



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 17, 2026 – 06:10 PM UTC

PDB ID : 3MCO / pdb_00003mco
Title : Crystal Structure of the 6-hydroxymethyl-7,8-dihydropterin pyrophosphokinase dihydropteroate synthase bifunctional enzyme from Francisella tularensis
Authors : Pemble IV, C.W.; Mehta, P.K.; Mehra, S.; Li, Z.; Lee, R.E.; White, S.W.
Deposited on : 2010-03-29
Resolution : 2.30 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

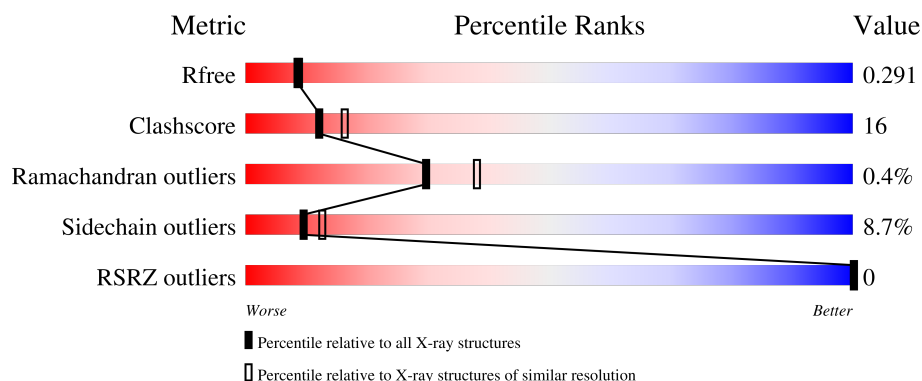
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	442	
1	B	442	

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 6506 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 2-amino-4-hydroxy-6-hydroxymethyldihydropteridine pyrophosphokinase/dihydropteroate synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	397	Total	C	N	O	S	0	0	0
			3208	2058	552	592	6			
1	B	386	Total	C	N	O	S	0	0	0
			3119	2000	539	574	6			

There are 44 discrepancies between the modelled and reference sequences:

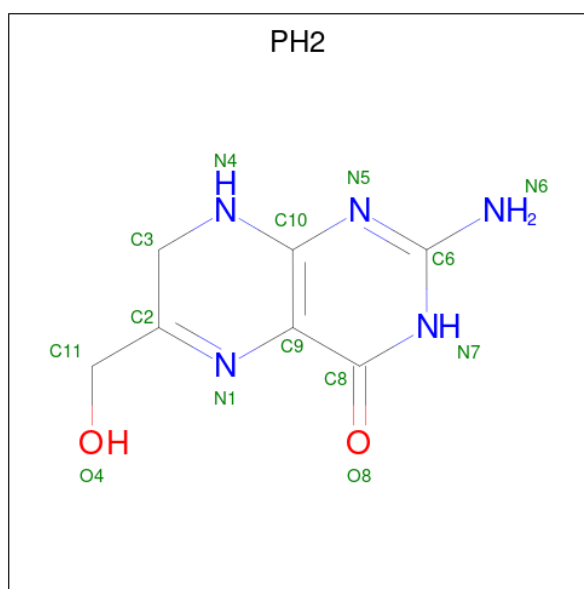
Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	expression tag	UNP Q2A2W3
A	-18	GLY	-	expression tag	UNP Q2A2W3
A	-17	SER	-	expression tag	UNP Q2A2W3
A	-16	SER	-	expression tag	UNP Q2A2W3
A	-15	HIS	-	expression tag	UNP Q2A2W3
A	-14	HIS	-	expression tag	UNP Q2A2W3
A	-13	HIS	-	expression tag	UNP Q2A2W3
A	-12	HIS	-	expression tag	UNP Q2A2W3
A	-11	HIS	-	expression tag	UNP Q2A2W3
A	-10	HIS	-	expression tag	UNP Q2A2W3
A	-9	SER	-	expression tag	UNP Q2A2W3
A	-8	SER	-	expression tag	UNP Q2A2W3
A	-7	GLY	-	expression tag	UNP Q2A2W3
A	-6	LEU	-	expression tag	UNP Q2A2W3
A	-5	VAL	-	expression tag	UNP Q2A2W3
A	-4	PRO	-	expression tag	UNP Q2A2W3
A	-3	ARG	-	expression tag	UNP Q2A2W3
A	-2	GLY	-	expression tag	UNP Q2A2W3
A	-1	SER	-	expression tag	UNP Q2A2W3
A	0	HIS	-	expression tag	UNP Q2A2W3
A	1	MET	-	expression tag	UNP Q2A2W3
A	2	VAL	-	expression tag	UNP Q2A2W3
B	-19	MET	-	expression tag	UNP Q2A2W3
B	-18	GLY	-	expression tag	UNP Q2A2W3

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-17	SER	-	expression tag	UNP Q2A2W3
B	-16	SER	-	expression tag	UNP Q2A2W3
B	-15	HIS	-	expression tag	UNP Q2A2W3
B	-14	HIS	-	expression tag	UNP Q2A2W3
B	-13	HIS	-	expression tag	UNP Q2A2W3
B	-12	HIS	-	expression tag	UNP Q2A2W3
B	-11	HIS	-	expression tag	UNP Q2A2W3
B	-10	HIS	-	expression tag	UNP Q2A2W3
B	-9	SER	-	expression tag	UNP Q2A2W3
B	-8	SER	-	expression tag	UNP Q2A2W3
B	-7	GLY	-	expression tag	UNP Q2A2W3
B	-6	LEU	-	expression tag	UNP Q2A2W3
B	-5	VAL	-	expression tag	UNP Q2A2W3
B	-4	PRO	-	expression tag	UNP Q2A2W3
B	-3	ARG	-	expression tag	UNP Q2A2W3
B	-2	GLY	-	expression tag	UNP Q2A2W3
B	-1	SER	-	expression tag	UNP Q2A2W3
B	0	HIS	-	expression tag	UNP Q2A2W3
B	1	MET	-	expression tag	UNP Q2A2W3
B	2	VAL	-	expression tag	UNP Q2A2W3

- Molecule 2 is 2-AMINO-6-HYDROXYMETHYL-7,8-DIHYDRO-3H-PTERIDIN-4-ONE (CCD ID: PH2) (formula: C₇H₉N₅O₂).



