



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 15, 2026 – 12:46 PM UTC

PDB ID : 1A35 / pdb_00001a35
Title : HUMAN TOPOISOMERASE I/DNA COMPLEX
Authors : Redinbo, M.R.; Stewart, L.; Kuhn, P.; Champoux, J.J.; Hol, W.G.
Deposited on : 1998-01-29
Resolution : 2.50 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)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

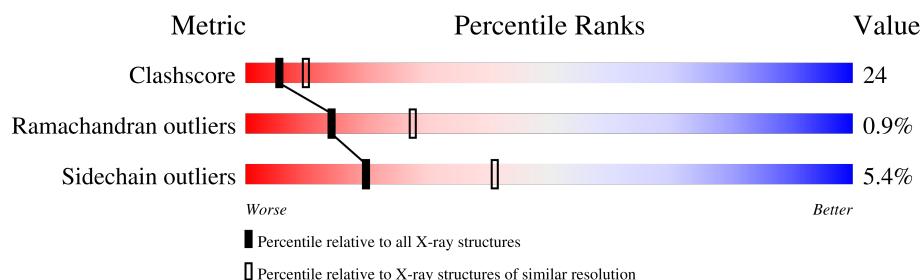
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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))
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)

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 $\leq 5\%$

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	C	22	
2	D	22	
3	A	591	

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 4947 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 (5'-D(*AP*AP*AP*AP*AP*GP*AP*CP*TP*TP*AP*GP*AP*AP*AP*AP*AP*(BRU)P*(BRU)P*TP*TP*T)-3').

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	C	22	Total	Br	C	N	O	P	0	0	0
			452	2	217	87	125	21			

- Molecule 2 is a DNA chain called DNA (5'-D(*AP*AP*AP*AP*AP*TP*+UP*+UP*+UP*+UP*CP*+UP*AP*AP*GP*TP*CP*TP*TP*TP*+ UP*T)-3').

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	D	22	Total	Br	C	N	O	P	0	0	0
			444	6	212	70	135	21			

- Molecule 3 is a protein called PROTEIN (DNA TOPOISOMERASE I).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	A	474	Total	C	N	O	S	0	0	0
			3778	2431	662	663	22			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	723	PHE	TYR	engineered mutation	UNP P11387

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	C	23	Total	O	0	0
			23	23		
4	D	44	Total	O	0	0
			44	44		
4	A	206	Total	O	0	0
			206	206		

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. 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. 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.

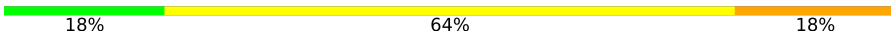
Note EDS was not executed.

- Molecule 1: DNA (5'-D(*AP*AP*AP*AP*AP*GP*AP*CP*TP*TP*AP*GP*AP*AP*AP*AP*AP*(BRU)P*(BRU)P*TP*TP*T)-3')

Chain C: 

