



wwPDB X-ray Structure Validation Summary Report ⓘ

Nov 15, 2017 – 09:32 AM EST

PDB ID : 4XP4
Title : X-ray structure of Drosophila dopamine transporter in complex with cocaine
Authors : Aravind, P.; Wang, K.; Gouaux, E.
Deposited on : unknown
Resolution : 2.80 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

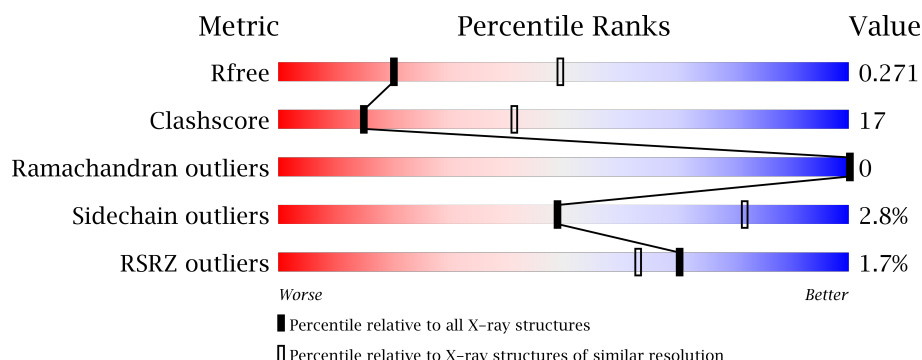
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 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	2583 (2.80-2.80)
Clashscore	112137	3033 (2.80-2.80)
Ramachandran outliers	110173	2983 (2.80-2.80)
Sidechain outliers	110143	2985 (2.80-2.80)
RSRZ outliers	101464	2610 (2.80-2.80)

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	545	<div> <div>3%</div> <div>65%</div> <div>31%</div> <div>• •</div> </div>
2	L	237	<div> <div>3%</div> <div>65%</div> <div>24%</div> <div>• 10%</div> </div>
3	H	240	<div> <div>3%</div> <div>66%</div> <div>25%</div> <div>9%</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
4	Y01	A	701	-	-	-	X
5	P4G	A	702	-	-	-	X
9	NA	A	707	-	-	-	X

2 Entry composition

There are 11 unique types of molecules in this entry. The entry contains 7631 atoms, of which 58 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 Dopamine transporter.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	534	Total	C	N	O	S	0	1	0
			4191	2815	642	716	18			

There are 48 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	20	MET	-	initiating methionine	UNP Q7K4Y6
A	74	ALA	VAL	engineered mutation	UNP Q7K4Y6
A	?	-	SER	deletion	UNP Q7K4Y6
A	?	-	GLN	deletion	UNP Q7K4Y6
A	?	-	ASN	deletion	UNP Q7K4Y6
A	?	-	ALA	deletion	UNP Q7K4Y6
A	?	-	SER	deletion	UNP Q7K4Y6
A	?	-	ARG	deletion	UNP Q7K4Y6
A	?	-	VAL	deletion	UNP Q7K4Y6
A	?	-	PRO	deletion	UNP Q7K4Y6
A	?	-	VAL	deletion	UNP Q7K4Y6
A	?	-	ILE	deletion	UNP Q7K4Y6
A	?	-	GLY	deletion	UNP Q7K4Y6
A	?	-	ASN	deletion	UNP Q7K4Y6
A	?	-	TYR	deletion	UNP Q7K4Y6
A	?	-	SER	deletion	UNP Q7K4Y6
A	?	-	ASP	deletion	UNP Q7K4Y6
A	?	-	LEU	deletion	UNP Q7K4Y6
A	?	-	TYR	deletion	UNP Q7K4Y6
A	?	-	ALA	deletion	UNP Q7K4Y6
A	?	-	MET	deletion	UNP Q7K4Y6
A	?	-	GLY	deletion	UNP Q7K4Y6
A	?	-	ASN	deletion	UNP Q7K4Y6
A	?	-	GLN	deletion	UNP Q7K4Y6
A	?	-	SER	deletion	UNP Q7K4Y6
A	?	-	LEU	deletion	UNP Q7K4Y6
A	?	-	LEU	deletion	UNP Q7K4Y6

