



wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 18, 2023 – 09:15 PM EDT

PDB ID : 1WDW
Title : Structural basis of mutual activation of the tryptophan synthase a2b2 complex from a hyperthermophile, *Pyrococcus furiosus*
Authors : Lee, S.J.; Ogasahara, K.; Ma, J.; Nishio, K.; Ishida, M.; Yamagata, Y.; Tsukihara, T.; Yutani, K.; RIKEN Structural Genomics/Proteomics Initiative (RSGI)
Deposited on : 2004-05-19
Resolution : 3.00 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 ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtrriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36

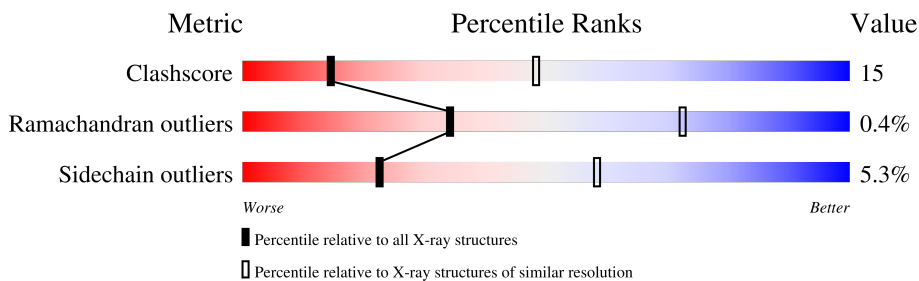
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.00 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	141614	2416 (3.00-3.00)
Ramachandran outliers	138981	2333 (3.00-3.00)
Sidechain outliers	138945	2336 (3.00-3.00)





The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	248	
1	C	248	
1	E	248	
1	G	248	
1	I	248	
1	K	248	
2	B	385	
2	D	385	

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Mol	Chain	Length	Quality of chain	
2	F	385	 70%	26% .
2	H	385	 69%	28% .
2	J	385	 70%	27% .
2	L	385	 68%	30% .

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 29563 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 Tryptophan synthase alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	241	Total 1895	C 1224	N 321	O 346	S 4	0	0	0
1	C	241	Total 1895	C 1225	N 321	O 345	S 4	0	0	0
1	E	248	Total 1942	C 1251	N 331	O 356	S 4	0	0	0
1	G	242	Total 1904	C 1230	N 322	O 348	S 4	0	0	0
1	I	244	Total 1919	C 1238	N 327	O 350	S 4	0	0	0
1	K	234	Total 1835	C 1184	N 313	O 334	S 4	0	0	0

- Molecule 2 is a protein called Tryptophan synthase beta chain 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	385	Total 2977	C 1902	N 512	O 551	S 12	0	0	0
2	D	385	Total 2977	C 1902	N 512	O 551	S 12	0	0	0
2	F	385	Total 2977	C 1902	N 512	O 551	S 12	0	0	0
2	H	385	Total 2977	C 1902	N 512	O 551	S 12	0	0	0
2	J	385	Total 2977	C 1902	N 512	O 551	S 12	0	0	0
2	L	385	Total 2977	C 1902	N 512	O 551	S 12	0	0	0

- Molecule 3 is PYRIDOXAL-5'-PHOSPHATE (three-letter code: PLP) (formula: C₈H₁₀NO₆P).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
3	B	1	Total 15	C 8	N 1	O 5	P 1	0	0
3	D	1	Total 15	C 8	N 1	O 5	P 1	0	0
3	F	1	Total 15	C 8	N 1	O 5	P 1	0	0
3	H	1	Total 15	C 8	N 1	O 5	P 1	0	0
3	J	1	Total 15	C 8	N 1	O 5	P 1	0	0
3	L	1	Total 15	C 8	N 1	O 5	P 1	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	23	Total 23	O 23	0	0
4	C	2	Total 2	O 2	0	0
4	D	23	Total 23	O 23	0	0
4	E	4	Total 4	O 4	0	0
4	F	33	Total 33	O 33	0	0
4	G	9	Total 9	O 9	0	0

