Full wwPDB X-ray Structure Validation Report (i)

May 23, 2020 – 09:36 pm BST

PDB ID	:	4LU5
Title	:	Structure of murine IgG2a A20G2-Fab in complex with vaccinia antigen A33R at the resolution of 2.9 Angstroms
Authors	:	Matho, M.H.; Schlossman, A.M.; Zajonc, D.M.
Deposited on	:	2013-07-24
Resolution	:	2.90 Å(reported)

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

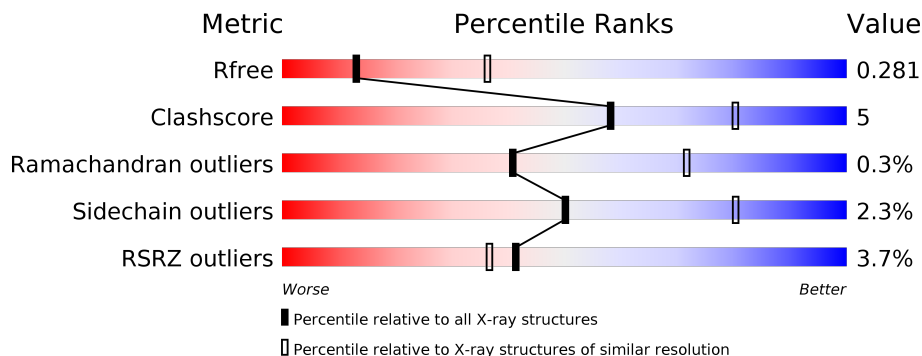|		
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.11
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

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 2.90 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	Percentile Ranks	Value
Rfree		0.281
Clashscore		5
Ramachandran outliers		0.3%
Sidechain outliers		2.3%
RSRZ outliers		3.7%

Worse   *Better*

■ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R$_{free}$	130704	1957 (2.90-2.90)
Clashscore	141614	2172 (2.90-2.90)
Ramachandran outliers	138981	2115 (2.90-2.90)
Sidechain outliers	138945	2117 (2.90-2.90)
RSRZ outliers	127900	1906 (2.90-2.90)

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 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 <=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	97	5% 81% 7% · 10%
1	B	97	3% 74% 14% 11%
2	H	213	2% 85% 14% ·
2	I	213	7% 82% 16% ·
3	L	219	84% 16%
3	M	219	5% 88% 11%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 8008 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 A33R.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	87	Total 679	C 419	N 106	O 147	S 7	0	0	0
1	B	86	Total 671	C 415	N 105	O 144	S 7	0	0	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	89	MET	SER	ENGINEERED MUTATION	UNP Q71TT1
A	118	MET	LEU	ENGINEERED MUTATION	UNP Q71TT1
A	123	ALA	LYS	ENGINEERED MUTATION	UNP Q71TT1
A	140	MET	LEU	ENGINEERED MUTATION	UNP Q71TT1
B	89	MET	SER	ENGINEERED MUTATION	UNP Q71TT1
B	118	MET	LEU	ENGINEERED MUTATION	UNP Q71TT1
B	123	ALA	LYS	ENGINEERED MUTATION	UNP Q71TT1
B	140	MET	LEU	ENGINEERED MUTATION	UNP Q71TT1

- Molecule 2 is a protein called Murine IgG2a A20G2 Heavy chain Fab domain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	H	209	Total 1601	C 1020	N 262	O 312	S 7	0	0	0
2	I	210	Total 1602	C 1020	N 262	O 313	S 7	0	0	0

- Molecule 3 is a protein called Murine IgG2a A20G2 Light chain Fab domain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	L	219	Total 1698	C 1064	N 285	O 342	S 7	0	0	0
3	M	219	Total 1698	C 1064	N 285	O 342	S 7	0	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	6	Total 6	O 6	0	0
4	B	6	Total 6	O 6	0	0
4	H	9	Total 9	O 9	0	0
4	I	5	Total 5	O 5	0	0
4	L	14	Total 14	O 14	0	0
4	M	19	Total 19	O 19	0	0

