WORLDWIDE wwPDB PROTEIN DATA BANK

Full wwPDB X-ray Structure Validation Report ⓘ

Jan 29, 2026 – 04:10 PM JST

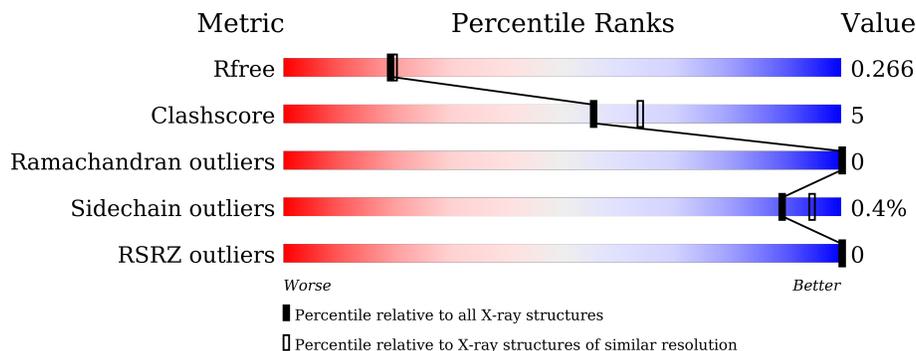|		
PDB ID	:	9V9O / pdb_00009v9o
Title	:	Crystal structure of CDC48A-N domain in complex with PUX5 SHP box motif and UBX domain
Authors	:	Arold, S.T.; Zhang, J.
Deposited on	:	2025-06-01
Resolution	:	2.20 Å(reported)

1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:
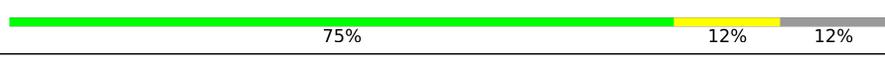*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.20 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		0.266
Clashscore		5
Ramachandran outliers		0
Sidechain outliers		0.4%
RSRZ outliers		0

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$_{free}$	164625	5791 (2.20-2.20)
Clashscore	180529	6634 (2.20-2.20)
Ramachandran outliers	177936	6560 (2.20-2.20)
Sidechain outliers	177891	6561 (2.20-2.20)
RSRZ outliers	164620	5791 (2.20-2.20)

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	A	301	77% 10% 12%
1	B	301	78% 9% 12%
1	C	301	75% 12% 12%
1	D	301	74% 14% 12%

2 Entry composition ⓘ

There are 3 unique types of molecules in this entry. The entry contains 8378 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 Cell division control protein 48 homolog A,Plant UBX domain-containing protein 5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	264	Total	C	N	O	S	0	0	0
			2068	1302	370	388	8			
1	B	264	Total	C	N	O	S	0	0	0
			2068	1302	370	388	8			
1	C	264	Total	C	N	O	S	0	0	0
			2068	1302	370	388	8			
1	D	264	Total	C	N	O	S	0	0	0
			2068	1302	370	388	8			

There are 44 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	26	GLY	-	expression tag	UNP P54609
A	27	SER	-	expression tag	UNP P54609
A	200	GLY	-	linker	UNP P54609
A	201	GLY	-	linker	UNP P54609
A	202	SER	-	linker	UNP P54609
A	203	GLY	-	linker	UNP P54609
A	204	GLY	-	linker	UNP P54609
A	205	SER	-	linker	UNP P54609
A	206	GLY	-	linker	UNP P54609
A	207	GLY	-	linker	UNP P54609
A	208	SER	-	linker	UNP P54609
B	26	GLY	-	expression tag	UNP P54609
B	27	SER	-	expression tag	UNP P54609
B	200	GLY	-	linker	UNP P54609
B	201	GLY	-	linker	UNP P54609
B	202	SER	-	linker	UNP P54609
B	203	GLY	-	linker	UNP P54609
B	204	GLY	-	linker	UNP P54609
B	205	SER	-	linker	UNP P54609
B	206	GLY	-	linker	UNP P54609

