wwPDB X-ray Structure Validation Summary Report (i)

Oct 13, 2025 – 07:01 PM EDT

PDB ID	:	4NOG / pdb_00004nog
Title	:	Crystal structure of a putative ornithine aminotransferase from Toxoplasma gondii ME49 in complex with pyrodoxal-5'-phosphate
Authors	:	Filippova, E.V.; Halavaty, A.; Ruan, J.; Shuvalova, L.; Flores, K.; Dubrovska, I.; Ngo, H.; Shanmugam, D.; Roos, D.; Anderson, W.F.; Center for Structural Genomics of Infectious Diseases (CSGID)
Deposited on	:	2013-11-19
Resolution	:	1.20 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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:

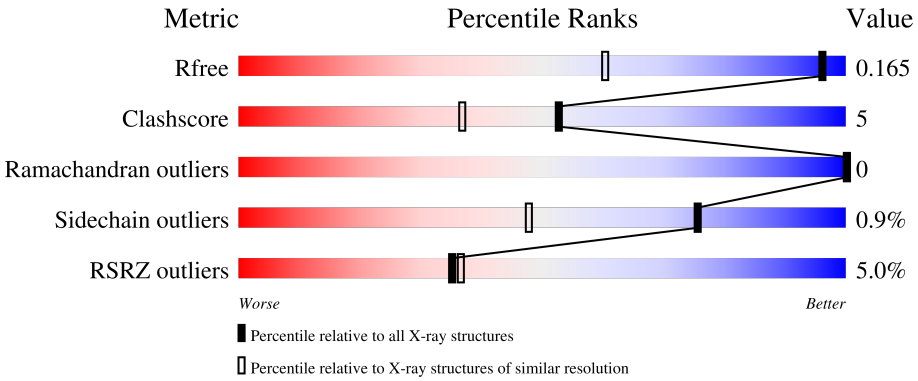
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.46

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 1.20 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}	164625	1079 (1.20-1.20)
Clashscore	180529	1183 (1.20-1.20)
Ramachandran outliers	177936	1146 (1.20-1.20)
Sidechain outliers	177891	1146 (1.20-1.20)
RSRZ outliers	164620	1078 (1.20-1.20)

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	442	2% 88% 7% • 5%
1	B	442	7% 88% 8% •

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	BME	A	502	-	-	X	-
6	PEG	B	504	-	-	X	-

2 Entry composition (i)

There are 7 unique types of molecules in this entry. The entry contains 7897 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 Putative ornithine aminotransferase, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	422	Total	C	N	O	S	0	16	0
			3401	2147	603	630	21			
1	B	424	Total	C	N	O	S	0	12	0
			3384	2133	602	629	20			

There are 34 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	16	MET	-	expression tag	UNP S8EY38
A	442	GLY	-	expression tag	UNP S8EY38
A	443	GLU	-	expression tag	UNP S8EY38
A	444	ASN	-	expression tag	UNP S8EY38
A	445	LEU	-	expression tag	UNP S8EY38
A	446	TYR	-	expression tag	UNP S8EY38
A	447	PHE	-	expression tag	UNP S8EY38
A	448	GLN	-	expression tag	UNP S8EY38
A	449	SER	-	expression tag	UNP S8EY38
A	450	ALA	-	expression tag	UNP S8EY38
A	451	GLY	-	expression tag	UNP S8EY38
A	452	HIS	-	expression tag	UNP S8EY38
A	453	HIS	-	expression tag	UNP S8EY38
A	454	HIS	-	expression tag	UNP S8EY38
A	455	HIS	-	expression tag	UNP S8EY38
A	456	HIS	-	expression tag	UNP S8EY38
A	457	HIS	-	expression tag	UNP S8EY38
B	16	MET	-	expression tag	UNP S8EY38
B	442	GLY	-	expression tag	UNP S8EY38
B	443	GLU	-	expression tag	UNP S8EY38
B	444	ASN	-	expression tag	UNP S8EY38
B	445	LEU	-	expression tag	UNP S8EY38
B	446	TYR	-	expression tag	UNP S8EY38
B	447	PHE	-	expression tag	UNP S8EY38
B	448	GLN	-	expression tag	UNP S8EY38

