



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 09:46 AM UTC

PDB ID : 3OIS / pdb_00003ois
Title : Crystal Structure Xylellain, a cysteine protease from Xylella fastidiosa
Authors : Leite, N.R.; Faro, A.R.; Oliva, M.A.V.; Thiemann, O.H.; Oliva, G.
Deposited on : 2010-08-19
Resolution : 1.65 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

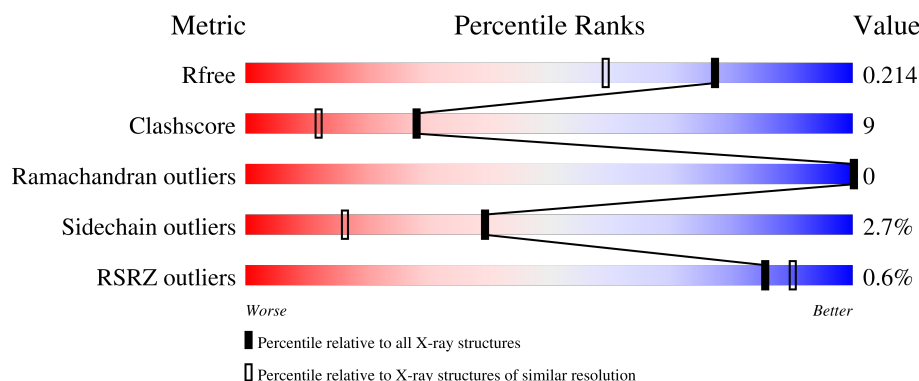
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.65 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	2563 (1.66-1.66)
Clashscore	190562	2662 (1.66-1.66)
Ramachandran outliers	187476	2621 (1.66-1.66)
Sidechain outliers	187428	2621 (1.66-1.66)
RSRZ outliers	180081	2564 (1.66-1.66)

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	291	
1	B	291	
1	C	291	
1	D	291	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 10499 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 Cysteine protease.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	268	Total	C	N	O	S	0	17	0
			2247	1448	378	414	7			
1	B	267	Total	C	N	O	S	0	23	0
			2273	1467	384	415	7			
1	C	267	Total	C	N	O	S	0	17	0
			2220	1431	370	412	7			
1	D	268	Total	C	N	O	S	0	14	0
			2223	1430	377	409	7			

There are 80 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	expression tag	UNP Q9PGZ0
A	2	GLY	-	expression tag	UNP Q9PGZ0
A	3	SER	-	expression tag	UNP Q9PGZ0
A	4	SER	-	expression tag	UNP Q9PGZ0
A	5	HIS	-	expression tag	UNP Q9PGZ0
A	6	HIS	-	expression tag	UNP Q9PGZ0
A	7	HIS	-	expression tag	UNP Q9PGZ0
A	8	HIS	-	expression tag	UNP Q9PGZ0
A	9	HIS	-	expression tag	UNP Q9PGZ0
A	10	HIS	-	expression tag	UNP Q9PGZ0
A	11	SER	-	expression tag	UNP Q9PGZ0
A	12	SER	-	expression tag	UNP Q9PGZ0
A	13	GLY	-	expression tag	UNP Q9PGZ0
A	14	LEU	-	expression tag	UNP Q9PGZ0
A	15	VAL	-	expression tag	UNP Q9PGZ0
A	16	PRO	-	expression tag	UNP Q9PGZ0
A	17	ARG	-	expression tag	UNP Q9PGZ0
A	18	GLY	-	expression tag	UNP Q9PGZ0
A	19	SER	-	expression tag	UNP Q9PGZ0
A	20	HIS	-	expression tag	UNP Q9PGZ0
B	1	MET	-	expression tag	UNP Q9PGZ0

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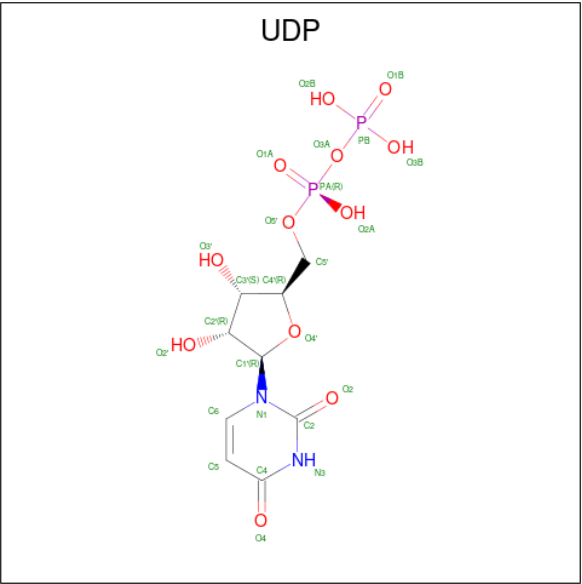
Chain	Residue	Modelled	Actual	Comment	Reference
B	2	GLY	-	expression tag	UNP Q9PGZ0
B	3	SER	-	expression tag	UNP Q9PGZ0
B	4	SER	-	expression tag	UNP Q9PGZ0
B	5	HIS	-	expression tag	UNP Q9PGZ0
B	6	HIS	-	expression tag	UNP Q9PGZ0
B	7	HIS	-	expression tag	UNP Q9PGZ0
B	8	HIS	-	expression tag	UNP Q9PGZ0
B	9	HIS	-	expression tag	UNP Q9PGZ0
B	10	HIS	-	expression tag	UNP Q9PGZ0
B	11	SER	-	expression tag	UNP Q9PGZ0
B	12	SER	-	expression tag	UNP Q9PGZ0
B	13	GLY	-	expression tag	UNP Q9PGZ0
B	14	LEU	-	expression tag	UNP Q9PGZ0
B	15	VAL	-	expression tag	UNP Q9PGZ0
B	16	PRO	-	expression tag	UNP Q9PGZ0
B	17	ARG	-	expression tag	UNP Q9PGZ0
B	18	GLY	-	expression tag	UNP Q9PGZ0
B	19	SER	-	expression tag	UNP Q9PGZ0
B	20	HIS	-	expression tag	UNP Q9PGZ0
C	1	MET	-	expression tag	UNP Q9PGZ0
C	2	GLY	-	expression tag	UNP Q9PGZ0
C	3	SER	-	expression tag	UNP Q9PGZ0
C	4	SER	-	expression tag	UNP Q9PGZ0
C	5	HIS	-	expression tag	UNP Q9PGZ0
C	6	HIS	-	expression tag	UNP Q9PGZ0
C	7	HIS	-	expression tag	UNP Q9PGZ0
C	8	HIS	-	expression tag	UNP Q9PGZ0
C	9	HIS	-	expression tag	UNP Q9PGZ0
C	10	HIS	-	expression tag	UNP Q9PGZ0
C	11	SER	-	expression tag	UNP Q9PGZ0
C	12	SER	-	expression tag	UNP Q9PGZ0
C	13	GLY	-	expression tag	UNP Q9PGZ0
C	14	LEU	-	expression tag	UNP Q9PGZ0
C	15	VAL	-	expression tag	UNP Q9PGZ0
C	16	PRO	-	expression tag	UNP Q9PGZ0
C	17	ARG	-	expression tag	UNP Q9PGZ0
C	18	GLY	-	expression tag	UNP Q9PGZ0
C	19	SER	-	expression tag	UNP Q9PGZ0
C	20	HIS	-	expression tag	UNP Q9PGZ0
D	1	MET	-	expression tag	UNP Q9PGZ0
D	2	GLY	-	expression tag	UNP Q9PGZ0
D	3	SER	-	expression tag	UNP Q9PGZ0