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Chain	Residue	Modelled	Actual	Comment	Reference
B	207	GLY	-	linker	UNP P54609
B	208	SER	-	linker	UNP P54609
C	26	GLY	-	expression tag	UNP P54609
C	27	SER	-	expression tag	UNP P54609
C	200	GLY	-	linker	UNP P54609
C	201	GLY	-	linker	UNP P54609
C	202	SER	-	linker	UNP P54609
C	203	GLY	-	linker	UNP P54609
C	204	GLY	-	linker	UNP P54609
C	205	SER	-	linker	UNP P54609
C	206	GLY	-	linker	UNP P54609
C	207	GLY	-	linker	UNP P54609
C	208	SER	-	linker	UNP P54609
D	26	GLY	-	expression tag	UNP P54609
D	27	SER	-	expression tag	UNP P54609
D	200	GLY	-	linker	UNP P54609
D	201	GLY	-	linker	UNP P54609
D	202	SER	-	linker	UNP P54609
D	203	GLY	-	linker	UNP P54609
D	204	GLY	-	linker	UNP P54609
D	205	SER	-	linker	UNP P54609
D	206	GLY	-	linker	UNP P54609
D	207	GLY	-	linker	UNP P54609
D	208	SER	-	linker	UNP P54609

- Molecule 2 is SODIUM ION (CCD ID: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total 2	Na 2	0	0
2	C	4	Total 4	Na 4	0	0
2	D	1	Total 1	Na 1	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	25	Total 25	O 25	0	0
3	B	21	Total 21	O 21	0	0

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	C	29	Total 29	O 29	0	0
3	D	24	Total 24	O 24	0	0

3 Residue-property plots ⓘ

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: Cell division control protein 48 homolog A,Plant UBX domain-containing protein 5
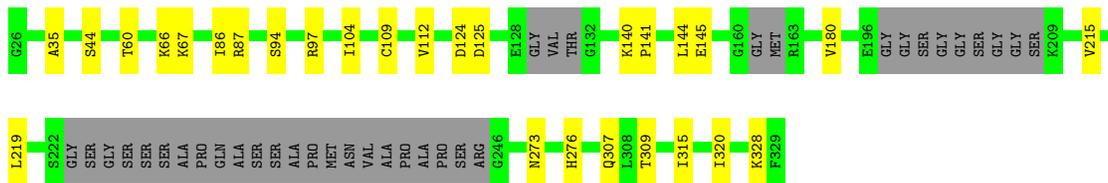
Chain A:
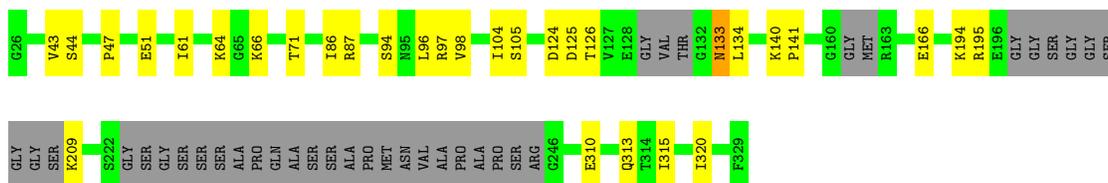
• Molecule 1: Cell division control protein 48 homolog A,Plant UBX domain-containing protein 5

Chain B:

• Molecule 1: Cell division control protein 48 homolog A,Plant UBX domain-containing protein 5

Chain C:
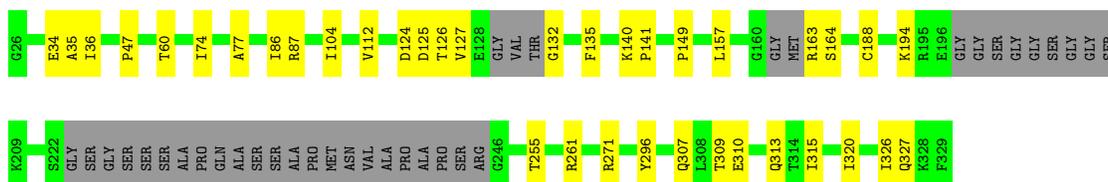
• Molecule 1: Cell division control protein 48 homolog A,Plant UBX domain-containing protein 5

