WORLDWIDE wwPDB PROTEIN DATA BANK

Full wwPDB X-ray Structure Validation Report ⓘ

Oct 24, 2024 – 11:32 AM EDT

PDB ID	:	7HL0
Title	:	Group deposition for crystallographic fragment screening of the NS5 RNA-dependent RNA polymerase from Dengue virus serotype 2 – Crystal structure of the NS5 RNA-dependent RNA polymerase from Dengue virus serotype 2 in complex with NCL-00023818 (DNV2_NS5A-x0963)
Authors	:	Saini, M.; Chopra, A.; Aschenbrenner, J.C.; Marples, P.G.; Balcomb, B.H.; Fearon, D.; von Delft, F.; Ruiz, F.X.; Arnold, E.
Deposited on	:	2024-10-15
Resolution	:	2.23 Å(reported)

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

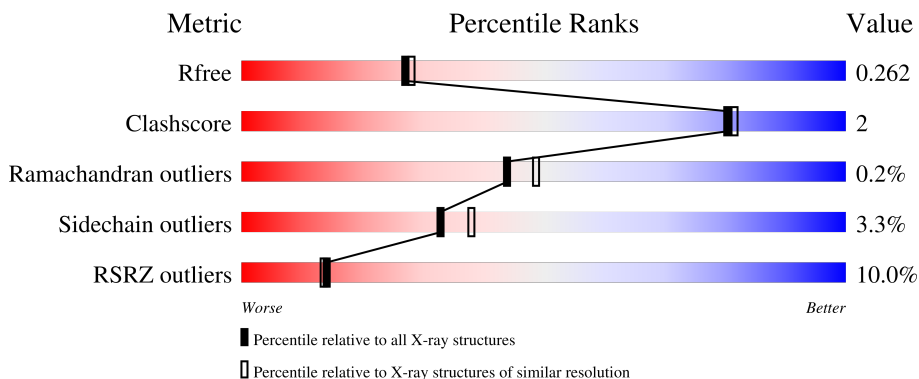|		
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.003 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)

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 2.23 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		0.262
Clashscore		2
Ramachandran outliers		0.2%
Sidechain outliers		3.3%
RSRZ outliers		10.0%

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	3139 (2.26-2.22)
Clashscore	180529	3381 (2.26-2.22)
Ramachandran outliers	177936	3334 (2.26-2.22)
Sidechain outliers	177891	3335 (2.26-2.22)
RSRZ outliers	164620	3138 (2.26-2.22)

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	637	9% / 84% / 7% · 9%

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:

Ideal geometry (DNA, RNA)   :   Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)   :   2.39

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
5	PO4	A	1007	-	-	X	-

2 Entry composition ⓘ

There are 8 unique types of molecules in this entry. The entry contains 5321 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 Genome polyprotein.

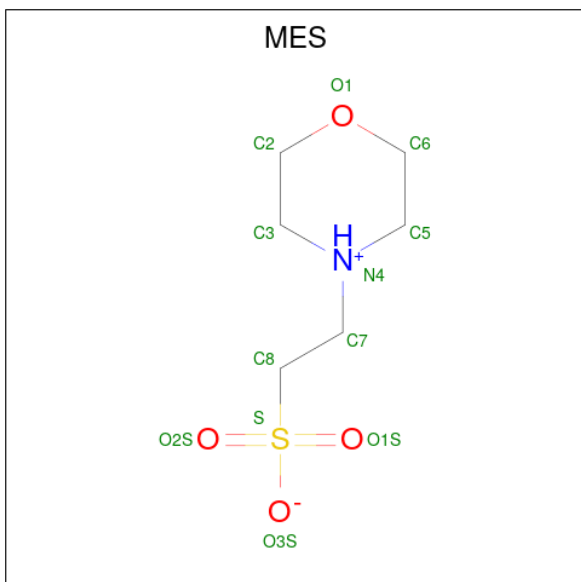| Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	582	Total 4822	C 3036	N 865	O 887	S 34	0	8	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	264	GLY	-	expression tag	UNP Q91H74
A	265	PRO	-	expression tag	UNP Q91H74

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total 2	Zn 2	0	0

- Molecule 3 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (three-letter code: MES) (formula: $C_6H_{13}NO_4S$).