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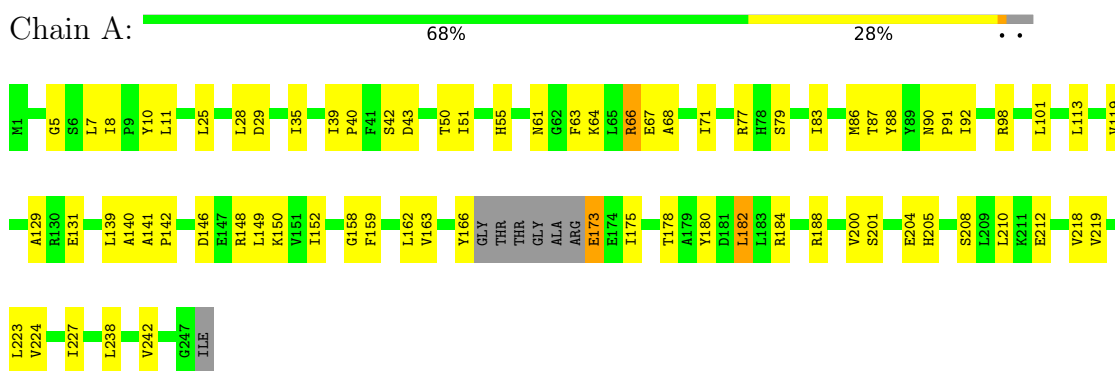
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	H	36	Total 36	O 36	0	0
4	I	13	Total 13	O 13	0	0
4	J	43	Total 43	O 43	0	0
4	L	35	Total 35	O 35	0	0

3 Residue-property plots

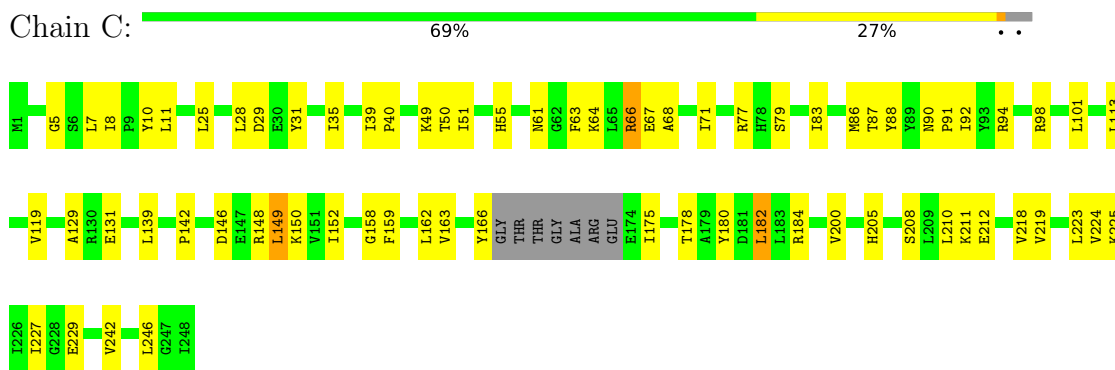
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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. 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.

Note EDS was not executed.

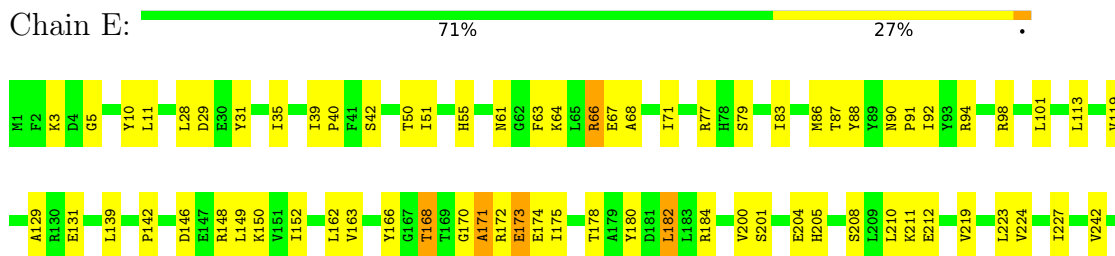
- Molecule 1: Tryptophan synthase alpha chain



- Molecule 1: Tryptophan synthase alpha chain



- Molecule 1: Tryptophan synthase alpha chain



L246
G247
I248

• Molecule 1: Tryptophan synthase alpha chain

Chain G: 71% 25% ..

