wwPDB X-ray Structure Validation Summary Report (i)

Nov 6, 2023 – 08:41 PM EST

PDB ID	:	1T6J
Title	:	Crystal Structure of Phenylalanine Ammonia Lyase from Rhodosporidium toruloides
Authors	:	Calabrese, J.C.; Jordan, D.B.
Deposited on	:	2004-05-06
Resolution	:	2.10 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 (i)) were used in the production of this report:

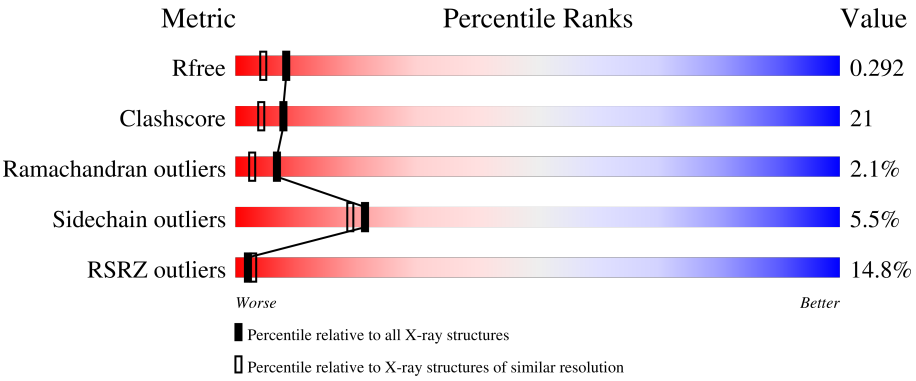
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 2.10 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	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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	714	10% 60% 27% . 9%
1	B	714	16% 54% 32% 5% 9%

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
1	175	A	211	X	-	-	-
1	175	B	211	X	-	-	-

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 10300 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 phenylalanine ammonia-lyase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	647	Total	C	N	O	S	Se	0	0	0
			4939	3104	878	940	4	13			
1	B	647	Total	C	N	O	S	Se	0	0	0
			4939	3104	878	940	4	13			

There are 36 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MSE	MET	modified residue	UNP P11544
A	51	MSE	MET	modified residue	UNP P11544
A	107	MSE	MET	modified residue	UNP P11544
A	169	MSE	MET	modified residue	UNP P11544
A	211	175	ALA	SEE REMARK 999	UNP P11544
A	211	175	SER	SEE REMARK 999	UNP P11544
A	211	175	GLY	SEE REMARK 999	UNP P11544
A	250	MSE	MET	modified residue	UNP P11544
A	278	MSE	MET	modified residue	UNP P11544
A	288	MSE	MET	modified residue	UNP P11544
A	299	MSE	MET	modified residue	UNP P11544
A	304	MSE	MET	modified residue	UNP P11544
A	422	MSE	MET	modified residue	UNP P11544
A	443	MSE	MET	modified residue	UNP P11544
A	448	MSE	MET	modified residue	UNP P11544
A	497	MSE	MET	modified residue	UNP P11544
A	564	MSE	MET	modified residue	UNP P11544
A	714	MSE	MET	modified residue	UNP P11544
B	1	MSE	MET	modified residue	UNP P11544
B	51	MSE	MET	modified residue	UNP P11544
B	107	MSE	MET	modified residue	UNP P11544
B	169	MSE	MET	modified residue	UNP P11544
B	211	175	ALA	SEE REMARK 999	UNP P11544
B	211	175	SER	SEE REMARK 999	UNP P11544
B	211	175	GLY	SEE REMARK 999	UNP P11544

