



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 07:04 AM UTC

PDB ID : 4DSE / pdb_00004dse
Title : Ternary complex of Bacillus DNA Polymerase I Large Fragment F710Y, DNA duplex, and rCTP (paired with dG of template) in presence of Mg²⁺
Authors : Wang, W.; Beese, L.S.
Deposited on : 2012-02-18
Resolution : 1.67 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
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
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

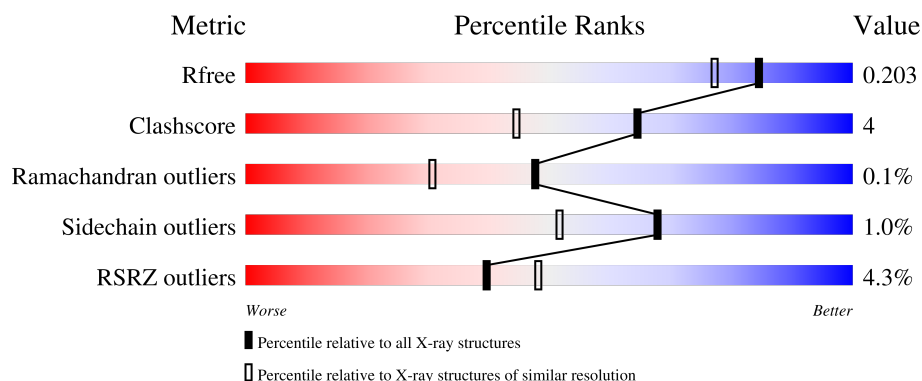
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.67 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	1054 (1.68-1.68)
Clashscore	190562	1078 (1.68-1.68)
Ramachandran outliers	187476	1068 (1.68-1.68)
Sidechain outliers	187428	1067 (1.68-1.68)
RSRZ outliers	180081	1055 (1.68-1.68)

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	592	<div> <div>6%</div> <div>86%</div> <div>6%</div> <div>8%</div> </div>
1	D	592	<div> <div>3%</div> <div>89%</div> <div>8%</div> <div>..</div> </div>
2	B	9	<div> <div>56%</div> <div>22%</div> <div>22%</div> </div>
2	E	9	<div> <div>78%</div> <div>22%</div> </div>
3	C	13	<div> <div>69%</div> <div>31%</div> </div>

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Mol	Chain	Length	Quality of chain
3	F	13	<div><div></div><div>8%</div><div>85%</div><div>8%</div><div>8%</div></div>

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 20892 atoms, of which 9688 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 DNA polymerase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	546	Total	C	H	N	O	S	0	6	0
			8882	2803	4479	766	819	15			
1	D	579	Total	C	H	N	O	S	0	14	0
			9459	2984	4763	814	881	17			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	598	ALA	ASP	engineered mutation	UNP Q5KWC1
A	710	TYR	PHE	engineered mutation	UNP Q5KWC1
A	823	HIS	ARG	SEE REMARK 999	UNP Q5KWC1
D	598	ALA	ASP	engineered mutation	UNP Q5KWC1
D	710	TYR	PHE	engineered mutation	UNP Q5KWC1
D	823	HIS	ARG	SEE REMARK 999	UNP Q5KWC1

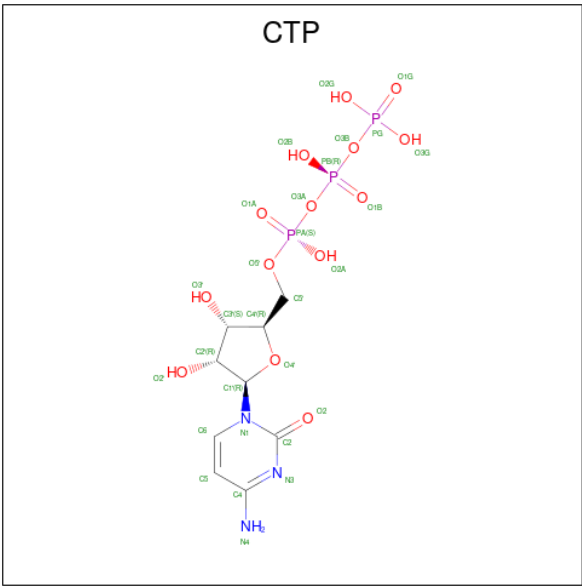
- Molecule 2 is a DNA chain called DNA (5'-D(*CP*CP*TP*GP*AP*CP*TP*CP*(DOC))-3').

