



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 12, 2026 – 04:09 PM EST

PDB ID : 9Z1C / pdb_00009z1c
Title : Isoreticular co-crystal 1 with asymmetrical expanded duplex (31mer) containing insert sequence CTAATTAGGC, crystal soaked in alternate solvent prior to diffraction
Authors : Shields, E.T.; Slaughter, C.K.; Magna, E.N.; Snow, C.D.
Deposited on : 2025-11-03
Resolution : 3.04 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	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
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)	:	2.48

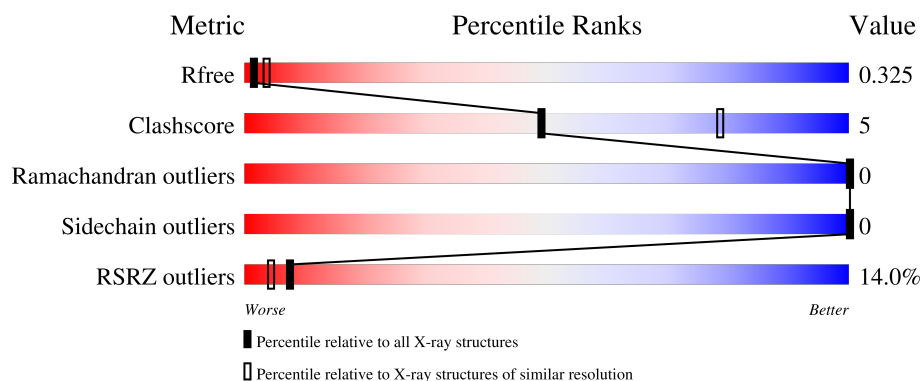
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.04 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}	164625	3418 (3.08-3.00)
Clashscore	180529	3811 (3.08-3.00)
Ramachandran outliers	177936	3656 (3.08-3.00)
Sidechain outliers	177891	3658 (3.08-3.00)
RSRZ outliers	164620	3430 (3.08-3.00)

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	31	61% 39%
2	B	31	3% 48% 52%
3	C	263	14% 75% 7% 18%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	K	B	101	-	-	-	X
5	MG	C	301	-	-	-	X

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 2915 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	A	31	Total	C	N	O	P	0	0	0
			631	301	113	186	31			

- Molecule 2 is a DNA chain called DNA (31-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	31	Total	C	N	O	P	0	0	0
			640	304	119	186	31			

- Molecule 3 is a protein called Replication initiation protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	216	Total	C	N	O	S	0	1	0
			1640	1042	288	303	7			

There are 13 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	-11	MET	-	initiating methionine	UNP P03856
C	-10	ARG	-	expression tag	UNP P03856
C	-9	GLY	-	expression tag	UNP P03856
C	-8	SER	-	expression tag	UNP P03856
C	-7	HIS	-	expression tag	UNP P03856
C	-6	HIS	-	expression tag	UNP P03856
C	-5	HIS	-	expression tag	UNP P03856
C	-4	HIS	-	expression tag	UNP P03856
C	-3	HIS	-	expression tag	UNP P03856
C	-2	HIS	-	expression tag	UNP P03856
C	-1	GLY	-	expression tag	UNP P03856
C	0	SER	-	expression tag	UNP P03856
C	118	PRO	ARG	conflict	UNP P03856

- Molecule 4 is POTASSIUM ION (CCD ID: K) (formula: K).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	2	Total 2	K 2	0	0
4	B	1	Total 1	K 1	0	0

- Molecule 5 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	C	1	Total 1	Mg 1	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.

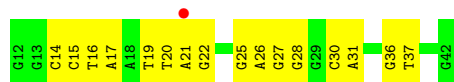
- Molecule 1: DNA (31-MER)

Chain A:  61% 39%



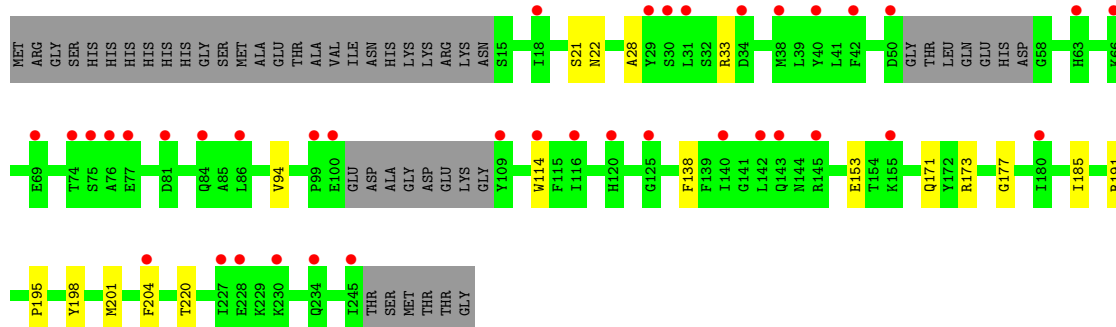
- Molecule 2: DNA (31-MER)

Chain B:  3% 48% 52%



- Molecule 3: Replication initiation protein

Chain C:  14% 75% 7% 18%



4 Data and refinement statistics

Property	Value	Source
Space group	I 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	72.72Å 129.49Å 131.28Å 90.00° 90.95° 90.00°	Depositor
Resolution (Å)	45.27 – 3.04 45.27 – 3.04	Depositor EDS
% Data completeness (in resolution range)	98.4 (45.27-3.04) 98.3 (45.27-3.04)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.14 (at 3.06Å)	Xtriage
Refinement program	PHENIX 1.21.2_5419	Depositor
R, R_{free}	0.300 , 0.325 0.300 , 0.325	Depositor DCC
R_{free} test set	2315 reflections (9.58%)	wwPDB-VP
Wilson B-factor (Å ²)	92.4	Xtriage
Anisotropy	0.132	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.27 , 51.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.45$, $\langle L^2 \rangle = 0.28$	Xtriage
Estimated twinning fraction	0.023 for -h,-l,-k 0.000 for -h,l,k 0.001 for h,-k,-l	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	2915	wwPDB-VP
Average B, all atoms (Å ²)	122.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.63% 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