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Chain	Residue	Modelled	Actual	Comment	Reference
D	4	SER	-	expression tag	UNP Q9PGZ0
D	5	HIS	-	expression tag	UNP Q9PGZ0
D	6	HIS	-	expression tag	UNP Q9PGZ0
D	7	HIS	-	expression tag	UNP Q9PGZ0
D	8	HIS	-	expression tag	UNP Q9PGZ0
D	9	HIS	-	expression tag	UNP Q9PGZ0
D	10	HIS	-	expression tag	UNP Q9PGZ0
D	11	SER	-	expression tag	UNP Q9PGZ0
D	12	SER	-	expression tag	UNP Q9PGZ0
D	13	GLY	-	expression tag	UNP Q9PGZ0
D	14	LEU	-	expression tag	UNP Q9PGZ0
D	15	VAL	-	expression tag	UNP Q9PGZ0
D	16	PRO	-	expression tag	UNP Q9PGZ0
D	17	ARG	-	expression tag	UNP Q9PGZ0
D	18	GLY	-	expression tag	UNP Q9PGZ0
D	19	SER	-	expression tag	UNP Q9PGZ0
D	20	HIS	-	expression tag	UNP Q9PGZ0

- Molecule 2 is URIDINE-5'-DIPHOSPHATE (CCD ID: UDP) (formula: $C_9H_{14}N_2O_{12}P_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			25	9	2	12	2		
2	B	1	Total	C	N	O	P	0	0
			25	9	2	12	2		
2	C	1	Total	C	N	O	P	0	0
			25	9	2	12	2		

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	D	1	Total	C	N	O	P	0	0
			25	9	2	12	2		

- Molecule 3 is water.

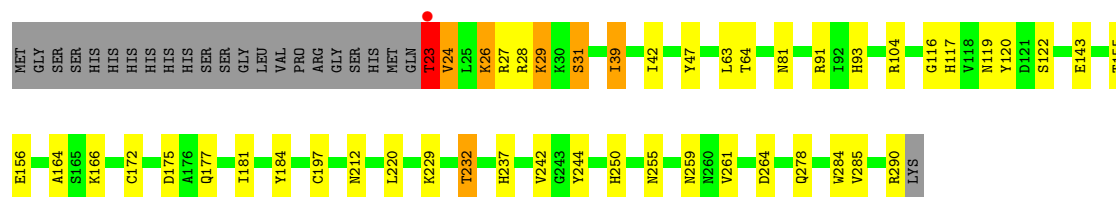
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	398	Total	O	0	0
			398	398		
3	B	380	Total	O	0	1
			381	381		
3	C	336	Total	O	0	0
			336	336		
3	D	321	Total	O	0	0
			321	321		

3 Residue-property plots

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

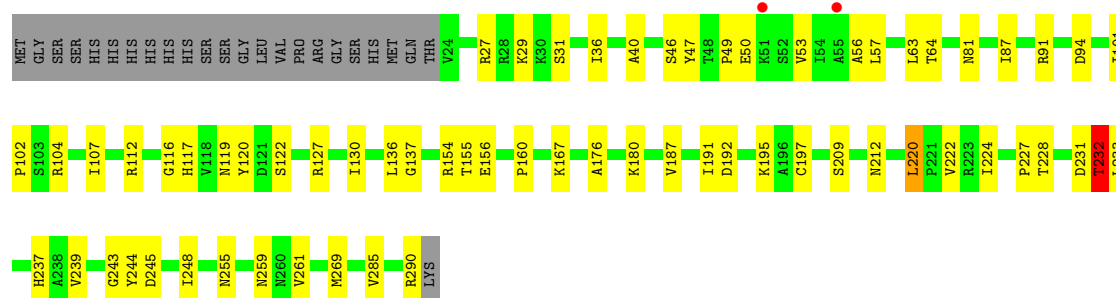
• Molecule 1: Cysteine protease

Chain A: 



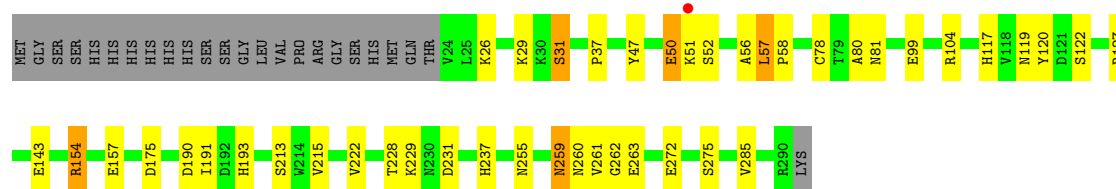
• Molecule 1: Cysteine protease

Chain B: 



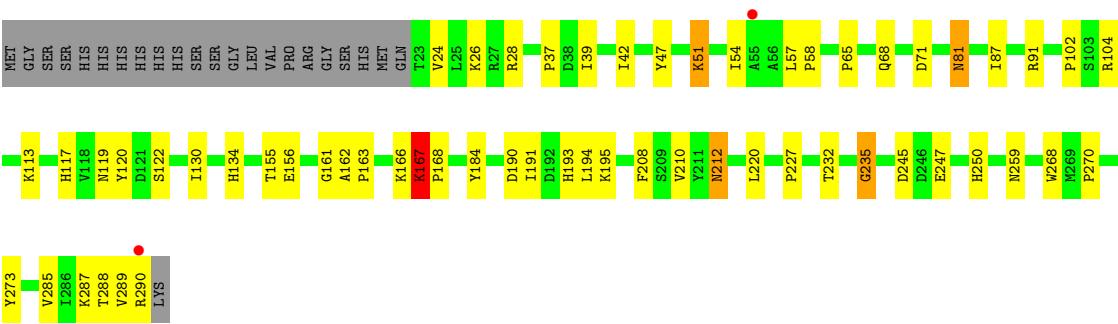
• Molecule 1: Cysteine protease

Chain C: 



• Molecule 1: Cysteine protease

Chain D: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	55.09Å 69.31Å 82.37Å 75.86° 75.43° 66.51°	Depositor
Resolution (Å)	23.06 – 1.65 23.06 – 1.65	Depositor EDS
% Data completeness (in resolution range)	91.0 (23.06-1.65) 91.0 (23.06-1.65)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	0.05	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.96 (at 1.65Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.166 , 0.216 0.164 , 0.214	Depositor DCC
R_{free} test set	5859 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å ²)	20.6	Xtriage
Anisotropy	0.030	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 46.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	10499	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.94% 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 [i](#)

5.1 Standard geometry [i](#)

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

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	1.41	10/2364 (0.4%)	1.15	2/3213 (0.1%)
1	B	1.40	7/2406 (0.3%)	1.28	14/3266 (0.4%)
1	C	1.36	3/2338 (0.1%)	1.24	4/3181 (0.1%)
1	D	1.43	7/2331 (0.3%)	1.24	12/3172 (0.4%)
All	All	1.40	27/9439 (0.3%)	1.23	32/12832 (0.2%)

All (27) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	220	LEU	C-O	13.01	1.30	1.23
1	B	36	ILE	N-CA	7.87	1.53	1.46
1	C	78	CYS	N-CA	7.17	1.55	1.46
1	B	176	ALA	CA-CB	7.09	1.64	1.53
1	A	220	LEU	N-CA	6.82	1.51	1.46
1	B	36	ILE	CA-CB	-6.58	1.49	1.54
1	B	239	VAL	N-CA	6.36	1.53	1.46
1	B	243	GLY	N-CA	6.36	1.51	1.45
1	D	235	GLY	N-CA	6.31	1.51	1.45
1	A	24	VAL	CA-CB	6.25	1.61	1.54
1	A	181	ILE	CA-CB	5.82	1.62	1.54
1	D	39	ILE	C-O	5.77	1.30	1.24
1	D	71	ASP	CA-C	-5.75	1.46	1.52
1	D	270	PRO	N-CA	5.72	1.54	1.47
1	A	220	LEU	CA-C	5.60	1.57	1.53
1	A	39	ILE	N-CA	5.58	1.52	1.46
1	A	242	VAL	CA-CB	5.47	1.61	1.54
1	A	261	VAL	CA-CB	5.46	1.63	1.54
1	A	164	ALA	CA-CB	5.34	1.62	1.53
1	A	31	SER	N-CA	5.22	1.52	1.46
1	B	107	ILE	CA-CB	-5.21	1.48	1.54
1	D	102	PRO	C-O	5.17	1.29	1.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	137	GLY	N-CA	5.17	1.52	1.45
1	A	250	HIS	N-CA	5.13	1.52	1.45
1	C	80	ALA	CA-CB	5.07	1.61	1.53
1	D	288	THR	CA-CB	5.01	1.61	1.53
1	C	261	VAL	N-CA	-5.01	1.40	1.46

