



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 08:28 PM UTC

PDB ID : 1RY8 / pdb_00001ry8
Title : Prostaglandin F synthase complexed with NADPH and rutin
Authors : Komoto, J.; Yamada, T.; Watanabe, K.; Takusagawa, F.
Deposited on : 2003-12-19
Resolution : 1.69 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

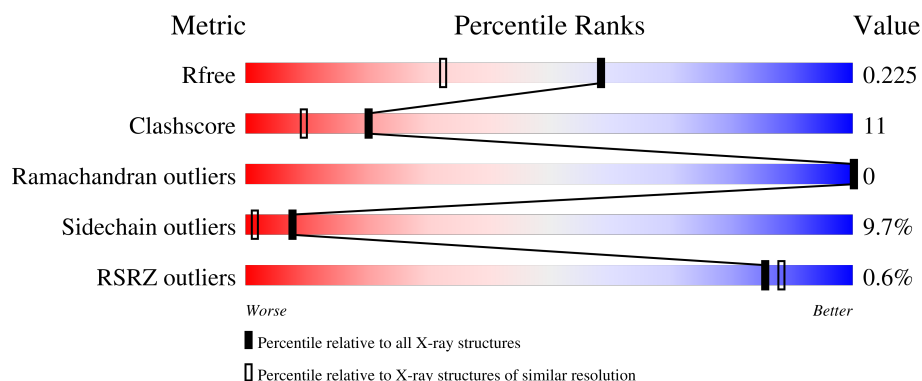
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.69 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	5551 (1.70-1.70)
Clashscore	190562	5924 (1.70-1.70)
Ramachandran outliers	187476	5846 (1.70-1.70)
Sidechain outliers	187428	5846 (1.70-1.70)
RSRZ outliers	180081	5554 (1.70-1.70)

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 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	323	
1	B	323	

2 Entry composition [i](#)

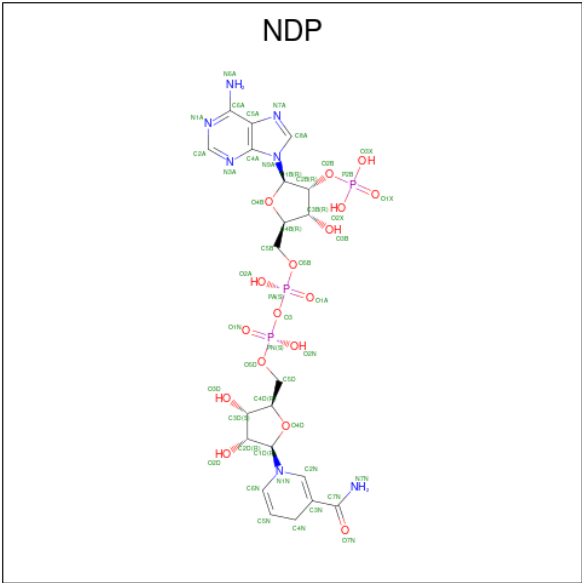
There are 4 unique types of molecules in this entry. The entry contains 5815 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Aldo-keto reductase family 1 member C3.

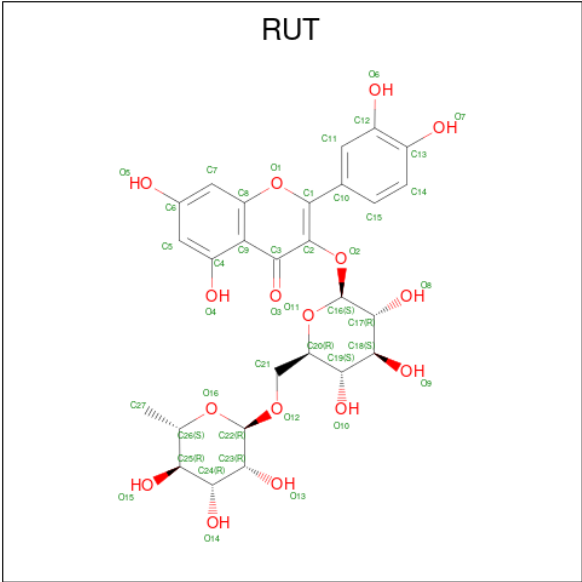
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	319	Total	C	N	O	S	0	0	0
			2563	1632	445	474	12			
1	B	319	Total	C	N	O	S	0	0	0
			2563	1632	445	474	12			

- Molecule 2 is NADPH DIHYDRO-NICOTINAMIDE-ADENINE-DINUCLEOTIDE PHOSPHATE (CCD ID: NDP) (formula: C₂₁H₃₀N₇O₁₇P₃).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			48	21	7	17	3		
2	B	1	Total	C	N	O	P	0	0
			48	21	7	17	3		

- Molecule 3 is RUTIN (CCD ID: RUT) (formula: C₂₇H₃₀O₁₆).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			43	27	16		
3	B	1	Total	C	O	0	0
			43	27	16		

- Molecule 4 is water.

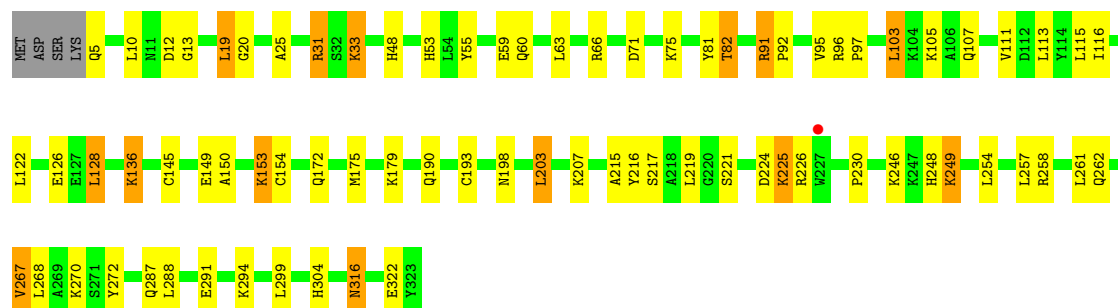
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	253	Total	O	0	0
			253	253		
4	B	254	Total	O	0	0
			254	254		

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.

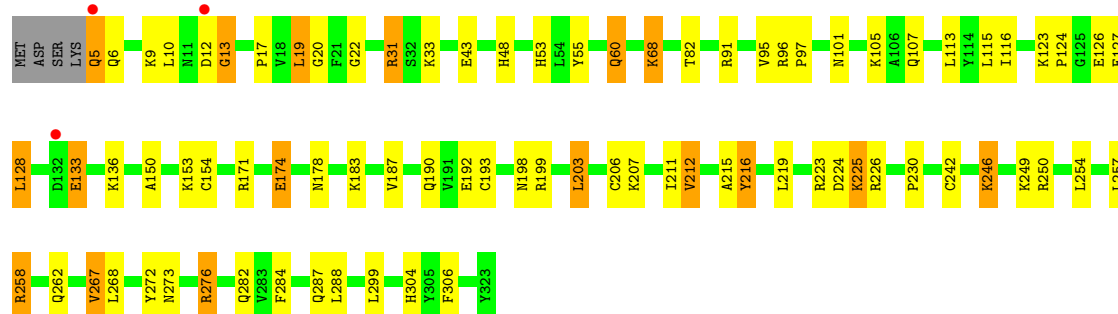
- Molecule 1: Aldo-keto reductase family 1 member C3

Chain A: 



- Molecule 1: Aldo-keto reductase family 1 member C3

Chain B: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	47.06Å 49.37Å 83.59Å 73.90° 86.30° 69.90°	Depositor
Resolution (Å)	10.00 – 1.69 10.00 – 1.69	Depositor EDS
% Data completeness (in resolution range)	(Not available) (10.00-1.69) 93.4 (10.00-1.69)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.86 (at 1.69Å)	Xtriage
Refinement program	X-PLOR 3.851	Depositor
R, R_{free}	0.205 , 0.249 0.184 , 0.225	Depositor DCC
R_{free} test set	7316 reflections (10.10%)	wwPDB-VP
Wilson B-factor (Å ²)	15.7	Xtriage
Anisotropy	0.402	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.24 , 60.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.007 for -h,-k,-k+1	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	5815	wwPDB-VP
Average B, all atoms (Å ²)	17.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.98% 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: NDP, RUT

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	0.39	0/2622	0.89	8/3547 (0.2%)
1	B	0.39	0/2622	0.86	6/3547 (0.2%)
All	All	0.39	0/5244	0.87	14/7094 (0.2%)

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	B	0	1

There are no bond length outliers.