MES

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	S	0	1
			24	12	2	8	2		

- Molecule 4 is DIMETHYL SULFOXIDE (three-letter code: DMS) (formula: C_2H_6OS).
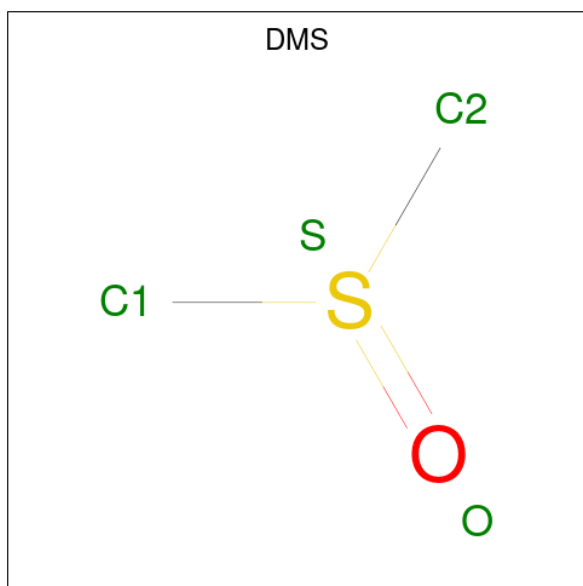
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	O	S	0	0
			4	2	1	1		
4	A	1	Total	C	O	S	0	0
			4	2	1	1		
4	A	1	Total	C	O	S	0	0
			4	2	1	1		

- Molecule 5 is PHOSPHATE ION (three-letter code: PO4) (formula: O_4P).

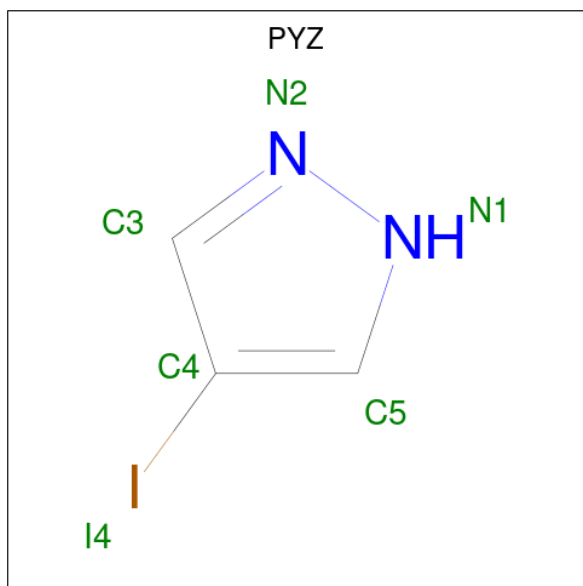| Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total O P 5 4 1			0	0
5	A	1	Total O P 5 4 1			0	0

- Molecule 6 is DI(HYDROXYETHYL)ETHER (three-letter code: PEG) (formula: $C_4H_{10}O_3$).
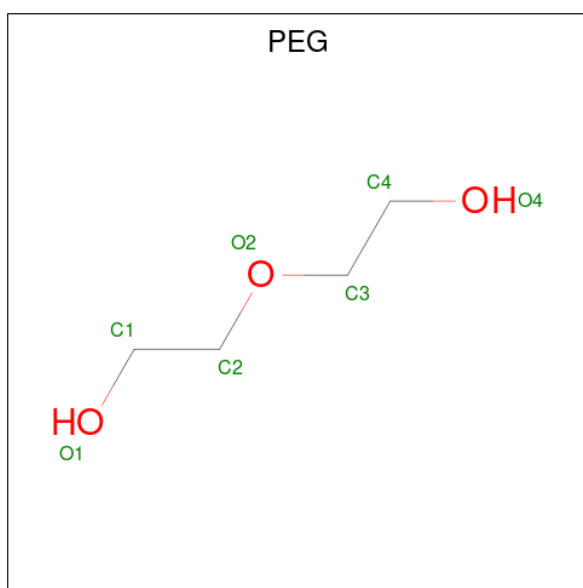
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total C O 7 4 3			0	0

