



# wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 3, 2023 – 06:14 AM EDT

PDB ID : 1I9R  
Title : STRUCTURE OF CD40L IN COMPLEX WITH THE FAB FRAGMENT OF HUMANIZED 5C8 ANTIBODY  
Authors : Karpusas, M.; Lucci, J.; Ferrant, J.; Benjamin, C.; Hsu, Y.-M.  
Deposited on : 2001-03-20  
Resolution : 3.10 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 : 4.02b-467  
Xtriage (Phenix) : 1.13  
EDS : 2.34  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.34

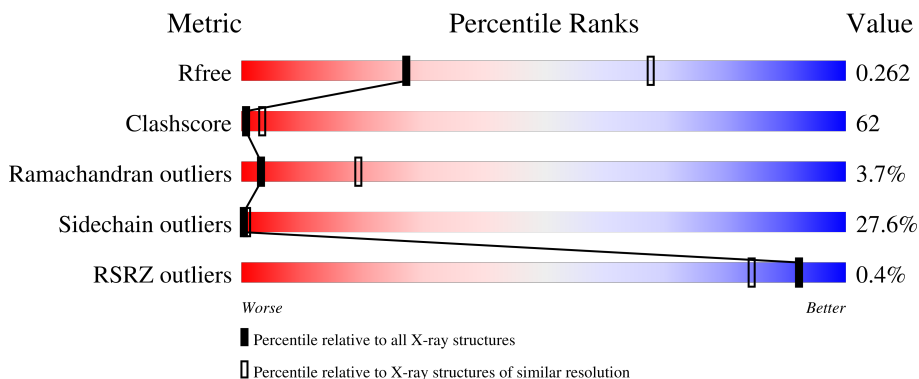
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.10 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.




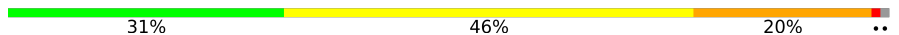
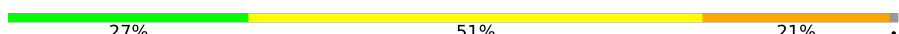
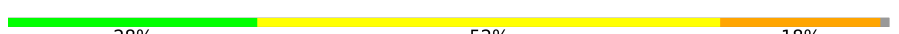
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	1094 (3.10-3.10)
Clashscore	141614	1184 (3.10-3.10)
Ramachandran outliers	138981	1141 (3.10-3.10)
Sidechain outliers	138945	1141 (3.10-3.10)
RSRZ outliers	127900	1067 (3.10-3.10)

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	146	<div style="display: flex; align-items: center;"> <div style="width: 2%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 23%; height: 10px; background-color: green; margin-right: 2px;"></div> <div style="width: 52%; height: 10px; background-color: yellow; margin-right: 2px;"></div> <div style="width: 21%; height: 10px; background-color: orange; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: grey; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: grey;"></div> </div> <p style="font-size: small; margin-top: 5px;">2% 23% 52% 21% ..</p>
1	B	146	<div style="display: flex; align-items: center;"> <div style="width: 0%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 22%; height: 10px; background-color: green; margin-right: 2px;"></div> <div style="width: 51%; height: 10px; background-color: yellow; margin-right: 2px;"></div> <div style="width: 24%; height: 10px; background-color: orange; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: grey; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: grey;"></div> </div> <p style="font-size: small; margin-top: 5px;">% 22% 51% 24% ..</p>
1	C	146	<div style="display: flex; align-items: center;"> <div style="width: 0%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 23%; height: 10px; background-color: green; margin-right: 2px;"></div> <div style="width: 53%; height: 10px; background-color: yellow; margin-right: 2px;"></div> <div style="width: 20%; height: 10px; background-color: orange; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: grey; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: grey;"></div> </div> <p style="font-size: small; margin-top: 5px;">% 23% 53% 20% ..</p>
2	H	219	<div style="display: flex; align-items: center;"> <div style="width: 0%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 27%; height: 10px; background-color: green; margin-right: 2px;"></div> <div style="width: 55%; height: 10px; background-color: yellow; margin-right: 2px;"></div> <div style="width: 16%; height: 10px; background-color: orange; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: grey;"></div> </div> <p style="font-size: small; margin-top: 5px;">27% 55% 16% .</p>
2	K	219	<div style="display: flex; align-items: center;"> <div style="width: 0%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 25%; height: 10px; background-color: green; margin-right: 2px;"></div> <div style="width: 56%; height: 10px; background-color: yellow; margin-right: 2px;"></div> <div style="width: 17%; height: 10px; background-color: orange; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: grey;"></div> </div> <p style="font-size: small; margin-top: 5px;">25% 56% 17% .</p>

