wwPDB X-ray Structure Validation Summary Report (i)

Oct 12, 2021 – 12:38 PM EDT

PDB ID	:	2A3V
Title	:	Structural basis for broad DNA-specificity in integron recombination
Authors	:	MacDonald, D.; Demarre, G.; Bouvier, M.; Mazel, D.; Gopaul, D.N.
Deposited on	:	2005-06-27
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 (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

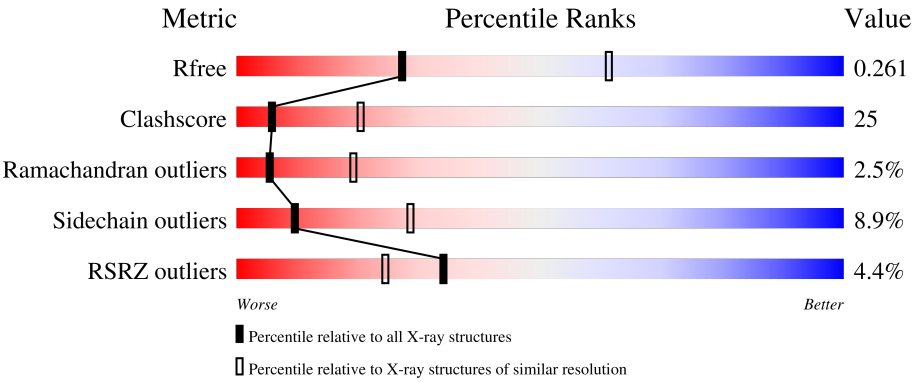
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.23.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.23.2

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 2.80 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}	130704	3140 (2.80-2.80)
Clashscore	141614	3569 (2.80-2.80)
Ramachandran outliers	138981	3498 (2.80-2.80)
Sidechain outliers	138945	3500 (2.80-2.80)
RSRZ outliers	127900	3078 (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 <=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	40	8% 28% 45% 5% 22%
1	G	40	2% 30% 38% 5% 28%
2	F	43	9% 42% 35% · 21%
2	H	43	5% 16% 49% 9% 26%
3	A	320	5% 50% 40% 7% ·

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Mol	Chain	Length	Quality of chain
3	B	320	3% 58% 36% 6%
3	C	320	6% 52% 40% 7%
3	D	320	2% 58% 35% 7%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 13236 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 (31-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	E	31	Total	C	N	O	P	0	0	0
			632	300	120	182	30			
1	G	29	Total	C	N	O	P	0	0	0
			592	281	112	171	28			

- Molecule 2 is a DNA chain called DNA (34-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	F	34	Total	C	N	O	P	0	0	0
			693	332	121	207	33			
2	H	32	Total	C	N	O	P	0	0	0
			651	312	114	194	31			

- Molecule 3 is a protein called site-specific recombinase IntI4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	A	313	Total	C	N	O	S	0	0	0
			2592	1662	465	457	8			
3	B	320	Total	C	N	O	S	0	0	0
			2643	1693	475	466	9			
3	C	317	Total	C	N	O	S	0	0	0
			2620	1678	472	461	9			
3	D	320	Total	C	N	O	S	0	0	0
			2643	1693	475	466	9			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	2	GLY	LYS	engineered mutation	GB 9657688
B	2	GLY	LYS	engineered mutation	GB 9657688
C	2	GLY	LYS	engineered mutation	GB 9657688
D	2	GLY	LYS	engineered mutation	GB 9657688

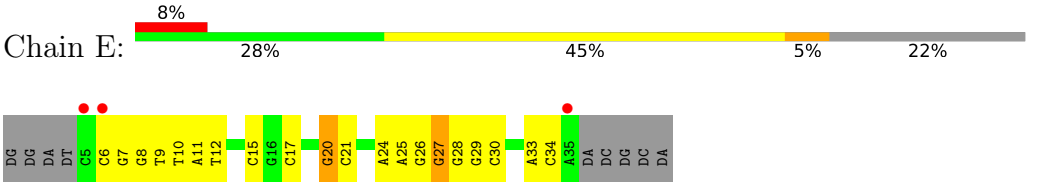
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	E	7	Total O 7 7	0	0
4	F	4	Total O 4 4	0	0
4	G	6	Total O 6 6	0	0
4	H	4	Total O 4 4	0	0
4	A	36	Total O 36 36	0	0
4	B	40	Total O 40 40	0	0
4	C	32	Total O 32 32	0	0
4	D	41	Total O 41 41	0	0

