



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 09:33 AM UTC

PDB ID : 2HMI / pdb_00002hmi
Title : HIV-1 REVERSE TRANSCRIPTASE/FRAGMENT OF FAB 28/DNA COMPLEX
Authors : Ding, J.; Arnold, E.
Deposited on : 1998-04-10
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

<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

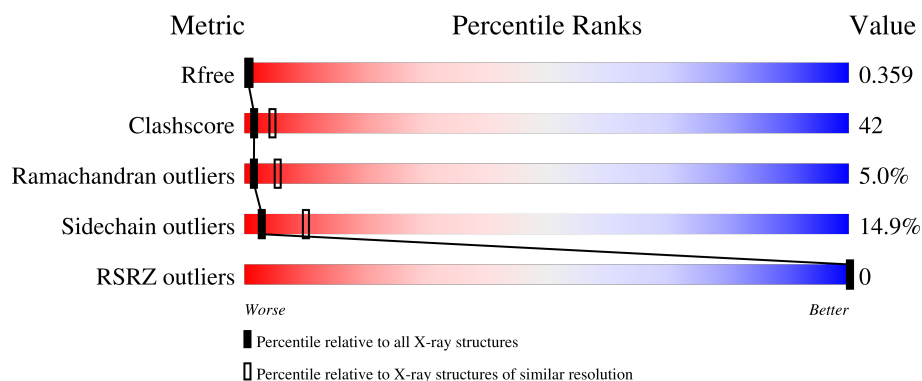
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 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.



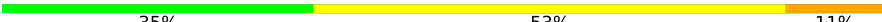
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
Sidechain outliers	187428	4198 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)

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 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	E	19	95% 5%
2	F	18	94% 6%
3	A	558	39% 50% 10% .
4	B	430	37% 51% 10% .
5	C	214	36% 52% 12%

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Mol	Chain	Length	Quality of chain
6	D	220	 A horizontal bar chart showing the quality of chain D. The bar is divided into three segments: green (35%), yellow (53%), and orange (11%). The percentages are labeled below the segments.

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 11647 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 DNA chain called DNA (5'-D(*AP*TP*GP*GP*CP*GP*CP*CP*GP*AP*AP*CP*AP*GP*GP*GP*AP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	E	19	Total	C	N	O	P	0	0	0
			390	184	80	108	18			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	F	18	Total	C	N	O	P	0	0	0
			363	173	64	109	17			

- Molecule 3 is a protein called SUBUNIT OF V-1 REVERSE TRANSCRIPTASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	A	558	Total	C	N	O	S	0	0	0
			4219	2728	703	781	7			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	280	SER	CYS	engineered mutation	UNP P03366

- Molecule 4 is a protein called HISUBUNIT OF V-1 REVERSE TRANSCRIPTASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	B	430	Total	C	N	O	S	0	0	0
			3411	2216	568	620	7			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	280	SER	CYS	engineered mutation	UNP P03366

- Molecule 5 is a protein called FAB FRAGMENT OF MONOCLONAL ANTIBODY 28.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	C	214	Total	C	N	O	S	0	0	0
			1616	1010	256	343	7			

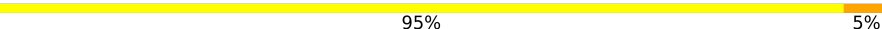
- Molecule 6 is a protein called FAB FRAGMENT OF MONOCLONAL ANTIBODY 28.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
6	D	220	Total	C	N	O	S	0	0	0
			1648	1037	270	333	8			

3 Residue-property plots

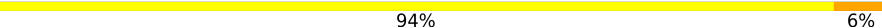
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: DNA (5'-D(*AP*TP*GP*GP*CP*GP*CP*CP*GP*AP*AP*CP*AP*GP*GP*GP*AP*C)-3')

Chain E: 

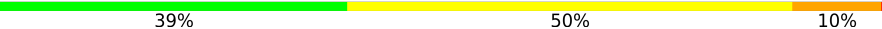
A801
T802
G803
G804
C805
G806
C807
C808
C809
G810
A811
A812
C813
A814
G815
G816
C817
A818
C819

