Full wwPDB X-ray Structure Validation Report (i)

Nov 7, 2023 – 02:42 PM JST

PDB ID	:	5X0I
Title	:	Crystal structure of PKM2 R399E mutant complexed with FBP and serine
Authors	:	Wang, W.C.; Chen, T.J.
Deposited on	:	2017-01-20
Resolution	:	2.64 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 (i) 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 (i)) were used in the production of this report:

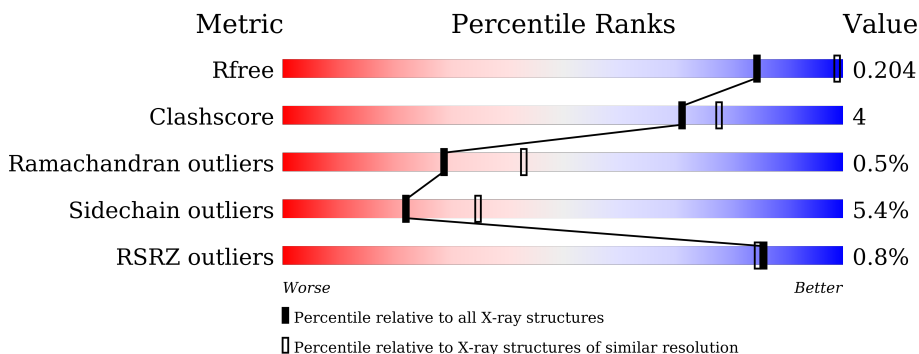|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance ⓘ

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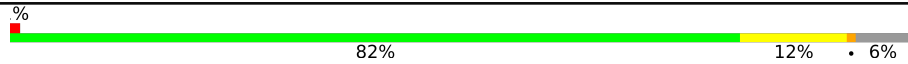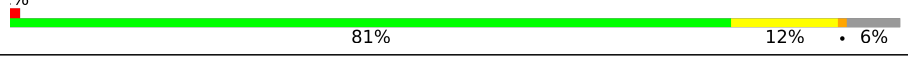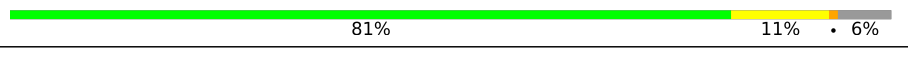*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.64 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	Percentile Ranks	Value
Rfree		0.204
Clashscore		4
Ramachandran outliers		0.5%
Sidechain outliers		5.4%
RSRZ outliers		0.8%

Worse   *Better*

▌ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	1426 (2.66-2.62)
Clashscore	141614	1472 (2.66-2.62)
Ramachandran outliers	138981	1446 (2.66-2.62)
Sidechain outliers	138945	1446 (2.66-2.62)
RSRZ outliers	127900	1408 (2.66-2.62)

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	551	.% 82% 12% · 6%
1	B	551	.% 79% 13% · 7%
1	C	551	.% 81% 12% · 6%
1	D	551	81% 11% · 6%

2 Entry composition ⓘ

There are 7 unique types of molecules in this entry. The entry contains 16023 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 Pyruvate kinase PKM.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	518	Total	C	N	O	S	0	0	0
			3963	2491	701	746	25			
1	B	515	Total	C	N	O	S	0	0	0
			3949	2484	698	742	25			
1	C	518	Total	C	N	O	S	0	0	0
			3963	2491	701	746	25			
1	D	518	Total	C	N	O	S	0	0	0
			3963	2491	701	746	25			

There are 84 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	expression tag	UNP P14618
A	-18	GLY	-	expression tag	UNP P14618
A	-17	SER	-	expression tag	UNP P14618
A	-16	SER	-	expression tag	UNP P14618
A	-15	HIS	-	expression tag	UNP P14618
A	-14	HIS	-	expression tag	UNP P14618
A	-13	HIS	-	expression tag	UNP P14618
A	-12	HIS	-	expression tag	UNP P14618
A	-11	HIS	-	expression tag	UNP P14618
A	-10	HIS	-	expression tag	UNP P14618
A	-9	SER	-	expression tag	UNP P14618
A	-8	SER	-	expression tag	UNP P14618
A	-7	GLY	-	expression tag	UNP P14618
A	-6	LEU	-	expression tag	UNP P14618
A	-5	VAL	-	expression tag	UNP P14618
A	-4	PRO	-	expression tag	UNP P14618
A	-3	ARG	-	expression tag	UNP P14618
A	-2	GLY	-	expression tag	UNP P14618
A	-1	SER	-	expression tag	UNP P14618
A	0	HIS	-	expression tag	UNP P14618
A	399	GLU	ARG	engineered mutation	UNP P14618

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
B	-19	MET	-	expression tag	UNP P14618
B	-18	GLY	-	expression tag	UNP P14618
B	-17	SER	-	expression tag	UNP P14618
B	-16	SER	-	expression tag	UNP P14618
B	-15	HIS	-	expression tag	UNP P14618
B	-14	HIS	-	expression tag	UNP P14618
B	-13	HIS	-	expression tag	UNP P14618
B	-12	HIS	-	expression tag	UNP P14618
B	-11	HIS	-	expression tag	UNP P14618
B	-10	HIS	-	expression tag	UNP P14618
B	-9	SER	-	expression tag	UNP P14618
B	-8	SER	-	expression tag	UNP P14618
B	-7	GLY	-	expression tag	UNP P14618
B	-6	LEU	-	expression tag	UNP P14618
B	-5	VAL	-	expression tag	UNP P14618
B	-4	PRO	-	expression tag	UNP P14618
B	-3	ARG	-	expression tag	UNP P14618
B	-2	GLY	-	expression tag	UNP P14618
B	-1	SER	-	expression tag	UNP P14618
B	0	HIS	-	expression tag	UNP P14618
B	399	GLU	ARG	engineered mutation	UNP P14618
C	-19	MET	-	expression tag	UNP P14618
C	-18	GLY	-	expression tag	UNP P14618
C	-17	SER	-	expression tag	UNP P14618
C	-16	SER	-	expression tag	UNP P14618
C	-15	HIS	-	expression tag	UNP P14618
C	-14	HIS	-	expression tag	UNP P14618
C	-13	HIS	-	expression tag	UNP P14618
C	-12	HIS	-	expression tag	UNP P14618
C	-11	HIS	-	expression tag	UNP P14618
C	-10	HIS	-	expression tag	UNP P14618
C	-9	SER	-	expression tag	UNP P14618
C	-8	SER	-	expression tag	UNP P14618
C	-7	GLY	-	expression tag	UNP P14618
C	-6	LEU	-	expression tag	UNP P14618
C	-5	VAL	-	expression tag	UNP P14618
C	-4	PRO	-	expression tag	UNP P14618
C	-3	ARG	-	expression tag	UNP P14618
C	-2	GLY	-	expression tag	UNP P14618
C	-1	SER	-	expression tag	UNP P14618
C	0	HIS	-	expression tag	UNP P14618
C	399	GLU	ARG	engineered mutation	UNP P14618

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
D	-19	MET	-	expression tag	UNP P14618
D	-18	GLY	-	expression tag	UNP P14618
D	-17	SER	-	expression tag	UNP P14618
D	-16	SER	-	expression tag	UNP P14618
D	-15	HIS	-	expression tag	UNP P14618
D	-14	HIS	-	expression tag	UNP P14618
D	-13	HIS	-	expression tag	UNP P14618
D	-12	HIS	-	expression tag	UNP P14618
D	-11	HIS	-	expression tag	UNP P14618
D	-10	HIS	-	expression tag	UNP P14618
D	-9	SER	-	expression tag	UNP P14618
D	-8	SER	-	expression tag	UNP P14618
D	-7	GLY	-	expression tag	UNP P14618
D	-6	LEU	-	expression tag	UNP P14618
D	-5	VAL	-	expression tag	UNP P14618
D	-4	PRO	-	expression tag	UNP P14618
D	-3	ARG	-	expression tag	UNP P14618
D	-2	GLY	-	expression tag	UNP P14618
D	-1	SER	-	expression tag	UNP P14618
D	0	HIS	-	expression tag	UNP P14618
D	399	GLU	ARG	engineered mutation	UNP P14618