H1 G5 I8 P9 Y10 L11 L28 D29 E30 Y31 I35 I39 P40 F41 S42 D43 T50 I51 H55 N61 G62 F63 K64 L65 R66 E67 A68 I71 R77 I83 M86 T87 F88 Y89 P91 R98 L101 L113 V119 A129 R130 E131

L139 P142 D146 E147 R148 L149 K150 V151 I152 L162 V163 Y166 GLY THR THR THR GLY ARG E173 E174 I175 T178 A179 Y180 D181 L182 L183 R184 R188 V200 S201 H205 S208 L209 L210 K211 E212 V219 L223 V224 I227 V242 L246 G247 I248

• Molecule 1: Tryptophan synthase alpha chain

Chain I: 70% 27% ..

H1 G5 I8 Y10 L11 P16 L28 D29 I35 I39 P40 F41 S42 D43 T50 I51 H55 N61 G62 F63 K64 L65 R66 E67 A68 I71 R77 H78 S79 I83 M86 T87 Y88 Y89 P91 R98 L101 L113 V119 F120 H121

A129 R130 E131 L139 A140 A141 P142 D146 E147 R148 L149 K150 V151 I152 L162 V163 Y166 G167 THR THR GLY ALA E173 E174 I175 T178 A179 Y180 D181 L182 L183 R184 R188 V200 S201 H205 S208 L209 L210 K211 E212 V218 V219 L223 V224 I227

L238 V242 L248

• Molecule 1: Tryptophan synthase alpha chain

Chain K: 68% 26% 6%

H1 G5 S6 I7 I8 P9 Y10 L11 L25 L28 D29 E30 Y31 I35 I39 P40 F41 S42 T50 I51 H55 N61 G62 F63 K64 L65 R66 E67 A68 I71 R77 S79 I83 M86 T87 Y88 Y89 N90 P91 I92 R98 L101 L113

V119 A129 R130 E131 L139 P142 D146 E147 R148 L149 K150 V151 I152 T156 F159 L162 V163 S164 LEU TYR THR THR THR GLY ALA ARG ARG GLU GLU ILE PRD LYS THR A179 L182 L183 R184 R188 V200 H205 S208 L209 L210 K211 E212 V218 V219

