WORLDWIDE PDB
PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report ⓘ

Jun 25, 2024 – 11:22 AM EDT

|		
PDB ID	:	6QXS
Title	:	Crystal structure of Enteroccocus faecalis thymidylate synthase (EfTS) in complex with FdUMP
Authors	:	Pozzi, C.; Mangani, M.
Deposited on	:	2019-03-07
Resolution	:	2.88 Å(reported)

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 2.88 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.
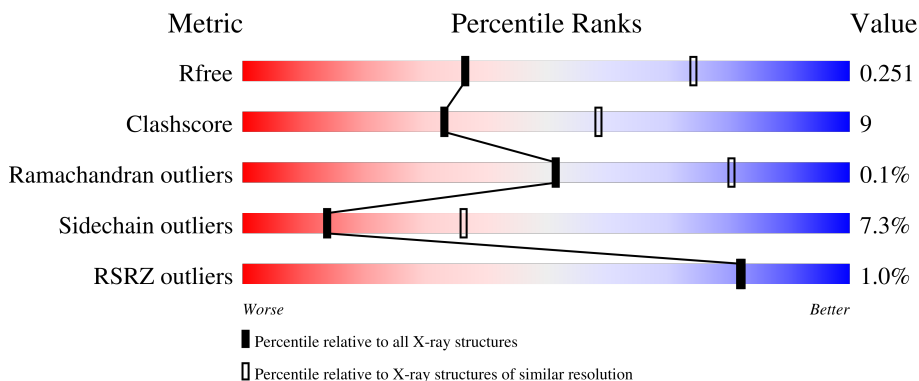
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	2691 (2.90-2.86)
Clashscore	141614	2947 (2.90-2.86)
Ramachandran outliers	138981	2868 (2.90-2.86)
Sidechain outliers	138945	2871 (2.90-2.86)
RSRZ outliers	127900	2629 (2.90-2.86)

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 <=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	315	75% 17% · 7%
2	B	315	78% 22% ·
2	C	315	2% 72% 18% · 7%
2	D	315	76% 23% ·

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
3	UFP	D	401	-	-	X	-

2 Entry composition (i)

There are 6 unique types of molecules in this entry. The entry contains 10117 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
1	A	292	Total	C	N	O	S	0	0	0
			2311	1488	386	426	11			

- Molecule 2 is a protein called Thymidylate synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	315	Total	C	N	O	S	0	0	0
			2546	1639	422	474	11			
2	C	292	Total	C	N	O	S	0	0	0
			2297	1485	381	421	10			
2	D	315	Total	C	N	O	S	0	0	0
			2516	1626	420	459	11			

- Molecule 3 is 5-FLUORO-2'-DEOXYURIDINE-5'-MONOPHOSPHATE (three-letter code: UFP) (formula: $C_9H_{12}FN_2O_8P$).
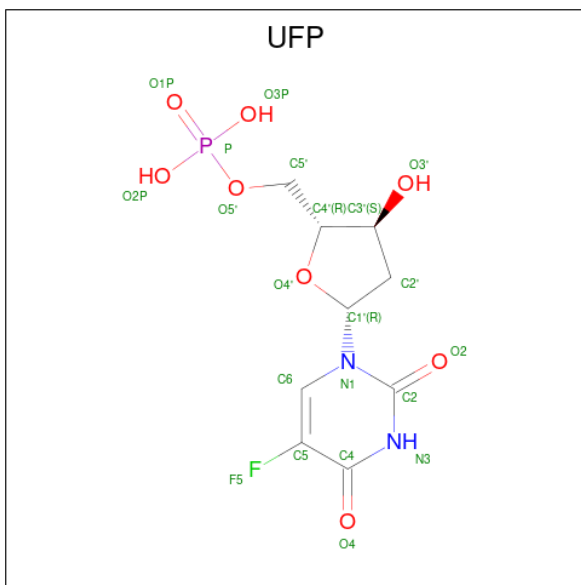
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
3	B	1	Total 21	C 9	F 1	N 2	O 8	P 1	0	0
3	D	1	Total 21	C 9	F 1	N 2	O 8	P 1	0	0

- Molecule 4 is SULFATE ION (three-letter code: SO4) (formula: O_4S).

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

- Molecule 5 is N-[4-({[(6S)-2-amino-5-formyl-4-oxo-3,4,5,6,7,8-hexahydropteridin-6-yl]methyl }amino)benzoyl]-L-glutamic acid (three-letter code: FFO) (formula: $C_{20}H_{23}N_7O_7$).