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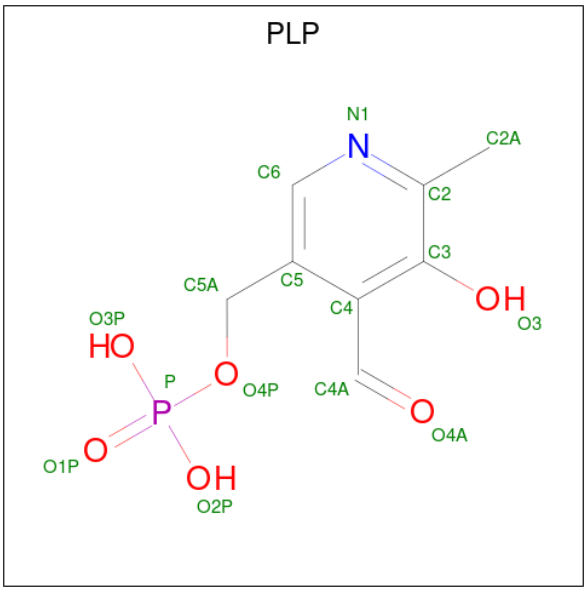
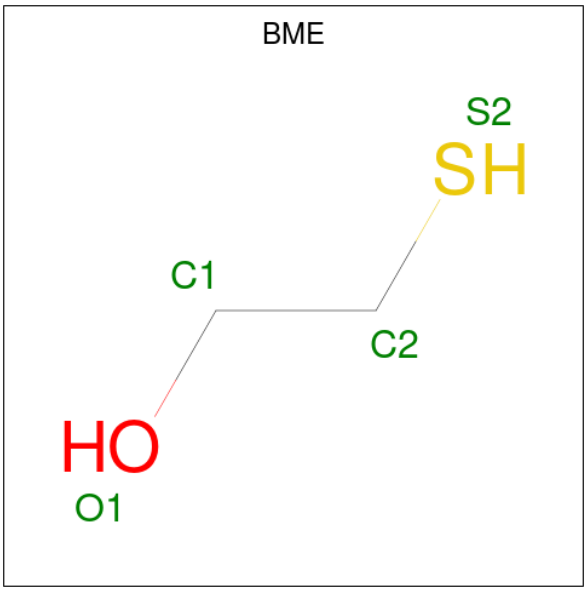
Chain	Residue	Modelled	Actual	Comment	Reference
B	449	SER	-	expression tag	UNP S8EY38
B	450	ALA	-	expression tag	UNP S8EY38
B	451	GLY	-	expression tag	UNP S8EY38
B	452	HIS	-	expression tag	UNP S8EY38
B	453	HIS	-	expression tag	UNP S8EY38
B	454	HIS	-	expression tag	UNP S8EY38
B	455	HIS	-	expression tag	UNP S8EY38
B	456	HIS	-	expression tag	UNP S8EY38
B	457	HIS	-	expression tag	UNP S8EY38

- Molecule 2 is PYRIDOXAL-5'-PHOSPHATE (CCD ID: PLP) (formula: $C_8H_{10}NO_6P$).



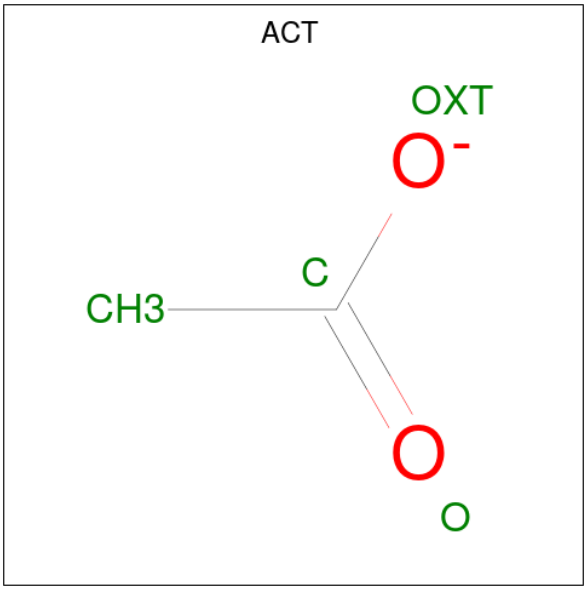
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			16	8	1	6	1		
2	B	1	Total	C	N	O	P	0	0
			16	8	1	6	1		