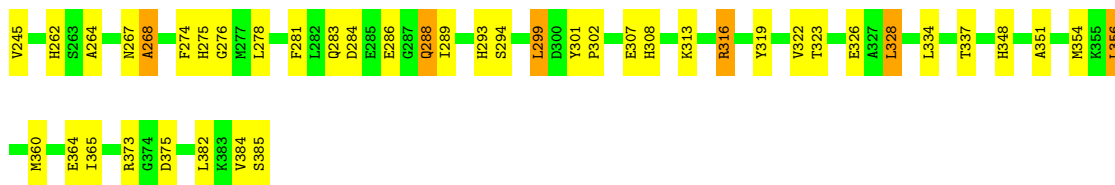
L223 V224 I227 L238 V242 G247 I248

• Molecule 2: Tryptophan synthase beta chain 1

Chain B: 70% 26%

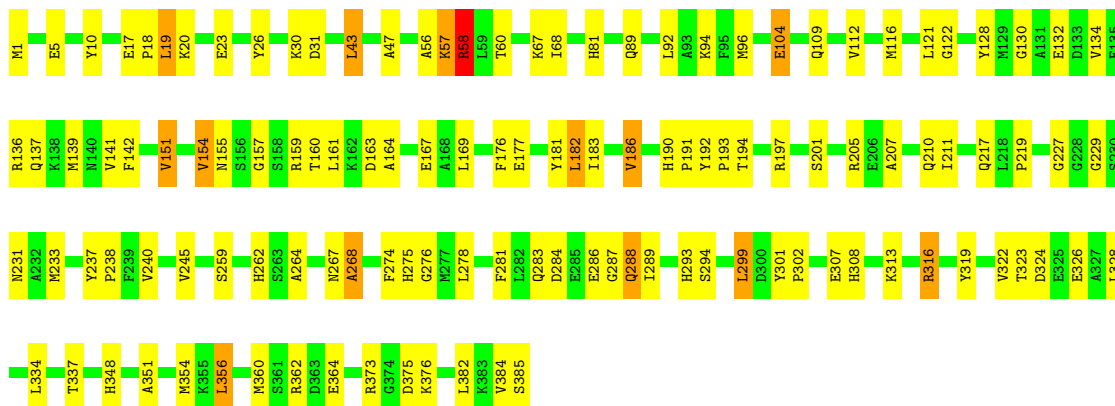
H1 E5 Q9 Y10 E13 T14 E17 P18 L19 V26 K30 D31 Q38 L39 L43 A47 A56 K57 R58 L59 T60 T68 H81 Q89 L92 N96 E104 V112 M116 G122 Y128 M129 G130 A131 E132 D133 V134 R136

M139 N140 V141 F142 V151 V154 M155 R159 T160 L161 L169 F176 E177 Y181 L182 I183 V186 H190 P191 Y192 P193 P194 T194 R197 S201 R205 E206 A207 K208 A209 Q210 I211 E215 F219 G227 G228 G229 S230 M231 A232 M233 V237 P238 F239 V240



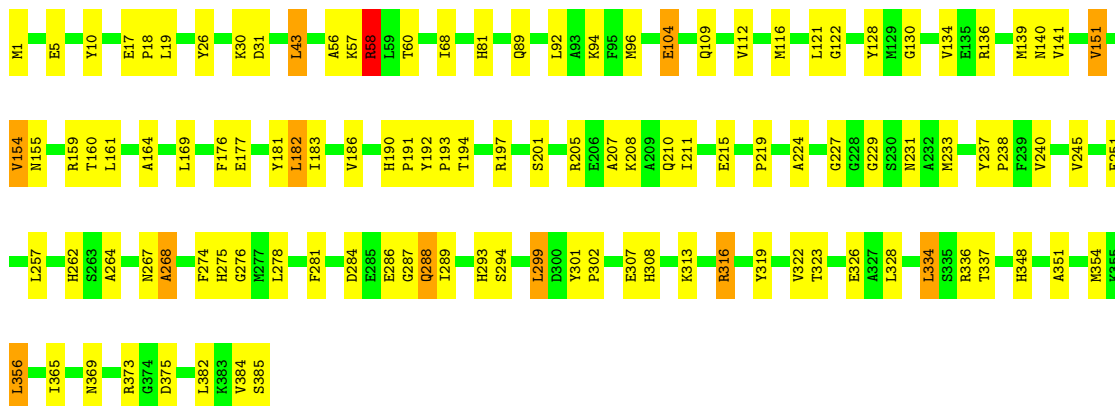
- Molecule 2: Tryptophan synthase beta chain 1

Chain D: 68% 28%



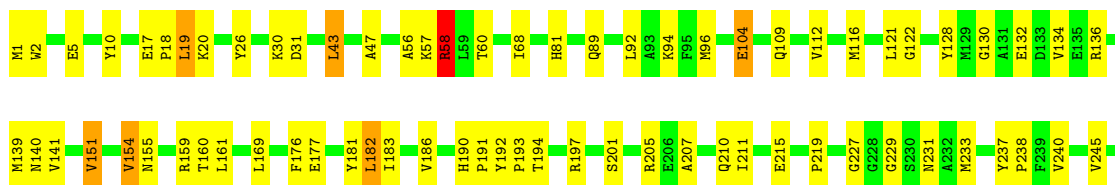
- Molecule 2: Tryptophan synthase beta chain 1