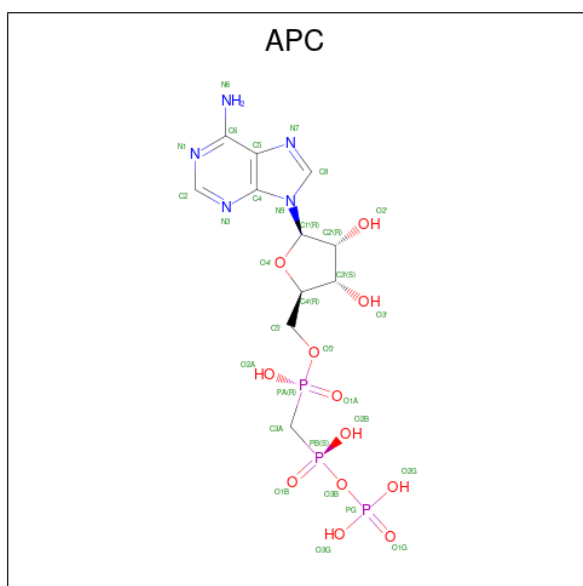
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			14	7	5	2		

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			14	7	5	2		
2	B	1	Total	C	N	O	0	0
			14	7	5	2		
2	B	1	Total	C	N	O	0	0
			14	7	5	2		

- Molecule 3 is DIPHOSPHOMETHYLPHOSPHONIC ACID ADENOSYL ESTER (CCD ID: APC) (formula: $C_{11}H_{18}N_5O_{12}P_3$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			31	11	5	12	3		
3	B	1	Total	C	N	O	P	0	0
			31	11	5	12	3		

- Molecule 4 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

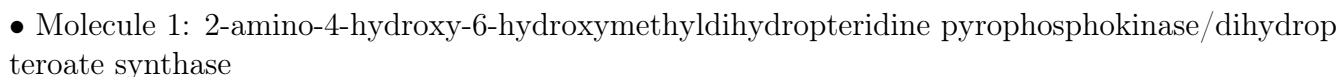
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	2	Total	Mg	0	0
			2	2		
4	B	2	Total	Mg	0	0
			2	2		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	29	Total 29	O 29	0	0
5	B	28	Total 28	O 28	0	0

- Molecule 1: 2-amino-4-hydroxy-6-hydroxymethyldihydropteridine pyrophosphokinase/dihydropterotate synthase

59% 27% 10%



57% 27% • 13%



T390	K391	ASP	SER	ASN	L395	R400	A401	T402	R403	E404	L405	S406	R407	K408	L409	E410	K411	L412	D413	I414	R418	V419	I422
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4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	42.52Å 58.47Å 109.33Å 82.00° 81.00° 68.08°	Depositor
Resolution (Å)	38.25 – 2.30 38.25 – 2.30	Depositor EDS
% Data completeness (in resolution range)	95.7 (38.25-2.30) 85.6 (38.25-2.30)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.71 (at 2.29Å)	Xtriage
Refinement program	PHENIX 1.5_2	Depositor
R, R_{free}	0.241 , 0.294 0.239 , 0.291	Depositor DCC
R_{free} test set	2090 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å ²)	36.7	Xtriage
Anisotropy	0.061	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 36.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.108 for h,h-k,h-l	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	6506	wwPDB-VP
Average B, all atoms (Å ²)	40.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.38% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: APC, PH2, MG

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	0.58	0/3255	0.91	9/4384 (0.2%)
1	B	0.59	0/3160	0.88	1/4250 (0.0%)
All	All	0.58	0/6415	0.89	10/8634 (0.1%)

There are no bond length outliers.

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	186	ASP	N-CA-C	6.60	119.58	110.35
1	A	217	LYS	CA-C-N	5.90	127.22	119.84
1	A	217	LYS	C-N-CA	5.90	127.22	119.84
1	A	89	ASP	N-CA-C	5.77	117.35	110.19
1	A	272	ILE	CB-CA-C	-5.28	105.14	111.85
1	A	297	LYS	N-CA-C	-5.20	103.17	110.50
1	B	343	ILE	N-CA-C	5.18	115.31	107.75
1	A	383	LYS	CA-C-N	5.14	125.43	119.47
1	A	383	LYS	C-N-CA	5.14	125.43	119.47
1	A	186	ASP	CB-CA-C	-5.12	101.52	109.61

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	3208	0	3342	104	0
1	B	3119	0	3269	101	0
2	A	28	0	16	0	0
2	B	28	0	16	0	0
3	A	31	0	14	0	0
3	B	31	0	14	1	0
4	A	2	0	0	0	0
4	B	2	0	0	0	0
5	A	29	0	0	2	0
5	B	28	0	0	0	0
All	All	6506	0	6671	205	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 16.

All (205) 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:319:ILE:HD13	1:B:319:ILE:H	1.21	1.05
1:A:92:ALA:HB1	1:A:93:PRO:HD2	1.42	0.98
1:A:88:ARG:NH2	1:A:98:ARG:HH21	1.71	0.87
1:B:44:LYS:HE2	1:B:58:ARG:HH12	1.40	0.86
1:A:349:PHE:O	1:A:383:LYS:HE2	1.76	0.85
1:A:240:LYS:HA	1:A:243:LEU:HD13	1.67	0.77
1:A:330:LYS:HA	1:A:333:LEU:HD12	1.67	0.76
1:A:194:ARG:HG2	1:A:194:ARG:HH11	1.51	0.75
1:B:11:ASN:HD21	1:B:98:ARG:HB3	1.51	0.75
1:B:34:ILE:HD13	1:B:64:VAL:HG21	1.68	0.75
1:A:194:ARG:HH11	1:A:194:ARG:CG	2.00	0.74
1:B:319:ILE:H	1:B:319:ILE:CD1	2.00	0.73
1:A:279:VAL:HA	1:A:301:ILE:HD12	1.71	0.73
1:A:193:GLN:HG3	1:A:194:ARG:HD3	1.71	0.72
1:A:357:THR:O	1:A:361:LEU:HD13	1.88	0.72
1:A:206:ALA:HB2	1:A:422:ILE:HD11	1.72	0.70
1:A:233:ASN:OD1	1:A:269:HIS:HE1	1.73	0.70
1:B:400:ARG:HB2	1:B:400:ARG:NH1	2.06	0.70
1:B:349:PHE:O	1:B:383:LYS:HE2	1.90	0.70
1:A:199:ASP:O	1:A:203:GLN:HG2	1.92	0.70
1:B:284:ILE:HD11	1:B:333:LEU:HD21	1.78	0.66
1:A:38:ALA:HA	5:A:434:HOH:O	1.94	0.66
1:B:285:GLU:O	1:B:289:GLN:HG3	1.95	0.66
1:B:58:ARG:HD3	1:B:247:ILE:HA	1.76	0.66