- Molecule 3 is BETA-MERCAPTOETHANOL (CCD ID: BME) (formula: C_2H_6OS).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C O S 4 2 1 1	0	0
3	B	1	Total C O S 4 2 1 1	0	0

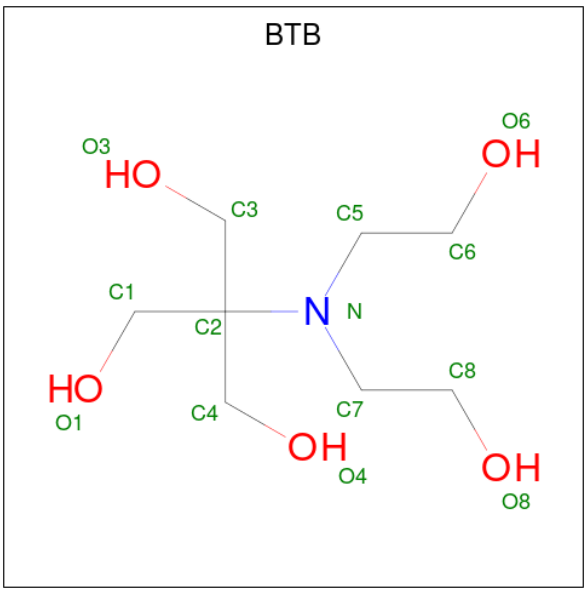
- Molecule 4 is ACETATE ION (CCD ID: ACT) (formula: $C_2H_3O_2$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	B	1	Total C O 4 2 2	0	0

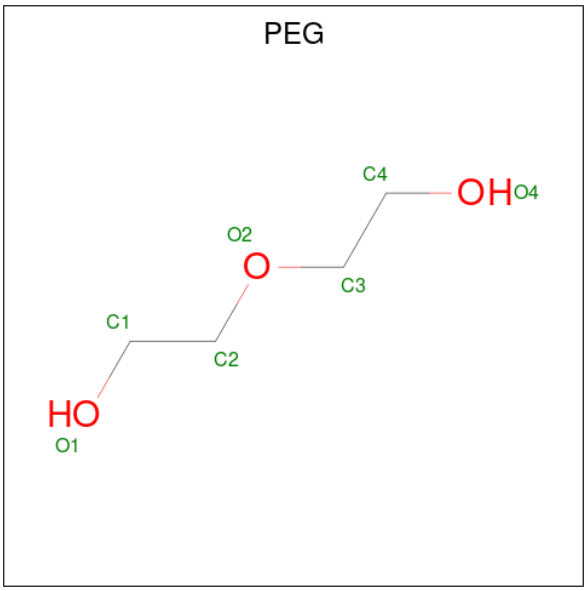
- Molecule 5 is 2-[BIS-(2-HYDROXY-ETHYL)-AMINO]-2-HYDROXYMETHYL-PROPAN

E-1,3-DIOL (CCD ID: BTB) (formula: $C_8H_{19}NO_5$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	B	1	Total C N O 14 8 1 5	0	0

- Molecule 6 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	B	1	Total C O 7 4 3	0	0

- Molecule 7 is water.

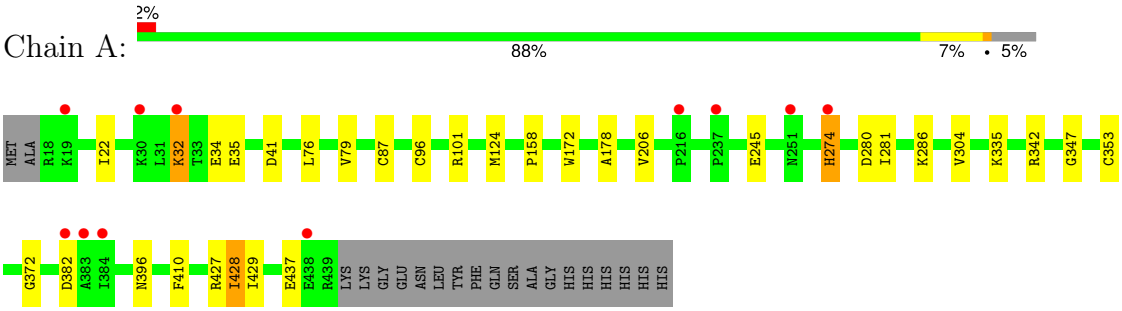
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	A	549	Total O 552 552	0	3
7	B	492	Total O 495 495	0	3

3 Residue-property plots (i)

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.