- Molecule 2 is 1,6-di-O-phosphono-beta-D-fructofuranose (three-letter code: FBP) (formula: $C_6H_{14}O_{12}P_2$).
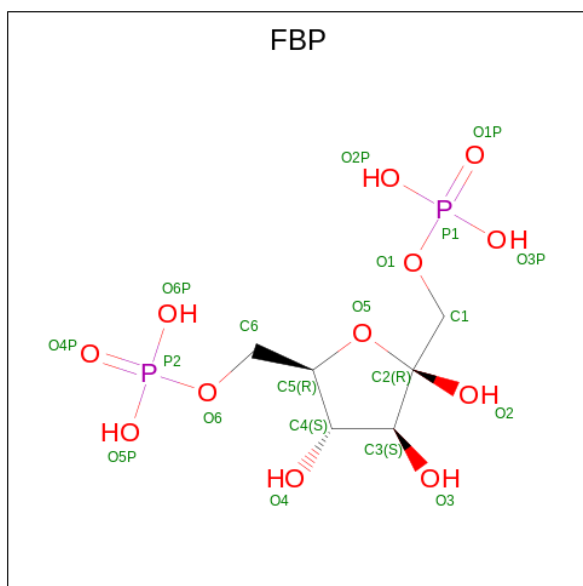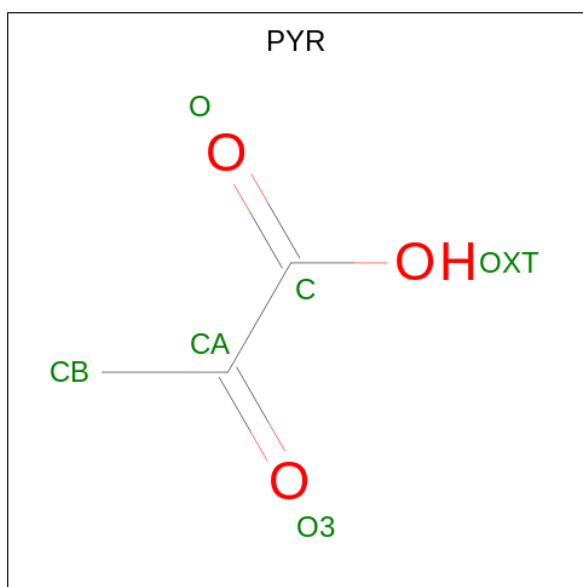
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	O	P	0	0
			20	6	12	2		
2	B	1	Total	C	O	P	0	0
			20	6	12	2		
2	C	1	Total	C	O	P	0	0
			20	6	12	2		
2	D	1	Total	C	O	P	0	0
			20	6	12	2		

- Molecule 3 is SERINE (three-letter code: SER) (formula: $C_3H_7NO_3$).
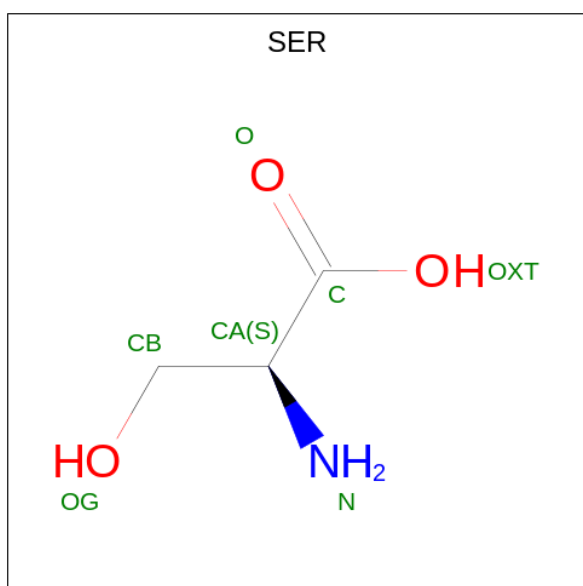
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			7	3	1	3		
3	B	1	Total	C	N	O	0	0
			7	3	1	3		
3	C	1	Total	C	N	O	0	0
			7	3	1	3		
3	D	1	Total	C	N	O	0	0
			7	3	1	3		

- Molecule 4 is PYRUVIC ACID (three-letter code: PYR) (formula: $C_3H_4O_3$).

PYR

O

O

OH OXT

C

CA

CB

O

O3

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total 6	C 3	O 3	0	0
4	B	1	Total 6	C 3	O 3	0	0
4	C	1	Total 6	C 3	O 3	0	0
4	D	1	Total 6	C 3	O 3	0	0

- Molecule 5 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total 1	Mg 1	0	0
5	B	1	Total 1	Mg 1	0	0
5	C	1	Total 1	Mg 1	0	0
5	D	1	Total 1	Mg 1	0	0

- Molecule 6 is POTASSIUM ION (three-letter code: K) (formula: K).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total 1	K 1	0	0

Continued on next page...

W O R L D W I D E

PDB

PROTEIN DATA BANK

Continued from previous page...

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	B	1	Total 1	K 1	0	0
6	C	1	Total 1	K 1	0	0
6	D	1	Total 1	K 1	0	0

- Molecule 7 is water.

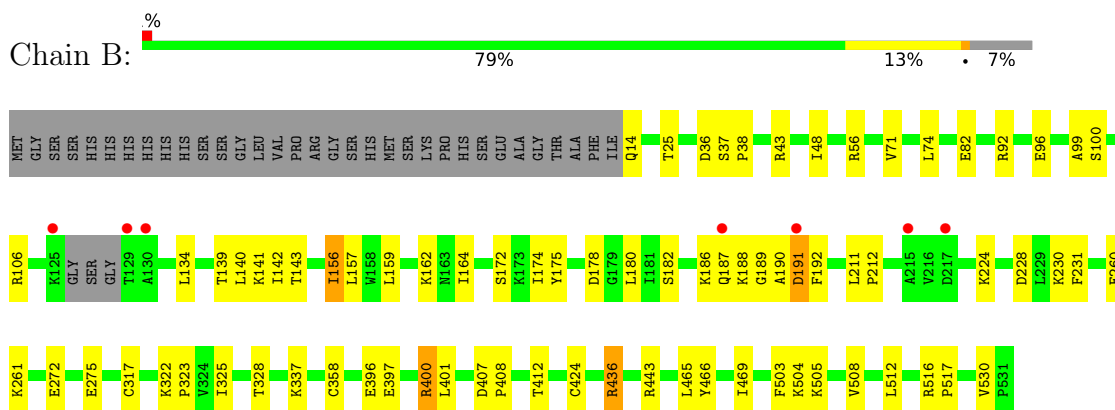| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	13	Total 13	O 13	0	0
7	B	13	Total 13	O 13	0	0
7	C	9	Total 9	O 9	0	0
7	D	10	Total 10	O 10	0	0

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.
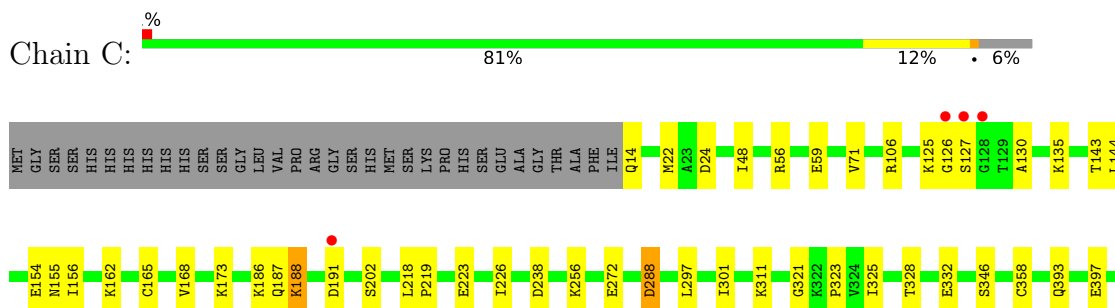
● Molecule 1: Pyruvate kinase PKM
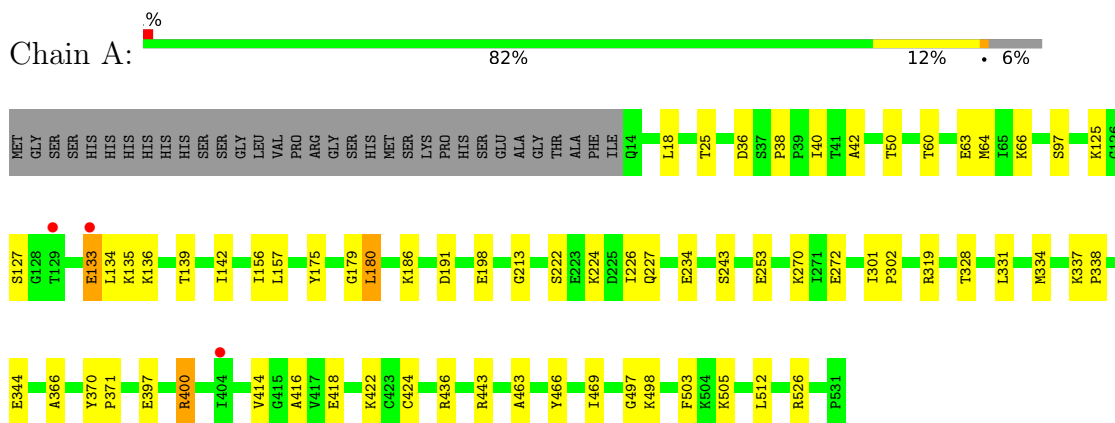
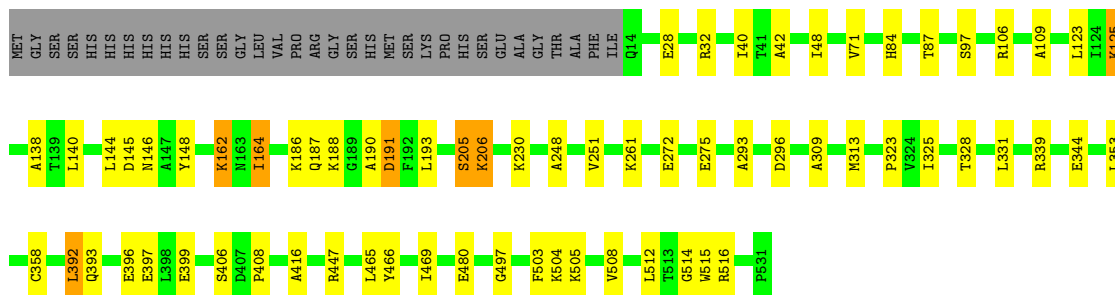Chain A:

● Molecule 1: Pyruvate kinase PKM

Chain B:

● Molecule 1: Pyruvate kinase PKM

Chain C:

L401 A402 P403 T409 E418 R436 S437 A438 R443 R461 I469 F470 P471 E480 A481 E484 D485 V486 D487 N491 G497 F503 K504 K505 G506 D507 L512 T513 G514 S519 T522 V528 P529 V530 P531

• Molecule 1: Pyruvate kinase PKM

Chain D:

81%   11%   • 6%

MET GLY SER SER HIS HIS HIS HIS HIS HIS SER SER GLY LEU VAL PRO ARG GLY SER HIS MET SER LYS PRO HIS SER GLU GLY ALA GLY THR ALA PHE ILE Q14 E28 R32 I40 T41 A42 I48 V71 H84 T87 S97 R106 A109 L123 I124 K125

A138 T139 L140 L144 D145 N146 A147 Y148 K162 N163 I164 K186 Q187 K188 G189 A190 D191 F192 L193 S205 K206 K230 A248 V251 K261 E272 E275 A293 D296 A309 M313 P323 V324 I325 T328 L331 R339 E344 L353

C358 L392 Q393 E396 E397 L398 E399 S406 D407 P408 A416 R447 L465 Y466 I469 E480 G497 F503 K504 K505 V508 L512 T513 G514 W515 R516 P531

4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	116.60Å 137.88Å 149.71Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 2.64 29.68 – 2.64	Depositor EDS
% Data completeness (in resolution range)	99.9 (30.00-2.64) 100.0 (29.68-2.64)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.86 (at 2.64Å)	Xtriage
Refinement program	REFMAC 5.8.0049	Depositor
R, R_{free}	0.180 , 0.218 0.185 , 0.204	Depositor DCC
R_{free} test set	3616 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å^2)	40.6	Xtriage
Anisotropy	0.306	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , 23.0	EDS
L-test for twinning[2]	$< |L| > = 0.49, < L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	16023	wwPDB-VP
Average B, all atoms (Å^2)	43.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.57% of the height of the origin peak. No significant pseudotranslation is detected.*

---

[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: MG, K, PYR, FBP

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	0.87	0/4027	0.76	3/5439 (0.1%)
1	B	0.84	0/4012	0.74	2/5418 (0.0%)
1	C	0.81	0/4027	0.73	0/5439
1	D	0.82	1/4027 (0.0%)	0.73	3/5439 (0.1%)
All	All	0.83	1/16093 (0.0%)	0.74	8/21735 (0.0%)

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	A	0	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	399	GLU	CG-CD	5.76	1.60	1.51

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	106	ARG	NE-CZ-NH1	7.90	124.25	120.30
1	B	106	ARG	NE-CZ-NH2	-6.89	116.86	120.30
1	A	180	LEU	CA-CB-CG	6.26	129.69	115.30
1	D	447	ARG	NE-CZ-NH2	-6.08	117.26	120.30
1	D	106	ARG	NE-CZ-NH2	-5.91	117.34	120.30
1	A	319	ARG	NE-CZ-NH1	5.25	122.92	120.30
1	D	106	ARG	NE-CZ-NH1	5.16	122.88	120.30
1	A	526	ARG	NE-CZ-NH2	-5.05	117.77	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	213	GLY	Peptide

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	3963	0	4041	30	0
1	B	3949	0	4029	35	0
1	C	3963	0	4041	28	0
1	D	3963	0	4041	29	0
2	A	20	0	10	0	0
2	B	20	0	10	0	0
2	C	20	0	10	1	0
2	D	20	0	10	1	0
3	A	7	0	4	0	0
3	B	7	0	4	1	0
3	C	7	0	4	0	0
3	D	7	0	4	0	0
4	A	6	0	0	0	0
4	B	6	0	0	0	0
4	C	6	0	0	0	0
4	D	6	0	0	1	0
5	A	1	0	0	0	0
5	B	1	0	0	0	0
5	C	1	0	0	0	0
5	D	1	0	0	0	0
6	A	1	0	0	0	0
6	B	1	0	0	0	0
6	C	1	0	0	0	0
6	D	1	0	0	0	0
7	A	13	0	0	0	0
7	B	13	0	0	0	0
7	C	9	0	0	0	0
7	D	10	0	0	0	0
All	All	16023	0	16208	114	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 4.

All (114) 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:A:136:LYS:HG3	1:A:198:GLU:O	1.89	0.72
1:C:106:ARG:NH2	1:C:471:PRO:O	2.24	0.71
1:A:133:GLU:O	1:A:133:GLU:HG2	1.92	0.68
1:B:412:THR:HG22	1:B:512:LEU:HD21	1.74	0.68
1:C:218:LEU:O	1:C:219:PRO:C	2.37	0.62
1:D:123:LEU:HA	1:D:205:SER:HB3	1.82	0.61
1:D:515:TRP:CE3	1:D:516:ARG:HG2	2.35	0.61
1:D:323:PRO:HB3	1:D:465:LEU:O	2.00	0.60
1:D:48:ILE:HG12	1:D:71:VAL:HB	1.84	0.59
1:B:143:THR:HA	1:B:191:ASP:O	2.02	0.59
1:B:466:TYR:HB2	1:B:469:ILE:HD12	1.87	0.57
1:D:515:TRP:CD2	1:D:516:ARG:HG2	2.40	0.56
1:C:393:GLN:O	1:C:397:GLU:HG3	2.06	0.56
1:A:243:SER:HA	1:A:270:LYS:HD3	1.89	0.55
1:C:497:GLY:HA3	1:C:503:PHE:CZ	2.42	0.55
1:D:497:GLY:HA3	1:D:503:PHE:CZ	2.42	0.54
1:A:370:TYR:N	1:A:371:PRO:CD	2.71	0.54
1:C:238:ASP:OD1	1:C:461:ARG:NE	2.40	0.54
1:A:463:ALA:HB1	1:A:469:ILE:HG21	1.90	0.52
1:B:92:ARG:O	1:B:96:GLU:HG2	2.10	0.52
1:A:334:MET:HA	1:A:337:LYS:O	2.11	0.51
1:A:50:THR:HG22	1:A:366:ALA:HB2	1.91	0.51
1:D:393:GLN:O	1:D:397:GLU:HG3	2.11	0.51
1:B:323:PRO:HB3	1:B:465:LEU:O	2.12	0.50
1:D:331:LEU:HD23	1:D:344:GLU:HB3	1.92	0.50
1:C:165:CYS:O	1:C:188:LYS:CE	2.60	0.50
1:D:28:GLU:O	1:D:32:ARG:HG3	2.11	0.50
1:C:311:LYS:HE3	1:D:353:LEU:CD1	2.41	0.50
1:D:466:TYR:HB2	1:D:469:ILE:HD12	1.94	0.50
1:D:514:GLY:HA3	2:D:601:FBP:O3	2.11	0.50
1:B:82:GLU:OE2	1:B:82:GLU:HA	2.11	0.50
1:D:145:ASP:HB3	1:D:148:TYR:HD2	1.77	0.49
1:C:321:GLY:HA2	1:C:443:ARG:HG2	1.94	0.49
1:A:331:LEU:HD23	1:A:344:GLU:HB3	1.95	0.49
1:B:516:ARG:HB2	1:B:517:PRO:CD	2.43	0.48
1:A:466:TYR:HB2	1:A:469:ILE:HD12	1.96	0.48
1:B:175:TYR:HE2	1:B:212:PRO:HG3	1.79	0.48