- Molecule 7 is 4-IODOPYRAZOLE (three-letter code: PYZ) (formula: $C_3H_3IN_2$) (labeled as

"Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
7	A	1	Total 6	C 3	I 1	N 2	0	0

- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	438	Total 438	O 438	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: Genome polyprotein
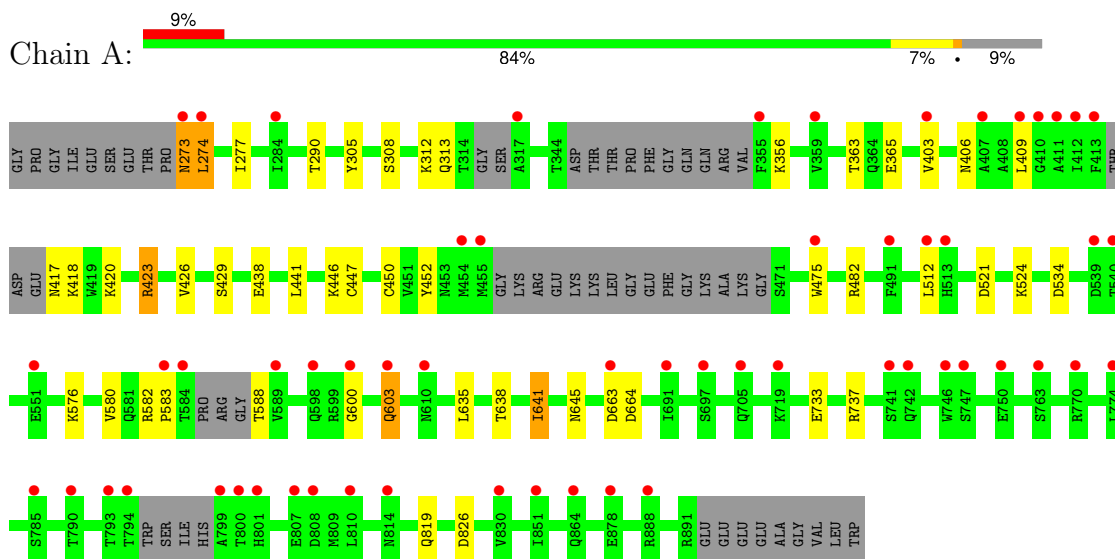
4 Data and refinement statistics (i)

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, α, β, γ	83.35Å 117.78Å 149.99Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.36 – 2.23 46.36 – 2.23	Depositor EDS
% Data completeness (in resolution range)	99.9 (46.36-2.23) 99.9 (46.36-2.23)	Depositor EDS
R_{merge}	0.39	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.19 (at 2.22Å)	Xtriage
Refinement program	REFMAC 5.8.0267, REFMAC5	Depositor
R, R_{free}	0.190 , 0.253 0.220 , 0.262	Depositor DCC
R_{free} test set	1847 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å^2)	43.1	Xtriage
Anisotropy	0.138	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 56.2	EDS
L-test for twinning[2]	$< |L| > = 0.49, < L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	5321	wwPDB-VP
Average B, all atoms (Å^2)	64.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.89% 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: PYZ, PO4, PEG, ZN, MES, DMS

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	0.74	0/4929	0.83	0/6645

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	273	ASN	Peptide

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	4822	0	4720	24	0
2	A	2	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	24	0	26	0	0
4	A	12	0	18	0	0
5	A	10	0	0	3	0
6	A	7	0	10	0	0
7	A	6	0	3	0	0
8	A	438	0	0	2	1
All	All	5321	0	4777	24	1

