



wwPDB EM Validation Summary Report i

Jan 14, 2026 – 04:14 PM JST

PDB ID : 9VDP / pdb_00009vdp
EMDB ID : EMD-64991
Title : Cryo-EM structure of the hexameric DRT4
Authors : Wang, Y.; Deng, Z.
Deposited on : 2025-06-09
Resolution : 2.27 Å (reported)

This is a wwPDB EM 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/EMValidationReportHelp>

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:

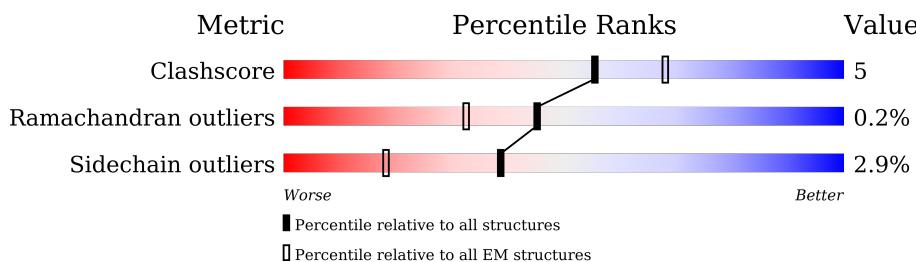
EMDB validation analysis : **FAILED**
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
EM percentile statistics : **NOT EXECUTED**
MapQ : **FAILED**
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.47

1 Overall quality at a glance

The following experimental techniques were used to determine the structure:
ELECTRON MICROSCOPY

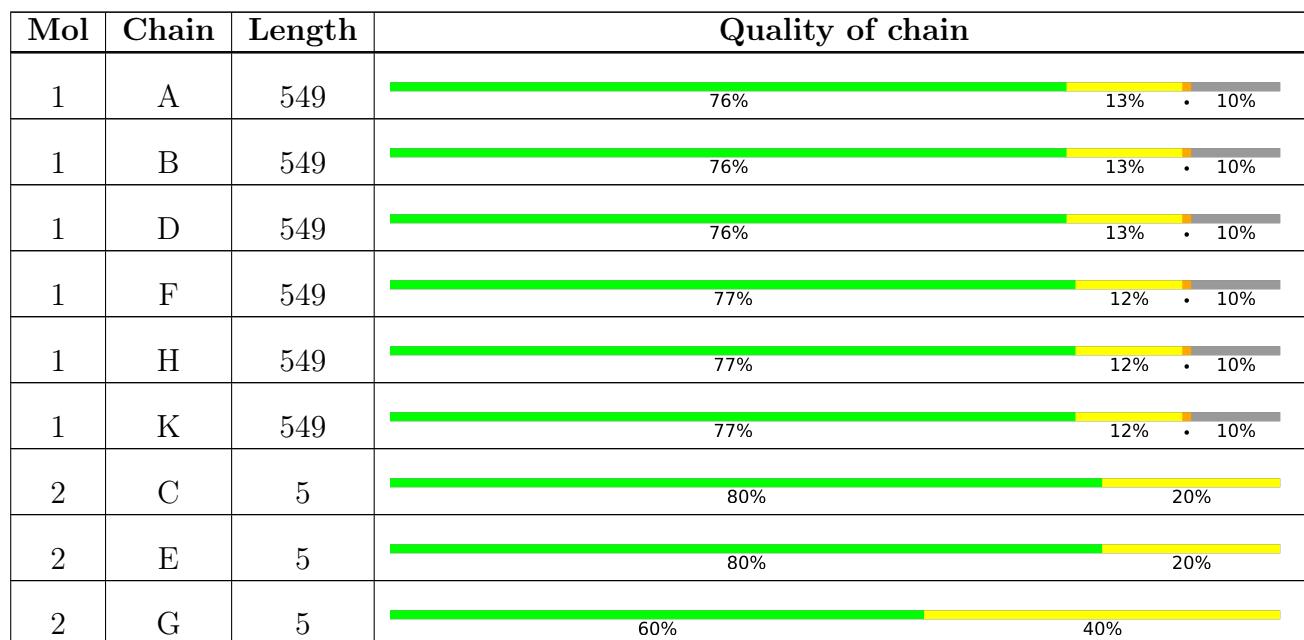
The reported resolution of this entry is 2.27 Å.