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	B	9	Total	C	H	N	O	P	0	0	0
			274	85	100	29	52	8			
2	E	9	Total	C	H	N	O	P	0	0	0
			274	85	100	29	52	8			

- Molecule 3 is a DNA chain called DNA (5'-D(*CP*AP*TP*GP*GP*GP*AP*GP*TP*CP*AP*GP*G)-3').

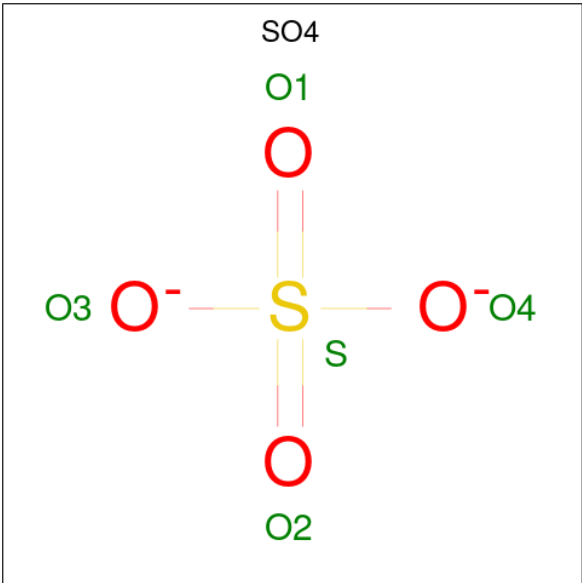
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
3	C	9	Total	C	H	N	O	P	0	0	0
			291	89	100	40	53	9			
3	F	12	Total	C	H	N	O	P	0	0	0
			385	119	134	52	69	11			

- Molecule 4 is CYTIDINE-5'-TRIPHOSPHATE (CCD ID: CTP) (formula: C₉H₁₆N₃O₁₄P₃).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
4	D	1	Total	C	H	N	O	P	0	0
			41	9	12	3	14	3		

- Molecule 5 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	D	1	Total	O	S	0	0
			5	4	1		
5	D	1	Total	O	S	0	0
			5	4	1		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	D	1	Total	O	S	0	0
			5	4	1		
5	D	1	Total	O	S	0	0
			5	4	1		

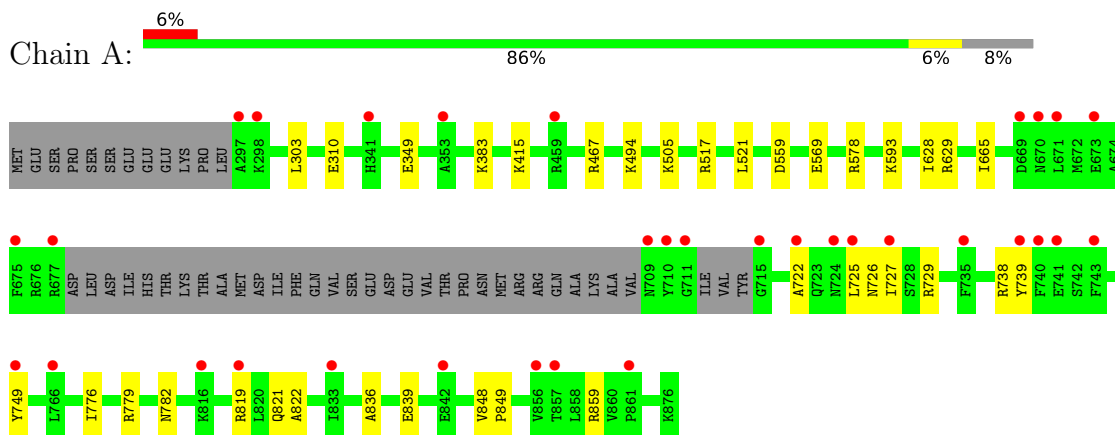
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	363	Total	O	0	0
			363	363		
6	D	723	Total	O	0	0
			723	723		
6	B	28	Total	O	0	0
			28	28		
6	C	55	Total	O	0	0
			55	55		
6	E	31	Total	O	0	0
			31	31		
6	F	66	Total	O	0	0
			66	66		