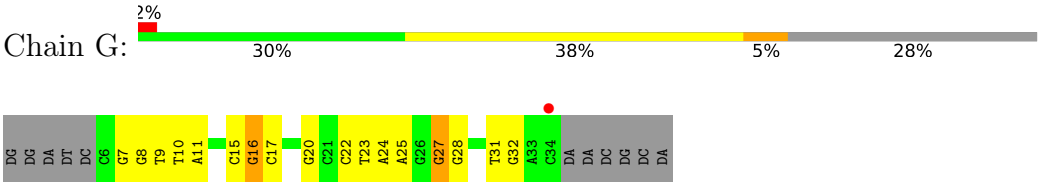
3 Residue-property plots (i)

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.

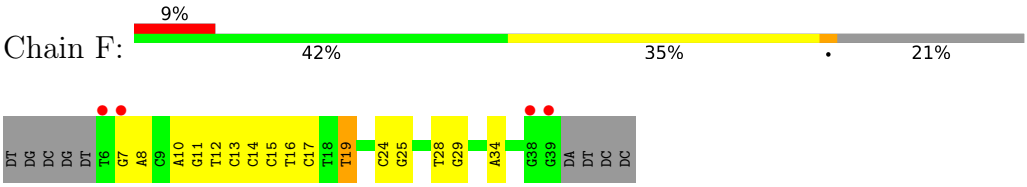
• Molecule 1: DNA (31-MER)



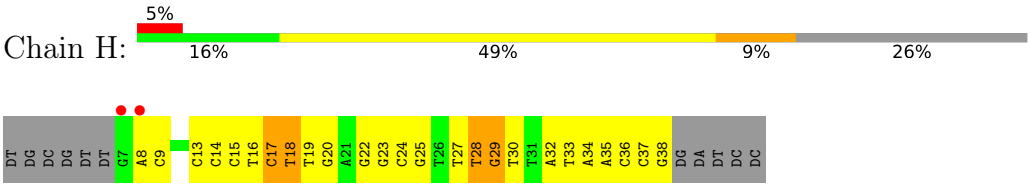
• Molecule 1: DNA (31-MER)



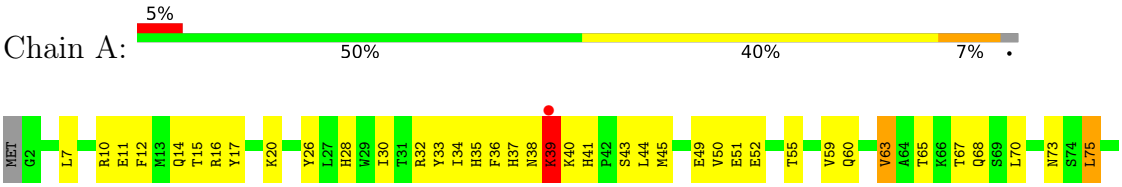
• Molecule 2: DNA (34-MER)

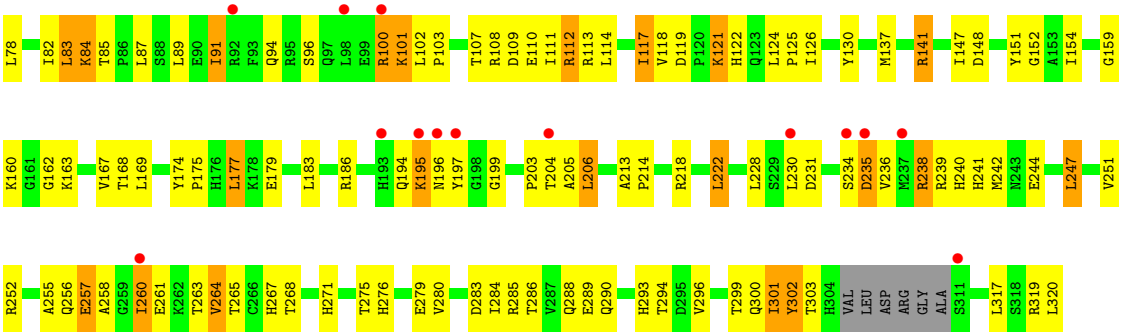


• Molecule 2: DNA (34-MER)