FFO

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	B	1	Total	C	N	O	0	0
			34	20	7	7		
5	D	1	Total	C	N	O	0	0
			34	20	7	7		

• Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	85	Total	O	0	0
			85	85		
6	B	94	Total	O	0	0
			94	94		
6	C	69	Total	O	0	0
			69	69		
6	D	79	Total	O	0	0
			79	79		

3 Residue-property plots ⓘ

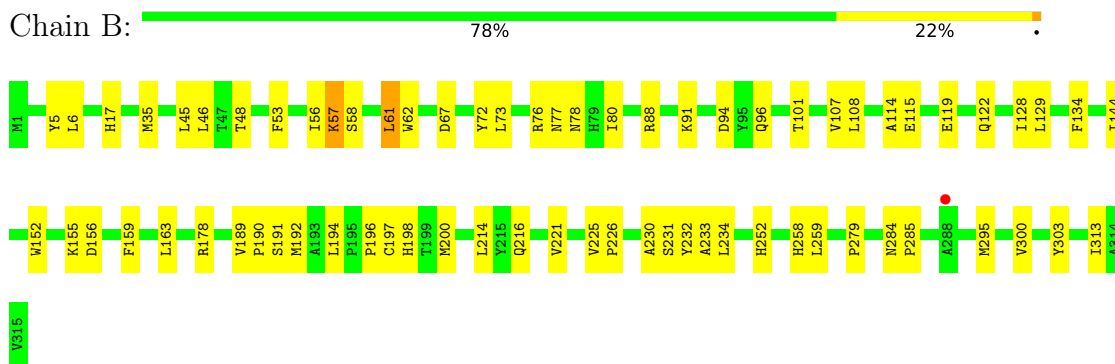These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: Thymidylate synthase

Chain A:

• Molecule 2: Thymidylate synthase

Chain B:

• Molecule 2: Thymidylate synthase

Chain C:

N228 I229 A230 L235 T236 H237 L238 I239 V251 V264 Q268 S277 L281 F293 V300 Y303 D304 P305 I313 ALA VAL

• Molecule 2: Thymidylate synthase

Chain D:

76% 23%

M1 I12 E15 G16 H17 F18 K19 R36 F43 L46 I56 L60 L61 W62 F63 D67 R71 Y72 L73 R76 N77 N78 H79 I80 V90 D94 D99 M100 T101 D102 F103 V107 A114 Y145 W149 W152 F159 L163 V166

S176 R177 R178 L179 I180 V181 E187 D188 V189 P190 S191 M192 A193 L194 C197 H198 F201 N206 K209 L214 Y215 A219 D220 V221 V225 P226 I229 A230 H237 L238 I239 A240 H241 E246 V247 V251 D256 L259 Y260 Q261 V264 P279 T280

L283 N284 P285 V290 D294 V300 P307 V315

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	72.04Å 94.84Å 97.00Å 90.00° 94.01° 90.00°	Depositor
Resolution (Å)	96.76 – 2.88 96.76 – 2.88	Depositor EDS
% Data completeness (in resolution range)	94.4 (96.76-2.88) 94.4 (96.76-2.88)	Depositor EDS
R_{merge}	0.15	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.93 (at 2.86Å)	Xtriage
Refinement program	REFMAC 5.8.0238	Depositor
R, R_{free}	0.200 , 0.252 0.200 , 0.251	Depositor DCC
R_{free} test set	1350 reflections (4.82%)	wwPDB-VP
Wilson B-factor (Å^2)	36.4	Xtriage
Anisotropy	0.274	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 45.7	EDS
L-test for twinning[2]	$< |L| > = 0.50, < L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	10117	wwPDB-VP
Average B, all atoms (Å^2)	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.85% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.
[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: UFP, FFO, CME, SO4

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	#$|Z|$>5	RMSZ	#$|Z|$>5
1	A	0.41	0/2363	0.79	0/3208
2	B	0.45	0/2618	0.82	0/3553
2	C	0.39	0/2360	0.80	0/3209
2	D	0.42	0/2588	0.84	0/3514
All	All	0.42	0/9929	0.81	0/13484

There are no bond length outliers.

There are no bond angle outliers.

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	2311	0	2140	36	0
2	B	2546	0	2414	39	0
2	C	2297	0	2143	33	0
2	D	2516	0	2378	51	0
3	B	21	0	10	5	0
3	D	21	0	10	7	0
4	B	5	0	0	0	0
4	D	5	0	0	0	0
5	B	34	0	21	6	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	D	34	0	21	4	0
6	A	85	0	0	3	0
6	B	94	0	0	5	0
6	C	69	0	0	3	0
6	D	79	0	0	3	0
All	All	10117	0	9137	163	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 9.

