



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 05:56 PM GMT

PDB ID : 4JZX
Title : Crystal Structure of Leshmaniasis major Farnesyl diphosphate synthase in complex with 3-BUTYL-1-(2,2-DIPHOSPHONOETHYL)PYRIDINIUM, IPP and Ca²⁺
Authors : Aripirala, S.; Gabelli, S.; Amzel, L.M.
Deposited on : 2013-04-03
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
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>
with specific help available everywhere you see the ⓘ symbol.

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

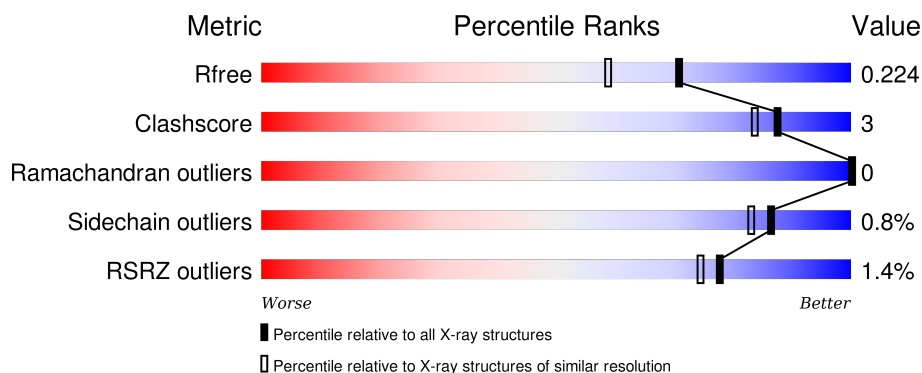
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 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}	91344	4533 (1.80-1.80)
Clashscore	102246	5383 (1.80-1.80)
Ramachandran outliers	100387	5320 (1.80-1.80)
Sidechain outliers	100360	5319 (1.80-1.80)
RSRZ outliers	91569	4547 (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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 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	362	<div> <div></div> <div>94% 6%</div> </div>
1	B	362	<div> <div>2%</div> <div>93% 7%</div> </div>

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 6674 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.

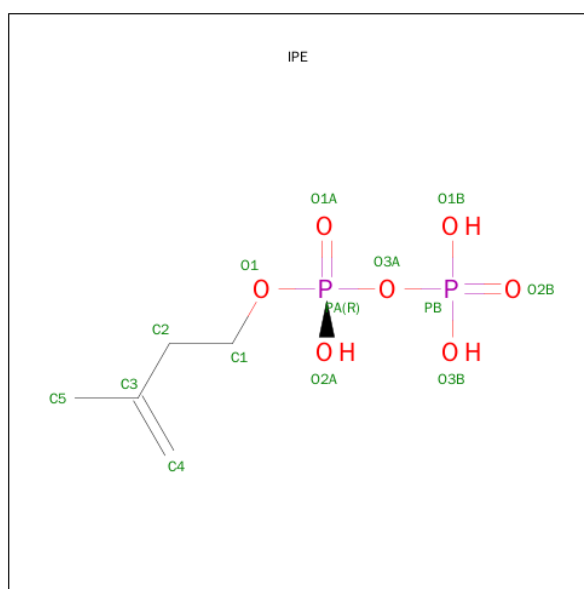
- Molecule 1 is a protein called Farnesyl pyrophosphate synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	362	Total	C	N	O	S	0	6	0
			2916	1866	480	546	24			
1	B	362	Total	C	N	O	S	0	5	0
			2908	1861	479	543	25			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	FME	-	EXPRESSION TAG	UNP Q4QBL1
B	1	FME	-	EXPRESSION TAG	UNP Q4QBL1

- Molecule 2 is 3-METHYLBUT-3-ENYL TRIHYDROGEN DIPHOSPHATE (three-letter code: IPE) (formula: C₅H₁₂O₇P₂).