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:182:GLN:HE22	1:A:216:THR:HB	1.59	0.66
1:A:382:ARG:O	1:A:384:PRO:HD3	1.95	0.66
1:A:407:ARG:NH1	1:A:410:GLU:OE1	2.30	0.65
1:B:44:LYS:HE2	1:B:58:ARG:NH1	2.12	0.64
1:B:330:LYS:O	1:B:334:LEU:HD13	1.98	0.64
1:A:343:ILE:HB	1:A:374:LEU:HD22	1.79	0.64
1:A:364:ASN:O	1:A:368:ILE:HG12	1.97	0.64
1:A:88:ARG:HH22	1:A:98:ARG:HH21	1.46	0.64
1:A:118:THR:HG21	1:A:122:LYS:HE3	1.79	0.62
1:B:302:HIS:HD2	1:B:325:TYR:CD1	2.17	0.62
1:B:322:VAL:O	1:B:326:ILE:HG12	2.00	0.61
1:B:182:GLN:HE22	1:B:216:THR:HB	1.64	0.61
1:A:111:ILE:HD11	1:A:144:PRO:HB2	1.82	0.61
1:A:338:ILE:HD11	1:A:343:ILE:HD11	1.83	0.61
1:A:112:LEU:O	1:A:118:THR:HA	2.01	0.61
1:A:119:ILE:HA	1:A:120:PRO:C	2.26	0.60
1:A:194:ARG:CG	1:A:194:ARG:NH1	2.64	0.60
1:B:319:ILE:HD13	1:B:319:ILE:N	2.06	0.60
1:B:281:CYS:HB3	1:B:329:LYS:NZ	2.17	0.59
1:B:58:ARG:HD3	1:B:246:LEU:O	2.02	0.58
1:B:343:ILE:O	1:B:374:LEU:HD22	2.03	0.58
1:A:252:VAL:HG13	1:A:272:ILE:O	2.03	0.58
1:A:281:CYS:HB3	1:A:329:LYS:NZ	2.19	0.57
1:A:58:ARG:HD3	1:A:246:LEU:O	2.04	0.57
1:B:11:ASN:ND2	1:B:98:ARG:HB3	2.18	0.57
1:B:281:CYS:HB3	1:B:329:LYS:HZ3	1.68	0.56
1:B:10:THR:HG22	1:B:19:ILE:HD11	1.87	0.56
1:B:364:ASN:O	1:B:368:ILE:HG12	2.05	0.56
1:B:368:ILE:HG22	1:B:372:LEU:HD12	1.85	0.56
1:B:11:ASN:HD22	1:B:11:ASN:C	2.12	0.56
1:B:11:ASN:ND2	1:B:11:ASN:C	2.62	0.56
1:B:240:LYS:HE3	1:B:269:HIS:HD2	1.71	0.56
1:A:213:ALA:HB1	1:A:231:LYS:HE3	1.88	0.55
1:A:223:ILE:HD12	1:A:228:GLU:HB2	1.88	0.55
1:A:381:SER:HB2	1:A:419:VAL:HA	1.88	0.55
1:A:284:ILE:HG23	1:A:332:ILE:HG21	1.89	0.55
1:B:302:HIS:ND1	1:B:322:VAL:HG22	2.22	0.55
1:B:199:ASP:O	1:B:203:GLN:HG2	2.07	0.55
1:B:174:MET:HB3	1:B:418:ARG:HA	1.87	0.54
1:B:208:ILE:HG12	1:B:251:LEU:HB2	1.89	0.54
1:A:242:GLN:O	1:A:243:LEU:C	2.51	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:266:LEU:O	1:A:270:HIS:HB3	2.09	0.53
1:B:377:LEU:HD23	1:B:378:VAL:N	2.22	0.53
1:B:143:HIS:CE1	1:B:145:LYS:HB2	2.43	0.53
1:B:233:ASN:OD1	1:B:269:HIS:HE1	1.91	0.53
1:B:143:HIS:HE1	1:B:145:LYS:HB2	1.75	0.52
1:B:1:MET:HE3	1:B:33:ARG:NH2	2.23	0.52
1:B:349:PHE:HB3	1:B:386:VAL:HG11	1.91	0.52
1:A:83:GLU:HG2	1:A:100:ILE:HD13	1.92	0.52
1:A:96:SER:HB2	1:A:97:PRO:HD2	1.90	0.52
1:B:99:VAL:HG23	1:B:100:ILE:N	2.25	0.52
1:B:99:VAL:HG23	1:B:100:ILE:H	1.75	0.52
1:B:403:ARG:O	1:B:407:ARG:HG2	2.09	0.52
1:B:287:LYS:O	1:B:291:ILE:HD13	2.10	0.52
1:B:282:ASN:CG	1:B:283:ASN:H	2.18	0.51
1:A:92:ALA:HB1	1:A:93:PRO:CD	2.26	0.51
1:B:302:HIS:CD2	1:B:325:TYR:CD1	2.99	0.50
1:A:3:GLN:NE2	1:A:35:ILE:HD13	2.26	0.50
1:A:14:PHE:HB3	1:A:251:LEU:HD21	1.94	0.50
1:B:42:SER:HG	1:B:58:ARG:HE	1.58	0.50
1:B:279:VAL:HA	1:B:301:ILE:HG13	1.94	0.50
1:A:326:ILE:HD13	1:A:345:PHE:HB2	1.93	0.50
1:A:340:GLN:NE2	1:A:373:GLU:HB3	2.26	0.50
1:B:358:ALA:HB1	1:B:386:VAL:HG12	1.94	0.49
1:A:100:ILE:HD12	1:A:100:ILE:O	2.13	0.49
1:B:119:ILE:HA	1:B:120:PRO:C	2.37	0.49
1:B:11:ASN:HD22	1:B:11:ASN:H	1.60	0.49
1:B:407:ARG:O	1:B:411:LYS:HG3	2.12	0.49
1:B:303:ASN:OD1	1:B:303:ASN:C	2.55	0.49
1:A:88:ARG:NH2	1:A:98:ARG:NH2	2.51	0.49
1:A:369:LYS:HE3	1:A:375:LYS:HA	1.94	0.49
1:A:83:GLU:O	1:A:100:ILE:HD11	2.12	0.48
1:B:282:ASN:OD1	1:B:283:ASN:N	2.45	0.48
1:A:36:ARG:HB3	1:A:137:LEU:CD2	2.43	0.48
1:B:0:HIS:CD2	1:B:0:HIS:N	2.81	0.48
1:A:284:ILE:CG2	1:A:332:ILE:HG21	2.42	0.48
1:A:349:PHE:HB3	1:A:386:VAL:CG2	2.43	0.48
1:B:332:ILE:O	1:B:335:LYS:HB3	2.14	0.48
1:B:284:ILE:HD13	1:B:329:LYS:HE3	1.95	0.48
1:A:174:MET:HB3	1:A:418:ARG:HA	1.94	0.48
1:A:182:GLN:NE2	1:A:217:LYS:HG2	2.29	0.48
1:A:394:ASN:O	1:A:398:LEU:HG	2.14	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:242:GLN:O	1:A:245:ASN:N	2.33	0.48
1:B:400:ARG:HB2	1:B:400:ARG:HH11	1.77	0.48
1:B:112:LEU:O	1:B:118:THR:HA	2.14	0.47
1:B:240:LYS:CE	1:B:269:HIS:HD2	2.26	0.47
1:B:217:LYS:HE2	1:B:218:PRO:HD2	1.95	0.47
1:A:233:ASN:OD1	1:A:269:HIS:CE1	2.62	0.47
1:A:392:ASP:OD2	1:A:392:ASP:N	2.47	0.47
1:A:372:LEU:O	1:A:373:GLU:CB	2.62	0.47
1:B:33:ARG:HH11	1:B:33:ARG:HG3	1.80	0.47