The worst 5 of 163 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:197:CYS:SG	3:D:401:UFP:C6	2.63	0.87
2:C:220:ASP:OD1	2:C:223:LEU:HB2	1.80	0.80
1:A:192:MET:HE3	6:A:410:HOH:O	1.84	0.76
2:C:168:GLU:HG2	6:C:437:HOH:O	1.86	0.76
2:D:78:ASN:OD1	2:D:80:ILE:HG12	1.84	0.76

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	287/315 (91%)	267 (93%)	20 (7%)	0	100	100
2	B	313/315 (99%)	297 (95%)	15 (5%)	1 (0%)	41	70
2	C	288/315 (91%)	271 (94%)	17 (6%)	0	100	100
2	D	313/315 (99%)	292 (93%)	21 (7%)	0	100	100
All	All	1201/1260 (95%)	1127 (94%)	73 (6%)	1 (0%)	51	80

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	144	ILE

5.3.2 Protein sidechains ⓘ

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	226/272 (83%)	211 (93%)	15 (7%)	16	41
2	B	265/273 (97%)	247 (93%)	18 (7%)	16	40
2	C	229/273 (84%)	208 (91%)	21 (9%)	9	25
2	D	255/273 (93%)	238 (93%)	17 (7%)	16	41
All	All	975/1091 (89%)	904 (93%)	71 (7%)	14	36

5 of 71 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	D	46	LEU
2	D	71	ARG
2	D	206	ASN
2	B	115	GLU
2	B	108	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 12 such sidechains are listed below:

Mol	Chain	Res	Type
2	C	121	HIS
2	C	151	HIS
2	D	241	HIS
2	D	96	GLN
1	A	241	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

1 non-standard protein/DNA/RNA residue is 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	#$|Z| > 2$
1	CME	A	197	1	8,9,10	0.35	0	5,9,11	0.55	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	CME	A	197	1	-	2/5/8/10	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	197	CME	CE-SD-SG-CB
1	A	197	CME	SD-CE-CZ-OH

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	197	CME	2	0

5.5 Carbohydrates ⓘ

There are no monosaccharides in this entry.

5.6 Ligand geometry ⓘ

6 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	UFP	B	401	-	22,22,22	1.86	4 (18%)	33,33,33	2.54	8 (24%)
4	SO4	D	402	-	4,4,4	0.43	0	6,6,6	0.06	0
5	FFO	B	403	-	33,36,36	1.01	1 (3%)	36,50,50	1.82	6 (16%)
5	FFO	D	403	-	33,36,36	0.95	1 (3%)	36,50,50	1.87	6 (16%)
4	SO4	B	402	-	4,4,4	0.40	0	6,6,6	0.09	0
3	UFP	D	401	-	22,22,22	1.74	4 (18%)	33,33,33	2.57	9 (27%)

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
5	FFO	B	403	-	-	3/24/37/37	0/3/3/3
3	UFP	B	401	-	-	2/10/22/22	0/2/2/2
3	UFP	D	401	-	-	2/10/22/22	0/2/2/2
5	FFO	D	403	-	-	5/24/37/37	0/3/3/3

The worst 5 of 10 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	401	UFP	C4-C5	4.99	1.50	1.44
3	D	401	UFP	C6-C5	4.63	1.40	1.33
3	D	401	UFP	C4-C5	4.58	1.50	1.44
3	B	401	UFP	C6-C5	4.40	1.39	1.33

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	401	UFP	C2-N1	3.12	1.43	1.38

The worst 5 of 29 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	D	401	UFP	C5-C4-N3	7.09	119.53	112.56
3	B	401	UFP	F5-C5-C4	7.09	122.97	116.40
3	B	401	UFP	C5-C4-N3	6.46	118.91	112.56
3	D	401	UFP	F5-C5-C4	6.16	122.11	116.40
5	B	403	FFO	C4A-C4-N3	5.97	121.52	110.99

There are no chirality outliers.

5 of 12 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	401	UFP	O4'-C4'-C5'-O5'
3	D	401	UFP	O4'-C4'-C5'-O5'
5	D	403	FFO	C6-C9-N10-C14
3	B	401	UFP	C3'-C4'-C5'-O5'
3	D	401	UFP	C3'-C4'-C5'-O5'

There are no ring outliers.

4 monomers are involved in 17 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	401	UFP	5	0
5	B	403	FFO	6	0
5	D	403	FFO	4	0
3	D	401	UFP	7	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 then 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.