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	13	GLY	N-CA-C	-7.73	105.49	114.69
1	B	116	ILE	N-CA-C	-7.32	96.92	107.98
1	A	116	ILE	N-CA-C	-7.14	97.20	107.98
1	B	95	VAL	N-CA-C	6.85	116.94	110.30
1	B	13	GLY	N-CA-C	-6.51	106.46	114.92
1	A	267	VAL	N-CA-C	6.41	117.09	108.11
1	A	91	ARG	CA-C-N	5.98	127.32	119.84
1	A	91	ARG	C-N-CA	5.98	127.32	119.84
1	A	322	GLU	N-CA-C	-5.93	104.94	111.82
1	B	267	VAL	N-CA-C	5.77	116.79	108.48
1	A	198	ASN	N-CA-C	5.42	119.74	113.18
1	B	198	ASN	N-CA-C	5.16	119.45	113.20
1	A	95	VAL	N-CA-C	5.10	115.22	110.42
1	B	272	TYR	N-CA-C	-5.01	105.64	112.26

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	216	TYR	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	A	2563	0	2558	56	0
1	B	2563	0	2558	58	0
2	A	48	0	26	12	0
2	B	48	0	26	6	0
3	A	43	0	28	1	0
3	B	43	0	28	2	0
4	A	253	0	0	1	0
4	B	254	0	0	2	0
All	All	5815	0	5224	119	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 11.

All (119) 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:262:GLN:HE22	1:B:288:LEU:H	1.04	0.99
1:B:96:ARG:HB2	1:B:153:LYS:HE3	1.43	0.98
1:B:123:LYS:HD2	1:B:124:PRO:HD2	1.52	0.92
1:A:262:GLN:HE22	1:A:288:LEU:H	0.95	0.91
1:A:258:ARG:HE	1:A:262:GLN:HE21	1.20	0.86
1:A:262:GLN:HE22	1:A:288:LEU:N	1.79	0.79
1:B:262:GLN:NE2	1:B:288:LEU:H	1.80	0.78
1:A:262:GLN:NE2	1:A:288:LEU:H	1.79	0.75
1:A:111:VAL:HG12	1:A:113:LEU:H	1.54	0.71
1:A:10:LEU:C	1:A:12:ASP:H	1.97	0.70
1:B:225:LYS:HD2	1:B:230:PRO:HB3	1.73	0.70
1:A:150:ALA:HA	1:A:153:LYS:HD3	1.72	0.69

