



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 18, 2026 – 01:36 AM UTC

PDB ID : 9I9F / pdb_00009i9f
Title : Crystal structure of apoform human eIF4A1 C-terminal domain
Authors : Turnbull, A.P.; Schmidt, T.; Bushell, M.
Deposited on : 2025-02-06
Resolution : 2.73 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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 ⓘ 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 ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

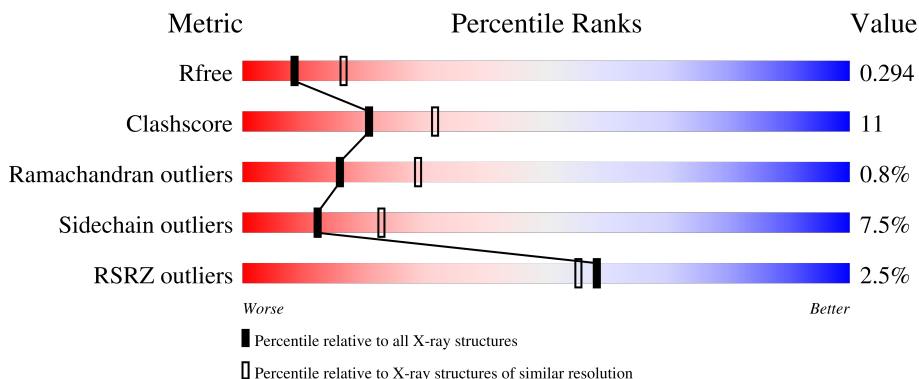
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.73 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}	180053	1819 (2.76-2.72)
Clashscore	190562	1866 (2.76-2.72)
Ramachandran outliers	187476	1830 (2.76-2.72)
Sidechain outliers	187428	1831 (2.76-2.72)
RSRZ outliers	180081	1819 (2.76-2.72)

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 $\leq 5\%$. 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	170	<div> <div>3%</div> <div>69%</div> <div>21%</div> <div>6%</div> <div>.</div> </div>
1	B	170	<div> <div>2%</div> <div>72%</div> <div>22%</div> <div>.</div> <div>.</div> </div>
1	C	170	<div> <div>2%</div> <div>79%</div> <div>12%</div> <div>.</div> <div>7%</div> </div>

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3775 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 Eukaryotic initiation factor 4A-I.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	164	Total	C	N	O	S	0	0	0
			1279	809	216	247	7			
1	B	164	Total	C	N	O	S	0	0	0
			1293	816	228	242	7			
1	C	158	Total	C	N	O	S	0	0	0
			1160	739	192	223	6			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	237	GLY	-	expression tag	UNP P60842
A	238	SER	-	expression tag	UNP P60842
B	237	GLY	-	expression tag	UNP P60842
B	238	SER	-	expression tag	UNP P60842
C	237	GLY	-	expression tag	UNP P60842
C	238	SER	-	expression tag	UNP P60842

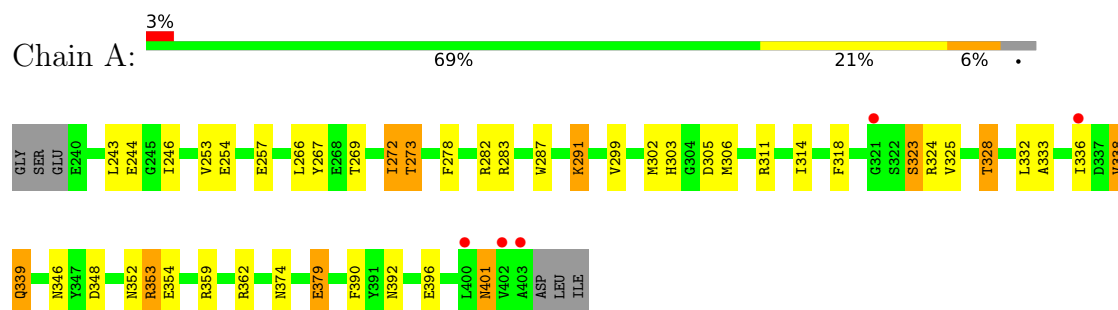
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	22	Total	O	0	0
			22	22		
2	B	18	Total	O	0	0
			18	18		
2	C	3	Total	O	0	0
			3	3		