Ligand UFP B 401

Bond lengths

Bond angles

Torsions

Rings

Ligand FFO B 403

Bond lengths

Bond angles

Torsions

Rings

Ligand FFO D 403

Bond lengths

Bond angles

Torsions

Rings

Ligand UFP D 401

Bond lengths

Bond angles

Torsions

Rings
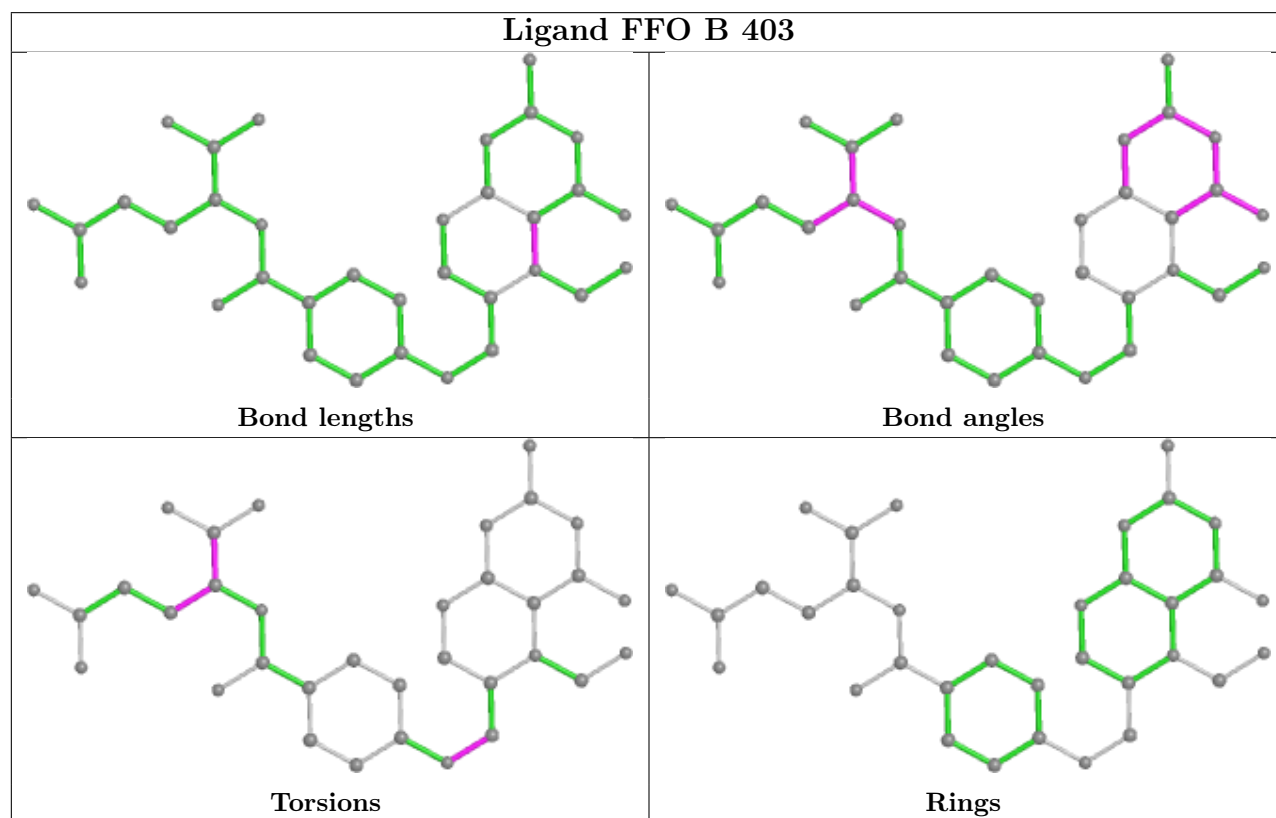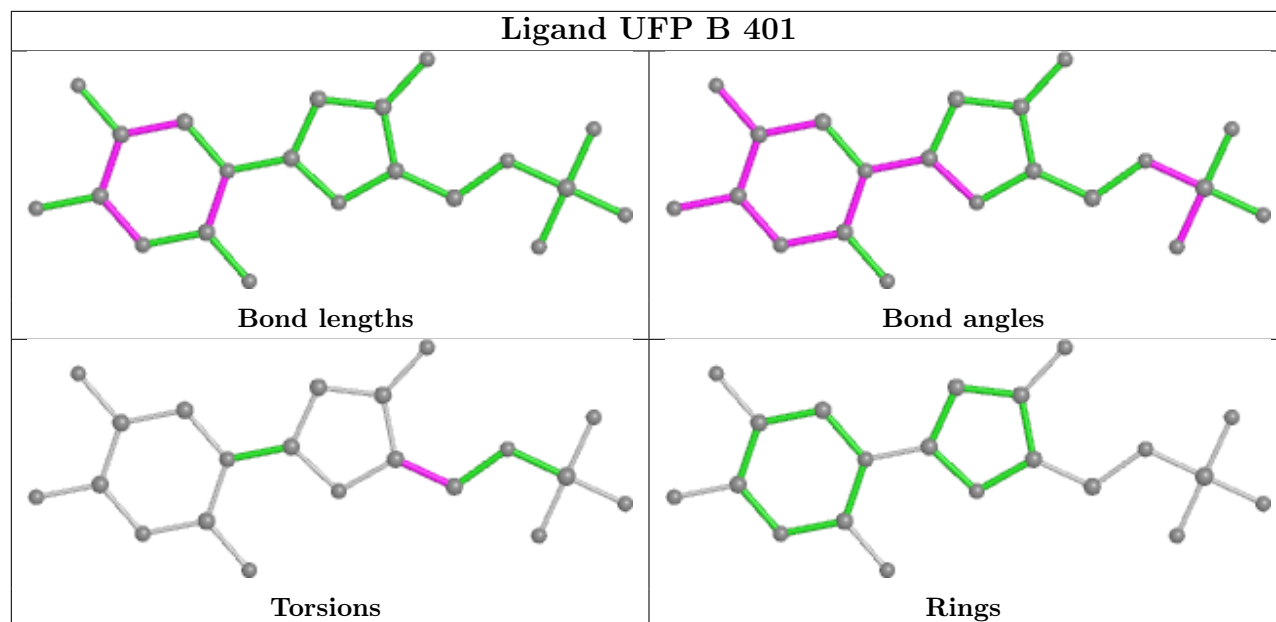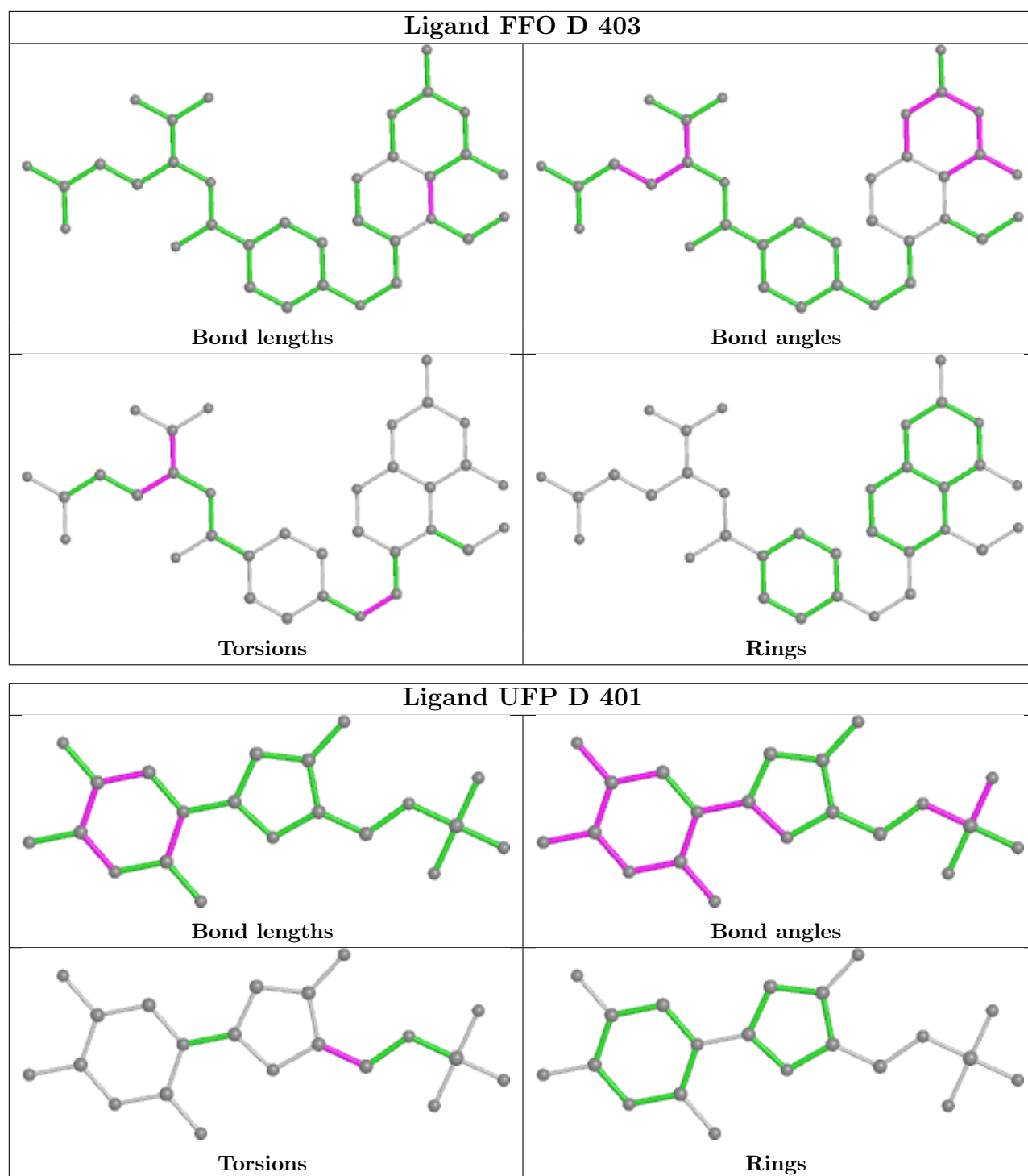
5.7　Other polymers ⓘ

