wwPDB X-ray Structure Validation Summary Report (i)

Sep 9, 2023 – 07:55 PM EDT

PDB ID	:	4I3H
Title	:	A three-gate structure of topoisomerase IV from Streptococcus pneumoniae
Authors	:	Laponogov, I.; Veselkov, D.A.; Pan, X.-S.; Crevel, I.; Fisher, L.M.; Sanderson, M.R.
Deposited on	:	2012-11-26
Resolution	:	3.70 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 types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

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

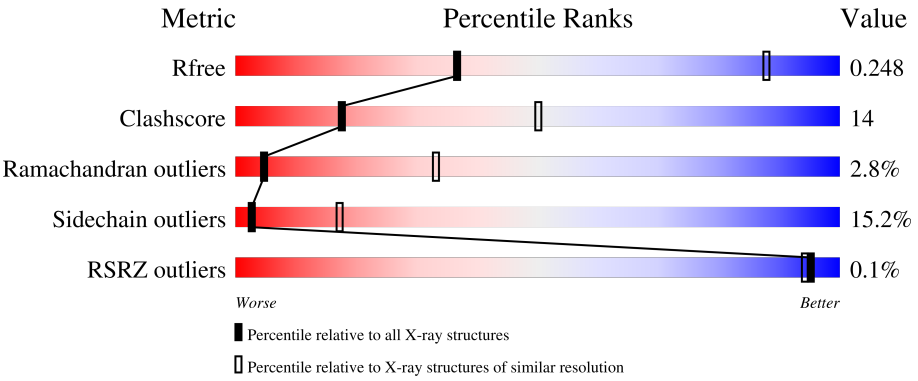
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35.1

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 3.70 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	1049 (3.88-3.52)
Clashscore	141614	1027 (3.86-3.54)
Ramachandran outliers	138981	1069 (3.88-3.52)
Sidechain outliers	138945	1065 (3.88-3.52)
RSRZ outliers	127900	1578 (3.90-3.50)

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	34	21% 18% · 59%
1	G	34	15% 32% 12% 41%
2	F	34	18% 12% 12% 59%
2	H	34	29% 21% 9% 41%
3	A	1144	58% 26% 6% 9%

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Mol	Chain	Length	Quality of chain
3	B	1144	

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 16228 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(*CP*AP*AP*AP*GP*GP*CP*GP*GP*TP*AP*AP*TP*AP*CP*GP*GP*TP*TP*AP*TP*CP*CP*AP*CP*AP*GP*AP*AP*TP*CP*AP*GP*G)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	E	14	Total	C	N	O	P	0	0	0
			282	133	52	83	14			
1	G	20	Total	C	N	O	P	0	0	0
			407	191	77	119	20			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	F	14	Total	C	N	O	P	0	0	0
			283	133	51	85	14			
2	H	20	Total	C	N	O	P	0	0	0
			402	189	72	121	20			

- Molecule 3 is a protein called Topoisomerase IV subunit B, DNA topoisomerase 4 subunit A chimera.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	A	1037	Total	C	N	O	S	0	0	0
			7477	4740	1286	1430	21			
3	B	1035	Total	C	N	O	S	0	0	0
			7372	4657	1280	1413	22			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1000	HIS	-	linker	UNP Q3HZ71
B	1000	HIS	-	linker	UNP Q3HZ71

- Molecule 4 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total Mg 1 1	0	0
4	B	1	Total Mg 1 1	0	0
4	H	1	Total Mg 1 1	0	0

- Molecule 5 is water.

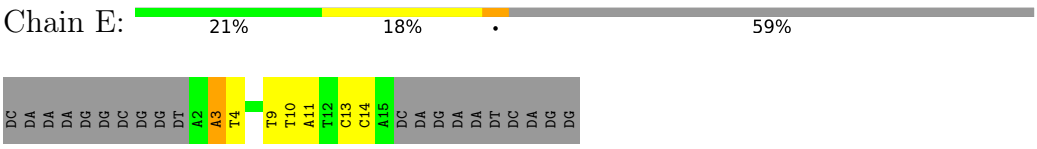
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	E	2	Total O 2 2	0	0

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.