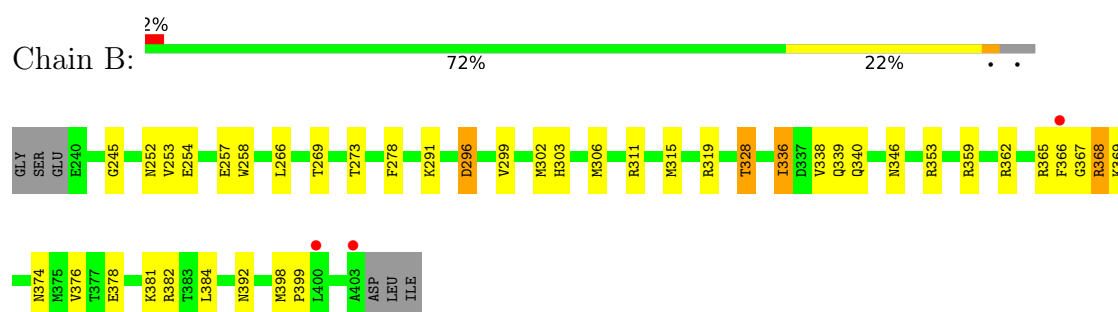
3 Residue-property plots [i](#)

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.

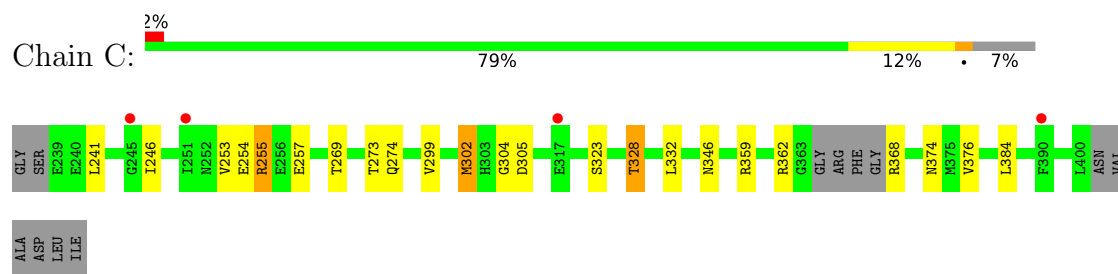
- Molecule 1: Eukaryotic initiation factor 4A-I



- Molecule 1: Eukaryotic initiation factor 4A-I



- Molecule 1: Eukaryotic initiation factor 4A-I



4 Data and refinement statistics

Property	Value	Source
Space group	P 31	Depositor
Cell constants a, b, c, α , β , γ	84.97Å 84.97Å 66.42Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	40.00 – 2.73 40.00 – 2.73	Depositor EDS
% Data completeness (in resolution range)	99.9 (40.00-2.73) 99.9 (40.00-2.73)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.47 (at 2.72Å)	Xtriage
Refinement program	REFMAC 5.8.0425	Depositor
R, R_{free}	0.229 , 0.294 0.232 , 0.294	Depositor DCC
R_{free} test set	674 reflections (4.74%)	wwPDB-VP
Wilson B-factor (Å ²)	65.2	Xtriage
Anisotropy	0.118	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 60.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.53$, $\langle L^2 \rangle = 0.36$	Xtriage
Estimated twinning fraction	0.018 for -h,-k,l 0.024 for h,-h-k,-l 0.000 for -k,-h,-l	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	3775	wwPDB-VP
Average B, all atoms (Å ²)	70.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.02% 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

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	A	0.57	0/1297	1.11	4/1759 (0.2%)
1	B	0.53	0/1311	1.11	3/1774 (0.2%)
1	C	0.53	0/1174	1.04	2/1599 (0.1%)
All	All	0.54	0/3782	1.09	9/5132 (0.2%)

There are no bond length outliers.

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	353	ARG	CB-CA-C	-5.84	101.47	110.81
1	B	269	THR	CA-CB-OG1	-5.69	101.06	109.60
1	A	269	THR	CA-CB-OG1	-5.68	101.08	109.60
1	A	348	ASP	CA-CB-CG	5.45	118.05	112.60
1	A	305	ASP	CA-CB-CG	5.33	117.94	112.60
1	B	296	ASP	CA-CB-CG	5.22	117.82	112.60
1	A	273	THR	CA-CB-OG1	-5.21	101.78	109.60
1	C	255	ARG	CB-CG-CD	5.21	123.29	111.30
1	C	269	THR	CA-CB-OG1	-5.20	101.81	109.60

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

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	1279	0	1225	42	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	1293	0	1265	29	0
1	C	1160	0	1057	13	0
2	A	22	0	0	3	0
2	B	18	0	0	1	0
2	C	3	0	0	0	0
All	All	3775	0	3547	81	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 11.

