



wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 8, 2017 – 01:25 AM EDT

PDB ID : 3HVD
Title : The Protective Antigen Component of Anthrax Toxin Forms Functional Octameric Complexes
Authors : Kintzer, A.F.; Dong, K.C.; Berger, J.M.; Krantz, B.A.
Deposited on : unknown
Resolution : 3.21 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20029824
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20029824

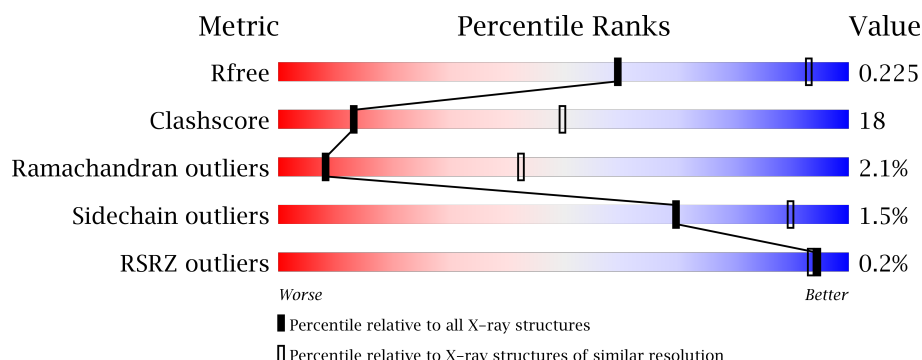
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.21 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}	100719	1015 (3.22-3.18)
Clashscore	112137	1009 (3.20-3.20)
Ramachandran outliers	110173	1118 (3.22-3.18)
Sidechain outliers	110143	1117 (3.22-3.18)
RSRZ outliers	101464	1020 (3.22-3.18)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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	548	<div> <div style="width: 57%; background-color: green;"></div> <div style="width: 36%; background-color: yellow;"></div> <div style="width: 5%; background-color: orange;"></div> <div style="width: 2%; background-color: red;"></div> <div style="width: 2%; background-color: grey;"></div> </div> <div>57% 36% • 5%</div>
1	B	548	<div> <div style="width: 60%; background-color: green;"></div> <div style="width: 34%; background-color: yellow;"></div> <div style="width: 5%; background-color: orange;"></div> <div style="width: 1%; background-color: red;"></div> <div style="width: 2%; background-color: grey;"></div> </div> <div>60% 34% • 5%</div>
1	C	548	<div> <div style="width: 58%; background-color: green;"></div> <div style="width: 35%; background-color: yellow;"></div> <div style="width: 6%; background-color: orange;"></div> <div style="width: 1%; background-color: red;"></div> <div style="width: 2%; background-color: grey;"></div> </div> <div>58% 35% • 6%</div>
1	D	548	<div> <div style="width: 60%; background-color: green;"></div> <div style="width: 33%; background-color: yellow;"></div> <div style="width: 5%; background-color: orange;"></div> <div style="width: 2%; background-color: red;"></div> <div style="width: 2%; background-color: grey;"></div> </div> <div>60% 33% • 5%</div>
1	E	548	<div> <div style="width: 57%; background-color: green;"></div> <div style="width: 36%; background-color: yellow;"></div> <div style="width: 5%; background-color: orange;"></div> <div style="width: 2%; background-color: red;"></div> <div style="width: 2%; background-color: grey;"></div> </div> <div>57% 36% • 5%</div>

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Mol	Chain	Length	Quality of chain
1	F	548	 60% 33% • 5%
1	G	548	 56% 37% • 5%
1	H	548	 59% 34% • 5%

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
2	CA	A	737	-	-	-	X

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 32701 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 Protective antigen.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	518	Total	C	N	O	S	0	0	0
			4067	2555	698	808	6			
1	B	523	Total	C	N	O	S	0	0	0
			4075	2555	704	810	6			
1	C	517	Total	C	N	O	S	0	0	0
			4078	2562	701	809	6			
1	D	518	Total	C	N	O	S	0	0	0
			4066	2554	698	808	6			
1	E	519	Total	C	N	O	S	0	0	0
			4091	2568	703	814	6			
1	F	519	Total	C	N	O	S	0	0	0
			4098	2572	706	814	6			
1	G	518	Total	C	N	O	S	0	0	0
			4094	2570	703	815	6			
1	H	518	Total	C	N	O	S	0	0	0
			4108	2578	704	820	6			