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.



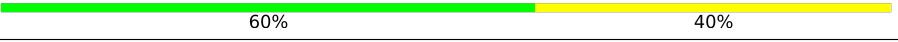
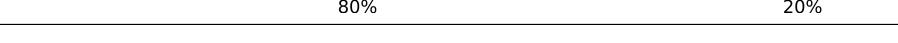
Metric	Whole archive (#Entries)	EM structures (#Entries)
Clashscore	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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 $\leq 5\%$



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Mol	Chain	Length	Quality of chain
2	I	5	 60% 40%
2	J	5	 60% 40%
2	L	5	 80% 20%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 24888 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, 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 Reverse transcriptase domain-containing protein.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	494	Total	C	N	O	S	0	0
			4049	2589	670	768	22		
1	B	494	Total	C	N	O	S	0	0
			4049	2589	670	768	22		
1	D	494	Total	C	N	O	S	0	0
			4049	2589	670	768	22		
1	F	494	Total	C	N	O	S	0	0
			4049	2589	670	768	22		
1	H	494	Total	C	N	O	S	0	0
			4049	2589	670	768	22		
1	K	494	Total	C	N	O	S	0	0
			4049	2589	670	768	22		

There are 54 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-8	HIS	-	expression tag	UNP A0A628R156
A	-7	HIS	-	expression tag	UNP A0A628R156
A	-6	HIS	-	expression tag	UNP A0A628R156
A	-5	HIS	-	expression tag	UNP A0A628R156
A	-4	HIS	-	expression tag	UNP A0A628R156
A	-3	HIS	-	expression tag	UNP A0A628R156
A	-2	SER	-	expression tag	UNP A0A628R156
A	-1	SER	-	expression tag	UNP A0A628R156
A	0	GLY	-	expression tag	UNP A0A628R156
B	-8	HIS	-	expression tag	UNP A0A628R156
B	-7	HIS	-	expression tag	UNP A0A628R156
B	-6	HIS	-	expression tag	UNP A0A628R156
B	-5	HIS	-	expression tag	UNP A0A628R156
B	-4	HIS	-	expression tag	UNP A0A628R156
B	-3	HIS	-	expression tag	UNP A0A628R156
B	-2	SER	-	expression tag	UNP A0A628R156
B	-1	SER	-	expression tag	UNP A0A628R156
B	0	GLY	-	expression tag	UNP A0A628R156

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Chain	Residue	Modelled	Actual	Comment	Reference
D	-8	HIS	-	expression tag	UNP A0A628R156
D	-7	HIS	-	expression tag	UNP A0A628R156
D	-6	HIS	-	expression tag	UNP A0A628R156
D	-5	HIS	-	expression tag	UNP A0A628R156
D	-4	HIS	-	expression tag	UNP A0A628R156
D	-3	HIS	-	expression tag	UNP A0A628R156
D	-2	SER	-	expression tag	UNP A0A628R156
D	-1	SER	-	expression tag	UNP A0A628R156
D	0	GLY	-	expression tag	UNP A0A628R156
F	-8	HIS	-	expression tag	UNP A0A628R156
F	-7	HIS	-	expression tag	UNP A0A628R156
F	-6	HIS	-	expression tag	UNP A0A628R156
F	-5	HIS	-	expression tag	UNP A0A628R156
F	-4	HIS	-	expression tag	UNP A0A628R156
F	-3	HIS	-	expression tag	UNP A0A628R156
F	-2	SER	-	expression tag	UNP A0A628R156
F	-1	SER	-	expression tag	UNP A0A628R156
F	0	GLY	-	expression tag	UNP A0A628R156
H	-8	HIS	-	expression tag	UNP A0A628R156
H	-7	HIS	-	expression tag	UNP A0A628R156
H	-6	HIS	-	expression tag	UNP A0A628R156
H	-5	HIS	-	expression tag	UNP A0A628R156
H	-4	HIS	-	expression tag	UNP A0A628R156
H	-3	HIS	-	expression tag	UNP A0A628R156
H	-2	SER	-	expression tag	UNP A0A628R156
H	-1	SER	-	expression tag	UNP A0A628R156
H	0	GLY	-	expression tag	UNP A0A628R156
K	-8	HIS	-	expression tag	UNP A0A628R156
K	-7	HIS	-	expression tag	UNP A0A628R156
K	-6	HIS	-	expression tag	UNP A0A628R156
K	-5	HIS	-	expression tag	UNP A0A628R156
K	-4	HIS	-	expression tag	UNP A0A628R156
K	-3	HIS	-	expression tag	UNP A0A628R156
K	-2	SER	-	expression tag	UNP A0A628R156
K	-1	SER	-	expression tag	UNP A0A628R156
K	0	GLY	-	expression tag	UNP A0A628R156