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:262:GLN:HE22	1:B:288:LEU:N	1.85	0.69
1:B:258:ARG:HD2	1:B:262:GLN:HE21	1.56	0.69
1:A:136:LYS:HA	1:A:136:LYS:HE2	1.76	0.68
1:B:60:GLN:NE2	1:B:60:GLN:H	1.92	0.68
1:A:219:LEU:HB2	2:A:2324:NDP:H52A	1.76	0.67
1:B:5:GLN:HA	1:B:284:PHE:CZ	2.31	0.66
1:B:250:ARG:HH11	1:B:282:GLN:HE21	1.43	0.65
1:A:33:LYS:HG2	1:A:272:TYR:HD1	1.61	0.65
1:A:63:LEU:HD23	1:A:66:ARG:NH1	2.13	0.64
1:B:224:ASP:OD1	1:B:226:ARG:HB2	1.97	0.64
1:A:257:LEU:HD23	1:A:267:VAL:HG21	1.81	0.62
1:A:149:GLU:HG3	1:A:179:LYS:HE2	1.81	0.61
1:B:101:ASN:HD21	1:B:105:LYS:HE3	1.65	0.61
1:B:257:LEU:HD13	4:B:1469:HOH:O	2.00	0.60
3:B:3325:RUT:O11	3:B:3325:RUT:H1	2.01	0.60
1:B:216:TYR:CE2	2:B:3324:NDP:H41N	2.35	0.60
3:A:2325:RUT:O11	3:A:2325:RUT:H1	2.01	0.60
1:A:257:LEU:HD23	1:A:267:VAL:CG2	2.32	0.59
1:B:53:HIS:CE1	1:B:128:LEU:HD11	2.38	0.59
1:B:257:LEU:HD23	1:B:267:VAL:HG21	1.83	0.59
1:A:96:ARG:HB2	1:A:153:LYS:HE3	1.84	0.59
1:B:96:ARG:HB2	1:B:153:LYS:CE	2.27	0.58
1:B:10:LEU:C	1:B:12:ASP:H	2.10	0.56
1:A:225:LYS:HD2	1:A:230:PRO:HB3	1.86	0.56
1:A:33:LYS:HG2	1:A:272:TYR:CD1	2.40	0.56
1:B:5:GLN:HA	1:B:284:PHE:CE2	2.41	0.56
1:B:20:GLY:HA2	1:B:48:HIS:HB3	1.88	0.56
1:B:31:ARG:O	1:B:60:GLN:HG2	2.06	0.56
1:A:203:LEU:HD22	1:A:207:LYS:HE3	1.88	0.55
1:A:219:LEU:CB	2:A:2324:NDP:H52A	2.36	0.55
1:A:216:TYR:CE2	2:A:2324:NDP:H41N	2.42	0.55
1:A:82:THR:HG21	4:A:1020:HOH:O	2.06	0.54
1:B:242:CYS:O	1:B:246:LYS:HD3	2.07	0.54
1:B:153:LYS:HG2	1:B:154:CYS:N	2.21	0.54
1:B:219:LEU:HB2	2:B:3324:NDP:H52A	1.89	0.54
1:B:101:ASN:ND2	1:B:105:LYS:HE3	2.23	0.53
1:B:273:ASN:HB3	1:B:276:ARG:HD3	1.90	0.53
1:A:224:ASP:OD1	1:A:226:ARG:HB2	2.10	0.51
1:B:174:GLU:HG3	1:B:178:ASN:ND2	2.25	0.51
1:A:63:LEU:HD23	1:A:66:ARG:HH12	1.75	0.51
1:A:217:SER:H	2:A:2324:NDP:H52N	1.75	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:219:LEU:CB	2:B:3324:NDP:H52A	2.42	0.50
1:B:60:GLN:H	1:B:60:GLN:HE21	1.58	0.50
2:A:2324:NDP:H51N	2:A:2324:NDP:H6N	1.92	0.50
1:A:216:TYR:CZ	2:A:2324:NDP:H41N	2.46	0.50
1:A:10:LEU:C	1:A:12:ASP:N	2.65	0.49
1:A:53:HIS:HE1	1:A:128:LEU:HD11	1.78	0.49
1:B:203:LEU:O	1:B:207:LYS:HG3	2.13	0.49
1:B:9:LYS:HZ2	1:B:13:GLY:HA2	1.78	0.49
1:A:111:VAL:HG12	1:A:113:LEU:N	2.27	0.48
1:B:10:LEU:C	1:B:12:ASP:N	2.69	0.48
1:A:53:HIS:CE1	1:A:128:LEU:HD11	2.48	0.48
1:B:304:HIS:NE2	1:B:306:PHE:O	2.46	0.48
1:A:113:LEU:HD21	1:A:115:LEU:HD21	1.95	0.48
1:B:5:GLN:HE22	1:B:19:LEU:H	1.60	0.48
1:B:192:GLU:HB2	1:B:216:TYR:CE2	2.48	0.48
1:A:190:GLN:OE1	2:A:2324:NDP:H2N	2.13	0.47
1:B:150:ALA:HA	1:B:153:LYS:HD3	1.96	0.47
1:B:53:HIS:HE1	1:B:128:LEU:HD11	1.77	0.47
1:B:17:PRO:HB2	1:B:48:HIS:HB2	1.96	0.47
1:B:250:ARG:HH11	1:B:282:GLN:NE2	2.08	0.47
1:A:81:TYR:O	1:A:111:VAL:HG13	2.15	0.46
1:A:270:LYS:HD3	1:A:270:LYS:C	2.40	0.46
1:B:133:GLU:H	1:B:133:GLU:HG3	1.35	0.46
1:B:9:LYS:NZ	1:B:13:GLY:HA2	2.30	0.45
1:A:96:ARG:HB3	1:A:97:PRO:HD3	1.99	0.45
1:A:219:LEU:HB2	2:A:2324:NDP:C5B	2.44	0.45
1:B:216:TYR:CZ	2:B:3324:NDP:H41N	2.51	0.45
1:A:103:LEU:CD1	1:A:111:VAL:HG23	2.47	0.44
1:B:224:ASP:CG	3:B:3325:RUT:H5	2.42	0.44
1:A:153:LYS:HG2	1:A:154:CYS:N	2.32	0.44
1:B:273:ASN:CB	1:B:276:ARG:HD3	2.47	0.44
1:A:225:LYS:HD3	1:A:225:LYS:HA	1.78	0.44
2:A:2324:NDP:H6N	2:A:2324:NDP:H3D	1.99	0.44
1:A:55:TYR:N	1:A:55:TYR:CD2	2.83	0.44
1:B:193:CYS:HB3	1:B:215:ALA:CB	2.48	0.44
1:B:219:LEU:HD11	1:B:257:LEU:HD21	2.00	0.44
1:B:113:LEU:HD21	1:B:115:LEU:HD21	2.00	0.43
1:A:217:SER:H	2:A:2324:NDP:C5D	2.30	0.43
1:B:60:GLN:NE2	1:B:60:GLN:N	2.65	0.43
1:B:123:LYS:CD	1:B:124:PRO:HD2	2.35	0.43
1:A:5:GLN:HE22	1:A:19:LEU:HB3	1.84	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:187:VAL:O	1:B:212:VAL:HG13	2.19	0.42
1:A:258:ARG:NH2	1:A:287:GLN:HG3	2.34	0.42
1:B:96:ARG:HB3	1:B:97:PRO:HD3	2.01	0.42
1:B:43:GLU:OE1	1:B:68:LYS:HE2	2.20	0.42
1:B:22:GLY:HA3	2:B:3324:NDP:H4D	2.02	0.42
1:B:55:TYR:N	1:B:55:TYR:CD2	2.87	0.42
1:A:291:GLU:OE2	1:A:294:LYS:HE2	2.19	0.42
1:A:20:GLY:HA2	1:A:48:HIS:HB3	2.01	0.41
1:A:63:LEU:CD2	1:A:66:ARG:HH12	2.33	0.41
1:A:248:HIS:O	1:A:249:LYS:HB2	2.20	0.41
1:A:82:THR:HB	1:A:113:LEU:HB3	2.02	0.41
1:B:91:ARG:HG3	4:B:1064:HOH:O	2.20	0.41
1:B:225:LYS:HA	1:B:225:LYS:HD3	1.78	0.41
1:A:172:GLN:O	1:A:175:MET:HE2	2.20	0.41
1:A:25:ALA:HB2	1:A:272:TYR:CZ	2.56	0.41
1:A:91:ARG:HA	1:A:92:PRO:HD2	1.80	0.41
1:A:193:CYS:HB3	1:A:215:ALA:CB	2.50	0.41
1:B:206:CYS:HB3	1:B:211:ILE:O	2.21	0.41
2:A:2324:NDP:H51N	2:A:2324:NDP:C6N	2.51	0.40
1:A:31:ARG:O	1:A:60:GLN:HG2	2.21	0.40
1:A:270:LYS:O	2:A:2324:NDP:H8A	2.21	0.40
1:A:316:ASN:HD22	1:A:316:ASN:HA	1.73	0.40
1:A:71:ASP:OD2	1:A:71:ASP:C	2.65	0.40
1:A:145:CYS:HB3	1:A:179:LYS:HD2	2.03	0.40
1:B:190:GLN:OE1	2:B:3324:NDP:H2N	2.22	0.40

There are no symmetry-related clashes.

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	317/323 (98%)	308 (97%)	9 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	317/323 (98%)	306 (96%)	11 (4%)	0	100	100
All	All	634/646 (98%)	614 (97%)	20 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	283/287 (99%)	258 (91%)	25 (9%)	9	2
1	B	283/287 (99%)	253 (89%)	30 (11%)	6	1
All	All	566/574 (99%)	511 (90%)	55 (10%)	8	1

All (55) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	19	LEU
1	A	31	ARG
1	A	33	LYS
1	A	59	GLU
1	A	75	LYS
1	A	82	THR
1	A	103	LEU
1	A	105	LYS
1	A	107	GLN
1	A	122	LEU
1	A	126	GLU
1	A	128	LEU
1	A	136	LYS
1	A	153	LYS
1	A	203	LEU
1	A	221	SER
1	A	225	LYS
1	A	246	LYS

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Mol	Chain	Res	Type
1	A	249	LYS
1	A	254	LEU
1	A	261	LEU
1	A	268	LEU
1	A	299	LEU
1	A	304	HIS
1	A	316	ASN
1	B	5	GLN
1	B	6	GLN
1	B	19	LEU
1	B	31	ARG
1	B	33	LYS
1	B	60	GLN
1	B	68	LYS
1	B	82	THR
1	B	107	GLN
1	B	126	GLU
1	B	127	GLU
1	B	128	LEU
1	B	133	GLU
1	B	136	LYS
1	B	171	ARG
1	B	174	GLU
1	B	183	LYS
1	B	199	ARG
1	B	203	LEU
1	B	212	VAL
1	B	223	ARG
1	B	225	LYS
1	B	246	LYS
1	B	249	LYS
1	B	254	LEU
1	B	258	ARG
1	B	268	LEU
1	B	276	ARG
1	B	287	GLN
1	B	299	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (18) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	5	GLN

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Mol	Chain	Res	Type
1	A	6	GLN
1	A	53	HIS
1	A	56	ASN
1	A	60	GLN
1	A	101	ASN
1	A	178	ASN
1	A	262	GLN
1	A	316	ASN
1	B	5	GLN
1	B	53	HIS
1	B	56	ASN
1	B	60	GLN
1	B	101	ASN
1	B	107	GLN
1	B	262	GLN
1	B	282	GLN
1	B	287	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 oligosaccharides 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
3	RUT	B	3325	-	47,47,47	2.87	19 (40%)	71,71,71	2.03	19 (26%)
3	RUT	A	2325	-	47,47,47	2.78	20 (42%)	71,71,71	2.09	21 (29%)
2	NDP	B	3324	-	51,52,52	1.58	12 (23%)	71,80,80	1.41	14 (19%)
2	NDP	A	2324	-	51,52,52	1.69	11 (21%)	71,80,80	1.42	13 (18%)