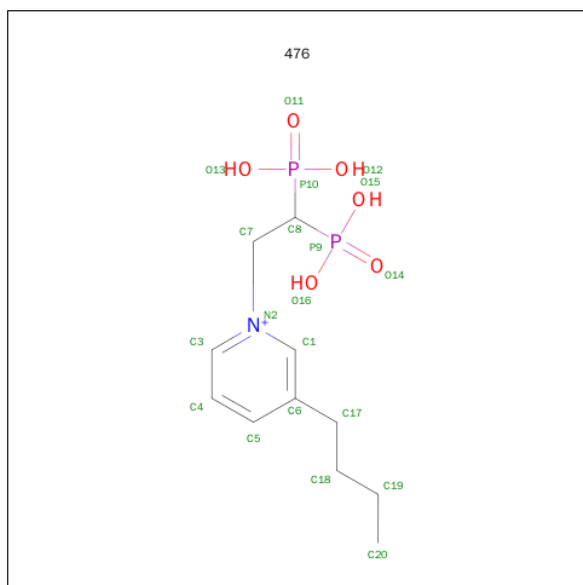
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	O	P	0	0
			14	5	7	2		

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

- Molecule 3 is 3-BUTYL-1-(2,2-DIPHOSPHONOETHYL)PYRIDINIUM (three-letter code: 476) (formula: $C_{11}H_{20}NO_6P_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total 20	C 11	N 1	O 6	P 2	0	0
3	B	1	Total 20	C 11	N 1	O 6	P 2	0	0

- Molecule 4 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	3	Total	Ca	0	0
			3	3		
4	A	3	Total	Ca	0	0
			3	3		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	394	Total	O	0	0
			394	394		

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	B	382	Total	O	0	0
			382	382		

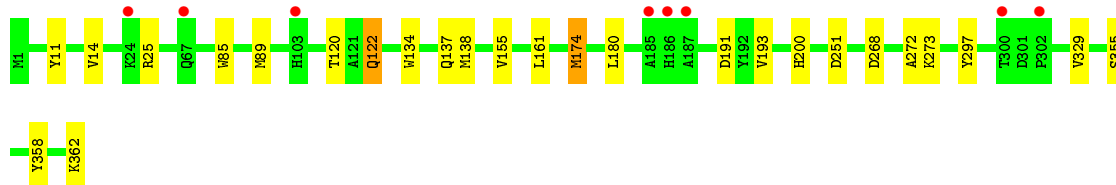
3 Residue-property plots [i](#)

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: Farnesyl pyrophosphate synthase



- Molecule 1: Farnesyl pyrophosphate synthase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	80.43 Å 85.81 Å 106.87 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	25.94 – 1.80 26.00 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.8 (25.94-1.80) 99.8 (26.00-1.80)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.96 (at 1.80 Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.178 , 0.227 0.177 , 0.224	Depositor DCC
R_{free} test set	3479 reflections (5.34%)	DCC
Wilson B-factor (Å ²)	28.5	Xtriage
Anisotropy	0.163	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 39.0	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Outliers	0 of 68612 reflections	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	6674	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 47.19 % of the origin peak, indicating pseudo translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo translational symmetry is equal to 1.0286e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹ Intensities estimated from amplitudes.

² 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: CA, FME, 476, IPE

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	0.44	0/2977	0.50	0/4034
1	B	0.43	0/2973	0.51	0/4027
All	All	0.43	0/5950	0.50	0/8061

There are no bond length outliers.

There are no bond angle outliers.

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	2916	0	2887	15	0
1	B	2908	0	2879	18	0
2	A	14	0	9	0	0
2	B	14	0	9	0	0
3	A	20	0	16	0	0
3	B	20	0	16	0	0
4	A	3	0	0	0	0
4	B	3	0	0	0	0
5	A	394	0	0	2	0
5	B	382	0	0	4	0
All	All	6674	0	5816	31	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 3.

