



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 31, 2016 – 07:46 PM GMT

PDB ID : 1H48  
Title : THE STRUCTURE OF 2 C - METHYL - D - ERYTHRITOL 2,4-CYCLODIPHOSPHATE SYNTHASE IN COMPLEX WITH CMP AND PRODUCT  
Authors : Kemp, L.E.; Alphey, M.S.; Bond, C.S.; Hunter, W.N.  
Deposited on : 2003-02-24  
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](mailto:validation@mail.wwpdb.org)  
A user guide is available at  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

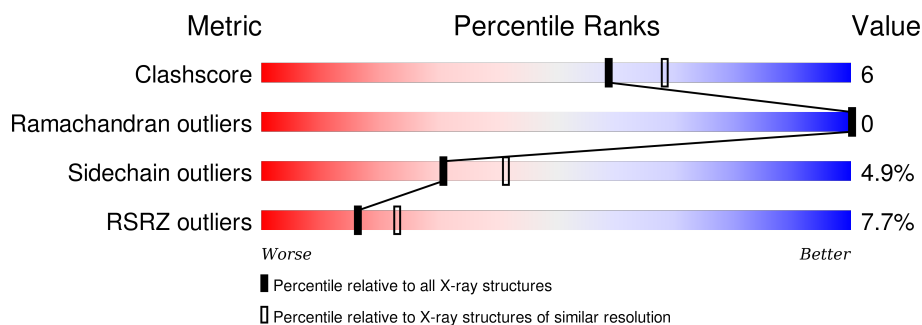
# 1 Overall quality at a glance

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))
Clashscore	102246	4452 (2.30-2.30)
Ramachandran outliers	100387	4410 (2.30-2.30)
Sidechain outliers	100360	4409 (2.30-2.30)
RSRZ outliers	91569	3857 (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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	161	<div> <div>7%</div> <div>82%14%..</div> </div>
1	B	161	<div> <div>7%</div> <div>86%11%..</div> </div>
1	C	161	<div> <div>4%</div> <div>86%12%..</div> </div>
1	D	161	<div> <div>7%</div> <div>81%14%..</div> </div>
1	E	161	<div> <div>14%</div> <div>78%18%..</div> </div>
1	F	161	<div> <div>6%</div> <div>81%15%..</div> </div>

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
2	CDI	A	421	-	-	-	X
2	CDI	B	421	-	-	-	X
2	CDI	C	421	-	-	-	X
2	CDI	D	421	-	-	-	X
2	CDI	F	421	-	-	-	X
4	C5P	C	901	-	-	-	X
4	C5P	D	901	-	-	-	X
4	C5P	F	901	-	-	-	X
6	GPP	G	903[A]	-	-	-	X
6	GPP	G	903[B]	-	-	-	X
6	GPP	G	903[C]	-	-	-	X
6	GPP	H	903[A]	-	-	-	X
6	GPP	H	903[B]	-	-	-	X
6	GPP	H	903[C]	-	-	-	X

## 2 Entry composition [i](#)

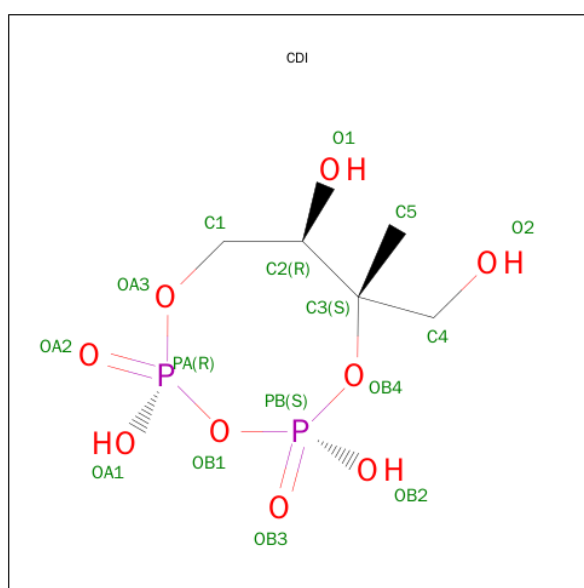
There are 7 unique types of molecules in this entry. The entry contains 7665 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 2C-METHYL-D-ERYTHRITOL-2,4-CYCLODIPHOSPHATE SYNTHASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	157	Total	C	N	O	S	0	4	0
			1188	753	207	220	8			
1	B	158	Total	C	N	O	S	0	2	0
			1189	755	208	219	7			
1	C	159	Total	C	N	O	S	0	4	1
			1198	760	209	221	8			
1	D	158	Total	C	N	O	S	0	4	0
			1196	759	208	221	8			
1	E	157	Total	C	N	O	S	0	1	0
			1177	747	207	216	7			
1	F	159	Total	C	N	O	S	0	1	1
			1186	753	209	217	7			

- Molecule 2 is 2C-METHYL-D-ERYTHRITOL 2,4-CYCLODIPHOSPHATE (three-letter code: CDI) (formula: C<sub>5</sub>H<sub>12</sub>O<sub>9</sub>P<sub>2</sub>).