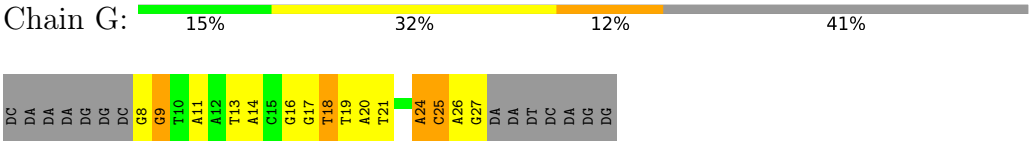
• Molecule 1: DNA (5'-D(*CP*AP*AP*AP*GP*GP*CP*GP*GP*TP*AP*AP*TP*AP*CP*GP*GP*TP*TP*AP*TP*CP*CP*AP*CP*AP*GP*AP*AP*TP*CP*AP*GP*G)-3')

Chain E:



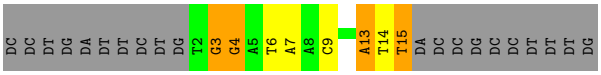
• Molecule 1: DNA (5'-D(*CP*AP*AP*AP*GP*GP*CP*GP*GP*TP*AP*AP*TP*AP*CP*GP*GP*TP*TP*AP*TP*CP*CP*AP*CP*AP*GP*AP*AP*TP*CP*AP*GP*G)-3')

Chain G:



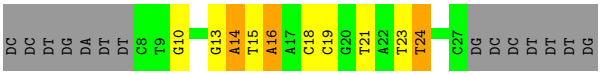
• Molecule 2: DNA (5'-D(*CP*CP*TP*GP*AP*TP*TP*CP*TP*GP*TP*GP*GP*AP*TP*AP*AP*CP*CP*GP*TP*AP*TP*TP*AP*CP*CP*GP*CP*CP*TP*TP*TP*G)-3')

Chain F:



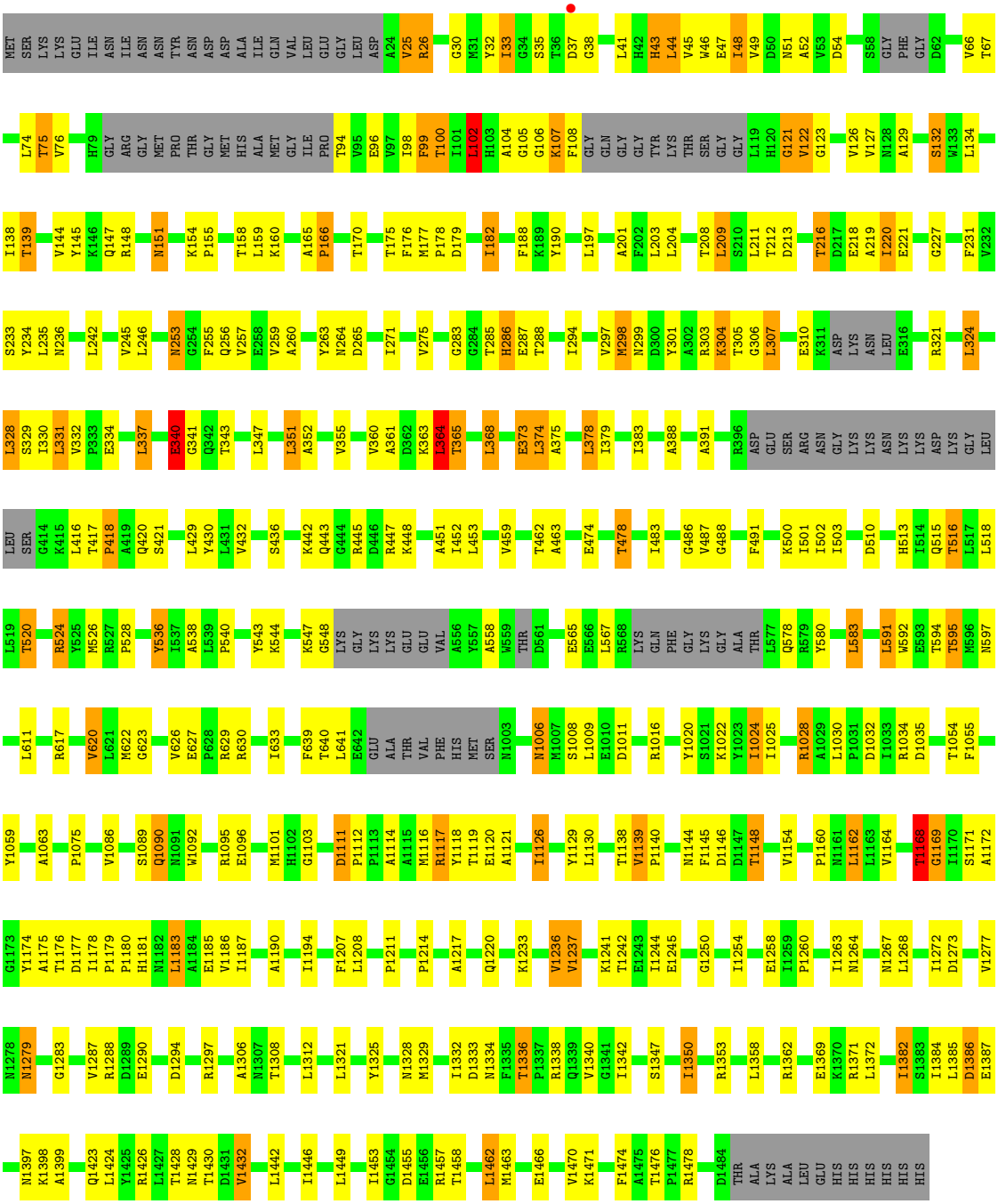
• Molecule 2: DNA (5'-D(*CP*CP*TP*GP*AP*TP*TP*CP*TP*GP*TP*GP*GP*AP*TP*AP*AP*CP*CP*GP*TP*AP*TP*TP*AP*CP*CP*GP*CP*CP*TP*TP*TP*G)-3')

Chain H:



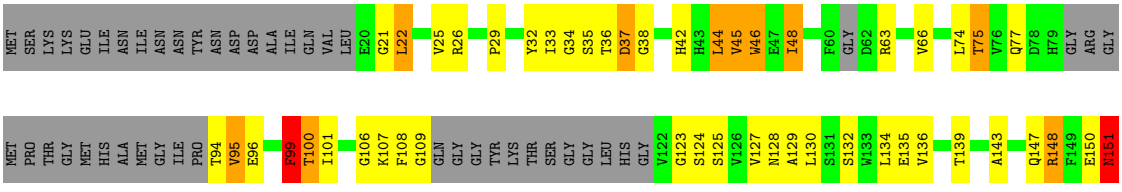
• Molecule 3: Topoisomerase IV subunit B, DNA topoisomerase 4 subunit A chimera

