Full wwPDB X-ray Structure Validation Report (i)

Oct 11, 2021 – 02:37 PM EDT

PDB ID	:	2HGX
Title	:	Crystal structure of Cys315Ala mutant of human mitochondrial branched chain aminotransferase
Authors	:	Yennawar, N.H.; Hutson, S.M.
Deposited on	:	2006-06-27
Resolution	:	1.80 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 following versions of software and data (see references (i)) were used in the production of this report:

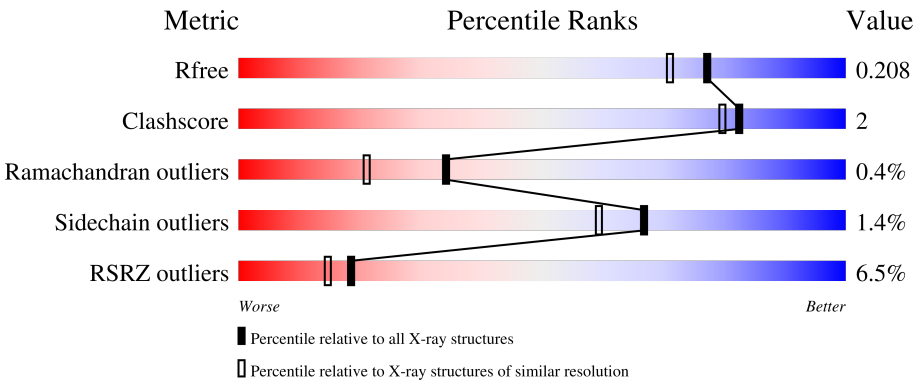
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.23.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.23.2

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 1.80 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	5950 (1.80-1.80)
Clashscore	141614	6793 (1.80-1.80)
Ramachandran outliers	138981	6697 (1.80-1.80)
Sidechain outliers	138945	6696 (1.80-1.80)
RSRZ outliers	127900	5850 (1.80-1.80)

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	365	7% 90% 7% • •
1	B	365	5% 93% 6% •

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
4	EPE	B	1004	-	-	-	X

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 6203 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.

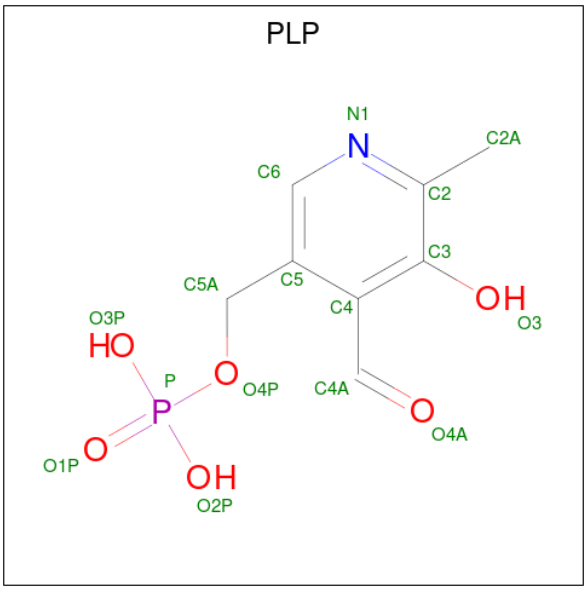
- Molecule 1 is a protein called Branched-chain-amino-acid aminotransferase, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	357	2853	1837	499	500	17	0	1	1
1	B	363	2930	1890	509	513	18	0	5	0

There are 4 discrepancies between the modelled and reference sequences:

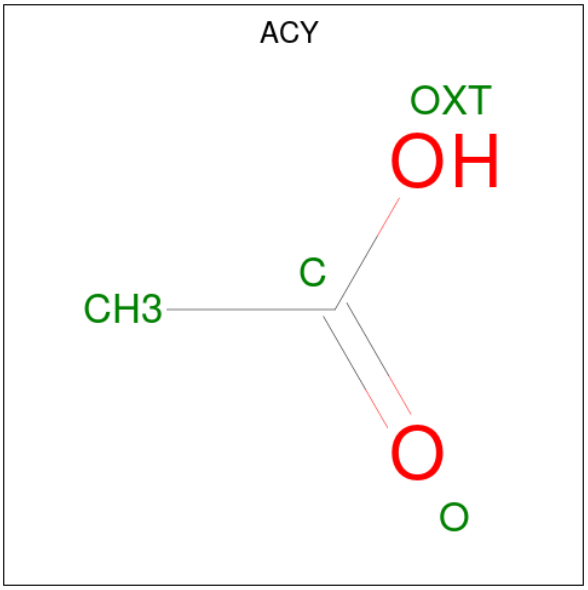
Chain	Residue	Modelled	Actual	Comment	Reference
A	159	ARG	THR	conflict	UNP O15382
A	315	ALA	CYS	engineered mutation	UNP O15382
B	659	ARG	THR	conflict	UNP O15382
B	815	ALA	CYS	engineered mutation	UNP O15382

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



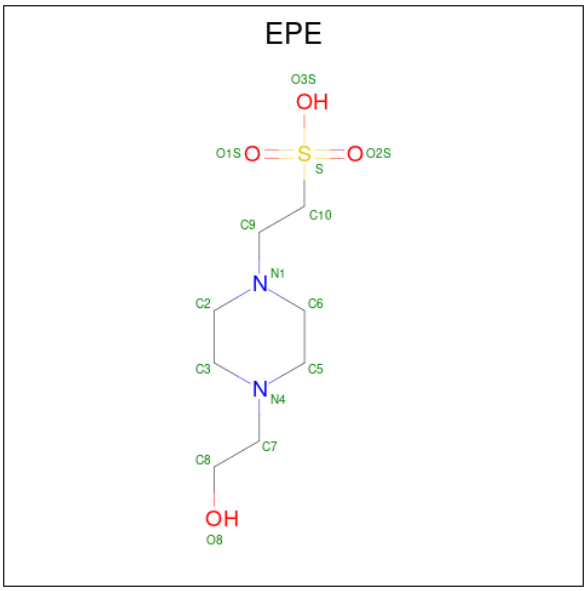
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	A	1	15	8	1	5	1	0	0
			Total	C	N	O	P		
2	B	1	15	8	1	5	1	0	0

- Molecule 3 is ACETIC ACID (three-letter code: ACY) (formula: $C_2H_4O_2$).



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

- Molecule 4 is 4-(2-HYDROXYETHYL)-1-PIPERAZINE ETHANESULFONIC ACID (three-letter code: EPE) (formula: $C_8H_{18}N_2O_4S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
4	B	1	15	8	2	4	1	0	0

- Molecule 5 is water.

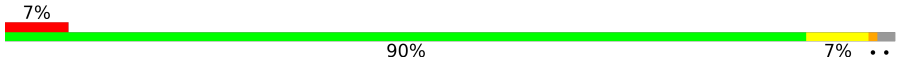
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	A	163	163	163	0	0
			Total	O		
5	B	200	200	200	0	0

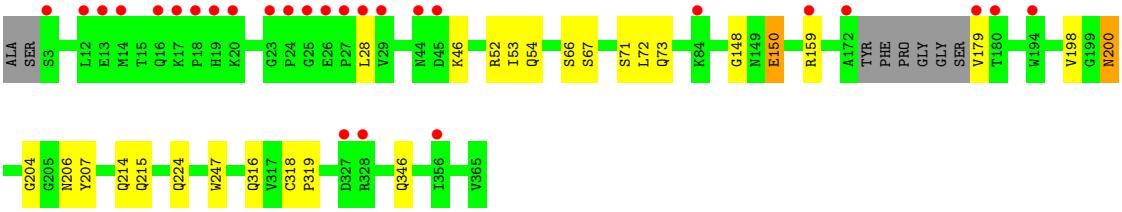
3 Residue-property plots (i)

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: Branched-chain-amino-acid aminotransferase, mitochondrial

