



wwPDB X-ray Structure Validation Summary Report ⓘ

Apr 5, 2026 – 01:23 PM UTC

PDB ID : 1NR8 / pdb_00001nr8
Title : The crystal structure of a D-Lysine-based chiral PNA-DNA duplex
Authors : Menchise, V.; De Simone, G.; Tedeschi, T.; Corradini, R.; Sforza, S.; Marchelli, R.; Capasso, D.; Saviano, M.; Pedone, C.
Deposited on : 2003-01-24
Resolution : 1.66 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 ⓘ 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
Mogul	:	2022.3.0, CSD as543be (2022)
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

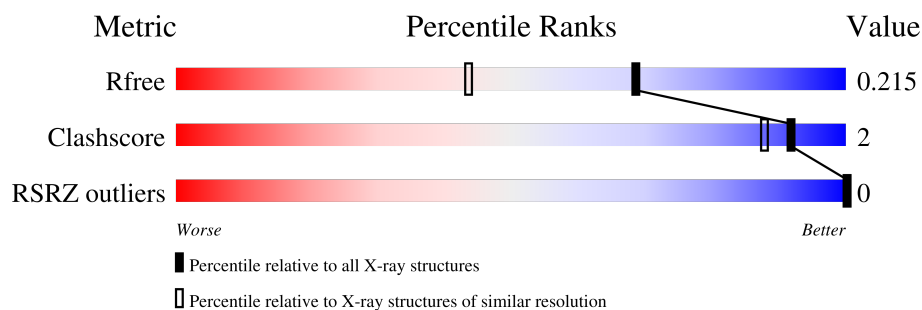
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.66 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	2563 (1.66-1.66)
Clashscore	190562	2662 (1.66-1.66)
RSRZ outliers	180081	2564 (1.66-1.66)

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	10	

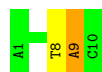
ENTRY-COMPOSITION INFOmissingINFO

2 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: 5'-D(P*AP*GP*TP*GP*AP*TP*CP*TP*AP*C)-3'

Chain A: 



3 Data and refinement statistics

Property	Value	Source
Space group	P 31	Depositor
Cell constants a, b, c, α , β , γ	34.94Å 34.94Å 35.80Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	20.00 – 1.66 20.00 – 1.67	Depositor EDS
% Data completeness (in resolution range)	(Not available) (20.00-1.66) 95.7 (20.00-1.67)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.06	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.48 (at 1.67Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.197 , 0.228 0.186 , 0.215	Depositor DCC
R_{free} test set	585 reflections (10.67%)	wwPDB-VP
Wilson B-factor (Å ²)	22.4	Xtriage
Anisotropy	0.207	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 43.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.005 for -h,-k,l 0.064 for h,-h-k,-l 0.029 for -k,-h,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	494	wwPDB-VP
Average B, all atoms (Å ²)	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 13.97% 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.

4 Model quality [i](#)

4.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: T66, CPN, NH2, C66, APN, GPN, MG, A66, TPN

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	0.32	0/226	0.65	0/347

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	A	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	9	DA	Sidechain

4.2 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	A	202	0	115	1	0
2	B	211	0	117	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	1	0	0	0	0
4	A	42	0	0	0	0
4	B	38	0	0	0	0
All	All	494	0	232	1	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 2.

All (1) 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:8:DT:H2''	1:A:9:DA:H5'	1.56	0.87

There are no symmetry-related clashes.

4.3 Torsion angles [i](#)

4.3.1 Protein backbone [i](#)

There are no protein molecules in this entry.

4.3.2 Protein sidechains [i](#)

There are no protein molecules in this entry.

4.3.3 RNA [i](#)

There are no RNA molecules in this entry.

4.4 Non-standard residues in protein, DNA, RNA chains [i](#)

7 non-standard protein/DNA/RNA residues are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
2	TPN	B	2	1,2	19,19,20	1.19	1 (5%)	24,25,27	1.80	6 (25%)
2	CPN	B	9	1,2	18,18,19	1.14	2 (11%)	21,23,25	1.74	7 (33%)
2	TPN	B	10	1,2	19,19,20	1.41	3 (15%)	24,25,27	1.77	7 (29%)
2	APN	B	3	1,2	21,21,22	1.33	3 (14%)	27,28,30	1.27	2 (7%)
2	GPN	B	1	1,2	22,22,23	1.02	1 (4%)	29,30,32	1.24	2 (6%)
2	GPN	B	4	3,1,2	22,22,23	1.05	1 (4%)	29,30,32	1.12	2 (6%)
2	APN	B	8	1,2	21,21,22	1.06	1 (4%)	27,28,30	1.20	3 (11%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	TPN	B	2	1,2	-	0/13/14/15	0/1/1/1
2	CPN	B	9	1,2	-	0/13/14/15	0/1/1/1
2	TPN	B	10	1,2	-	0/13/14/15	0/1/1/1
2	APN	B	3	1,2	-	0/13/14/15	0/2/2/2
2	GPN	B	1	1,2	-	1/13/14/15	0/2/2/2
2	GPN	B	4	3,1,2	-	0/13/14/15	0/2/2/2
2	APN	B	8	1,2	-	0/13/14/15	0/2/2/2