All (81) 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:A:272:ILE:C	1:A:272:ILE:HD12	1.81	1.04
1:C:274:GLN:HB2	1:C:323:SER:CB	2.02	0.88
1:B:302:MET:SD	1:B:306:MET:HE1	2.15	0.86
1:A:390:PHE:HA	1:B:368:ARG:CB	2.08	0.84
1:A:272:ILE:HD12	1:A:272:ILE:O	1.78	0.82
1:A:272:ILE:C	1:A:272:ILE:CD1	2.56	0.77
1:A:243:LEU:O	1:A:246:ILE:HG22	1.90	0.71
1:A:272:ILE:HD11	1:A:325:VAL:CG2	2.20	0.71
1:B:245:GLY:O	1:B:369:LYS:HB3	1.91	0.70
1:B:366:PHE:O	1:B:368:ARG:N	2.24	0.70
1:A:302:MET:HE3	1:A:306:MET:HE1	1.75	0.68
1:A:401:ASN:N	1:A:401:ASN:OD1	2.26	0.67
1:A:339:GLN:HE21	1:A:339:GLN:HA	1.60	0.65
1:B:362:ARG:HD2	1:B:368:ARG:O	1.97	0.64
1:A:311:ARG:O	1:A:314:ILE:HG22	1.98	0.64
1:B:302:MET:SD	1:B:306:MET:CE	2.88	0.62
1:B:315:MET:HE3	1:B:336:ILE:HA	1.83	0.61
1:B:302:MET:HE3	1:B:306:MET:CE	2.31	0.61
1:B:252:ASN:OD1	1:B:381:LYS:NZ	2.32	0.61
1:C:362:ARG:CG	1:C:368:ARG:O	2.50	0.60
1:A:272:ILE:CD1	1:A:325:VAL:CG2	2.80	0.59
1:B:303:HIS:O	1:B:306:MET:HG2	2.03	0.59
1:A:272:ILE:HD11	1:A:325:VAL:HG23	1.87	0.56
1:A:311:ARG:O	1:A:314:ILE:CG2	2.54	0.56
1:C:255:ARG:HG3	1:C:255:ARG:HH11	1.71	0.55
1:A:318:PHE:O	1:A:323:SER:HA	2.06	0.55
1:B:302:MET:HE1	1:B:336:ILE:HD13	1.88	0.55
1:A:303:HIS:H	1:A:306:MET:HE2	1.72	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:339:GLN:NE2	2:B:501:HOH:O	2.41	0.54
1:B:302:MET:CE	1:B:306:MET:CE	2.87	0.53
1:A:338:VAL:HG11	1:A:359:ARG:O	2.10	0.52
1:A:282:ARG:NH2	2:A:501:HOH:O	2.41	0.52
1:A:354:GLU:CG	1:B:319:ARG:HH11	2.22	0.52
1:A:338:VAL:O	1:A:338:VAL:CG1	2.58	0.51
1:B:302:MET:CB	1:B:328:THR:HG23	2.41	0.51
1:A:302:MET:CB	1:A:328:THR:HG23	2.41	0.50
1:A:353:ARG:NH1	1:B:340:GLN:O	2.44	0.50
1:A:272:ILE:HD12	1:A:273:THR:N	2.26	0.50
1:C:246:ILE:HD11	1:C:362:ARG:HB2	1.92	0.49
1:A:246:ILE:HB	1:A:362:ARG:HD3	1.94	0.49
1:A:253:VAL:O	1:A:254:GLU:C	2.55	0.49
1:B:253:VAL:O	1:B:254:GLU:C	2.55	0.49
1:A:324:ARG:HA	2:A:504:HOH:O	2.13	0.48
1:C:253:VAL:O	1:C:254:GLU:C	2.55	0.48
1:C:302:MET:CB	1:C:328:THR:HG23	2.44	0.48
1:A:302:MET:HB2	1:A:328:THR:HG23	1.95	0.47
1:B:346:ASN:HB2	1:B:374:ASN:HD22	1.79	0.47
1:B:346:ASN:HD21	1:B:359:ARG:HD3	1.79	0.47
1:C:346:ASN:HD21	1:C:359:ARG:HD3	1.80	0.47
1:B:254:GLU:HB2	1:B:258:TRP:CZ3	2.50	0.47
1:A:379:GLU:CD	1:A:379:GLU:H	2.23	0.47
1:A:328:THR:HG22	1:A:332:LEU:HB2	1.97	0.46
1:A:338:VAL:O	1:A:338:VAL:HG13	2.17	0.45
1:A:311:ARG:HA	1:A:314:ILE:HG22	1.99	0.45
1:B:278:PHE:HB2	1:B:346:ASN:HD22	1.82	0.45
1:A:287:TRP:NE1	1:A:291:LYS:HE3	2.31	0.45
1:C:346:ASN:HB2	1:C:374:ASN:HD22	1.82	0.45
1:C:302:MET:HB2	1:C:328:THR:HG23	1.98	0.44
1:C:255:ARG:HG3	1:C:255:ARG:NH1	2.32	0.44
1:B:376:VAL:HG11	1:B:384:LEU:HD22	2.00	0.44
1:C:328:THR:HG22	1:C:332:LEU:HB2	2.00	0.44
1:A:346:ASN:HB2	1:A:374:ASN:HD22	1.82	0.44
1:B:338:VAL:HG22	1:B:338:VAL:O	2.18	0.43
1:A:333:ALA:HA	1:A:336:ILE:HD12	1.99	0.43
1:B:392:ASN:C	1:B:392:ASN:HD22	2.26	0.43
1:A:283:ARG:NH1	2:A:502:HOH:O	2.46	0.43
1:B:302:MET:HB2	1:B:328:THR:HG23	2.00	0.42
1:A:243:LEU:C	1:A:246:ILE:HG22	2.45	0.42
1:B:365:ARG:HH11	1:B:365:ARG:HG2	1.84	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:352:ASN:OD1	1:A:354:GLU:HB2	2.20	0.42
1:B:378:GLU:OE2	1:B:378:GLU:HA	2.18	0.42
1:A:346:ASN:HD21	1:A:359:ARG:HD3	1.85	0.42
1:A:267:TYR:HA	1:A:272:ILE:HG23	2.02	0.41
1:A:311:ARG:C	1:A:314:ILE:HG22	2.44	0.41
1:B:306:MET:HE3	1:B:311:ARG:HG3	2.02	0.41
1:B:398:MET:HE2	1:B:398:MET:HB3	1.93	0.41
1:A:272:ILE:O	1:A:272:ILE:CD1	2.61	0.41
1:A:278:PHE:HB2	1:A:346:ASN:HD22	1.85	0.41
1:C:376:VAL:HG11	1:C:384:LEU:HD22	2.02	0.41
1:A:392:ASN:HD22	1:A:392:ASN:C	2.29	0.41
1:C:304:GLY:O	1:C:305:ASP:CB	2.69	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	162/170 (95%)	151 (93%)	10 (6%)	1 (1%)	21	36
1	B	162/170 (95%)	151 (93%)	8 (5%)	3 (2%)	6	10
1	C	154/170 (91%)	145 (94%)	9 (6%)	0	100	100
All	All	478/510 (94%)	447 (94%)	27 (6%)	4 (1%)	16	29

