Full wwPDB X-ray Structure Validation Report (i)

Feb 1, 2016 – 07:31 AM GMT

PDB ID	:	3B5B
Title	:	Crystal structure of the thymidylate synthase k48q
Authors	:	Sotelo-Mundo, R.R.; Arreola, R.; Maley, F.; Montfort, W.R.
Deposited on	:	2007-10-25
Resolution	:	2.70 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
http://wwpdb.org/validation/2016/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

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

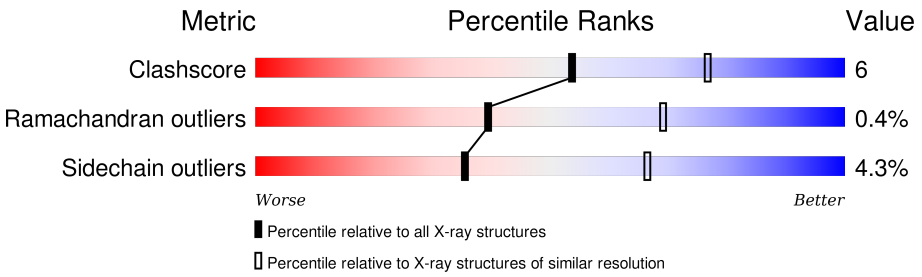
MolProbity	:	4.02b-467
Mogul	:	1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	trunk26865

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.70 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	102246	2422 (2.70-2.70)
Ramachandran outliers	100387	2382 (2.70-2.70)
Sidechain outliers	100360	2382 (2.70-2.70)

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 on the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria. 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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	264	84% 14% •
1	B	264	85% 13% •

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
2	NDU	A	265	X	-	-	-
4	FMT	B	0	-	-	X	-

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 4404 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.

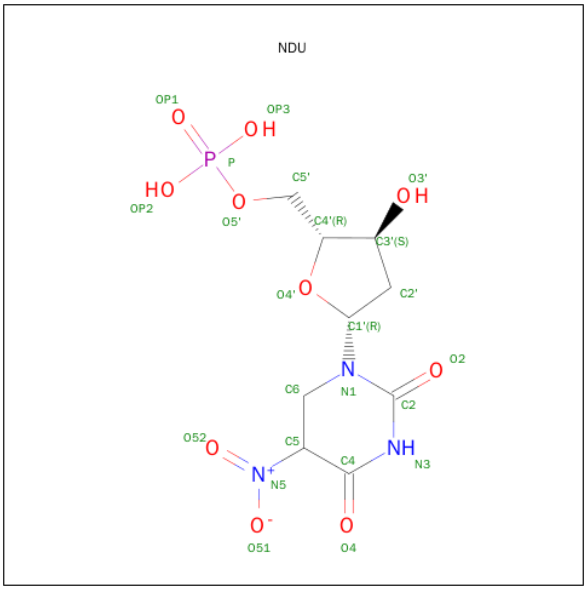
- Molecule 1 is a protein called Thymidylate synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	264	2150	1373	371	394	12	0	0	0
1	B	264	2150	1373	371	394	12	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

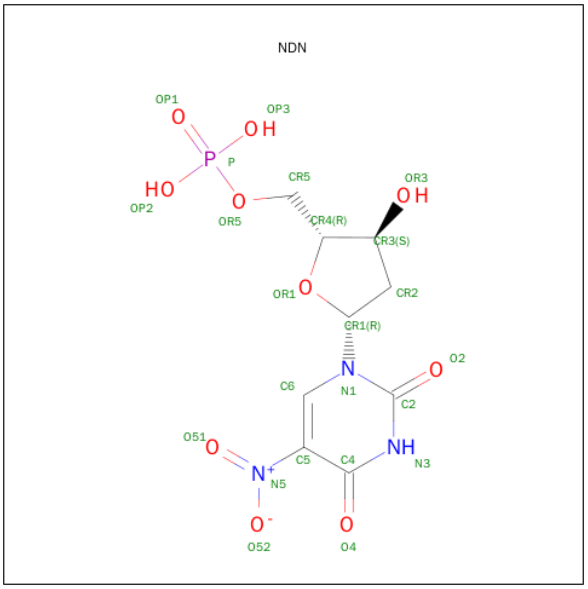
Chain	Residue	Modelled	Actual	Comment	Reference
A	48	GLN	LYS	ENGINEERED	UNP P0A884
B	48	GLN	LYS	ENGINEERED	UNP P0A884

- Molecule 2 is 2'-DEOXY-5-NITROURIDINE 5'-MONOPHOSPHATE (three-letter code: NDU) (formula: $C_9H_{14}N_3O_{10}P$).