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	RUT	B	3325	-	-	0/13/53/53	0/5/5/5
3	RUT	A	2325	-	-	0/13/53/53	0/5/5/5
2	NDP	B	3324	-	-	9/34/77/77	0/5/5/5
2	NDP	A	2324	-	-	12/34/77/77	0/5/5/5

All (62) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	3325	RUT	C15-C10	8.54	1.52	1.39
3	A	2325	RUT	C15-C10	8.37	1.52	1.39
3	B	3325	RUT	C5-C6	6.13	1.48	1.39
3	B	3325	RUT	C9-C4	6.10	1.51	1.41
3	A	2325	RUT	C5-C6	5.98	1.48	1.39
3	A	2325	RUT	C7-C8	5.87	1.48	1.38
3	B	3325	RUT	C7-C8	5.83	1.48	1.38
3	A	2325	RUT	C9-C4	5.80	1.50	1.41
3	B	3325	RUT	C10-C1	4.75	1.54	1.47
2	A	2324	NDP	PN-O3	-4.62	1.54	1.59
3	B	3325	RUT	C18-C17	4.01	1.62	1.52
3	A	2325	RUT	C18-C17	3.97	1.62	1.52
3	B	3325	RUT	O1-C1	3.93	1.42	1.37
3	A	2325	RUT	C10-C1	3.93	1.53	1.47
2	A	2324	NDP	C2A-N1A	3.88	1.40	1.33
3	A	2325	RUT	C25-C26	3.82	1.61	1.52
2	B	3324	NDP	C2A-N1A	3.76	1.40	1.33
3	B	3325	RUT	C7-C6	3.70	1.44	1.39
3	A	2325	RUT	C19-C20	3.63	1.60	1.53
3	A	2325	RUT	O1-C1	3.63	1.42	1.37
2	A	2324	NDP	C6N-N1N	3.61	1.46	1.37
3	B	3325	RUT	C19-C20	3.54	1.60	1.53

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	3325	RUT	C25-C26	3.50	1.60	1.52
3	A	2325	RUT	C7-C6	3.47	1.44	1.39
3	A	2325	RUT	C27-C26	3.40	1.59	1.51
3	B	3325	RUT	C15-C14	3.38	1.44	1.38
3	B	3325	RUT	C27-C26	3.32	1.59	1.51
3	B	3325	RUT	O2-C16	3.19	1.49	1.43
3	B	3325	RUT	O12-C22	3.14	1.45	1.40
2	B	3324	NDP	C6N-C5N	3.11	1.42	1.33
2	B	3324	NDP	C6N-N1N	3.11	1.44	1.37
3	A	2325	RUT	C15-C14	2.98	1.43	1.38
2	B	3324	NDP	C2A-N3A	2.95	1.39	1.33
2	A	2324	NDP	C6N-C5N	2.88	1.41	1.33
2	B	3324	NDP	C7N-C3N	2.84	1.54	1.48
3	A	2325	RUT	O12-C22	2.80	1.44	1.40
2	A	2324	NDP	C2A-N3A	2.76	1.38	1.33
3	B	3325	RUT	O16-C22	2.72	1.48	1.41
3	A	2325	RUT	O2-C16	2.66	1.48	1.43
2	A	2324	NDP	C4N-C5N	-2.65	1.42	1.49
3	A	2325	RUT	O12-C21	2.58	1.48	1.43
2	A	2324	NDP	C3D-C4D	2.57	1.59	1.53
3	A	2325	RUT	C25-C24	2.55	1.58	1.52
2	A	2324	NDP	PA-O1A	-2.55	1.42	1.50
3	B	3325	RUT	C25-C24	2.54	1.58	1.52
3	A	2325	RUT	O16-C22	2.52	1.48	1.41
3	B	3325	RUT	C9-C8	2.43	1.45	1.40
3	B	3325	RUT	O12-C21	2.43	1.48	1.43
2	B	3324	NDP	PN-O3	-2.43	1.56	1.59
2	B	3324	NDP	PA-O1A	-2.43	1.42	1.50
3	A	2325	RUT	O16-C26	2.36	1.50	1.44
2	A	2324	NDP	C4A-N3A	2.34	1.38	1.34
2	B	3324	NDP	O4D-C1D	2.32	1.47	1.42
3	A	2325	RUT	C9-C8	2.22	1.44	1.40
2	B	3324	NDP	C4N-C5N	-2.21	1.43	1.49
2	A	2324	NDP	C1D-N1N	2.16	1.52	1.46
2	B	3324	NDP	C4A-N3A	2.13	1.38	1.34
2	B	3324	NDP	C1D-N1N	2.11	1.52	1.46
2	A	2324	NDP	C7N-C3N	2.02	1.53	1.48
3	B	3325	RUT	O16-C26	2.02	1.49	1.44
3	A	2325	RUT	O3-C3	2.02	1.27	1.23
2	B	3324	NDP	C3D-C4D	2.01	1.58	1.53

All (67) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	2325	RUT	C14-C15-C10	-7.33	112.97	120.80
3	B	3325	RUT	C14-C15-C10	-7.26	113.05	120.80
3	A	2325	RUT	C8-C7-C6	-6.26	109.12	118.98
3	B	3325	RUT	C8-C7-C6	-6.26	109.13	118.98
3	B	3325	RUT	C7-C6-C5	5.43	127.92	120.47
3	A	2325	RUT	C7-C6-C5	5.32	127.77	120.47
3	A	2325	RUT	C7-C8-C9	4.33	129.32	121.79
3	B	3325	RUT	C7-C8-C9	4.20	129.10	121.79
2	B	3324	NDP	N3A-C2A-N1A	-3.73	122.94	128.58
2	A	2324	NDP	N3A-C2A-N1A	-3.69	122.99	128.58
3	A	2325	RUT	C4-C9-C8	-3.48	114.08	117.41
3	A	2325	RUT	O4-C4-C9	-3.38	114.89	121.14
3	A	2325	RUT	O1-C8-C9	-3.30	117.95	121.19
3	B	3325	RUT	O1-C8-C9	-3.28	117.97	121.19
3	B	3325	RUT	C4-C9-C8	-3.25	114.30	117.41
3	B	3325	RUT	O4-C4-C9	-3.21	115.20	121.14
2	A	2324	NDP	O5B-C5B-C4B	-3.18	98.16	108.99
3	A	2325	RUT	C11-C10-C1	-3.13	116.23	120.65
3	B	3325	RUT	C15-C14-C13	3.07	123.56	120.50
2	A	2324	NDP	O4B-C4B-C5B	-3.06	99.53	109.33
3	A	2325	RUT	C1-C2-C3	-3.05	118.82	122.02
2	B	3324	NDP	O2A-PA-O1A	3.04	126.60	112.44
3	A	2325	RUT	C15-C14-C13	3.04	123.53	120.50
2	A	2324	NDP	C3N-C2N-N1N	-3.02	118.77	123.20
2	B	3324	NDP	O5B-C5B-C4B	-2.98	98.84	108.99
3	B	3325	RUT	C1-C2-C3	-2.96	118.91	122.02
2	A	2324	NDP	O2A-PA-O1A	2.93	126.06	112.44
2	B	3324	NDP	O4B-C4B-C5B	-2.92	99.98	109.33
2	B	3324	NDP	C3N-C2N-N1N	-2.87	118.99	123.20
3	A	2325	RUT	C27-C26-C25	-2.82	107.92	113.08
2	A	2324	NDP	O4D-C4D-C5D	-2.81	100.34	109.33
3	B	3325	RUT	C27-C26-C25	-2.81	107.95	113.08
3	A	2325	RUT	O1-C1-C10	-2.77	106.99	110.87
2	B	3324	NDP	C6N-N1N-C2N	2.68	122.19	119.32
3	B	3325	RUT	C11-C10-C1	-2.67	116.89	120.65
3	A	2325	RUT	O5-C6-C7	-2.65	112.92	119.85
3	A	2325	RUT	C4-C9-C3	2.61	125.31	121.45
3	B	3325	RUT	O5-C6-C7	-2.59	113.08	119.85
3	A	2325	RUT	C24-C25-C26	-2.55	105.94	109.81
3	B	3325	RUT	C4-C9-C3	2.54	125.21	121.45
2	A	2324	NDP	C1B-N9A-C8A	2.50	132.65	127.09
3	A	2325	RUT	C10-C1-C2	2.49	131.75	128.52
2	A	2324	NDP	O7N-C7N-C3N	-2.46	116.26	120.90