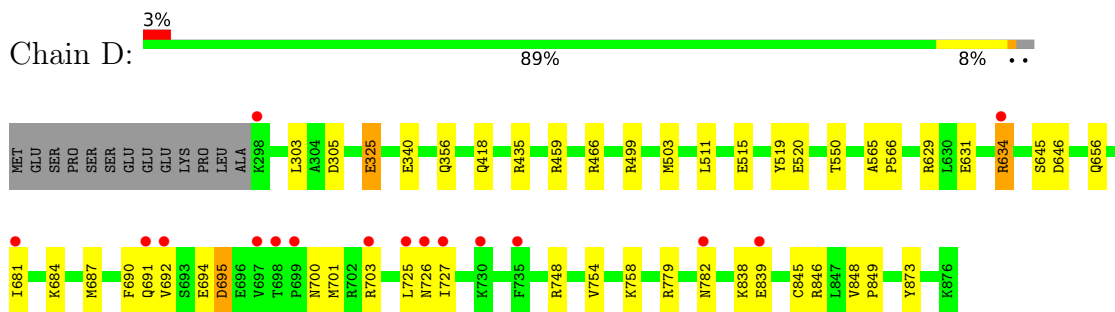
3 Residue-property plots [i](#)

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 polymerase



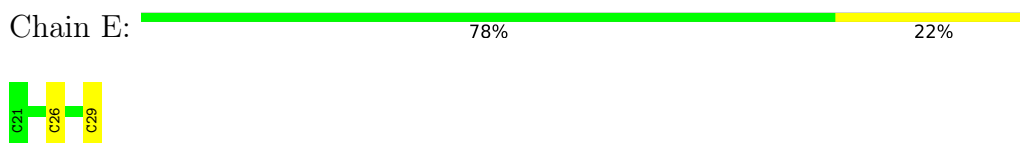
- Molecule 1: DNA polymerase



- Molecule 2: DNA (5'-D(*CP*CP*TP*GP*AP*CP*TP*CP*(DOC))-3')

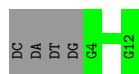


- Molecule 2: DNA (5'-D(*CP*CP*TP*GP*AP*CP*TP*CP*(DOC))-3')




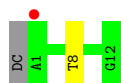
- Molecule 3: DNA (5'-D(*CP*AP*TP*GP*GP*GP*AP*GP*TP*CP*AP*GP*G)-3')

Chain C:  69% 31%



- Molecule 3: DNA (5'-D(*CP*AP*TP*GP*GP*GP*AP*GP*TP*CP*AP*GP*G)-3')

Chain F:  8% 85% 8% 8%



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	93.85Å 109.51Å 150.60Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	79.65 – 1.67 79.65 – 1.67	Depositor EDS
% Data completeness (in resolution range)	86.9 (79.65-1.67) 86.9 (79.65-1.67)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.06 (at 1.67Å)	Xtriage
Refinement program	PHENIX dev_1026	Depositor
R, R_{free}	0.175 , 0.200 0.179 , 0.203	Depositor DCC
R_{free} test set	7004 reflections (4.48%)	wwPDB-VP
Wilson B-factor (Å ²)	20.7	Xtriage
Anisotropy	0.058	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 48.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	20892	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.48% 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: DOC, CTP, SO4

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	0.54	0/4507	0.74	1/6085 (0.0%)
1	D	0.77	0/4842	0.86	1/6544 (0.0%)
2	B	0.46	0/173	1.31	3/264 (1.1%)
2	E	0.57	0/173	1.30	1/264 (0.4%)
3	C	0.55	0/215	1.09	0/331
3	F	0.58	0/283	1.19	1/437 (0.2%)
All	All	0.66	0/10193	0.85	7/13925 (0.1%)