All (32) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	57	LEU	CA-C-N	11.28	127.89	119.66
1	C	57	LEU	C-N-CA	11.28	127.89	119.66
1	D	87	ILE	N-CA-C	-6.94	104.00	110.53
1	C	260	ASN	N-CA-C	6.93	121.34	113.02
1	B	220[A]	LEU	CA-C-N	6.79	126.83	119.90
1	B	220[A]	LEU	C-N-CA	6.79	126.83	119.90
1	B	220[B]	LEU	CA-C-N	6.79	126.83	119.90
1	B	220[B]	LEU	C-N-CA	6.79	126.83	119.90
1	D	65	PRO	CA-C-N	-6.72	112.86	119.64
1	D	65	PRO	C-N-CA	-6.72	112.86	119.64
1	B	101	ILE	N-CA-C	-6.42	103.11	108.63
1	B	192	ASP	N-CA-C	6.03	117.85	111.28
1	D	81	ASN	N-CA-C	6.01	117.83	111.28
1	C	127	ARG	NE-CZ-NH2	-5.95	113.84	119.20
1	D	167	LYS	CA-C-N	5.87	125.88	119.90
1	D	167	LYS	C-N-CA	5.87	125.88	119.90
1	B	269	MET	CA-C-N	-5.59	114.03	119.78
1	B	269	MET	C-N-CA	-5.59	114.03	119.78
1	D	58	PRO	CA-C-N	-5.56	114.04	120.04
1	D	58	PRO	C-N-CA	-5.56	114.04	120.04
1	D	102	PRO	CA-C-O	-5.54	114.91	121.67
1	B	224	ILE	CA-C-N	-5.43	114.99	120.31
1	B	224	ILE	C-N-CA	-5.43	114.99	120.31
1	B	112	ARG	NE-CZ-NH1	-5.27	116.23	121.50
1	B	130	ILE	N-CA-C	-5.25	105.41	110.72
1	B	180	LYS	N-CA-C	5.23	117.81	110.23
1	A	23	THR	CA-C-N	-5.15	116.80	123.19
1	A	23	THR	C-N-CA	-5.15	116.80	123.19
1	D	162	ALA	CA-C-N	5.12	124.73	119.05
1	D	162	ALA	C-N-CA	5.12	124.73	119.05
1	B	232	THR	CA-CB-OG1	5.06	117.19	109.60
1	D	134	HIS	N-CA-C	5.01	116.56	111.14

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	2247	0	2217	39	0
1	B	2273	0	2270	50	0
1	C	2220	0	2181	42	1
1	D	2223	0	2185	42	0
2	A	25	0	11	0	0
2	B	25	0	11	0	0
2	C	25	0	11	0	0
2	D	25	0	11	0	0
3	A	398	0	0	9	2
3	B	381	0	0	19	2
3	C	336	0	0	6	1
3	D	321	0	0	11	2
All	All	10499	0	8897	158	4

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 9.

All (158) 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:102:PRO:HG3	3:B:1417:HOH:O	1.24	1.27
1:D:190:ASP:O	3:D:1433:HOH:O	1.63	1.15
1:B:94:ASP:OD2	1:B:290[B]:ARG:NH1	2.01	0.92
3:C:541:HOH:O	1:D:28[B]:ARG:HD2	1.70	0.91
1:B:56:ALA:HB3	3:B:1374:HOH:O	1.70	0.90
1:C:117:HIS:HD2	1:C:119:ASN:H	1.17	0.89
1:A:23:THR:HG21	1:B:136:LEU:HD23	1.56	0.88
1:C:228:THR:O	1:C:231[B]:ASP:HB2	1.77	0.85
1:A:91[A]:ARG:NH1	3:A:1104:HOH:O	2.07	0.85
1:B:290[B]:ARG:HG2	3:B:1268:HOH:O	1.76	0.84
1:A:117:HIS:HD2	1:A:119:ASN:H	1.28	0.81

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:117:HIS:HD2	1:B:119:ASN:H	1.26	0.80
1:B:228:THR:O	1:B:231[B]:ASP:HB2	1.81	0.80
1:A:27[A]:ARG:NH2	1:B:116:GLY:O	2.14	0.79
1:A:177[A]:GLN:NE2	3:A:1262:HOH:O	1.89	0.79
1:D:68[B]:GLN:NE2	1:D:259[B]:ASN:ND2	2.30	0.79
1:D:68[B]:GLN:NE2	1:D:259[B]:ASN:HD22	1.80	0.79
1:D:117:HIS:HD2	1:D:119:ASN:H	1.27	0.78
1:A:23:THR:CG2	1:B:136:LEU:HD23	2.15	0.77
1:C:29[A]:LYS:HE2	1:C:31:SER:HB3	1.64	0.77
1:A:27[B]:ARG:HD2	3:A:457:HOH:O	1.84	0.77
1:C:120[B]:TYR:CD1	1:C:157:GLU:HG2	2.19	0.77
1:C:51:LYS:O	3:C:979:HOH:O	2.05	0.74
1:D:287:LYS:HE2	1:D:289:VAL:HG22	1.70	0.73
1:A:278[B]:GLN:HG2	1:B:40:ALA:HB1	1.70	0.72
1:A:156:GLU:HG3	3:A:888:HOH:O	1.91	0.70
1:A:120[B]:TYR:CE2	1:A:122:SER:HB3	2.27	0.69
1:A:23:THR:CG2	1:B:136:LEU:CD2	2.70	0.69
1:A:23:THR:HG23	1:B:136:LEU:CD2	2.22	0.69
1:B:27:ARG:HD3	1:B:156:GLU:OE1	1.92	0.69
3:C:541:HOH:O	1:D:28[B]:ARG:CD	2.34	0.68
1:C:222[B]:VAL:HG12	1:C:262:GLY:HA2	1.75	0.68
1:B:212[B]:ASN:OD1	1:B:231[B]:ASP:OD1	2.13	0.66
1:C:120[B]:TYR:CE1	1:C:157:GLU:HG2	2.30	0.66
1:C:190[A]:ASP:OD1	1:C:193:HIS:HD2	1.79	0.66
1:C:272:GLU:HG2	3:C:603:HOH:O	1.96	0.65
1:B:212[B]:ASN:OD1	3:B:1429:HOH:O	2.15	0.64
1:B:117:HIS:CD2	1:B:119:ASN:H	2.12	0.64
1:A:290:ARG:HG3	3:A:1194:HOH:O	1.97	0.64
1:A:117:HIS:CD2	1:A:119:ASN:H	2.15	0.63
1:A:237:HIS:HE1	1:A:255:ASN:OD1	1.82	0.63
1:C:26:LYS:HE2	1:C:29[B]:LYS:HE3	1.80	0.63
1:C:222[B]:VAL:HG11	1:C:263:GLU:HG3	1.81	0.63
1:A:81:ASN:HD21	1:A:104:ARG:HH11	1.45	0.63
1:C:117:HIS:CD2	1:C:119:ASN:H	2.08	0.63
1:B:50:GLU:O	1:B:53:VAL:HG22	2.00	0.62
1:B:290[A]:ARG:HD3	3:B:1268:HOH:O	2.00	0.61
1:B:57:LEU:HD13	1:B:195[B]:LYS:HE3	1.83	0.60
1:D:212:ASN:ND2	1:D:232[A]:THR:H	2.00	0.59
1:D:120[B]:TYR:CE1	1:D:122:SER:HB3	2.36	0.59
1:D:212:ASN:ND2	1:D:232[B]:THR:H	2.00	0.59
1:C:237:HIS:HE1	1:C:255:ASN:OD1	1.84	0.59