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 (24) 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:664:ASP:OD1	5:A:1007:PO4:O4	1.91	0.88
1:A:534:ASP:OD1	5:A:1007:PO4:O4	2.08	0.70
1:A:664:ASP:OD1	5:A:1007:PO4:P	2.51	0.68
1:A:305:TYR:HH	1:A:308:SER:HG	1.46	0.63
1:A:409:LEU:HD22	8:A:1534:HOH:O	2.05	0.56
1:A:475:TRP:HZ3	1:A:576:LYS:HD3	1.74	0.53
1:A:475:TRP:CE3	1:A:600:GLY:HA3	2.44	0.53
1:A:819:GLN:NE2	8:A:1103:HOH:O	2.32	0.52
1:A:733:GLU:O	1:A:737:ARG:HG3	2.11	0.51
1:A:638:THR:O	1:A:641:ILE:HG22	2.10	0.51
1:A:447:CYS:SG	1:A:450:CYS:HB2	2.54	0.47
1:A:438:GLU:O	1:A:441:LEU:HB2	2.14	0.47
1:A:826:ASP:OD1	1:A:826:ASP:C	2.53	0.46
1:A:406:ASN:OD1	1:A:423:ARG:NH1	2.51	0.43
1:A:521:ASP:O	1:A:524:LYS:HB2	2.19	0.42
1:A:663:ASP:OD1	1:A:663:ASP:N	2.45	0.42
1:A:274:LEU:HA	1:A:277:ILE:HG13	2.01	0.42
1:A:312:LYS:O	1:A:313:GLN:HG3	2.19	0.42
1:A:403:VAL:HG21	1:A:426:VAL:HG21	2.03	0.41
1:A:582:ARG:HA	1:A:583:PRO:HD3	1.95	0.41
1:A:582:ARG:O	1:A:588:THR:HA	2.21	0.41
1:A:603:GLN:HE21	1:A:603:GLN:HB2	1.71	0.41
1:A:452:TYR:CZ	1:A:600:GLY:O	2.75	0.40
1:A:512[B]:LEU:HD23	1:A:512[B]:LEU:HA	1.93	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
8:A:1113:HOH:O	8:A:1113:HOH:O[2_445]	1.89	0.31

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	576/637 (90%)	539 (94%)	36 (6%)	1 (0%)	44 49

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	420	LYS

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
1	A	518/554 (94%)	501 (97%)	17 (3%)	33 38

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	273	ASN
1	A	274	LEU
1	A	290	THR
1	A	356	LYS
1	A	363	THR

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Mol	Chain	Res	Type
1	A	365	GLU
1	A	417	ASN
1	A	418	LYS
1	A	423	ARG
1	A	429	SER
1	A	446	LYS
1	A	482	ARG
1	A	580	VAL
1	A	603	GLN
1	A	635	LEU
1	A	641	ILE
1	A	645	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	417	ASN
1	A	603	GLN
1	A	618	GLN
1	A	693	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 11 ligands modelled in this entry, 2 are monoatomic - leaving 9 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	#$|Z| > 2$
5	PO4	A	1008	-	4,4,4	0.90	0	6,6,6	0.42	0
3	MES	A	1003[B]	-	12,12,12	0.70	0	15,16,16	0.30	0
4	DMS	A	1006	-	3,3,3	0.24	0	3,3,3	0.21	0
6	PEG	A	1009	-	6,6,6	0.19	0	5,5,5	0.14	0
4	DMS	A	1005	-	3,3,3	0.28	0	3,3,3	0.05	0
4	DMS	A	1004	-	3,3,3	0.27	0	3,3,3	0.14	0
3	MES	A	1003[A]	-	12,12,12	0.71	0	15,16,16	0.30	0
5	PO4	A	1007	-	4,4,4	1.25	1 (25%)	6,6,6	0.65	0
7	PYZ	A	1010	-	6,6,6	0.65	0	3,7,7	0.18	0

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
3	MES	A	1003[A]	-	-	2/6/14/14	0/1/1/1
3	MES	A	1003[B]	-	-	5/6/14/14	0/1/1/1
7	PYZ	A	1010	-	-	-	0/1/1/1
6	PEG	A	1009	-	-	1/4/4/4	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	1007	PO4	P-O1	2.04	1.55	1.50

There are no bond angle outliers.