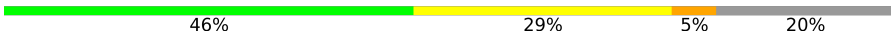


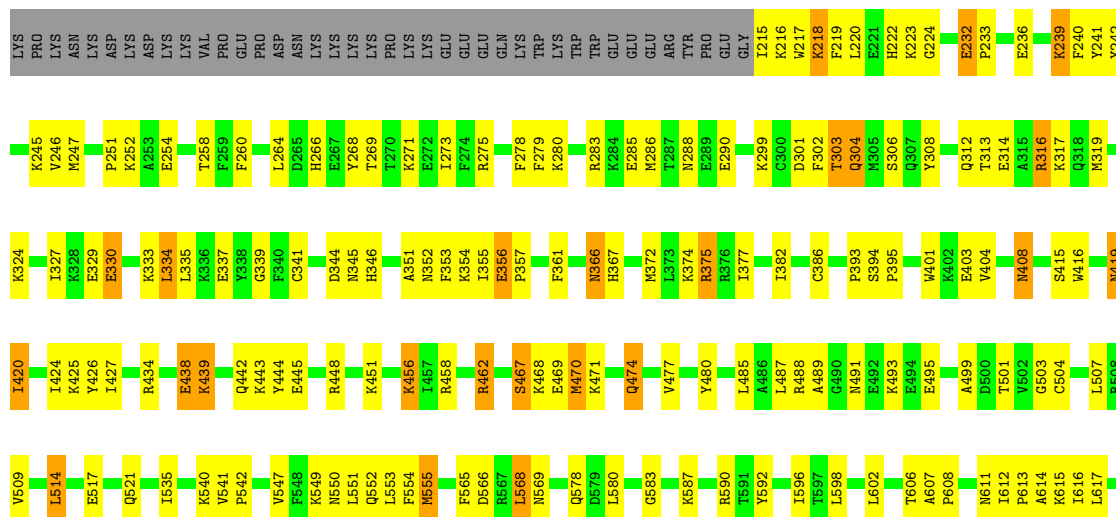
- Molecule 2: DNA (5'-D(*AP*AP*AP*AP*AP*TP*+UP*+UP*+UP*+UP*CP*+UP*AP*AP*GP*TP*CP*TP*TP*TP*+ UP*T)-3')

Chain D: 



- Molecule 3: PROTEIN (DNA TOPOISOMERASE I)

Chain A: 





4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	71.80 Å 66.30 Å 71.80 Å 90.00° 98.40° 90.00°	Depositor
Resolution (Å)	20.00 – 2.50	Depositor
% Data completeness (in resolution range)	87.0 (20.00-2.50)	Depositor
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.209 , 0.308	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	4947	wwPDB-VP
Average B, all atoms (Å ²)	41.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

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

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	C	0.42	0/464	0.86	0/712
2	D	0.54	0/360	0.92	0/546
3	A	0.69	1/3868 (0.0%)	1.11	25/5222 (0.5%)
All	All	0.66	1/4692 (0.0%)	1.07	25/6480 (0.4%)

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	C	0	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	555	MET	SD-CE	-5.49	1.65	1.79

All (25) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	356	GLU	CA-C-N	9.94	126.82	119.66
3	A	356	GLU	C-N-CA	9.94	126.82	119.66
3	A	419	ASN	N-CA-C	7.61	120.64	111.82
3	A	382	ILE	N-CA-C	6.72	117.77	108.89
3	A	303	THR	N-CA-C	6.35	117.87	111.07
3	A	468	LYS	N-CA-C	-6.28	105.90	112.93
3	A	634	ARG	N-CA-C	-6.14	100.48	109.63
3	A	485	LEU	N-CA-C	5.93	120.51	113.28
3	A	224	GLY	CA-C-N	5.89	125.86	120.03

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	224	GLY	C-N-CA	5.89	125.86	120.03
3	A	566	ASP	N-CA-C	-5.86	102.77	110.33
3	A	541	VAL	N-CA-C	5.72	114.41	107.61
3	A	232	GLU	CA-C-N	5.59	125.59	119.89
3	A	232	GLU	C-N-CA	5.59	125.59	119.89
3	A	420	ILE	N-CA-C	5.58	116.35	110.72
3	A	316	ARG	N-CA-C	-5.45	106.68	113.55
3	A	456	LYS	N-CA-C	-5.44	105.26	111.14
3	A	722	ASN	N-CA-C	5.43	120.78	114.04
3	A	723	PHE	N-CA-C	5.36	120.69	113.72
3	A	345	ASN	N-CA-C	5.25	119.78	113.17
3	A	550	ASN	N-CA-C	-5.25	105.56	111.28
3	A	330	GLU	N-CA-C	-5.25	105.74	111.82
3	A	617	LEU	N-CA-C	-5.09	105.81	111.36
3	A	239	LYS	N-CA-C	5.07	118.00	110.14
3	A	317	LYS	N-CA-C	-5.03	105.93	111.71

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	8	DC	Sidechain

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	C	452	0	245	27	0
2	D	444	0	238	34	0
3	A	3778	0	3713	159	0
4	A	206	0	0	36	0
4	C	23	0	0	3	0
4	D	44	0	0	12	0
All	All	4947	0	4196	206	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 24.