*Continued on next page...*

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Mol	Chain	Length	Quality of chain
2	X	219	
3	L	218	
3	M	218	
3	Y	218	

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 13170 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 CD40 LIGAND.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	143	1092	690	191	207	4	8	0	0
1	B	143	1092	690	191	207	4	8	0	0
1	C	143	1092	690	191	207	4	8	0	0

- Molecule 2 is a protein called IMMUNOGLOBULIN H.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	H	219	1637	1029	269	332	7	15	0	0
2	K	219	1637	1029	269	332	7	15	0	0
2	X	219	1637	1029	269	332	7	15	0	0

- Molecule 3 is a protein called IMMUNOGLOBULIN L.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	L	215	1660	1043	278	334	5	0	0	0
3	M	215	1660	1043	278	334	5	0	0	0
3	Y	215	1660	1043	278	334	5	0	0	0

- Molecule 4 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	H	1	Total	Zn	0	0
			1	1		

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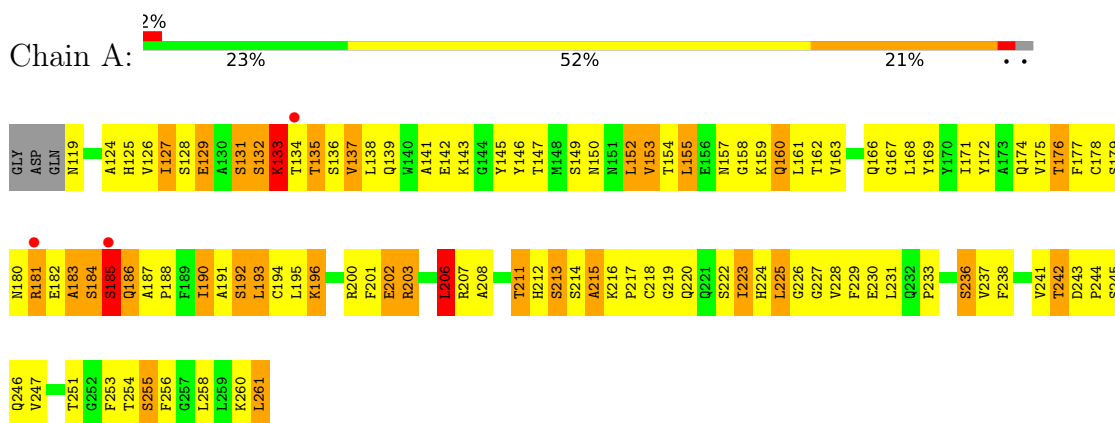
*Continued from previous page...*

<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>		<b>ZeroOcc</b>	<b>AltConf</b>
4	K	1	Total 1	Zn 1	0	0
4	X	1	Total 1	Zn 1	0	0