- Molecule 2 is a DNA chain called DNA (5'-D(P*CP*CP*CP*AP*A)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
2	I	5	Total	C	N	O	P	0	0
			99	47	19	28	5		

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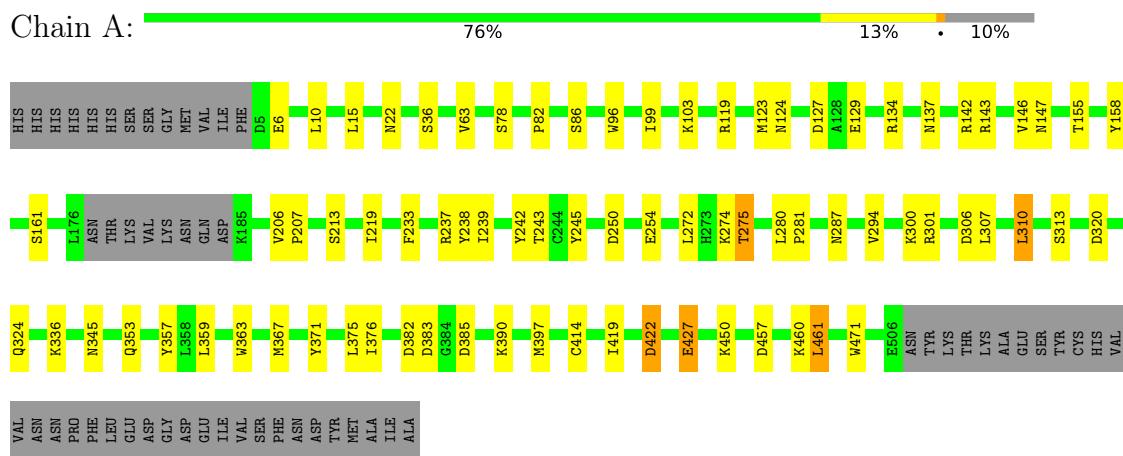
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Mol	Chain	Residues	Atoms					AltConf	Trace
2	C	5	Total	C	N	O	P	0	0
			99	47	19	28	5		
2	E	5	Total	C	N	O	P	0	0
			99	47	19	28	5		
2	G	5	Total	C	N	O	P	0	0
			99	47	19	28	5		
2	J	5	Total	C	N	O	P	0	0
			99	47	19	28	5		
2	L	5	Total	C	N	O	P	0	0
			99	47	19	28	5		