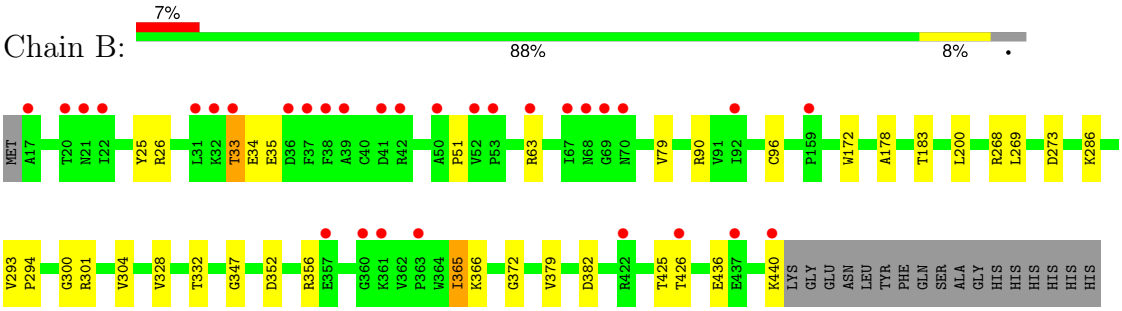
• Molecule 1: Putative ornithine aminotransferase, mitochondrial

Chain A:



• Molecule 1: Putative ornithine aminotransferase, mitochondrial

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α, β, γ	56.19Å 61.33Å 63.68Å 100.58° 93.23° 107.74°	Depositor
Resolution (Å)	62.14 – 1.20 62.14 – 1.20	Depositor EDS
% Data completeness (in resolution range)	90.8 (62.14-1.20) 90.8 (62.14-1.20)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.61 (at 1.20Å)	Xtriage
Refinement program	REFMAC 5.8.0049	Depositor
R, R_{free}	0.133 , 0.165 0.132 , 0.165	Depositor DCC
R_{free} test set	11260 reflections (4.56%)	wwPDB-VP
Wilson B-factor (Å^2)	9.8	Xtriage
Anisotropy	0.580	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 49.6	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	0.98	EDS
Total number of atoms	7897	wwPDB-VP
Average B, all atoms (Å^2)	18.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.87% 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: PEG, ACT, BME, BTB, PLP

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

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	#$\|Z\|$ >5	RMSZ	#$\|Z\|$ >5
1	A	1.11	6/3464 (0.2%)	0.99	2/4688 (0.0%)
1	B	1.17	4/3447 (0.1%)	1.02	3/4665 (0.1%)
All	All	1.14	10/6911 (0.1%)	1.01	5/9353 (0.1%)

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	300	GLY	C-O	-8.68	1.15	1.23
1	A	274	HIS	C-O	8.38	1.34	1.24
1	A	158	PRO	C-O	-6.68	1.19	1.25
1	A	35	GLU	C-O	-6.56	1.16	1.24
1	B	426	THR	CA-CB	6.33	1.63	1.53

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	34	GLU	N-CA-C	-5.51	105.28	111.28
1	B	63	ARG	NE-CZ-NH2	-5.49	114.26	119.20
1	A	41	ASP	CB-CA-C	-5.47	102.53	110.96
1	A	158	PRO	N-CA-C	5.42	115.67	110.47
1	B	63	ARG	CG-CD-NE	-5.08	100.81	112.00

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	3401	0	3418	33	0
1	B	3384	0	3396	35	0
2	A	16	0	8	0	0
2	B	16	0	7	1	0
3	A	4	0	5	6	0
3	B	4	0	5	2	0
4	B	4	0	3	0	0
5	B	14	0	19	0	0
6	B	7	0	10	5	0
7	A	552	0	0	7	0
7	B	495	0	0	15	0
All	All	7897	0	6871	67	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 5.