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	1003[B]	MES	C8-C7-N4-C3
3	A	1003[B]	MES	C7-C8-S-O1S
3	A	1003[B]	MES	C7-C8-S-O2S
6	A	1009	PEG	O2-C3-C4-O4

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Mol	Chain	Res	Type	Atoms
3	A	1003[B]	MES	C7-C8-S-O3S
3	A	1003[A]	MES	C8-C7-N4-C5
3	A	1003[A]	MES	C8-C7-N4-C3
3	A	1003[B]	MES	C8-C7-N4-C5

There are no ring outliers.

1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	1007	PO4	3	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

Ligand PYZ A 1010

Bond lengths

Bond angles

Torsions

Rings
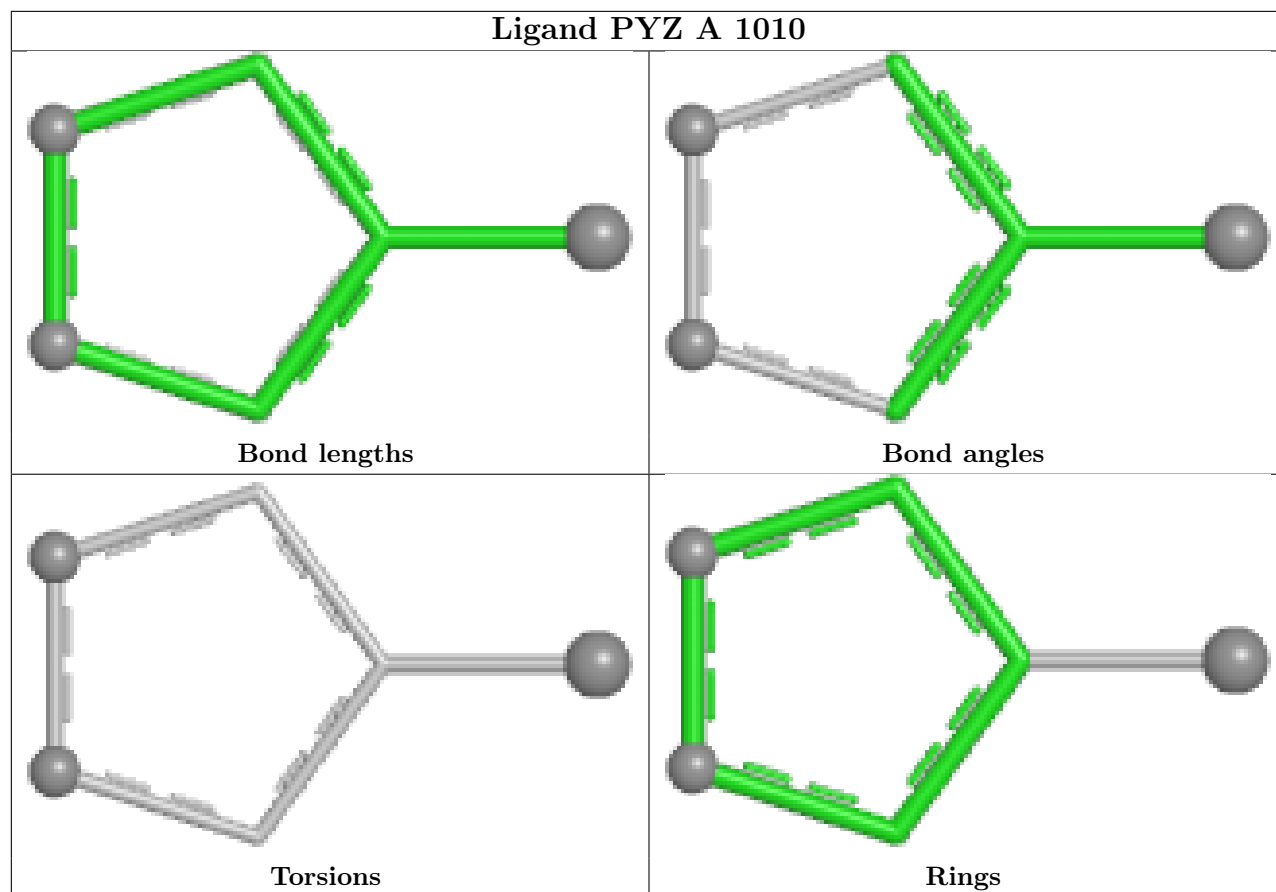
5.7 Other polymers ⓘ

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	582/637 (91%)	0.62	58 (9%)	14	13	9, 51, 126, 207	33 (5%)

All (58) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	719[A]	LYS	13.1
1	A	412	ILE	12.0
1	A	801[A]	HIS	11.1
1	A	830	VAL	10.6
1	A	763[A]	SER	9.6
1	A	512[A]	LEU	9.4