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	323	PRO	VAL	ENGINEERED	UNP Q08G54
A	324	GLY	HIS	ENGINEERED	UNP Q08G54
A	669	ARG	GLN	SEE REMARK 999	UNP Q08G54
B	303	PRO	VAL	ENGINEERED	UNP Q08G54
B	304	GLY	HIS	ENGINEERED	UNP Q08G54
B	669	ARG	GLN	SEE REMARK 999	UNP Q08G54
C	323	PRO	VAL	ENGINEERED	UNP Q08G54
C	324	GLY	HIS	ENGINEERED	UNP Q08G54
C	669	ARG	GLN	SEE REMARK 999	UNP Q08G54
D	323	PRO	VAL	ENGINEERED	UNP Q08G54
D	324	GLY	HIS	ENGINEERED	UNP Q08G54
D	669	ARG	GLN	SEE REMARK 999	UNP Q08G54
E	303	PRO	VAL	ENGINEERED	UNP Q08G54

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Chain	Residue	Modelled	Actual	Comment	Reference
E	324	GLY	HIS	ENGINEERED	UNP Q08G54
E	669	ARG	GLN	SEE REMARK 999	UNP Q08G54
F	323	PRO	VAL	ENGINEERED	UNP Q08G54
F	324	GLY	HIS	ENGINEERED	UNP Q08G54
F	669	ARG	GLN	SEE REMARK 999	UNP Q08G54
G	323	PRO	VAL	ENGINEERED	UNP Q08G54
G	324	GLY	HIS	ENGINEERED	UNP Q08G54
G	669	ARG	GLN	SEE REMARK 999	UNP Q08G54
H	323	PRO	VAL	ENGINEERED	UNP Q08G54
H	324	GLY	HIS	ENGINEERED	UNP Q08G54
H	669	ARG	GLN	SEE REMARK 999	UNP Q08G54

- Molecule 2 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	G	2	Total Ca 2 2	0	0
2	D	2	Total Ca 2 2	0	0
2	E	2	Total Ca 2 2	0	0
2	H	2	Total Ca 2 2	0	0
2	B	2	Total Ca 2 2	0	0
2	C	2	Total Ca 2 2	0	0
2	A	2	Total Ca 2 2	0	0
2	F	2	Total Ca 2 2	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total O 1 1	0	0
3	B	1	Total O 1 1	0	0
3	C	1	Total O 1 1	0	0
3	D	1	Total O 1 1	0	0