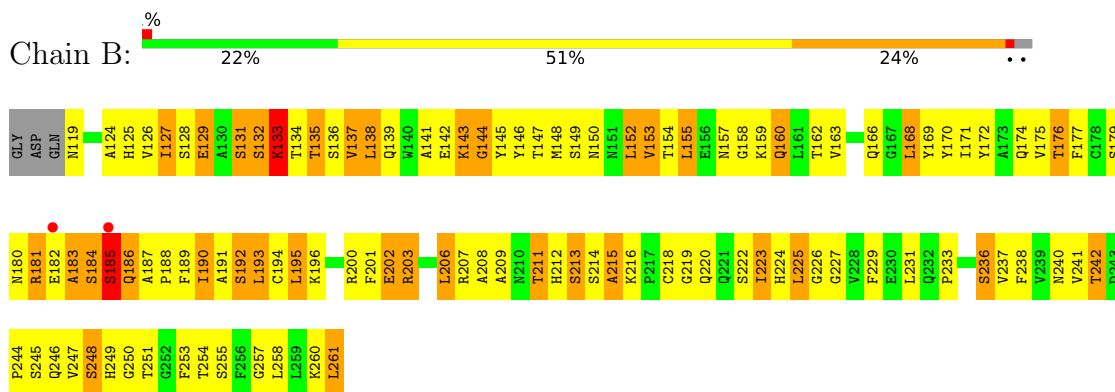
### 3 Residue-property plots [i](#)

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.