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	367	GLY
1	A	323	SER
1	B	399	PRO
1	B	368	ARG

5.3.2 Protein sidechains ⓘ

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	131/154 (85%)	118 (90%)	13 (10%)	7	14
1	B	134/154 (87%)	125 (93%)	9 (7%)	15	27
1	C	106/154 (69%)	100 (94%)	6 (6%)	18	34
All	All	371/462 (80%)	343 (92%)	28 (8%)	12	23

All (28) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	244	GLU
1	A	257	GLU
1	A	266	LEU
1	A	272	ILE
1	A	291	LYS
1	A	299	VAL
1	A	328	THR
1	A	338	VAL
1	A	339	GLN
1	A	353	ARG
1	A	379	GLU
1	A	396	GLU
1	A	401	ASN
1	B	257	GLU
1	B	266	LEU
1	B	273	THR
1	B	291	LYS
1	B	296	ASP
1	B	299	VAL
1	B	328	THR
1	B	336	ILE
1	B	382	ARG
1	C	241	LEU
1	C	257	GLU
1	C	273	THR
1	C	299	VAL

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Mol	Chain	Res	Type
1	C	302	MET
1	C	328	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	248	GLN
1	A	339	GLN
1	A	346	ASN
1	A	374	ASN
1	A	392	ASN
1	B	248	GLN
1	B	274	GLN
1	B	346	ASN
1	B	374	ASN
1	B	392	ASN
1	C	303	HIS
1	C	346	ASN
1	C	374	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 oligosaccharides 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 [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	164/170 (96%)	0.05	5 (3%)	52 50	34, 59, 100, 134	0
1	B	164/170 (96%)	0.18	3 (1%)	67 64	39, 64, 104, 128	0
1	C	158/170 (92%)	0.38	4 (2%)	58 55	47, 80, 127, 156	0
All	All	486/510 (95%)	0.20	12 (2%)	58 55	34, 70, 114, 156	0

All (12) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	403	ALA	4.5
1	A	403	ALA	2.8
1	A	336	ILE	2.7
1	A	402	VAL	2.7
1	C	317	GLU	2.7
1	A	321	GLY	2.4
1	C	390	PHE	2.4
1	C	251	ILE	2.4
1	B	400	LEU	2.3
1	B	366	PHE	2.3
1	A	400	LEU	2.2
1	C	245	GLY	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 oligosaccharides 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.