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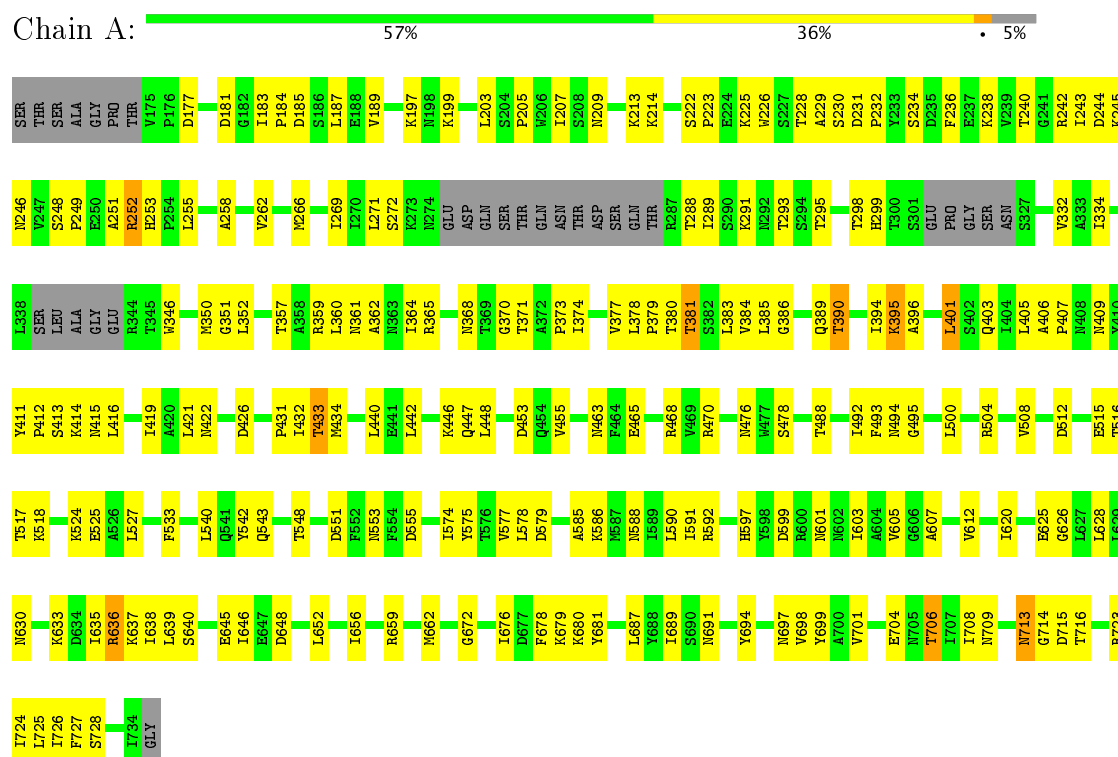
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	E	1	Total 1	O 1	0	0
3	F	1	Total 1	O 1	0	0
3	G	1	Total 1	O 1	0	0
3	H	1	Total 1	O 1	0	0

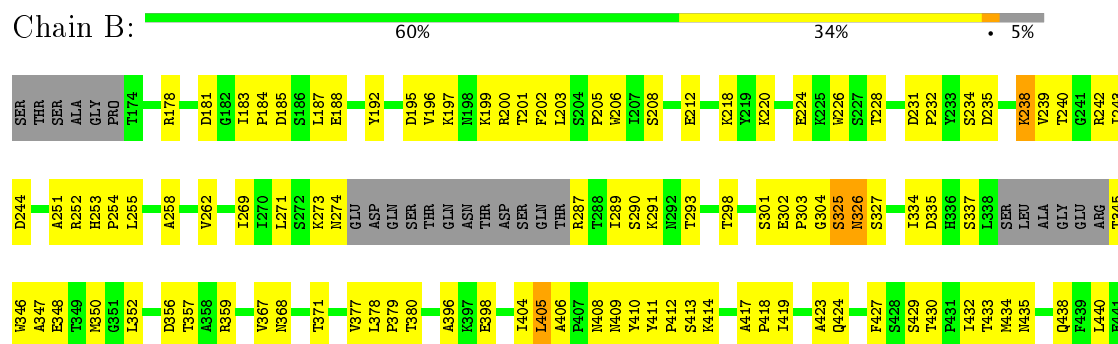
3 Residue-property plots

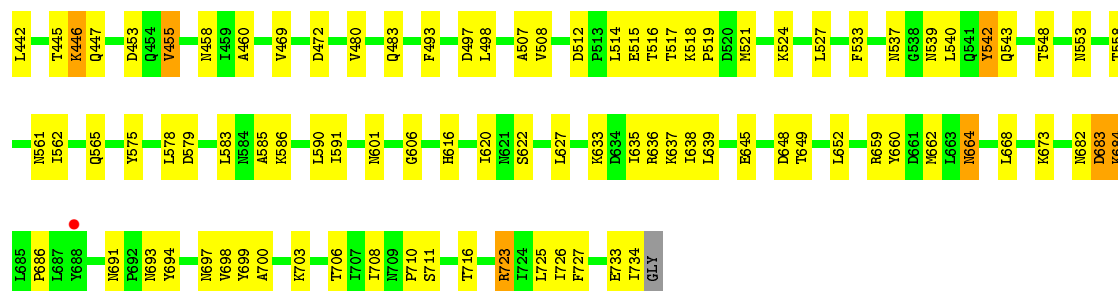
These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are 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 ($\text{RSRZ} > 2$). 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: Protective antigen