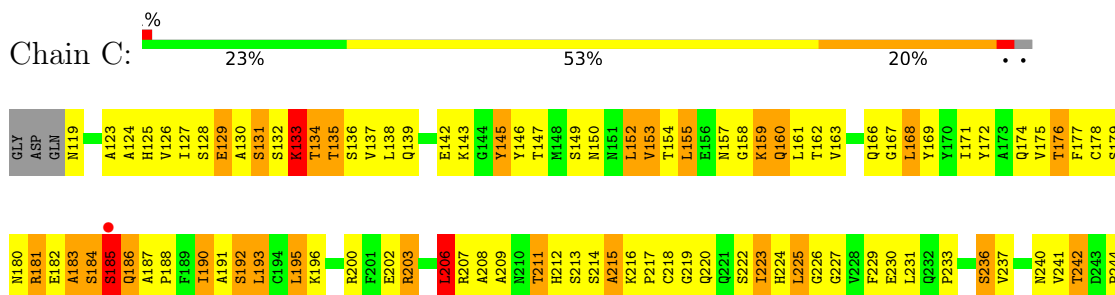
#### • Molecule 1: CD40 LIGAND



#### • Molecule 1: CD40 LIGAND



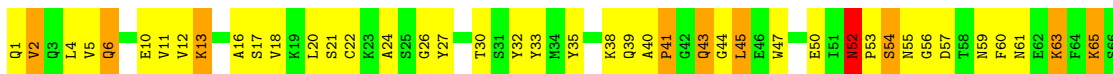
#### • Molecule 1: CD40 LIGAND





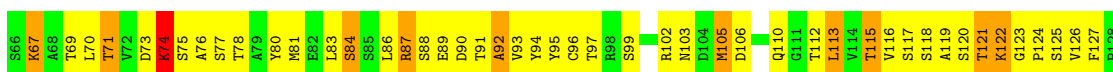
- Molecule 2: IMMUNOGLOBULIN H

Chain H: 27% 55% 16%



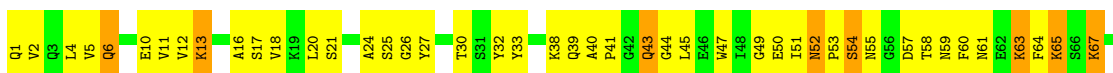
- Molecule 2: IMMUNOGLOBULIN H

Chain K: 25% 56% 17%



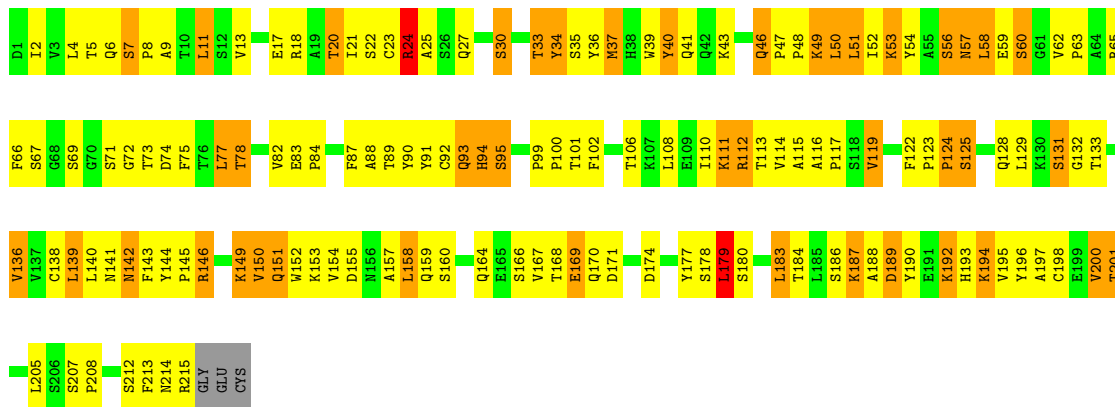
- Molecule 2: IMMUNOGLOBULIN H

Chain X: 30% 54% 15%

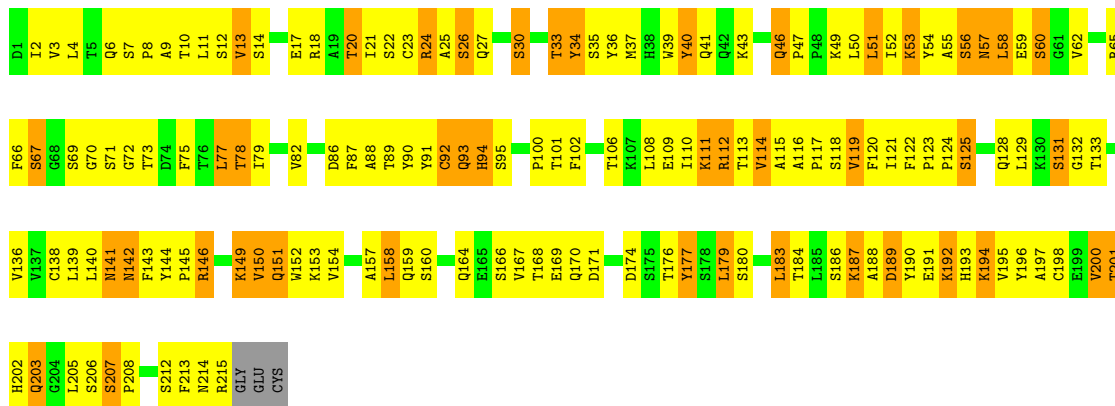
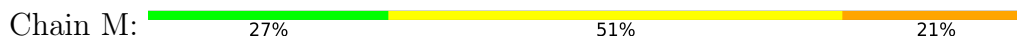