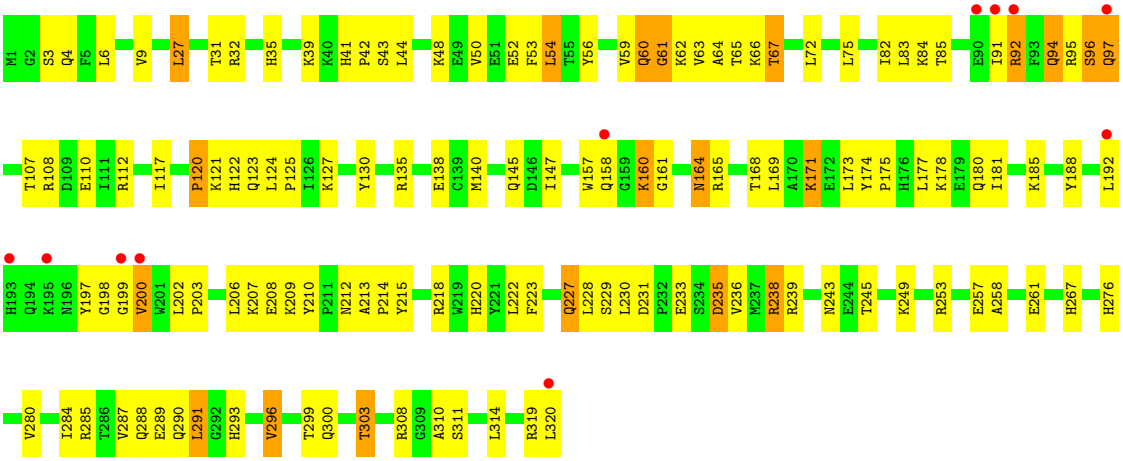
• Molecule 3: site-specific recombinase IntI4





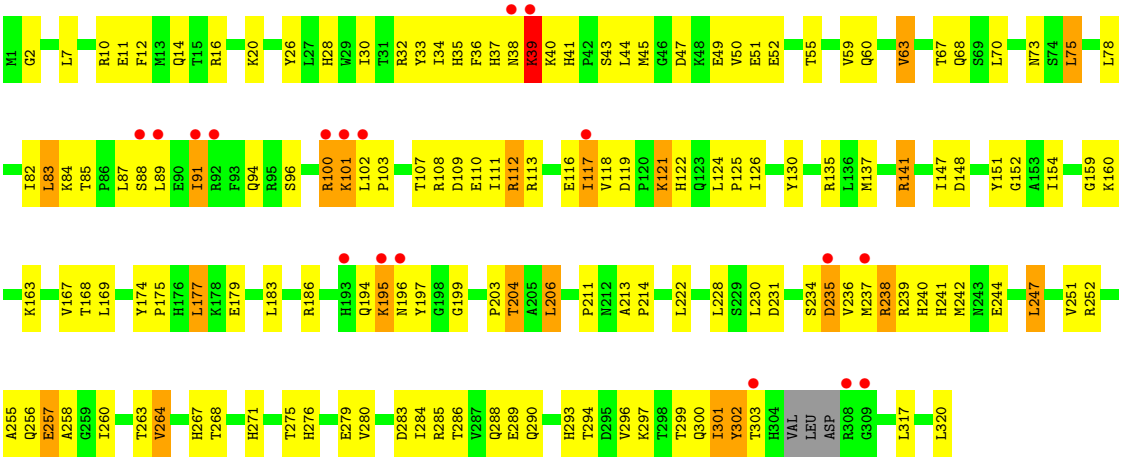
• Molecule 3: site-specific recombinase IntI4

Chain B:



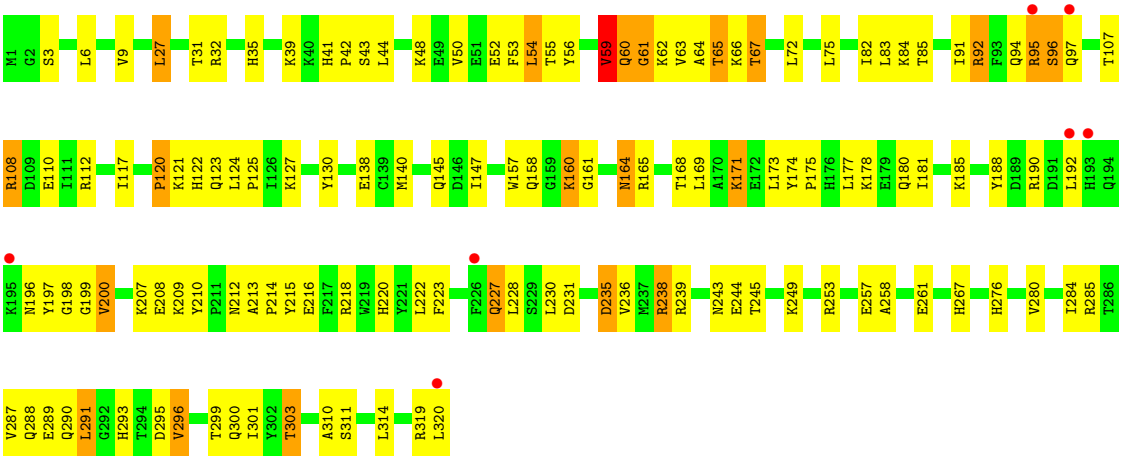
• Molecule 3: site-specific recombinase IntI4

Chain C:



• Molecule 3: site-specific recombinase IntI4

Chain D:


M1 G2 S3 L6 V9 L27 T31 R32 H35 K39 K40 H41 P42 S43 L44 K48 E49 V50 E51 E52 F53 L54 T55 Y56 V59 Q60 G61 K62 V63 A64 T65 K66 T67 L72 L75 I82 L83 K84 T85 I91 R92 F93 Q94 R95 S96 Q97 T107
R108 D109 E110 I111 R112 I117 P120 K121 H122 Q123 L124 P125 I126 K127 Y130 E138 C139 M140 Q145 D146 I147 W157 Q158 G159 K160 G161 N164 R165 T168 L169 A170 K171 E172 L173 Y174 P175 H176 L177 K178 E179 Q180 I181 K185 Y188 D189 R190 D191 L192 H193 Q194
K195 N196 Y197 G198 G199 V200 K207 E208 K209 Y210 P211 N212 A213 P214 Y215 E216 F217 R218 W219 H220 Y221 L222 F223 F226 Q227 L228 S229 L230 D231 D235 V236 M237 R238 R239 N243 E244 T245 K249 R253 E257 A258 E261 H267 H276 V280 I284 R285 T286
V287 Q288 E289 Q290 L291 G292 H293 T294 D295 V296 T299 Q300 I301 Y302 T303 A310 S311 L314 R319 L320

4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α, β, γ	149.90Å 170.20Å 209.40Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	44.60 – 2.80 44.59 – 2.80	Depositor EDS
% Data completeness (in resolution range)	96.8 (44.60-2.80) 96.4 (44.59-2.80)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	0.08	Depositor
$< I/\sigma(I) >$ [1]	3.04 (at 2.81Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.234 , 0.262 0.234 , 0.261	Depositor DCC
R_{free} test set	3214 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å^2)	59.5	Xtriage
Anisotropy	0.221	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , 56.6	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.91	EDS
Total number of atoms	13236	wwPDB-VP
Average B, all atoms (Å^2)	64.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 11.16% of the height of the origin peak. No significant pseudotranslation is detected.*

[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.

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	0.58	0/709	0.74	0/1092
1	G	0.61	0/664	0.79	0/1023
2	F	0.59	0/775	0.79	0/1195
2	H	0.65	0/728	0.92	3/1122 (0.3%)
3	A	0.45	0/2652	0.64	3/3578 (0.1%)
3	B	0.51	0/2704	0.76	3/3649 (0.1%)
3	C	0.45	0/2680	0.64	0/3614
3	D	0.51	0/2704	0.76	7/3649 (0.2%)
All	All	0.51	0/13616	0.73	16/18922 (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	E	0	2
1	G	0	3
2	F	0	3
2	H	0	3
All	All	0	11

There are no bond length outliers.

