4.1
2	D	380	ILE	4.1
3	F	23	ASN	3.9

6.2 Non-standard residues in protein, DNA, RNA chains

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

6.3 Carbohydrates

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, 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	B-factors(Å^2)	Q<0.9
6	BRJ	B	3802	4/4	0.45	0.44	42,42,42,42	0
6	BRJ	A	3805	4/4	0.63	0.37	50,50,50,50	0
5	CA	A	1162	1/1	0.74	0.13	39,39,39,39	0
6	BRJ	C	3808	4/4	0.75	0.26	68,68,68,68	0
6	BRJ	B	3801	4/4	0.79	0.24	44,44,44,44	0
6	BRJ	C	3807	4/4	0.80	0.28	58,58,58,58	0
6	BRJ	C	3811	4/4	0.88	0.21	77,77,77,77	0
5	CA	C	1112	1/1	0.89	0.08	56,56,56,56	0
6	BRJ	C	3810	4/4	0.93	0.17	56,56,56,56	0
5	CA	C	1218	1/1	0.95	0.12	42,42,42,42	0
6	BRJ	A	3804	4/4	0.97	0.11	44,44,44,44	0
6	BRJ	A	3803	4/4	0.98	0.10	42,42,42,42	0
6	BRJ	A	3806	4/4	0.98	0.12	33,33,33,33	0
6	BRJ	B	3800	4/4	0.98	0.09	43,43,43,43	0
4	FE	B	529	1/1	0.99	0.02	26,26,26,26	0
4	FE	A	529	1/1	0.99	0.03	25,25,25,25	0
5	CA	C	1111	1/1	0.99	0.07	27,27,27,27	0
6	BRJ	B	3809	4/4	0.99	0.08	36,36,36,36	0
4	FE	B	528	1/1	1.00	0.03	19,19,19,19	0
4	FE	A	528	1/1	1.00	0.03	20,20,20,20	0

6.5 Other polymers (i)

There are no such residues in this entry.