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	E	26	DC	N1-C1'-C2'	-6.83	103.25	113.50
2	B	26	DC	N1-C1'-C2'	-6.56	103.66	113.50
1	D	634	ARG	CG-CD-NE	-6.09	98.59	112.00
2	B	25	DA	P-O5'-C5'	5.55	128.33	120.00
3	F	8	DT	O4'-C1'-N1	-5.51	100.13	108.40
2	B	25	DA	C5'-C4'-C3'	5.26	122.79	114.90
1	A	859	ARG	N-CA-C	-5.04	106.97	113.23

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	4403	4479	4438	27	1
1	D	4696	4763	4688	45	1
2	B	174	100	103	2	0
2	E	174	100	103	2	0
3	C	191	100	101	0	0
3	F	251	134	136	0	0
4	D	29	12	12	3	0
5	D	20	0	0	0	0
6	A	363	0	0	16	1
6	B	28	0	0	0	0
6	C	55	0	0	0	0
6	D	723	0	0	23	2
6	E	31	0	0	0	0
6	F	66	0	0	0	0
All	All	11204	9688	9581	76	3

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 4.

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:845:CYS:SG	6:D:1121:HOH:O	2.32	0.88
1:A:821:GLN:O	6:A:1129:HOH:O	1.96	0.83
1:D:629:ARG:NH1	6:D:1383:HOH:O	2.10	0.83
1:A:839:GLU:HB2	6:A:1238:HOH:O	1.79	0.81
1:D:340:GLU:OE2	6:D:1600:HOH:O	2.04	0.75
1:D:418:GLN:NE2	6:D:1399:HOH:O	2.19	0.75
1:D:305:ASP:OD1	6:D:1641:HOH:O	2.05	0.74
1:A:467:ARG:HD2	6:A:1103:HOH:O	1.87	0.74
1:D:325:GLU:OE2	6:D:1119:HOH:O	2.08	0.72
1:D:550:THR:OG1	6:D:1637:HOH:O	2.09	0.70
4:D:901:CTP:O3G	6:D:1261:HOH:O	2.10	0.70
1:D:631:GLU:OE1	6:D:1660:HOH:O	2.09	0.69
1:A:559:ASP:OD2	6:A:1009:HOH:O	2.10	0.68
1:D:782:ASN:ND2	6:D:1691:HOH:O	2.26	0.66
1:D:779:ARG:NH1	6:D:1674:HOH:O	2.23	0.66
1:A:593:LYS:NZ	6:A:1232:HOH:O	2.28	0.66
1:D:846:ARG:HD2	6:D:1636:HOH:O	1.97	0.64
1:A:629:ARG:NH1	6:A:1076:HOH:O	2.32	0.62
1:A:726:ASN:ND2	6:A:1192:HOH:O	2.31	0.62
1:D:466:ARG:NH1	6:D:1232:HOH:O	2.34	0.61