All (206) 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)
2:D:105:DA:H2''	2:D:106:DT:C5'	1.85	1.06
2:D:105:DA:H2''	2:D:106:DT:H5'	1.38	1.03
1:C:8:DC:H2''	1:C:9:DT:C7	1.88	1.03
1:C:8:DC:C2'	1:C:9:DT:H71	1.87	1.02
3:A:623:ASN:HD21	3:A:716:LEU:HB3	1.28	0.97
1:C:8:DC:H2''	1:C:9:DT:H71	0.95	0.94
2:D:118:DT:H5'	4:D:1071:HOH:O	1.68	0.93
2:D:116:DT:H73	4:A:1076:HOH:O	1.70	0.91
2:D:122:DT:H71	4:D:1124:HOH:O	1.71	0.91
3:A:408:ASN:H	3:A:408:ASN:HD22	1.15	0.90
1:C:21:DT:H5''	4:C:1257:HOH:O	1.72	0.88
3:A:720:LYS:HE2	3:A:748:GLN:HE22	1.41	0.83
3:A:470:MET:HB3	4:A:1234:HOH:O	1.77	0.83
1:C:12:DG:H5''	3:A:535:ILE:HD11	1.59	0.82
3:A:487:LEU:HD12	4:A:1200:HOH:O	1.78	0.81
3:A:366:ASN:HD22	3:A:366:ASN:C	1.89	0.80
2:D:105:DA:H2''	2:D:106:DT:H5''	1.63	0.79
2:D:110:BRU:H2''	2:D:111:DC:H5'	1.66	0.77
3:A:504:CYS:SG	4:A:1200:HOH:O	2.46	0.73
2:D:105:DA:C2'	2:D:106:DT:H5''	2.18	0.72
1:C:19:BRU:H1'	1:C:20:DT:H5'	1.70	0.72
3:A:245:LYS:HE3	4:A:1241:HOH:O	1.87	0.72
3:A:732:TRP:HZ3	3:A:743:ILE:HD11	1.55	0.71
2:D:115:DG:H1'	4:D:1037:HOH:O	1.90	0.71
3:A:607:ALA:O	3:A:615:LYS:HE2	1.89	0.71
3:A:354:LYS:HG3	4:A:1046:HOH:O	1.90	0.71
2:D:104:DA:H2''	2:D:105:DA:H5''	1.73	0.70
3:A:286:MET:HB3	3:A:290:GLU:HB2	1.72	0.70
2:D:105:DA:C2'	2:D:106:DT:C5'	2.67	0.70
3:A:372:MET:SD	4:A:1221:HOH:O	2.50	0.70
3:A:612:ILE:HB	3:A:613:PRO:HD3	1.73	0.69
3:A:470:MET:HE2	3:A:553:LEU:HG	1.75	0.68
2:D:112:BRU:BR	4:D:1115:HOH:O	2.67	0.68
3:A:587:LYS:HB2	4:A:1141:HOH:O	1.93	0.68
3:A:551:LEU:O	3:A:555:MET:HG3	1.92	0.67
1:C:11:DA:OP2	3:A:723:PHE:HE1	1.77	0.67
3:A:568:LEU:HD22	3:A:569:ASN:N	2.09	0.67
3:A:735:LYS:HE2	3:A:761:GLU:O	1.93	0.67
3:A:720:LYS:HG3	4:A:1176:HOH:O	1.94	0.67
3:A:254:GLU:O	3:A:258:THR:HG23	1.95	0.66