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:29:LYS:HD2	3:A:1248:HOH:O	2.00	0.59
1:C:154:ARG:HH11	1:C:154:ARG:CB	2.16	0.59
1:B:167:LYS:HE3	3:B:783:HOH:O	2.02	0.58
1:C:47:TYR:CD1	1:C:285[A]:VAL:HG11	2.38	0.58
1:C:229:LYS:HE2	1:D:42:ILE:O	2.03	0.58
1:B:87:ILE:HG22	3:B:1417:HOH:O	2.03	0.57
1:C:50[B]:GLU:HG3	1:C:52:SER:H	1.70	0.57
1:C:190[A]:ASP:OD1	1:C:193:HIS:CD2	2.57	0.57
1:C:81:ASN:HD21	1:C:104:ARG:HH11	1.53	0.57
1:D:117:HIS:CD2	1:D:119:ASN:H	2.17	0.57
1:A:155:THR:O	1:B:117:HIS:HE1	1.88	0.56
1:B:237:HIS:HE1	1:B:255:ASN:OD1	1.87	0.56
1:D:194:LEU:N	3:D:1433:HOH:O	1.79	0.56
1:B:81:ASN:HD21	1:B:104:ARG:HH11	1.53	0.56
1:A:29:LYS:HE2	1:A:31:SER:O	2.06	0.55
1:B:91[B]:ARG:NH2	3:B:427:HOH:O	2.14	0.55
1:A:28:ARG:HD2	3:B:378:HOH:O	2.06	0.55
1:C:154:ARG:HH11	1:C:154:ARG:HB3	1.72	0.55
1:C:120[B]:TYR:CE1	1:C:157:GLU:CD	2.85	0.54
1:A:23:THR:HG23	1:B:136:LEU:HD21	1.89	0.54
1:D:81:ASN:HD21	1:D:104:ARG:HH11	1.55	0.54
1:C:191:ILE:HG12	1:C:275[B]:SER:OG	2.08	0.54
1:D:191:ILE:CG2	1:D:195:LYS:HE3	2.38	0.53
1:A:197:CYS:SG	1:A:285[B]:VAL:HG11	2.48	0.53
1:D:191:ILE:C	3:D:1433:HOH:O	2.51	0.53
1:B:49:PRO:O	3:B:931:HOH:O	2.19	0.52
1:B:232:THR:HG23	3:B:453:HOH:O	2.10	0.51
1:C:117:HIS:HE1	1:D:155:THR:O	1.93	0.51
1:B:232:THR:CG2	3:B:453:HOH:O	2.59	0.51
1:D:51:LYS:HE2	3:D:1064:HOH:O	2.10	0.51
1:B:47:TYR:CD1	1:B:285[B]:VAL:HG21	2.46	0.50
1:B:102:PRO:CG	3:B:1417:HOH:O	2.08	0.50
1:A:47:TYR:CD1	1:A:285[B]:VAL:HG21	2.47	0.49
1:A:27[B]:ARG:HD3	1:A:28:ARG:O	2.12	0.49
1:B:191:ILE:HD11	3:B:796:HOH:O	2.13	0.49
1:D:210[B]:VAL:HG22	1:D:235:GLY:O	2.12	0.49
1:D:47:TYR:CD1	1:D:285[B]:VAL:HG11	2.48	0.49
1:B:191:ILE:CG2	1:B:195[A]:LYS:HE3	2.43	0.48
1:D:117:HIS:HB3	1:D:120[B]:TYR:CD2	2.49	0.48
1:B:195[B]:LYS:HD2	1:B:244:TYR:CE2	2.48	0.48
1:B:290[B]:ARG:CG	3:B:1268:HOH:O	2.47	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:117:HIS:HB3	1:C:120[B]:TYR:HD2	1.79	0.47
1:D:191:ILE:O	1:D:195:LYS:HG3	2.13	0.47
1:C:259:ASN:HD22	1:C:259:ASN:C	2.21	0.47
1:D:190:ASP:OD1	1:D:193[B]:HIS:ND1	2.48	0.47
1:D:208:PHE:CE2	1:D:210[B]:VAL:HG12	2.50	0.47
1:C:56:ALA:O	1:C:58:PRO:HD3	2.15	0.46
1:C:120[B]:TYR:CE1	1:C:157:GLU:CG	2.98	0.46
1:C:120[A]:TYR:CE2	1:C:122:SER:HB3	2.50	0.46
1:A:117:HIS:HE1	1:B:155:THR:O	1.98	0.46
1:B:220[A]:LEU:HD23	1:B:261:VAL:CG1	2.46	0.46
1:D:245:ASP:OD2	1:D:247:GLU:HB3	2.16	0.46
1:A:244:TYR:N	3:A:1419:HOH:O	2.48	0.46
1:C:213:SER:OG	1:C:231[A]:ASP:OD2	2.33	0.46
1:B:209:SER:HB3	1:B:233:LEU:CD1	2.46	0.46
1:C:213:SER:HB3	1:C:231[A]:ASP:OD2	2.16	0.45
1:A:39:ILE:HG13	3:B:1424:HOH:O	2.16	0.45
1:A:184:TYR:HD2	1:A:284:TRP:CZ3	2.34	0.45
1:C:57:LEU:HA	1:C:58:PRO:HD2	1.72	0.45
1:D:91[B]:ARG:HD3	3:D:1033:HOH:O	2.15	0.45
1:C:26:LYS:HD3	3:D:1323:HOH:O	2.15	0.45
1:A:212:ASN:HB3	1:A:232[A]:THR:HG23	1.97	0.45
3:C:822:HOH:O	1:D:113:LYS:NZ	2.50	0.45
1:A:63:LEU:O	1:A:64:THR:C	2.60	0.44
1:A:229:LYS:NZ	3:A:1425:HOH:O	2.50	0.44
1:B:231[A]:ASP:HA	3:B:1429:HOH:O	2.17	0.44
1:D:161:GLY:O	1:D:166:LYS:HE3	2.18	0.44
1:A:26:LYS:HD3	3:A:1366:HOH:O	2.18	0.43
1:C:99:GLU:HG3	3:C:817:HOH:O	2.18	0.43
1:C:117:HIS:HB3	1:C:120[B]:TYR:CD2	2.53	0.43
1:D:212:ASN:N	1:D:212:ASN:HD22	2.16	0.43
1:C:120[B]:TYR:CE2	1:D:120[B]:TYR:CD2	3.07	0.43
1:A:143[A]:GLU:HG2	1:A:172:CYS:SG	2.58	0.43
1:A:166:LYS:HE3	1:A:166:LYS:HB3	1.72	0.43
1:D:156:GLU:HG3	3:D:1310:HOH:O	2.18	0.43
1:B:197:CYS:SG	1:B:285[B]:VAL:HG11	2.58	0.42
1:B:231[B]:ASP:HA	3:B:1429:HOH:O	2.18	0.42
1:C:213:SER:CB	1:C:231[A]:ASP:OD2	2.67	0.42
1:A:143[A]:GLU:OE2	1:A:175:ASP:OD2	2.38	0.42
1:B:245[A]:ASP:OD2	1:B:248:ILE:HG12	2.18	0.42
1:C:213:SER:HB3	1:C:231[A]:ASP:CG	2.44	0.42
1:B:119:ASN:HB2	1:B:120[B]:TYR:CE2	2.54	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:222[B]:VAL:HG12	1:C:262:GLY:CA	2.46	0.42
1:B:127[B]:ARG:HD3	3:B:858:HOH:O	2.20	0.42
1:B:29:LYS:HE2	1:B:31:SER:O	2.20	0.42
1:C:37:PRO:HB2	1:D:37:PRO:HB2	2.02	0.42
1:B:120[A]:TYR:CE1	1:B:122:SER:HB3	2.55	0.42
1:A:116:GLY:O	1:B:27:ARG:NH2	2.47	0.42
1:D:68[A]:GLN:NE2	3:D:651:HOH:O	2.53	0.42
1:C:50[B]:GLU:HG3	1:C:52:SER:N	2.32	0.41
1:D:57:LEU:HD22	1:D:195:LYS:HB3	2.02	0.41
1:D:130:ILE:HG21	1:D:184:TYR:CG	2.55	0.41
1:B:50:GLU:O	1:B:53:VAL:CG2	2.67	0.41
1:D:68[A]:GLN:HG3	3:D:651:HOH:O	2.20	0.41
1:D:167:LYS:HA	1:D:168:PRO:HD3	1.81	0.41
1:A:42:ILE:HD13	1:B:227:PRO:HB2	2.03	0.41
1:D:227:PRO:HD3	1:D:273:TYR:CE1	2.55	0.41
1:A:120[B]:TYR:CE2	1:A:122:SER:CB	3.02	0.41
1:D:54:ILE:CG2	3:D:1306:HOH:O	2.68	0.41
1:D:245:ASP:OD2	1:D:247:GLU:CB	2.69	0.41
1:C:143:GLU:OE2	1:C:175:ASP:OD2	2.38	0.40
1:D:247:GLU:HG2	3:D:853:HOH:O	2.21	0.40
1:D:250:HIS:CD2	1:D:268:TRP:HB3	2.56	0.40
1:B:63:LEU:O	1:B:64:THR:C	2.65	0.40