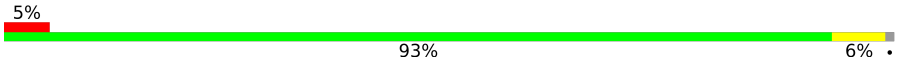
Chain A:

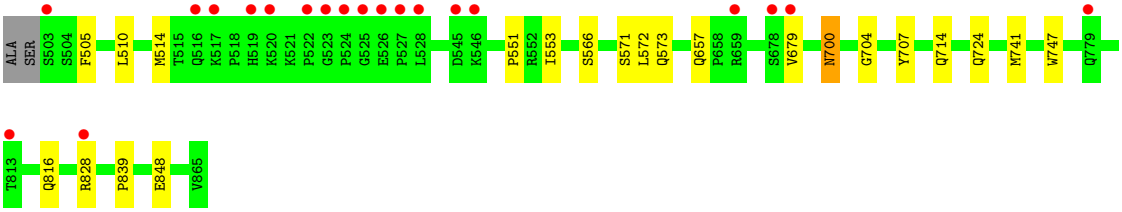




• Molecule 1: Branched-chain-amino-acid aminotransferase, mitochondrial

Chain B:





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	58.74Å 109.90Å 59.59Å 90.00° 96.51° 90.00°	Depositor
Resolution (Å)	25.00 – 1.80 29.18 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.2 (25.00-1.80) 99.5 (29.18-1.80)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	7.90 (at 1.80Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.208 , 0.231 0.206 , 0.208	Depositor DCC
R_{free} test set	3506 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å^2)	17.2	Xtriage
Anisotropy	0.180	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.41 , 48.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.017 for l,-k,h	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	6203	wwPDB-VP
Average B, all atoms (Å^2)	19.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.00% 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 (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: ACY, PLP, EPE

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	0.61	0/2926	0.73	1/3971 (0.0%)
1	B	0.62	0/3007	0.72	0/4083
All	All	0.62	0/5933	0.72	1/8054 (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
1	B	0	1
All	All	0	2

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	53	ILE	N-CA-C	-5.22	96.91	111.00

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	207	TYR	Sidechain
1	B	707	TYR	Sidechain

5.2 Too-close contacts (i)

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	2853	0	2877	17	0
1	B	2930	0	2952	16	0
2	A	15	0	6	0	0
2	B	15	0	6	0	0
3	A	4	0	3	0	0
3	B	8	0	6	0	0
4	B	15	0	17	1	0
5	A	163	0	0	0	0
5	B	200	0	0	2	0
All	All	6203	0	5867	29	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 2.

All (29) 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:200:ASN:H	1:A:200:ASN:HD22	1.15	0.88
1:B:700:ASN:HD22	1:B:700:ASN:H	1.20	0.87
1:A:150:GLU:HG3	1:A:159:ARG:H	1.58	0.68
1:A:215:GLN:HE22	1:B:657:GLN:NE2	1.98	0.61
1:A:73:GLN:HE22	1:B:571:SER:H	1.48	0.59
1:A:200:ASN:H	1:A:200:ASN:ND2	1.95	0.58
1:A:71:SER:H	1:B:573:GLN:HE22	1.52	0.55
1:A:214:GLN:HE22	1:A:224:GLN:HA	1.73	0.53
1:B:714:GLN:HE22	1:B:724:GLN:HA	1.74	0.53
1:A:179:VAL:HG11	1:A:346:GLN:HE22	1.75	0.51
1:B:700:ASN:H	1:B:700:ASN:ND2	1.99	0.51
1:B:573:GLN:HE21	1:B:704:GLY:HA3	1.77	0.49
1:B:566:SER:HB2	1:B:572:LEU:HD12	1.96	0.48
1:A:66:SER:HB2	1:A:72:LEU:HD12	1.97	0.47
1:A:73:GLN:HE21	1:A:204:GLY:HA3	1.79	0.47
1:A:198:VAL:HG23	1:A:206:ASN:HD21	1.80	0.47
1:A:52:ARG:HE	1:A:54:GLN:NE2	2.11	0.46
1:B:700:ASN:HD22	1:B:700:ASN:N	1.98	0.46