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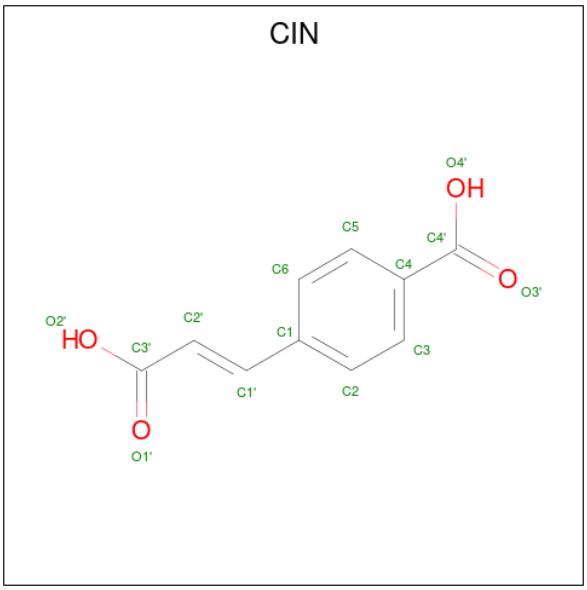
Chain	Residue	Modelled	Actual	Comment	Reference
B	250	MSE	MET	modified residue	UNP P11544
B	278	MSE	MET	modified residue	UNP P11544
B	288	MSE	MET	modified residue	UNP P11544
B	299	MSE	MET	modified residue	UNP P11544
B	304	MSE	MET	modified residue	UNP P11544
B	422	MSE	MET	modified residue	UNP P11544
B	443	MSE	MET	modified residue	UNP P11544
B	448	MSE	MET	modified residue	UNP P11544
B	497	MSE	MET	modified residue	UNP P11544
B	564	MSE	MET	modified residue	UNP P11544
B	714	MSE	MET	modified residue	UNP P11544

- Molecule 2 is 4-CARBOXYCINNAMIC ACID (three-letter code: CIN) (formula: $C_{10}H_8O_4$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	B	1	Total C O 11 9 2	0	0

- Molecule 3 is water.

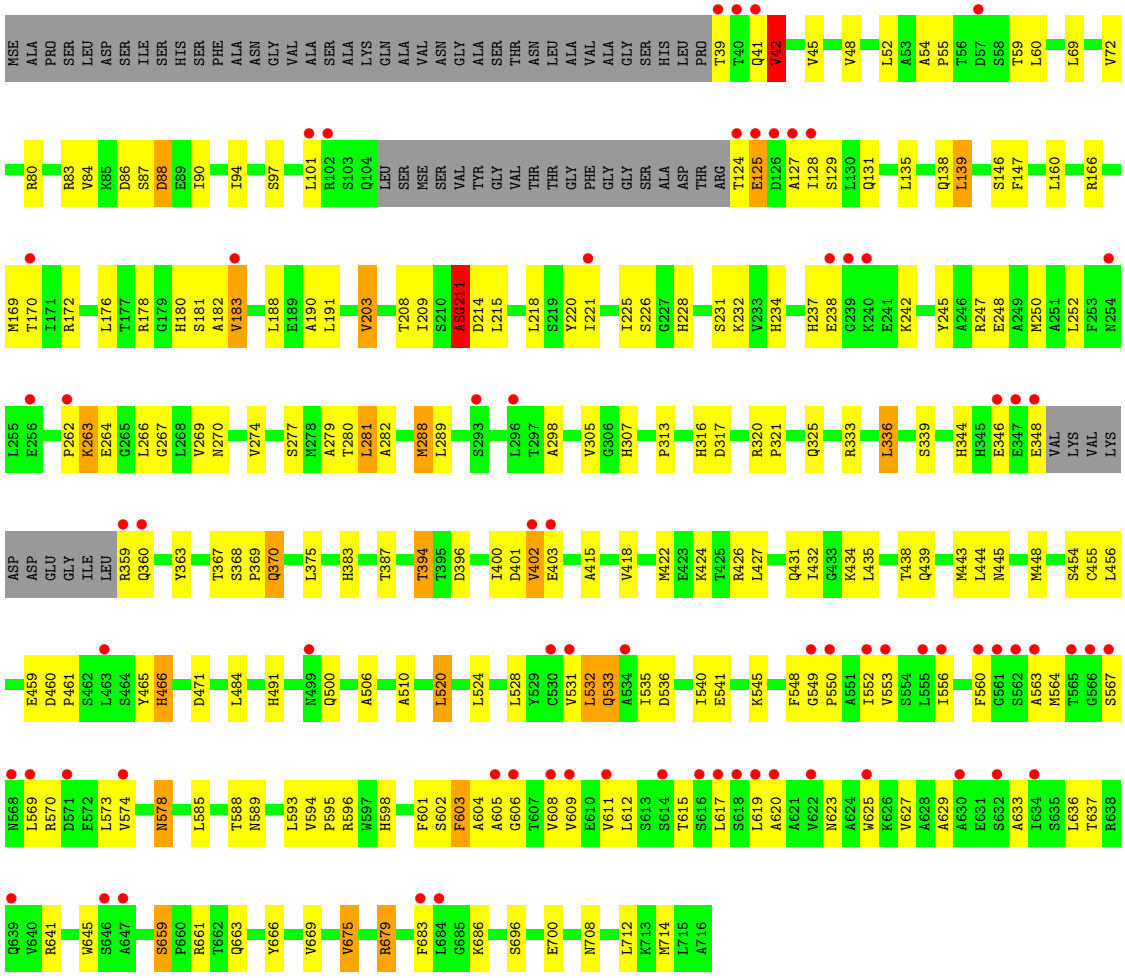
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	245	Total O 245 245	0	0
3	B	166	Total O 166 166	0	0

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.