# 3 Residue-property plots (i)

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 (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.
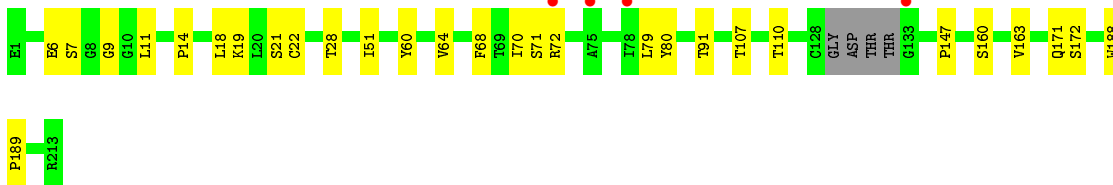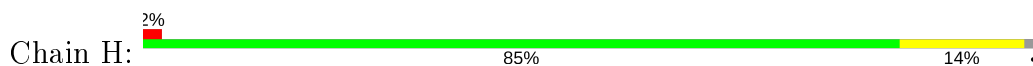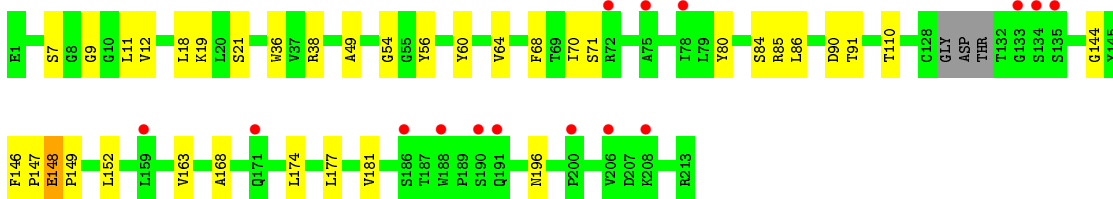
- Molecule 1: A33R
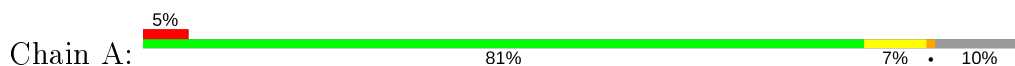
- Molecule 1: A33R
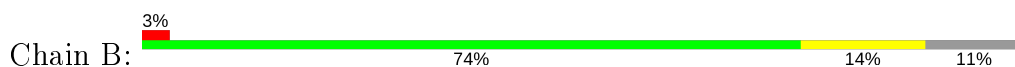
- Molecule 2: Murine IgG2a A20G2 Heavy chain Fab domain

- Molecule 2: Murine IgG2a A20G2 Heavy chain Fab domain
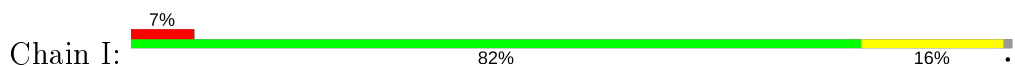
- Molecule 3: Murine IgG2a A20G2 Light chain Fab domain

Chain L:

84%   16%

D1 T7 P8 L9 T14 I15 G16 S22 L30 N39 W40 L41 L42 Q43 R44 D60 S70 L78 R82 L88 Y91 V94 T102 K112 R113 A114 E128 T131 Y145 P146 K147 D148 I155 S173 M180 S181 L184 N195

H203 T207 N215 E218 C219
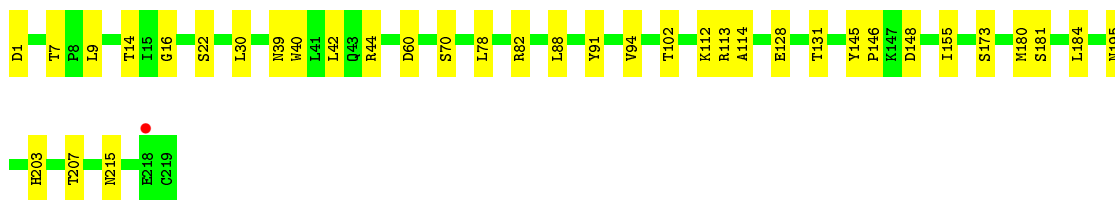
• Molecule 3: Murine IgG2a A20G2 Light chain Fab domain

Chain M:

5%

88%   11%

D1 L9 T14 I15 D60 D65 S70 G71 S72 L88 K112 V120 P125 S126 S127 E128 G134 A135 S136 V137 F140 Y145 P146 K147 D148 K154 Q171 K174 M180 S181 S182 T183 L184 Y191 E192 R193 T198 N217 E218 C219

4   Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	49.90Å 157.26Å 175.89Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	54.94 – 2.90 54.94 – 2.90	Depositor EDS
% Data completeness (in resolution range)	97.2 (54.94-2.90) 97.2 (54.94-2.90)	Depositor EDS
R_{merge}	0.23	Depositor
R_{sym}	0.23	Depositor
$< I/\sigma(I) >$ [1]	2.04 (at 2.91Å)	Xtriage
Refinement program	REFMAC 5.7.0029	Depositor
R, R_{free}	0.234 , 0.282 0.234 , 0.281	Depositor DCC
R_{free} test set	1556 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å^2)	38.6	Xtriage
Anisotropy	0.217	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 33.2	EDS
L-test for twinning[2]	$< |L| > = 0.46$, $< L^2 > = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.89	EDS
Total number of atoms	8008	wwPDB-VP
Average B, all atoms (Å^2)	37.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 30.40 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.3173e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

Full wwPDB X-ray Structure Validation Report

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	0.31	0/692	0.49	0/938
1	B	0.32	0/684	0.51	0/927
2	H	0.30	0/1642	0.51	0/2238
2	I	0.30	0/1643	0.49	0/2241
3	L	0.31	0/1735	0.51	0/2354
3	M	0.30	0/1735	0.51	0/2354
All	All	0.30	0/8131	0.51	0/11052

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	679	0	611	4	0
1	B	671	0	607	9	0
2	H	1601	0	1574	15	0
2	I	1602	0	1564	20	0
3	L	1698	0	1658	17	0
3	M	1698	0	1657	10	0
4	A	6	0	0	0	0
4	B	6	0	0	0	0
4	H	9	0	0	0	0
4	I	5	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	L	14	0	0	0	0
4	M	19	0	0	0	0
All	All	8008	0	7671	75	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.

