



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 10:56 PM UTC

PDB ID : 1M9C / pdb_00001m9c
Title : X-ray crystal structure of Cyclophilin A/HIV-1 CA N-terminal domain (1-146)
M-type Complex.
Authors : Howard, B.R.; Vajdos, F.F.; Li, S.; Sundquist, W.I.; Hill, C.P.
Deposited on : 2002-07-28
Resolution : 2.00 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

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ 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 ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

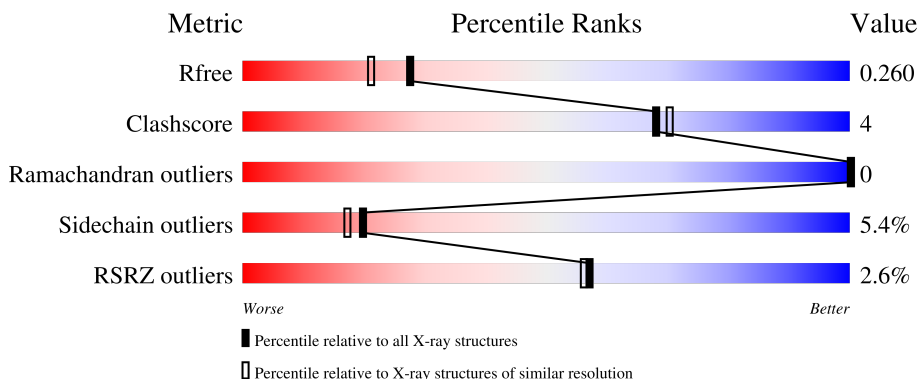
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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}	180053	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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 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 $\leq 5\%$. 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	165	 86% 13% .
1	B	165	 88% 8% . .
2	C	146	 69% 27% .
2	D	146	 69% 21% . . 7%

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 4856 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 Cyclophilin A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	165	Total	C	N	O	S	0	0	0
			1266	802	218	237	9			
1	B	163	Total	C	N	O	S	0	0	0
			1251	792	216	235	8			

- Molecule 2 is a protein called HIV-1 Capsid.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	146	Total	C	N	O	S	15	0	0
			1136	718	200	210	8			
2	D	136	Total	C	N	O	S	10	0	0
			1059	670	186	196	7			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	120	HIS	ASN	see remark 999	UNP Q72497
D	120	HIS	ASN	see remark 999	UNP Q72497

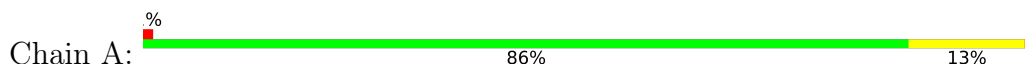
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	59	Total	O	0	0
			59	59		
3	B	30	Total	O	0	0
			30	30		
3	C	40	Total	O	0	0
			40	40		
3	D	15	Total	O	0	0
			15	15		

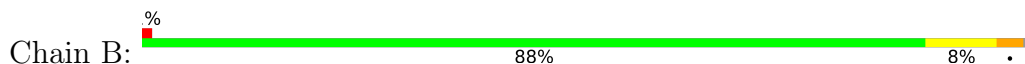
3 Residue-property plots [i](#)

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.