The worst 5 of 67 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:425:THR:HG21	3:B:505:BME:H22	1.45	0.97
1:A:353[B]:CYS:HG	3:A:502:BME:C1	1.83	0.91
1:A:353[B]:CYS:SG	1:A:429[B]:ILE:HD11	2.14	0.87
1:B:352:ASP:HB3	7:B:993:HOH:O	1.75	0.87
1:B:25:TYR:HB2	7:B:945:HOH:O	1.75	0.86

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	436/442 (99%)	422 (97%)	14 (3%)	0	100	100
1	B	434/442 (98%)	419 (96%)	15 (4%)	0	100	100
All	All	870/884 (98%)	841 (97%)	29 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	365/365 (100%)	361 (99%)	4 (1%)	70	37
1	B	362/365 (99%)	358 (99%)	4 (1%)	70	37
All	All	727/730 (100%)	719 (99%)	8 (1%)	75	37

5 of 8 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	365[B]	ILE
1	B	365[A]	ILE
1	B	26	ARG
1	A	437	GLU
1	B	79	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	70	ASN
1	A	274	HIS
1	B	70	ASN
1	B	260	GLN
1	B	396	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)

7 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	PLP	B	501	-	16,16,16	1.28	2 (12%)	20,23,23	1.63	4 (20%)
2	PLP	A	501	-	16,16,16	1.15	3 (18%)	20,23,23	1.18	1 (5%)
3	BME	B	505	1	3,3,3	0.16	0	2,2,2	1.32	0
5	BTB	B	503	-	13,13,13	1.15	2 (15%)	7,16,16	1.60	2 (28%)
3	BME	A	502	-	3,3,3	0.52	0	2,2,2	0.59	0
4	ACT	B	502	-	3,3,3	0.77	0	3,3,3	0.72	0
6	PEG	B	504	-	6,6,6	0.56	0	5,5,5	1.08	0

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	PLP	B	501	-	-	0/8/8/8	0/1/1/1
2	PLP	A	501	-	-	0/8/8/8	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	BME	B	505	1	-	0/1/1/1	-
5	BTB	B	503	-	-	6/21/21/21	-
3	BME	A	502	-	-	1/1/1/1	-
6	PEG	B	504	-	-	3/4/4/4	-

The worst 5 of 7 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	501	PLP	C3-C2	2.65	1.43	1.41
2	B	501	PLP	O4A-C4A	2.55	1.30	1.21
5	B	503	BTB	C5-N	2.38	1.51	1.48
2	B	501	PLP	C4-C5	2.37	1.45	1.42
2	A	501	PLP	C4-C3	2.15	1.44	1.41

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	501	PLP	C4-C3-C2	-4.03	117.88	120.14
2	A	501	PLP	C3-C4-C5	-3.06	115.82	118.28
2	B	501	PLP	C5-C6-N1	-2.71	119.42	123.83
2	B	501	PLP	O2P-P-O4P	-2.64	99.78	106.67
5	B	503	BTB	O4-C4-C2	-2.19	106.25	111.40

There are no chirality outliers.

5 of 10 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	B	503	BTB	N-C2-C4-O4
5	B	503	BTB	C1-C2-N-C5
5	B	503	BTB	C3-C2-N-C5
5	B	503	BTB	C4-C2-N-C5
3	A	502	BME	O1-C1-C2-S2

There are no ring outliers.

4 monomers are involved in 14 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	501	PLP	1	0
3	B	505	BME	2	0
3	A	502	BME	6	0
6	B	504	PEG	5	0

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

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^{th} 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	422/442 (95%)	-0.13	11 (2%)	57	56	5, 13, 33, 92	16 (3%)
1	B	424/442 (95%)	0.06	31 (7%)	22	21	5, 13, 36, 98	12 (2%)
All	All	846/884 (95%)	-0.04	42 (4%)	35	36	5, 13, 35, 98	28 (3%)

The worst 5 of 42 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	31	LEU	5.8
1	B	33	THR	5.3
1	B	68	ASN	5.0
1	B	426	THR	4.1
1	B	20	THR	3.8

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 oligosaccharides 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, 95^{th} 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	BME	B	505	4/4	0.84	0.15	34,34,34,36	3
6	PEG	B	504	7/7	0.88	0.13	27,32,43,44	0
5	BTB	B	503	14/14	0.90	0.09	19,22,31,37	0
3	BME	A	502	4/4	0.91	0.09	27,35,39,42	1
4	ACT	B	502	4/4	0.91	0.09	28,32,33,38	0
2	PLP	B	501	16/16	0.99	0.05	10,11,14,53	0
2	PLP	A	501	16/16	0.99	0.05	9,11,14,32	0

6.5 Other polymers (i)

There are no such residues in this entry.