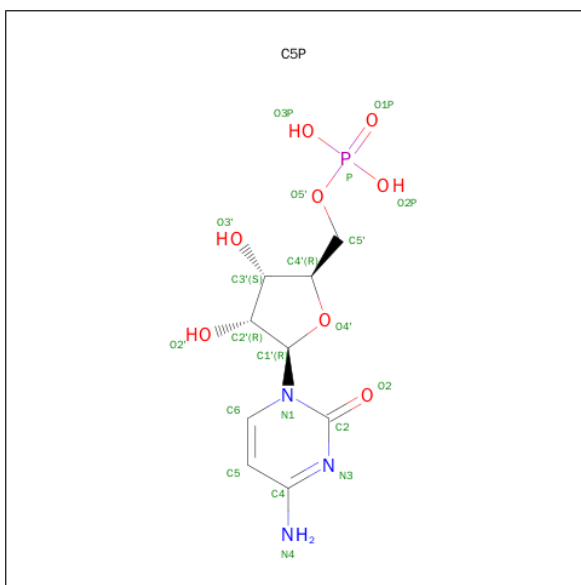


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	O	P	0	0
			16	5	9	2		
2	B	1	Total	C	O	P	0	0
			16	5	9	2		
2	C	1	Total	C	O	P	0	0
			16	5	9	2		
2	D	1	Total	C	O	P	0	0
			16	5	9	2		
2	E	1	Total	C	O	P	0	0
			16	5	9	2		
2	F	1	Total	C	O	P	0	0
			16	5	9	2		

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	D	1	Total	Zn	0	0
			1	1		
3	E	1	Total	Zn	0	0
			1	1		
3	B	1	Total	Zn	0	0
			1	1		
3	C	1	Total	Zn	0	0
			1	1		
3	A	1	Total	Zn	0	0
			1	1		
3	F	1	Total	Zn	0	0
			1	1		

- Molecule 4 is CYTIDINE-5'-MONOPHOSPHATE (three-letter code: C5P) (formula: C<sub>9</sub>H<sub>14</sub>N<sub>3</sub>O<sub>8</sub>P).

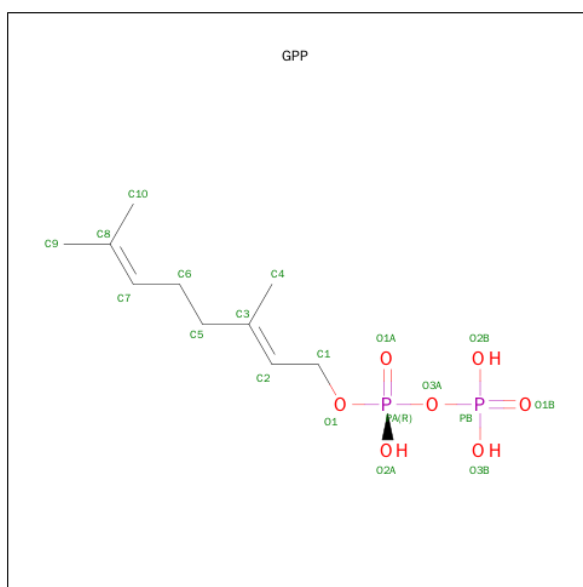


Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	P	0	0
			21	9	3	8	1		
4	B	1	Total	C	N	O	P	0	0
			21	9	3	8	1		
4	C	1	Total	C	N	O	P	0	0
			21	9	3	8	1		
4	D	1	Total	C	N	O	P	0	0
			21	9	3	8	1		
4	E	1	Total	C	N	O	P	0	0
			21	9	3	8	1		
4	F	1	Total	C	N	O	P	0	0
			21	9	3	8	1		

- Molecule 5 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	D	1	Total	Mn	0	0
			1	1		
5	C	1	Total	Mn	0	0
			1	1		

- Molecule 6 is GERANYL DIPHOSPHATE (three-letter code: GPP) (formula: C<sub>10</sub>H<sub>20</sub>O<sub>7</sub>P<sub>2</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	G	1	Total	C	O	P	0	1
			57	30	21	6		
6	H	1	Total	C	O	P	0	1
			57	30	21	6		

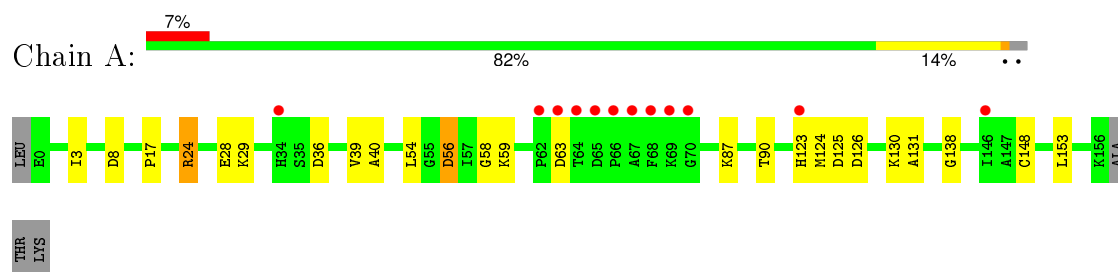
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	45	Total	O	0	1
			45	45		
7	B	31	Total	O	0	0
			31	31		
7	C	44	Total	O	0	0
			44	44		
7	D	30	Total	O	0	0
			30	30		
7	E	12	Total	O	0	0
			12	12		
7	F	25	Total	O	0	0
			25	25		

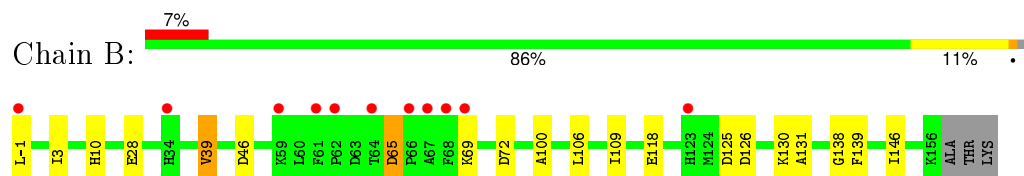
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

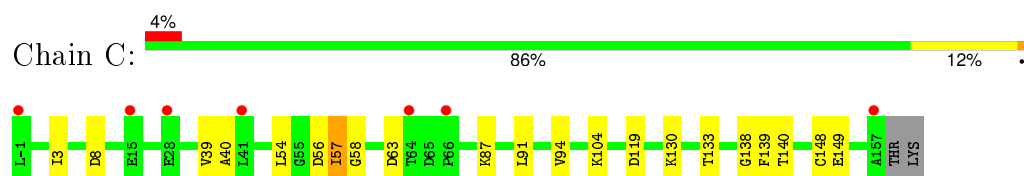
- Molecule 1: 2C-METHYL-D-ERYTHRITOL-2,4-CYCLODIPHOSPHATE SYNTHASE