Chain D:

G26 V31 A35 S44 T49 L53 T60 T71 I74 K85 I86 R87 M88 R93 S94 N95 L96 R97 V98 R99 I104 C109 V112 D125 E128 GLY VAL THR G132 K140 P141 L157 G160 GLY MET R163 S164 E185 K194 R195

E196 GLY GLY SER GLY GLY SER GLY GLY SER K209 R217 T218 S222 GLY SER GLY SER SER SER ALA PRO GLN ALA SER SER SER ALA PRO MET ASN VAL ALA PRO ALA PRO SER ARG G246 Y296 M301 K306 E310 Q313 T314 I315 E316 Q317 I320 F329

4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α, β, γ	34.88Å 87.11Å 95.97Å 88.59° 86.67° 89.89°	Depositor
Resolution (Å)	95.78 – 2.20 95.78 – 2.20	Depositor EDS
% Data completeness (in resolution range)	66.7 (95.78-2.20) 69.5 (95.78-2.20)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.55 (at 2.20Å)	Xtriage
Refinement program	PHENIX (1.21.1_5286: ???)	Depositor
R, R_{free}	0.224 , 0.268 0.224 , 0.266	Depositor DCC
R_{free} test set	1968 reflections (3.44%)	wwPDB-VP
Wilson B-factor (Å^2)	43.1	Xtriage
Anisotropy	0.025	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 29.5	EDS
L-test for twinning[2]	$< |L| > = 0.51, < L^2 > = 0.34$	Xtriage
Estimated twinning fraction	0.157 for -h,k,-l	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	8378	wwPDB-VP
Average B, all atoms (Å^2)	48.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.24% of the height of the origin peak. No significant pseudotranslation is detected.*

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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.

5 Model quality ⓘ

5.1 Standard geometry ⓘ

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

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	0.15	0/2100	0.32	1/2834 (0.0%)
1	B	0.08	0/2100	0.25	0/2834
1	C	0.11	0/2100	0.28	0/2834
1	D	0.10	0/2100	0.26	0/2834
All	All	0.11	0/8400	0.28	1/11336 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	133	ASN	N-CA-C	-5.14	106.17	112.90