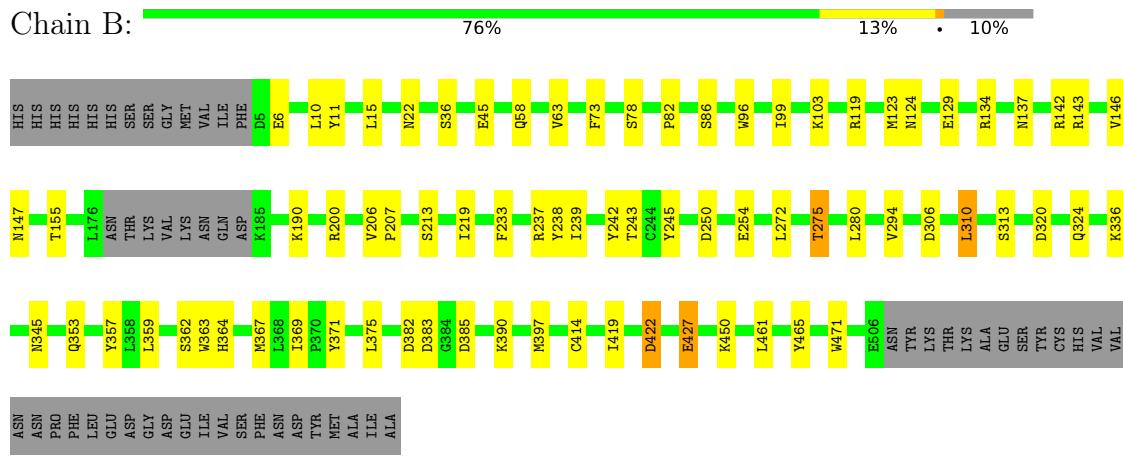
3 Residue-property plots [i](#)

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. 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. 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: Reverse transcriptase domain-containing protein

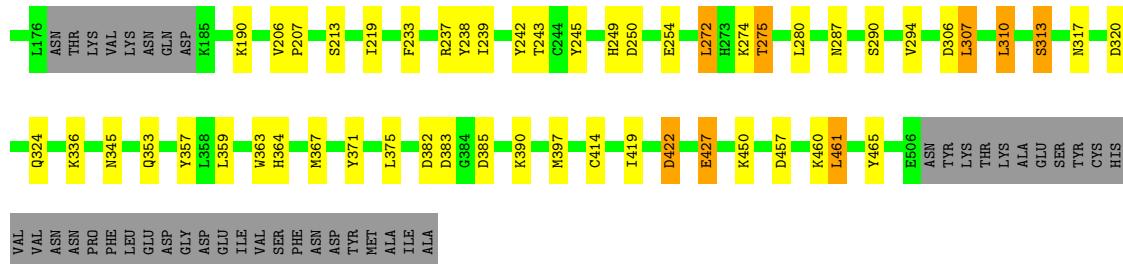


- Molecule 1: Reverse transcriptase domain-containing protein



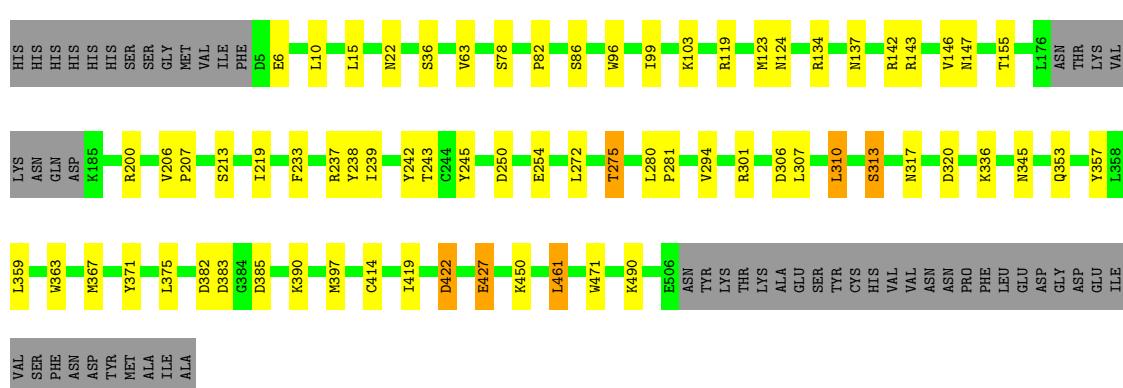
- Molecule 1: Reverse transcriptase domain-containing protein