All (75) 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:B:184:MET:HG3	1:B:185:ASN:H	1.48	0.79
2:H:91:THR:HG23	2:H:110:THR:HA	1.65	0.78
1:B:139:VAL:O	1:B:142:THR:HG22	1.85	0.76
2:H:64:VAL:HG13	2:H:68:PHE:HB2	1.67	0.74
1:B:142:THR:HG23	1:B:144:LEU:H	1.57	0.69
2:I:91:THR:HG23	2:I:110:THR:HA	1.74	0.69
2:I:71:SER:HB2	2:I:80:TYR:HB2	1.75	0.69
2:I:7:SER:HB2	2:I:21:SER:HB2	1.77	0.65
2:H:9:GLY:HA2	2:H:18:LEU:HD21	1.77	0.65
2:I:11:LEU:HB2	2:I:147:PRO:HG3	1.79	0.64
2:H:7:SER:HB2	2:H:21:SER:HB2	1.79	0.64
2:H:71:SER:HB2	2:H:80:TYR:HB2	1.80	0.61
2:I:148:GLU:HG2	2:I:149:PRO:HA	1.82	0.61
2:I:168:ALA:HB2	2:I:177:LEU:HD12	1.84	0.60
2:H:11:LEU:HB2	2:H:147:PRO:HG3	1.86	0.57
2:I:12:VAL:HG21	2:I:86:LEU:HD13	1.85	0.57
1:B:184:MET:O	1:B:185:ASN:HB2	2.06	0.56
3:L:88:LEU:HD21	3:L:173:SER:HA	1.87	0.55
3:L:14:THR:HA	3:L:112:LYS:HB2	1.89	0.55
3:M:88:LEU:HD22	3:M:171:GLN:HB3	1.89	0.54
2:I:144:GLY:HA2	2:I:174:LEU:HB3	1.90	0.54
2:H:171:GLN:HG3	2:H:172:SER:H	1.73	0.53
2:I:84:SER:OG	2:I:85:ARG:NH1	2.43	0.52
3:M:14:THR:HA	3:M:112:LYS:HB2	1.92	0.52
1:B:103:LEU:HB2	1:B:110:TYR:HB2	1.91	0.52
2:I:60:TYR:OH	2:I:70:ILE:HG22	2.12	0.50
2:I:54:GLY:HA3	2:I:56:TYR:CE2	2.48	0.48
3:L:128:GLU:O	3:L:131:THR:HB	2.14	0.48
2:I:64:VAL:HG13	2:I:68:PHE:CG	2.48	0.47
3:M:154:LYS:HB2	3:M:198:THR:HB	1.95	0.47
2:H:171:GLN:HG3	2:H:172:SER:N	2.28	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:H:60:TYR:OH	2:H:70:ILE:HG22	2.15	0.46
2:I:38:ARG:NH1	2:I:90:ASP:HA	2.31	0.46
3:L:113:ARG:NH1	3:L:114:ALA:O	2.41	0.46
1:B:119:PHE:CD1	1:B:156:GLY:HA2	2.51	0.46
3:L:42:LEU:HD13	3:L:91:TYR:CZ	2.50	0.46
3:L:180:MET:HG2	3:L:181:SER:N	2.31	0.45
2:I:19:LYS:HE3	2:I:80:TYR:CD1	2.52	0.45
1:B:184:MET:O	1:B:185:ASN:CB	2.65	0.44
1:B:141:ILE:O	1:B:141:ILE:HG22	2.16	0.44
3:M:112:LYS:HA	3:M:145:TYR:OH	2.18	0.44
2:H:188:TRP:CG	2:H:189:PRO:HA	2.53	0.43
2:I:9:GLY:HA2	2:I:18:LEU:HD21	1.99	0.43
2:H:51:ILE:HD13	2:H:72:ARG:HD3	2.00	0.43
3:M:120:VAL:HA	3:M:140:PHE:O	2.19	0.43
2:H:22:CYS:HB3	2:H:79:LEU:HB3	1.99	0.43
1:A:175:VAL:O	1:A:176:ARG:HG3	2.18	0.43
1:A:103:LEU:HB2	1:A:110:TYR:HB2	2.00	0.43
1:A:119:PHE:CD1	1:A:156:GLY:HA2	2.54	0.42
3:L:155:ILE:HD11	3:L:184:LEU:HD21	2.01	0.42
3:L:16:GLY:HA2	3:L:82:ARG:HG2	2.02	0.42
2:H:19:LYS:HE3	2:H:80:TYR:HB3	2.02	0.42
3:L:7:THR:HG23	3:L:22:SER:HB2	2.02	0.42
3:L:40:TRP:CE2	3:L:78:LEU:HB2	2.54	0.42
2:H:160:SER:O	2:H:163:VAL:HG22	2.20	0.42
2:I:64:VAL:HG13	2:I:68:PHE:HB2	2.02	0.41
3:L:113:ARG:HG2	3:L:114:ALA:H	1.85	0.41
3:L:1:ASP:HB3	3:L:102:THR:HG21	2.02	0.41
3:M:145:TYR:CG	3:M:146:PRO:HA	2.55	0.41
2:I:152:LEU:HA	2:I:196:ASN:O	2.20	0.41
3:M:180:MET:HE2	3:M:182:SER:HB2	2.02	0.41
3:L:112:LYS:HA	3:L:145:TYR:OH	2.20	0.41
3:L:113:ARG:HG2	3:L:114:ALA:N	2.36	0.41
3:M:136:SER:HA	3:M:184:LEU:O	2.20	0.41
1:A:141:ILE:HG22	1:A:141:ILE:O	2.21	0.41
2:H:6:GLU:HB3	2:H:107:THR:HB	2.03	0.41
3:M:125:PRO:HD3	3:M:137:VAL:HG22	2.02	0.41
1:B:149:GLU:O	1:B:150:ASP:HB2	2.20	0.41
3:L:195:ASN:HB2	3:L:215:ASN:OD1	2.20	0.41
3:L:146:PRO:HD2	3:L:203:HIS:CE1	2.56	0.41
3:L:39:ASN:HB2	3:L:94:VAL:HG13	2.03	0.41
3:M:180:MET:HG2	3:M:181:SER:N	2.36	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:I:146:PHE:HA	2:I:147:PRO:HA	1.84	0.40
2:I:163:VAL:HG12	2:I:181:VAL:HG23	2.02	0.40
2:I:36:TRP:HB2	2:I:49:ALA:HB3	2.03	0.40