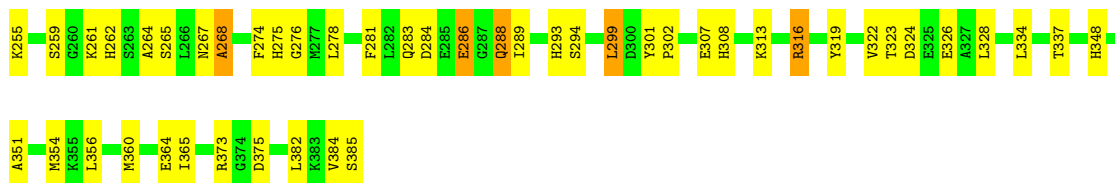
Chain F: 70% 26%



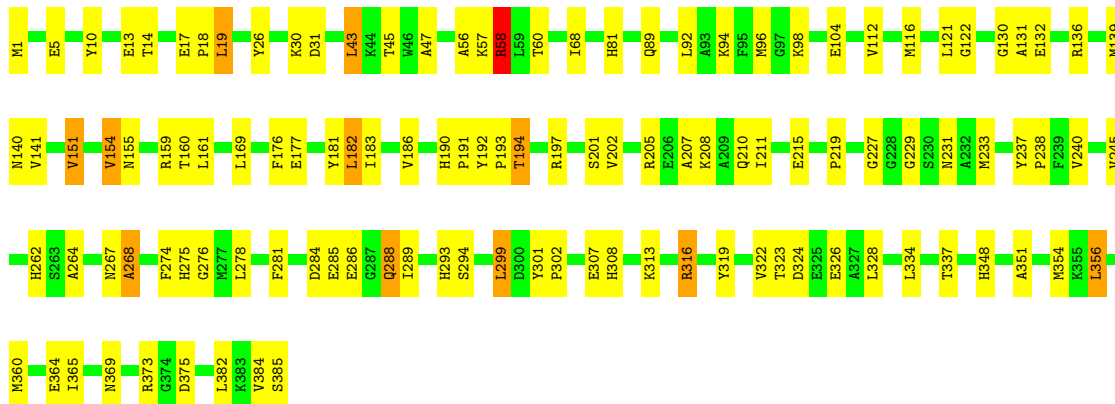
- Molecule 2: Tryptophan synthase beta chain 1

Chain H: 69% 28%

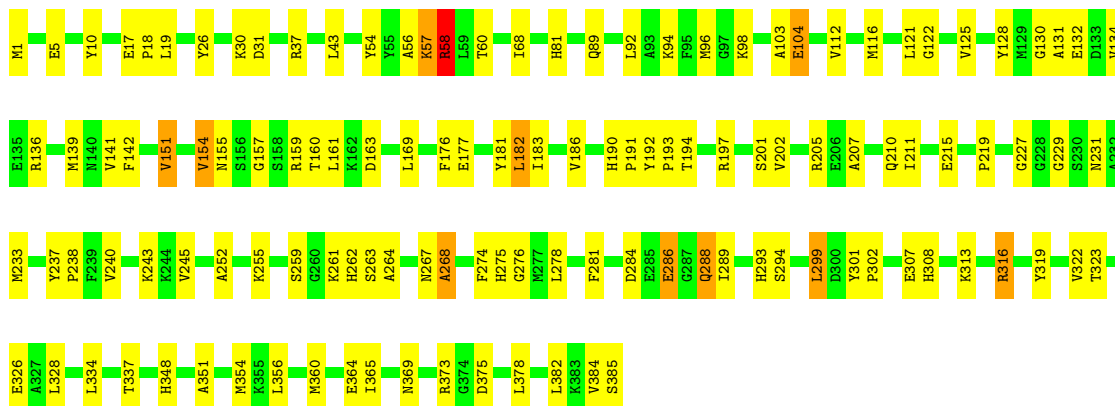




- Molecule 2: Tryptophan synthase beta chain 1



- Molecule 2: Tryptophan synthase beta chain 1



4 Data and refinement statistics

Xtrriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	89.06Å 220.26Å 292.56Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	89.17 – 3.00	Depositor
% Data completeness (in resolution range)	97.7 (89.17-3.00)	Depositor
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.196 , 0.231	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	29563	wwPDB-VP
Average B, all atoms (Å ²)	71.0	wwPDB-VP