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	3325	RUT	C4-C5-C6	-2.42	117.44	119.67
3	B	3325	RUT	C24-C25-C26	-2.39	106.18	109.81
2	B	3324	NDP	O3X-P2B-O2X	2.38	116.74	107.80
3	A	2325	RUT	C4-C5-C6	-2.38	117.47	119.67
3	A	2325	RUT	O2-C2-C3	2.32	120.36	118.24
2	A	2324	NDP	C4A-N9A-C1B	-2.30	121.26	126.63
2	B	3324	NDP	C1B-N9A-C8A	2.29	132.18	127.09
2	A	2324	NDP	O3X-P2B-O2X	2.29	116.38	107.80
3	A	2325	RUT	C8-O1-C1	2.27	124.14	120.67
2	B	3324	NDP	O7N-C7N-C3N	-2.21	116.74	120.90
3	A	2325	RUT	O1-C8-C7	-2.20	112.72	115.83
3	B	3325	RUT	C8-O1-C1	2.18	124.01	120.67
3	B	3325	RUT	O1-C1-C10	-2.17	107.83	110.87
2	B	3324	NDP	C4B-O4B-C1B	2.15	114.21	109.47
2	A	2324	NDP	O2N-PN-O5D	2.09	117.05	107.57
2	A	2324	NDP	C6N-N1N-C2N	2.09	121.55	119.32
2	B	3324	NDP	C2B-C3B-C4B	2.07	106.45	101.99
2	A	2324	NDP	C4B-O4B-C1B	2.06	114.02	109.47
2	B	3324	NDP	C4A-N9A-C1B	-2.06	121.82	126.63
3	B	3325	RUT	O1-C8-C7	-2.05	112.93	115.83
3	A	2325	RUT	C15-C10-C11	2.04	121.61	119.25
2	B	3324	NDP	C3N-C7N-N7N	2.03	121.27	117.67
2	B	3324	NDP	C3B-C2B-C1B	2.02	106.67	102.81
3	B	3325	RUT	C10-C1-C2	2.01	131.12	128.52

There are no chirality outliers.

All (21) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	2324	NDP	C5D-O5D-PN-O3
2	A	2324	NDP	C5D-O5D-PN-O1N
2	B	3324	NDP	C5B-O5B-PA-O1A
2	A	2324	NDP	PA-O3-PN-O5D
2	B	3324	NDP	PA-O3-PN-O5D
2	B	3324	NDP	O4D-C1D-N1N-C2N
2	A	2324	NDP	C2B-C1B-N9A-C8A
2	B	3324	NDP	C2B-C1B-N9A-C8A
2	A	2324	NDP	C5B-O5B-PA-O1A
2	B	3324	NDP	C5D-O5D-PN-O1N
2	A	2324	NDP	O4D-C1D-N1N-C2N
2	A	2324	NDP	C2N-C3N-C7N-N7N
2	B	3324	NDP	C2N-C3N-C7N-N7N

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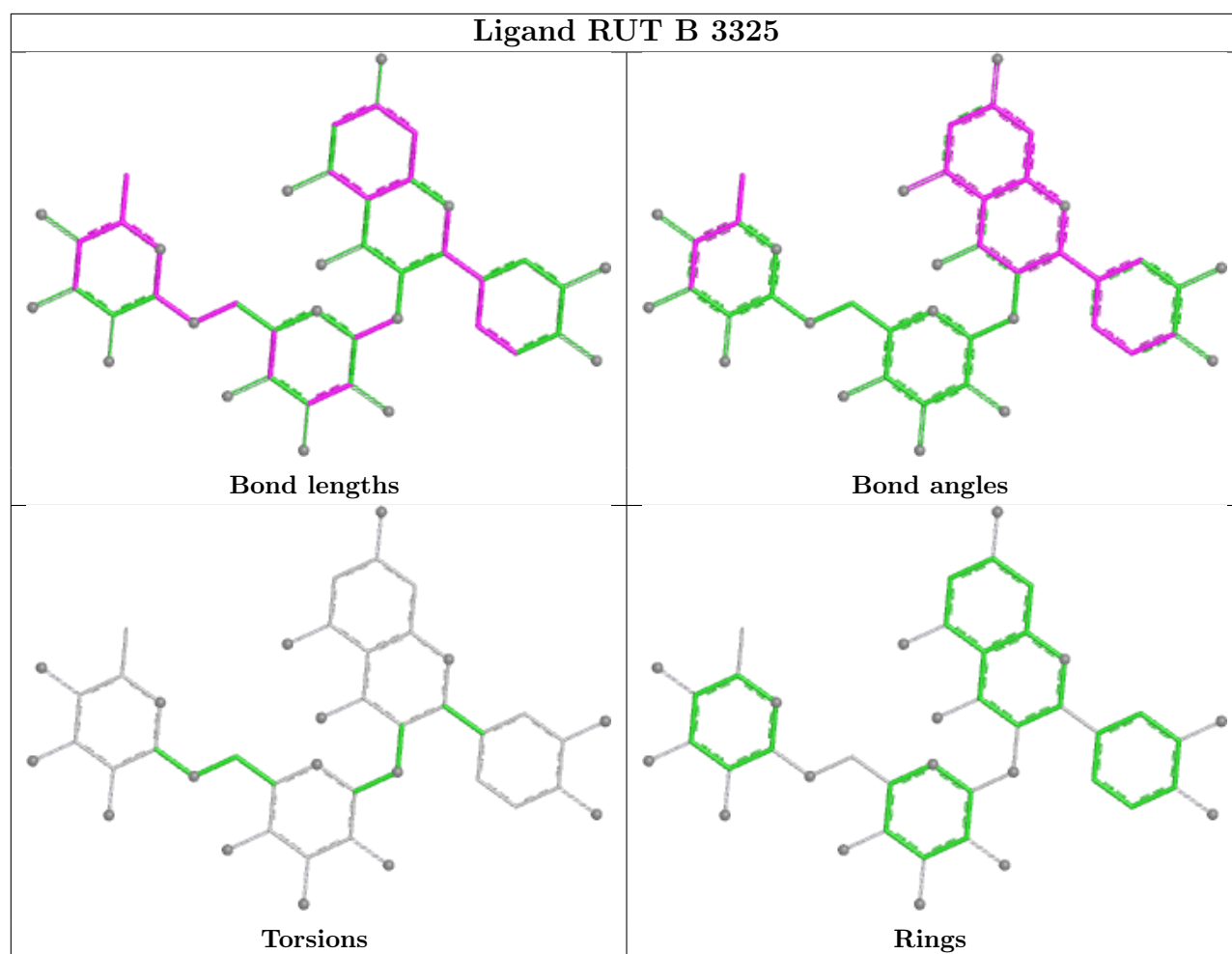
Mol	Chain	Res	Type	Atoms
2	A	2324	NDP	C4D-C5D-O5D-PN
2	B	3324	NDP	C4D-C5D-O5D-PN
2	A	2324	NDP	O4B-C1B-N9A-C8A
2	B	3324	NDP	O4B-C1B-N9A-C8A
2	A	2324	NDP	O4B-C4B-C5B-O5B
2	B	3324	NDP	O4B-C4B-C5B-O5B
2	A	2324	NDP	C2B-O2B-P2B-O3X
2	A	2324	NDP	O4D-C4D-C5D-O5D