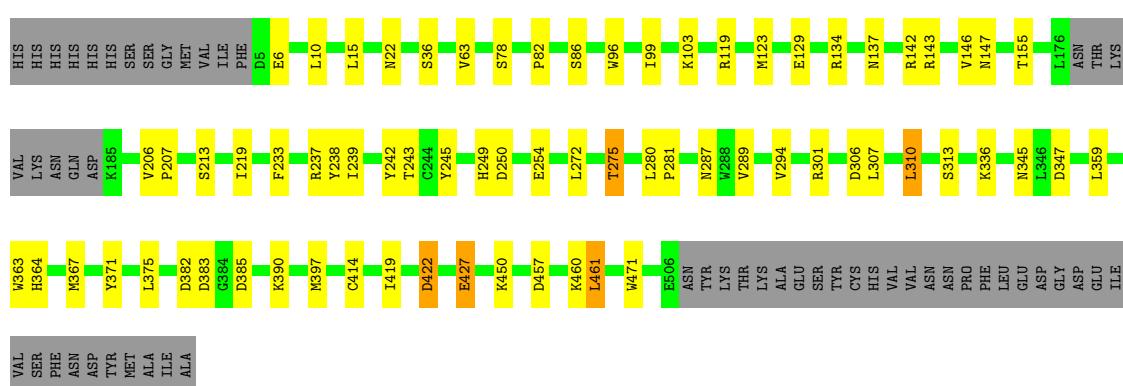
- Molecule 1: Reverse transcriptase domain-containing protein

Chain F:



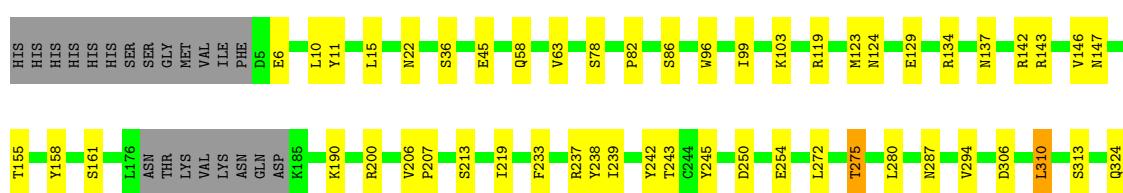
- Molecule 1: Reverse transcriptase domain-containing protein

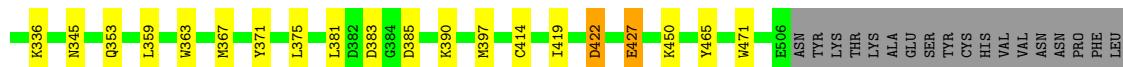
Chain H



- Molecule 1: Reverse transcriptase domain-containing protein

Chain K





- Molecule 2: DNA (5'-D(P*CP*CP*CP*AP*A)-3')

Chain I: 



- Molecule 2: DNA (5'-D(P*CP*CP*CP*AP*A)-3')

Chain C: 



- Molecule 2: DNA (5'-D(P*CP*CP*CP*AP*A)-3')

Chain E: 



- Molecule 2: DNA (5'-D(P*CP*CP*CP*AP*A)-3')

Chain G: 

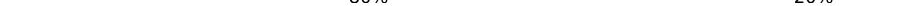


- Molecule 2: DNA (5'-D(P*CP*CP*CP*AP*A)-3')

Chain J: 



- Molecule 2: DNA (5'-D(P*CP*CP*CP*AP*A)-3')

Chain L: 



4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	306468	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING ONLY	Depositor
Microscope	JEOL CRYO ARM 300	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	40	Depositor
Minimum defocus (nm)	500	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor