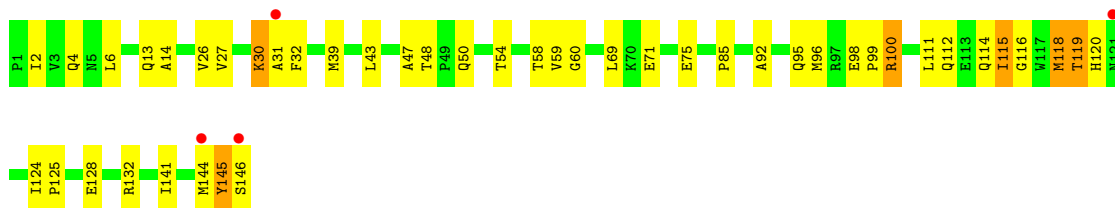
- Molecule 1: Cyclophilin A



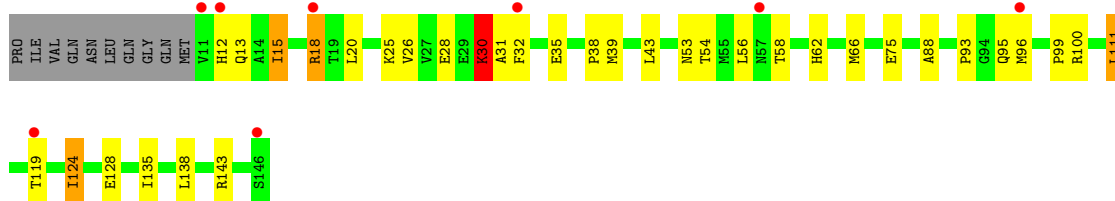
- Molecule 1: Cyclophilin A



- Molecule 2: HIV-1 Capsid



- Molecule 2: HIV-1 Capsid



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	38.45Å 113.23Å 67.01Å 90.00° 100.53° 90.00°	Depositor
Resolution (Å)	37.80 – 2.00 37.80 – 2.00	Depositor EDS
% Data completeness (in resolution range)	83.0 (37.80-2.00) 82.9 (37.80-2.00)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	0.06	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.45 (at 2.00Å)	Xtriage
Refinement program	REFMAC 5.0	Depositor
R, R_{free}	0.195 , 0.259 0.202 , 0.260	Depositor DCC
R_{free} test set	3125 reflections (9.90%)	wwPDB-VP
Wilson B-factor (Å ²)	26.5	Xtriage
Anisotropy	0.742	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 28.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	4856	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.12% 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

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	1.11	1/1294 (0.1%)	1.71	22/1733 (1.3%)
1	B	0.98	0/1279	1.56	8/1713 (0.5%)
2	C	1.24	4/1164 (0.3%)	1.82	18/1583 (1.1%)
2	D	1.54	3/1086 (0.3%)	1.96	20/1478 (1.4%)
All	All	1.22	8/4823 (0.2%)	1.76	68/6507 (1.0%)

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
2	D	0	1

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	31	ALA	C-N	26.75	1.66	1.33
2	D	30	LYS	C-N	24.64	1.62	1.33
2	D	28	GLU	CA-CB	-20.10	1.21	1.53
2	C	112	GLN	CA-CB	16.65	1.79	1.53
2	C	4	GLN	CA-CB	-12.82	1.35	1.53
2	C	118	MET	SD-CE	-11.95	1.49	1.79
1	A	101	ALA	CA-CB	-8.26	1.41	1.53
2	C	14	ALA	CA-CB	5.05	1.61	1.53

All (68) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	30	LYS	O-C-N	-32.97	81.61	123.16
2	C	112	GLN	N-CA-CB	-9.73	95.90	110.01
2	D	28	GLU	N-CA-CB	9.61	124.43	109.82
2	D	124	ILE	N-CA-C	-9.46	98.78	108.15

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	98	GLU	N-CA-C	-7.67	99.98	109.65
2	C	47	ALA	N-CA-C	7.60	121.21	110.50
1	A	48	TYR	N-CA-C	7.25	121.36	112.23
1	A	101	ALA	CA-C-N	-7.23	110.14	123.01
1	A	101	ALA	C-N-CA	-7.23	110.14	123.01
2	D	31	ALA	CA-C-N	-6.88	112.32	122.78
2	D	31	ALA	C-N-CA	-6.88	112.32	122.78
2	D	30	LYS	N-CA-C	-6.76	99.19	109.95
2	C	85	PRO	CA-C-O	6.67	129.30	121.56
1	A	86	GLU	N-CA-C	6.62	118.16	111.07
2	C	115	ILE	N-CA-CB	-6.56	100.74	110.58
2	D	56	LEU	N-CA-C	6.47	119.32	111.82
1	B	118	LYS	N-CA-C	-6.31	99.73	109.76
1	B	157	THR	N-CA-C	6.16	119.68	110.14
1	A	17	LEU	CA-C-O	6.15	128.73	120.13
2	C	100	ARG	NE-CZ-NH1	6.11	127.61	121.50
1	A	69	ARG	CA-C-N	-6.11	113.46	123.05
1	A	69	ARG	C-N-CA	-6.11	113.46	123.05
1	B	23	GLU	CA-C-O	-6.08	113.75	120.69
1	A	18	GLY	N-CA-C	5.94	118.59	110.69
2	C	13	GLN	N-CA-CB	-5.79	100.77	111.53
1	A	5	THR	OG1-CB-CG2	-5.76	97.77	109.30
1	A	164	LEU	CA-C-N	5.76	132.07	121.70
1	A	164	LEU	C-N-CA	5.76	132.07	121.70
2	C	30	LYS	CA-C-O	5.74	126.01	119.18
1	A	15	GLU	CA-C-N	5.74	126.07	119.93
1	A	15	GLU	C-N-CA	5.74	126.07	119.93
2	C	132	ARG	CA-C-O	5.74	127.04	120.90
2	D	62	HIS	CB-CA-C	-5.70	100.63	111.97
1	A	136	MET	N-CA-C	-5.61	105.26	111.71
1	B	5	THR	OG1-CB-CG2	-5.54	98.22	109.30
2	D	75	GLU	N-CA-C	-5.54	105.32	111.36
2	D	35	GLU	N-CA-C	5.54	118.08	111.71
2	D	100	ARG	NE-CZ-NH1	5.52	127.02	121.50
1	A	133	LYS	N-CA-C	-5.51	105.34	112.68
2	C	60	GLY	CA-C-O	-5.50	114.61	121.53
2	C	114	GLN	N-CA-C	-5.48	105.21	111.07
2	D	88	ALA	CA-C-N	5.47	130.45	121.87
2	D	88	ALA	C-N-CA	5.47	130.45	121.87
1	A	19	ARG	NE-CZ-NH2	5.45	124.11	119.20
1	A	17	LEU	N-CA-C	-5.40	105.50	112.68
2	C	115	ILE	CA-C-O	5.33	126.50	120.85