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Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	TYR	deletion	UNP Q7K4Y6
A	?	-	ASN	deletion	UNP Q7K4Y6
A	?	-	GLU	deletion	UNP Q7K4Y6
A	?	-	THR	deletion	UNP Q7K4Y6
A	?	-	TYR	deletion	UNP Q7K4Y6
A	?	-	MET	deletion	UNP Q7K4Y6
A	?	-	ASN	deletion	UNP Q7K4Y6
A	?	-	GLY	deletion	UNP Q7K4Y6
A	?	-	SER	deletion	UNP Q7K4Y6
A	?	-	SER	deletion	UNP Q7K4Y6
A	?	-	LEU	deletion	UNP Q7K4Y6
A	?	-	ASP	deletion	UNP Q7K4Y6
A	?	-	THR	deletion	UNP Q7K4Y6
A	?	-	SER	deletion	UNP Q7K4Y6
A	?	-	ALA	deletion	UNP Q7K4Y6
A	?	-	VAL	deletion	UNP Q7K4Y6
A	415	ALA	LEU	engineered mutation	UNP Q7K4Y6
A	602	LEU	-	expression tag	UNP Q7K4Y6
A	603	VAL	-	expression tag	UNP Q7K4Y6
A	604	PRO	-	expression tag	UNP Q7K4Y6
A	605	ARG	-	expression tag	UNP Q7K4Y6

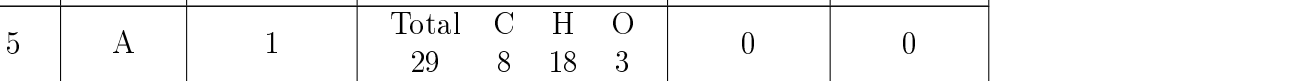
- Molecule 2 is a protein called ANTIBODY FRAGMENT HEAVY CHAIN-PROTEIN, 9D5-HEAVY CHAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	214	Total	C	N	O	S	0	0	0
			1619	1007	268	336	8			

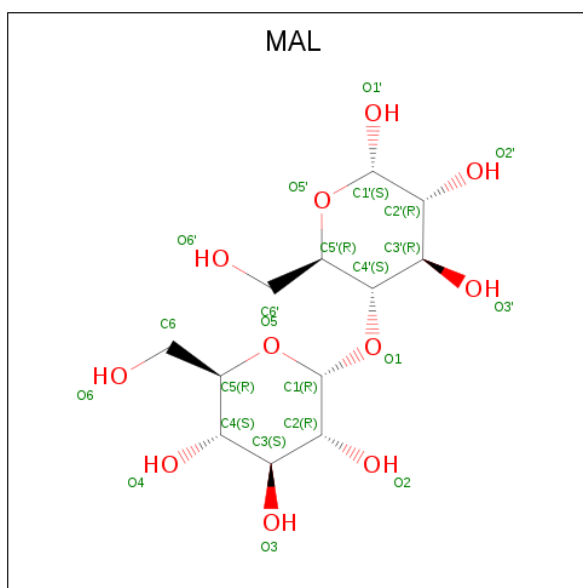
- Molecule 3 is a protein called ANTIBODY FRAGMENT HEAVY CHAIN-PROTEIN, 9D5-LIGHT CHAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	H	219	Total	C	N	O	S	0	0	0
			1618	1019	275	316	8			

- Molecule 4 is CHOLESTEROL HEMISUCCINATE (three-letter code: Y01) (formula: C₃₁H₅₀O₄).

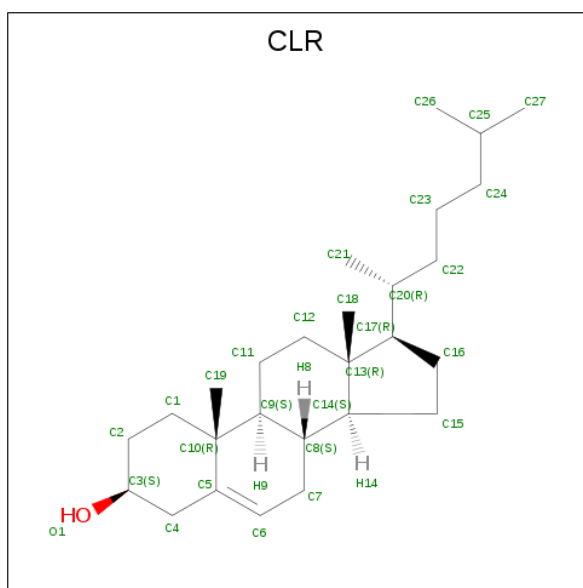


- Molecule 6 is MALTOSE (three-letter code: MAL) (formula: $C_{12}H_{22}O_{11}$).