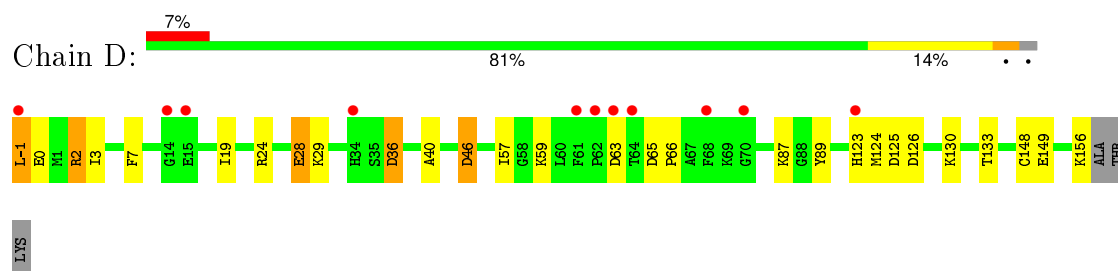
- Molecule 1: 2C-METHYL-D-ERYTHRITOL-2,4-CYCLODIPHOSPHATE SYNTHASE



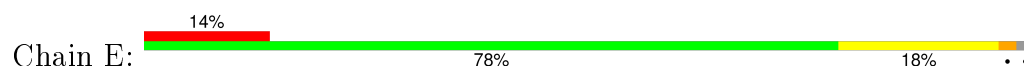
- Molecule 1: 2C-METHYL-D-ERYTHRITOL-2,4-CYCLODIPHOSPHATE SYNTHASE



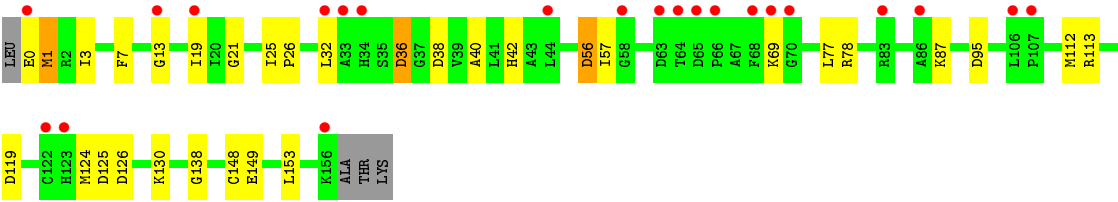
- Molecule 1: 2C-METHYL-D-ERYTHRITOL-2,4-CYCLODIPHOSPHATE SYNTHASE



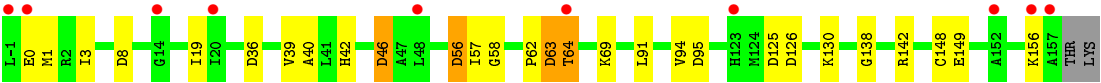
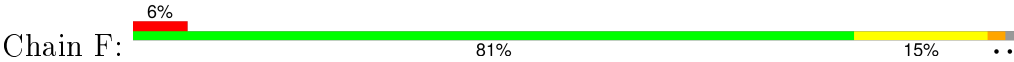
- Molecule 1: 2C-METHYL-D-ERYTHRITOL-2,4-CYCLODIPHOSPHATE SYNTHASE







• Molecule 1: 2C-METHYL-D-ERYTHRITOL-2,4-CYCLODIPHOSPHATE SYNTHASE



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	198.12Å 150.29Å 57.56Å 90.00° 106.52° 90.00°	Depositor
Resolution (Å)	20.00 – 2.30 19.68 – 2.26	Depositor EDS
% Data completeness (in resolution range)	99.9 (20.00-2.30) 91.2 (19.68-2.26)	Depositor EDS
$R_{merge}$	0.05	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	0.97 (at 2.26Å)	Xtriage
Refinement program	REFMAC 5.1.19	Depositor
R, $R_{free}$	0.202 , 0.236 0.200 , (Not available)	Depositor DCC
$R_{free}$ test set	No test flags present.	DCC
Wilson B-factor (Å <sup>2</sup> )	42.4	Xtriage
Anisotropy	0.137	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 39.0	EDS
Estimated twinning fraction	0.024 for -h-2*k,l	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	0 of 73131 reflections	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	7665	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.48% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 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: ZN, MN, GPP, CDI, C5P

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	0.62	0/1226	0.86	5/1657 (0.3%)
1	B	0.58	0/1219	0.82	6/1648 (0.4%)
1	C	0.64	0/1236	0.83	3/1671 (0.2%)
1	D	0.58	0/1234	0.82	6/1668 (0.4%)
1	E	0.46	0/1203	0.78	6/1626 (0.4%)
1	F	0.57	0/1212	0.84	7/1639 (0.4%)
All	All	0.58	0/7330	0.83	33/9909 (0.3%)

There are no bond length outliers.