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	43	LEU	N-CA-C	5.31	119.39	113.01
1	B	20	VAL	CB-CA-C	-5.29	101.56	110.71
1	B	3	ASN	N-CA-CB	-5.28	101.53	110.50
1	B	48	TYR	N-CA-C	5.28	117.94	111.82
2	C	96	MET	CB-CG-SD	-5.26	96.93	112.70
2	C	100	ARG	NE-CZ-NH2	-5.25	114.48	119.20
2	D	38	PRO	N-CA-C	-5.24	106.57	113.65
2	D	18	ARG	CB-CG-CD	5.21	123.29	111.30
2	D	99	PRO	CA-C-O	-5.18	115.69	121.23
2	D	58	THR	N-CA-C	-5.17	106.48	112.89
1	A	148	ARG	N-CA-C	5.15	116.89	111.28
1	A	120	GLU	CG-CD-OE2	-5.11	106.65	118.40
2	C	99	PRO	CA-C-O	-5.11	115.18	121.31
2	D	53	ASN	CA-C-N	-5.10	113.44	120.28
2	D	53	ASN	C-N-CA	-5.10	113.44	120.28
1	A	134	GLU	CA-CB-CG	5.10	124.30	114.10
2	C	2	ILE	N-CA-CB	-5.06	105.21	110.72
1	A	15	GLU	CA-C-O	-5.04	115.52	119.66
2	C	145	TYR	N-CA-C	-5.03	105.62	112.26
1	A	160	ASP	N-CA-CB	-5.01	103.64	111.56
1	B	3	ASN	N-CA-C	-5.01	96.97	111.00
2	D	66	MET	CG-SD-CE	-5.01	89.89	100.90

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	D	30	LYS	Mainchain

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	1266	0	1237	4	0
1	B	1251	0	1216	9	0
2	C	1136	0	1135	15	0
2	D	1059	0	1052	7	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	59	0	0	0	0
3	B	30	0	0	0	0
3	C	40	0	0	1	0
3	D	15	0	0	0	0
All	All	4856	0	4640	33	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 4.