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:499:ARG:NE	6:D:1386:HOH:O	2.23	0.60
1:A:738:ARG:HD3	6:A:1224:HOH:O	2.02	0.58
1:D:692:VAL:HG21	1:D:701:MET:HE1	1.84	0.58
1:D:520:GLU:OE2	6:D:1492:HOH:O	2.16	0.58
1:D:690:PHE:HB2	1:D:701:MET:HE3	1.84	0.58
1:D:325:GLU:H	1:D:325:GLU:CD	2.11	0.56
1:A:819:ARG:NH2	6:A:1166:HOH:O	2.39	0.56
1:D:520:GLU:CD	6:D:1492:HOH:O	2.49	0.55
1:A:665:ILE:HG22	1:A:749:TYR:CE1	2.41	0.55
1:A:782:ASN:ND2	6:A:1246:HOH:O	2.34	0.55
1:A:722:ALA:HB2	1:A:729:ARG:HA	1.91	0.52
1:D:634:ARG:NH1	1:D:873:TYR:CD1	2.78	0.52
1:D:435:ARG:NH2	6:D:1314:HOH:O	2.39	0.51
1:A:738:ARG:NH1	6:A:1224:HOH:O	2.44	0.51
1:A:848:VAL:HB	1:A:849:PRO:HD3	1.92	0.51
1:A:310:GLU:HG2	6:A:1008:HOH:O	2.11	0.51
1:A:779:ARG:NH2	6:A:1236:HOH:O	2.44	0.50
1:D:656:GLN:OE1	1:D:681:ILE:HG22	2.12	0.50
1:D:754:VAL:CG1	1:D:758:LYS:HE2	2.43	0.49
1:D:459:ARG:NH2	6:D:1589:HOH:O	2.45	0.48
1:A:569:GLU:HA	6:A:1097:HOH:O	2.13	0.47
1:D:748:ARG:HD3	6:D:1418:HOH:O	2.14	0.47
4:D:901:CTP:C4'	2:E:29:DOC:H2'	2.44	0.47
1:D:848:VAL:HB	1:D:849:PRO:HD3	1.98	0.46
1:A:665:ILE:CG2	1:A:749:TYR:CE1	2.99	0.46
1:A:822:ALA:CB	1:A:836:ALA:HB2	2.46	0.46
1:A:578:ARG:NH1	2:B:25:DA:H5''	2.32	0.45
1:D:499:ARG:HG2	1:D:503:MET:HE2	1.97	0.45
1:D:838:LYS:NZ	1:D:839[B]:GLU:OE2	2.45	0.45
1:D:725:LEU:O	1:D:726:ASN:C	2.59	0.45
1:A:725:LEU:HB2	1:A:727:ILE:HG12	1.99	0.44
1:A:739:TYR:CD2	1:A:739:TYR:C	2.95	0.44
1:A:494:LYS:NZ	6:A:1115:HOH:O	2.50	0.44
1:D:687:MET:CE	1:D:694:GLU:HA	2.48	0.44
1:D:690:PHE:CD1	1:D:701:MET:HE3	2.52	0.44
4:D:901:CTP:H4'	2:E:29:DOC:H2'	2.00	0.44
1:D:690:PHE:CB	1:D:701:MET:HE3	2.49	0.43
1:D:725:LEU:HB2	1:D:727:ILE:HG12	2.00	0.43
1:D:515:GLU:HG2	1:D:519:TYR:CE2	2.54	0.43
1:D:550:THR:CG2	6:D:1637:HOH:O	2.67	0.42
1:D:645:SER:O	1:D:646:ASP:HB2	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:782:ASN:CG	6:D:1691:HOH:O	2.62	0.42
1:D:634:ARG:NE	6:D:1310:HOH:O	2.52	0.42
1:D:692:VAL:CG2	1:D:701:MET:HE1	2.49	0.42
1:D:703:ARG:NH2	6:D:1294:HOH:O	2.53	0.42
2:B:26:DC:H2''	2:B:27:DT:O5'	2.19	0.42
1:A:383:LYS:HE2	6:A:1094:HOH:O	2.20	0.41
1:D:565:ALA:N	1:D:566:PRO:CD	2.83	0.41
1:A:517:ARG:NH2	1:A:521:LEU:HD21	2.35	0.41
1:D:687:MET:HE1	1:D:694:GLU:HB2	2.02	0.41
1:A:665:ILE:HG21	1:A:749:TYR:CZ	2.55	0.41
1:A:822:ALA:HB2	1:A:836:ALA:HB2	2.01	0.40
1:D:695:ASP:OD1	1:D:695:ASP:N	2.46	0.40
1:D:754:VAL:HG12	1:D:758:LYS:HE2	2.04	0.40
1:D:687:MET:HE2	1:D:694:GLU:HA	2.03	0.40
1:D:684:LYS:O	1:D:687:MET:HG2	2.22	0.40

All (3) 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)
6:D:1171:HOH:O	6:D:1400:HOH:O[4_445]	1.53	0.67
6:A:997:HOH:O	6:D:1358:HOH:O[2_745]	1.71	0.49
1:A:505:LYS:HZ3	1:D:356:GLN:OE1[2_745]	1.55	0.05

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	546/592 (92%)	533 (98%)	12 (2%)	1 (0%)	43	27
1	D	591/592 (100%)	578 (98%)	13 (2%)	0	100	100
All	All	1137/1184 (96%)	1111 (98%)	25 (2%)	1 (0%)	48	31

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	628	ILE

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	470/507 (93%)	466 (99%)	4 (1%)	70	55
1	D	508/507 (100%)	502 (99%)	6 (1%)	63	43
All	All	978/1014 (96%)	968 (99%)	10 (1%)	68	52