1:B:240:LYS:NZ	1:B:269:HIS:HD2	2.13	0.47
1:B:359:ARG:NH2	1:B:388:GLY:HA2	2.29	0.47
1:B:408:LYS:O	1:B:412:LEU:HG	2.14	0.47
1:A:118:THR:CG2	1:A:122:LYS:HE3	2.44	0.47
1:B:192:ASN:O	1:B:193:GLN:C	2.58	0.47
1:A:38:ALA:HB2	1:A:137:LEU:HG	1.97	0.46
1:A:199:ASP:OD1	1:A:203:GLN:NE2	2.48	0.46
1:A:368:ILE:HG22	1:A:372:LEU:CD1	2.44	0.46
1:B:400:ARG:HB2	1:B:400:ARG:CZ	2.45	0.46
1:A:223:ILE:CD1	1:A:228:GLU:HB2	2.46	0.46
1:A:275:MET:HB2	1:A:297:LYS:HB2	1.97	0.46
1:A:284:ILE:CG2	1:A:285:GLU:N	2.76	0.46
1:B:382:ARG:O	1:B:384:PRO:HD3	2.15	0.46
1:A:96:SER:O	1:A:98:ARG:HG2	2.16	0.46
1:B:58:ARG:CD	1:B:247:ILE:HA	2.43	0.46
1:B:409:LEU:HD22	1:B:414:ILE:HG13	1.98	0.46
1:A:255:ASP:OD2	1:A:255:ASP:C	2.57	0.46
1:B:357:THR:O	1:B:358:ALA:C	2.59	0.45
1:B:365:ILE:HG23	1:B:366:ILE:H	1.81	0.45
1:A:257:ARG:HB3	1:A:279:VAL:HG13	1.98	0.45
1:A:403:ARG:NH1	1:A:422:ILE:C	2.74	0.45
1:B:349:PHE:CG	1:B:386:VAL:HG11	2.51	0.45
1:B:368:ILE:HG22	1:B:372:LEU:CD1	2.46	0.45
1:A:236:LEU:HD22	1:A:272:ILE:HD11	1.99	0.45
1:B:11:ASN:HD22	1:B:11:ASN:N	2.14	0.45
1:A:338:ILE:O	1:A:338:ILE:HD13	2.16	0.45
1:B:369:LYS:HG3	1:B:374:LEU:O	2.16	0.45
1:A:278:ASP:OD2	1:A:280:GLU:O	2.35	0.45
1:B:98:ARG:C	1:B:98:ARG:HD3	2.42	0.45
1:B:223:ILE:O	1:B:258:LYS:NZ	2.44	0.45
1:A:281:CYS:HB3	1:A:329:LYS:HE2	1.98	0.45
1:A:193:GLN:CG	1:A:194:ARG:HD3	2.44	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:240:LYS:HE3	1:A:272:ILE:HD13	1.99	0.44
1:A:347:ILE:HB	1:A:349:PHE:CE1	2.52	0.44
1:B:365:ILE:HG23	1:B:366:ILE:N	2.32	0.44
1:B:41:TYR:HB3	1:B:161:ILE:HD11	2.00	0.44
1:B:132:ALA:HB3	1:B:133:PRO:HD3	1.99	0.44
1:A:281:CYS:HB3	1:A:329:LYS:CE	2.47	0.44
1:B:401:ALA:HA	1:B:404:GLU:OE1	2.18	0.44
1:B:405:LEU:O	1:B:405:LEU:HD12	2.18	0.44
1:A:58:ARG:HD3	1:A:247:ILE:HA	2.00	0.44
1:A:121:HIS:CE1	1:A:123:GLU:HB2	2.53	0.44
1:B:112:LEU:CD1	1:B:114:THR:HG23	2.47	0.44
1:B:353:LYS:HB3	1:B:357:THR:OG1	2.18	0.44
1:A:8:ILE:HG12	1:A:102:LEU:CD2	2.48	0.43
1:B:112:LEU:HD11	1:B:114:THR:HG23	2.00	0.43
1:A:240:LYS:NZ	1:A:269:HIS:HD2	2.16	0.43
1:B:319:ILE:HG12	1:B:320:ASP:H	1.84	0.43
1:A:206:ALA:HB2	1:A:422:ILE:CD1	2.47	0.43
1:A:127:ARG:HD3	1:A:129:PHE:CZ	2.54	0.43
1:B:148:GLU:O	1:B:148:GLU:HG2	2.19	0.43
1:A:300:ILE:HD11	1:A:333:LEU:CD1	2.48	0.43
1:A:345:PHE:CE1	1:A:347:ILE:HD12	2.53	0.43
1:B:42:SER:OG	1:B:58:ARG:NE	2.36	0.43
1:A:345:PHE:HE1	1:A:347:ILE:HD12	1.83	0.43
1:B:70:LEU:HD22	1:B:74:GLU:HB3	2.01	0.43
1:A:349:PHE:HB3	1:A:386:VAL:HG21	1.99	0.42
1:B:284:ILE:HG23	1:B:285:GLU:N	2.34	0.42
1:A:333:LEU:HB3	1:A:338:ILE:CD1	2.49	0.42
1:A:235:PHE:CD1	1:A:235:PHE:C	2.96	0.42
1:B:35:ILE:O	1:B:36:ARG:HB2	2.18	0.42
1:B:368:ILE:HG12	1:B:368:ILE:H	1.69	0.42
1:B:248:TYR:CE2	1:B:250:PRO:HA	2.55	0.42
1:A:332:ILE:O	1:A:335:LYS:HB3	2.20	0.42
1:A:37:LYS:O	5:A:434:HOH:O	2.22	0.42
1:B:127:ARG:NH2	3:B:425:APC:O2G	2.45	0.42
1:A:96:SER:O	1:A:97:PRO:C	2.61	0.42
1:A:153:ILE:O	1:A:156:LYS:HB3	2.19	0.42
1:A:182:GLN:NE2	1:A:216:THR:HB	2.32	0.41
1:A:340:GLN:HE21	1:A:373:GLU:HB3	1.85	0.41
1:A:211:ILE:HD13	1:A:235:PHE:CE1	2.55	0.41
1:A:281:CYS:HB3	1:A:329:LYS:HZ1	1.84	0.41
1:B:349:PHE:HB3	1:B:386:VAL:CG1	2.49	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:63:ALA:O	1:A:137:LEU:HD11	2.19	0.41
1:A:90:LEU:O	1:A:91:ASN:C	2.62	0.41
1:A:168:LEU:HD12	1:A:168:LEU:HA	1.87	0.41
1:A:365:ILE:HD11	1:A:376:ALA:HB1	2.02	0.41
1:B:349:PHE:CB	1:B:386:VAL:HG11	2.50	0.41
1:B:390:THR:O	1:B:391:LYS:HG3	2.19	0.41
1:B:40:LEU:HB3	1:B:164:LEU:HD12	2.03	0.41
1:B:70:LEU:CD2	1:B:74:GLU:HB3	2.51	0.41
1:A:217:LYS:HA	1:A:218:PRO:HD3	1.95	0.41
1:B:192:ASN:O	1:B:195:LYS:N	2.54	0.41
1:A:223:ILE:O	1:A:258:LYS:NZ	2.53	0.40
1:B:240:LYS:NZ	1:B:269:HIS:CD2	2.90	0.40
1:A:118:THR:HG21	1:A:122:LYS:CE	2.47	0.40
1:A:183:SER:O	1:A:193:GLN:HG2	2.21	0.40
1:A:369:LYS:HG3	1:A:374:LEU:O	2.21	0.40
1:B:381:SER:HB2	1:B:419:VAL:HA	2.03	0.40
1:B:40:LEU:HD12	1:B:166:GLN:C	2.47	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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