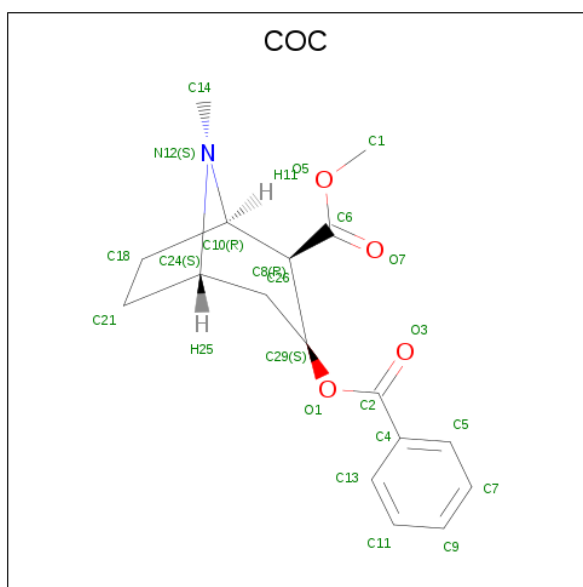
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	A	1	Total	C	H	O	0	0
			45	12	22	11		

- Molecule 7 is CHOLESTEROL (three-letter code: CLR) (formula: $C_{27}H_{46}O$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total	C	O	0	0
			28	27	1		

- Molecule 8 is COCAINE (three-letter code: COC) (formula: $C_{17}H_{21}NO_4$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
8	A	1	Total	C	N	O	0	0
			22	17	1	4		

- Molecule 9 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	2	Total	Na	0	0
			2	2		

- Molecule 10 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	A	1	Total	Cl	0	0
			1	1		

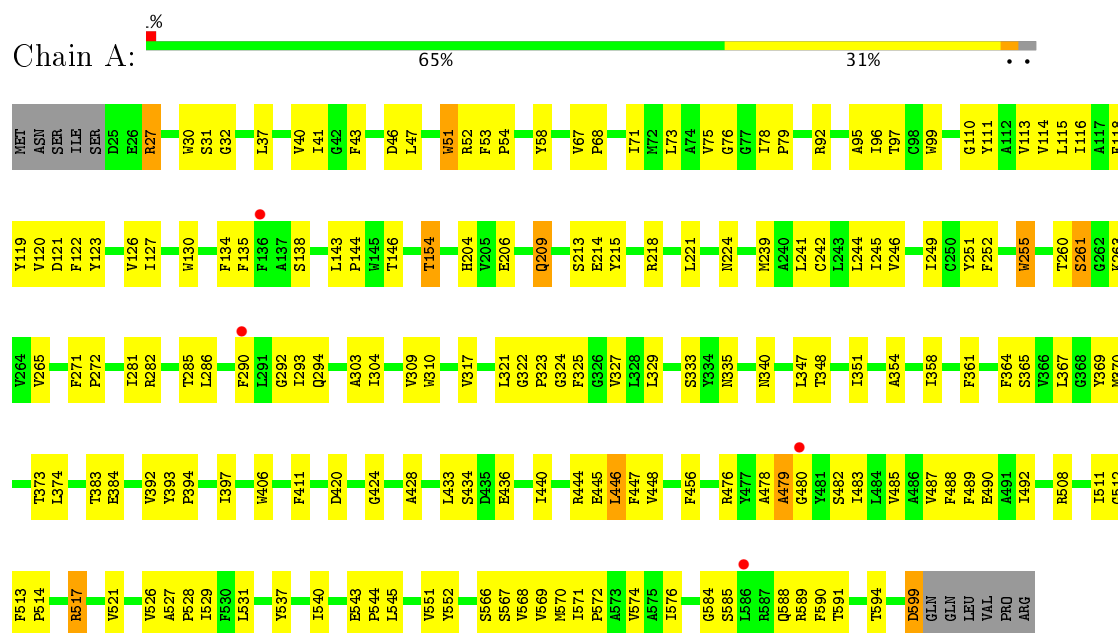
- Molecule 11 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
11	A	8	Total	O	0	0
			8	8		
11	L	2	Total	O	0	0
			2	2		
11	H	2	Total	O	0	0
			2	2		