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:12:DG:C5'	3:A:535:ILE:HD11	2.25	0.66
3:A:330:GLU:O	3:A:333:LYS:HG2	1.95	0.65
3:A:470:MET:CE	3:A:553:LEU:HG	2.26	0.65
3:A:239:LYS:HD3	3:A:246:VAL:HG11	1.80	0.64
3:A:720:LYS:HE3	4:A:1176:HOH:O	1.96	0.64
2:D:116:DT:C7	4:A:1076:HOH:O	2.38	0.64
2:D:112:BRU:H6	4:D:1107:HOH:O	1.97	0.64
2:D:110:BRU:H2''	2:D:111:DC:C5'	2.28	0.63
3:A:375:ARG:HG2	3:A:419:ASN:ND2	2.13	0.63
3:A:279:PHE:O	3:A:283:ARG:HG3	1.99	0.63
3:A:355:ILE:HG21	3:A:377:ILE:HB	1.81	0.62
3:A:744:TYR:HD1	3:A:748:GLN:HE21	1.48	0.62
1:C:17:DA:C2	2:D:106:DT:N3	2.62	0.62
3:A:732:TRP:CZ3	3:A:743:ILE:HD11	2.34	0.61
3:A:218:LYS:HA	3:A:218:LYS:CE	2.30	0.61
3:A:470:MET:HG2	3:A:554:PHE:HE1	1.65	0.61
3:A:720:LYS:HA	4:A:1275:HOH:O	1.99	0.61
3:A:744:TYR:HD1	3:A:748:GLN:NE2	1.98	0.61
3:A:542:PRO:HD2	4:A:1230:HOH:O	1.99	0.61
1:C:19:BRU:H2''	1:C:20:DT:H71	1.83	0.60
3:A:727:ARG:HG2	3:A:759:ALA:HB2	1.84	0.60
1:C:16:DA:H8	4:C:1060:HOH:O	1.84	0.60
3:A:746:LYS:O	3:A:750:GLU:HG2	2.02	0.60
1:C:11:DA:H2'	1:C:12:DG:C8	2.36	0.60
3:A:218:LYS:HA	3:A:218:LYS:HE3	1.83	0.60
3:A:623:ASN:ND2	3:A:716:LEU:HB3	2.10	0.59
3:A:568:LEU:HD22	3:A:569:ASN:H	1.65	0.59
3:A:503:GLY:O	3:A:507:LEU:HG	2.03	0.58
2:D:113:DA:C2'	4:D:1001:HOH:O	2.51	0.58
3:A:271:LYS:NZ	4:A:1191:HOH:O	2.36	0.58
1:C:11:DA:OP2	3:A:723:PHE:CE1	2.55	0.58
3:A:443:LYS:HD3	4:A:1089:HOH:O	2.03	0.58
3:A:416:TRP:HH2	4:A:1068:HOH:O	1.87	0.57
1:C:9:DT:H5'	3:A:439:LYS:NZ	2.19	0.57
1:C:19:BRU:C2'	1:C:20:DT:H71	2.35	0.57
3:A:590:ARG:NH1	4:A:1088:HOH:O	2.38	0.57
3:A:611:ASN:OD1	3:A:614:ALA:HB3	2.05	0.56
3:A:756:ILE:O	3:A:756:ILE:HG22	2.05	0.56
3:A:745:ASN:O	3:A:749:ARG:HG3	2.05	0.56
1:C:2:DA:H2''	1:C:3:DA:OP2	2.06	0.56
3:A:408:ASN:HD22	3:A:408:ASN:N	1.89	0.55