All (4) 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)
3:B:1277:HOH:O	3:C:1349:HOH:O[1_655]	2.04	0.16
1:C:215:VAL:O	3:B:444:HOH:O[1_455]	2.08	0.12
3:A:339:HOH:O	3:D:591:HOH:O[1_654]	2.09	0.11
3:A:1039:HOH:O	3:D:1178:HOH:O[1_654]	2.15	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	283/291 (97%)	278 (98%)	5 (2%)	0	100	100
1	B	287/291 (99%)	282 (98%)	5 (2%)	0	100	100
1	C	282/291 (97%)	275 (98%)	7 (2%)	0	100	100
1	D	280/291 (96%)	274 (98%)	6 (2%)	0	100	100
All	All	1132/1164 (97%)	1109 (98%)	23 (2%)	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	248/251 (99%)	239 (96%)	9 (4%)	31	9
1	B	253/251 (101%)	245 (97%)	8 (3%)	34	12
1	C	247/251 (98%)	242 (98%)	5 (2%)	48	26
1	D	245/251 (98%)	238 (97%)	7 (3%)	37	14
All	All	993/1004 (99%)	964 (97%)	29 (3%)	39	14

All (29) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	23	THR
1	A	24	VAL
1	A	26	LYS
1	A	29	LYS
1	A	232[A]	THR
1	A	232[B]	THR
1	A	259	ASN
1	A	264[A]	ASP
1	A	264[B]	ASP
1	B	46	SER

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Mol	Chain	Res	Type
1	B	154	ARG
1	B	160	PRO
1	B	187	VAL
1	B	222[A]	VAL
1	B	222[B]	VAL
1	B	232	THR
1	B	259	ASN
1	C	31	SER
1	C	50[A]	GLU
1	C	50[B]	GLU
1	C	154	ARG
1	C	259	ASN
1	D	24	VAL
1	D	26	LYS
1	D	51	LYS
1	D	163	PRO
1	D	167	LYS
1	D	212	ASN
1	D	290	ARG

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

Mol	Chain	Res	Type
1	A	72	GLN
1	A	81	ASN
1	A	117	HIS
1	A	237	HIS
1	A	259	ASN
1	B	68	GLN
1	B	72	GLN
1	B	81	ASN
1	B	96	GLN
1	B	117	HIS
1	B	237	HIS
1	B	259	ASN
1	C	68	GLN
1	C	72	GLN
1	C	81	ASN
1	C	110	ASN
1	C	117	HIS
1	C	237	HIS
1	C	259	ASN

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Mol	Chain	Res	Type
1	D	72	GLN
1	D	81	ASN
1	D	96	GLN
1	D	110	ASN
1	D	117	HIS
1	D	212	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

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	$\# Z > 2$
2	UDP	A	292	-	25,26,26	1.45	4 (16%)	38,40,40	1.55	5 (13%)
2	UDP	B	292	-	25,26,26	1.45	4 (16%)	38,40,40	1.60	5 (13%)
2	UDP	D	292	-	25,26,26	1.64	4 (16%)	38,40,40	1.89	10 (26%)
2	UDP	C	292	-	25,26,26	1.28	4 (16%)	38,40,40	1.45	7 (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
2	UDP	A	292	-	-	2/16/32/32	0/2/2/2
2	UDP	B	292	-	-	2/16/32/32	0/2/2/2
2	UDP	D	292	-	-	2/16/32/32	0/2/2/2
2	UDP	C	292	-	-	0/16/32/32	0/2/2/2

All (16) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	292	UDP	PA-O3A	-5.20	1.53	1.59
2	A	292	UDP	PA-O3A	3.58	1.63	1.59
2	C	292	UDP	C6-C5	3.29	1.42	1.35
2	B	292	UDP	C6-C5	3.07	1.42	1.35
2	B	292	UDP	C2-N3	3.05	1.43	1.38
2	A	292	UDP	PB-O2B	-2.79	1.44	1.54
2	B	292	UDP	PB-O2B	-2.65	1.45	1.54
2	D	292	UDP	O2-C2	2.55	1.27	1.23
2	C	292	UDP	O4-C4	2.49	1.29	1.24
2	A	292	UDP	C6-C5	2.40	1.40	1.35
2	B	292	UDP	C2-N1	-2.36	1.34	1.38
2	C	292	UDP	PA-O1A	-2.21	1.43	1.50
2	D	292	UDP	C6-C5	2.08	1.39	1.35
2	C	292	UDP	C2-N3	2.07	1.41	1.38
2	D	292	UDP	C3'-C4'	2.04	1.58	1.53
2	A	292	UDP	O2-C2	-2.00	1.19	1.23

All (27) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	292	UDP	C4-N3-C2	-5.46	119.83	126.61
2	D	292	UDP	C5-C4-N3	4.94	121.72	114.80
2	B	292	UDP	C4-N3-C2	-4.83	120.62	126.61
2	B	292	UDP	C5-C4-N3	4.77	121.49	114.80
2	A	292	UDP	C5-C4-N3	4.49	121.09	114.80
2	A	292	UDP	C4-N3-C2	-4.21	121.39	126.61
2	B	292	UDP	C6-C5-C4	-3.75	114.75	119.53
2	C	292	UDP	C5-C4-N3	3.46	119.64	114.80
2	C	292	UDP	C4-N3-C2	-3.22	122.62	126.61
2	D	292	UDP	O4-C4-N3	-3.01	114.91	119.27
2	C	292	UDP	O2-C2-N1	-2.99	118.90	122.80
2	D	292	UDP	O2-C2-N3	-2.80	116.33	121.49

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	292	UDP	O3A-PA-O1A	2.78	119.06	110.70
2	D	292	UDP	O4'-C4'-C3'	-2.59	100.01	105.15
2	A	292	UDP	O3B-PB-O3A	2.55	113.19	104.64
2	C	292	UDP	O2'-C2'-C3'	-2.49	103.84	111.82
2	A	292	UDP	N3-C2-N1	2.46	118.10	114.89
2	A	292	UDP	C6-C5-C4	-2.46	116.40	119.53
2	C	292	UDP	N3-C2-N1	2.38	117.99	114.89
2	D	292	UDP	O2-C2-N1	2.33	125.82	122.80
2	D	292	UDP	O3'-C3'-C4'	2.32	117.74	111.08
2	D	292	UDP	N3-C2-N1	2.22	117.78	114.89
2	B	292	UDP	O4-C4-C5	-2.09	121.55	125.16
2	D	292	UDP	C6-N1-C2	2.06	123.51	121.00
2	C	292	UDP	C6-C5-C4	-2.05	116.91	119.53
2	C	292	UDP	O4'-C4'-C3'	-2.04	101.11	105.15
2	B	292	UDP	C4'-O4'-C1'	-2.03	104.97	109.47

There are no chirality outliers.