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

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	387/442 (88%)	357 (92%)	28 (7%)	2 (0%)	24	31
1	B	376/442 (85%)	349 (93%)	26 (7%)	1 (0%)	36	46
All	All	763/884 (86%)	706 (92%)	54 (7%)	3 (0%)	30	38

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	169	ALA

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Mol	Chain	Res	Type
1	A	282	ASN
1	B	147	VAL

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	357/396 (90%)	328 (92%)	29 (8%)	11	14
1	B	348/396 (88%)	316 (91%)	32 (9%)	8	11
All	All	705/792 (89%)	644 (91%)	61 (9%)	9	12

All (61) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	12	SER
1	A	19	ILE
1	A	36	ARG
1	A	56	ASP
1	A	57	ILE
1	A	89	ASP
1	A	90	LEU
1	A	100	ILE
1	A	104	ILE
1	A	118	THR
1	A	122	LYS
1	A	125	ILE
1	A	138	SER
1	A	160	GLU
1	A	163	LYS
1	A	168	LEU
1	A	194	ARG
1	A	217	LYS
1	A	219	ASP
1	A	226	GLU
1	A	252	VAL

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Mol	Chain	Res	Type
1	A	259	LEU
1	A	279	VAL
1	A	284	ILE
1	A	338	ILE
1	A	359	ARG
1	A	387	LEU
1	A	392	ASP
1	A	393	SER
1	B	0	HIS
1	B	5	ILE
1	B	11	ASN
1	B	34	ILE
1	B	46	VAL
1	B	67	SER
1	B	71	LYS
1	B	73	ASP
1	B	78	LEU
1	B	98	ARG
1	B	118	THR
1	B	125	ILE
1	B	145	LYS
1	B	149	TRP
1	B	160	GLU
1	B	168	LEU
1	B	172	ILE
1	B	185	SER
1	B	193	GLN
1	B	226	GLU
1	B	243	LEU
1	B	249	LYS
1	B	280	GLU
1	B	301	ILE
1	B	303	ASN
1	B	319	ILE
1	B	334	LEU
1	B	370	ARG
1	B	371	ARG
1	B	377	LEU
1	B	400	ARG
1	B	404	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (19) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	197	ASN
1	A	269	HIS
1	A	295	ASN
1	A	302	HIS
1	A	342	ASN
1	B	0	HIS
1	B	3	GLN
1	B	11	ASN
1	B	29	GLN
1	B	30	GLN
1	B	182	GLN
1	B	197	ASN
1	B	242	GLN
1	B	245	ASN
1	B	269	HIS
1	B	295	ASN
1	B	302	HIS
1	B	328	GLN
1	B	342	ASN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 10 ligands modelled in this entry, 4 are monoatomic - leaving 6 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	PH2	B	423	4	12,15,15	3.62	2 (16%)	11,21,21	2.59	4 (36%)
2	PH2	A	424	-	12,15,15	3.73	2 (16%)	11,21,21	2.46	5 (45%)
3	APC	A	425	4	29,33,33	2.57	13 (44%)	44,52,52	2.23	13 (29%)
2	PH2	B	424	-	12,15,15	3.72	3 (25%)	11,21,21	2.22	3 (27%)
2	PH2	A	423	4	12,15,15	3.76	2 (16%)	11,21,21	2.26	4 (36%)
3	APC	B	425	4	29,33,33	2.76	12 (41%)	44,52,52	2.26	13 (29%)

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	PH2	B	423	4	-	0/0/11/11	0/2/2/2
2	PH2	A	424	-	-	0/0/11/11	0/2/2/2
3	APC	A	425	4	-	6/19/38/38	0/3/3/3
2	PH2	B	424	-	-	0/0/11/11	0/2/2/2
2	PH2	A	423	4	-	0/0/11/11	0/2/2/2
3	APC	B	425	4	-	4/19/38/38	0/3/3/3

All (34) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	423	PH2	C3-C2	-9.26	1.39	1.49
2	A	424	PH2	C3-C2	-9.25	1.39	1.49
2	B	424	PH2	C3-C2	-9.08	1.39	1.49
2	B	423	PH2	C3-C2	-8.72	1.39	1.49
2	A	423	PH2	C3-N4	-8.56	1.32	1.45
2	B	424	PH2	C3-N4	-8.52	1.32	1.45
2	B	423	PH2	C3-N4	-8.48	1.32	1.45
2	A	424	PH2	C3-N4	-8.22	1.33	1.45
3	B	425	APC	C2-N3	7.73	1.47	1.33
3	A	425	APC	C2-N3	6.77	1.45	1.33
3	B	425	APC	C2-N1	4.99	1.42	1.33
3	B	425	APC	C5-C6	4.58	1.53	1.41
3	A	425	APC	C2-N1	4.55	1.42	1.33
3	A	425	APC	C5-C6	4.37	1.53	1.41
3	B	425	APC	C8-N7	4.34	1.40	1.31