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: 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	0.37	0/1931	0.59	0/2605
1	C	0.38	0/1931	0.58	0/2604
1	E	0.39	0/1979	0.59	0/2670
1	G	0.37	0/1940	0.57	0/2616
1	I	0.39	0/1955	0.58	0/2635
1	K	0.42	0/1869	0.57	0/2519
2	B	0.40	0/3038	0.65	2/4099 (0.0%)
2	D	0.40	0/3038	0.66	3/4099 (0.1%)
2	F	0.40	0/3038	0.65	3/4099 (0.1%)
2	H	0.40	0/3038	0.66	2/4099 (0.0%)
2	J	0.40	0/3038	0.65	3/4099 (0.1%)
2	L	0.40	0/3038	0.66	3/4099 (0.1%)
All	All	0.39	0/29833	0.63	16/40243 (0.0%)

There are no bond length outliers.

The worst 5 of 16 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	H	58	ARG	NE-CZ-NH2	-11.35	114.63	120.30
2	L	58	ARG	NE-CZ-NH2	-10.32	115.14	120.30
2	D	58	ARG	NE-CZ-NH2	-9.31	115.64	120.30
2	B	58	ARG	NE-CZ-NH2	-8.65	115.98	120.30
2	F	58	ARG	NE-CZ-NH2	-7.98	116.31	120.30

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	1895	0	1948	55	0
1	C	1895	0	1953	54	0
1	E	1942	0	1998	60	0
1	G	1904	0	1959	54	1
1	I	1919	0	1975	57	0
1	K	1835	0	1889	51	0
2	B	2977	0	2999	109	0
2	D	2977	0	2999	120	0
2	F	2977	0	2999	102	0
2	H	2977	0	2999	103	0
2	J	2977	0	2999	111	0
2	L	2977	0	2999	120	1
3	B	15	0	7	0	0
3	D	15	0	7	0	0
3	F	15	0	6	1	0
3	H	15	0	7	0	0
3	J	15	0	7	0	0
3	L	15	0	7	0	0
4	B	23	0	0	2	0
4	C	2	0	0	0	0
4	D	23	0	0	4	0
4	E	4	0	0	1	0
4	F	33	0	0	6	0
4	G	9	0	0	1	0
4	H	36	0	0	2	0
4	I	13	0	0	3	0
4	J	43	0	0	5	0
4	L	35	0	0	9	0
All	All	29563	0	29757	909	1

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 15.

The worst 5 of 909 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)
2:J:122:GLY:CA	2:L:58:ARG:HH22	1.25	1.49
2:F:122:GLY:CA	2:H:58:ARG:HH22	1.31	1.40
2:B:122:GLY:CA	2:D:58:ARG:HH22	1.44	1.30
2:F:122:GLY:HA2	2:H:58:ARG:NH2	1.45	1.27
2:B:58:ARG:HH22	2:D:122:GLY:CA	1.46	1.27

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:G:66:ARG:NH2	2:L:98:LYS:O[4_466]	2.11	0.09

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	237/248 (96%)	226 (95%)	11 (5%)	0	100	100
1	C	237/248 (96%)	226 (95%)	11 (5%)	0	100	100
1	E	246/248 (99%)	230 (94%)	15 (6%)	1 (0%)	34	72
1	G	238/248 (96%)	228 (96%)	10 (4%)	0	100	100
1	I	240/248 (97%)	228 (95%)	12 (5%)	0	100	100
1	K	230/248 (93%)	219 (95%)	11 (5%)	0	100	100
2	B	383/385 (100%)	352 (92%)	29 (8%)	2 (0%)	29	68
2	D	383/385 (100%)	355 (93%)	25 (6%)	3 (1%)	19	57
2	F	383/385 (100%)	354 (92%)	27 (7%)	2 (0%)	29	68
2	H	383/385 (100%)	358 (94%)	22 (6%)	3 (1%)	19	57
2	J	383/385 (100%)	357 (93%)	24 (6%)	2 (0%)	29	68
2	L	383/385 (100%)	356 (93%)	24 (6%)	3 (1%)	19	57
All	All	3726/3798 (98%)	3489 (94%)	221 (6%)	16 (0%)	34	72