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	303	LEU
1	A	349	GLU
1	A	415	LYS
1	A	776	ILE
1	D	303	LEU
1	D	325	GLU
1	D	511	LEU
1	D	691	GLN
1	D	695	ASP
1	D	700	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	341	HIS
1	A	543	GLN
1	A	709	ASN
1	A	793	ASN
1	D	356	GLN
1	D	468	ASN

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Mol	Chain	Res	Type
1	D	470	GLN
1	D	573	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

2 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	DOC	E	29	2,3	16,19,20	0.76	0	20,26,29	0.96	0
2	DOC	B	29	2,3	16,19,20	0.42	0	20,26,29	0.87	1 (5%)

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	DOC	E	29	2,3	-	0/7/18/19	0/2/2/2
2	DOC	B	29	2,3	-	0/7/18/19	0/2/2/2

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	29	DOC	C4'-O4'-C1'	-2.15	107.78	109.81

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	E	29	DOC	2	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

5 ligands 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	$\# Z > 2$
4	CTP	D	901	-	29,30,30	1.81	7 (24%)	43,47,47	1.20	5 (11%)
5	SO4	D	905	-	4,4,4	0.30	0	6,6,6	0.14	0
5	SO4	D	902	-	4,4,4	0.36	0	6,6,6	0.17	0
5	SO4	D	903	-	4,4,4	0.23	0	6,6,6	0.60	0
5	SO4	D	904	-	4,4,4	0.27	0	6,6,6	0.14	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
4	CTP	D	901	-	-	0/22/38/38	0/2/2/2

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	D	901	CTP	O2-C2	5.50	1.33	1.23
4	D	901	CTP	C4-N4	3.97	1.43	1.33

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	D	901	CTP	C2-N3	2.99	1.42	1.36
4	D	901	CTP	PA-O3A	-2.56	1.56	1.59
4	D	901	CTP	PB-O3B	-2.46	1.56	1.59
4	D	901	CTP	C3'-C2'	-2.03	1.47	1.53
4	D	901	CTP	C6-C5	2.03	1.39	1.35

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	D	901	CTP	O2B-PB-O3B	3.38	116.40	107.27
4	D	901	CTP	O2-C2-N3	-2.36	118.61	122.33
4	D	901	CTP	O2G-PG-O3B	2.30	112.36	104.64
4	D	901	CTP	O3A-PA-O1A	2.16	117.20	110.70
4	D	901	CTP	O3B-PB-O1B	-2.03	104.60	110.70

There are no chirality outliers.

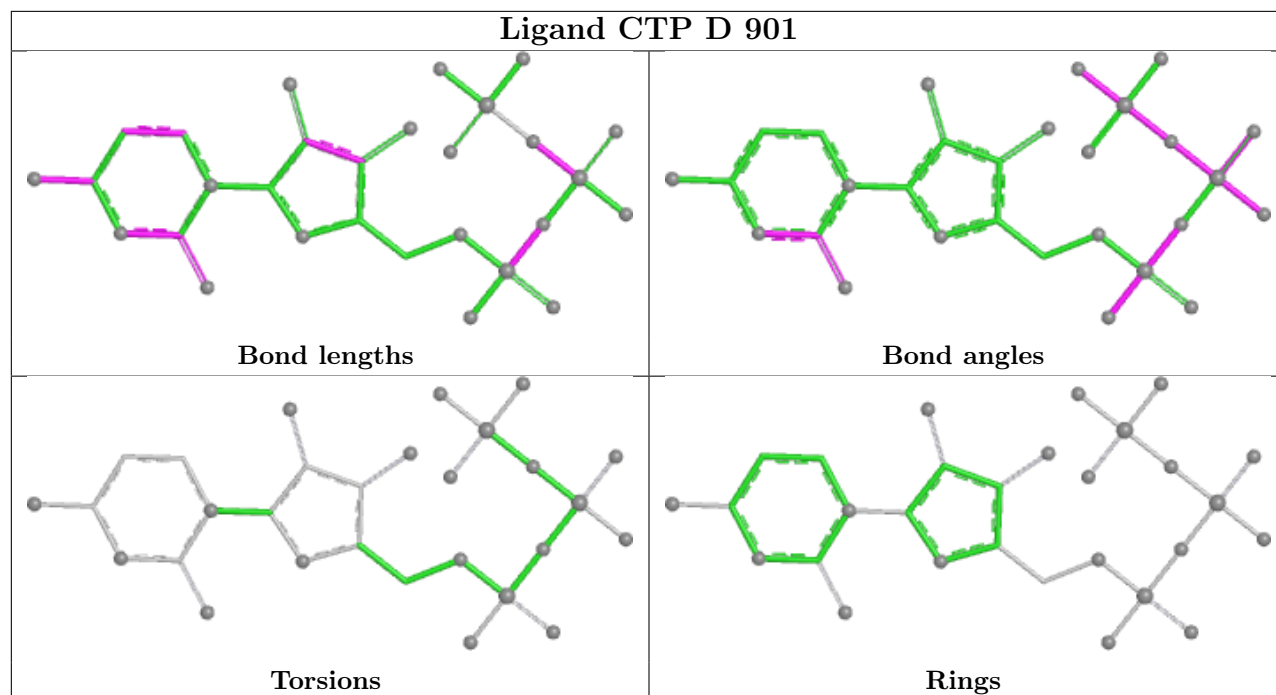
There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	D	901	CTP	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 than 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.