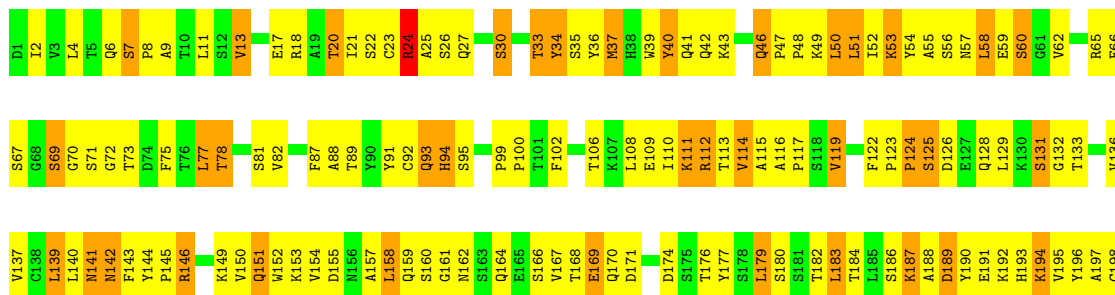
• Molecule 3: IMMUNOGLOBULIN L



• Molecule 3: IMMUNOGLOBULIN L



• Molecule 3: IMMUNOGLOBULIN L





E199	V200	T201	H202	Q203	G204	L205	S206	P207	P208	S212	F213	M214	R215	GLY	GLU	CYS
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## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	224.48Å 129.91Å 96.49Å 90.00° 109.60° 90.00°	Depositor
Resolution (Å)	35.00 – 3.10 31.13 – 2.63	Depositor EDS
% Data completeness (in resolution range)	(Not available) (35.00-3.10) 60.4 (31.13-2.63)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	5.21 (at 2.64Å)	Xtrriage
Refinement program	X-PLOR 98.0	Depositor
R, $R_{free}$	0.233 , 0.285 0.212 , 0.262	Depositor DCC
$R_{free}$ test set	4671 reflections (10.04%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	41.6	Xtrriage
Anisotropy	0.448	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 70.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.89	EDS
Total number of atoms	13170	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	23.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.29% 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](#)

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

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	0.89	0/1115	0.95	1/1510 (0.1%)
1	B	0.92	0/1115	0.96	1/1510 (0.1%)
1	C	0.85	0/1115	0.97	1/1510 (0.1%)
2	H	0.69	0/1674	0.94	5/2277 (0.2%)
2	K	0.76	0/1674	0.95	3/2277 (0.1%)
2	X	0.78	0/1674	0.96	4/2277 (0.2%)
3	L	0.80	0/1701	0.96	4/2314 (0.2%)
3	M	0.85	0/1701	0.96	2/2314 (0.1%)
3	Y	0.86	1/1701 (0.1%)	1.00	2/2314 (0.1%)
All	All	0.82	1/13470 (0.0%)	0.96	23/18303 (0.1%)

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	C	0	1
2	H	0	1
2	K	0	2
3	M	0	1
All	All	0	5

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	Y	111	LYS	CD-CE	5.67	1.65	1.51

The worst 5 of 23 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	L	24	ARG	NE-CZ-NH2	-11.26	114.67	120.30
3	Y	24	ARG	NE-CZ-NH2	-8.99	115.81	120.30
1	A	206	LEU	CA-CB-CG	7.90	133.47	115.30
2	H	143	LEU	CA-CB-CG	6.90	131.17	115.30
2	X	129	LEU	N-CA-C	-6.89	92.40	111.00

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	145	TYR	Sidechain
2	H	35	TYR	Sidechain
2	K	32	TYR	Sidechain
2	K	35	TYR	Sidechain
3	M	177	TYR	Sidechain

## 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	1092	0	1085	151	0
1	B	1092	0	1085	169	0
1	C	1092	0	1085	158	0
2	H	1637	0	1606	195	0
2	K	1637	0	1606	181	0
2	X	1637	0	1606	199	0
3	L	1660	0	1610	207	3
3	M	1660	0	1610	206	1
3	Y	1660	0	1610	228	3
4	H	1	0	0	0	0
4	K	1	0	0	0	0
4	X	1	0	0	0	0
All	All	13170	0	12903	1595	4

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 62.

The worst 5 of 1595 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)
3:Y:13:VAL:HG22	3:Y:17:GLU:HB3	1.25	1.10
3:L:13:VAL:HG22	3:L:17:GLU:HB3	1.30	1.09
2:K:91:THR:HG23	2:K:115:THR:HA	1.29	1.08
2:H:91:THR:HG23	2:H:115:THR:HA	1.32	1.08
2:H:124:PRO:HD2	2:H:210:THR:HG21	1.31	1.08

All (4) 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)
3:M:24:ARG:NH1	3:M:24:ARG:NH2[2_655]	2.03	0.17
3:L:24:ARG:NH2	3:Y:24:ARG:NH2[4_555]	2.06	0.14
3:L:24:ARG:NH2	3:Y:24:ARG:NH1[4_555]	2.11	0.09
3:L:24:ARG:NH1	3:Y:24:ARG:NH2[4_555]	2.13	0.07