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	425	APC	C6-N6	4.31	1.45	1.34
3	A	425	APC	C8-N7	4.03	1.39	1.31
3	A	425	APC	C6-N6	3.31	1.42	1.34
3	B	425	APC	C4-N3	3.27	1.40	1.34
3	B	425	APC	C4-N9	3.19	1.44	1.37
3	A	425	APC	C4-N3	3.12	1.40	1.34
3	A	425	APC	C5-C4	-3.11	1.33	1.39
3	B	425	APC	O4'-C1'	3.09	1.49	1.42
3	B	425	APC	C1'-N9	3.04	1.54	1.46
3	A	425	APC	O4'-C1'	2.99	1.48	1.42
3	B	425	APC	C2'-C3'	-2.91	1.45	1.53
3	A	425	APC	PB-O2B	-2.86	1.49	1.56
3	B	425	APC	PB-O2B	-2.85	1.49	1.56
3	A	425	APC	C1'-N9	2.64	1.53	1.46
3	A	425	APC	C2'-C3'	-2.63	1.46	1.53
3	B	425	APC	C5-C4	-2.58	1.34	1.39
3	A	425	APC	C4-N9	2.57	1.43	1.37
3	A	425	APC	PA-O2A	-2.26	1.50	1.56
2	B	424	PH2	O4-C11	-2.05	1.35	1.41

All (42) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	425	APC	O4'-C1'-N9	6.99	121.52	108.09
3	A	425	APC	O4'-C1'-N9	6.18	119.96	108.09
3	A	425	APC	N3-C2-N1	-5.80	119.80	128.58
3	B	425	APC	N3-C2-N1	-5.61	120.09	128.58
3	A	425	APC	N9-C8-N7	-5.04	106.79	113.94
2	B	423	PH2	C6-N5-C10	4.73	121.71	113.36
2	B	424	PH2	C6-N5-C10	4.59	121.45	113.36
2	A	424	PH2	C6-N5-C10	4.55	121.39	113.36
2	A	423	PH2	C6-N5-C10	4.53	121.35	113.36
3	B	425	APC	N9-C8-N7	-4.48	107.58	113.94
3	B	425	APC	C5-C4-N3	-4.30	120.79	126.72
2	B	423	PH2	C6-N7-C8	-3.93	117.98	125.11
2	B	423	PH2	O4-C11-C2	3.89	119.74	111.84
2	A	424	PH2	C6-N7-C8	-3.82	118.17	125.11
3	A	425	APC	C5-C4-N3	-3.69	121.64	126.72
3	A	425	APC	C4-N9-C8	3.48	109.39	105.74
3	B	425	APC	PB-O3B-PG	-3.44	120.14	132.45
3	A	425	APC	O4'-C4'-C5'	3.40	120.23	109.33
2	A	423	PH2	C6-N7-C8	-3.34	119.06	125.11

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	424	PH2	C6-N7-C8	-3.25	119.21	125.11
3	B	425	APC	N3-C4-N9	3.11	132.46	127.17
3	B	425	APC	C2-N3-C4	2.99	119.12	111.83
3	A	425	APC	C5-N7-C8	2.93	108.05	103.45
2	A	424	PH2	O8-C8-C9	-2.85	119.00	126.53
3	A	425	APC	C2-N3-C4	2.83	118.74	111.83
3	B	425	APC	C4-N9-C8	2.82	108.69	105.74
3	B	425	APC	C5-N7-C8	2.72	107.72	103.45
2	A	423	PH2	O4-C11-C2	2.59	117.11	111.84
3	A	425	APC	N3-C4-N9	2.59	131.57	127.17
3	A	425	APC	C4-N9-C1'	-2.55	120.67	126.63
3	A	425	APC	O4'-C4'-C3'	2.50	110.12	105.15
2	B	423	PH2	C9-C8-N7	2.50	119.61	113.25
2	A	423	PH2	C9-C8-N7	2.46	119.50	113.25
2	A	424	PH2	C9-C8-N7	2.36	119.26	113.25
3	A	425	APC	PB-O3B-PG	-2.26	124.35	132.45
3	B	425	APC	C2'-C1'-N9	2.21	118.79	113.30
3	B	425	APC	C5-C6-N6	-2.20	117.84	123.29
3	A	425	APC	O2'-C2'-C3'	2.17	118.76	111.82
3	B	425	APC	C6-C5-C4	2.14	120.10	117.18
2	A	424	PH2	N6-C6-N7	2.13	121.25	116.76
2	B	424	PH2	C9-C8-N7	2.06	118.51	113.25
3	B	425	APC	O4'-C4'-C5'	2.05	115.89	109.33

There are no chirality outliers.

All (10) torsion outliers are listed below:

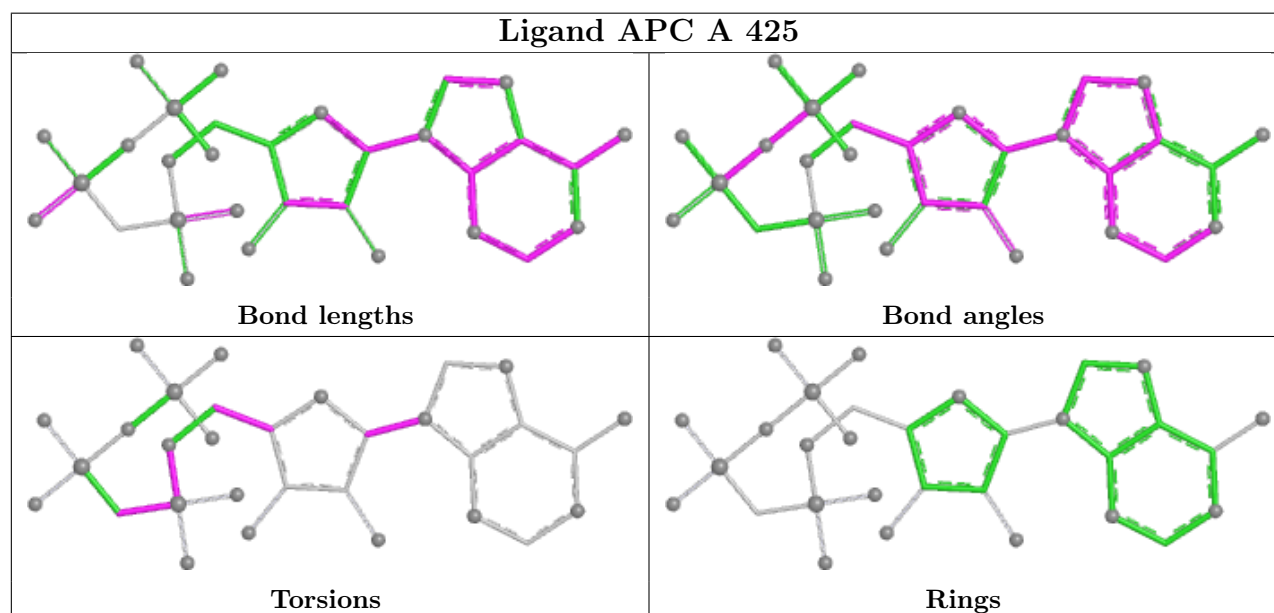
Mol	Chain	Res	Type	Atoms
3	A	425	APC	PB-C3A-PA-O1A
3	A	425	APC	PB-C3A-PA-O2A
3	A	425	APC	PB-C3A-PA-O5'
3	B	425	APC	PB-C3A-PA-O1A
3	B	425	APC	PB-C3A-PA-O2A
3	B	425	APC	PB-C3A-PA-O5'
3	B	425	APC	O4'-C1'-N9-C8
3	A	425	APC	O4'-C1'-N9-C8
3	A	425	APC	C5'-O5'-PA-C3A
3	A	425	APC	O4'-C4'-C5'-O5'

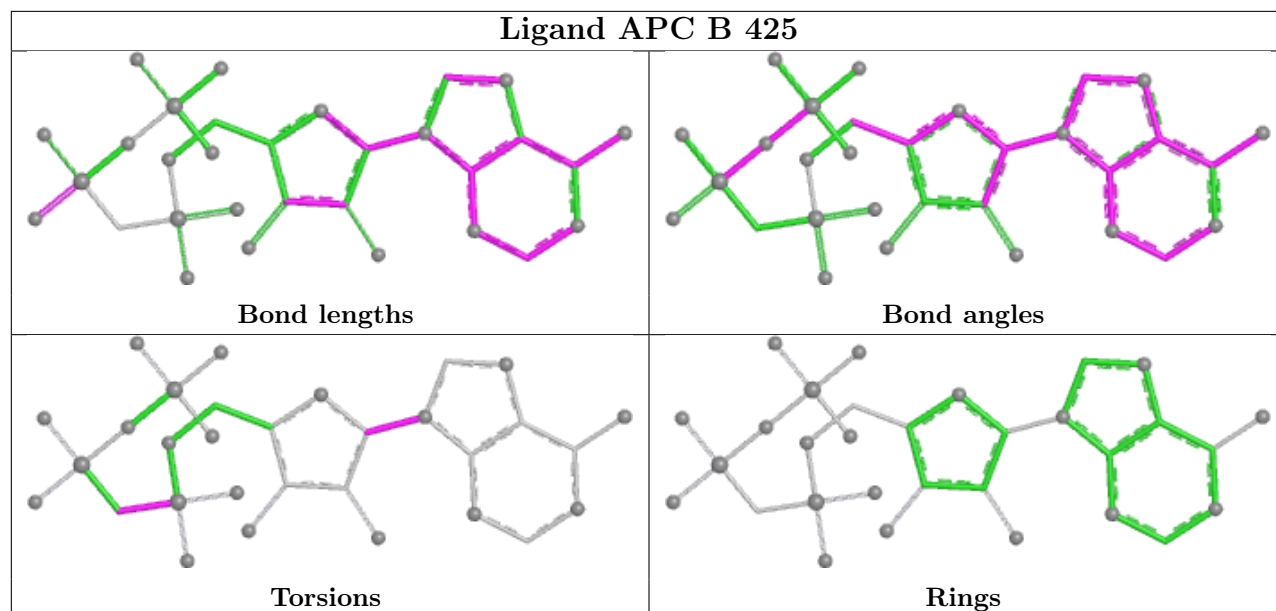
There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	425	APC	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 than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	397/442 (89%)	-1.06	0 100 100	22, 39, 64, 79	0
1	B	386/442 (87%)	-1.09	0 100 100	21, 37, 59, 72	0
All	All	783/884 (88%)	-1.07	0 100 100	21, 38, 62, 79	0

There are no RSRZ outliers to report.

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

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

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q< 0.9’ lists the number of atoms with occupancy less than 0.9.