All (33) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	8	ASP	CB-CG-OD2	7.20	124.78	118.30
1	F	126	ASP	CB-CG-OD2	6.57	124.21	118.30
1	A	24	ARG	NE-CZ-NH2	-6.20	117.20	120.30
1	F	95	ASP	CB-CG-OD2	6.19	123.87	118.30
1	F	36	ASP	CB-CG-OD2	6.18	123.86	118.30
1	C	63	ASP	CB-CG-OD2	6.08	123.77	118.30
1	C	8	ASP	CB-CG-OD2	6.00	123.70	118.30
1	D	46	ASP	CB-CG-OD2	5.99	123.69	118.30
1	F	63	ASP	CB-CG-OD2	5.99	123.69	118.30
1	F	56	ASP	CB-CG-OD2	5.99	123.69	118.30
1	A	56	ASP	CB-CG-OD2	5.93	123.64	118.30
1	B	126	ASP	CB-CG-OD2	5.92	123.63	118.30
1	F	8	ASP	CB-CG-OD2	5.88	123.59	118.30
1	E	95	ASP	CB-CG-OD2	5.87	123.58	118.30
1	D	24	ARG	NE-CZ-NH1	5.80	123.20	120.30
1	B	125[A]	ASP	CB-CG-OD2	5.78	123.50	118.30
1	B	125[B]	ASP	CB-CG-OD2	5.78	123.50	118.30
1	D	24	ARG	NE-CZ-NH2	-5.68	117.46	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	63	ASP	CB-CG-OD2	5.67	123.41	118.30
1	C	119	ASP	CB-CG-OD2	5.63	123.37	118.30
1	E	36	ASP	CB-CG-OD2	5.63	123.36	118.30
1	E	125	ASP	CB-CG-OD2	5.60	123.34	118.30
1	E	126	ASP	CB-CG-OD2	5.47	123.23	118.30
1	A	126	ASP	CB-CG-OD2	5.46	123.21	118.30
1	D	36	ASP	CB-CG-OD2	5.45	123.21	118.30
1	F	46	ASP	CB-CG-OD2	5.42	123.18	118.30
1	A	36	ASP	CB-CG-OD2	5.35	123.12	118.30
1	E	38	ASP	CB-CG-OD2	5.34	123.11	118.30
1	E	56	ASP	CB-CG-OD2	5.34	123.11	118.30
1	B	46	ASP	CB-CG-OD2	5.27	123.04	118.30
1	D	126	ASP	CB-CG-OD2	5.10	122.89	118.30
1	B	72	ASP	CB-CG-OD2	5.07	122.87	118.30
1	B	65	ASP	CB-CG-OD2	5.01	122.81	118.30

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	1188	0	1192	13	0
1	B	1189	0	1200	11	0
1	C	1198	0	1205	17	0
1	D	1196	0	1203	16	0
1	E	1177	0	1189	15	0
1	F	1186	0	1200	15	0
2	A	16	0	10	0	0
2	B	16	0	10	0	0
2	C	16	0	10	2	0
2	D	16	0	10	0	0
2	E	16	0	10	2	0
2	F	16	0	10	4	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	C	1	0	0	0	0
3	D	1	0	0	0	0
3	E	1	0	0	0	0
3	F	1	0	0	0	0
4	A	21	0	12	2	0
4	B	21	0	12	1	0
4	C	21	0	12	5	0
4	D	21	0	12	0	0
4	E	21	0	12	0	0
4	F	21	0	12	2	0
5	C	1	0	0	0	0
5	D	1	0	0	0	0
6	G	57	0	51	10	0
6	H	57	0	51	7	0
7	A	45	0	0	2	0
7	B	31	0	0	1	0
7	C	44	0	0	2	0
7	D	30	0	0	5	0
7	E	12	0	0	0	0
7	F	25	0	0	0	0
All	All	7665	0	7423	86	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 6.

All (86) 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:F:57:ILE:HD13	2:F:421:CDI:HC12	1.51	0.89
1:C:57:ILE:HD12	2:C:421:CDI:HC11	1.56	0.87
1:C:58:GLY:HA3	4:C:901:C5P:C3'	2.09	0.82
1:C:58:GLY:HA3	4:C:901:C5P:O3'	1.80	0.81
1:A:54:LEU:HD21	1:A:87:LYS:HD2	1.67	0.75
1:D:46:ASP:OD1	1:D:57:ILE:HG12	1.86	0.75
1:F:46:ASP:OD1	1:F:57:ILE:HG13	1.89	0.73
1:B:10:HIS:HD2	1:B:39:VAL:HG13	1.59	0.67
1:D:149:GLU:OE2	7:D:2030:HOH:O	2.13	0.65
1:D:133:THR:HG23	4:F:901:C5P:O1P	1.96	0.65
7:D:2030:HOH:O	1:F:149:GLU:OE2	2.15	0.64
1:F:0:GLU:HB2	1:F:156:LYS:HB3	1.79	0.64
1:F:57:ILE:HD13	2:F:421:CDI:C1	2.25	0.63