## 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	141/146 (97%)	121 (86%)	14 (10%)	6 (4%)	2	16
1	B	141/146 (97%)	119 (84%)	15 (11%)	7 (5%)	2	13
1	C	141/146 (97%)	121 (86%)	14 (10%)	6 (4%)	2	16
2	H	217/219 (99%)	179 (82%)	27 (12%)	11 (5%)	2	13
2	K	217/219 (99%)	176 (81%)	32 (15%)	9 (4%)	3	16
2	X	217/219 (99%)	182 (84%)	27 (12%)	8 (4%)	3	19
3	L	213/218 (98%)	181 (85%)	28 (13%)	4 (2%)	8	33
3	M	213/218 (98%)	182 (85%)	25 (12%)	6 (3%)	5	25
3	Y	213/218 (98%)	179 (84%)	28 (13%)	6 (3%)	5	25
All	All	1713/1749 (98%)	1440 (84%)	210 (12%)	63 (4%)	3	19

5 of 63 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	183	ALA
1	A	202	GLU
1	B	133	LYS
1	B	183	ALA
1	B	202	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	120/122 (98%)	83 (69%)	37 (31%)	0 0
1	B	120/122 (98%)	82 (68%)	38 (32%)	0 0
1	C	120/122 (98%)	86 (72%)	34 (28%)	0 1
2	H	187/187 (100%)	138 (74%)	49 (26%)	0 1
2	K	187/187 (100%)	131 (70%)	56 (30%)	0 1
2	X	187/187 (100%)	137 (73%)	50 (27%)	0 1
3	L	190/192 (99%)	140 (74%)	50 (26%)	0 1
3	M	190/192 (99%)	141 (74%)	49 (26%)	0 1
3	Y	190/192 (99%)	141 (74%)	49 (26%)	0 1
All	All	1491/1503 (99%)	1079 (72%)	412 (28%)	0 1

5 of 412 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	K	113	LEU
3	M	78	THR
3	Y	150	VAL
2	K	140	THR
2	K	209	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 76 such sidechains are listed below:

Mol	Chain	Res	Type
3	M	164	GLN
3	Y	141	ASN
3	M	214	ASN
2	X	110	GLN
3	Y	214	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 monosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

Of 3 ligands modelled in this entry, 3 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, 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	142/146 (97%)	-0.62	3 (2%) 63 43	2, 12, 51, 78	0
1	B	142/146 (97%)	-0.73	2 (1%) 75 56	3, 12, 50, 76	0
1	C	142/146 (97%)	-0.69	1 (0%) 87 75	2, 12, 49, 78	0
2	H	219/219 (100%)	-0.66	0 100 100	4, 31, 56, 70	3 (1%)
2	K	219/219 (100%)	-0.71	1 (0%) 91 81	3, 29, 53, 68	3 (1%)
2	X	219/219 (100%)	-0.77	0 100 100	2, 27, 52, 68	3 (1%)
3	L	215/218 (98%)	-0.81	0 100 100	3, 16, 61, 69	0
3	M	215/218 (98%)	-0.88	0 100 100	3, 14, 58, 68	0
3	Y	215/218 (98%)	-0.89	0 100 100	2, 15, 58, 68	0
All	All	1728/1749 (98%)	-0.76	7 (0%) 92 84	2, 19, 57, 78	9 (0%)

The worst 5 of 7 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	185	SER	4.0
1	A	185	SER	3.8
1	B	185	SER	3.1
1	A	134	THR	2.4
2	K	1	GLN	2.3

### 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 monosaccharides in this entry.



## 6.4 Ligands [i](#)

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. The B-factors column lists the minimum, median, 95<sup>th</sup> 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	B-factors(Å <sup>2</sup> )	Q<0.9
4	ZN	K	499	1/1	0.97	0.04	38,38,38,38	0
4	ZN	H	498	1/1	0.98	0.04	39,39,39,39	0
4	ZN	X	500	1/1	0.99	0.05	38,38,38,38	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.