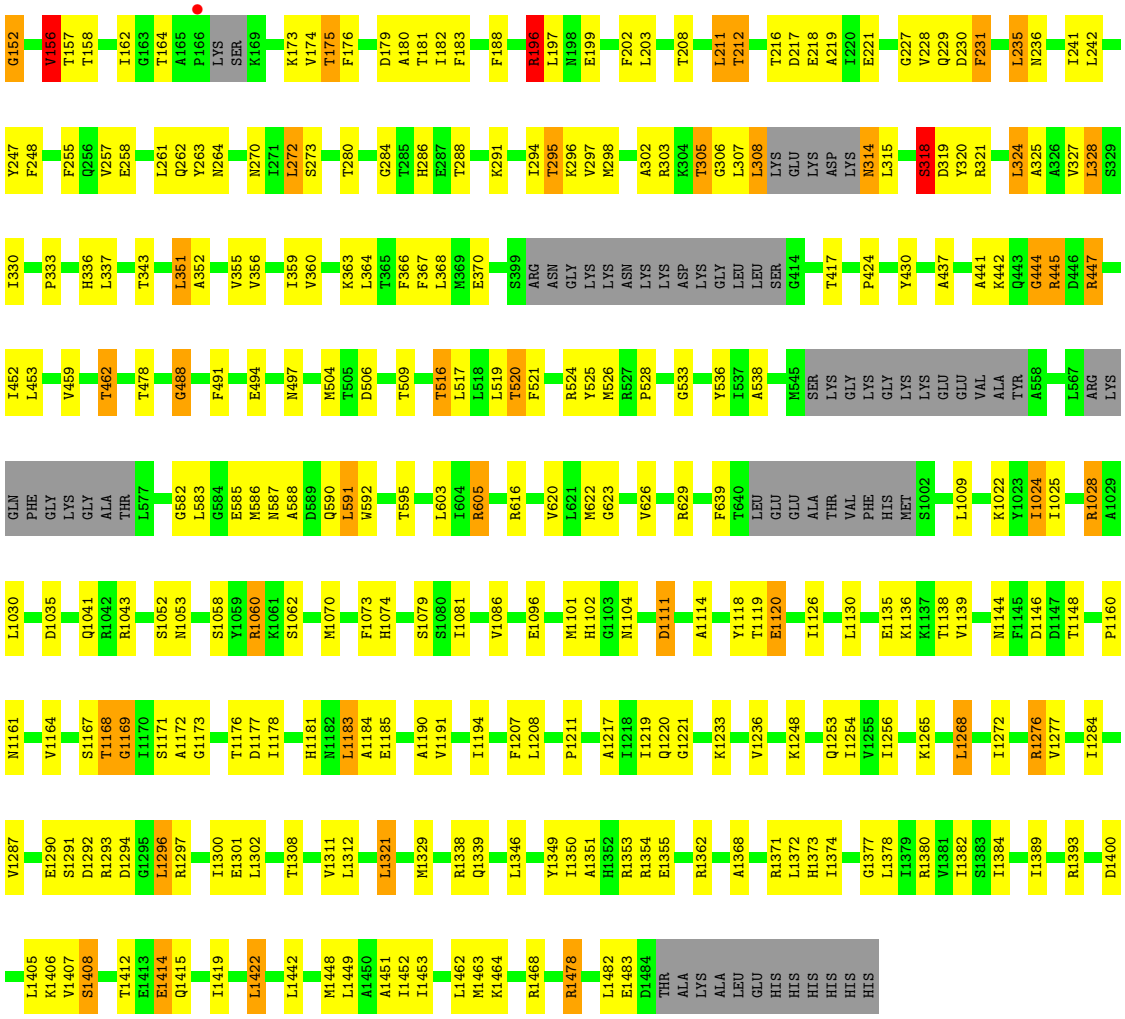
Chain A:



• Molecule 3: Topoisomerase IV subunit B, DNA topoisomerase 4 subunit A chimera

Chain B:




G152 V156 T157 T158 I162 G163 T164 A165 P166 LYS SER K169 K173 V174 T175 F176 D179 A180 T181 I182 F183 F188 R196 L197 N198 E199 F202 L203 T208 L211 T212 T216 D217 E218 A219 I220 E221 G227 V228 Q229 D230 F231 L235 N236 I241 L242
Y247 F248 F255 Q256 V257 E258 L261 Q262 Y263 N264 N270 I271 L272 S273 T280 G284 T285 H286 E287 T288 K291 I294 T295 K296 V297 M298 A302 R303 K304 T305 G306 L307 L308 LYS GLU LYS ASP LYS N314 L315 S318 D319 Y320 R321 L324 A325 A326 V327 L328 S329
I330 P333 H336 L337 T343 L351 A352 V355 V356 I359 V360 K363 L364 T365 F366 F367 L368 M369 E370 S399 ARG ASN GLY LYS LYS ASN LYS LYS ASP LYS GLY LEU LEU SER G414 T417 P424 Y430 A437 A441 K442 Q443 G444 R445 D446 R447
I452 L453 V459 T462 T478 G488 F491 E494 N497 M504 T505 D506 T509 T516 L517 L518 L519 T520 F521 R524 Y525 M526 R527 P528 G533 Y536 I537 A538 M545 SER LYS GLY LYS GLY LYS LYS GLU GLU VAL ALA TYR A558 L567 ARG LYS
GLN PHE GLY LYS GLY ALA THR L577 G582 L583 G584 E585 M586 N587 A588 D589 Q590 L591 W592 T595 L603 I604 R605 R616 V620 L621 M622 G623 V626 R629 F639 T640 LEU GLU GLU ALA THR VAL PHE HIS MET S1002 L1009 K1022 Y1023 I1024 I1025 R1028 A1029
L1030 D1035 Q1041 R1042 R1043 S1052 N1053 S1058 Y1059 R1060 K1061 S1062 M1070 F1073 H1074 S1079 S1080 I1081 V1086 E1096 M1101 H1102 G1103 N1104 D1111 A1114 Y1118 T1119 E1120 I1126 L1130 E1135 K1136 K1137 T1138 V1139 N1144 F1145 D1146 D1147 T1148 P1160
N1161 V1164 S1167 T1168 G1169 I1170 S1171 A1172 G1173 T1176 D1177 I1178 H1181 N1182 L1183 A1184 E1185 A1190 V1191 I1194 F1207 L1208 P1211 A1217 I1218 I1219 Q1220 G1221 K1233 V1236 K1248 Q1253 I1254 V1255 I1256 K1265 L1268 I1272 R1276 V1277 I1284
V1287 E1290 S1291 D1292 R1293 D1294 G1295 L1296 R1297 I1300 E1301 L1302 T1308 V1311 L1312 L1321 M1329 R1338 Q1339 L1346 Y1349 I1350 A1351 H1352 R1353 R1354 E1355 R1362 A1368 R1371 L1372 H1373 I1374 G1377 L1378 I1379 R1380 V1381 I1382 S1383 I1384 I1389 R1393 D1400
L1405 K1406 V1407 S1408 T1412 E1413 E1414 Q1415 I1419 L1422 L1442 M1448 L1449 A1450 A1451 I1452 I1453 L1462 M1463 K1464 R1468 R1478 L1482 E1483 D1484 THR ALA LYS ALA LEU GLU HIS HIS HIS HIS HIS HIS

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 42 21 2	Depositor
Cell constants a, b, c, α, β, γ	160.60Å 160.60Å 280.56Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	71.82 – 3.70 71.82 – 3.70	Depositor EDS
% Data completeness (in resolution range)	99.7 (71.82-3.70) 99.7 (71.82-3.70)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	0.12	Depositor
$< I/\sigma(I) >$ [1]	4.10 (at 3.67Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.7.2_869)	Depositor
R, R_{free}	0.185 , 0.248 0.183 , 0.248	Depositor DCC
R_{free} test set	2006 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å^2)	95.5	Xtriage
Anisotropy	0.205	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.26 , 82.0	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	0.91	EDS
Total number of atoms	16228	wwPDB-VP
Average B, all atoms (Å^2)	91.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.52% 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