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:17:DA:H2''	1:C:18:BRU:O5'	2.05	0.55
3:A:366:ASN:ND2	3:A:499:ALA:HA	2.21	0.55
3:A:606:THR:HG21	3:A:736:TRP:NE1	2.21	0.55
3:A:216:LYS:NZ	4:A:1256:HOH:O	2.39	0.55
3:A:271:LYS:O	3:A:275:ARG:HG3	2.06	0.55
3:A:715:ALA:HB1	4:A:1173:HOH:O	2.07	0.55
3:A:395:PRO:HD3	3:A:401:TRP:NE1	2.22	0.54
3:A:735:LYS:HE2	3:A:761:GLU:C	2.33	0.53
3:A:477:VAL:O	3:A:480:TYR:HB3	2.08	0.53
3:A:241:TYR:HB2	3:A:301:ASP:HB3	1.91	0.53
3:A:375:ARG:HH11	3:A:419:ASN:HB3	1.74	0.53
3:A:623:ASN:ND2	3:A:716:LEU:HD13	2.23	0.53
3:A:366:ASN:C	3:A:366:ASN:ND2	2.62	0.52
3:A:242:TYR:CE1	3:A:299:LYS:HB2	2.45	0.52
3:A:451:LYS:HG3	3:A:592:TYR:HE1	1.72	0.52
2:D:104:DA:C2'	2:D:105:DA:H5''	2.38	0.51
3:A:744:TYR:HA	3:A:748:GLN:NE2	2.25	0.51
3:A:444:TYR:O	3:A:448:ARG:HG3	2.11	0.51
3:A:346:HIS:CD2	4:A:1188:HOH:O	2.62	0.51
3:A:458:ARG:O	3:A:462:ARG:HB2	2.11	0.51
3:A:314:GLU:C	3:A:316:ARG:H	2.17	0.51
2:D:115:DG:H3'	4:A:1076:HOH:O	2.11	0.51
1:C:17:DA:H2	2:D:106:DT:H3	1.51	0.51
3:A:240:PHE:HD2	3:A:247:MET:HB3	1.76	0.51
3:A:273:ILE:HG12	4:A:1109:HOH:O	2.10	0.51
3:A:366:ASN:ND2	3:A:366:ASN:O	2.43	0.50
1:C:12:DG:H5''	3:A:535:ILE:CD1	2.37	0.50
3:A:215:ILE:HD13	3:A:218:LYS:HZ3	1.77	0.50
3:A:623:ASN:HD22	3:A:623:ASN:C	2.19	0.50
3:A:493:LYS:HE2	4:A:1258:HOH:O	2.12	0.50
1:C:6:DG:H2'	3:A:424:ILE:HD12	1.93	0.49
3:A:251:PRO:HG2	4:A:1039:HOH:O	2.12	0.49
3:A:266:HIS:CE1	3:A:268:TYR:CD2	2.99	0.49
3:A:415:SER:HA	3:A:425:LYS:O	2.13	0.49
1:C:1:DA:H2''	1:C:2:DA:O5'	2.12	0.49
2:D:117:DC:C1'	4:D:1193:HOH:O	2.61	0.49
3:A:728:ILE:HB	4:A:1055:HOH:O	2.12	0.49
3:A:456:LYS:NZ	3:A:580:LEU:HB3	2.28	0.48
3:A:252:LYS:HE2	3:A:285:GLU:OE1	2.14	0.48
3:A:313:THR:HA	3:A:316:ARG:NH2	2.29	0.48
3:A:754:TRP:O	3:A:758:MET:HG2	2.13	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:A:352:ASN:O	3:A:427:ILE:HG23	2.14	0.48