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:175:TYR:HB3	1:A:179:GLY:HA2	1.96	0.47
1:A:36:ASP:O	1:A:38:PRO:HD3	2.15	0.47
1:D:309:ALA:HB1	1:D:313:MET:HE2	1.97	0.47
1:C:288:ASP:O	1:C:323:PRO:HD2	2.14	0.47
1:A:25:THR:HB	1:B:397:GLU:HG2	1.96	0.47
1:D:205:SER:O	1:D:206:LYS:HB2	2.15	0.47
1:D:272:GLU:HB3	1:D:293:ALA:HB3	1.96	0.47
1:A:443:ARG:HG2	1:A:443:ARG:O	2.15	0.47
1:C:528:VAL:HG12	1:C:529:PRO:O	2.16	0.46
1:A:397:GLU:CD	1:B:25:THR:HB	2.35	0.46
1:C:321:GLY:HA3	1:C:443:ARG:HD3	1.98	0.46
1:B:99:ALA:O	1:B:100:SER:C	2.54	0.46
1:C:48:ILE:HG12	1:C:71:VAL:HB	1.98	0.46
1:D:325:ILE:HG12	1:D:358:CYS:HB2	1.98	0.46
1:B:400:ARG:CZ	1:D:392:LEU:HD21	2.46	0.45
1:A:418:GLU:HG2	1:C:418:GLU:OE1	2.17	0.45
1:D:144:LEU:HD13	1:D:162:LYS:O	2.17	0.45
1:A:25:THR:HB	1:B:397:GLU:CG	2.46	0.45
1:A:416:ALA:HB2	1:A:512:LEU:HD11	1.98	0.45
1:C:127:SER:HB3	1:C:130:ALA:HB2	1.98	0.45
1:B:516:ARG:HB2	1:B:517:PRO:HD2	1.98	0.45
1:D:416:ALA:HB2	1:D:512:LEU:HD11	1.99	0.45
1:B:36:ASP:O	1:B:38:PRO:HD3	2.17	0.44
1:C:409:THR:HG23	1:C:522:THR:HB	1.99	0.44
1:D:40:ILE:HD12	1:D:42:ALA:HB3	1.99	0.44
1:A:337:LYS:HD2	1:B:180:LEU:HD22	1.98	0.44
1:B:188:LYS:HG2	1:B:189:GLY:H	1.82	0.44
1:D:190:ALA:O	1:D:191:ASP:CB	2.65	0.44
1:C:321:GLY:CA	1:C:443:ARG:HG2	2.48	0.44
1:C:438:ALA:HB1	1:C:469:ILE:HD13	1.99	0.44
1:B:141:LYS:HB3	1:B:156:ILE:HD13	1.99	0.43
1:B:228:ASP:O	1:B:231:PHE:HB3	2.18	0.43
1:C:325:ILE:HG12	1:C:358:CYS:HB2	2.01	0.43
1:C:514:GLY:HA3	2:C:601:FBP:O3	2.17	0.43
1:D:296:ASP:OD2	4:D:603:PYR:O	2.35	0.43
1:A:226:ILE:O	1:A:227:GLN:C	2.54	0.43
1:B:407:ASP:HA	1:B:408:PRO:HD2	1.90	0.43
1:B:325:ILE:HG12	1:B:358:CYS:HB2	2.00	0.43
1:A:136:LYS:CG	1:A:198:GLU:O	2.63	0.43
1:B:174:ILE:HG12	1:B:211:LEU:CD2	2.49	0.43
1:B:186:LYS:O	1:B:187:GLN:HG2	2.19	0.43

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:248:ALA:O	1:D:251:VAL:N	2.51	0.43
1:B:436:ARG:HG2	1:B:436:ARG:HH11	1.83	0.43
1:D:406:SER:O	1:D:408:PRO:HD3	2.19	0.43
1:C:486:VAL:O	1:C:487:ASP:C	2.57	0.43
1:D:71:VAL:HG22	1:D:109:ALA:HB3	2.00	0.43
1:B:503:PHE:CD1	1:B:530:VAL:HG21	2.53	0.42
1:A:497:GLY:HA3	1:A:503:PHE:CZ	2.53	0.42
1:A:301:ILE:HB	1:A:302:PRO:HD2	2.02	0.42
1:A:338:PRO:HB3	1:A:370:TYR:CE1	2.55	0.42
1:A:142:ILE:HA	1:A:157:LEU:O	2.20	0.42
1:D:84:HIS:O	1:D:87:THR:N	2.50	0.42
1:A:222:SER:O	1:A:226:ILE:HG13	2.19	0.42
1:D:164:ILE:HD12	1:D:193:LEU:HD11	2.02	0.42
1:B:190:ALA:O	1:B:191:ASP:CB	2.68	0.42
1:B:14:GLN:O	1:B:14:GLN:HG3	2.20	0.42
1:C:168:VAL:O	1:C:188:LYS:HE3	2.20	0.42
1:C:297:LEU:O	1:C:301:ILE:HG12	2.19	0.41
1:A:18:LEU:HD23	1:A:18:LEU:HA	1.84	0.41
1:B:48:ILE:HG12	1:B:71:VAL:HB	2.00	0.41
1:B:317:CYS:HB3	1:B:322:LYS:O	2.20	0.41
1:C:507:ASP:O	1:C:530:VAL:HG23	2.20	0.41
1:A:400:ARG:NH2	1:C:22:MET:O	2.53	0.41
1:B:175:TYR:CE2	1:B:212:PRO:HG3	2.55	0.41
1:B:178:ASP:N	1:B:178:ASP:OD1	2.53	0.41
1:C:332:GLU:HA	1:C:332:GLU:OE1	2.20	0.41
1:B:142:ILE:O	1:B:192:PHE:HA	2.20	0.41
1:A:63:GLU:OE2	1:A:66:LYS:NZ	2.49	0.41
1:B:140:LEU:HD21	1:B:157:LEU:HD22	2.03	0.41
1:A:40:ILE:HD12	1:A:42:ALA:HB3	2.02	0.41
1:C:144:LEU:HD13	1:C:162:LYS:O	2.20	0.41
1:C:223:GLU:OE2	1:C:223:GLU:N	2.49	0.41
1:D:125:LYS:H	1:D:125:LYS:HG3	1.71	0.41
1:B:159:LEU:HD12	1:B:164:ILE:CD1	2.51	0.40
1:C:143:THR:HG21	1:C:156:ILE:HD11	2.04	0.40
1:B:43:ARG:O	3:B:602:SER:HB2	2.21	0.40
1:A:60:THR:O	1:A:64:MET:HG2	2.21	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	516/551 (94%)	493 (96%)	22 (4%)	1 (0%)	47	64
1	B	511/551 (93%)	490 (96%)	19 (4%)	2 (0%)	34	48
1	C	516/551 (94%)	494 (96%)	19 (4%)	3 (1%)	25	37
1	D	516/551 (94%)	487 (94%)	25 (5%)	4 (1%)	19	28
All	All	2059/2204 (93%)	1964 (95%)	85 (4%)	10 (0%)	29	43

All (10) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	328	THR
1	D	191	ASP
1	C	125	LYS
1	D	138	ALA
1	B	191	ASP
1	C	126	GLY
1	C	328	THR
1	D	206	LYS
1	D	328	THR
1	B	328	THR

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	426/453 (94%)	404 (95%)	22 (5%)	23	36

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	425/453 (94%)	400 (94%)	25 (6%)	19	30
1	C	426/453 (94%)	400 (94%)	26 (6%)	18	29
1	D	426/453 (94%)	406 (95%)	20 (5%)	26	40
All	All	1703/1812 (94%)	1610 (94%)	93 (6%)	22	33

All (93) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	97	SER
1	A	125	LYS
1	A	127	SER
1	A	133	GLU
1	A	134	LEU
1	A	135	LYS
1	A	139	THR
1	A	156	ILE
1	A	180	LEU
1	A	186	LYS
1	A	191	ASP
1	A	224	LYS
1	A	234	GLU
1	A	253	GLU
1	A	272	GLU
1	A	400	ARG
1	A	414	VAL
1	A	422	LYS
1	A	424	CYS
1	A	436	ARG
1	A	498	LYS
1	A	505	LYS
1	B	37	SER
1	B	56	ARG
1	B	74	LEU
1	B	134	LEU
1	B	139	THR
1	B	156	ILE
1	B	162	LYS
1	B	172	SER
1	B	182	SER
1	B	224	LYS
1	B	230	LYS

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	B	260	GLU
1	B	261	LYS
1	B	272	GLU
1	B	275	GLU
1	B	337	LYS
1	B	396	GLU
1	B	400	ARG
1	B	401	LEU
1	B	424	CYS
1	B	436	ARG
1	B	443	ARG
1	B	504	LYS
1	B	505	LYS
1	B	508	VAL
1	C	14	GLN
1	C	24	ASP
1	C	56	ARG
1	C	59	GLU
1	C	135	LYS
1	C	154	GLU
1	C	155	ASN
1	C	173	LYS
1	C	186	LYS
1	C	187	GLN
1	C	188	LYS
1	C	191	ASP
1	C	202	SER
1	C	226	ILE
1	C	256	LYS
1	C	272	GLU
1	C	288	ASP
1	C	346	SER
1	C	401	LEU
1	C	418	GLU
1	C	436	ARG
1	C	484	GLU
1	C	491	ASN
1	C	505	LYS
1	C	512	LEU
1	C	519	SER
1	D	97	SER
1	D	125	LYS

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	D	140	LEU
1	D	146	ASN
1	D	162	LYS
1	D	164	ILE
1	D	186	LYS
1	D	187	GLN
1	D	188	LYS
1	D	205	SER
1	D	230	LYS
1	D	261	LYS
1	D	275	GLU
1	D	339	ARG
1	D	392	LEU
1	D	396	GLU
1	D	480	GLU
1	D	504	LYS
1	D	505	LYS
1	D	508	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	479	GLN
1	B	264	ASN
1	C	155	ASN
1	C	184	GLN
1	D	146	ASN
1	D	187	GLN
1	D	318	ASN
1	D	479	GLN

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 (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 20 ligands modelled in this entry, 8 are monoatomic - leaving 12 for Mogul analysis.