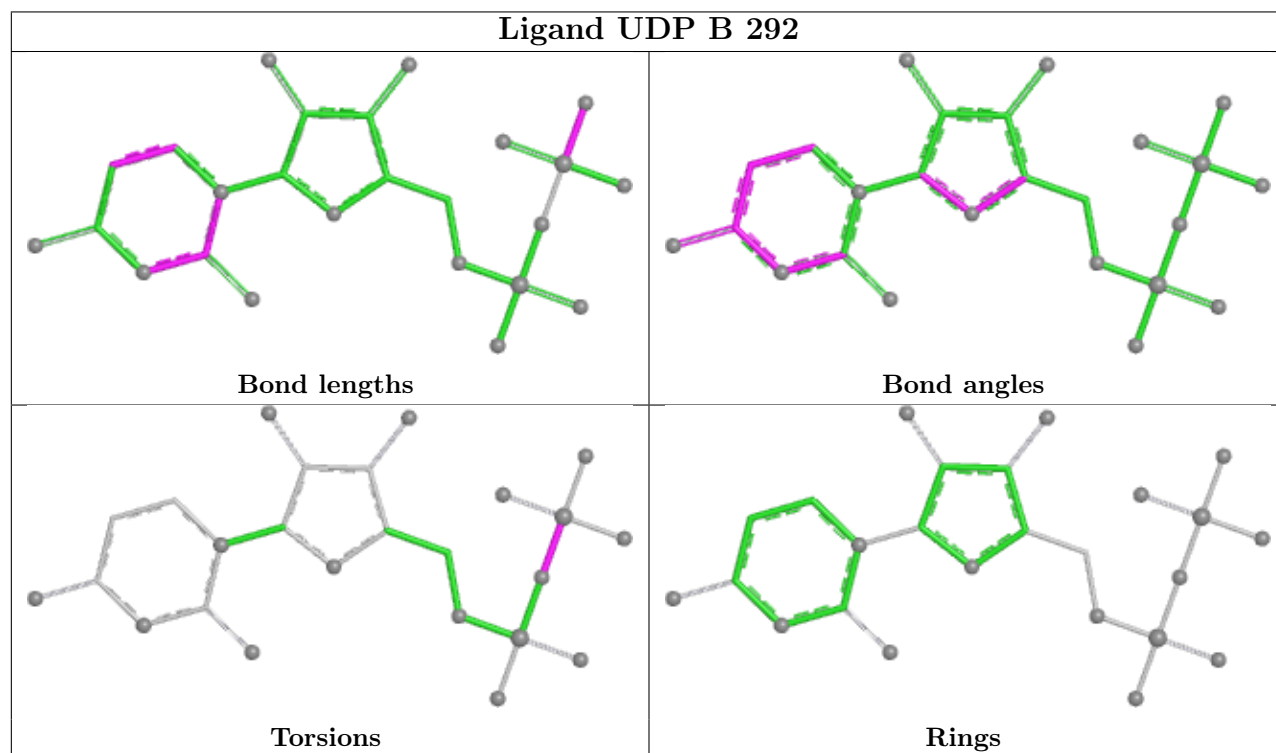
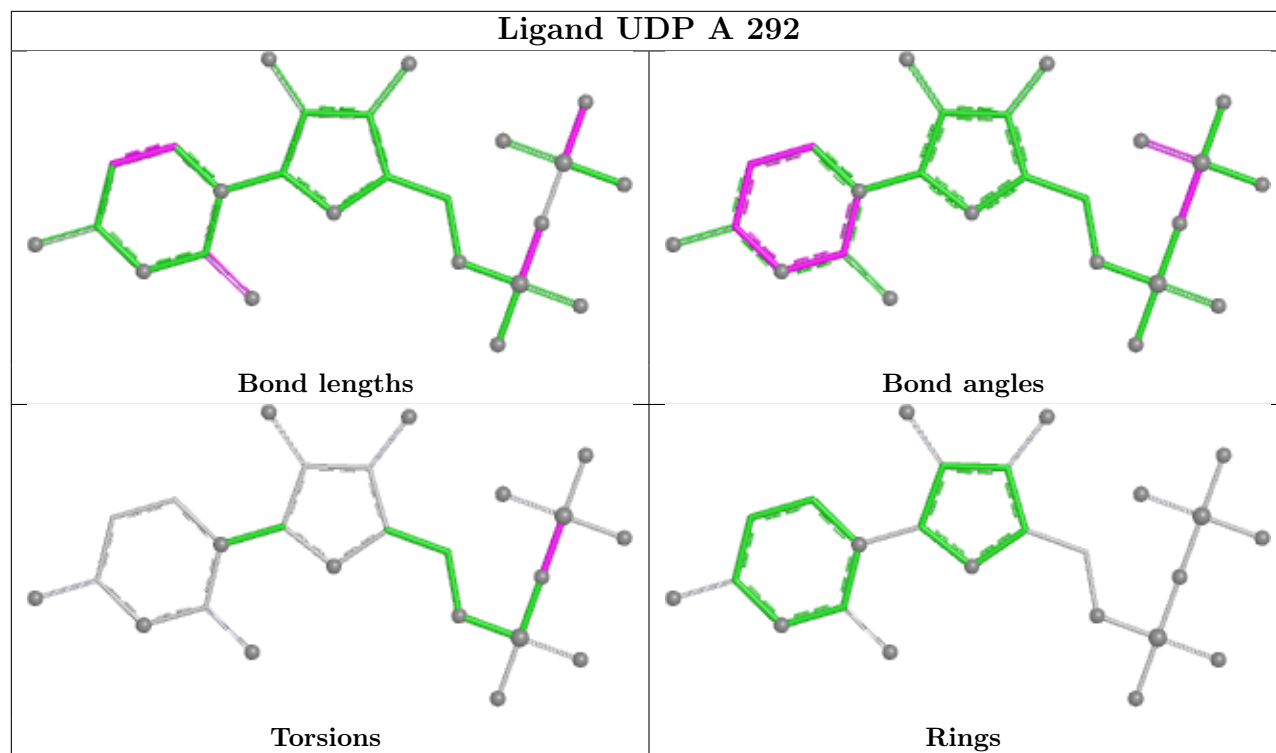
All (6) torsion outliers are listed below:

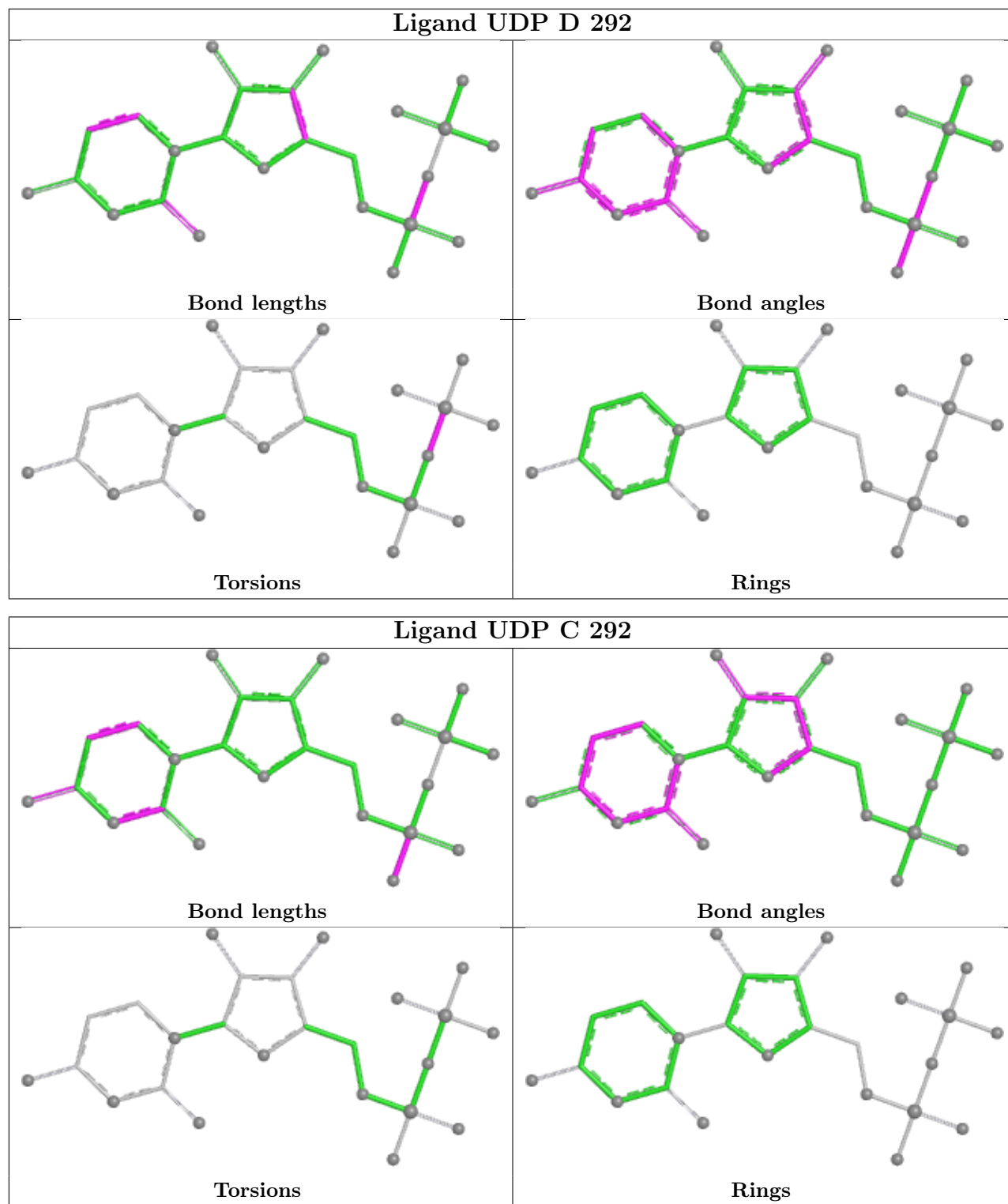
Mol	Chain	Res	Type	Atoms
2	A	292	UDP	PA-O3A-PB-O3B
2	B	292	UDP	PA-O3A-PB-O3B
2	D	292	UDP	PA-O3A-PB-O3B
2	D	292	UDP	PA-O3A-PB-O1B
2	B	292	UDP	PA-O3A-PB-O1B
2	A	292	UDP	PA-O3A-PB-O1B

There are no ring outliers.

No monomer is involved in short contacts.

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 ⓘ

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	268/291 (92%)	-0.72	1 (0%) 88 92	8, 16, 29, 51	20 (7%)
1	B	267/291 (91%)	-0.53	2 (0%) 84 89	7, 18, 32, 49	26 (9%)
1	C	267/291 (91%)	-0.53	1 (0%) 88 92	8, 19, 33, 39	21 (7%)
1	D	268/291 (92%)	-0.32	2 (0%) 84 89	8, 21, 36, 46	18 (6%)
All	All	1070/1164 (91%)	-0.53	6 (0%) 85 90	7, 18, 33, 51	85 (7%)

All (6) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	290	ARG	5.8
1	B	51	LYS	4.6
1	D	55	ALA	3.1
1	B	55	ALA	3.0
1	A	23	THR	2.3
1	C	51	LYS	2.1

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.

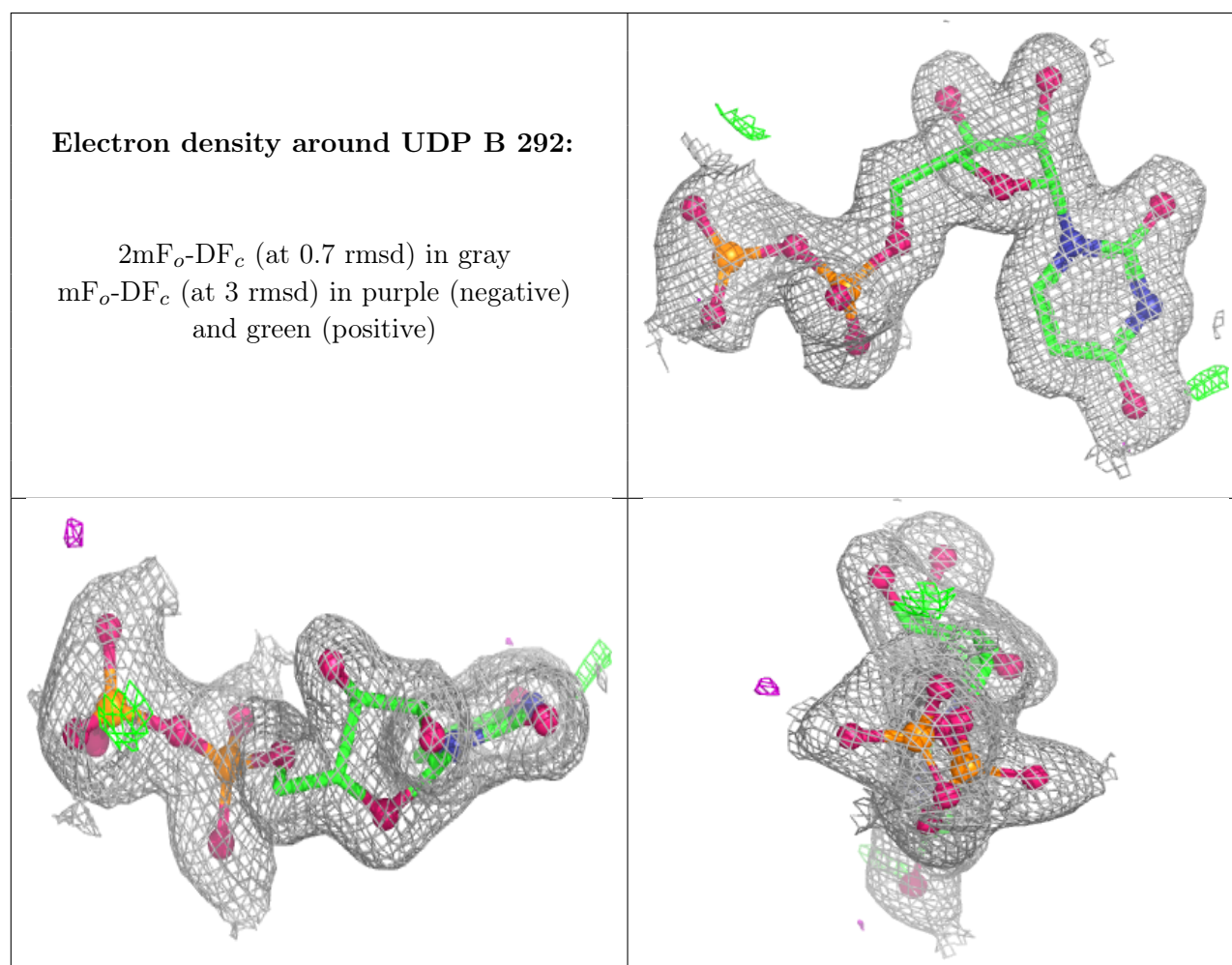
6.4 Ligands [i](#)

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.