3:A:346:HIS:HD2	4:A:1188:HOH:O	1.96	0.48
3:A:471:LYS:HG3	4:A:1142:HOH:O	2.14	0.48
1:C:9:DT:C5'	3:A:439:LYS:NZ	2.75	0.48
3:A:218:LYS:HA	3:A:218:LYS:NZ	2.29	0.48
3:A:264:LEU:HD23	3:A:269:THR:HG21	1.96	0.48
2:D:117:DC:OP1	3:A:587:LYS:HG2	2.14	0.47
2:D:120:DT:H2'	2:D:121:BRU:BR	2.69	0.47
3:A:324:LYS:O	3:A:327:ILE:HG13	2.14	0.47
3:A:334:LEU:HD23	3:A:353:PHE:HE1	1.79	0.47
3:A:403:GLU:HG2	3:A:404:VAL:N	2.29	0.47
2:D:113:DA:H2''	4:D:1001:HOH:O	2.12	0.47
3:A:760:ASP:C	3:A:762:ASP:H	2.22	0.47
3:A:514:LEU:HD23	3:A:552:GLN:HG2	1.97	0.47
3:A:264:LEU:HD11	3:A:302:PHE:HB2	1.97	0.47
3:A:438:GLU:HB2	4:A:1245:HOH:O	2.14	0.47
3:A:308:TYR:O	3:A:312:GLN:HG2	2.14	0.46
1:C:17:DA:N1	2:D:106:DT:C4	2.83	0.46
2:D:104:DA:H2''	2:D:105:DA:C5'	2.44	0.46
3:A:612:ILE:O	3:A:616:ILE:HG13	2.15	0.46
2:D:118:DT:C5'	4:D:1071:HOH:O	2.45	0.46
3:A:222:HIS:HB3	3:A:341:CYS:HB2	1.98	0.46
3:A:632:HIS:CD2	4:A:1148:HOH:O	2.69	0.45
3:A:602:LEU:HD23	3:A:602:LEU:HA	1.77	0.45
1:C:17:DA:H2''	1:C:18:BRU:H6	1.98	0.45
3:A:236:GLU:HB2	4:A:1127:HOH:O	2.17	0.45
3:A:718:THR:O	3:A:722:ASN:N	2.45	0.45
3:A:304:GLN:HE21	3:A:304:GLN:HB3	1.60	0.44
3:A:720:LYS:HE2	3:A:748:GLN:NE2	2.19	0.44
3:A:260:PHE:HB2	3:A:278:PHE:CE1	2.52	0.44
3:A:393:PRO:O	3:A:401:TRP:NE1	2.44	0.44
3:A:607:ALA:HB3	4:A:1053:HOH:O	2.16	0.44
3:A:623:ASN:ND2	3:A:623:ASN:C	2.73	0.44
3:A:219:PHE:HB3	3:A:344:ASP:HA	2.00	0.44
4:D:1094:HOH:O	3:A:374:LYS:NZ	2.50	0.44
2:D:105:DA:C1'	2:D:106:DT:H5''	2.48	0.44
3:A:220:LEU:HD23	3:A:386:CYS:HA	2.00	0.44
3:A:329:GLU:HG2	4:A:1220:HOH:O	2.17	0.44
3:A:366:ASN:HD21	3:A:499:ALA:HA	1.82	0.44
3:A:517:GLU:HA	3:A:521:GLN:O	2.18	0.44
3:A:247:MET:HE3	3:A:247:MET:HB2	1.68	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:A:314:GLU:C	3:A:316:ARG:N	2.76	0.43