The worst 5 of 12 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	3	APN	C4-N3	3.54	1.41	1.34
2	B	2	TPN	C2-N1	3.11	1.42	1.37
2	B	8	APN	C4-N3	2.62	1.39	1.34
2	B	9	CPN	C8'-N1	2.55	1.49	1.46
2	B	1	GPN	C4-N3	2.52	1.40	1.34

The worst 5 of 29 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	3	APN	C8'-C7'-N4'	4.79	122.85	117.04
2	B	1	GPN	C7'-C8'-N9	4.72	117.11	110.73
2	B	2	TPN	C8'-C7'-N4'	4.14	122.06	117.04
2	B	4	GPN	C8'-C7'-N4'	4.06	121.97	117.04

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	9	CPN	C8'-C7'-N4'	3.95	121.84	117.04

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	1	GPN	C-C5'-N4'-C7'

There are no ring outliers.

No monomer is involved in short contacts.

4.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

4.6 Ligand geometry [i](#)

Of 1 ligands modelled in this entry, 1 is 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.

4.7 Other polymers [i](#)

Of 11 such residues modelled in this entry, 1 is modelled with single atom - leaving 10 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	C66	B	7	2	22,23,24	0.97	1 (4%)	21,29,31	1.92	6 (28%)
2	TPN	B	2	1,2	19,19,20	1.19	1 (5%)	24,25,27	1.80	6 (25%)
2	CPN	B	9	1,2	18,18,19	1.14	2 (11%)	21,23,25	1.74	7 (33%)
2	TPN	B	10	1,2	19,19,20	1.41	3 (15%)	24,25,27	1.77	7 (29%)
2	APN	B	3	1,2	21,21,22	1.33	3 (14%)	27,28,30	1.27	2 (7%)
2	GPN	B	1	1,2	22,22,23	1.02	1 (4%)	29,30,32	1.24	2 (6%)
2	GPN	B	4	3,1,2	22,22,23	1.05	1 (4%)	29,30,32	1.12	2 (6%)
2	T66	B	6	2	23,24,25	1.12	3 (13%)	24,31,33	1.73	7 (29%)
2	APN	B	8	1,2	21,21,22	1.06	1 (4%)	27,28,30	1.20	3 (11%)
2	A66	B	5	3,2	25,26,27	0.93	1 (4%)	27,34,36	1.14	3 (11%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	C66	B	7	2	-	2/20/22/24	0/1/1/1
2	TPN	B	2	1,2	-	0/13/14/15	0/1/1/1
2	CPN	B	9	1,2	-	0/13/14/15	0/1/1/1
2	TPN	B	10	1,2	-	0/13/14/15	0/1/1/1
2	APN	B	3	1,2	-	0/13/14/15	0/2/2/2
2	GPN	B	1	1,2	-	1/13/14/15	0/2/2/2
2	GPN	B	4	3,1,2	-	0/13/14/15	0/2/2/2
2	T66	B	6	2	-	3/20/22/24	0/1/1/1
2	APN	B	8	1,2	-	0/13/14/15	0/2/2/2
2	A66	B	5	3,2	-	1/20/22/24	0/2/2/2

The worst 5 of 17 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	3	APN	C4-N3	3.54	1.41	1.34
2	B	2	TPN	C2-N1	3.11	1.42	1.37
2	B	5	A66	C4-N3	2.82	1.39	1.34
2	B	8	APN	C4-N3	2.62	1.39	1.34
2	B	6	T66	C6-N1	2.60	1.42	1.37

The worst 5 of 45 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
2	B	3	APN	C8'-C7'-N4'	4.79	122.85	117.04
2	B	1	GPN	C7'-C8'-N9	4.72	117.11	110.73
2	B	7	C66	C2'-C3'-N4'	4.56	119.27	112.10
2	B	2	TPN	C8'-C7'-N4'	4.14	122.06	117.04
2	B	4	GPN	C8'-C7'-N4'	4.06	121.97	117.04

There are no chirality outliers.

5 of 7 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	6	T66	O1'-C'-C5'-CB
2	B	7	C66	O1'-C'-C5'-CB
2	B	7	C66	CE-CD-CG-CB
2	B	5	A66	CE-CD-CG-CB
2	B	1	GPN	C-C5'-N4'-C7'

There are no ring outliers.

No monomer is involved in short contacts.

4.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

5 Fit of model and data [i](#)

5.1 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	10/10 (100%)	-0.39	0 100 100	19, 23, 33, 33	0

There are no RSRZ outliers to report.

5.2 Non-standard residues in protein, DNA, RNA chains [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
2	TPN	B	10	19/20	0.89	0.09	22,25,37,39	0
2	CPN	B	9	18/19	0.92	0.07	21,24,29,31	0
2	TPN	B	2	19/20	0.93	0.07	17,22,23,24	0
2	APN	B	8	20/21	0.94	0.07	17,19,24,25	0
2	APN	B	3	20/21	0.94	0.07	20,22,24,25	0
2	GPN	B	4	21/22	0.94	0.06	17,20,24,25	0
2	GPN	B	1	21/22	0.95	0.06	18,21,25,27	0

5.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.4 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($\text{\AA}^2$)	Q<0.9
3	MG	B	9001	1/1	0.94	0.11	35,35,35,35	0

5.5 Other polymers [i](#)

There are no such residues in this entry.