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

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	0.16	0/706	0.33	0/1086
2	B	0.20	0/718	0.41	0/1107
3	C	0.11	0/1682	0.38	0/2284
All	All	0.15	0/3106	0.38	0/4477

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

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	631	0	350	8	0
2	B	640	0	350	10	0
3	C	1640	0	1460	11	0
4	A	2	0	0	0	0
4	B	1	0	0	0	0
5	C	1	0	0	0	0
All	All	2915	0	2160	27	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 (27) 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:13:DT:H2''	1:A:14:DG:C8	2.36	0.60
2:B:19:DT:H2''	2:B:20:DT:H5'	1.86	0.58
3:C:185:ILE:HG21	3:C:201:MET:HE1	1.89	0.55
1:A:13:DT:H3'	3:C:33:ARG:NH2	2.23	0.53
2:B:30:DC:H2''	2:B:31:DA:C8	2.45	0.52
1:A:10:DA:H2''	1:A:11:DA:H5''	1.90	0.52
2:B:17:DA:C8	2:B:17:DA:H5'	2.45	0.52
2:B:36:DG:H4'	2:B:37:DT:OP1	2.13	0.49
2:B:27:DG:H2'	2:B:28:DG:C8	2.49	0.48
3:C:28:ALA:HA	3:C:191:ARG:O	2.14	0.48
2:B:36:DG:H2''	2:B:37:DT:O5'	2.14	0.47
3:C:195:PRO:HD2	3:C:198:TYR:CD2	2.50	0.47
3:C:21:SER:HB3	3:C:138:PHE:O	2.14	0.46
1:A:27:DT:H2''	1:A:28:DA:C8	2.51	0.46
1:A:3:DT:H2'	1:A:4:DG:C8	2.50	0.46
1:A:23:DT:H2''	1:A:24:DA:C8	2.51	0.46
3:C:198:TYR:O	3:C:204:PHE:HB2	2.17	0.45
1:A:13:DT:H3'	3:C:33:ARG:HH22	1.82	0.45
3:C:173:ARG:HD2	3:C:177:GLY:HA2	1.99	0.45
3:C:94:VAL:HB	3:C:114:TRP:CZ2	2.53	0.43
3:C:153:GLU:O	3:C:220:THR:HG22	2.19	0.43
2:B:21:DA:H2''	2:B:22:DG:OP2	2.19	0.42
2:B:25:DG:H2''	2:B:26:DA:C8	2.55	0.42
2:B:14:DC:H2''	2:B:15:DC:O5'	2.21	0.41
2:B:16:DT:H2''	2:B:17:DA:C8	2.55	0.41
1:A:29:DG:H2''	1:A:30:DG:C8	2.56	0.41
3:C:22:ASN:OD1	3:C:171:GLN:HG3	2.20	0.41

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	
3	C	211/263 (80%)	206 (98%)	5 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	C	154/236 (65%)	154 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

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

Mol	Chain	Res	Type
3	C	193	GLN

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](#)

Of 4 ligands modelled in this entry, 4 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(Å ²)	Q<0.9
1	A	31/31 (100%)	0.03	0 100 100	89, 122, 167, 171	0
2	B	31/31 (100%)	0.33	1 (3%) 50 30	90, 123, 174, 176	0
3	C	216/263 (82%)	1.07	38 (17%) 4 3	57, 117, 146, 172	1 (0%)
All	All	278/325 (85%)	0.87	39 (14%) 7 4	57, 118, 165, 176	1 (0%)

All (39) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	C	180	ILE	4.6
3	C	50	ASP	4.4
3	C	245	ILE	4.0
3	C	140	ILE	3.9
3	C	234	GLN	3.5
3	C	143	GLN	3.2
3	C	125	GLY	2.9
3	C	99	PRO	2.9
3	C	100	GLU	2.8
3	C	38	MET	2.7
3	C	42	PHE	2.7
3	C	63	HIS	2.7
3	C	30	SER	2.7
3	C	77	GLU	2.7
3	C	145	ARG	2.6
3	C	116	ILE	2.5
3	C	114	TRP	2.5
3	C	76	ALA	2.5
3	C	142	LEU	2.5
3	C	81	ASP	2.4
3	C	86	LEU	2.4
3	C	120	HIS	2.4
3	C	29	TYR	2.4

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Mol	Chain	Res	Type	RSRZ
3	C	109	TYR	2.4
3	C	18	ILE	2.3
3	C	155	LYS	2.3
3	C	230	LYS	2.3
3	C	84	GLN	2.3
3	C	31	LEU	2.2
3	C	69	GLU	2.2
3	C	74	THR	2.2
3	C	66	LYS	2.1
3	C	227	ILE	2.1
2	B	21	DA	2.1
3	C	40	TYR	2.1
3	C	34	ASP	2.1
3	C	204	PHE	2.1
3	C	75	SER	2.1
3	C	228	GLU	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](#)

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(Å ²)	Q<0.9
5	MG	C	301	1/1	0.69	0.74	110,110,110,110	0
4	K	B	101	1/1	0.70	0.47	164,164,164,164	0
4	K	A	101	1/1	0.73	0.26	184,184,184,184	0
4	K	A	102	1/1	0.86	0.41	155,155,155,155	0

6.5 Other polymers [i](#)

There are no such residues in this entry.