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 ⓘ

6.1 Protein, DNA and RNA chains ⓘ

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q< 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2			OWAB(Å^2)	Q<0.9
1	A	291/315 (92%)	0.10	3 (1%)	82	82	18, 41, 75, 97	0
2	B	315/315 (100%)	-0.15	1 (0%)	94	94	17, 31, 50, 67	0
2	C	292/315 (92%)	0.13	7 (2%)	59	57	14, 43, 90, 111	0
2	D	315/315 (100%)	-0.05	1 (0%)	94	94	15, 33, 60, 86	0
All	All	1213/1260 (96%)	0.00	12 (0%)	82	82	14, 37, 74, 111	0

The worst 5 of 12 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	C	130	ASN	2.8
1	A	130	ASN	2.6
1	A	313	ILE	2.5
2	C	135	ALA	2.5
1	A	224	GLY	2.3

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

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.

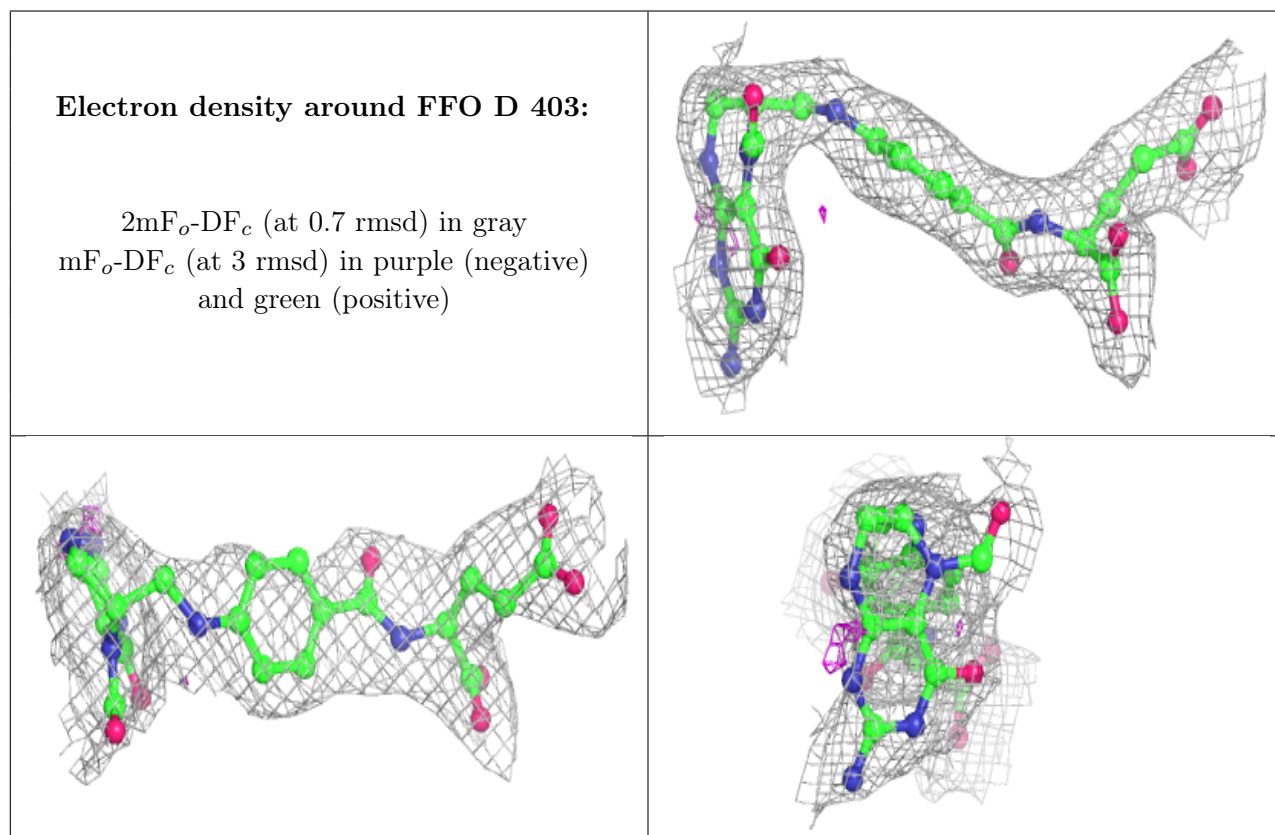| Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
1	CME	A	197	10/11	0.92	0.20	33,38,54,56	0

