



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 10:08 PM UTC

PDB ID : 3H4E / pdb\_00003h4e  
Title : X-ray Structure of Hexameric HIV-1 CA  
Authors : Pornillos, O.  
Deposited on : 2009-04-19  
Resolution : 2.70 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](mailto: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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0  
Xtrriage (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

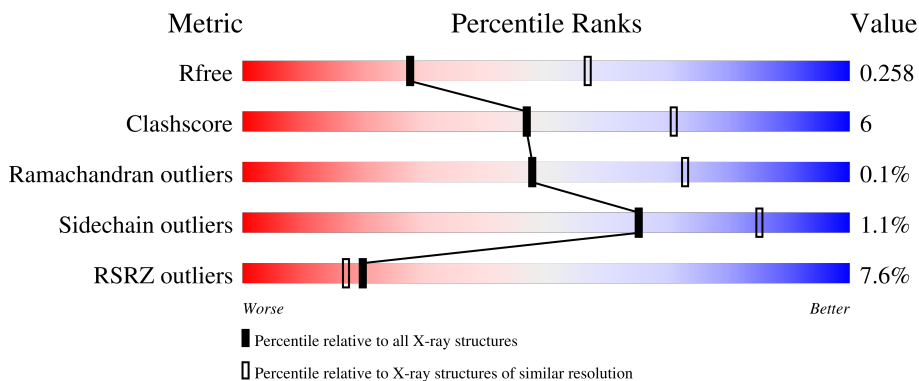
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.70 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	3538 (2.70-2.70)
Clashscore	190562	3843 (2.70-2.70)
Ramachandran outliers	187476	3778 (2.70-2.70)
Sidechain outliers	187428	3778 (2.70-2.70)
RSRZ outliers	180081	3538 (2.70-2.70)

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  $\geq 3$ , 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	231	
1	B	231	
1	C	231	
1	D	231	
1	E	231	

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Mol	Chain	Length	Quality of chain
1	F	231	<p>4% 80% 14% 5%</p>
1	G	231	<p>5% 81% 13% 6%</p>
1	H	231	<p>7% 75% 14% 10%</p>
1	I	231	<p>7% 78% 13% 9%</p>
1	J	231	<p>10% 76% 15% 7%</p>
1	K	231	<p>8% 75% 10% 14%</p>
1	L	231	<p>5% 79% 10% 11%</p>

## 2 Entry composition [i](#)

There is only 1 type of molecule in this entry. The entry contains 19082 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 Capsid protein p24.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	218	Total 1632	C 1028	N 284	O 306	S 14	0	0	0
1	B	204	Total 1564	C 986	N 271	O 293	S 14	0	0	0
1	C	212	Total 1618	C 1015	N 283	O 306	S 14	0	0	0
1	D	200	Total 1522	C 955	N 266	O 287	S 14	0	0	0
1	E	207	Total 1574	C 991	N 273	O 297	S 13	0	0	0
1	F	219	Total 1661	C 1044	N 290	O 313	S 14	0	0	0
1	G	218	Total 1652	C 1037	N 288	O 313	S 14	0	0	0
1	H	208	Total 1587	C 999	N 278	O 296	S 14	0	0	0
1	I	211	Total 1588	C 1005	N 273	O 296	S 14	0	0	0
1	J	214	Total 1630	C 1022	N 286	O 308	S 14	0	0	0
1	K	198	Total 1509	C 950	N 262	O 283	S 14	0	0	0
1	L	205	Total 1545	C 973	N 265	O 294	S 13	0	0	0

There are 48 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	14	CYS	ALA	engineered mutation	UNP P12497
A	45	CYS	GLU	engineered mutation	UNP P12497
A	184	ALA	TRP	engineered mutation	UNP P12497
A	185	ALA	MET	engineered mutation	UNP P12497
B	14	CYS	ALA	engineered mutation	UNP P12497