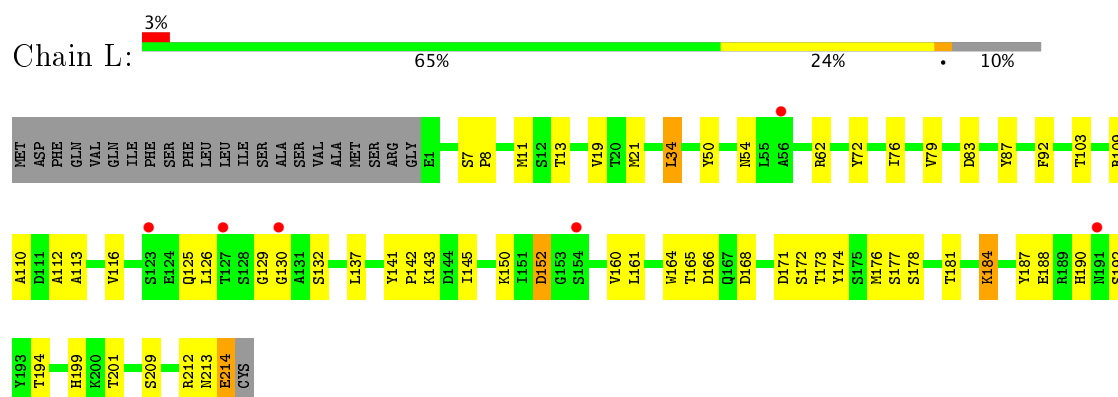
3 Residue-property plots

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: Dopamine transporter

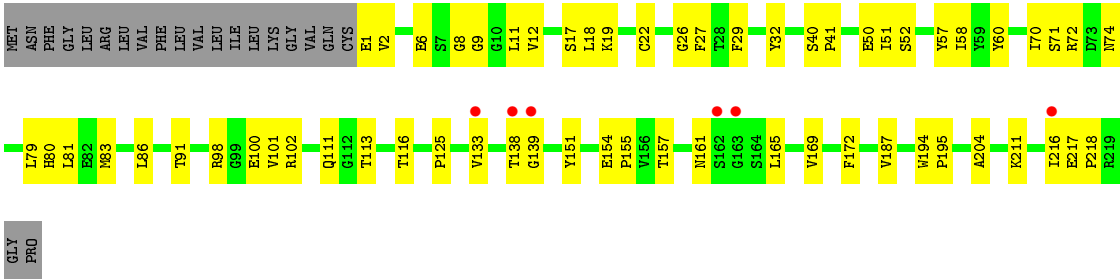


• Molecule 2: ANTIBODY FRAGMENT HEAVY CHAIN-PROTEIN, 9D5-HEAVY CHAIN



• Molecule 3: ANTIBODY FRAGMENT HEAVY CHAIN-PROTEIN, 9D5-LIGHT CHAIN





GLY
PRO

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	97.06Å 140.73Å 166.69Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	45.88 – 2.80 48.22 – 2.80	Depositor EDS
% Data completeness (in resolution range)	99.0 (45.88-2.80) 98.9 (48.22-2.80)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.16 (at 2.81Å)	Xtriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.236 , 0.266 0.246 , 0.271	Depositor DCC
R_{free} test set	2739 reflections (5.09%)	DCC
Wilson B-factor (Å ²)	77.6	Xtriage
Anisotropy	0.305	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 57.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	7631	wwPDB-VP
Average B, all atoms (Å ²)	72.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.69% 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: Y01, CL, P4G, NA, COC, MAL, CLR

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	0/4338	0.43	0/5940
2	L	0.23	0/1657	0.44	1/2254 (0.0%)
3	H	0.23	0/1657	0.42	0/2262
All	All	0.25	0/7652	0.43	1/10456 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	2
3	H	0	1
All	All	0	3

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	L	152	ASP	CB-CG-OD2	5.20	122.98	118.30

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	478	ALA	Peptide
1	A	479	ALA	Peptide
3	H	98	ARG	Peptide

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	4191	0	4061	157	0
2	L	1619	0	1523	52	0
3	H	1618	0	1539	42	0
4	A	35	0	49	6	0
5	A	22	36	36	2	0
6	A	23	22	22	0	0
7	A	28	0	46	2	0
8	A	22	0	21	2	0
9	A	2	0	0	0	0
10	A	1	0	0	0	0
11	A	8	0	0	0	0
11	H	2	0	0	1	0
11	L	2	0	0	0	0
All	All	7573	58	7297	251	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 17.

The worst 5 of 251 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:52:ARG:NH1	1:A:384:GLU:OE2	1.74	1.20
1:A:121:ASP:HB3	8:A:706:COC:H10	1.36	1.06
1:A:78:ILE:HD12	4:A:701:Y01:HAK1	1.46	0.94
3:H:83:MET:HB3	3:H:86:LEU:HD21	1.48	0.94
2:L:129:GLY:H	2:L:184:LYS:HZ1	1.15	0.87

There are no symmetry-related clashes.