6.3 Carbohydrates ⓘ

There are no monosaccharides in this entry.

6.4 Ligands ⓘ

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
5	FFO	D	403	34/34	0.88	0.25	44,50,59,61	0
5	FFO	B	403	34/34	0.89	0.20	35,43,52,57	0
3	UFP	B	401	21/21	0.94	0.24	44,56,66,77	0
3	UFP	D	401	21/21	0.95	0.21	47,60,93,97	0
4	SO4	B	402	5/5	0.97	0.09	58,58,61,67	0
4	SO4	D	402	5/5	0.97	0.13	49,52,55,57	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.
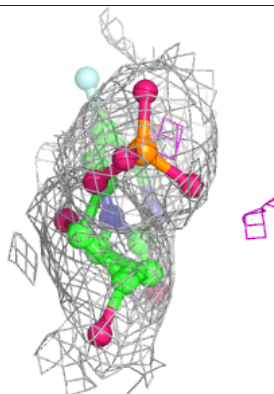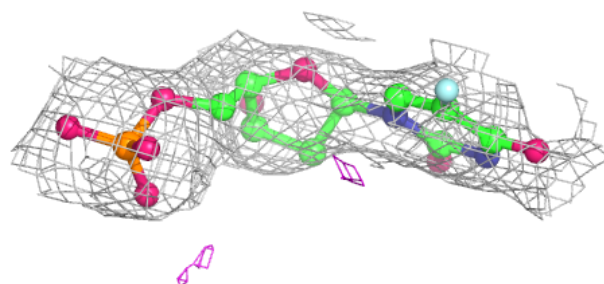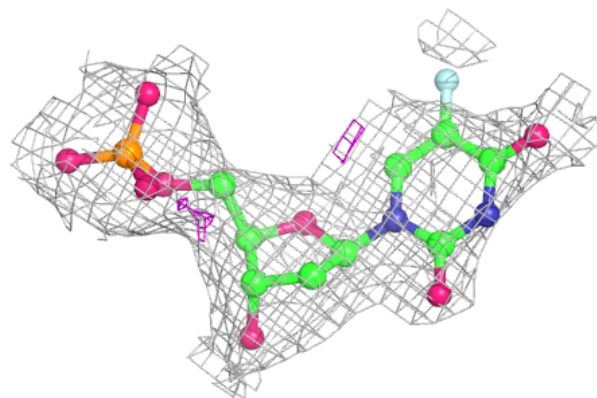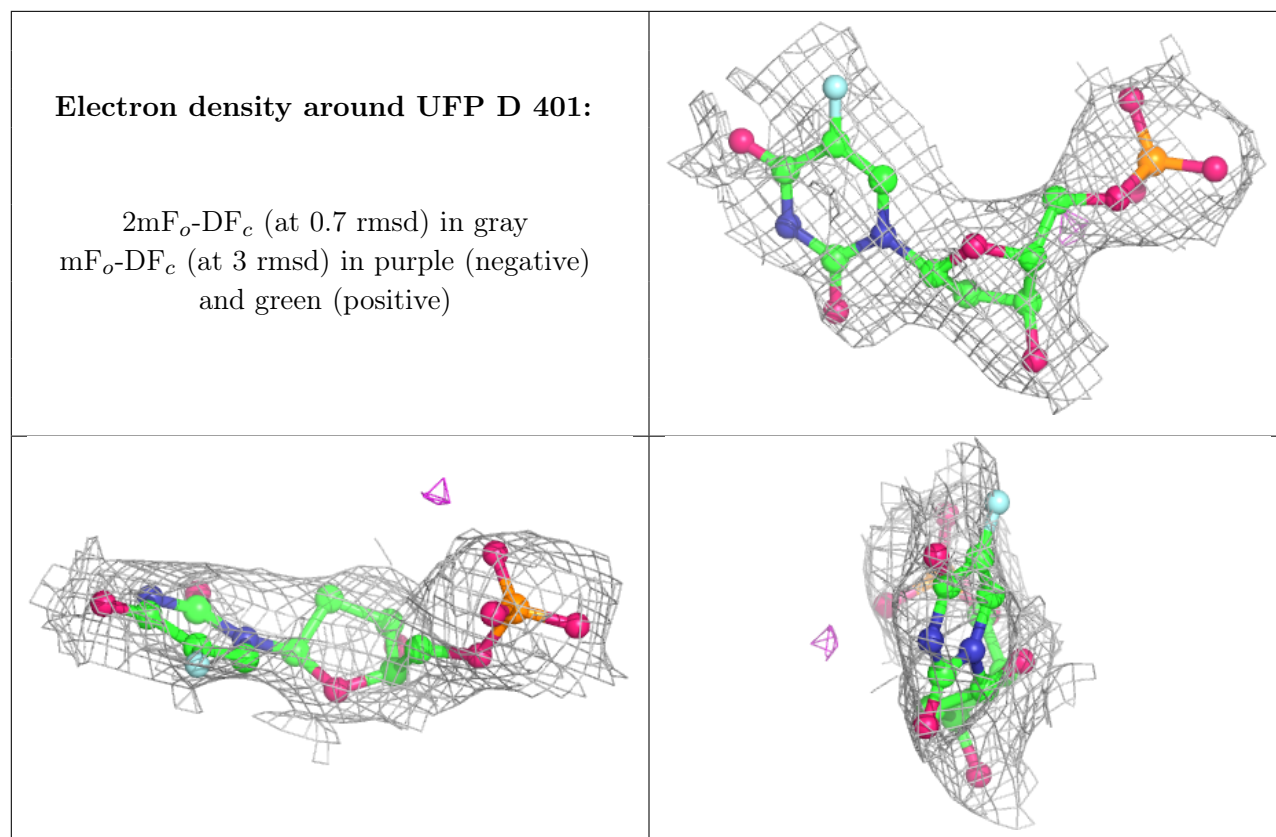