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Chain	Residue	Modelled	Actual	Comment	Reference
B	45	CYS	GLU	engineered mutation	UNP P12497
B	184	ALA	TRP	engineered mutation	UNP P12497
B	185	ALA	MET	engineered mutation	UNP P12497
C	14	CYS	ALA	engineered mutation	UNP P12497
C	45	CYS	GLU	engineered mutation	UNP P12497
C	184	ALA	TRP	engineered mutation	UNP P12497
C	185	ALA	MET	engineered mutation	UNP P12497
D	14	CYS	ALA	engineered mutation	UNP P12497
D	45	CYS	GLU	engineered mutation	UNP P12497
D	184	ALA	TRP	engineered mutation	UNP P12497
D	185	ALA	MET	engineered mutation	UNP P12497
E	14	CYS	ALA	engineered mutation	UNP P12497
E	45	CYS	GLU	engineered mutation	UNP P12497
E	184	ALA	TRP	engineered mutation	UNP P12497
E	185	ALA	MET	engineered mutation	UNP P12497
F	14	CYS	ALA	engineered mutation	UNP P12497
F	45	CYS	GLU	engineered mutation	UNP P12497
F	184	ALA	TRP	engineered mutation	UNP P12497
F	185	ALA	MET	engineered mutation	UNP P12497
G	14	CYS	ALA	engineered mutation	UNP P12497
G	45	CYS	GLU	engineered mutation	UNP P12497
G	184	ALA	TRP	engineered mutation	UNP P12497
G	185	ALA	MET	engineered mutation	UNP P12497
H	14	CYS	ALA	engineered mutation	UNP P12497
H	45	CYS	GLU	engineered mutation	UNP P12497
H	184	ALA	TRP	engineered mutation	UNP P12497
H	185	ALA	MET	engineered mutation	UNP P12497
I	14	CYS	ALA	engineered mutation	UNP P12497
I	45	CYS	GLU	engineered mutation	UNP P12497
I	184	ALA	TRP	engineered mutation	UNP P12497
I	185	ALA	MET	engineered mutation	UNP P12497
J	14	CYS	ALA	engineered mutation	UNP P12497
J	45	CYS	GLU	engineered mutation	UNP P12497
J	184	ALA	TRP	engineered mutation	UNP P12497
J	185	ALA	MET	engineered mutation	UNP P12497
K	14	CYS	ALA	engineered mutation	UNP P12497
K	45	CYS	GLU	engineered mutation	UNP P12497
K	184	ALA	TRP	engineered mutation	UNP P12497
K	185	ALA	MET	engineered mutation	UNP P12497
L	14	CYS	ALA	engineered mutation	UNP P12497
L	45	CYS	GLU	engineered mutation	UNP P12497
L	184	ALA	TRP	engineered mutation	UNP P12497

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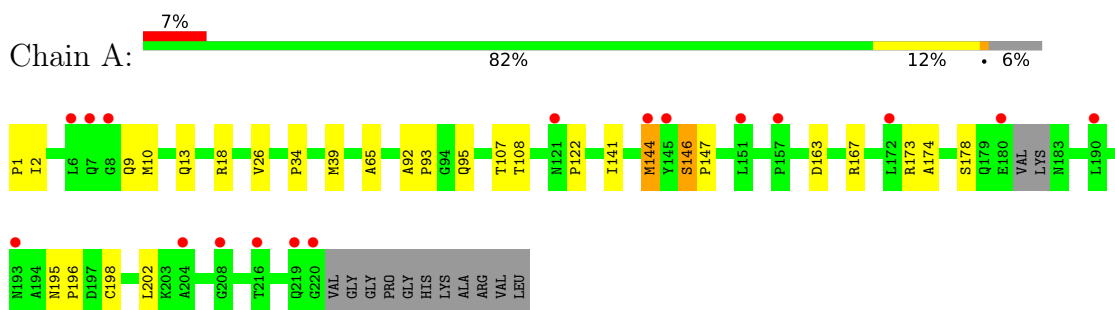
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<b>Chain</b>	<b>Residue</b>	<b>Modelled</b>	<b>Actual</b>	<b>Comment</b>	<b>Reference</b>
L	185	ALA	MET	engineered mutation	UNP P12497

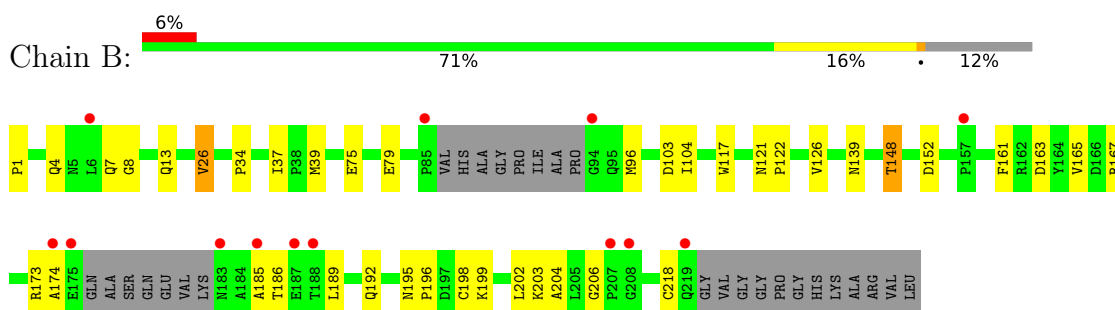
### 3 Residue-property plots [i](#)

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.