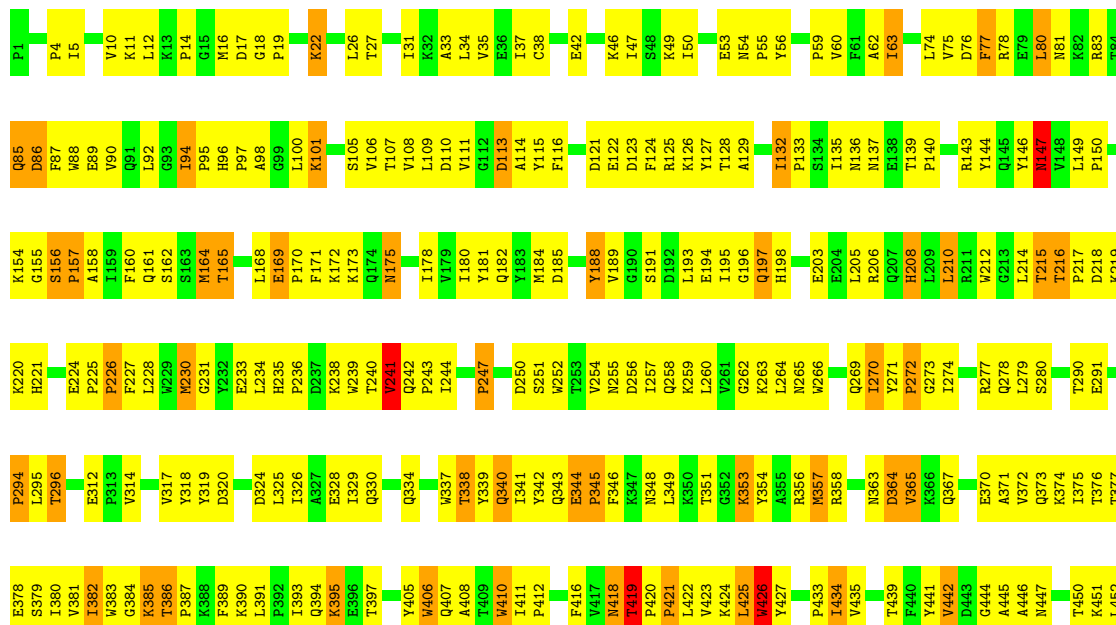
- Molecule 2: DNA (5'-D(*GP*TP*CP*CP*CP*TP*GP*TP*TP*CP*GP*GP*GP*CP*GP*CP*CP*A)-3')

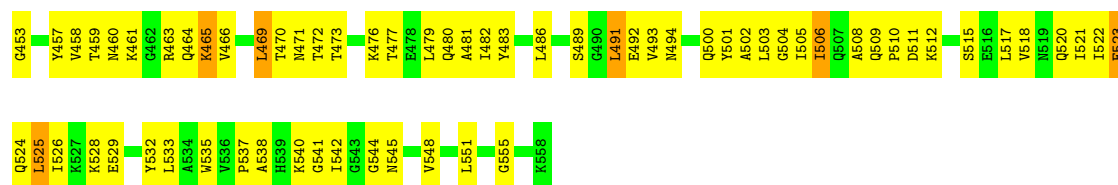
Chain F: 