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	FBP	D	601	-	18,20,20	1.03	1 (5%)	23,32,32	1.19	3 (13%)
3	SER	B	602	-	5,6,6	0.63	0	5,7,7	1.85	2 (40%)
3	SER	C	602	-	5,6,6	1.16	1 (20%)	5,7,7	2.34	2 (40%)
2	FBP	B	601	-	18,20,20	0.75	0	23,32,32	1.13	3 (13%)
2	FBP	C	601	-	18,20,20	0.76	0	23,32,32	1.24	4 (17%)
3	SER	D	602	-	5,6,6	0.85	0	5,7,7	2.16	2 (40%)
3	SER	A	602	-	5,6,6	0.72	0	5,7,7	1.97	2 (40%)
4	PYR	B	603	5	5,5,5	1.42	1 (20%)	3,6,6	1.41	1 (33%)
2	FBP	A	601	-	18,20,20	0.67	0	23,32,32	1.38	3 (13%)
4	PYR	C	603	5	5,5,5	1.34	0	3,6,6	2.01	1 (33%)
4	PYR	A	603	5	5,5,5	1.60	1 (20%)	3,6,6	0.79	0
4	PYR	D	603	5	5,5,5	1.78	1 (20%)	3,6,6	2.41	1 (33%)

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	FBP	D	601	-	-	3/13/32/32	0/1/1/1
3	SER	B	602	-	-	0/6/6/6	-
3	SER	C	602	-	-	0/6/6/6	-
2	FBP	B	601	-	-	2/13/32/32	0/1/1/1

Continued on next page...

Continued from previous page...

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	FBP	C	601	-	-	5/13/32/32	0/1/1/1
3	SER	D	602	-	-	0/6/6/6	-
3	SER	A	602	-	-	0/6/6/6	-
4	PYR	B	603	5	-	0/4/4/4	-
2	FBP	A	601	-	-	9/13/32/32	0/1/1/1
4	PYR	C	603	5	-	0/4/4/4	-
4	PYR	A	603	5	-	0/4/4/4	-
4	PYR	D	603	5	-	3/4/4/4	-

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	D	603	PYR	CA-C	-3.54	1.41	1.54
4	A	603	PYR	CA-C	-2.67	1.44	1.54
2	D	601	FBP	O5-C2	2.46	1.47	1.43
4	B	603	PYR	CA-C	-2.40	1.45	1.54
3	C	602	SER	OXT-C	-2.23	1.23	1.30

All (24) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	D	602	SER	OXT-C-O	-3.93	115.16	124.09
4	D	603	PYR	O3-CA-CB	3.70	127.93	119.73
3	C	602	SER	OXT-C-O	-3.53	116.06	124.09
3	C	602	SER	OXT-C-CA	3.52	125.38	113.38
3	A	602	SER	OXT-C-O	-3.41	116.34	124.09
2	A	601	FBP	O6P-P2-O5P	3.31	120.31	107.64
3	B	602	SER	OXT-C-CA	2.96	123.45	113.38
2	D	601	FBP	O3P-P1-O1	-2.76	99.39	106.73
3	D	602	SER	OXT-C-CA	2.70	122.60	113.38
3	B	602	SER	OXT-C-O	-2.66	118.06	124.09
2	A	601	FBP	O5P-P2-O6	-2.64	99.70	106.73
3	A	602	SER	OXT-C-CA	2.63	122.33	113.38
4	C	603	PYR	OXT-C-CA	2.62	121.15	113.97
2	B	601	FBP	O3P-P1-O1	-2.58	99.87	106.73
2	B	601	FBP	O3P-P1-O2P	2.47	117.06	107.64
2	A	601	FBP	P1-O1-C1	2.42	124.96	118.30
2	D	601	FBP	O6P-P2-O5P	2.41	116.86	107.64
2	D	601	FBP	O3P-P1-O2P	2.33	116.53	107.64
2	C	601	FBP	O3P-P1-O1	-2.29	100.65	106.73
2	C	601	FBP	O3P-P1-O2P	2.19	116.01	107.64

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	C	601	FBP	O6P-P2-O5P	2.16	115.89	107.64
2	C	601	FBP	O5-C5-C6	2.09	114.06	109.45
2	B	601	FBP	O6P-P2-O5P	2.06	115.50	107.64
4	B	603	PYR	O3-CA-CB	2.03	124.24	119.73

There are no chirality outliers.

All (22) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	601	FBP	C1-O1-P1-O1P
2	A	601	FBP	C1-O1-P1-O2P
2	A	601	FBP	C1-O1-P1-O3P
2	A	601	FBP	O1-C1-C2-O2
2	A	601	FBP	O1-C1-C2-C3
2	A	601	FBP	O1-C1-C2-O5
2	B	601	FBP	C4-C5-C6-O6
2	C	601	FBP	C1-O1-P1-O1P
4	D	603	PYR	O-C-CA-CB
4	D	603	PYR	OXT-C-CA-CB
2	A	601	FBP	C4-C5-C6-O6
2	C	601	FBP	C4-C5-C6-O6
2	D	601	FBP	C4-C5-C6-O6
2	A	601	FBP	O5-C5-C6-O6
2	B	601	FBP	O5-C5-C6-O6
2	D	601	FBP	O5-C5-C6-O6
2	C	601	FBP	O5-C5-C6-O6
2	C	601	FBP	C1-O1-P1-O3P
2	A	601	FBP	C6-O6-P2-O4P
2	D	601	FBP	C6-O6-P2-O4P
4	D	603	PYR	OXT-C-CA-O3
2	C	601	FBP	C1-O1-P1-O2P

There are no ring outliers.

4 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	D	601	FBP	1	0
3	B	602	SER	1	0
2	C	601	FBP	1	0
4	D	603	PYR	1	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 FBP D 601