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	2068	0	2096	16	0
1	B	2068	0	2096	16	0
1	C	2068	0	2096	20	0
1	D	2068	0	2096	25	0
2	A	2	0	0	0	0
2	C	4	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	D	1	0	0	0	0
3	A	25	0	0	0	0
3	B	21	0	0	0	0
3	C	29	0	0	0	0
3	D	24	0	0	1	0
All	All	8378	0	8384	76	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 (76) 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:D:128:GLU:O	1:D:163:ARG:NH1	2.16	0.77
1:B:44:SER:HB2	1:B:87:ARG:HB2	1.76	0.66
1:C:47:PRO:HG3	1:C:77:ALA:HB1	1.79	0.64
1:C:60:THR:HG21	1:C:112:VAL:HG11	1.80	0.63
1:D:44:SER:HB2	1:D:87:ARG:HB2	1.79	0.63
1:D:310:GLU:HB2	1:D:313:GLN:HB2	1.81	0.62
1:D:60:THR:HG21	1:D:112:VAL:HG11	1.81	0.62
1:A:310:GLU:HB2	1:A:313:GLN:HB2	1.82	0.61
1:A:86:ILE:HG21	1:A:104:ILE:HD11	1.83	0.61
1:A:44:SER:HB2	1:A:87:ARG:HB2	1.83	0.60
1:A:125:ASP:OD2	1:A:195:ARG:NH2	2.35	0.59
1:D:217:ARG:NH1	3:D:501:HOH:O	2.35	0.59
1:C:310:GLU:HB2	1:C:313:GLN:HB2	1.86	0.58
1:B:60:THR:HG21	1:B:112:VAL:HG11	1.85	0.57
1:A:66:LYS:HG3	1:A:98:VAL:HG12	1.87	0.57
1:D:35:ALA:HA	1:D:87:ARG:HB3	1.89	0.55
1:C:36:ILE:HG13	1:C:87:ARG:HD3	1.88	0.54
1:D:157:LEU:HD11	1:D:164:SER:HB3	1.89	0.54
1:B:66:LYS:HE3	1:B:67:LYS:H	1.73	0.54
1:A:126:THR:HG21	1:A:166:GLU:H	1.71	0.54
1:B:35:ALA:HA	1:B:87:ARG:HB3	1.89	0.53
1:C:315:ILE:HG23	1:C:320:ILE:HG13	1.91	0.53
1:C:255:THR:HG22	1:C:271:ARG:HE	1.74	0.53
1:D:86:ILE:HG21	1:D:104:ILE:HD11	1.91	0.53
1:D:74:ILE:HD13	1:D:301:MET:HE3	1.91	0.53
1:C:307:GLN:HG2	1:C:309:THR:HG23	1.90	0.52
1:D:315:ILE:HG23	1:D:320:ILE:HG13	1.91	0.52
1:A:315:ILE:HG23	1:A:320:ILE:HG13	1.91	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:94:SER:O	1:D:97:ARG:NH1	2.43	0.50
1:B:315:ILE:HG23	1:B:320:ILE:HG13	1.94	0.50
1:C:126:THR:O	1:C:163:ARG:NH1	2.39	0.49
1:C:127:VAL:HA	1:C:163:ARG:HH22	1.77	0.49
1:C:86:ILE:HG21	1:C:104:ILE:HD11	1.94	0.49
1:A:94:SER:O	1:A:97:ARG:NH1	2.46	0.48
1:D:60:THR:HG22	1:D:109:CYS:HB3	1.95	0.48
1:B:86:ILE:HG21	1:B:104:ILE:HD11	1.96	0.47
1:C:132:GLY:HA2	1:D:217:ARG:NH2	2.29	0.47
1:C:124:ASP:OD1	1:C:125:ASP:N	2.47	0.46
1:A:194:LYS:HB3	1:A:194:LYS:HE3	1.82	0.46
1:B:307:GLN:HG2	1:B:309:THR:HG23	1.98	0.46
1:C:261:ARG:HB2	1:C:326:ILE:HD12	1.98	0.46
1:D:71:THR:HG22	1:D:96:LEU:HD21	1.97	0.46
1:D:125:ASP:OD2	1:D:195:ARG:NH1	2.41	0.45
1:D:49:THR:O	1:D:53:LEU:HG	2.16	0.45
1:D:35:ALA:HB2	1:D:88:MET:C	2.42	0.45
1:B:60:THR:HG22	1:B:109:CYS:HB3	1.97	0.45
1:A:71:THR:HG22	1:A:96:LEU:HD21	1.98	0.45
1:B:94:SER:O	1:B:97:ARG:NH1	2.49	0.44
1:A:209:LYS:HB3	1:A:209:LYS:HE2	1.82	0.44
1:B:124:ASP:OD1	1:B:125:ASP:N	2.52	0.43
1:D:140:LYS:HB3	1:D:141:PRO:HD3	2.00	0.43
1:B:144:LEU:HG	1:B:145:GLU:HG2	2.00	0.43
1:D:125:ASP:OD1	1:D:125:ASP:N	2.45	0.43
1:D:185:GLU:HG2	1:D:218:THR:HG22	2.00	0.43
1:A:124:ASP:OD1	1:A:125:ASP:N	2.51	0.43
1:B:66:LYS:HD2	1:B:66:LYS:HA	1.72	0.42
1:D:31:VAL:HB	1:D:85:LYS:HG2	2.00	0.42
1:A:43:VAL:HG21	1:A:61:ILE:HD11	2.01	0.42
1:D:296:TYR:HB3	1:D:329:PHE:CE1	2.54	0.42
1:B:273:ASN:H	1:B:276:HIS:CD2	2.37	0.42
1:C:194:LYS:HD2	1:C:194:LYS:N	2.34	0.42
1:D:93:ARG:HE	1:D:99:ARG:NH2	2.17	0.42
1:A:64:LYS:HB2	1:A:105:SER:OG	2.20	0.42
1:D:306:LYS:HB3	1:D:306:LYS:HE2	1.89	0.42
1:D:314:THR:OG1	1:D:317:GLN:HG2	2.20	0.42
1:B:145:GLU:OE1	1:B:328:LYS:NZ	2.52	0.42
1:B:180:VAL:HG12	1:B:219:LEU:HD22	2.01	0.41
1:A:140:LYS:HB3	1:A:141:PRO:HD3	2.02	0.41
1:C:34:GLU:OE1	1:C:35:ALA:N	2.50	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:47:PRO:O	1:A:51:GLU:HG3	2.21	0.41
1:C:74:ILE:HD11	1:C:149:PRO:HD3	2.03	0.41
1:B:140:LYS:HB3	1:B:141:PRO:HD3	2.01	0.41
1:C:135:PHE:HB2	1:C:188:CYS:SG	2.60	0.41
1:C:140:LYS:HB3	1:C:141:PRO:HD3	2.03	0.41
1:C:157:LEU:HD12	1:C:164:SER:HB3	2.02	0.40
1:C:296:TYR:CD2	1:C:327:GLN:HG3	2.57	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	254/301 (84%)	247 (97%)	7 (3%)	0	100	100
1	B	254/301 (84%)	246 (97%)	8 (3%)	0	100	100
1	C	254/301 (84%)	244 (96%)	10 (4%)	0	100	100
1	D	254/301 (84%)	244 (96%)	10 (4%)	0	100	100
All	All	1016/1204 (84%)	981 (97%)	35 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	229/251 (91%)	227 (99%)	2 (1%)	75	86
1	B	229/251 (91%)	228 (100%)	1 (0%)	89	95
1	C	229/251 (91%)	229 (100%)	0	100	100
1	D	229/251 (91%)	228 (100%)	1 (0%)	89	95
All	All	916/1004 (91%)	912 (100%)	4 (0%)	89	95