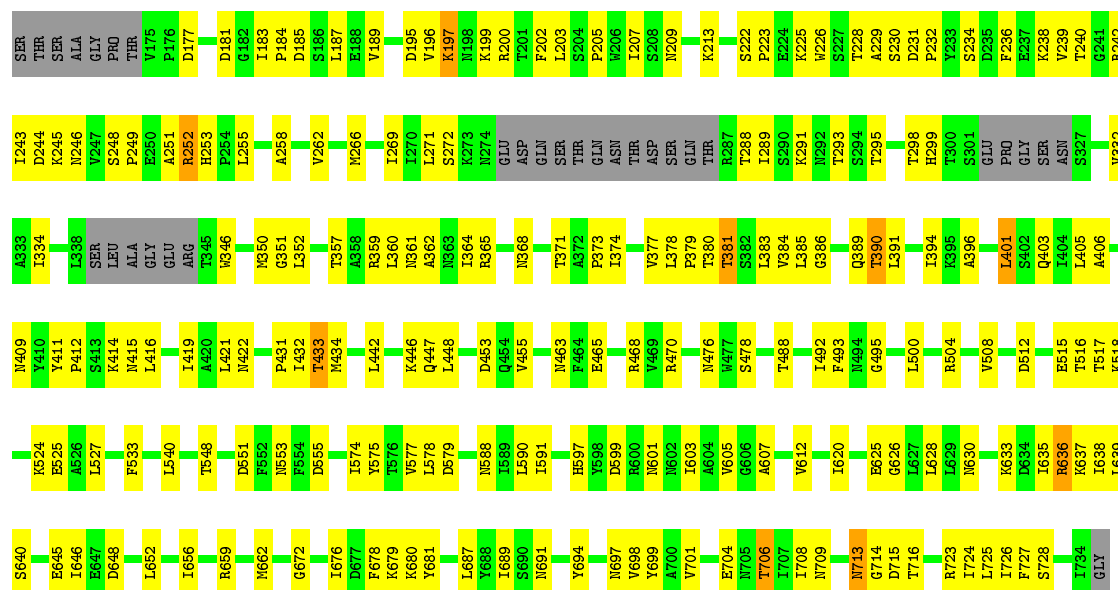
• Molecule 1: Protective antigen





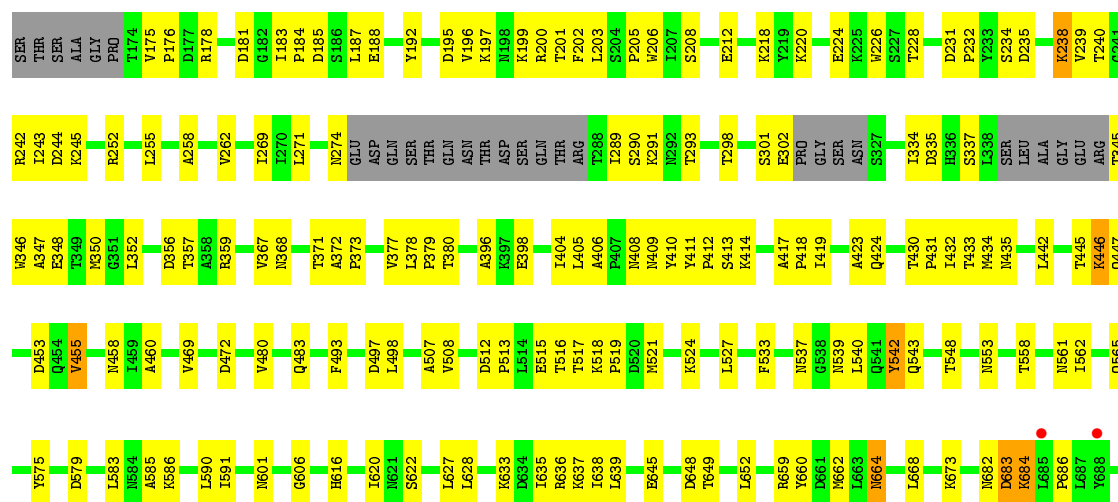
• Molecule 1: Protective antigen

Chain C: 58% 35% 6%



• Molecule 1: Protective antigen

Chain D: 60% 33% 5%





Response	Percentage
Yes	56%
No	37%
Don't know	5%



Response	Percentage
Yes	59%
No	34%
Don't know	5%



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	125.60 Å 125.67 Å 125.82 Å 106.64° 110.82° 110.98°	Depositor
Resolution (Å)	47.27 – 3.21 47.28 – 3.21	Depositor EDS
% Data completeness (in resolution range)	90.3 (47.27-3.21) 75.4 (47.28-3.21)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	0.12	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.16 (at 3.19 Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 2009_02_15_2320_3)	Depositor
R, R_{free}	0.210 , 0.249 0.183 , 0.225	Depositor DCC
R_{free} test set	1676 reflections (1.92%)	DCC
Wilson B-factor (Å ²)	60.6	Xtriage
Anisotropy	0.034	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 22.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.438 for -l,-h,h+k+l 0.438 for -k,h+k+l,-h 0.032 for k,h,-h-k-l 0.458 for -h-k-l,l,k 0.033 for h+k+l,-k,-l 0.033 for l,-h-k-l,h 0.032 for -h,-l,-k	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	32701	wwPDB-VP
Average B, all atoms (Å ²)	58.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.73% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section:
CA

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	0.25	0/4136	0.45	0/5617
1	B	0.24	0/4144	0.46	0/5632
1	C	0.25	0/4147	0.45	0/5629
1	D	0.24	0/4134	0.45	0/5614
1	E	0.25	0/4161	0.45	0/5650