5 Model quality i

5.1 Standard geometry i

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	0.17	0/4146	0.41	1/5612 (0.0%)
1	B	0.17	0/4146	0.41	1/5612 (0.0%)
1	D	0.17	0/4146	0.41	1/5612 (0.0%)
1	F	0.17	0/4146	0.41	1/5612 (0.0%)
1	H	0.17	0/4146	0.41	1/5612 (0.0%)
1	K	0.17	0/4146	0.41	1/5612 (0.0%)
2	C	0.35	0/110	0.68	0/166
2	E	0.35	0/110	0.68	0/166
2	G	0.34	0/110	0.68	0/166
2	I	0.35	0/110	0.68	0/166
2	J	0.35	0/110	0.68	0/166
2	L	0.34	0/110	0.68	0/166
All	All	0.17	0/25536	0.42	6/34668 (0.0%)

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	H	383	ASP	CB-CA-C	-6.05	109.59	116.54
1	A	383	ASP	CB-CA-C	-6.04	109.59	116.54
1	F	383	ASP	CB-CA-C	-6.03	109.61	116.54
1	D	383	ASP	CB-CA-C	-6.02	109.62	116.54
1	K	383	ASP	CB-CA-C	-6.02	109.62	116.54

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	4049	0	3936	47	0
1	B	4049	0	3936	40	0
1	D	4049	0	3936	48	0
1	F	4049	0	3936	38	0
1	H	4049	0	3936	39	0
1	K	4049	0	3936	39	0
2	C	99	0	56	1	0
2	E	99	0	56	1	0
2	G	99	0	56	2	0
2	I	99	0	56	2	0
2	J	99	0	56	2	0
2	L	99	0	56	1	0
All	All	24888	0	23952	233	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 5.

The worst 5 of 233 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:D:124:ASN:ND2	2:E:8:DA:N7	2.34	0.76
1:A:124:ASN:ND2	2:I:8:DA:N7	2.43	0.66
1:D:129:GLU:OE1	1:K:353:GLN:NE2	2.29	0.65
1:F:147:ASN:O	1:F:275:THR:HA	1.99	0.63
1:K:147:ASN:O	1:K:275:THR:HA	1.99	0.63

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 PDB entries followed by that with respect to all EM entries.

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	490/549 (89%)	472 (96%)	17 (4%)	1 (0%)	44 53
1	B	490/549 (89%)	472 (96%)	17 (4%)	1 (0%)	44 53
1	D	490/549 (89%)	472 (96%)	17 (4%)	1 (0%)	44 53
1	F	490/549 (89%)	472 (96%)	17 (4%)	1 (0%)	44 53
1	H	490/549 (89%)	472 (96%)	17 (4%)	1 (0%)	44 53
1	K	490/549 (89%)	472 (96%)	17 (4%)	1 (0%)	44 53
All	All	2940/3294 (89%)	2832 (96%)	102 (4%)	6 (0%)	45 53

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	239	ILE
1	B	239	ILE
1	D	239	ILE
1	F	239	ILE
1	H	239	ILE

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 PDB entries followed by that with respect to all EM entries.

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	452/502 (90%)	439 (97%)	13 (3%)	37 51
1	B	452/502 (90%)	439 (97%)	13 (3%)	37 51
1	D	452/502 (90%)	438 (97%)	14 (3%)	35 49
1	F	452/502 (90%)	438 (97%)	14 (3%)	35 49
1	H	452/502 (90%)	438 (97%)	14 (3%)	35 49
1	K	452/502 (90%)	440 (97%)	12 (3%)	40 54
All	All	2712/3012 (90%)	2632 (97%)	80 (3%)	39 51

5 of 80 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	H	272	LEU

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Mol	Chain	Res	Type
1	K	272	LEU
1	H	294	VAL
1	H	422	ASP
1	K	313	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 39 such sidechains are listed below:

Mol	Chain	Res	Type
1	H	295	ASN
1	K	293	ASN
1	H	326	ASN
1	K	58	GLN
1	K	326	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 [\(i\)](#)

There are no chain breaks in this entry.