Bond lengths

Bond angles

Torsions

Rings

Ligand FBP B 601

Bond lengths

Bond angles

Torsions

Rings

Ligand FBP C 601

Bond lengths

Bond angles

Torsions

Rings

Ligand FBP A 601
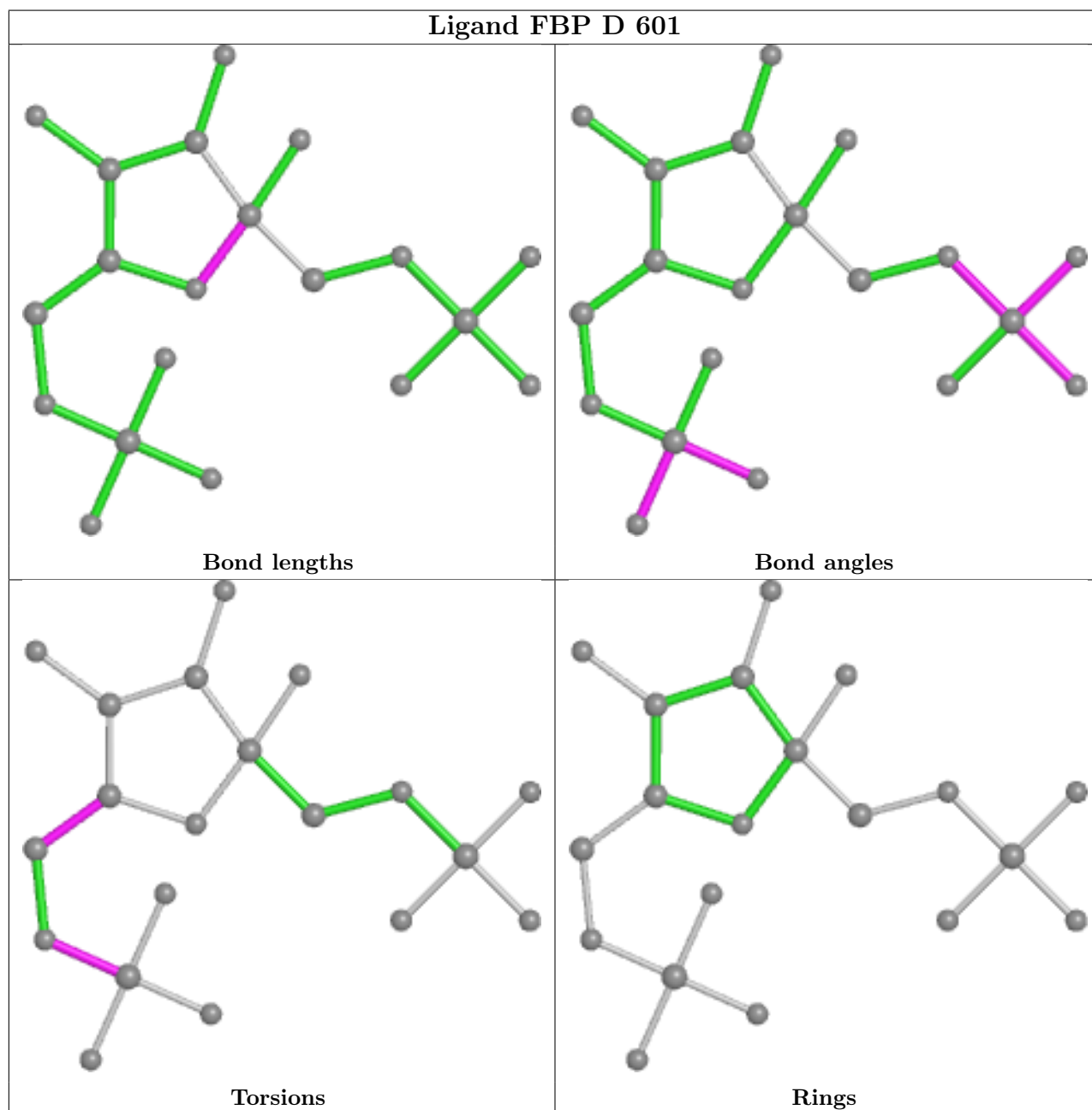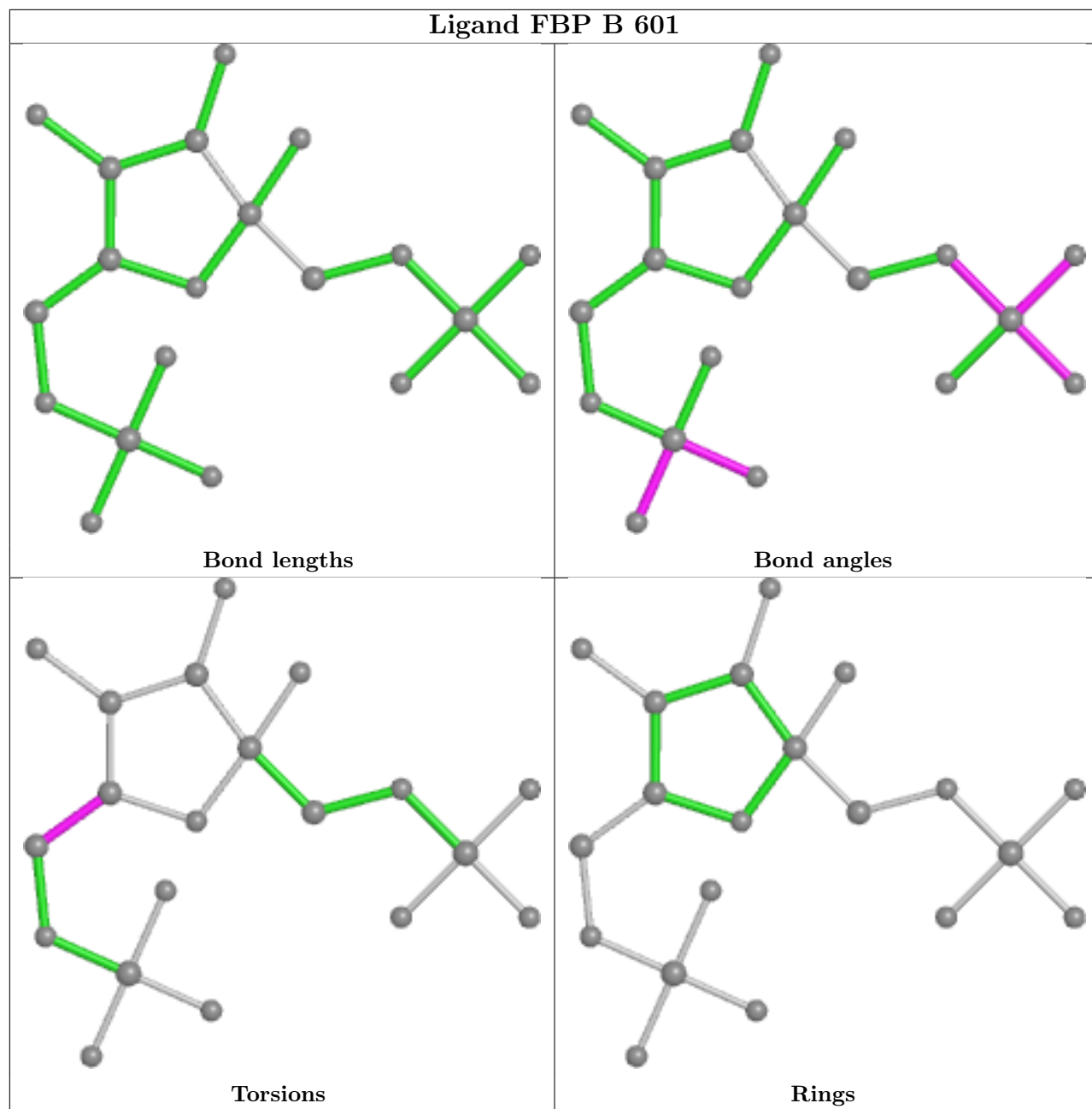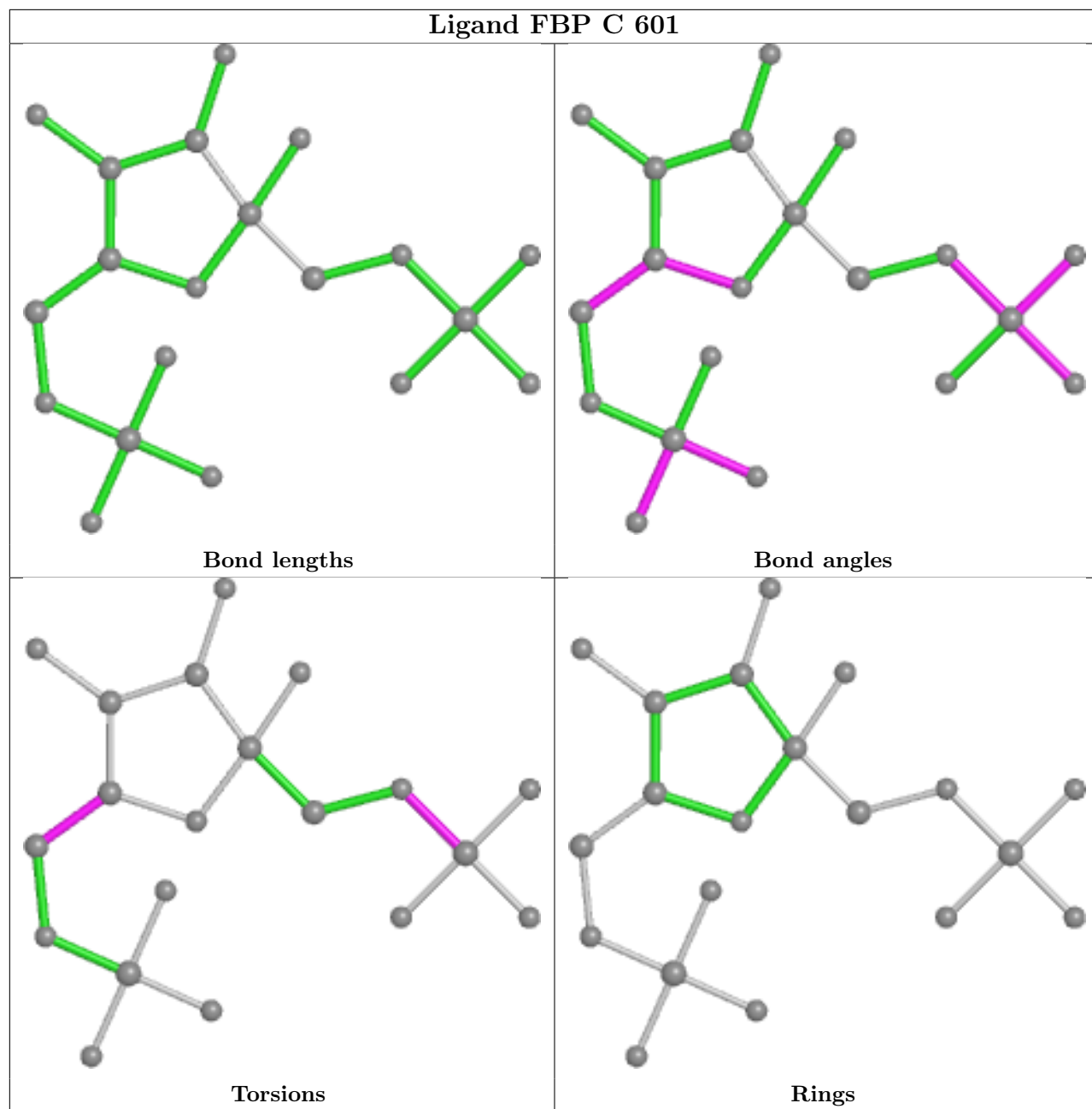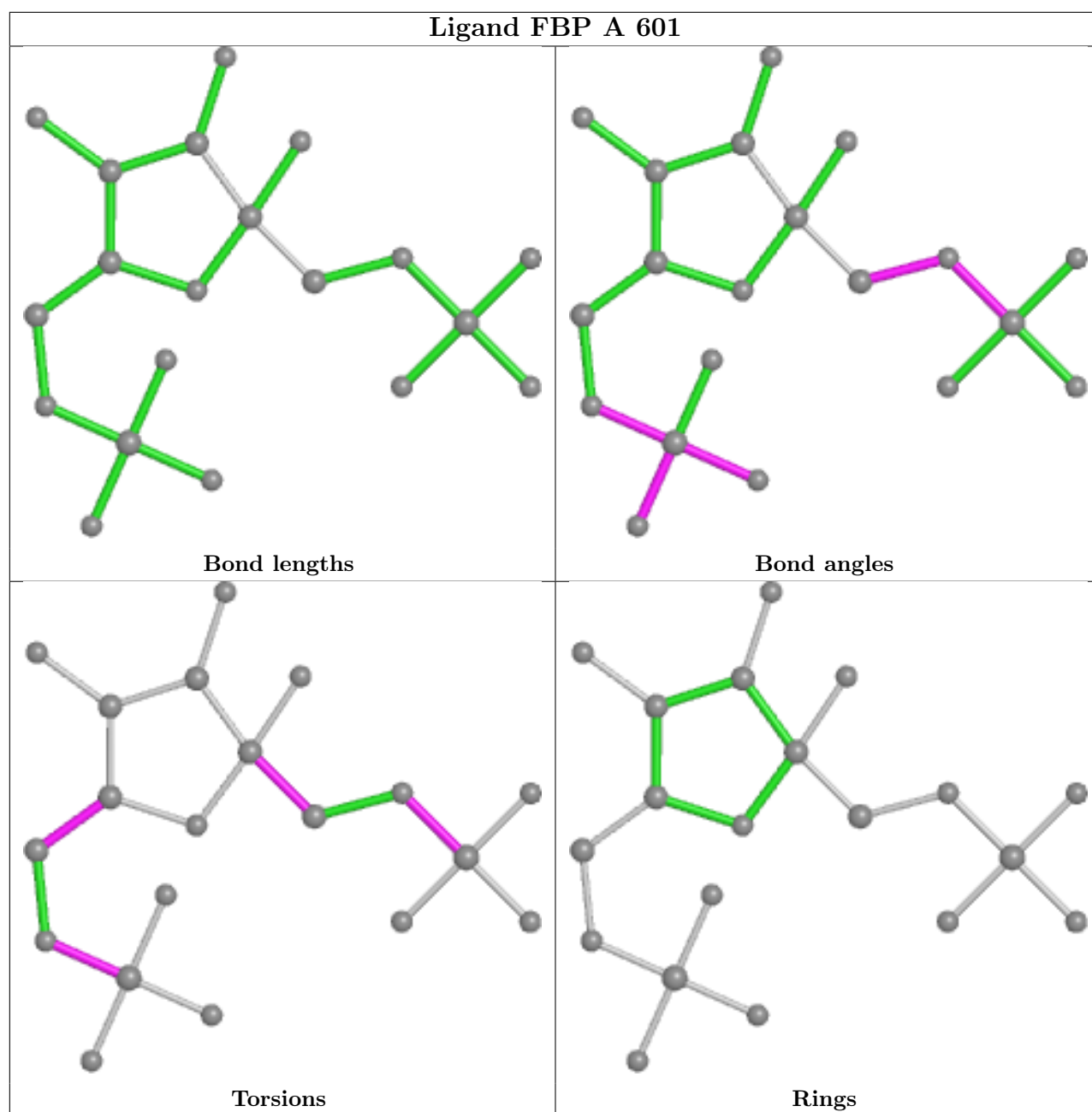
5.7 Other polymers ⓘ