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	83/97 (86%)	78 (94%)	4 (5%)	1 (1%)	13	40
1	B	82/97 (84%)	76 (93%)	6 (7%)	0	100	100
2	H	205/213 (96%)	195 (95%)	9 (4%)	1 (0%)	29	61
2	I	206/213 (97%)	193 (94%)	13 (6%)	0	100	100
3	L	217/219 (99%)	211 (97%)	6 (3%)	0	100	100
3	M	217/219 (99%)	209 (96%)	7 (3%)	1 (0%)	29	61
All	All	1010/1058 (96%)	962 (95%)	45 (4%)	3 (0%)	41	71

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	H	14	PRO
3	M	218	GLU
1	A	141	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 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	78/89 (88%)	77 (99%)	1 (1%)	69	90
1	B	77/89 (86%)	75 (97%)	2 (3%)	46	77
2	H	181/184 (98%)	180 (99%)	1 (1%)	86	96
2	I	180/184 (98%)	179 (99%)	1 (1%)	86	96
3	L	196/196 (100%)	189 (96%)	7 (4%)	35	69
3	M	196/196 (100%)	187 (95%)	9 (5%)	27	60
All	All	908/938 (97%)	887 (98%)	21 (2%)	50	80

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	162	THR
1	B	162	THR
1	B	170	ASP
2	H	28	THR
2	I	148	GLU
3	L	9	LEU
3	L	30	LEU
3	L	44	ARG
3	L	60	ASP
3	L	70	SER
3	L	148	ASP
3	L	207	THR
3	M	9	LEU
3	M	15	ILE
3	M	60	ASP
3	M	65	ASP
3	M	70	SER
3	M	148	ASP
3	M	174	LYS
3	M	180	MET
3	M	219	CYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
2	I	171	GLN

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 carbohydrates in this entry.

5.6 Ligand geometry ⓘ

There are no ligands in this entry.

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

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	87/97 (89%)	0.45	5 (5%)	23	19	22, 34, 66, 91	0
1	B	86/97 (88%)	0.21	3 (3%)	44	38	20, 30, 59, 83	0
2	H	209/213 (98%)	0.27	4 (1%)	66	65	19, 37, 53, 63	0
2	I	210/213 (98%)	0.54	15 (7%)	16	12	22, 50, 80, 90	0
3	L	219/219 (100%)	-0.07	1 (0%)	91	91	17, 28, 45, 76	0
3	M	219/219 (100%)	0.20	10 (4%)	32	29	18, 35, 68, 93	0
All	All	1030/1058 (97%)	0.25	38 (3%)	41	37	17, 35, 72, 93	0

All (38) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	I	135	SER	4.0
1	B	168	ASP	3.7
3	M	127	SER	3.6
3	M	219	CYS	3.5
3	M	217	ASN	3.3
2	I	186	SER	3.2
3	M	134	GLY	3.1
2	I	206	VAL	2.9
2	I	72	ARG	2.9
2	H	72	ARG	2.7
2	I	208	LYS	2.6
1	A	185	ASN	2.6
2	H	78	ILE	2.6
3	M	125	PRO	2.5
1	A	165	ASP	2.4
2	I	171	GLN	2.4
2	H	75	ALA	2.4
3	M	193	ARG	2.4
1	A	167	GLN	2.3

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Full wwPDB X-ray Structure Validation Report

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Mol	Chain	Res	Type	RSRZ
3	L	218	GLU	2.3
1	B	164	SER	2.3
2	I	133	GLY	2.3
2	I	188	TRP	2.3
3	M	72	SER	2.3
3	M	192	GLU	2.3
3	M	128	GLU	2.2
1	B	162	THR	2.2
2	I	159	LEU	2.2
3	M	191	TYR	2.2
2	I	191	GLN	2.1
1	A	141	ILE	2.1
2	I	200	PRO	2.1
2	I	78	ILE	2.1
2	I	134	SER	2.0
1	A	164	SER	2.0
2	H	133	GLY	2.0
2	I	75	ALA	2.0
2	I	190	SER	2.0

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 (i)

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.