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 ⓘ

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	546/592 (92%)	0.59	33 (6%) 27 36	12, 44, 77, 107	3 (0%)
1	D	579/592 (97%)	-0.26	16 (2%) 55 62	8, 24, 49, 75	7 (1%)
2	B	8/9 (88%)	-0.15	0 100 100	28, 33, 44, 52	0
2	E	8/9 (88%)	-0.35	0 100 100	18, 26, 40, 53	0
3	C	9/13 (69%)	-0.53	0 100 100	22, 27, 37, 46	0
3	F	12/13 (92%)	-0.26	1 (8%) 17 21	15, 26, 64, 82	0
All	All	1162/1228 (94%)	0.14	50 (4%) 40 48	8, 34, 69, 107	10 (0%)

All (50) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	677	ARG	5.0
1	A	727	ILE	4.7
1	A	297	ALA	4.1
1	A	725	LEU	4.0
1	A	739	TYR	3.8
1	A	715	GLY	3.8
1	A	743	PHE	3.7
1	D	839[A]	GLU	3.6
1	A	711	GLY	3.5
1	D	703	ARG	3.2
1	D	735	PHE	3.2
1	D	698	THR	3.1
1	D	725	LEU	3.0
1	A	735	PHE	3.0
1	D	782	ASN	2.9
1	A	749	TYR	2.8
1	A	833[A]	ILE	2.8
1	A	819	ARG	2.8
1	D	699	PRO	2.8

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Mol	Chain	Res	Type	RSRZ
3	F	1	DA	2.8
1	A	709	ASN	2.7
1	D	697	VAL	2.7
1	D	727	ILE	2.6
1	A	722	ALA	2.6
1	D	726	ASN	2.6
1	A	671	LEU	2.5
1	A	669	ASP	2.4
1	A	740	PHE	2.4
1	D	634	ARG	2.4
1	A	861	PRO	2.3
1	A	673	GLU	2.3
1	A	675	PHE	2.3
1	D	681	ILE	2.3
1	A	842	GLU	2.3
1	A	741	GLU	2.3
1	D	692	VAL	2.3
1	A	766	LEU	2.3
1	A	298	LYS	2.3
1	D	298	LYS	2.3
1	D	730	LYS	2.3
1	A	816	LYS	2.2
1	D	691	GLN	2.2
1	A	724	ASN	2.2
1	A	341	HIS	2.1
1	A	710	TYR	2.1
1	A	353	ALA	2.1
1	A	459	ARG	2.0
1	A	857	THR	2.0
1	A	670	ASN	2.0
1	A	856	VAL	2.0

6.2 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(\AA^2)	Q<0.9
2	DOC	B	29	18/19	0.94	0.10	31,35,43,46	0
2	DOC	E	29	18/19	0.98	0.05	15,18,24,26	0