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	133	ASN
1	A	134	LEU
1	B	215	VAL
1	D	194	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	275	HIS
1	A	297	GLN
1	A	313	GLN
1	B	108	GLN
1	B	276	HIS
1	B	307	GLN
1	C	54	GLN
1	C	213	GLN
1	D	275	HIS
1	D	313	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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 7 ligands modelled in this entry, 7 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 ⓘ

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 ⓘ

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, 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(Å²)	Q<0.9
1	A	264/301 (87%)	-1.56	0	100	100	33, 46, 70, 113	0
1	B	264/301 (87%)	-1.55	0	100	100	31, 46, 72, 97	0
1	C	264/301 (87%)	-1.58	0	100	100	29, 45, 68, 94	0
1	D	264/301 (87%)	-1.54	0	100	100	30, 47, 76, 101	0
All	All	1056/1204 (87%)	-1.56	0	100	100	29, 46, 72, 113	0

There are no RSRZ outliers to report.

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 oligosaccharides 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, 95th 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(Å²)	Q<0.9
2	NA	C	404	1/1	0.96	0.08	30,30,30,30	0
2	NA	D	401	1/1	0.96	0.04	30,30,30,30	0
2	NA	C	402	1/1	0.98	0.03	49,49,49,49	0
2	NA	A	401	1/1	0.99	0.03	46,46,46,46	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	NA	C	403	1/1	0.99	0.05	30,30,30,30	0
2	NA	A	402	1/1	0.99	0.02	30,30,30,30	0
2	NA	C	401	1/1	0.99	0.03	46,46,46,46	0

6.5 Other polymers ⓘ

There are no such residues in this entry.