3:A:470:MET:HG2	3:A:554:PHE:CE1	2.48	0.43
2:D:105:DA:H1'	2:D:106:DT:H5''	2.00	0.43
3:A:223:LYS:HG3	3:A:337:GLU:O	2.18	0.43
3:A:266:HIS:CE1	3:A:268:TYR:HD2	2.37	0.43
3:A:752:PHE:HD1	4:A:1120:HOH:O	2.01	0.43
2:D:101:DA:H2	4:D:1011:HOH:O	2.00	0.43
2:D:110:BRU:H1'	2:D:111:DC:H5''	2.00	0.43
3:A:493:LYS:HA	3:A:493:LYS:HD3	1.77	0.43
3:A:316:ARG:HA	3:A:319:MET:HG3	2.01	0.42
3:A:361:PHE:HB2	3:A:420:ILE:HD13	2.01	0.42
3:A:404:VAL:N	4:A:1134:HOH:O	2.52	0.42
3:A:607:ALA:HA	3:A:608:PRO:HD3	1.91	0.42
3:A:501:THR:HB	4:A:1098:HOH:O	2.18	0.42
3:A:596:ILE:HD12	3:A:596:ILE:HA	1.81	0.42
3:A:241:TYR:HA	3:A:245:LYS:O	2.19	0.42
3:A:626:VAL:HG11	3:A:724:LEU:HD21	2.00	0.42
1:C:11:DA:C2	2:D:113:DA:C2	3.08	0.42
2:D:117:DC:H1'	4:D:1193:HOH:O	2.19	0.42
3:A:218:LYS:HA	3:A:218:LYS:HZ1	1.85	0.42
3:A:288:ASN:HD22	3:A:288:ASN:HA	1.67	0.41
1:C:12:DG:H2'	4:C:1123:HOH:O	2.20	0.41
3:A:598:LEU:HB2	3:A:724:LEU:HD22	2.02	0.41
2:D:106:DT:H2''	2:D:107:BRU:O5'	2.21	0.41
3:A:451:LYS:HA	3:A:592:TYR:CE1	2.56	0.41
3:A:303:THR:HA	3:A:306:SER:HB3	2.03	0.41
3:A:366:ASN:O	3:A:367:HIS:C	2.63	0.41
3:A:578:GLN:HE22	3:A:583:GLY:HA2	1.85	0.41
3:A:232:GLU:HA	3:A:233:PRO:HD3	1.86	0.41
3:A:239:LYS:H	3:A:304:GLN:NE2	2.18	0.41
3:A:474:GLN:NE2	3:A:565:PHE:HA	2.36	0.41
3:A:491:ASN:HB2	4:A:1258:HOH:O	2.21	0.41
3:A:549:LYS:HD3	3:A:552:GLN:OE1	2.21	0.41
3:A:217:TRP:CZ2	3:A:408:ASN:HA	2.56	0.41
3:A:467:SER:C	3:A:469:GLU:H	2.28	0.41
3:A:335:LEU:O	3:A:339:GLY:HA3	2.21	0.40
3:A:732:TRP:HZ3	3:A:743:ILE:CD1	2.30	0.40
1:C:6:DG:H2''	3:A:426:TYR:OH	2.21	0.40
3:A:442:GLN:O	3:A:445:GLU:HB2	2.22	0.40
3:A:488:ARG:O	3:A:489:ALA:C	2.63	0.40
3:A:356:GLU:HA	3:A:357:PRO:HD3	1.76	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:A:611:ASN:O	3:A:612:ILE:C	2.63	0.40
3:A:731:ALA:HB1	3:A:735:LYS:HE3	2.04	0.40