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

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	0.83	1/316 (0.3%)	1.85	12/483 (2.5%)
1	G	0.96	0/457	1.94	12/701 (1.7%)
2	F	0.80	0/317	1.91	10/485 (2.1%)
2	H	0.86	0/450	1.83	13/689 (1.9%)
3	A	0.45	0/7600	0.67	2/10359 (0.0%)
3	B	0.43	0/7491	0.65	2/10214 (0.0%)
All	All	0.50	1/16631 (0.0%)	0.87	51/22931 (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
3	A	0	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	E	4	DT	C1'-N1	5.18	1.55	1.49

The worst 5 of 51 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	G	20	DA	O4'-C1'-N9	15.76	119.03	108.00
2	H	16	DA	O4'-C4'-C3'	-10.97	99.42	106.00
1	G	24	DA	O4'-C1'-N9	-8.97	101.72	108.00
2	H	21	DT	O4'-C4'-C3'	-8.15	101.11	106.00
2	H	24	DT	O4'-C1'-N1	-8.15	102.30	108.00

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
3	A	102	LEU	Peptide

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	282	0	147	8	0
1	G	407	0	211	10	0
2	F	283	0	145	11	0
2	H	402	0	209	8	0
3	A	7477	0	6788	217	0
3	B	7372	0	6577	186	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	H	1	0	0	0	0
5	E	2	0	0	0	0
All	All	16228	0	14077	414	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 14.

The worst 5 of 414 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:E:3:DA:N6	2:F:13:DA:N6	2.20	0.89
1:E:3:DA:N1	2:F:13:DA:N1	2.21	0.89
3:A:520:THR:HG21	3:A:622:MET:HG3	1.56	0.88
3:B:48:ILE:HG12	3:B:127:VAL:HG21	1.60	0.82
1:E:3:DA:N6	2:F:13:DA:C6	2.47	0.82

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	1017/1144 (89%)	891 (88%)	101 (10%)	25 (2%)	5 35
3	B	1015/1144 (89%)	868 (86%)	115 (11%)	32 (3%)	4 31
All	All	2032/2288 (89%)	1759 (87%)	216 (11%)	57 (3%)	5 33

5 of 57 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	A	305	THR
3	A	373	GLU
3	A	1398	LYS
3	B	35	SER
3	B	99	PHE

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	672/969 (69%)	565 (84%)	107 (16%)	2 16
3	B	640/969 (66%)	548 (86%)	92 (14%)	3 19
All	All	1312/1938 (68%)	1113 (85%)	199 (15%)	3 17

5 of 199 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	B	100	THR

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Mol	Chain	Res	Type
3	B	314	ASN
3	B	151	ASN
3	B	212	THR
3	B	445	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
3	A	51	ASN
3	A	264	ASN
3	B	264	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

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	14/34 (41%)	-0.60	0	100	100	144, 201, 233, 259	14 (100%)
1	G	20/34 (58%)	-0.50	0	100	100	66, 82, 159, 192	0
2	F	14/34 (41%)	-0.62	0	100	100	138, 196, 225, 254	14 (100%)
2	H	20/34 (58%)	-0.56	0	100	100	60, 85, 168, 199	0
3	A	1037/1144 (90%)	-0.51	1 (0%)	95	94	35, 83, 129, 225	0
3	B	1035/1144 (90%)	-0.49	1 (0%)	95	94	44, 89, 136, 212	0
All	All	2140/2424 (88%)	-0.50	2 (0%)	95	94	35, 86, 142, 259	28 (1%)

All (2) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	B	166	PRO	3.3
3	A	37	ASP	2.9

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

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^{th} 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^2)	Q<0.9
4	MG	B	1700	1/1	0.85	0.07	109,109,109,109	0
4	MG	H	1901	1/1	0.90	0.15	72,72,72,72	0
4	MG	A	1700	1/1	0.92	0.23	94,94,94,94	0

6.5 Other polymers (i)

There are no such residues in this entry.