1	A	810	LEU	9.2
1	A	864[A]	GLN	9.2
1	A	741[A]	SER	9.1
1	A	691	ILE	9.1
1	A	540	THR	9.0
1	A	539	ASP	9.0
1	A	746	TRP	8.5
1	A	774	LEU	8.4
1	A	705	GLN	8.3
1	A	814	ASN	8.2
1	A	747	SER	8.2
1	A	610	ASN	7.6
1	A	851	ILE	7.6
1	A	663	ASP	7.4
1	A	878	GLU	7.3
1	A	513	HIS	7.3
1	A	697	SER	7.3
1	A	551[A]	GLU	7.2
1	A	808	ASP	7.1
1	A	770	ARG	6.9
1	A	807	GLU	6.9

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Mol	Chain	Res	Type	RSRZ
1	A	785[A]	SER	6.6
1	A	598	GLN	6.2
1	A	888	ARG	5.5
1	A	355	PHE	4.4
1	A	790	THR	4.1
1	A	750	GLU	4.0
1	A	794	THR	4.0
1	A	413	PHE	4.0
1	A	411	ALA	3.8
1	A	800	THR	3.4
1	A	799	ALA	3.2
1	A	274	LEU	3.0
1	A	410	GLY	3.0
1	A	359	VAL	3.0
1	A	403	VAL	3.0
1	A	407	ALA	2.9
1	A	584	THR	2.9
1	A	409	LEU	2.8
1	A	603	GLN	2.7
1	A	491	PHE	2.6
1	A	793	THR	2.4
1	A	455	MET	2.4
1	A	317	ALA	2.4
1	A	600	GLY	2.3
1	A	589	VAL	2.2
1	A	475	TRP	2.2
1	A	583	PRO	2.2
1	A	742	GLN	2.2
1	A	273	ASN	2.1
1	A	454	MET	2.0
1	A	284	ILE	2.0