6.3 Carbohydrates [i](#)

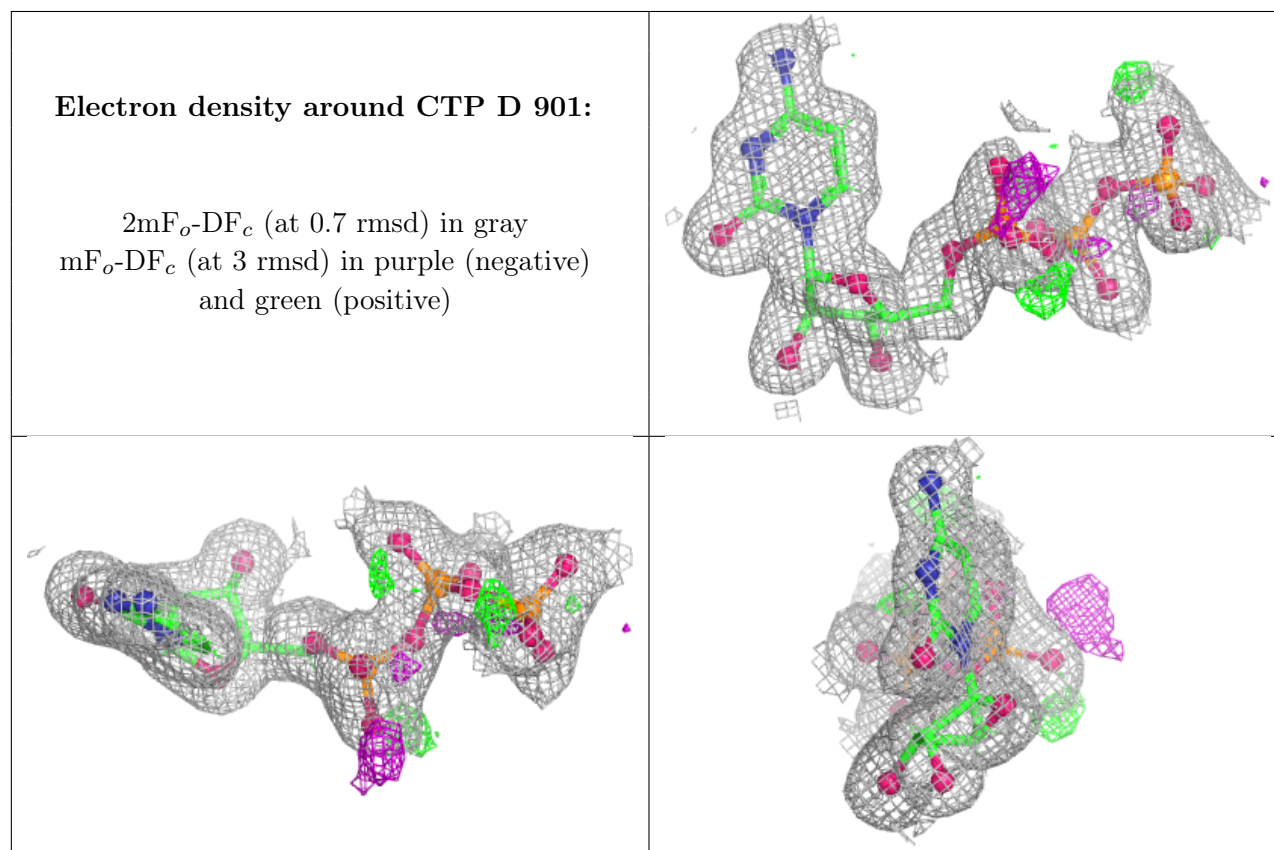
There are no oligosaccharides in this entry.

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(\AA^2)	Q<0.9
5	SO4	D	904	5/5	0.78	0.12	60,62,66,67	0
5	SO4	D	905	5/5	0.85	0.09	56,60,66,68	0
5	SO4	D	902	5/5	0.90	0.12	32,35,43,51	0
5	SO4	D	903	5/5	0.96	0.07	30,33,41,44	0
4	CTP	D	901	29/29	0.97	0.06	17,22,30,33	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.



6.5 Other polymers [i](#)

There are no such residues in this entry.