5 of 16 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	E	171	ALA
2	J	268	ALA
2	L	268	ALA
2	B	268	ALA
2	D	186	VAL

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	201/205 (98%)	193 (96%)	8 (4%)	31 68
1	C	201/205 (98%)	194 (96%)	7 (4%)	36 71
1	E	205/205 (100%)	196 (96%)	9 (4%)	28 65
1	G	202/205 (98%)	195 (96%)	7 (4%)	36 71
1	I	203/205 (99%)	196 (97%)	7 (3%)	37 72
1	K	194/205 (95%)	189 (97%)	5 (3%)	46 78
2	B	306/306 (100%)	285 (93%)	21 (7%)	15 48
2	D	306/306 (100%)	287 (94%)	19 (6%)	18 52
2	F	306/306 (100%)	287 (94%)	19 (6%)	18 52
2	H	306/306 (100%)	286 (94%)	20 (6%)	17 50
2	J	306/306 (100%)	286 (94%)	20 (6%)	17 50
2	L	306/306 (100%)	286 (94%)	20 (6%)	17 50
All	All	3042/3066 (99%)	2880 (95%)	162 (5%)	22 58

5 of 162 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	I	178	THR
2	L	43	LEU
2	J	57	LYS
2	J	286	GLU

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Mol	Chain	Res	Type
2	L	169	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 104 such sidechains are listed below:

Mol	Chain	Res	Type
2	H	77	HIS
1	I	99	ASN
2	L	283	GLN
2	H	140	ASN
2	H	283	GLN

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
3	PLP	L	400	2	15,15,16	1.61	5 (33%)	20,22,23	1.97	5 (25%)
3	PLP	B	400	2	15,15,16	1.64	3 (20%)	20,22,23	1.95	4 (20%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	PLP	J	400	2	15,15,16	1.68	4 (26%)	20,22,23	1.91	3 (15%)
3	PLP	F	400	2	15,15,16	1.52	4 (26%)	20,22,23	1.98	4 (20%)
3	PLP	D	400	2	15,15,16	1.60	3 (20%)	20,22,23	2.07	5 (25%)
3	PLP	H	400	2	15,15,16	1.71	5 (33%)	20,22,23	1.93	6 (30%)

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
3	PLP	L	400	2	-	0/6/6/8	0/1/1/1
3	PLP	B	400	2	-	0/6/6/8	0/1/1/1
3	PLP	J	400	2	-	0/6/6/8	0/1/1/1
3	PLP	F	400	2	-	0/6/6/8	0/1/1/1
3	PLP	D	400	2	-	0/6/6/8	0/1/1/1
3	PLP	H	400	2	-	0/6/6/8	0/1/1/1

The worst 5 of 24 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	H	400	PLP	C5-C4	3.17	1.44	1.40
3	B	400	PLP	C5-C4	3.16	1.44	1.40
3	J	400	PLP	C2-N1	3.01	1.39	1.33
3	D	400	PLP	C2-N1	2.87	1.39	1.33
3	J	400	PLP	C5-C4	2.83	1.43	1.40

The worst 5 of 27 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	D	400	PLP	O4P-C5A-C5	5.94	120.66	109.35
3	F	400	PLP	O4P-C5A-C5	5.78	120.36	109.35
3	L	400	PLP	O4P-C5A-C5	5.75	120.31	109.35
3	J	400	PLP	O4P-C5A-C5	5.58	119.99	109.35
3	H	400	PLP	O4P-C5A-C5	5.49	119.82	109.35

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	F	400	PLP	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](#)

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates [i](#)

EDS was not executed - this section is therefore empty.

6.4 Ligands [i](#)

EDS was not executed - this section is therefore empty.

6.5 Other polymers [i](#)

EDS was not executed - this section is therefore empty.