Electron density around FFO D 403:

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

Electron density around FFO B 403:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)
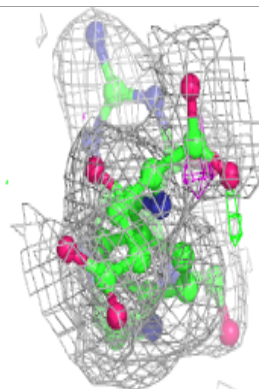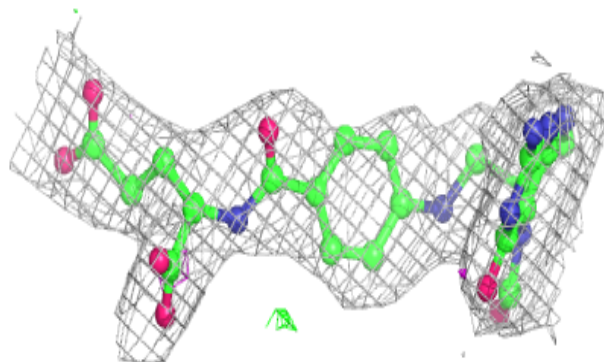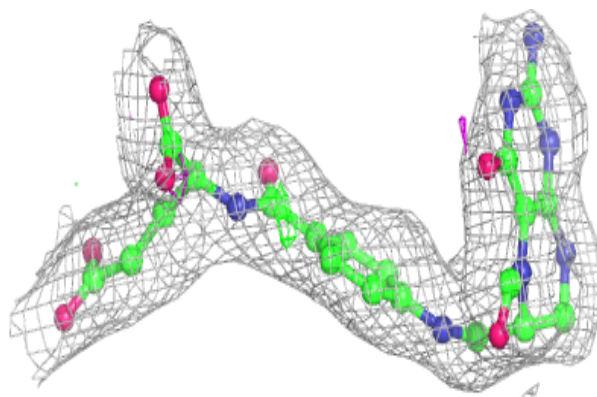
Electron density around UFP B 401:

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

Electron density around UFP D 401:

$2mF_o$-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.