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:200:ASN:HD22	1:A:200:ASN:N	1.94	0.46
1:A:179:VAL:HG11	1:A:346:GLN:NE2	2.32	0.45
1:B:679[B]:VAL:HG22	5:B:272:HOH:O	2.17	0.44
1:A:73:GLN:NE2	1:B:571:SER:H	2.14	0.43
1:B:848:GLU:OE1	4:B:1004:EPE:H81	2.18	0.43
1:B:505:PHE:HB2	1:B:551:PRO:HD3	2.01	0.43
1:B:714:GLN:NE2	5:B:16:HOH:O	2.51	0.42
1:A:67:SER:HB3	1:A:148:GLY:O	2.19	0.42
1:B:724:GLN:HE22	1:B:741:MET:CE	2.33	0.42
1:A:318:CYS:HA	1:A:319:PRO:HD3	1.94	0.41
1:B:510:LEU:HD11	1:B:553:ILE:HG13	2.03	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	354/365 (97%)	341 (96%)	12 (3%)	1 (0%)	41	27
1	B	366/365 (100%)	357 (98%)	7 (2%)	2 (0%)	29	15
All	All	720/730 (99%)	698 (97%)	19 (3%)	3 (0%)	34	21

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	316	GLN
1	B	816	GLN
1	B	839	PRO

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	310/315 (98%)	305 (98%)	5 (2%)	62	54
1	B	318/315 (101%)	313 (98%)	5 (2%)	62	54
All	All	628/630 (100%)	618 (98%)	10 (2%)	67	54

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	28	LEU
1	A	46	LYS
1	A	150	GLU
1	A	200	ASN
1	A	247	TRP
1	B	514[A]	MET
1	B	514[B]	MET
1	B	700	ASN
1	B	747	TRP
1	B	828	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (21) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	54	GLN
1	A	73	GLN
1	A	96	ASN
1	A	200	ASN
1	A	206	ASN
1	A	214	GLN
1	A	242	ASN
1	A	249	HIS
1	A	295	GLN
1	A	346	GLN
1	B	516	GLN
1	B	573	GLN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	B	586	GLN
1	B	657	GLN
1	B	700	ASN
1	B	706	ASN
1	B	714	GLN
1	B	715	GLN
1	B	724	GLN
1	B	734	GLN
1	B	742	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 monosaccharides in this entry.

5.6 Ligand geometry (i)

6 ligands are modelled in this entry.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
4	EPE	B	1004	-	15,15,15	1.49	4 (26%)	18,20,20	0.99	1 (5%)
3	ACY	A	1001	-	1,3,3	2.64	1 (100%)	0,3,3	-	-
2	PLP	A	400	1	15,15,16	1.47	3 (20%)	20,22,23	1.67	5 (25%)
2	PLP	B	401	1	15,15,16	1.56	3 (20%)	20,22,23	1.72	6 (30%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
3	ACY	B	1003	-	1,3,3	2.87	1 (100%)	0,3,3	-	-
3	ACY	B	1002	-	1,3,3	2.68	1 (100%)	0,3,3	-	-

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	A	400	1	-	0/6/6/8	0/1/1/1
4	EPE	B	1004	-	-	1/9/19/19	0/1/1/1
2	PLP	B	401	1	-	1/6/6/8	0/1/1/1

All (13) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	401	PLP	C4A-C4	2.99	1.57	1.51
3	B	1003	ACY	CH3-C	2.87	1.52	1.48
3	B	1002	ACY	CH3-C	2.68	1.52	1.48
4	B	1004	EPE	C10-S	2.65	1.81	1.77
3	A	1001	ACY	CH3-C	2.64	1.52	1.48
2	A	400	PLP	C4A-C4	2.59	1.57	1.51
4	B	1004	EPE	C6-N1	2.45	1.53	1.46
4	B	1004	EPE	C9-N1	2.37	1.52	1.47
2	B	401	PLP	C5-C4	2.29	1.43	1.40
4	B	1004	EPE	C2-N1	2.20	1.53	1.46
2	B	401	PLP	P-O1P	-2.12	1.43	1.50
2	A	400	PLP	P-O1P	-2.12	1.43	1.50
2	A	400	PLP	C5-C4	2.01	1.42	1.40