1	F	0.24	0/4167	0.46	0/5655
1	G	0.25	0/4163	0.46	0/5650
1	H	0.24	0/4177	0.45	0/5667
All	All	0.25	0/33229	0.45	0/45114

There are no bond length outliers.

There are no bond angle outliers.

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	4067	0	4005	164	0
1	B	4075	0	3995	143	0
1	C	4078	0	4036	159	0
1	D	4066	0	4005	140	0
1	E	4091	0	4035	160	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	F	4098	0	4057	146	0
1	G	4094	0	4050	168	0
1	H	4108	0	4078	151	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
2	C	2	0	0	0	0
2	D	2	0	0	0	0
2	E	2	0	0	0	0
2	F	2	0	0	0	0
2	G	2	0	0	0	0
2	H	2	0	0	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
3	D	1	0	0	0	0
3	E	1	0	0	0	0
3	F	1	0	0	0	0
3	G	1	0	0	0	0
3	H	1	0	0	0	0
All	All	32701	0	32261	1181	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 18.

The worst 5 of 1181 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:H:648:ASP:HB3	1:H:652:LEU:HB3	1.40	1.03
1:D:648:ASP:HB3	1:D:652:LEU:HB3	1.48	0.94
1:B:274:ASN:HD21	1:B:359:ARG:HB3	1.32	0.92
1:B:187:LEU:HD21	1:B:205:PRO:HG3	1.53	0.90
1:B:231:ASP:HB2	1:B:232:PRO:HD2	1.55	0.89

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	510/548 (93%)	450 (88%)	52 (10%)	8 (2%)	11	50
1	B	517/548 (94%)	448 (87%)	54 (10%)	15 (3%)	5	33
1	C	509/548 (93%)	446 (88%)	55 (11%)	8 (2%)	11	50
1	D	510/548 (93%)	449 (88%)	48 (9%)	13 (2%)	6	38
1	E	511/548 (93%)	447 (88%)	55 (11%)	9 (2%)	10	47
1	F	511/548 (93%)	446 (87%)	52 (10%)	13 (2%)	6	38
1	G	510/548 (93%)	448 (88%)	54 (11%)	8 (2%)	11	50
1	H	510/548 (93%)	447 (88%)	51 (10%)	12 (2%)	7	39
All	All	4088/4384 (93%)	3581 (88%)	421 (10%)	86 (2%)	8	42