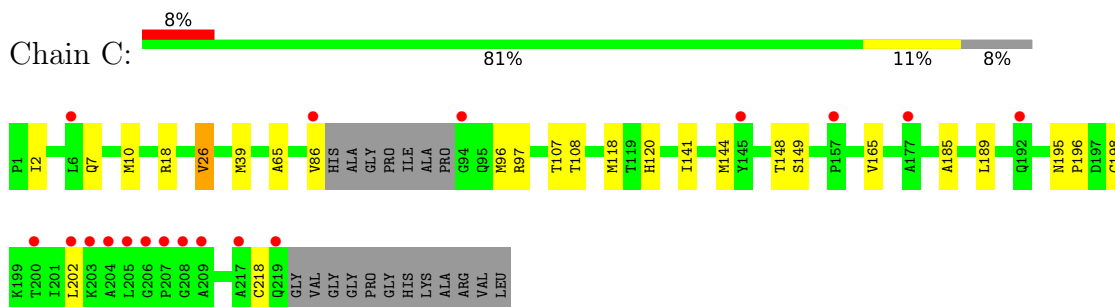
- Molecule 1: Capsid protein p24



- Molecule 1: Capsid protein p24

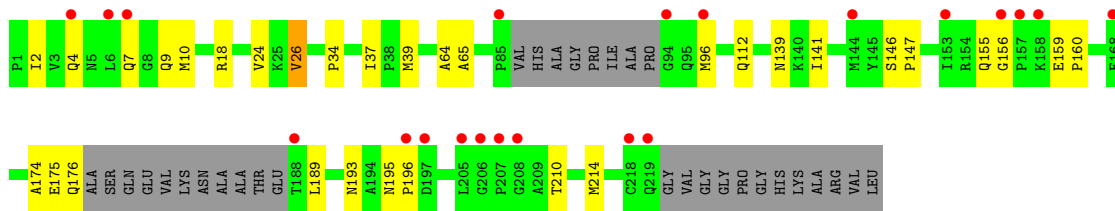


- Molecule 1: Capsid protein p24

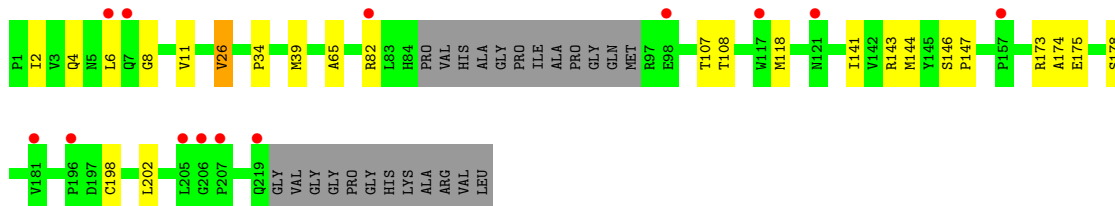
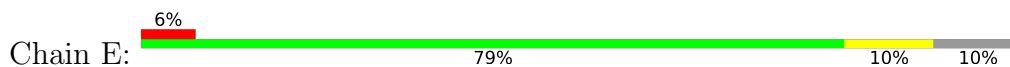


- Molecule 1: Capsid protein p24

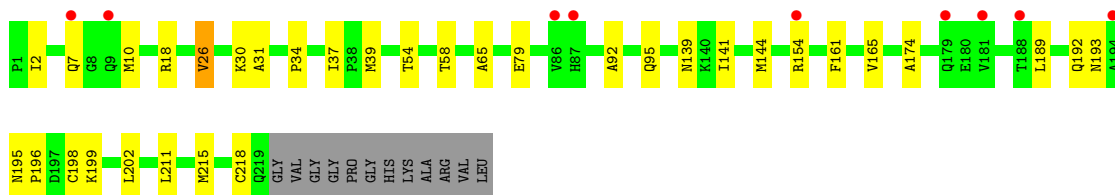
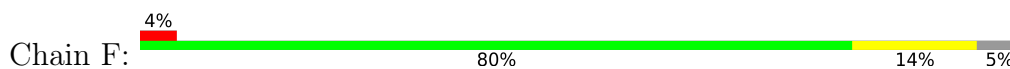