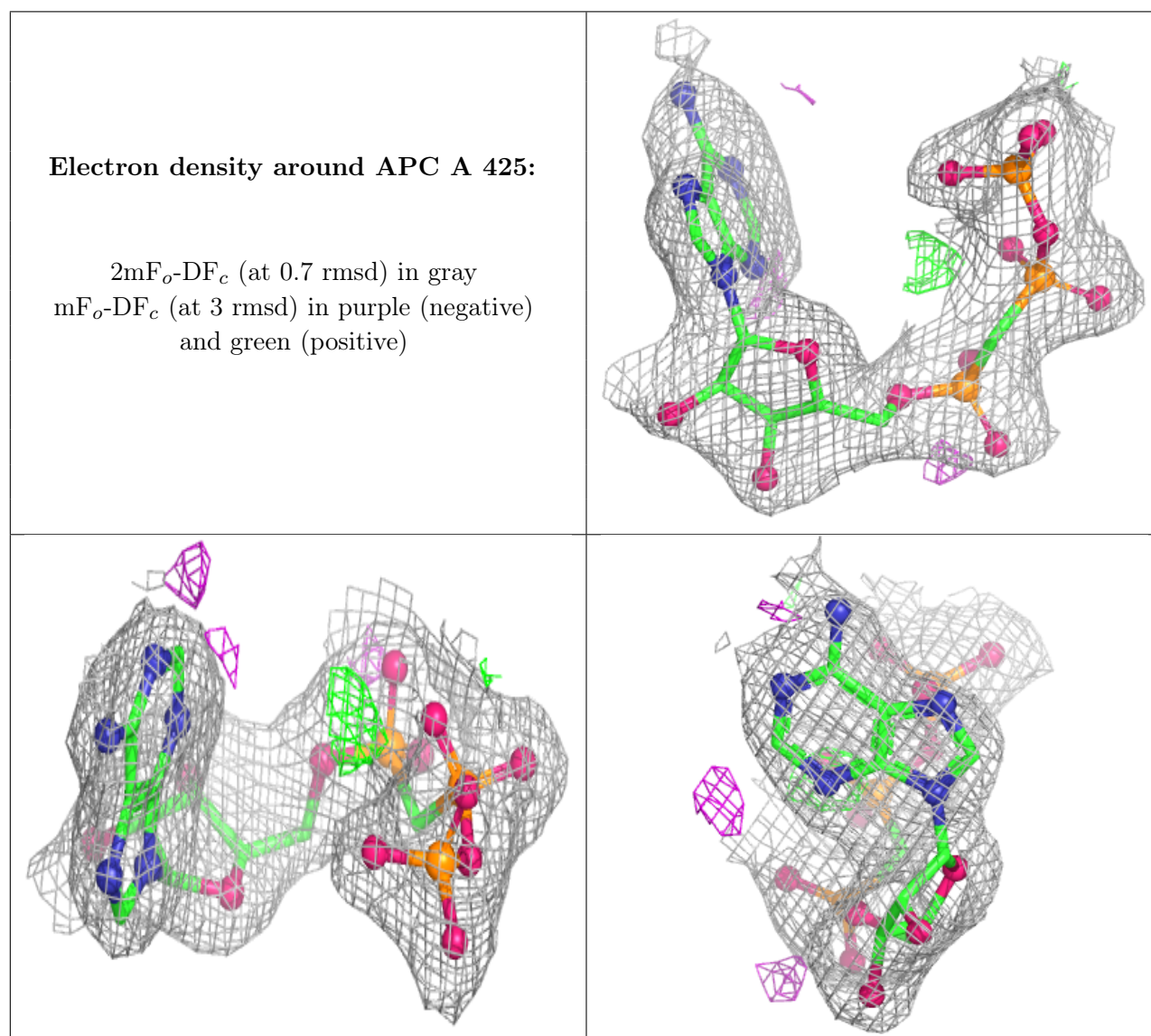
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
2	PH2	A	424	14/14	0.98	0.04	37,41,47,49	0
2	PH2	B	424	14/14	0.98	0.05	29,37,40,41	0
4	MG	A	426	1/1	0.98	0.05	35,35,35,35	0
2	PH2	A	423	14/14	0.99	0.04	22,29,37,38	0
3	APC	A	425	31/31	0.99	0.04	24,30,37,40	0
3	APC	B	425	31/31	0.99	0.04	28,33,39,43	0
2	PH2	B	423	14/14	0.99	0.03	24,29,34,36	0

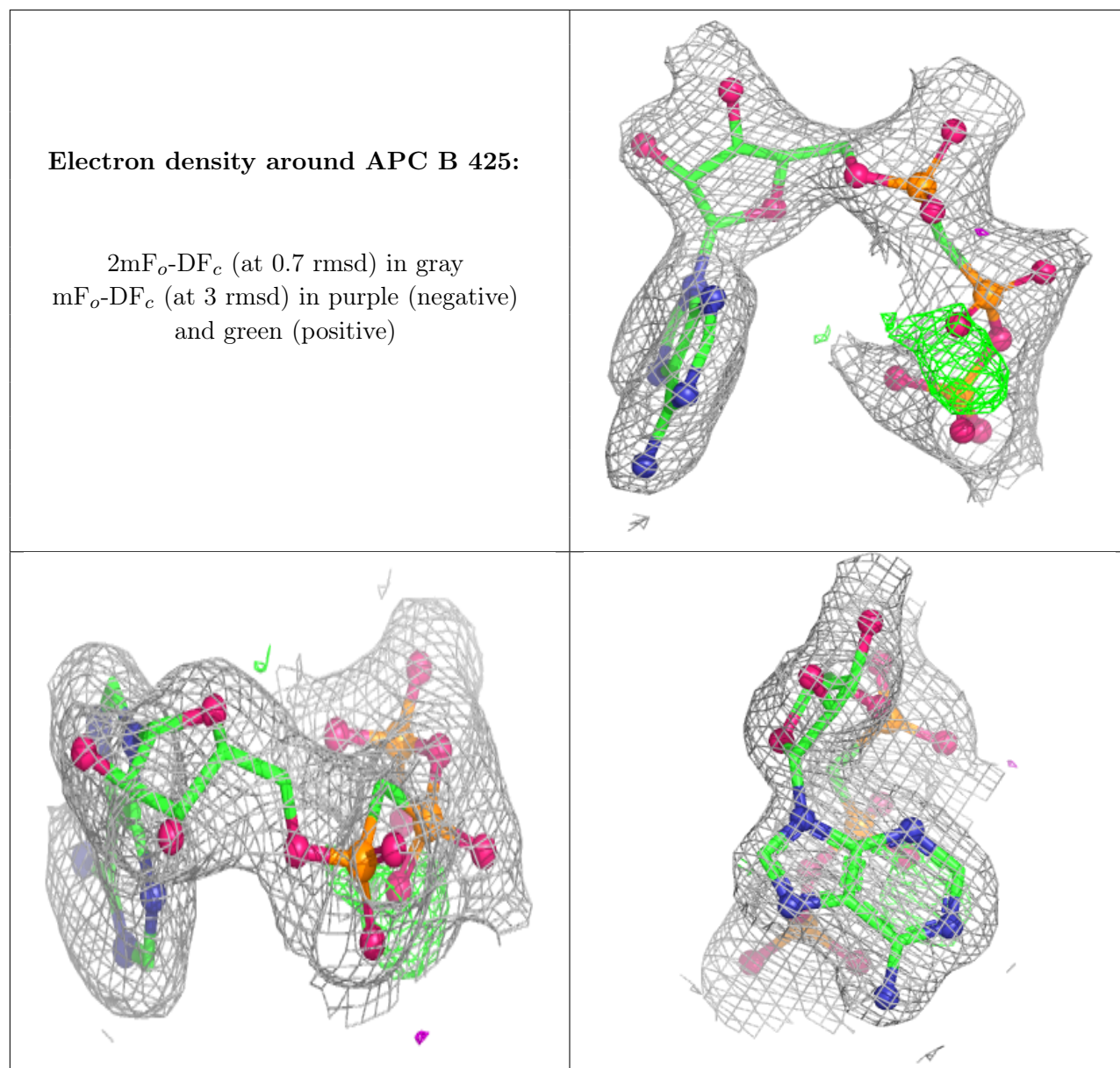
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	MG	A	427	1/1	0.99	0.04	35,35,35,35	0
4	MG	B	426	1/1	0.99	0.03	30,30,30,30	0
4	MG	B	427	1/1	0.99	0.04	38,38,38,38	0

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.





6.5 Other polymers ⓘ

There are no such residues in this entry.