5 of 86 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	713	ASN
1	B	181	ASP
1	B	325	SER
1	B	326	ASN
1	B	398	GLU

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	453/491 (92%)	443 (98%)	10 (2%)	57	85

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	450/491 (92%)	446 (99%)	4 (1%)	82	94
1	C	457/491 (93%)	448 (98%)	9 (2%)	60	86
1	D	452/491 (92%)	449 (99%)	3 (1%)	87	96
1	E	458/491 (93%)	449 (98%)	9 (2%)	60	86
1	F	460/491 (94%)	455 (99%)	5 (1%)	78	92
1	G	460/491 (94%)	452 (98%)	8 (2%)	66	88
1	H	465/491 (95%)	457 (98%)	8 (2%)	66	88
All	All	3655/3928 (93%)	3599 (98%)	56 (2%)	70	90

5 of 56 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	723	ARG
1	E	433	THR
1	H	401	LEU
1	E	200	ARG
1	E	381	THR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 59 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	597	HIS
1	E	597	HIS
1	H	483	GLN
1	E	363	ASN
1	E	437	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 [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 16 ligands modelled in this entry, 16 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

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 [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	A	518/548 (94%)	-0.67	0 100 100	5, 45, 111, 207	0
1	B	523/548 (95%)	-0.57	1 (0%) 94 93	4, 55, 140, 335	0
1	C	517/548 (94%)	-0.65	0 100 100	8, 46, 110, 234	0
1	D	518/548 (94%)	-0.55	2 (0%) 92 89	8, 54, 136, 258	0
1	E	519/548 (94%)	-0.63	0 100 100	5, 46, 120, 198	0
1	F	519/548 (94%)	-0.56	2 (0%) 92 89	5, 55, 142, 205	0
1	G	518/548 (94%)	-0.64	1 (0%) 94 93	5, 46, 111, 264	0
1	H	518/548 (94%)	-0.57	1 (0%) 94 93	6, 54, 135, 221	0
All	All	4150/4384 (94%)	-0.61	7 (0%) 94 93	4, 50, 126, 335	0

The worst 5 of 7 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	688	TYR	3.9
1	B	688	TYR	3.0
1	F	732	TYR	2.8
1	G	426	ASP	2.6
1	H	732	TYR	2.4

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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95th 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	LLDF	B-factors(Å ²)	Q<0.9
2	CA	A	737	1/1	0.97	0.18	2.42	20,20,20,20	0
2	CA	F	736	1/1	0.98	0.17	1.65	47,47,47,47	0
2	CA	C	737	1/1	0.98	0.17	1.54	18,18,18,18	0
2	CA	C	736	1/1	0.99	0.20	1.42	33,33,33,33	0
2	CA	E	736	1/1	0.98	0.17	1.37	38,38,38,38	0
2	CA	F	737	1/1	0.99	0.17	1.25	20,20,20,20	0
2	CA	D	737	1/1	0.99	0.16	1.09	25,25,25,25	0
2	CA	G	736	1/1	1.00	0.20	0.92	40,40,40,40	0
2	CA	E	737	1/1	0.99	0.16	0.86	24,24,24,24	0
2	CA	G	737	1/1	0.99	0.17	0.80	23,23,23,23	0
2	CA	D	736	1/1	0.97	0.15	0.67	44,44,44,44	0
2	CA	B	736	1/1	0.96	0.17	0.67	56,56,56,56	0
2	CA	H	737	1/1	0.96	0.15	0.28	21,21,21,21	0
2	CA	A	736	1/1	0.99	0.15	0.28	35,35,35,35	0
2	CA	H	736	1/1	0.99	0.15	0.09	37,37,37,37	0
2	CA	B	737	1/1	0.99	0.15	-0.10	20,20,20,20	0

6.5 Other polymers ⓘ

There are no such residues in this entry.