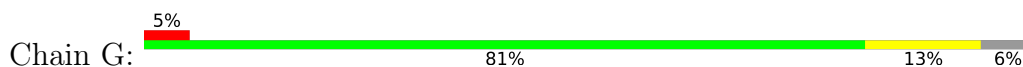
- Molecule 1: Capsid protein p24



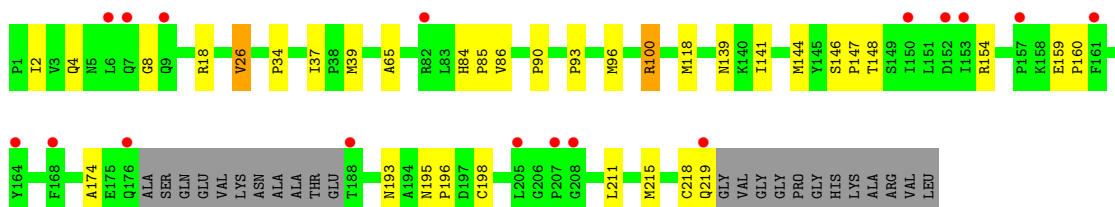
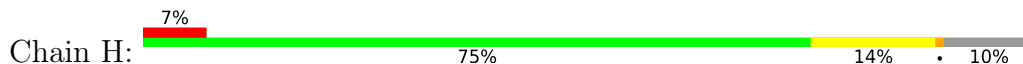
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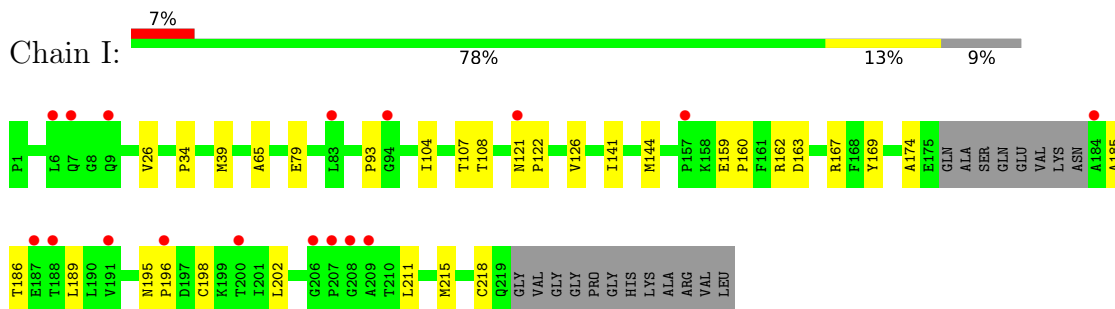
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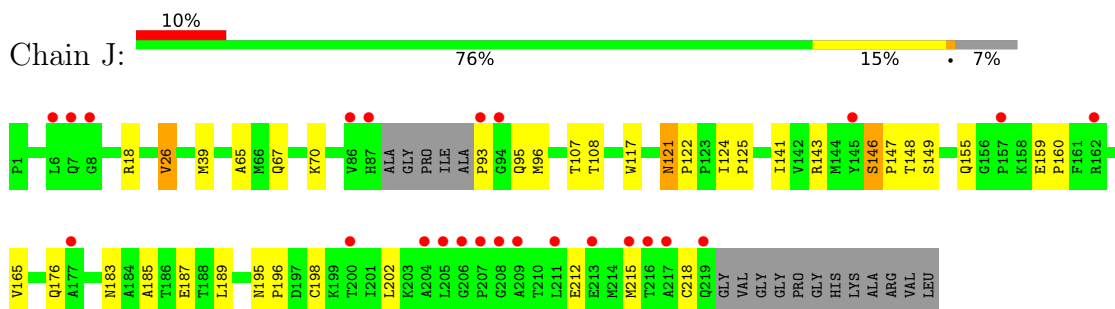
- Molecule 1: Capsid protein p24