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:B:901:C5P:O1P	1:C:133:THR:HG23	1.99	0.62
7:C:2044:HOH:O	6:G:903[B]:GPP:H91	1.99	0.62
1:E:56:ASP:HB3	1:F:130:LYS:HB2	1.83	0.60
1:D:19:ILE:HD11	7:D:2004:HOH:O	2.02	0.59
1:A:131:ALA:O	4:C:901:C5P:H2'1	2.03	0.58
1:A:58:GLY:HA3	4:A:901:C5P:O3'	2.02	0.58
1:D:130:LYS:HB2	1:F:56:ASP:HB3	1.86	0.57
1:F:58:GLY:HA3	4:F:901:C5P:O3'	2.05	0.57
1:B:138:GLY:HA3	6:G:903[B]:GPP:H12	1.86	0.57
1:B:118:GLU:HG3	7:B:2025:HOH:O	2.05	0.56
1:A:3:ILE:HG22	1:A:153:LEU:HD13	1.89	0.55
1:F:62:PRO:C	1:F:64:THR:H	2.10	0.54
1:F:138:GLY:HA2	6:H:903[B]:GPP:O3B	2.08	0.53
1:C:57:ILE:CD1	2:C:421:CDI:HC11	2.35	0.53
1:C:139:PHE:HD1	6:G:903[B]:GPP:O2A	1.92	0.53
1:E:40:ALA:HA	1:E:148[A]:CYS:SG	2.49	0.53
1:C:58:GLY:HA3	4:C:901:C5P:H3'	1.91	0.53
1:A:40:ALA:HA	1:A:148[A]:CYS:SG	2.48	0.52
1:A:138:GLY:HA3	6:G:903[A]:GPP:H12	1.91	0.52
1:C:58:GLY:CA	4:C:901:C5P:O3'	2.55	0.52
1:B:139:PHE:HD1	6:G:903[A]:GPP:O2A	1.94	0.51
1:C:54:LEU:HD21	1:C:87:LYS:HD2	1.93	0.50
1:E:138:GLY:HA2	6:H:903[A]:GPP:O3B	2.11	0.50
1:B:3:ILE:HD12	1:C:3:ILE:HG13	1.92	0.50
1:E:13:GLY:HA3	1:E:32:LEU:HG	1.94	0.50
1:A:130:LYS:HB2	1:C:56:ASP:OD2	2.12	0.50
1:D:89:TYR:CE1	1:D:156:LYS:HB2	2.48	0.49
1:E:3:ILE:HD12	1:F:3:ILE:HG13	1.94	0.49
1:D:3:ILE:HD12	1:E:153:LEU:HB2	1.94	0.49
1:A:56:ASP:HB3	1:B:130:LYS:HB2	1.95	0.48
1:F:142:ARG:NH1	6:H:903[C]:GPP:O1B	2.36	0.48
1:D:28[A]:GLU:HG2	1:D:29:LYS:HG3	1.95	0.48
1:A:123:HIS:HB3	7:A:2037:HOH:O	2.15	0.47
1:A:17:PRO:HG3	1:A:24:ARG:HD3	1.97	0.47
4:A:901:C5P:H2'1	1:B:131:ALA:O	2.15	0.46
1:C:40:ALA:HA	1:C:148[A]:CYS:SG	2.56	0.46
1:F:91:LEU:HD11	1:F:94:VAL:HG13	1.98	0.46
1:E:7:PHE:HD1	1:E:149:GLU:HG2	1.81	0.46
1:E:19:ILE:HD13	1:E:36:ASP:HB2	1.97	0.46
1:F:40:ALA:HA	1:F:148[A]:CYS:SG	2.55	0.46
1:B:106:LEU:HA	1:B:109:ILE:HD12	1.98	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:10:HIS:CD2	1:B:39:VAL:HG13	2.45	0.45
1:C:139:PHE:CD1	6:G:903[B]:GPP:O2A	2.70	0.45
1:A:28:GLU:HG3	1:A:29:LYS:HG3	1.98	0.45
1:C:138:GLY:HA2	6:G:903[B]:GPP:O1B	2.17	0.45
1:A:125[A]:ASP:CG	7:A:2037:HOH:O	2.54	0.45
1:E:87:LYS:HE2	1:E:87:LYS:HB3	1.74	0.45
1:B:138:GLY:HA2	6:G:903[A]:GPP:O1B	2.16	0.44
1:B:100:ALA:HB2	1:B:146:ILE:HG23	1.99	0.43
1:D:65:ASP:HA	1:D:66:PRO:HD2	1.88	0.43
1:C:91:LEU:HD11	1:C:94:VAL:HG13	2.00	0.43
1:E:77:LEU:HD23	1:E:119:ASP:HB3	2.00	0.43
1:D:40:ALA:HA	1:D:148[A]:CYS:SG	2.59	0.43
1:D:7:PHE:HD1	1:D:149:GLU:HG2	1.84	0.43
1:C:149:GLU:OE2	7:C:2044:HOH:O	2.22	0.43
1:E:25:ILE:HA	1:E:26:PRO:HD2	1.84	0.43
1:F:42:HIS:CE1	2:F:421:CDI:HC51	2.54	0.43
1:C:140:THR:OG1	6:G:903[C]:GPP:H41	2.19	0.43
6:H:903[B]:GPP:H61	6:H:903[B]:GPP:H2	1.66	0.42
1:E:1:MET:HB2	1:E:153:LEU:HD11	2.01	0.42
1:A:138:GLY:HA2	6:G:903[C]:GPP:O1B	2.20	0.42
1:E:57:ILE:HG23	2:E:421:CDI:HC12	2.01	0.42
1:D:89:TYR:CD1	1:D:156:LYS:HB2	2.55	0.42
7:D:2030:HOH:O	6:H:903[B]:GPP:H91	2.19	0.42
2:F:421:CDI:HC11	2:F:421:CDI:HC51	1.82	0.41
6:H:903[C]:GPP:H61	6:H:903[C]:GPP:H2	1.70	0.41
1:D:19:ILE:HD12	1:D:36:ASP:HB2	2.02	0.41
1:D:2:ARG:HD3	1:D:89:TYR:CE1	2.55	0.41
1:E:42:HIS:CE1	2:E:421:CDI:HC51	2.56	0.41
1:E:21:GLY:HA3	1:E:112:MET:HG2	2.02	0.41
7:D:2030:HOH:O	6:H:903[C]:GPP:H91	2.20	0.41
1:D:-1:LEU:HB3	1:D:0:GLU:H	1.53	0.41

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	159/161 (99%)	155 (98%)	4 (2%)	0	100	100
1	B	158/161 (98%)	154 (98%)	4 (2%)	0	100	100
1	C	161/161 (100%)	156 (97%)	5 (3%)	0	100	100
1	D	160/161 (99%)	157 (98%)	3 (2%)	0	100	100
1	E	156/161 (97%)	147 (94%)	9 (6%)	0	100	100
1	F	158/161 (98%)	153 (97%)	5 (3%)	0	100	100
All	All	952/966 (99%)	922 (97%)	30 (3%)	0	100	100

There are no Ramachandran outliers to report.