All (33) 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:31:LYS:NZ	1:B:84:GLU:OE2	2.01	0.93
2:D:30:LYS:O	2:D:32:PHE:N	2.03	0.91
2:C:48:THR:HG22	2:C:118:MET:HE1	1.71	0.72
2:D:26:VAL:HG21	2:D:39:MET:HG2	1.73	0.70
2:C:100:ARG:HD3	3:C:155:HOH:O	1.95	0.66
2:D:12:HIS:CE1	2:D:111:LEU:HD11	2.31	0.66
2:C:32:PHE:O	2:C:145:TYR:HB2	2.04	0.58
1:B:3:ASN:HB3	1:B:24:LEU:O	2.03	0.58
2:C:50:GLN:HE22	2:C:111:LEU:HD22	1.69	0.57
2:C:54:THR:O	2:C:58:THR:HG23	2.04	0.57
2:C:69:LEU:HB2	2:C:141:ILE:HD11	1.88	0.56
1:B:98:LEU:HG	1:B:129:PHE:CZ	2.45	0.51
1:B:71:ASN:HD22	1:B:71:ASN:C	2.19	0.50
1:B:61:MET:O	1:B:61:MET:HE3	2.12	0.49
2:C:27:VAL:HG11	2:C:59:VAL:HG13	1.94	0.49
1:B:84:GLU:H	1:B:84:GLU:CD	2.20	0.49
2:C:26:VAL:HG21	2:C:39:MET:HG2	1.95	0.49
2:C:115:ILE:O	2:C:119:THR:HB	2.13	0.48
1:B:60:PHE:CD2	2:C:92:ALA:HB2	2.51	0.46
1:B:76:LYS:O	1:B:110:SER:HB3	2.16	0.45
2:C:125:PRO:HB2	2:C:128:GLU:HB3	1.97	0.45
1:A:61:MET:HE3	1:A:61:MET:O	2.17	0.44
2:C:71:GLU:O	2:C:75:GLU:HG3	2.18	0.44
1:A:15:GLU:HA	1:A:16:PRO:HD2	1.82	0.43
2:C:30:LYS:O	2:C:31:ALA:C	2.57	0.43
2:D:39:MET:O	2:D:43:LEU:HG	2.18	0.43
2:D:96:MET:HE2	2:D:96:MET:HB3	1.93	0.42
1:A:102:ASN:OD1	1:A:102:ASN:C	2.62	0.42
2:D:15:ILE:HD11	2:D:54:THR:HB	2.02	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:66:ASP:C	1:A:66:ASP:OD1	2.62	0.42
2:D:138:LEU:HA	2:D:138:LEU:HD23	1.85	0.41
2:C:116:GLY:O	2:C:120:HIS:HB2	2.20	0.41
1:B:60:PHE:CE2	2:C:92:ALA:HB2	2.56	0.41

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	163/165 (99%)	156 (96%)	7 (4%)	0	100	100
1	B	161/165 (98%)	153 (95%)	8 (5%)	0	100	100
2	C	144/146 (99%)	139 (96%)	5 (4%)	0	100	100
2	D	134/146 (92%)	131 (98%)	3 (2%)	0	100	100
All	All	602/622 (97%)	579 (96%)	23 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	133/133 (100%)	130 (98%)	3 (2%)	44	49
1	B	131/133 (98%)	126 (96%)	5 (4%)	29	29

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	C	123/123 (100%)	117 (95%)	6 (5%)	22	20
2	D	114/123 (93%)	101 (89%)	13 (11%)	5	3
All	All	501/512 (98%)	474 (95%)	27 (5%)	20	17

All (27) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	29	VAL
1	A	131	LYS
1	B	20	VAL
1	B	24	LEU
1	B	29	VAL
1	B	71	ASN
1	B	84	GLU
2	C	6	LEU
2	C	95	GLN
2	C	119	THR
2	C	124	ILE
2	C	144	MET
2	C	146	SER
2	D	13	GLN
2	D	15	ILE
2	D	18	ARG
2	D	20	LEU
2	D	25	LYS
2	D	93	PRO
2	D	95	GLN
2	D	111	LEU
2	D	119	THR
2	D	124	ILE
2	D	128	GLU
2	D	135	ILE
2	D	143	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	71	ASN
2	C	21	ASN

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Mol	Chain	Res	Type
2	C	50	GLN
2	C	74	ASN
2	D	13	GLN
2	D	67	GLN
2	D	84	HIS
2	D	121	ASN

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
2	D	2

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	D	31:ALA	C	32:PHE	N	1.66

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Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	D	30:LYS	C	31:ALA	N	1.63

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, 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	165/165 (100%)	-0.26	2 (1%) 76 76	16, 24, 37, 58	0
1	B	163/165 (98%)	0.07	2 (1%) 76 76	20, 31, 46, 55	0
2	C	146/146 (100%)	0.16	4 (2%) 56 55	12, 30, 49, 69	3 (2%)
2	D	135/146 (92%)	0.59	8 (5%) 28 27	23, 38, 65, 81	1 (0%)
All	All	609/622 (97%)	0.12	16 (2%) 57 56	12, 30, 50, 81	4 (0%)

All (16) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	C	146	SER	4.6
2	D	11	VAL	3.8
2	D	12	HIS	3.5
1	A	1	MET	3.1
2	C	121	ASN	2.9
1	A	165	GLU	2.9
1	B	101	ALA	2.6
2	C	144	MET	2.6
2	D	57	ASN	2.6
1	B	117	ALA	2.6
2	D	32	PHE	2.6
2	D	96	MET	2.5
2	D	18	ARG	2.5
2	C	31	ALA	2.3
2	D	119	THR	2.2
2	D	146	SER	2.2

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 [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.