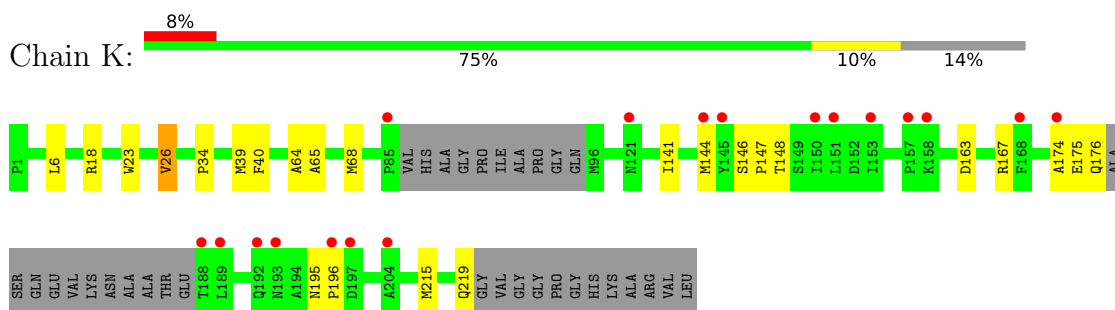
- Molecule 1: Capsid protein p24



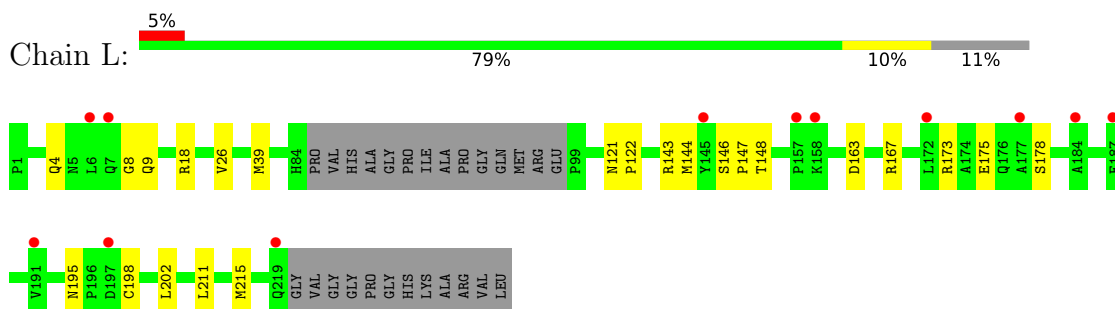
- Molecule 1: Capsid protein p24



- Molecule 1: Capsid protein p24



- Molecule 1: Capsid protein p24



## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	136.06Å 136.66Å 208.45Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	34.74 – 2.70 34.74 – 2.70	Depositor EDS
% Data completeness (in resolution range)	95.9 (34.74-2.70) 95.8 (34.74-2.70)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.32 (at 2.72Å)	Xtrriage
Refinement program	PHENIX (phenix.refine)	Depositor
R, $R_{free}$	0.238 , 0.263 (Not available) , 0.258	Depositor DCC
$R_{free}$ test set	2565 reflections (2.51%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	53.3	Xtrriage
Anisotropy	0.085	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 26.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	0.027 for k,h,-l	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	19082	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	56.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.98% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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](#)

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	0.47	0/1668	0.81	2/2273 (0.1%)
1	B	0.46	0/1596	0.78	0/2168
1	C	0.46	0/1651	0.78	0/2246
1	D	0.47	0/1554	0.79	0/2112
1	E	0.48	0/1606	0.76	0/2185
1	F	0.46	0/1697	0.77	0/2310
1	G	0.44	0/1687	0.80	0/2297
1	H	0.44	0/1623	0.76	0/2210
1	I	0.47	0/1624	0.80	0/2213
1	J	0.46	0/1664	0.81	2/2263 (0.1%)
1	K	0.46	0/1541	0.75	0/2096
1	L	0.46	0/1577	0.75	0/2148
All	All	0.46	0/19488	0.78	4/26521 (0.0%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	J	146	SER	CA-C-N	8.81	128.52	119.19
1	J	146	SER	C-N-CA	8.81	128.52	119.19
1	A	146	SER	CA-C-N	7.28	128.53	120.45
1	A	146	SER	C-N-CA	7.28	128.53	120.45

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	1632	0	1575	20	0
1	B	1564	0	1533	27	0
1	C	1618	0	1573	18	0
1	D	1522	0	1455	19	0
1	E	1574	0	1532	14	1
1	F	1661	0	1612	23	0
1	G	1652	0	1604	20	0
1	H	1587	0	1546	22	0
1	I	1588	0	1544	21	0
1	J	1630	0	1583	26	1
1	K	1509	0	1452	18	0
1	L	1545	0	1483	14	0
All	All	19082	0	18492	213	1

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 6.