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	400	PLP	O4P-C5A-C5	3.84	116.66	109.35
2	B	401	PLP	O4P-C5A-C5	3.54	116.10	109.35
2	B	401	PLP	O2P-P-O4P	-2.52	100.02	106.73
2	A	400	PLP	O2P-P-O4P	-2.46	100.18	106.73
2	B	401	PLP	O3P-P-O1P	2.46	120.30	110.68
2	B	401	PLP	C5A-C5-C6	-2.38	115.46	119.37
2	B	401	PLP	C4A-C4-C5	2.38	123.38	120.94
4	B	1004	EPE	C7-N4-C5	-2.37	105.17	111.23
2	A	400	PLP	O3P-P-O1P	2.36	119.92	110.68

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	401	PLP	C6-C5-C4	2.24	119.92	118.16
2	A	400	PLP	C5A-C5-C6	-2.12	115.88	119.37
2	A	400	PLP	O4P-P-O1P	2.01	112.11	106.47

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	B	1004	EPE	N4-C7-C8-O8
2	B	401	PLP	C5A-O4P-P-O1P

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	1004	EPE	1	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 (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	357/365 (97%)	0.41	27 (7%)	13	10	8, 17, 33, 48	0
1	B	363/365 (99%)	0.28	20 (5%)	25	20	8, 17, 31, 42	0
All	All	720/730 (98%)	0.34	47 (6%)	18	15	8, 17, 32, 48	0

All (47) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	172	ALA	11.9
1	A	25	GLY	10.6
1	B	524	PRO	10.1
1	A	3	SER	9.1
1	A	26	GLU	8.2
1	A	17	LYS	7.6
1	B	523	GLY	6.6
1	B	525	GLY	6.1
1	A	27	PRO	5.6
1	B	503	SER	5.1
1	B	526	GLU	4.7
1	A	28	LEU	4.7
1	A	19	HIS	4.7
1	B	546	LYS	4.5
1	A	179	VAL	4.4
1	A	16	GLN	3.8
1	A	24	PRO	3.7
1	B	527	PRO	3.7
1	A	12	LEU	3.7
1	B	545	ASP	3.5
1	A	84	LYS	3.5
1	A	20	LYS	3.4
1	A	18	PRO	3.3
1	B	517	LYS	3.3

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	A	29	VAL	3.2
1	A	194	TRP	3.2
1	B	520	LYS	3.2
1	B	528	LEU	3.0
1	B	519	HIS	3.0
1	A	45	ASP	3.0
1	A	23	GLY	2.9
1	B	679[A]	VAL	2.9
1	B	779	GLN	2.5
1	A	180	THR	2.4
1	A	13	GLU	2.4
1	B	659	ARG	2.2
1	B	516	GLN	2.2
1	A	356	ILE	2.2
1	A	159	ARG	2.2
1	A	14	MET	2.1
1	B	813[A]	THR	2.1
1	B	828	ARG	2.1
1	B	522	PRO	2.1
1	A	328	ARG	2.0
1	A	44	ASN	2.0
1	A	327	ASP	2.0
1	B	678	SER	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 monosaccharides 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.

Continued on next page...

Continued from previous page...

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
4	EPE	B	1004	15/15	0.30	0.53	42,44,53,55	0
3	ACY	B	1002	4/4	0.75	0.24	36,36,37,37	0
3	ACY	B	1003	4/4	0.77	0.15	37,37,38,38	0
3	ACY	A	1001	4/4	0.81	0.28	38,39,39,39	0
2	PLP	A	400	15/16	0.96	0.13	11,13,19,19	0
2	PLP	B	401	15/16	0.96	0.12	10,13,16,17	0

6.5 Other polymers (i)

There are no such residues in this entry.