The worst 5 of 16 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	D	96	SER	CA-C-N	-8.96	97.50	117.20
3	A	39	LYS	CA-C-N	-7.41	100.91	117.20
2	H	28	DT	OP1-P-OP2	-6.91	109.23	119.60
3	B	94	GLN	C-N-CA	-6.60	105.21	121.70
3	B	96	SER	CA-C-N	-6.57	102.76	117.20

There are no chirality outliers.

5 of 11 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	E	20	DG	Sidechain
1	E	27	DG	Sidechain
2	F	17	DC	Sidechain
2	F	19	DT	Sidechain
2	F	29	DG	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	E	632	0	348	35	0
1	G	592	0	326	15	0
2	F	693	0	387	20	0
2	H	651	0	364	40	0
3	A	2592	0	2637	147	1
3	B	2643	0	2695	144	0
3	C	2620	0	2670	155	0
3	D	2643	0	2695	138	0
4	A	36	0	0	5	0
4	B	40	0	0	3	0
4	C	32	0	0	7	0
4	D	41	0	0	5	0
4	E	7	0	0	4	0
4	F	4	0	0	1	0
4	G	6	0	0	0	0
4	H	4	0	0	0	0
All	All	13236	0	12122	633	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 25.

The worst 5 of 633 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:B:35:HIS:ND1	3:B:39:LYS:HD3	1.38	1.36

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:B:35:HIS:CE1	3:B:39:LYS:HD3	1.81	1.13
3:B:35:HIS:CE1	3:B:39:LYS:CD	2.32	1.10
1:E:9:DT:H2"	1:E:10:DT:H5"	1.35	1.08
3:D:65:THR:HG21	3:D:95:ARG:HD2	1.28	1.08

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)
3:A:35:HIS:CE1	3:A:35:HIS:CE1[3_656]	1.78	0.42

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	309/320 (97%)	270 (87%)	29 (9%)	10 (3%)	4	13
3	B	318/320 (99%)	282 (89%)	31 (10%)	5 (2%)	9	31
3	C	313/320 (98%)	276 (88%)	26 (8%)	11 (4%)	3	12
3	D	318/320 (99%)	280 (88%)	33 (10%)	5 (2%)	9	31
All	All	1258/1280 (98%)	1108 (88%)	119 (10%)	31 (2%)	5	19

5 of 31 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	A	39	LYS
3	A	84	LYS
3	A	117	ILE
3	A	235	ASP
3	B	84	LYS

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	282/287 (98%)	260 (92%)	22 (8%)	12 35
3	B	287/287 (100%)	259 (90%)	28 (10%)	8 24
3	C	284/287 (99%)	262 (92%)	22 (8%)	13 35
3	D	287/287 (100%)	258 (90%)	29 (10%)	7 22
All	All	1140/1148 (99%)	1039 (91%)	101 (9%)	9 28

5 of 101 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	C	112	ARG
3	C	302	TYR
3	D	303	THR
3	C	141	ARG
3	C	222	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 54 such sidechains are listed below:

Mol	Chain	Res	Type
3	C	73	ASN
3	C	288	GLN
3	D	220	HIS
3	C	145	GLN
3	C	196	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)

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

6.1 Protein, DNA and RNA chains

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^{th} 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	31/40 (77%)	0.26	3 (9%) 7 4	38, 62, 154, 171	0
1	G	29/40 (72%)	0.13	1 (3%) 45 35	33, 63, 132, 160	0
2	F	34/43 (79%)	0.10	4 (11%) 4 2	35, 58, 164, 175	0
2	H	32/43 (74%)	0.09	2 (6%) 20 12	35, 57, 119, 169	0
3	A	313/320 (97%)	0.11	15 (4%) 30 21	30, 60, 107, 125	0
3	B	320/320 (100%)	-0.02	11 (3%) 45 35	27, 54, 93, 131	0
3	C	317/320 (99%)	0.24	18 (5%) 23 15	30, 61, 108, 125	0
3	D	320/320 (100%)	-0.02	7 (2%) 62 52	26, 54, 93, 131	0
All	All	1396/1446 (96%)	0.08	61 (4%) 34 24	26, 57, 108, 175	0

The worst 5 of 61 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	C	308	ARG	7.2
3	C	309	GLY	6.0
3	A	98	LEU	5.3
1	E	5	DC	5.1
3	B	320	LEU	4.3

6.2 Non-standard residues in protein, DNA, RNA chains

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates

There are no monosaccharides in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.