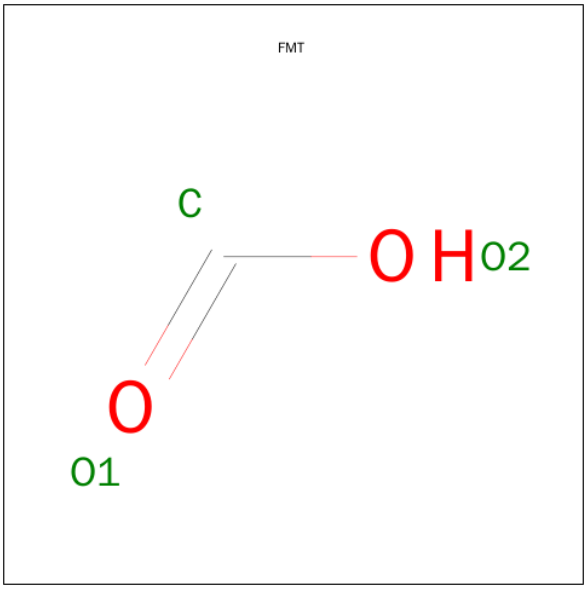
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	A	1	23	9	3	10	1	0	0

- Molecule 3 is 2'-DEOXY-5-NITROURIDINE 5'-(DIHYDROGEN PHOSPHATE) (three-letter code: NDN) (formula: $C_9H_{12}N_3O_{10}P$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
3	B	1	23	9	3	10	1	0	0

- Molecule 4 is FORMIC ACID (three-letter code: FMT) (formula: CH_2O_2).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
4	A	1	3	1	2	0	0

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
4	B	1	3	1	2	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	A	34	34	34	0	0
			Total	O		
5	B	18	18	18	0	0

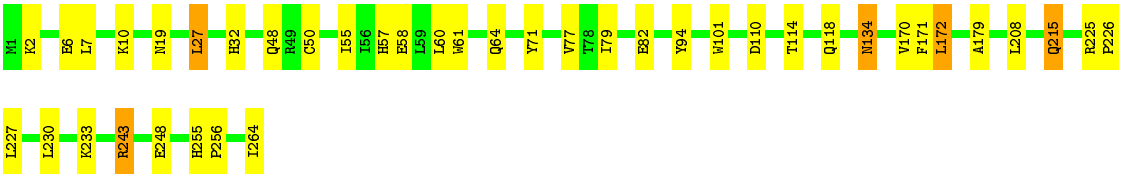
3 Residue-property plots (i)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

Note EDS was not executed.

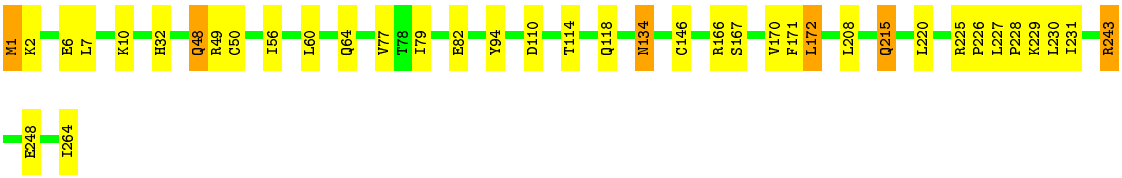
- Molecule 1: Thymidylate synthase

Chain A:



- Molecule 1: Thymidylate synthase

Chain B:



4 Data and refinement statistics (i)

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

Property	Value	Source
Space group	P 63	Depositor
Cell constants a, b, c, α, β, γ	127.37Å 127.37Å 67.84Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	25.55 – 2.70	Depositor
% Data completeness (in resolution range)	97.4 (25.55-2.70)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.09	Depositor
Refinement program	CNS 1.2	Depositor
R, R_{free}	0.193 , 0.234	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	4404	wwPDB-VP
Average B, all atoms (Å^2)	32.0	wwPDB-VP

5 Model quality (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: FMT, NDU, NDN

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	0.36	0/2210	0.64	0/3001
1	B	0.38	0/2210	0.65	1/3001 (0.0%)
All	All	0.37	0/4420	0.65	1/6002 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	1	MET	N-CA-C	-6.39	93.74	111.00

There are no chirality outliers.

There are no planarity outliers.

5.2 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	2150	0	2074	25	0
1	B	2150	0	2075	29	0
2	A	23	0	10	0	0
3	B	23	0	10	1	0
4	A	3	0	0	0	0
4	B	3	0	0	5	0
5	A	34	0	0	0	0
5	B	18	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	4404	0	4169	54	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 6.