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	A	533/545 (98%)	516 (97%)	17 (3%)	0	100	100
2	L	212/237 (90%)	205 (97%)	7 (3%)	0	100	100
3	H	217/240 (90%)	209 (96%)	8 (4%)	0	100	100
All	All	962/1022 (94%)	930 (97%)	32 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	425/450 (94%)	410 (96%)	15 (4%)	41	75
2	L	182/207 (88%)	177 (97%)	5 (3%)	50	83
3	H	173/205 (84%)	171 (99%)	2 (1%)	75	94
All	All	780/862 (90%)	758 (97%)	22 (3%)	49	82

5 of 22 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	261	SER
1	A	517	ARG
3	H	111	GLN
1	A	420	ASP
1	A	446	LEU

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 ⓘ

Of 9 ligands modelled in this entry, 3 are monoatomic - leaving 6 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	Y01	A	701	-	35,38,38	4.29	14 (40%)	54,57,57	1.98	17 (31%)
5	P4G	A	702	-	10,10,10	0.65	0	9,9,9	0.24	0
5	P4G	A	703	-	10,10,10	0.68	0	9,9,9	0.35	0
6	MAL	A	704	-	24,24,24	0.47	0	35,35,35	0.93	1 (2%)
7	CLR	A	705	-	31,31,31	0.69	0	48,48,48	1.13	4 (8%)
8	COC	A	706	-	24,24,24	4.49	9 (37%)	29,34,34	2.37	10 (34%)

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
4	Y01	A	701	-	-	0/17/77/77	0/4/4/4
5	P4G	A	702	-	-	0/8/8/8	0/0/0/0
5	P4G	A	703	-	-	0/8/8/8	0/0/0/0

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
6	MAL	A	704	-	-	0/8/48/48	0/2/2/2
7	CLR	A	705	-	-	0/10/68/68	0/4/4/4
8	COC	A	706	-	-	0/14/39/39	0/1/3/3

The worst 5 of 23 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
8	A	706	COC	C24-N12	-12.20	1.32	1.48
8	A	706	COC	O1-C29	-11.02	1.26	1.46
4	A	701	Y01	CBB-CBE	-9.97	1.36	1.54
8	A	706	COC	C10-N12	-7.65	1.31	1.47
4	A	701	Y01	CAU-CBI	-6.92	1.41	1.54

The worst 5 of 32 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
8	A	706	COC	C26-C24-C21	-5.13	108.00	112.63
4	A	701	Y01	CBI-CBE-CBB	-4.46	112.31	119.47
4	A	701	Y01	CAK-CAI-CAZ	-3.73	117.82	125.06
4	A	701	Y01	CAE-CBI-CBG	-3.47	105.17	111.73
4	A	701	Y01	CAE-CBI-CBE	-3.26	105.56	111.73

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5 monomers are involved in 12 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	701	Y01	6	0
5	A	702	P4G	1	0
5	A	703	P4G	1	0
7	A	705	CLR	2	0
8	A	706	COC	2	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 [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	534/545 (97%)	-0.07	4 (0%) 87 83	55, 70, 92, 122	0
2	L	214/237 (90%)	-0.05	6 (2%) 53 43	51, 67, 99, 122	0
3	H	219/240 (91%)	-0.04	6 (2%) 55 44	53, 68, 104, 140	0
All	All	967/1022 (94%)	-0.06	16 (1%) 70 63	51, 69, 98, 140	0

The worst 5 of 16 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	H	138	THR	3.5
3	H	162	SER	2.9
1	A	136	PHE	2.9
2	L	123	SER	2.8
3	H	216	ILE	2.8

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
9	NA	A	707	1/1	0.93	0.40	5.60	62,62,62,62	0
5	P4G	A	702	11/11	0.57	0.41	3.68	89,108,119,126	0
4	Y01	A	701	35/35	0.85	0.35	3.47	67,85,102,108	0
5	P4G	A	703	11/11	0.58	0.28	1.08	96,121,130,132	0
7	CLR	A	705	28/28	0.95	0.21	0.10	57,71,77,79	0
6	MAL	A	704	23/23	0.82	0.20	-0.01	90,108,127,133	0
8	COC	A	706	22/22	0.97	0.22	-0.39	56,65,70,72	0
9	NA	A	708	1/1	0.89	0.20	-1.64	56,56,56,56	0
10	CL	A	709	1/1	0.90	0.16	-2.19	79,79,79,79	0

6.5 Other polymers [i](#)

There are no such residues in this entry.