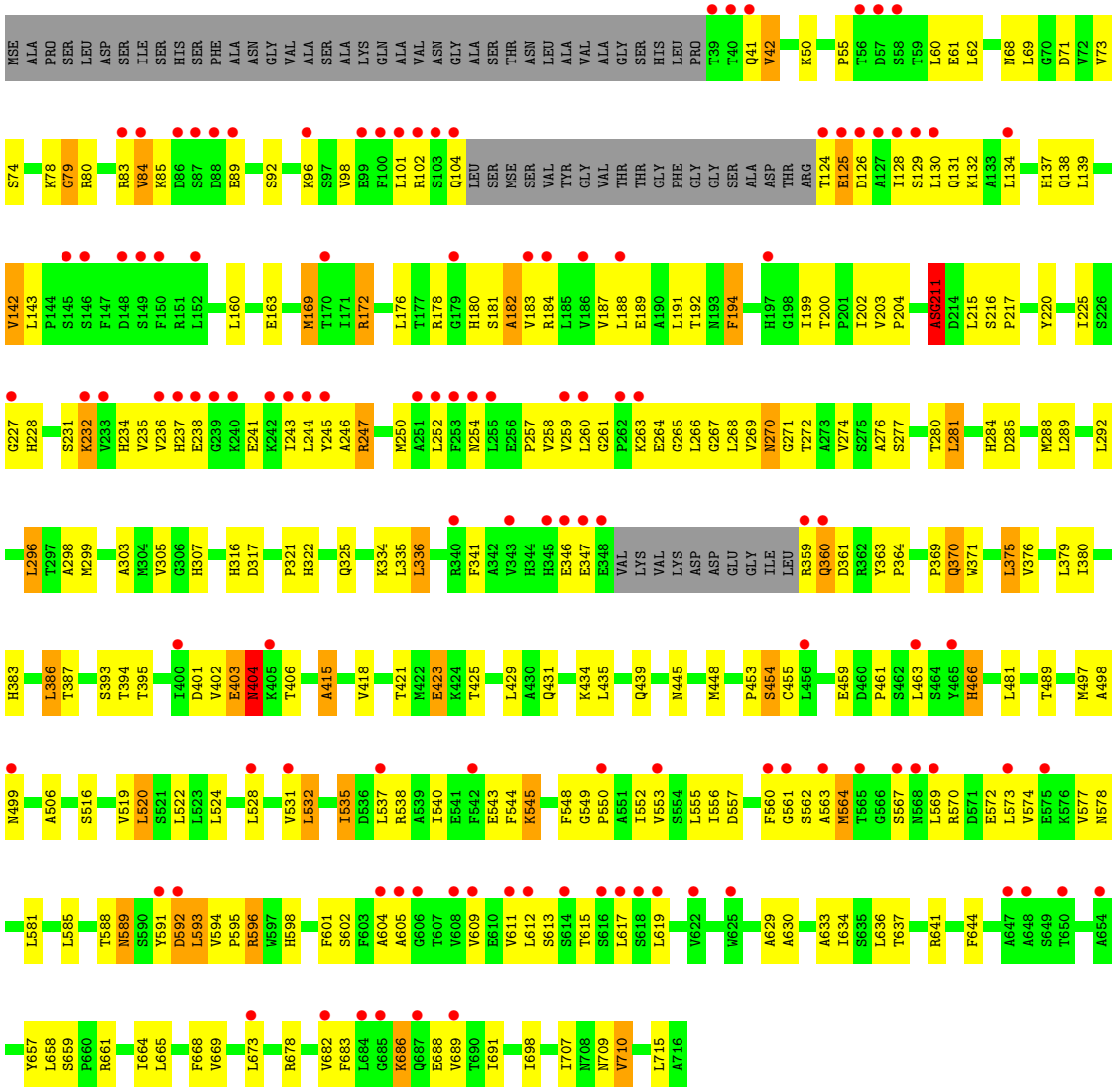
• Molecule 1: phenylalanine ammonia-lyase