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	518/551 (94%)	-0.55	3 (0%)	89	88	19, 35, 61, 102	0
1	B	515/551 (93%)	-0.50	7 (1%)	75	73	23, 35, 81, 119	0
1	C	518/551 (94%)	-0.43	7 (1%)	75	73	23, 40, 77, 108	0
1	D	518/551 (94%)	-0.39	0	100	100	23, 41, 79, 100	0
All	All	2069/2204 (93%)	-0.47	17 (0%)	86	85	19, 38, 77, 119	0

All (17) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	217	ASP	3.5
1	C	403	PRO	3.2
1	B	191	ASP	3.1
1	B	215	ALA	3.0
1	A	133	GLU	2.8
1	C	480	GLU	2.8
1	B	130	ALA	2.7
1	C	481	ALA	2.5
1	C	128	GLY	2.5
1	B	187	GLN	2.5
1	B	129	THR	2.4
1	A	404	ILE	2.4
1	C	127	SER	2.3
1	A	129	THR	2.3
1	C	126	GLY	2.2
1	B	125	LYS	2.2
1	C	191	ASP	2.1

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

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

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
3	SER	A	602	7/7	0.91	0.19	31,37,38,39	0
3	SER	B	602	7/7	0.91	0.25	39,44,47,47	0
6	K	C	605	1/1	0.92	0.13	44,44,44,44	0
3	SER	C	602	7/7	0.93	0.21	44,44,50,51	0
4	PYR	D	603	6/6	0.94	0.21	40,41,45,46	0
3	SER	D	602	7/7	0.95	0.31	42,46,50,55	0
5	MG	A	604	1/1	0.96	0.23	28,28,28,28	0
5	MG	B	604	1/1	0.96	0.24	33,33,33,33	0
5	MG	D	604	1/1	0.96	0.27	46,46,46,46	0
4	PYR	C	603	6/6	0.96	0.17	30,34,36,38	0
6	K	A	605	1/1	0.97	0.14	44,44,44,44	0
6	K	B	605	1/1	0.97	0.07	42,42,42,42	0
4	PYR	B	603	6/6	0.97	0.17	24,25,32,35	0
6	K	D	605	1/1	0.97	0.08	52,52,52,52	0
2	FBP	D	601	20/20	0.98	0.09	20,26,31,31	0
2	FBP	A	601	20/20	0.98	0.09	22,28,33,36	0
4	PYR	A	603	6/6	0.98	0.19	36,38,38,41	0
2	FBP	C	601	20/20	0.98	0.10	27,31,40,41	0
5	MG	C	604	1/1	0.98	0.23	35,35,35,35	0
2	FBP	B	601	20/20	0.99	0.09	21,25,32,34	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.
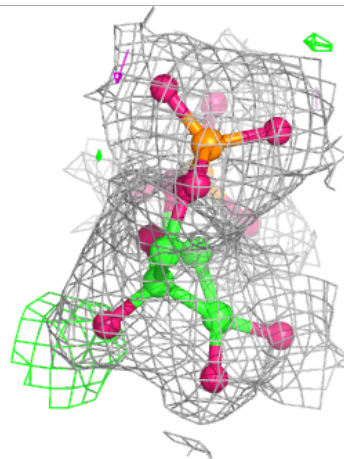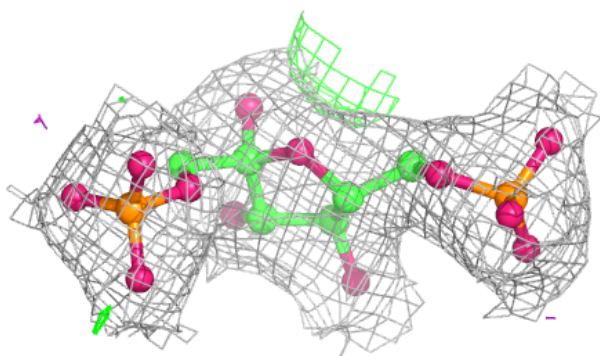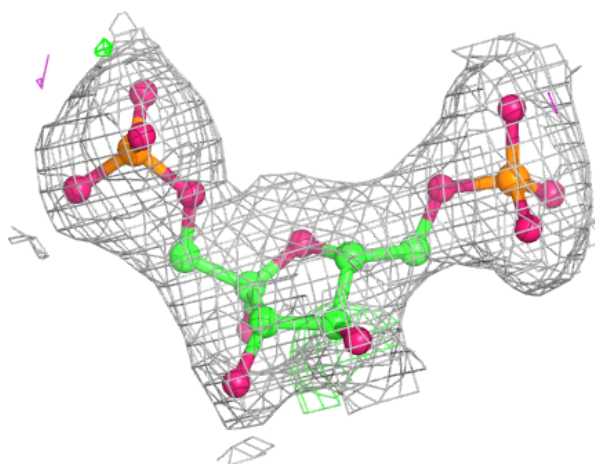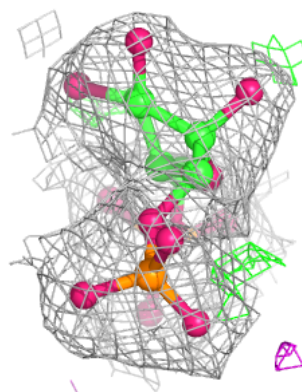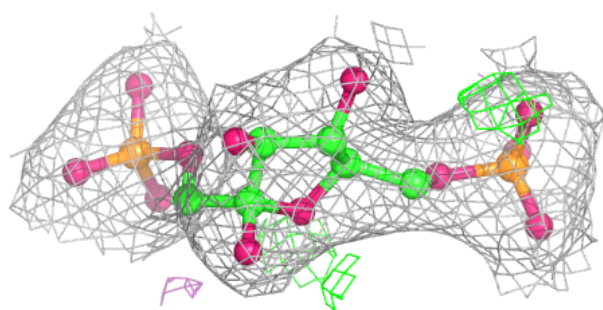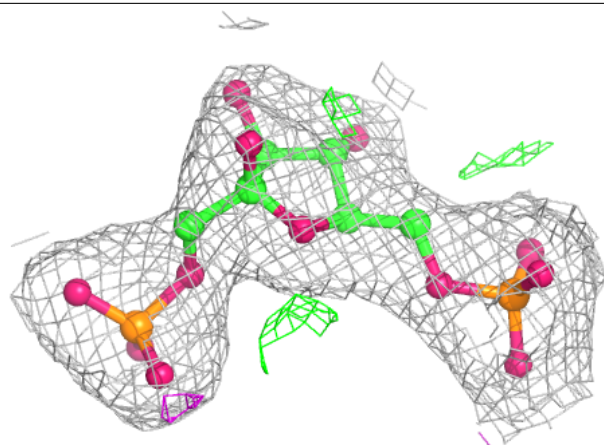
Electron density around FBP D 601:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
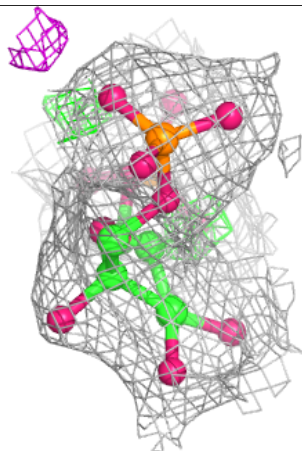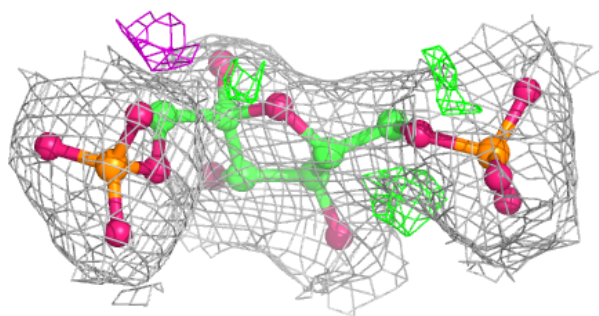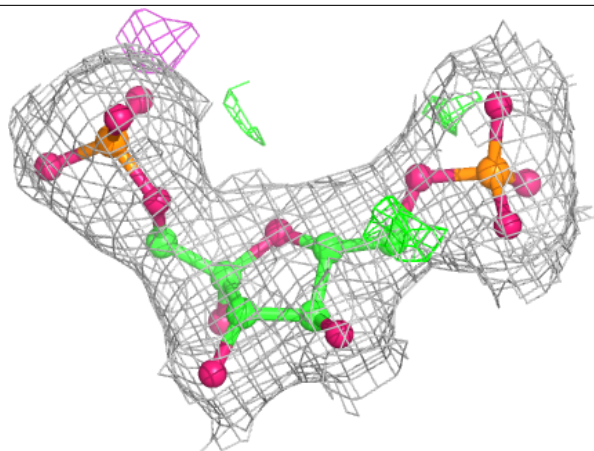
Electron density around FBP A 601:

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 FBP C 601:

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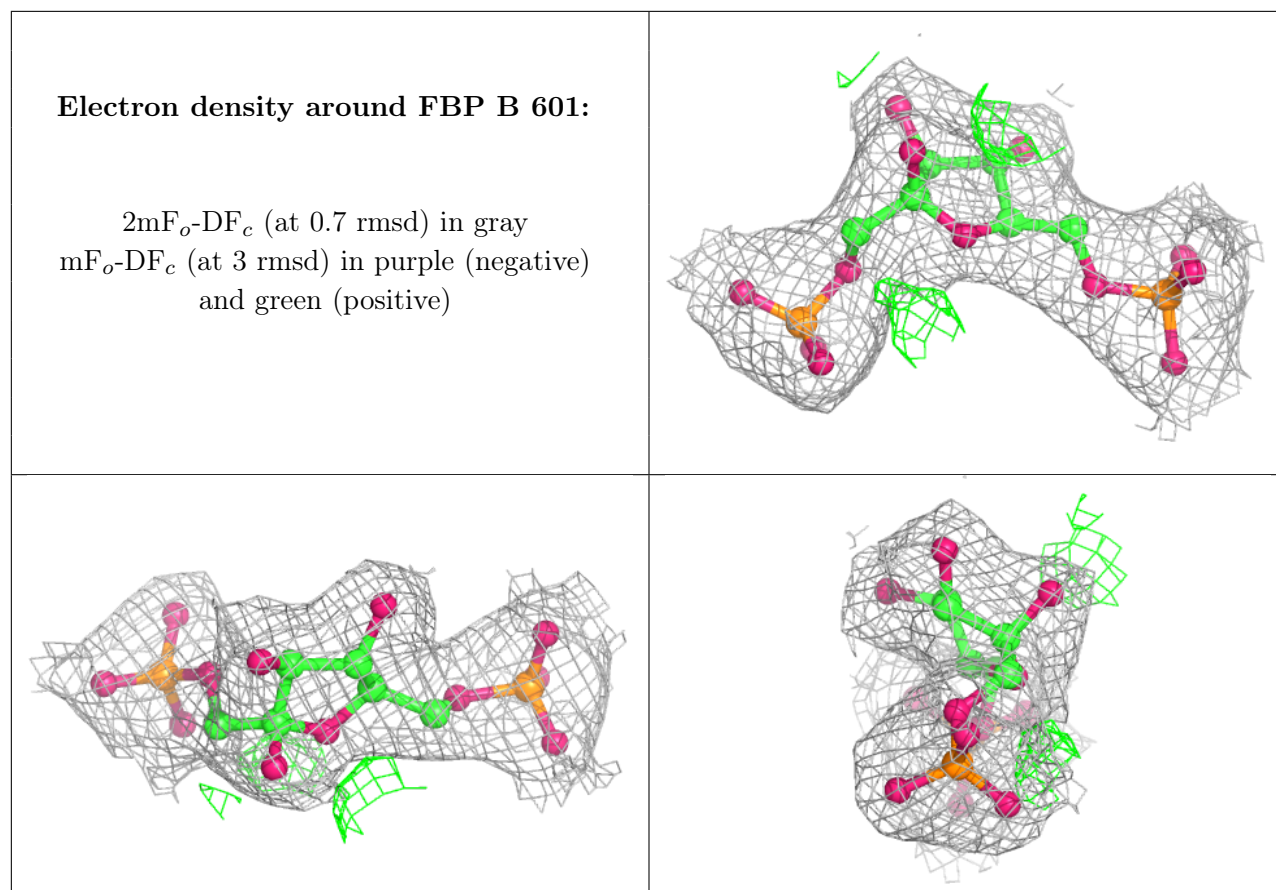and green (positive)

Electron density around FBP B 601:

$2mF_o$-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.