G821
T822
C823
C824
C825
T826
G827
T828
T829
G830
G831
G832
G833
C834
G835
C836
C837
A838

- Molecule 3: SUBUNIT OF V-1 REVERSE TRANSCRIPTASE

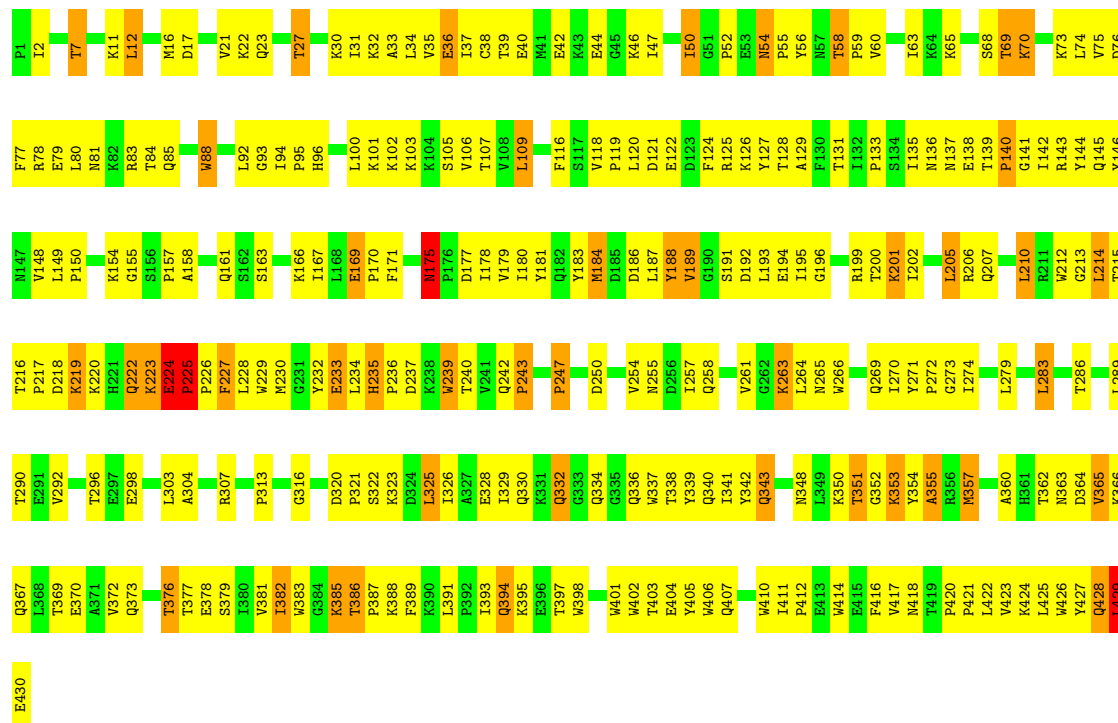
Chain A: 





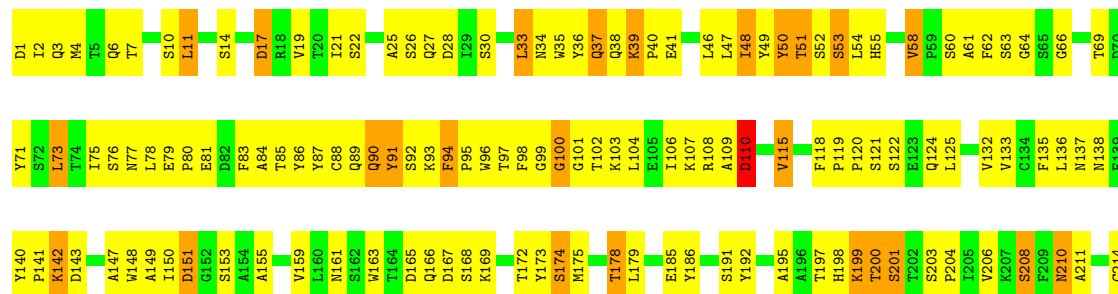
• Molecule 4: HISUBUNIT OF V-1 REVERSE TRANSCRIPTASE

Chain B: 37% 51% 10%



• Molecule 5: FAB FRAGMENT OF MONOCLONAL ANTIBODY 28

Chain C: 36% 52% 12%



• Molecule 6: FAB FRAGMENT OF MONOCLONAL ANTIBODY 28

Chain D: 35% 53% 11%



4 Data and refinement statistics

Property	Value	Source
Space group	P 32 1 2	Depositor
Cell constants a, b, c, α , β , γ	169.00Å 169.00Å 221.00Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	8.00 – 2.80 8.00 – 2.81	Depositor EDS
% Data completeness (in resolution range)	74.8 (8.00-2.80) 87.1 (8.00-2.81)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.96 (at 2.81Å)	Xtriage
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.271 , 0.352 0.287 , 0.359	Depositor DCC
R_{free} test set	3867 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å ²)	39.7	Xtriage
Anisotropy	0.298	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.18 , 36.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.39$, $\langle L^2 \rangle = 0.21$	Xtriage
Estimated twinning fraction	0.069 for -h,-k,l	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	11647	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.12% 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	E	0.40	0/439	0.78	0/676
2	F	0.34	0/405	0.93	2/623 (0.3%)
3	A	0.64	0/4330	0.79	10/5925 (0.2%)
4	B	0.82	5/3510 (0.1%)	0.84	11/4783 (0.2%)
5	C	0.66	0/1654	0.78	6/2256 (0.3%)
6	D	0.82	0/1691	0.84	3/2320 (0.1%)
All	All	0.71	5/12029 (0.0%)	0.81	32/16583 (0.2%)