Chain A:



• Molecule 1: phenylalanine ammonia-lyase

Chain B:


MSE ALA PRO SER LEU ASP SER ILE SER HIS SER PHE ALA ASN GLY VAL ALA SER ALA LYS GLN ALA VAL ASN GLY ALA SER THR ASN LEU ALA VAL ALA GLY SER HIS LEU PRO T39 T40 Q41 V42 K50 P55 T56 D57 S58 T59 L60 E61 L62 N68 L69 G70 D71 V72 V73
S74 K78 G79 R80 R83 V84 K85 D86 S87 D88 E89 S92 K96 S97 V98 E99 F100 L101 R102 S103 Q104 LEU SER MSE SER VAL TYR GLY VAL THR THR GLY PHE GLY GLY SER ALA ASP THR ARG T124 E125 D126 A127 I128 S129 L130 Q131 K132 A133 L134 H137 Q138 L139
V142 L143 P144 S145 S146 F147 D148 S149 F150 R151 L152 L160 E163 M169 T170 I171 R172 L176 T177 R178 G179 H180 S181 A182 V183 R184 L185 V186 V187 L188 E189 A190 L191 T192 N193 F194 H197 G198 I199 T200 P201 I202 V203 P204 AS#211 D214 L215 S216 P217 Y220 I225 S226
G227 H228 S231 K232 V233 H234 V235 V236 H237 E238 G239 K240 E241 K242 I243 L244 Y245 A246 R247 M250 A251 L252 F253 N254 L255 E256 P257 V258 V259 L260 G261 P262 K263 E264 G265 L266 G267 L268 V269 N270 G271 T272 A273 V274 S275 A276 S277 T280 L281 H284 D285 M288 L289 L292
L296 T297 A298 M299 A303 M304 V305 G306 H307 H316 D317 P321 H322 Q325 K334 L335 L336 R340 F341 A342 V343 H344 H345 E346 E347 E348 VAL LYS VAL LYS ASP ASP GLU GLY ILE LEU R359 Q360 D361 R362 Y363 P364 P369 Q370 W371 L375 V376 L379 I380
H383 L386 T387 S393 T394 T395 I400 D401 V402 E403 N404 K405 T406 A415 V418 T421 M422 E423 K424 T425 L429 A430 Q431 K434 L435 Q439 N445 M448 P453 S454 C455 L456 E459 D460 P461 S462 L463 S464 Y465 H466 L481 T489 M497 A498
N499 A506 S516 V519 L520 S521 L522 L523 L524 L528 V531 L532 I535 D536 L537 R538 A539 I540 E541 F542 E543 F544 K545 F548 G549 P550 A551 I552 V553 S554 L555 I556 D557 F560 G561 S562 A563 M564 T565 G566 S567 N568 L569 R570 D571 E572 L573 V574 E575 K576 V577 N578
L581 L585 T588 N589 S590 Y591 D592 L593 V594 P595 R596 W597 H598 F601 S602 F603 A604 A605 G606 T607 V608 V609 E610 V611 L612 S613 S614 T615 S616 L617 S618 L619 V622 W625 A629 A630 A633 I634 S635 L636 T637 R641 F644 A647 A648 S649 T650 A654
Y657 L658 S659 P660 R661 I664 L665 F668 V669 L673 R678 V682 F683 L684 G685 K686 Q687 E688 V689 T690 I691 I698 I707 N708 N709 V710 L715 A716

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α, β, γ	107.86Å 107.86Å 204.38Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	25.00 – 2.10 24.77 – 2.10	Depositor EDS
% Data completeness (in resolution range)	(Not available) (25.00-2.10) 93.6 (24.77-2.10)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.42 (at 2.10Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.243 , 0.298 0.246 , 0.292	Depositor DCC
R_{free} test set	1934 reflections (2.56%)	wwPDB-VP
Wilson B-factor (Å^2)	31.2	Xtriage
Anisotropy	0.701	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 51.2	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Estimated twinning fraction	0.029 for -h,-k,l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	10300	wwPDB-VP
Average B, all atoms (Å^2)	49.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.17% 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: 175, CIN

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	0.33	0/4995	0.64	0/6756
1	B	0.32	0/4995	0.61	0/6756
All	All	0.32	0/9990	0.63	0/13512

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	2	2
1	B	2	2
All	All	4	4

There are no bond length outliers.