### 5.3.2 Protein sidechains ⓘ

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	122/121 (101%)	117 (96%)	5 (4%)	37	50
1	B	121/121 (100%)	116 (96%)	5 (4%)	37	50
1	C	123/121 (102%)	119 (97%)	4 (3%)	45	61
1	D	123/121 (102%)	115 (94%)	8 (6%)	21	27
1	E	119/121 (98%)	112 (94%)	7 (6%)	24	32
1	F	120/121 (99%)	113 (94%)	7 (6%)	25	33
All	All	728/726 (100%)	692 (95%)	36 (5%)	31	41

All (36) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	39	VAL
1	A	59	LYS
1	A	63	ASP
1	A	90	THR

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Mol	Chain	Res	Type
1	A	124	MET
1	B	-1	LEU
1	B	28	GLU
1	B	39	VAL
1	B	65	ASP
1	B	69	LYS
1	C	39	VAL
1	C	57	ILE
1	C	104	LYS
1	C	130	LYS
1	D	-1	LEU
1	D	2	ARG
1	D	28[A]	GLU
1	D	28[B]	GLU
1	D	59	LYS
1	D	87	LYS
1	D	123	HIS
1	D	124	MET
1	E	0	GLU
1	E	1	MET
1	E	69	LYS
1	E	78	ARG
1	E	113	ARG
1	E	124	MET
1	E	130	LYS
1	F	1	MET
1	F	19	ILE
1	F	39	VAL
1	F	63	ASP
1	F	64	THR
1	F	69	LYS
1	F	125	ASP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	108	HIS

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

## 5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 26 ligands modelled in this entry, 8 are monoatomic - leaving 18 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	CDI	A	421	3	14,16,16	1.45	4 (28%)	12,26,26	1.60	2 (16%)
4	C5P	A	901	-	17,22,22	1.00	1 (5%)	22,33,33	1.16	1 (4%)
2	CDI	B	421	3	14,16,16	1.09	2 (14%)	12,26,26	1.32	1 (8%)
4	C5P	B	901	-	17,22,22	1.04	2 (11%)	22,33,33	1.19	2 (9%)
2	CDI	C	421	3	14,16,16	1.46	4 (28%)	12,26,26	1.76	2 (16%)
4	C5P	C	901	-	17,22,22	1.05	2 (11%)	22,33,33	1.34	3 (13%)
2	CDI	D	421	3	14,16,16	1.11	2 (14%)	12,26,26	1.76	2 (16%)
4	C5P	D	901	-	17,22,22	1.02	2 (11%)	22,33,33	1.20	1 (4%)
2	CDI	E	421	3	14,16,16	1.10	2 (14%)	12,26,26	1.38	2 (16%)
4	C5P	E	901	-	17,22,22	1.10	2 (11%)	22,33,33	1.32	2 (9%)
2	CDI	F	421	3	14,16,16	1.17	2 (14%)	12,26,26	1.74	2 (16%)
4	C5P	F	901	-	17,22,22	0.97	1 (5%)	22,33,33	1.26	2 (9%)
6	GPP	G	903[A]	-	16,18,18	1.06	2 (12%)	21,25,25	1.27	3 (14%)
6	GPP	G	903[B]	-	16,18,18	1.04	2 (12%)	21,25,25	1.31	3 (14%)
6	GPP	G	903[C]	-	16,18,18	1.02	2 (12%)	21,25,25	1.28	4 (19%)
6	GPP	H	903[A]	-	16,18,18	1.07	2 (12%)	21,25,25	1.19	2 (9%)
6	GPP	H	903[B]	-	16,18,18	1.12	2 (12%)	21,25,25	1.24	3 (14%)
6	GPP	H	903[C]	-	16,18,18	1.08	2 (12%)	21,25,25	1.18	1 (4%)

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	CDI	A	421	3	-	0/0/27/27	0/0/1/1
4	C5P	A	901	-	-	0/6/26/26	0/2/2/2
2	CDI	B	421	3	-	0/0/27/27	0/0/1/1
4	C5P	B	901	-	-	0/6/26/26	0/2/2/2
2	CDI	C	421	3	-	0/0/27/27	0/0/1/1
4	C5P	C	901	-	-	0/6/26/26	0/2/2/2
2	CDI	D	421	3	-	0/0/27/27	0/0/1/1
4	C5P	D	901	-	-	0/6/26/26	0/2/2/2
2	CDI	E	421	3	-	0/0/27/27	0/0/1/1
4	C5P	E	901	-	-	0/6/26/26	0/2/2/2
2	CDI	F	421	3	-	0/0/27/27	0/0/1/1
4	C5P	F	901	-	-	0/6/26/26	0/2/2/2
6	GPP	G	903[A]	-	-	0/19/19/19	0/0/0/0
6	GPP	G	903[B]	-	-	0/19/19/19	0/0/0/0
6	GPP	G	903[C]	-	-	0/19/19/19	0/0/0/0
6	GPP	H	903[A]	-	-	0/19/19/19	0/0/0/0
6	GPP	H	903[B]	-	-	0/19/19/19	0/0/0/0
6	GPP	H	903[C]	-	-	0/19/19/19	0/0/0/0

All (38) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	421	CDI	PB-OB4	2.00	1.61	1.58
2	B	421	CDI	PB-OB4	2.03	1.62	1.58
2	C	421	CDI	PA-OB1	2.06	1.64	1.59
2	E	421	CDI	PA-OA3	2.07	1.62	1.58
4	D	901	C5P	O4'-C1'	2.08	1.43	1.41
6	G	903[C]	GPP	PB-O1B	2.17	1.58	1.51
6	G	903[B]	GPP	PB-O1B	2.19	1.58	1.51
2	B	421	CDI	PA-OA3	2.22	1.62	1.58
2	E	421	CDI	PB-OB4	2.25	1.62	1.58
2	F	421	CDI	PA-OA3	2.26	1.62	1.58
2	A	421	CDI	PB-OB1	2.26	1.64	1.59
6	G	903[A]	GPP	PB-O1B	2.27	1.58	1.51
2	C	421	CDI	PB-OB1	2.27	1.64	1.59
4	B	901	C5P	O4'-C1'	2.30	1.44	1.41
6	H	903[A]	GPP	PB-O1B	2.33	1.58	1.51
6	H	903[C]	GPP	PB-O1B	2.33	1.58	1.51
2	F	421	CDI	PB-OB4	2.35	1.62	1.58