The worst 5 of 213 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:J:212:GLU:HG3	1:K:144:MET:SD	2.10	0.91
1:H:4:GLN:NE2	1:H:8:GLY:HA2	1.89	0.88
1:C:96:MET:HE2	1:H:93:PRO:HA	1.59	0.85
1:B:199:LYS:O	1:B:203:LYS:HG3	1.76	0.84
1:H:154:ARG:HG2	1:H:193:ASN:HB3	1.68	0.75

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:82:ARG:NH1	1:J:155:GLN:O[3_454]	2.16	0.04

## 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	214/231 (93%)	212 (99%)	2 (1%)	0	100	100
1	B	198/231 (86%)	194 (98%)	3 (2%)	1 (0%)	24	48
1	C	208/231 (90%)	205 (99%)	3 (1%)	0	100	100
1	D	194/231 (84%)	191 (98%)	3 (2%)	0	100	100
1	E	203/231 (88%)	197 (97%)	6 (3%)	0	100	100
1	F	217/231 (94%)	210 (97%)	7 (3%)	0	100	100
1	G	214/231 (93%)	209 (98%)	5 (2%)	0	100	100
1	H	204/231 (88%)	201 (98%)	3 (2%)	0	100	100
1	I	207/231 (90%)	203 (98%)	3 (1%)	1 (0%)	24	48
1	J	210/231 (91%)	206 (98%)	4 (2%)	0	100	100
1	K	192/231 (83%)	190 (99%)	2 (1%)	0	100	100
1	L	201/231 (87%)	197 (98%)	4 (2%)	0	100	100
All	All	2462/2772 (89%)	2415 (98%)	45 (2%)	2 (0%)	48	73

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	I	186	THR
1	B	186	THR

### 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	168/193 (87%)	167 (99%)	1 (1%)	78	91
1	B	166/193 (86%)	164 (99%)	2 (1%)	63	84
1	C	171/193 (89%)	170 (99%)	1 (1%)	78	91
1	D	158/193 (82%)	155 (98%)	3 (2%)	50	77
1	E	165/193 (86%)	164 (99%)	1 (1%)	78	91

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	F	172/193 (89%)	171 (99%)	1 (1%)	78	91
1	G	173/193 (90%)	172 (99%)	1 (1%)	78	91
1	H	168/193 (87%)	164 (98%)	4 (2%)	43	72
1	I	165/193 (86%)	165 (100%)	0	100	100
1	J	172/193 (89%)	169 (98%)	3 (2%)	53	79
1	K	158/193 (82%)	156 (99%)	2 (1%)	61	83
1	L	160/193 (83%)	158 (99%)	2 (1%)	61	83
All	All	1996/2316 (86%)	1975 (99%)	21 (1%)	65	85

5 of 21 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	J	26	VAL
1	K	26	VAL
1	L	148	THR
1	K	148	THR
1	J	121	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 25 such sidechains are listed below:

Mol	Chain	Res	Type
1	F	13	GLN
1	G	9	GLN
1	L	9	GLN
1	F	84	HIS
1	G	219	GLN

### 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.

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	218/231 (94%)	0.38	17 (7%) 19 16	31, 51, 88, 116	0
1	B	204/231 (88%)	0.39	13 (6%) 25 22	31, 53, 84, 116	0
1	C	212/231 (91%)	0.32	18 (8%) 16 14	32, 51, 88, 117	0
1	D	200/231 (86%)	0.44	21 (10%) 11 9	33, 51, 89, 119	0
1	E	207/231 (89%)	0.47	13 (6%) 26 23	33, 52, 85, 113	0
1	F	219/231 (94%)	0.27	9 (4%) 41 37	33, 51, 89, 115	0
1	G	218/231 (94%)	0.39	12 (5%) 30 27	34, 53, 91, 116	0
1	H	208/231 (90%)	0.41	17 (8%) 17 15	35, 53, 89, 119	0
1	I	211/231 (91%)	0.49	17 (8%) 18 15	35, 52, 86, 116	0
1	J	214/231 (92%)	0.38	24 (11%) 10 8	32, 52, 88, 116	0
1	K	198/231 (85%)	0.44	18 (9%) 15 12	33, 52, 88, 116	0
1	L	205/231 (88%)	0.36	12 (5%) 28 25	33, 53, 89, 117	0
All	All	2514/2772 (90%)	0.39	191 (7%) 20 17	31, 52, 89, 119	0

The worst 5 of 191 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	188	THR	7.0
1	K	188	THR	5.2
1	H	153	ILE	4.8
1	E	98	GLU	4.4
1	H	207	PRO	4.2

### 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 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.