There are no bond angle outliers.

All (4) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	A	211	175	C3,C2
1	B	211	175	C3,C2

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	211	175	Mainchain,Peptide
1	B	211	175	Mainchain,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	4939	0	4995	187	0
1	B	4939	0	4995	244	0
2	B	11	0	6	0	0
3	A	245	0	0	6	0
3	B	166	0	0	17	0
All	All	10300	0	9996	427	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 21.

The worst 5 of 427 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:247:ARG:HH11	1:B:247:ARG:HB3	1.11	1.08
1:A:279:ALA:HA	1:A:422:MSE:HE2	1.42	1.01
1:A:422:MSE:HE3	1:A:510:ALA:HA	1.43	0.99
1:A:593:LEU:HD11	1:A:637:THR:HG21	1.46	0.94
1:A:169:MSE:HE3	1:A:221:ILE:HG23	1.51	0.93

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	640/714 (90%)	587 (92%)	44 (7%)	9 (1%)	11 6

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	B	640/714 (90%)	571 (89%)	51 (8%)	18 (3%)	5 1
All	All	1280/1428 (90%)	1158 (90%)	95 (7%)	27 (2%)	7 3

5 of 27 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	42	VAL
1	B	238	GLU
1	B	360	GLN
1	B	454	SER
1	A	88	ASP

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	538/573 (94%)	516 (96%)	22 (4%)	30 31
1	B	538/573 (94%)	501 (93%)	37 (7%)	15 12
All	All	1076/1146 (94%)	1017 (94%)	59 (6%)	21 19

5 of 59 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	194	PHE
1	B	636	LEU
1	B	289	LEU
1	B	596	ARG
1	B	535	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 40 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	383	HIS
1	B	559	HIS

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Mol	Chain	Res	Type
1	B	392	GLN
1	B	445	ASN
1	B	589	ASN

5.3.3 RNA

There are no RNA molecules in this entry.

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

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	175	A	211	1	12,14,15	1.36	2 (16%)	9,19,21	5.34	3 (33%)
1	175	B	211	1	12,14,15	1.28	1 (8%)	9,19,21	5.31	4 (44%)

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	175	A	211	1	2/2/5/7	0/3/25/26	0/1/1/1
1	175	B	211	1	2/2/5/7	0/3/25/26	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	211	175	C3-C5	-2.98	1.47	1.52
1	B	211	175	C3-C5	-2.88	1.48	1.52
1	A	211	175	O6-C5	2.34	1.26	1.22

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	211	175	C4-C3-N2	13.21	130.64	114.09
1	A	211	175	C4-C3-N2	13.07	130.47	114.09
1	B	211	175	C4-C3-C5	7.60	130.68	112.19
1	A	211	175	C4-C3-C5	7.58	130.65	112.19
1	A	211	175	C-C0-N0	4.02	119.49	112.65

All (4) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	A	211	175	C3
1	A	211	175	C2
1	B	211	175	C3
1	B	211	175	C2

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

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	CIN	B	1001	-	11,11,14	1.63	3 (27%)	13,13,18	0.44	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
2	CIN	B	1001	-	-	0/5/5/9	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1001	CIN	O1'-C3'	2.74	1.30	1.23
2	B	1001	CIN	C2-C1	2.28	1.43	1.39
2	B	1001	CIN	C6-C1	2.15	1.43	1.39

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, 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	633/714 (88%)	0.75	72 (11%)	5 6	22, 42, 88, 103	0
1	B	633/714 (88%)	1.00	116 (18%)	1 1	23, 48, 87, 101	0
All	All	1266/1428 (88%)	0.88	188 (14%)	2 3	22, 45, 88, 103	0

The worst 5 of 188 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	127	ALA	9.4
1	A	124	THR	8.6
1	A	569	LEU	6.2
1	B	254	ASN	6.2
1	B	239	GLY	6.2

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

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
1	175	A	211	14/15	0.89	0.15	36,40,44,44	0
1	175	B	211	14/15	0.90	0.14	37,43,44,45	0

6.3 Carbohydrates

There are no monosaccharides in this entry.

6.4 Ligands

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
2	CIN	B	1001	11/14	0.60	0.35	83,84,85,85	0

6.5 Other polymers

There are no such residues in this entry.