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	F	901	C5P	P-O1P	2.36	1.58	1.51
6	H	903[B]	GPP	PA-O1A	2.37	1.59	1.51
6	H	903[B]	GPP	PB-O1B	2.38	1.59	1.51
6	G	903[C]	GPP	PA-O1A	2.39	1.59	1.51
4	C	901	C5P	O4'-C1'	2.39	1.44	1.41
6	H	903[A]	GPP	PA-O1A	2.42	1.60	1.51
2	A	421	CDI	PA-OA3	2.43	1.62	1.58
4	B	901	C5P	P-O1P	2.43	1.59	1.51
6	H	903[C]	GPP	PA-O1A	2.43	1.60	1.51
6	G	903[B]	GPP	PA-O1A	2.46	1.60	1.51
2	A	421	CDI	PA-OB1	2.51	1.65	1.59
4	C	901	C5P	P-O1P	2.53	1.59	1.51
6	G	903[A]	GPP	PA-O1A	2.54	1.60	1.51
4	E	901	C5P	P-O1P	2.60	1.59	1.51
4	D	901	C5P	P-O1P	2.60	1.59	1.51
2	D	421	CDI	PA-OA3	2.65	1.63	1.58
4	E	901	C5P	O4'-C1'	2.66	1.44	1.41
4	A	901	C5P	P-O1P	2.66	1.59	1.51
2	C	421	CDI	PA-OA3	2.81	1.63	1.58
2	C	421	CDI	PB-OB4	2.84	1.63	1.58
2	A	421	CDI	PB-OB4	2.93	1.63	1.58

All (38) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	421	CDI	C5-C3-C4	-3.98	104.51	110.29
2	F	421	CDI	C5-C3-C4	-3.93	104.58	110.29
6	H	903[C]	GPP	PA-O3A-PB	-3.75	120.10	132.67
2	D	421	CDI	C5-C3-C4	-3.59	105.08	110.29
2	A	421	CDI	C5-C3-C4	-3.45	105.27	110.29
6	H	903[A]	GPP	PA-O3A-PB	-3.29	121.63	132.67
6	H	903[B]	GPP	PA-O3A-PB	-3.20	121.93	132.67
6	G	903[B]	GPP	PA-O3A-PB	-2.96	122.75	132.67
6	G	903[A]	GPP	PA-O3A-PB	-2.94	122.80	132.67
4	C	901	C5P	O3'-C3'-C2'	-2.72	102.98	111.83
6	G	903[C]	GPP	PA-O3A-PB	-2.65	123.80	132.67
2	E	421	CDI	C5-C3-C4	-2.30	106.94	110.29
6	G	903[C]	GPP	C4-C3-C2	-2.23	119.13	123.50
6	H	903[A]	GPP	C10-C8-C9	2.02	119.61	114.64
6	H	903[B]	GPP	C4-C3-C5	2.09	118.60	115.41
6	H	903[B]	GPP	C10-C8-C9	2.10	119.80	114.64
6	G	903[C]	GPP	C10-C8-C9	2.10	119.81	114.64

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	G	903[C]	GPP	C4-C3-C5	2.17	118.72	115.41
6	G	903[B]	GPP	C4-C3-C5	2.21	118.78	115.41
6	G	903[A]	GPP	C10-C8-C9	2.22	120.10	114.64
4	C	901	C5P	O3P-P-O5'	2.23	112.98	106.56
4	F	901	C5P	O4'-C1'-N1	2.28	112.89	108.08
4	E	901	C5P	O4'-C1'-N1	2.29	112.92	108.08
6	G	903[A]	GPP	C4-C3-C5	2.38	119.04	115.41
4	B	901	C5P	O4'-C1'-N1	2.41	113.17	108.08
6	G	903[B]	GPP	C10-C8-C9	2.53	120.85	114.64
2	E	421	CDI	OB4-C3-C5	2.74	113.29	106.57
2	A	421	CDI	OB4-C3-C5	2.96	113.83	106.57
4	C	901	C5P	C2-N3-C4	3.11	120.00	115.61
2	B	421	CDI	OB4-C3-C5	3.15	114.28	106.57
4	B	901	C5P	C2-N3-C4	3.19	120.11	115.61
2	F	421	CDI	OB4-C3-C5	3.53	115.22	106.57
2	D	421	CDI	OB4-C3-C5	3.62	115.45	106.57
4	D	901	C5P	C2-N3-C4	3.64	120.75	115.61
4	F	901	C5P	C2-N3-C4	3.67	120.79	115.61
4	A	901	C5P	C2-N3-C4	3.73	120.87	115.61
2	C	421	CDI	OB4-C3-C5	3.84	115.97	106.57
4	E	901	C5P	C2-N3-C4	3.96	121.19	115.61

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

13 monomers are involved in 35 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	901	C5P	2	0
4	B	901	C5P	1	0
2	C	421	CDI	2	0
4	C	901	C5P	5	0
2	E	421	CDI	2	0
2	F	421	CDI	4	0
4	F	901	C5P	2	0
6	G	903[A]	GPP	3	0
6	G	903[B]	GPP	5	0
6	G	903[C]	GPP	2	0
6	H	903[A]	GPP	1	0
6	H	903[B]	GPP	3	0
6	H	903[C]	GPP	3	0