There are no symmetry-related clashes.

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
3	A	470/591 (80%)	445 (95%)	21 (4%)	4 (1%)	14 27

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	A	761	GLU
3	A	495	GLU
3	A	351	ALA
3	A	714	ILE

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	A	388/535 (72%)	367 (95%)	21 (5%)	20 41

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	A	218	LYS
3	A	280	LYS
3	A	304	GLN
3	A	334	LEU
3	A	366	ASN
3	A	375	ARG
3	A	394	SER
3	A	408	ASN
3	A	434	ARG
3	A	438	GLU
3	A	439	LYS
3	A	462	ARG
3	A	467	SER
3	A	470	MET
3	A	474	GLN
3	A	509	VAL
3	A	514	LEU
3	A	540	LYS
3	A	547	VAL
3	A	568	LEU
3	A	623	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
3	A	288	ASN
3	A	304	GLN
3	A	366	ASN
3	A	408	ASN
3	A	421	GLN
3	A	430	ASN
3	A	576	HIS
3	A	601	GLN
3	A	623	ASN
3	A	632	HIS
3	A	748	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

8 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	BRU	D	109	1,2	18,21,22	2.19	1 (5%)	25,30,33	0.84	1 (4%)
2	BRU	D	107	1,2	18,21,22	2.13	1 (5%)	25,30,33	1.04	3 (12%)
2	BRU	D	112	1,2	18,21,22	2.19	1 (5%)	25,30,33	1.07	2 (8%)
2	BRU	D	108	1,2	18,21,22	2.13	1 (5%)	25,30,33	1.03	3 (12%)
1	BRU	C	18	1,2	18,21,22	2.20	1 (5%)	25,30,33	0.88	1 (4%)
2	BRU	D	121	1,2	18,21,22	2.26	1 (5%)	25,30,33	0.79	1 (4%)
2	BRU	D	110	1,2	18,21,22	2.21	1 (5%)	25,30,33	0.88	1 (4%)
1	BRU	C	19	1,2	18,21,22	2.27	1 (5%)	25,30,33	0.90	1 (4%)

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	BRU	D	109	1,2	-	1/7/21/22	0/2/2/2
2	BRU	D	107	1,2	-	1/7/21/22	0/2/2/2
2	BRU	D	112	1,2	-	4/7/21/22	0/2/2/2
2	BRU	D	108	1,2	-	0/7/21/22	0/2/2/2
1	BRU	C	18	1,2	-	0/7/21/22	0/2/2/2
2	BRU	D	121	1,2	-	0/7/21/22	0/2/2/2
2	BRU	D	110	1,2	-	0/7/21/22	0/2/2/2
1	BRU	C	19	1,2	-	1/7/21/22	0/2/2/2

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	19	BRU	BR-C5	9.54	2.10	1.88
2	D	121	BRU	BR-C5	9.44	2.10	1.88

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	18	BRU	BR-C5	9.27	2.10	1.88
2	D	110	BRU	BR-C5	9.25	2.10	1.88
2	D	109	BRU	BR-C5	9.16	2.09	1.88
2	D	112	BRU	BR-C5	9.03	2.09	1.88
2	D	108	BRU	BR-C5	8.98	2.09	1.88
2	D	107	BRU	BR-C5	8.92	2.09	1.88

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	18	BRU	C6-C5-C4	-2.85	117.78	120.67
1	C	19	BRU	C6-C5-C4	-2.81	117.82	120.67
2	D	121	BRU	C6-C5-C4	-2.57	118.06	120.67
2	D	108	BRU	C2'-C1'-N1	2.43	119.89	113.81
2	D	107	BRU	C6-C5-C4	-2.34	118.30	120.67
2	D	112	BRU	C6-C5-C4	-2.32	118.32	120.67
2	D	107	BRU	C2'-C1'-N1	2.32	119.61	113.81
2	D	108	BRU	C6-C5-C4	-2.30	118.34	120.67
2	D	109	BRU	C6-C5-C4	-2.22	118.42	120.67
2	D	110	BRU	C6-C5-C4	-2.19	118.45	120.67
2	D	107	BRU	BR-C5-C6	2.14	123.63	120.64
2	D	108	BRU	BR-C5-C6	2.13	123.63	120.64
2	D	112	BRU	C3'-C2'-C1'	-2.03	97.64	102.60

There are no chirality outliers.

All (7) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	D	112	BRU	C2'-C1'-N1-C6
2	D	112	BRU	O4'-C1'-N1-C6
2	D	107	BRU	O4'-C4'-C5'-O5'
2	D	112	BRU	C2'-C1'-N1-C2
2	D	112	BRU	O4'-C1'-N1-C2
1	C	19	BRU	O4'-C4'-C5'-O5'
2	D	109	BRU	O4'-C4'-C5'-O5'

There are no ring outliers.

6 monomers are involved in 12 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	D	107	BRU	1	0

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Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	D	112	BRU	2	0
1	C	18	BRU	2	0
2	D	121	BRU	1	0
2	D	110	BRU	3	0
1	C	19	BRU	3	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.