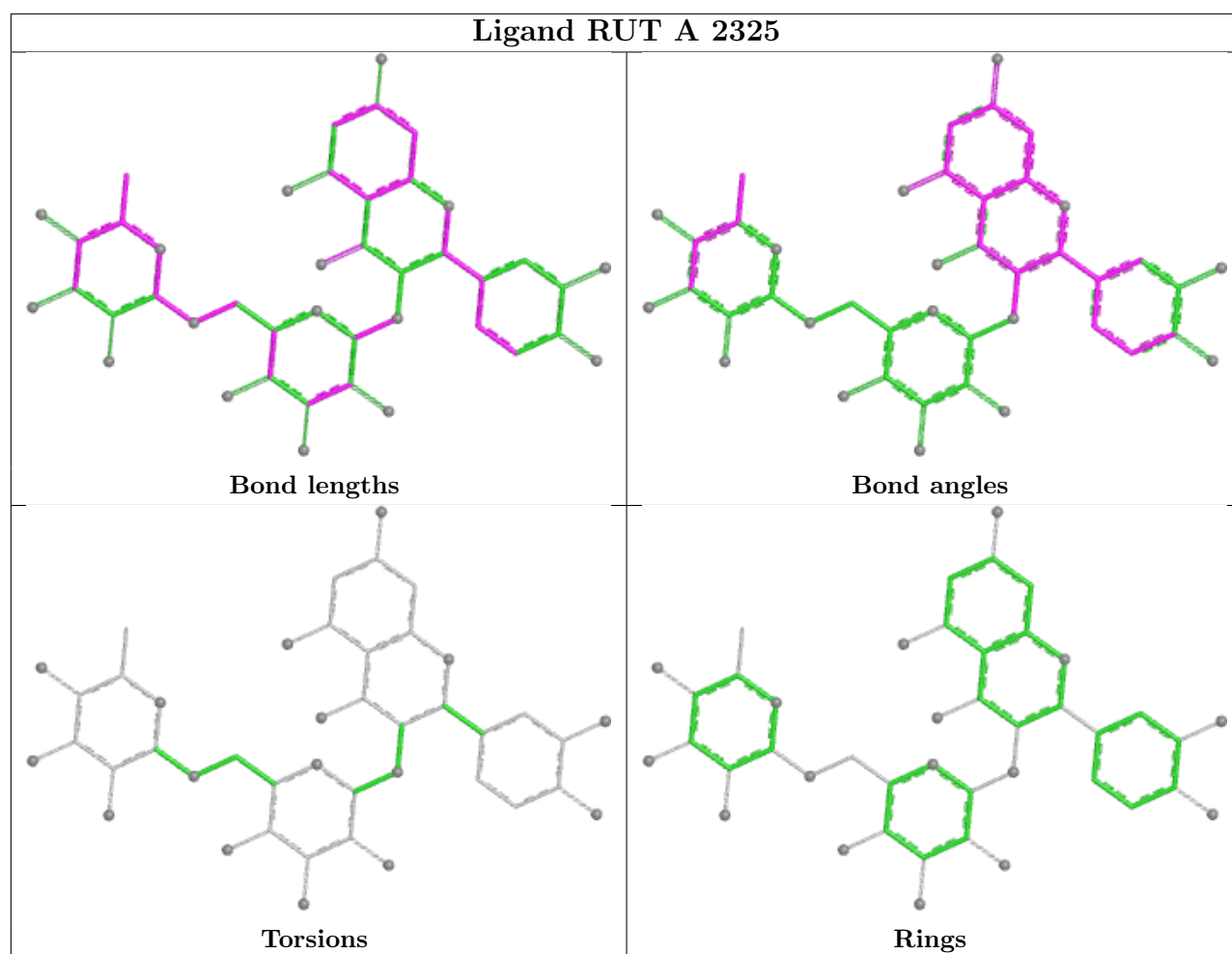
There are no ring outliers.

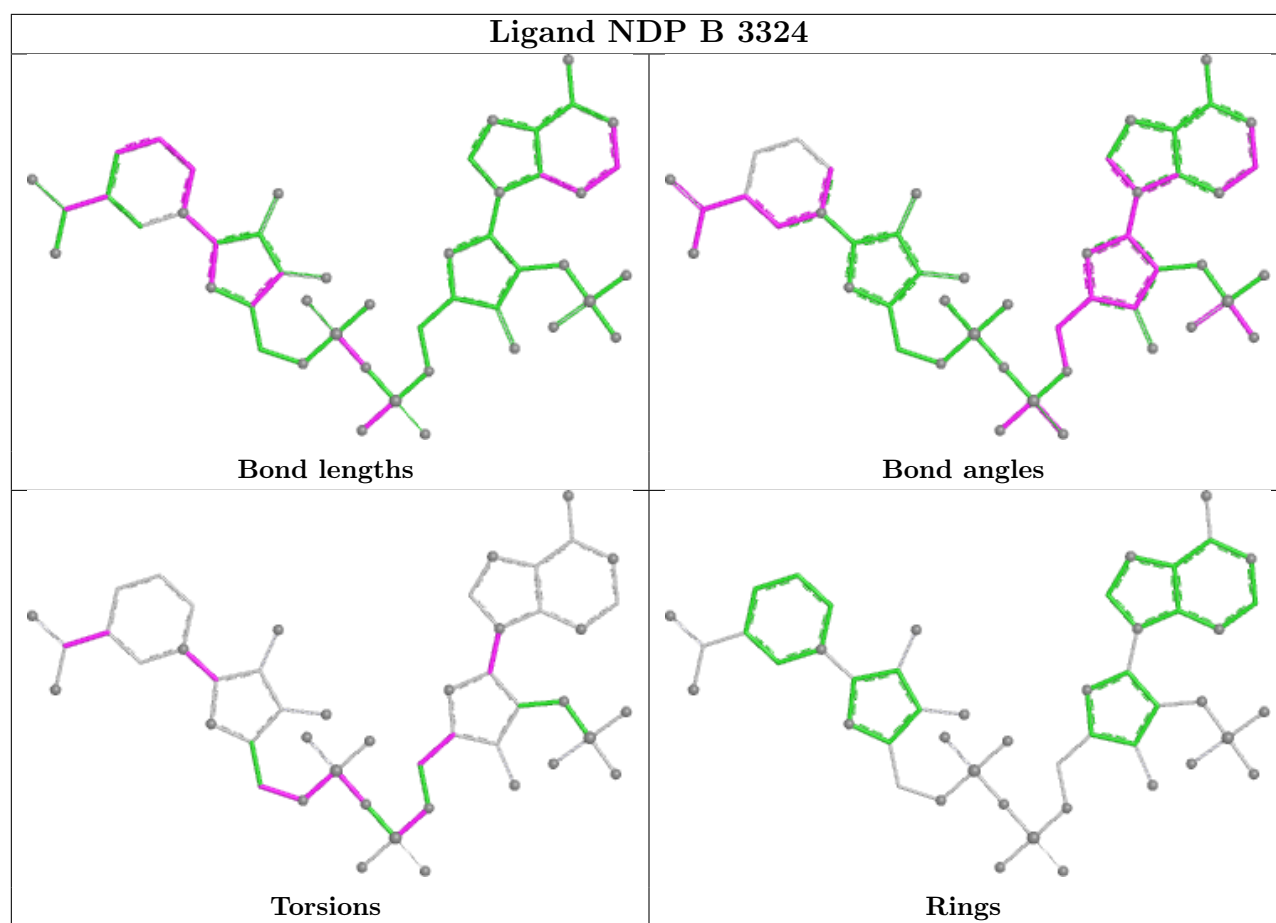
4 monomers are involved in 21 short contacts:

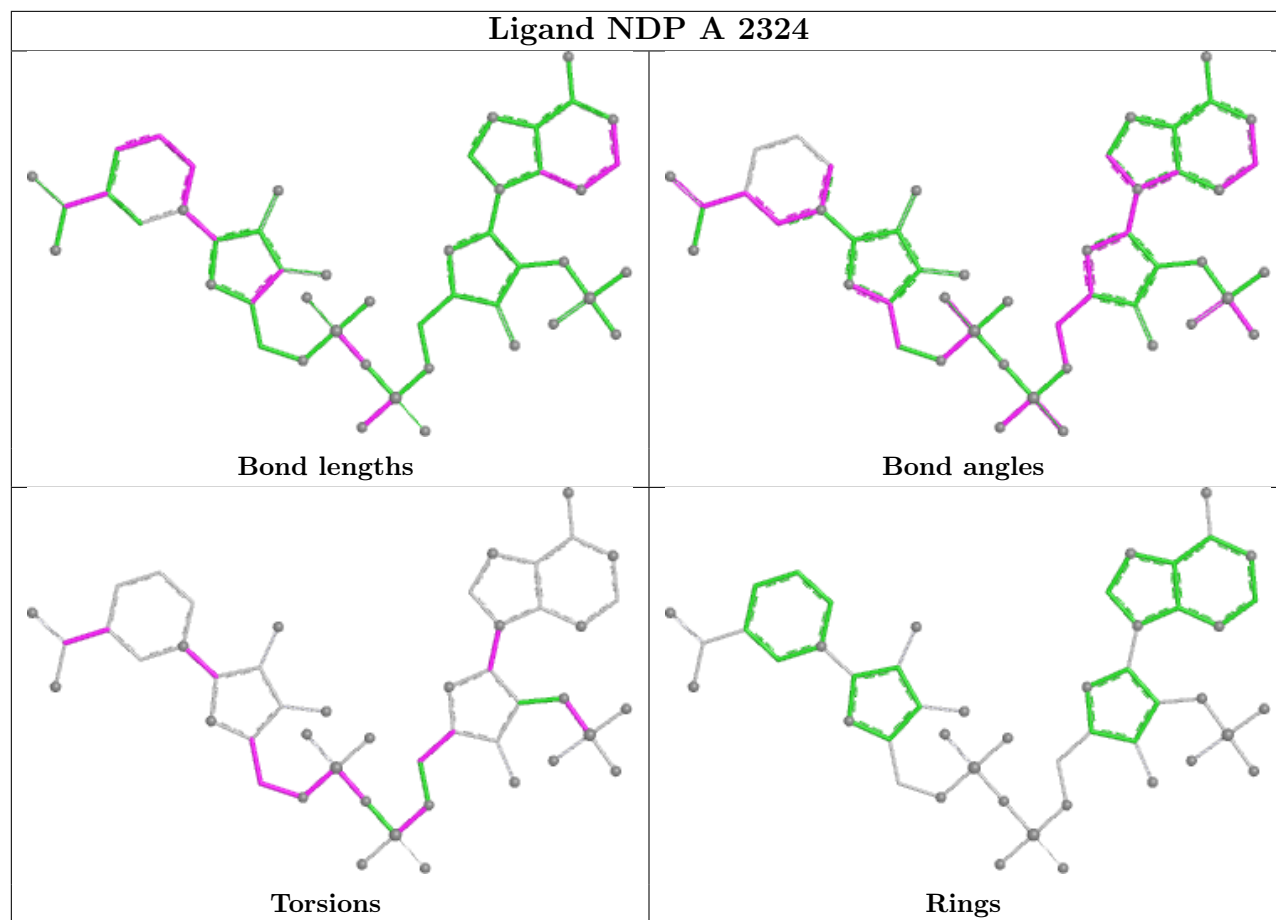
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	3325	RUT	2	0
3	A	2325	RUT	1	0
2	B	3324	NDP	6	0
2	A	2324	NDP	12	0

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 [i](#)

6.1 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	319/323 (98%)	-0.40	1 (0%) 90 91	6, 14, 32, 47	0
1	B	319/323 (98%)	-0.36	3 (0%) 81 83	7, 15, 34, 56	0
All	All	638/646 (98%)	-0.38	4 (0%) 85 88	6, 15, 33, 56	0

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	12	ASP	2.5
1	A	227	TRP	2.2
1	B	5	GLN	2.1
1	B	132	ASP	2.0

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

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

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(Å ²)	Q<0.9
3	RUT	A	2325	43/43	0.87	0.09	12,29,37,40	0

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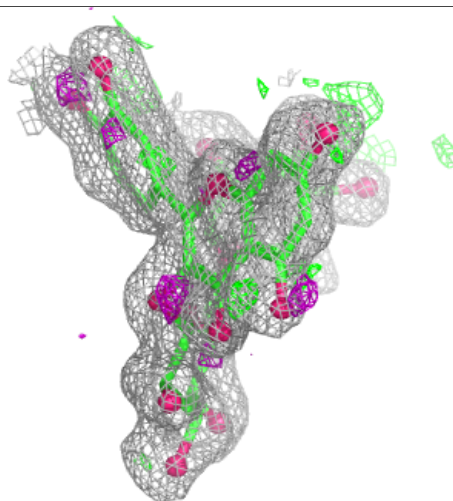
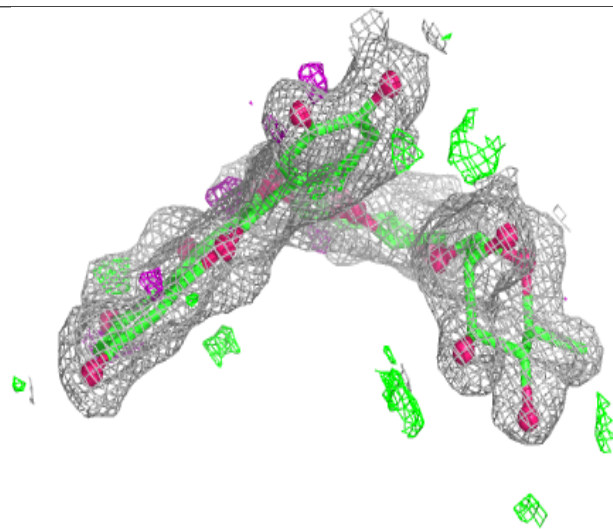
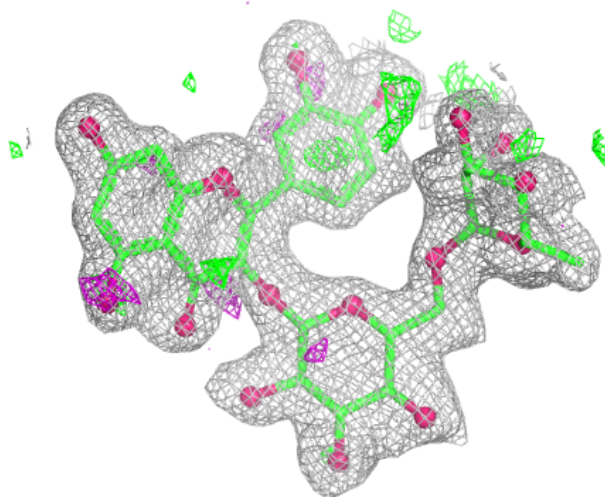
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
3	RUT	B	3325	43/43	0.89	0.08	11,28,33,35	0
2	NDP	A	2324	48/48	0.94	0.08	6,10,14,17	0
2	NDP	B	3324	48/48	0.95	0.06	6,11,16,18	0

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.