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	157/161 (97%)	0.20	12 (7%) 17 24	32, 40, 77, 93	2 (1%)
1	B	158/161 (98%)	0.18	11 (6%) 19 27	33, 44, 83, 95	2 (1%)
1	C	159/161 (98%)	0.01	7 (4%) 38 47	29, 39, 60, 68	1 (0%)
1	D	158/161 (98%)	0.16	11 (6%) 19 27	35, 46, 75, 82	4 (2%)
1	E	157/161 (97%)	0.72	22 (14%) 4 6	46, 65, 92, 100	9 (5%)
1	F	159/161 (98%)	0.12	10 (6%) 23 31	34, 46, 64, 75	3 (1%)
All	All	948/966 (98%)	0.23	73 (7%) 16 23	29, 46, 78, 100	21 (2%)

All (73) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	E	64	THR	8.8
1	A	64	THR	7.8
1	F	157	ALA	7.6
1	D	64	THR	7.5
1	A	66	PRO	7.1
1	F	-1	LEU	6.9
1	D	-1	LEU	6.6
1	E	63	ASP	5.7
1	B	61	PHE	5.5
1	D	63	ASP	5.1
1	A	68	PHE	4.9
1	B	64	THR	4.9
1	E	58	GLY	4.7
1	A	70	GLY	4.5
1	C	-1	LEU	4.5
1	D	34	HIS	4.4
1	B	-1	LEU	4.3
1	A	65	ASP	4.3
1	B	66	PRO	4.1

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Mol	Chain	Res	Type	RSRZ
1	E	34	HIS	4.0
1	C	64	THR	3.5
1	E	66	PRO	3.4
1	A	62	PRO	3.4
1	E	33	ALA	3.4
1	E	70	GLY	3.3
1	A	63	ASP	3.3
1	B	68	PHE	3.2
1	F	64	THR	3.2
1	E	13	GLY	3.2
1	B	69	LYS	3.1
1	C	15	GLU	3.1
1	E	0	GLU	3.1
1	B	67	ALA	3.1
1	E	69	LYS	3.0
1	B	59	LYS	2.9
1	F	156	LYS	2.9
1	A	123	HIS	2.9
1	B	34	HIS	2.9
1	D	68	PHE	2.9
1	E	86	ALA	2.8
1	E	65	ASP	2.8
1	E	122	CYS	2.8
1	E	156	LYS	2.8
1	C	157	ALA	2.7
1	B	123	HIS	2.7
1	E	32	LEU	2.7
1	A	69	LYS	2.7
1	E	106	LEU	2.6
1	E	68	PHE	2.6
1	E	44	LEU	2.6
1	C	28[A]	GLU	2.6
1	C	66	PRO	2.5
1	A	146	ILE	2.5
1	F	0	GLU	2.4
1	D	123	HIS	2.4
1	E	123	HIS	2.4
1	F	152	ALA	2.3
1	D	14	GLY	2.3
1	A	67	ALA	2.3
1	E	107	PRO	2.3
1	D	70	GLY	2.3

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Mol	Chain	Res	Type	RSRZ
1	E	83	ARG	2.3
1	F	20	ILE	2.2
1	D	15	GLU	2.2
1	F	14	GLY	2.1
1	F	48	LEU	2.1
1	A	34	HIS	2.1
1	D	61	PHE	2.0
1	C	41	LEU	2.0
1	F	123	HIS	2.0
1	E	19	ILE	2.0
1	B	62	PRO	2.0
1	D	62	PRO	2.0

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

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

## 6.3 Carbohydrates [i](#)

There are no carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95<sup>th</sup> 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	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
6	GPP	G	903[C]	19/19	0.76	0.53	15.83	54,68,79,80	19
6	GPP	G	903[A]	19/19	0.76	0.53	15.04	54,68,81,81	19
6	GPP	G	903[B]	19/19	0.76	0.53	14.72	56,70,83,83	19
6	GPP	H	903[A]	19/19	0.76	0.52	12.99	61,74,91,91	19
6	GPP	H	903[B]	19/19	0.76	0.52	12.94	64,75,92,93	19
6	GPP	H	903[C]	19/19	0.76	0.52	12.17	64,75,93,93	19
2	CDI	F	421	16/16	0.76	0.44	9.32	52,55,59,59	16
4	C5P	F	901	21/21	0.80	0.33	6.13	83,91,99,100	0
2	CDI	C	421	16/16	0.83	0.35	5.26	77,79,81,81	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
2	CDI	B	421	16/16	0.69	0.53	3.97	72,74,75,75	16
4	C5P	C	901	21/21	0.87	0.26	3.31	52,65,76,78	0
2	CDI	A	421	16/16	0.78	0.45	2.88	88,90,91,92	0
4	C5P	D	901	21/21	0.73	0.39	2.32	145,147,150,150	0
2	CDI	D	421	16/16	0.83	0.41	1.97	64,66,68,68	16
4	C5P	A	901	21/21	0.81	0.25	1.80	70,84,95,95	0
4	C5P	B	901	21/21	0.79	0.27	1.76	65,83,95,95	0
2	CDI	E	421	16/16	0.78	0.39	1.39	68,70,73,74	16
4	C5P	E	901	21/21	0.78	0.31	1.33	83,93,100,101	0
5	MN	C	902	1/1	0.99	0.05	-3.65	58,58,58,58	0
5	MN	D	902	1/1	0.99	0.03	-4.97	72,72,72,72	0
3	ZN	E	900	1/1	0.95	0.09	-	73,73,73,73	0
3	ZN	B	900	1/1	0.99	0.09	-	58,58,58,58	0
3	ZN	A	900	1/1	0.99	0.02	-	50,50,50,50	0
3	ZN	D	900	1/1	0.99	0.03	-	58,58,58,58	0
3	ZN	C	900	1/1	1.00	0.06	-	43,43,43,43	0
3	ZN	F	900	1/1	1.00	0.06	-	51,51,51,51	0

## 6.5 Other polymers

There are no such residues in this entry.