All (31) 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:14:VAL:HG11	1:B:138:MET:SD	2.19	0.83
1:A:14[A]:VAL:HG11	1:A:138:MET:SD	2.23	0.78
1:B:268:ASP:HA	1:B:273:LYS:HG3	1.83	0.60
1:B:14:VAL:CG1	1:B:138:MET:SD	2.89	0.59
1:A:91:GLN:HA	1:A:91:GLN:HE21	1.68	0.58
1:B:89:MET:HE3	1:B:134:TRP:HB3	1.85	0.57
1:A:14[A]:VAL:CG1	1:A:138:MET:SD	2.93	0.56
1:B:200:HIS:HE1	1:B:251:ASP:OD2	1.91	0.53
1:B:329:VAL:HG21	1:B:358:TYR:CE1	2.45	0.52
1:B:25:ARG:HH12	1:B:137:GLN:NE2	2.08	0.51
1:B:272:ALA:HA	1:B:297:TYR:CE2	2.46	0.51
1:A:335:LEU:HD22	5:A:787:HOH:O	2.12	0.50
1:A:236:HIS:HD2	5:A:806:HOH:O	1.92	0.50
1:A:268:ASP:HA	1:A:273:LYS:HG3	1.93	0.50
1:A:155[A]:VAL:HG23	1:A:214:TRP:CZ3	2.46	0.49
1:A:272:ALA:HA	1:A:297:TYR:CE2	2.47	0.49
1:A:161:LEU:HD22	1:B:137:GLN:HG3	1.95	0.48
1:B:191:ASP:OD1	1:B:193:VAL:HG23	2.13	0.48
1:B:25:ARG:HH12	1:B:137:GLN:HE22	1.60	0.48
1:B:329:VAL:CG2	1:B:358:TYR:CE1	2.97	0.48
1:B:174:MET:HG2	5:B:643:HOH:O	2.15	0.46
1:B:355:SER:HB3	5:B:798:HOH:O	2.14	0.46
1:A:68:MET:SD	1:A:76:VAL:HG21	2.58	0.44
1:A:137:GLN:HG3	1:B:161:LEU:HD22	1.99	0.43
1:B:11:TYR:HB2	1:B:85:TRP:CZ2	2.54	0.43
1:B:155:VAL:HG13	5:B:791:HOH:O	2.20	0.42
1:A:180:LEU:HD12	5:B:767:HOH:O	2.19	0.42
1:A:318:LEU:O	1:A:322:GLU:HG2	2.19	0.42
1:A:236:HIS:O	1:A:240:MET:HG2	2.21	0.41
1:B:120:THR:HB	1:B:122:GLN:HE21	1.86	0.41
1:A:11:TYR:HB2	1:A:85:TRP:CZ2	2.56	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	366/362 (101%)	363 (99%)	3 (1%)	0	100	100
1	B	365/362 (101%)	362 (99%)	3 (1%)	0	100	100
All	All	731/724 (101%)	725 (99%)	6 (1%)	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	308/302 (102%)	307 (100%)	1 (0%)	94	94
1	B	307/302 (102%)	303 (99%)	4 (1%)	76	68
All	All	615/604 (102%)	610 (99%)	5 (1%)	86	83

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	91	GLN
1	B	122	GLN
1	B	174	MET
1	B	180	LEU
1	B	362	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	91	GLN
1	A	186	HIS
1	A	236	HIS
1	A	361	GLN
1	B	116	HIS
1	B	137	GLN
1	B	186	HIS
1	B	188	ASN
1	B	200	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

2 non-standard protein/DNA/RNA residues 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	$\# Z > 2$
1	FME	A	1	1	8,9,10	0.74	0	6,9,11	3.62	3 (50%)
1	FME	B	1	1	8,9,10	0.77	0	6,9,11	3.10	2 (33%)

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	FME	A	1	1	-	0/6/9/11	0/0/0/0
1	FME	B	1	1	-	0/6/9/11	0/0/0/0