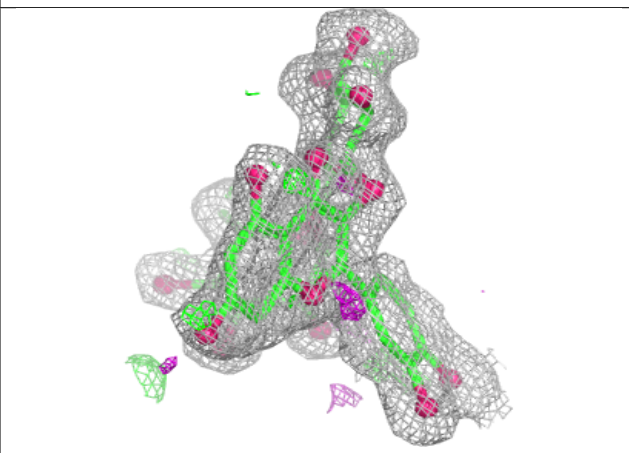
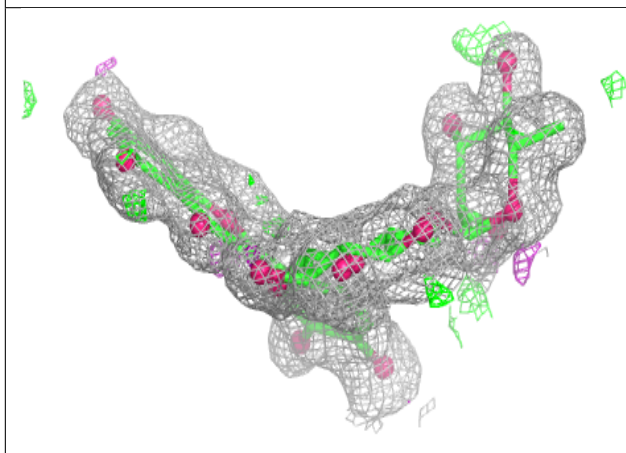
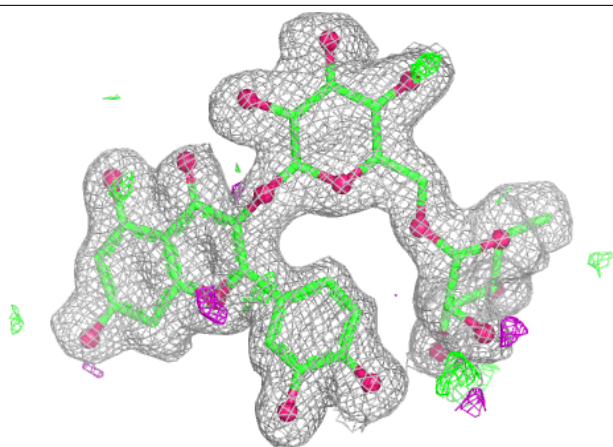
Electron density around RUT A 2325:

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

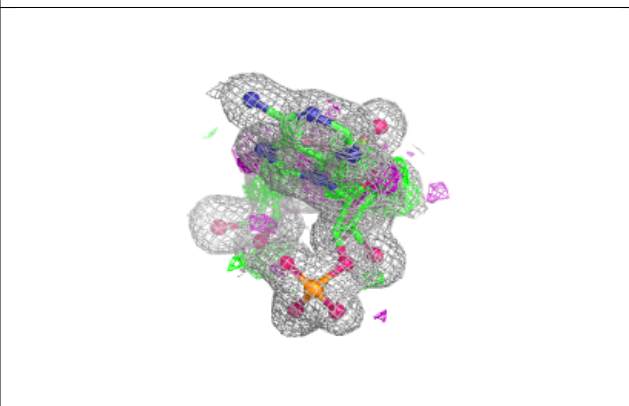
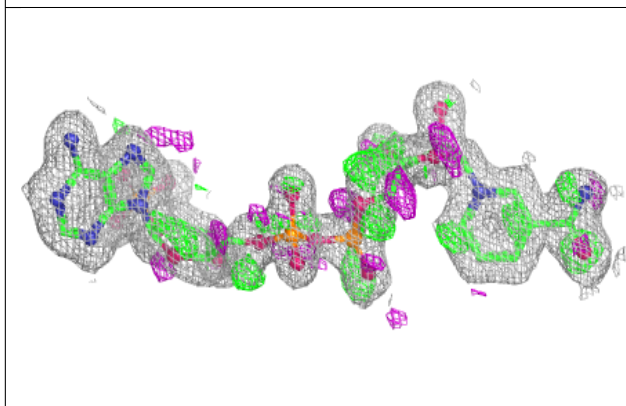
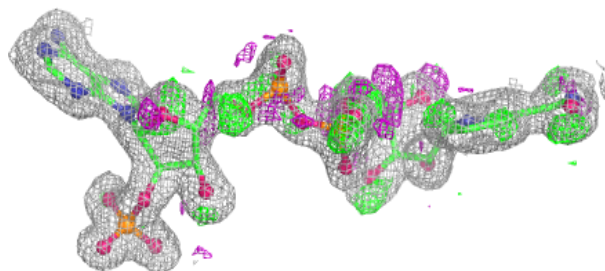


Electron density around RUT B 3325:

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

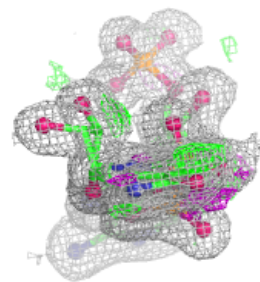
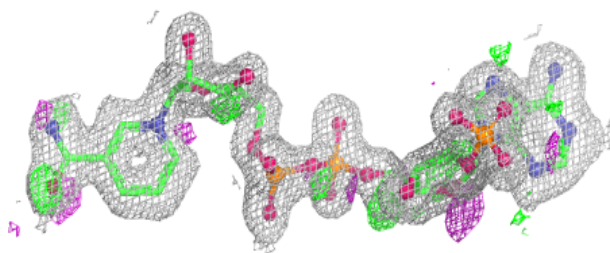
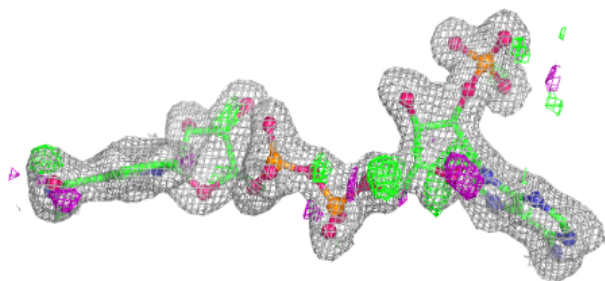
**Electron density around NDP A 2324:**

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



Electron density around NDP B 3324:

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



6.5 Other polymers [i](#)

There are no such residues in this entry.