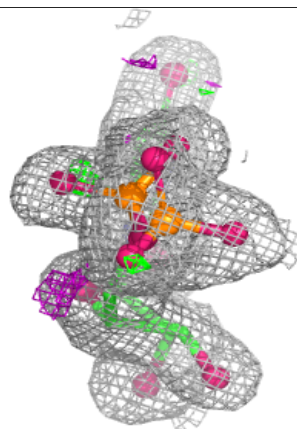
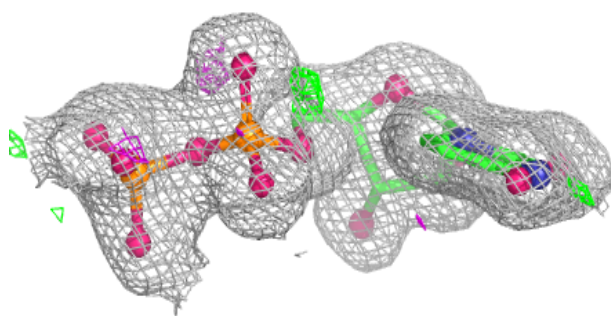
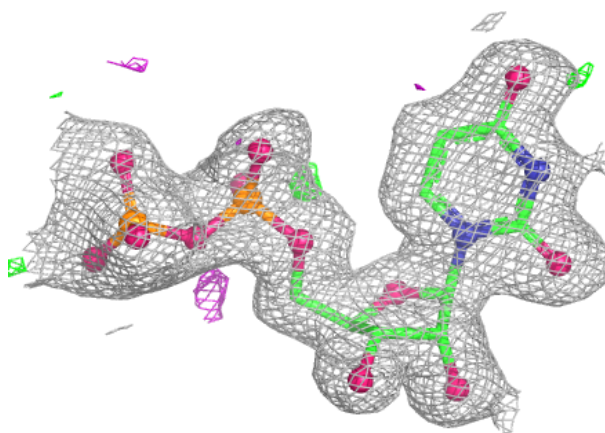
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	UDP	B	292	25/25	0.97	0.05	14,18,33,38	0
2	UDP	D	292	25/25	0.97	0.05	15,19,38,41	0
2	UDP	C	292	25/25	0.98	0.04	13,17,28,34	0
2	UDP	A	292	25/25	0.98	0.04	13,18,34,39	0

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.



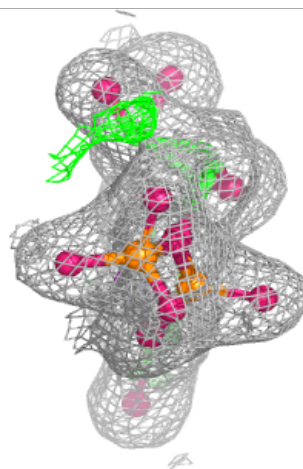
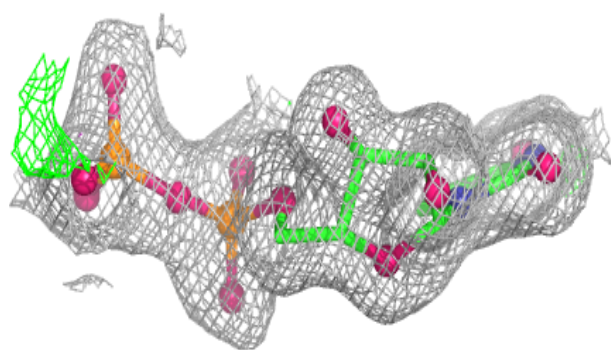
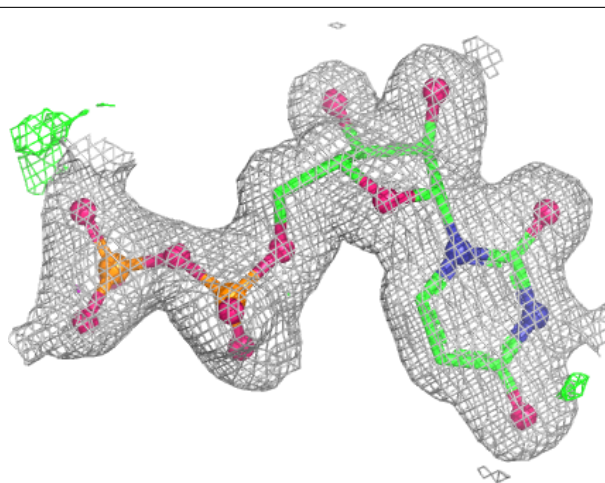
Electron density around UDP D 292:

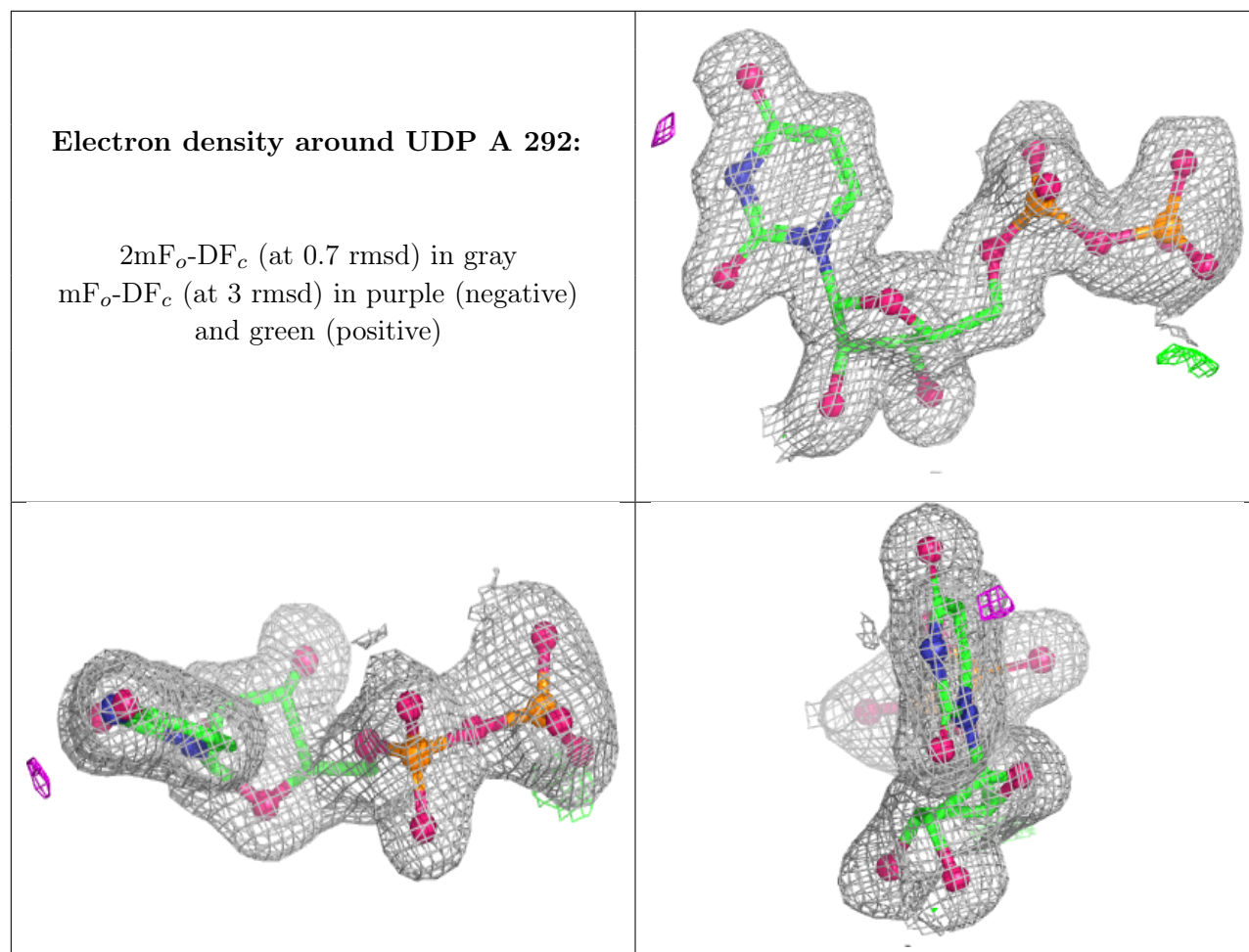
$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around UDP C 292:

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





6.5 Other polymers ⓘ

There are no such residues in this entry.