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	E	0	1
2	F	1	0
3	A	0	1
4	B	0	1
5	C	0	2
All	All	1	5

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	224	GLU	CA-C	7.07	1.61	1.52
4	B	250	ASP	CA-C	6.07	1.55	1.52
4	B	225	PRO	CA-C	5.98	1.57	1.52
4	B	7	THR	CA-CB	5.56	1.60	1.53
4	B	21	VAL	CA-CB	-5.23	1.48	1.54

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

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	F	825	DC	C2'-C3'-O3'	12.60	130.39	111.50
3	A	320	ASP	CA-C-N	7.47	126.73	118.97
3	A	320	ASP	C-N-CA	7.47	126.73	118.97
2	F	825	DC	C4'-C3'-O3'	7.25	120.88	110.00
4	B	243	PRO	N-CA-CB	6.96	110.56	103.25

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
2	F	825	DC	C3'

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
3	A	188	TYR	Sidechain
4	B	188	TYR	Sidechain
5	C	87	TYR	Sidechain
5	C	91	TYR	Sidechain
1	E	801	DA	Sidechain

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	E	390	0	212	53	0
2	F	363	0	204	80	0
3	A	4219	0	3981	335	0
4	B	3411	0	3298	286	0
5	C	1616	0	1517	113	0
6	D	1648	0	1602	131	0
All	All	11647	0	10814	950	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 42.

The worst 5 of 950 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)
2:F:825:DC:C2'	2:F:826:DT:H5'	1.68	1.23
2:F:833:DG:H2''	2:F:834:DC:H5'	1.23	1.18
2:F:828:DT:H2'	2:F:829:DT:H71	1.32	1.12
1:E:802:DT:H2''	1:E:803:DG:H5'	1.31	1.10
2:F:823:DC:H2''	2:F:824:DC:H5''	1.27	1.09

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	
3	A	556/558 (100%)	428 (77%)	104 (19%)	24 (4%)	2	7
4	B	428/430 (100%)	337 (79%)	70 (16%)	21 (5%)	1	6
5	C	212/214 (99%)	171 (81%)	29 (14%)	12 (6%)	1	4
6	D	218/220 (99%)	173 (79%)	32 (15%)	13 (6%)	1	3
All	All	1414/1422 (99%)	1109 (78%)	235 (17%)	70 (5%)	1	5

5 of 70 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	A	63	ILE
3	A	85	GLN
3	A	136	ASN
3	A	247	PRO
3	A	251	SER

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	
3	A	414/498 (83%)	358 (86%)	56 (14%)	4	13
4	B	350/392 (89%)	300 (86%)	50 (14%)	3	11
5	C	182/182 (100%)	151 (83%)	31 (17%)	2	7
6	D	191/191 (100%)	159 (83%)	32 (17%)	2	8
All	All	1137/1263 (90%)	968 (85%)	169 (15%)	3	10

5 of 169 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
5	C	50	TYR
6	D	25	SER
5	C	73	LEU
5	C	185	GLU
6	D	86	THR

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

Mol	Chain	Res	Type
4	B	269	GLN
5	C	90	GLN
6	D	206	ASN
5	C	37	GLN
5	C	137	ASN

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 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, 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	E	19/19 (100%)	-1.63	0 100 100	54, 67, 83, 83	0
2	F	18/18 (100%)	-1.62	0 100 100	60, 70, 79, 82	0
3	A	558/558 (100%)	-1.51	0 100 100	3, 47, 71, 79	0
4	B	430/430 (100%)	-1.60	0 100 100	3, 21, 65, 91	0
5	C	214/214 (100%)	-1.54	0 100 100	7, 34, 61, 70	0
6	D	220/220 (100%)	-1.63	0 100 100	3, 23, 43, 68	0
All	All	1459/1459 (100%)	-1.56	0 100 100	3, 35, 68, 91	0

There are no RSRZ outliers to report.

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.