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	1	FME	CA-N-CN	-8.12	110.33	122.82
1	B	1	FME	CA-N-CN	-7.01	112.03	122.82
1	A	1	FME	O1-CN-N	-2.67	120.91	124.76
1	B	1	FME	O-C-CA	-2.20	119.64	125.44
1	A	1	FME	O-C-CA	-2.10	119.88	125.44

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 10 ligands modelled in this entry, 6 are monoatomic - leaving 4 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	IPE	A	401	-	10,13,13	0.61	0	14,19,19	0.90	1 (7%)
3	476	A	402	4	19,20,20	1.15	2 (10%)	23,29,29	2.17	4 (17%)
2	IPE	B	401	-	10,13,13	0.59	0	14,19,19	0.82	1 (7%)
3	476	B	402	4	19,20,20	1.27	2 (10%)	23,29,29	2.20	3 (13%)

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	IPE	A	401	-	-	0/13/13/13	0/0/0/0
3	476	A	402	4	-	0/18/20/20	0/1/1/1
2	IPE	B	401	-	-	0/13/13/13	0/0/0/0
3	476	B	402	4	-	0/18/20/20	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	402	476	P10-O13	-2.63	1.50	1.54
3	A	402	476	P10-O12	-2.20	1.51	1.54
3	A	402	476	P10-O13	-2.13	1.51	1.54
3	B	402	476	P9-O15	-2.02	1.51	1.54

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	402	476	C7-N2-C1	-6.95	115.04	119.64
3	A	402	476	C7-N2-C1	-6.39	115.41	119.64
3	A	402	476	O13-P10-O12	2.14	114.00	107.57
2	A	401	IPE	O3B-PB-O1B	2.15	115.56	107.38
2	B	401	IPE	O3B-PB-O1B	2.16	115.62	107.38
3	B	402	476	O15-P9-O16	2.24	114.31	107.57
3	A	402	476	C6-C1-N2	2.40	122.50	120.97
3	B	402	476	C7-N2-C3	6.26	123.95	119.66
3	A	402	476	C7-N2-C3	6.45	124.08	119.66

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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, 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	361/362 (99%)	-0.12	2 (0%) 90 88	19, 26, 33, 38	0
1	B	361/362 (99%)	-0.10	8 (2%) 65 60	20, 26, 37, 49	0
All	All	722/724 (99%)	-0.11	10 (1%) 78 74	19, 26, 35, 49	0

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	67	GLN	7.0
1	A	103	HIS	3.1
1	B	300	THR	2.8
1	B	186	HIS	2.7
1	B	185	ALA	2.4
1	B	103[A]	HIS	2.3
1	B	187	ALA	2.2
1	A	334[A]	GLN	2.1
1	B	302	PRO	2.1
1	B	24	LYS	2.0

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

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, 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	LLDF	B-factors(Å ²)	Q<0.9
1	FME	B	1	10/11	0.85	0.20	-	34,36,42,43	0
1	FME	A	1	10/11	0.85	0.20	-	37,39,44,45	0

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, 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	LLDF	B-factors(\AA^2)	Q<0.9
3	476	B	402	20/20	0.98	0.11	0.39	23,24,27,29	0
3	476	A	402	20/20	0.99	0.11	0.28	22,24,26,29	0
2	IPE	B	401	14/14	0.98	0.10	-0.28	22,23,24,26	0
4	CA	A	404	1/1	1.00	0.08	-0.83	23,23,23,23	0
2	IPE	A	401	14/14	0.99	0.08	-0.94	21,23,25,25	0
4	CA	B	404	1/1	0.99	0.06	-2.62	24,24,24,24	0
4	CA	A	403	1/1	0.99	0.06	-	24,24,24,24	0
4	CA	A	405	1/1	0.99	0.03	-	26,26,26,26	0
4	CA	B	403	1/1	0.99	0.08	-	24,24,24,24	0
4	CA	B	405	1/1	1.00	0.04	-	28,28,28,28	0

6.5 Other polymers [i](#)

There are no such residues in this entry.