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.
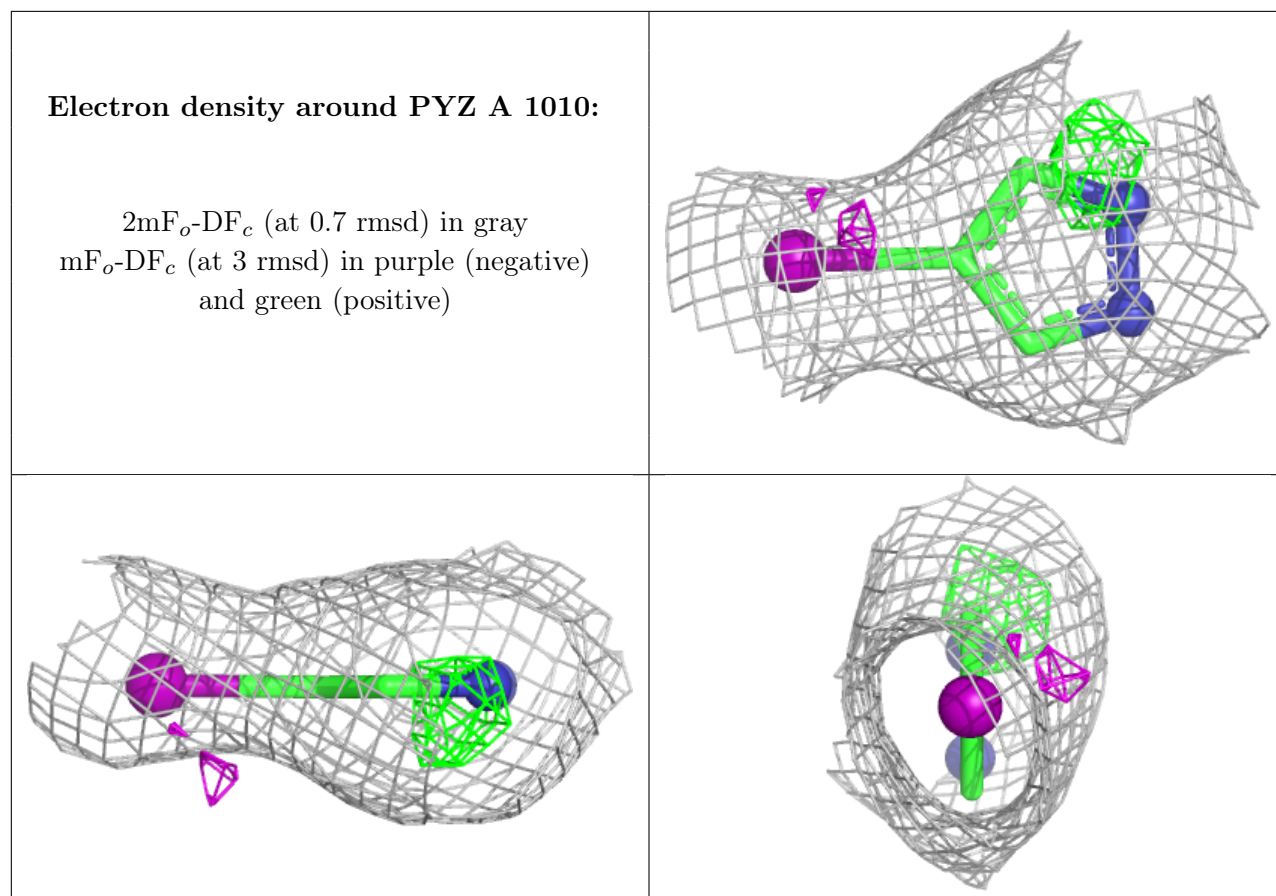
6.3 Carbohydrates ⓘ

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, 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
7	PYZ	A	1010	6/6	0.60	0.16	76,85,98,184	6
5	PO4	A	1008	5/5	0.77	0.13	95,112,115,129	0
5	PO4	A	1007	5/5	0.80	0.11	55,72,85,92	0
4	DMS	A	1005	4/4	0.84	0.22	113,117,118,125	0
6	PEG	A	1009	7/7	0.86	0.15	67,86,93,93	0
3	MES	A	1003[A]	12/12	0.95	0.34	38,39,41,41	12
4	DMS	A	1006	4/4	0.95	0.14	58,62,63,67	0
3	MES	A	1003[B]	12/12	0.95	0.34	647,672,756,761	12
4	DMS	A	1004	4/4	0.97	0.10	64,67,67,67	0
2	ZN	A	1002	1/1	1.00	0.01	69,69,69,69	0
2	ZN	A	1001	1/1	1.00	0.01	33,33,33,33	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around PYZ A 1010:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

6.5 Other polymers ⓘ

There are no such residues in this entry.