All (54) 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:B:1:MET:CA	4:B:0:FMT:C	2.38	1.01
1:B:1:MET:H3	4:B:0:FMT:C	1.66	0.99
1:A:215:GLN:HE21	1:A:215:GLN:H	1.06	0.94
1:B:215:GLN:HE21	1:B:215:GLN:H	1.13	0.90
1:A:215:GLN:NE2	1:A:215:GLN:H	1.72	0.86
1:B:215:GLN:NE2	1:B:215:GLN:H	1.82	0.78
1:B:114:THR:O	1:B:118:GLN:HG3	1.92	0.69
1:B:110:ASP:O	1:B:114:THR:HG23	1.91	0.69
1:B:82:GLU:HG2	1:B:264:ILE:HD13	1.75	0.69
1:A:215:GLN:N	1:A:215:GLN:HE21	1.87	0.69
1:A:114:THR:O	1:A:118:GLN:HG3	1.92	0.68
1:B:146:CYS:SG	3:B:265:NDN:C6	2.85	0.65
1:A:170:VAL:HB	1:A:208:LEU:HD13	1.79	0.65
1:A:110:ASP:O	1:A:114:THR:HG23	1.98	0.63
1:A:243:ARG:HH11	1:A:243:ARG:HB2	1.64	0.63
1:B:215:GLN:HE21	1:B:215:GLN:N	1.93	0.62
1:B:60:LEU:O	1:B:64:GLN:HG2	1.99	0.62
1:B:134:ASN:C	1:B:134:ASN:HD22	2.03	0.61
1:A:82:GLU:HG2	1:A:264:ILE:HD13	1.83	0.59
1:B:166:ARG:HG3	1:B:167:SER:N	2.18	0.59
1:B:170:VAL:HB	1:B:208:LEU:HD13	1.85	0.58
1:A:134:ASN:C	1:A:134:ASN:HD22	2.08	0.57
1:A:243:ARG:CB	1:A:243:ARG:HH11	2.18	0.55
1:A:225:ARG:HB3	1:A:226:PRO:HD2	1.90	0.52
1:A:171:PHE:HD1	1:A:172:LEU:HD13	1.75	0.52
1:A:233:LYS:HE3	1:A:248:GLU:HB2	1.91	0.51
1:A:77:VAL:HG12	1:A:79:ILE:HG12	1.92	0.51
1:A:82:GLU:HG2	1:A:264:ILE:CD1	2.41	0.51
1:A:10:LYS:NZ	1:A:32:HIS:HD2	2.10	0.50
1:A:55:ILE:HD13	1:A:179:ALA:HB3	1.96	0.48
1:B:2:LYS:O	1:B:6:GLU:HG3	2.15	0.47
1:B:1:MET:HA	4:B:0:FMT:C	2.37	0.47
1:B:10:LYS:NZ	1:B:32:HIS:HD2	2.12	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:82:GLU:HG2	1:B:264:ILE:CD1	2.44	0.47
1:B:231:ILE:HB	1:B:248:GLU:HB3	1.96	0.46
1:A:58:GLU:O	1:A:61:TRP:HB3	2.15	0.46
1:A:60:LEU:O	1:A:64:GLN:HG2	2.16	0.46
1:B:225:ARG:HB3	1:B:226:PRO:HD2	1.98	0.46
1:A:57:HIS:HD2	1:A:71:TYR:OH	1.99	0.45
1:B:56:ILE:O	1:B:60:LEU:HG	2.17	0.44
1:B:228:PRO:C	1:B:229:LYS:HD2	2.38	0.44
1:B:1:MET:CA	4:B:0:FMT:O2	2.65	0.43
1:B:77:VAL:HG12	1:B:79:ILE:HG12	2.00	0.43
1:B:228:PRO:O	1:B:229:LYS:HD2	2.19	0.43
1:B:171:PHE:HD1	1:B:172:LEU:HD13	1.84	0.43
1:B:1:MET:HA	4:B:0:FMT:O2	2.19	0.42
1:A:101:TRP:CH2	1:A:134:ASN:HA	2.55	0.42
1:A:27:LEU:HA	1:A:27:LEU:HD23	1.90	0.42
1:B:48:GLN:HG3	1:B:49:ARG:N	2.33	0.41
1:B:220:LEU:HD12	1:B:220:LEU:HA	1.89	0.41
1:A:215:GLN:NE2	1:A:215:GLN:N	2.54	0.41
1:A:2:LYS:O	1:A:6:GLU:HG3	2.20	0.41
1:A:255:HIS:HB3	1:A:256:PRO:HD2	2.02	0.41
1:B:243:ARG:HH11	1:B:243:ARG:CB	2.34	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
1	A	262/264 (99%)	253 (97%)	8 (3%)	1 (0%)	39 69
1	B	262/264 (99%)	254 (97%)	7 (3%)	1 (0%)	39 69
All	All	524/528 (99%)	507 (97%)	15 (3%)	2 (0%)	39 69

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	94	TYR
1	B	94	TYR

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	233/233 (100%)	222 (95%)	11 (5%)	32	63
1	B	233/233 (100%)	224 (96%)	9 (4%)	39	70
All	All	466/466 (100%)	446 (96%)	20 (4%)	35	66

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	7	LEU
1	A	19	ASN
1	A	27	LEU
1	A	48	GLN
1	A	50	CYS
1	A	134	ASN
1	A	172	LEU
1	A	215	GLN
1	A	227	LEU
1	A	230	LEU
1	A	243	ARG
1	B	7	LEU
1	B	48	GLN
1	B	50	CYS
1	B	134	ASN
1	B	172	LEU
1	B	215	GLN
1	B	227	LEU
1	B	230	LEU
1	B	243	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (25) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	32	HIS
1	A	33	GLN
1	A	57	HIS
1	A	73	HIS
1	A	75	ASN
1	A	97	GLN
1	A	108	HIS
1	A	117	ASN
1	A	118	GLN
1	A	134	ASN
1	A	151	GLN
1	A	162	GLN
1	A	215	GLN
1	A	217	HIS
1	B	32	HIS
1	B	57	HIS
1	B	75	ASN
1	B	87	ASN
1	B	97	GLN
1	B	117	ASN
1	B	118	GLN
1	B	134	ASN
1	B	151	GLN
1	B	162	GLN
1	B	215	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 carbohydrates in this entry.

5.6 Ligand geometry (i)

4 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	FMT	A	0	1	0,2,2	0.00	-	0,1,1	0.00	-
2	NDU	A	265	1	21,24,24	2.76	6 (28%)	28,36,36	2.51	5 (17%)
4	FMT	B	0	1	0,2,2	0.00	-	0,1,1	0.00	-
3	NDN	B	265	-	17,24,24	3.79	3 (17%)	20,36,36	3.75	4 (20%)

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	FMT	A	0	1	-	0/0/0/0	0/0/0/0
2	NDU	A	265	1	1/1/9/10	0/12/42/42	0/2/2/2
4	FMT	B	0	1	-	0/0/0/0	0/0/0/0
3	NDN	B	265	-	-	0/8/26/26	0/2/2/2

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	265	NDU	O2-C2	-2.80	1.17	1.23
2	A	265	NDU	C6-C5	2.63	1.56	1.52
2	A	265	NDU	C1'-N1	2.82	1.49	1.45
3	B	265	NDN	C4-N3	3.54	1.39	1.33
2	A	265	NDU	C5-C4	4.06	1.57	1.51
2	A	265	NDU	C2-N1	4.13	1.42	1.35
3	B	265	NDN	C6-C5	8.52	1.54	1.38
2	A	265	NDU	C6-N1	9.28	1.59	1.46
3	B	265	NDN	C6-N1	12.03	1.53	1.35

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	B	265	NDN	C5-C4-N3	-4.32	116.13	123.32
2	A	265	NDU	C2'-C1'-N1	-3.03	111.99	115.66
2	A	265	NDU	N3-C2-N1	2.19	118.79	116.60
2	A	265	NDU	C6-C5-C4	2.55	117.47	111.08
3	B	265	NDN	OP3-P-OP2	2.70	117.66	107.38
2	A	265	NDU	C1'-N1-C2	6.93	127.80	118.06
3	B	265	NDN	OR1-CR1-N1	8.29	122.06	107.72
2	A	265	NDU	O4'-C1'-N1	9.45	121.14	108.40
3	B	265	NDN	C4-N3-C2	13.10	126.57	115.25

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
2	A	265	NDU	C5

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	0	FMT	5	0
3	B	265	NDN	1	0

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 (i)

6.1 Protein, DNA and RNA chains (i)

EDS was not executed - this section will therefore be empty.

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

EDS was not executed - this section will therefore be empty.

6.3 Carbohydrates (i)

EDS was not executed - this section will therefore be empty.

6.4 Ligands (i)

EDS was not executed - this section will therefore be empty.

6.5 Other polymers (i)

EDS was not executed - this section will therefore be empty.