



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 15, 2017 – 01:37 am GMT

PDB ID : 3P03
Title : Crystal structure of BetP-G153D with choline bound
Authors : Perez, C.; Ressler, S.; Ziegler, Z.
Deposited on : 2010-09-27
Resolution : 3.35 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

<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 : 1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix) : 1.9-1692
EDS : trunk28620
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)
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) : recalc28949

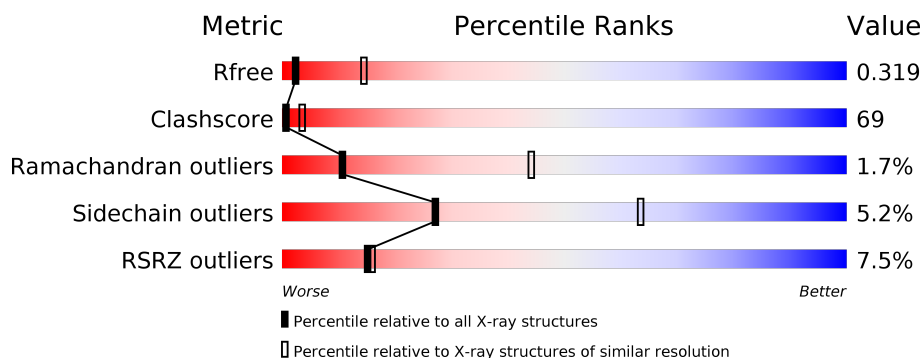
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.35 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}	100719	1156 (3.42-3.30)
Clashscore	112137	1231 (3.42-3.30)
Ramachandran outliers	110173	1212 (3.42-3.30)
Sidechain outliers	110143	1211 (3.42-3.30)
RSRZ outliers	101464	1165 (3.42-3.30)

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 ≥ 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	566	<div> <div>8%</div> <div>30%</div> <div>55%</div> <div>11%</div> </div>
1	B	566	<div> <div>8%</div> <div>28%</div> <div>52%</div> <div>16%</div> </div>
1	C	566	<div> <div>4%</div> <div>27%</div> <div>57%</div> <div>10%</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	CHT	C	2486	-	-	X	X

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 11349 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.

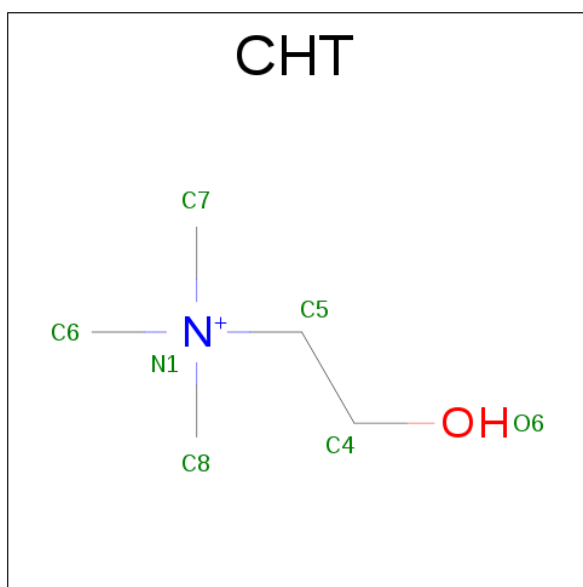
- Molecule 1 is a protein called Glycine betaine transporter BetP.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	504	Total	C	N	O	S	0	0	0
			3868	2542	641	669	16			
1	B	476	Total	C	N	O	S	0	0	0
			3612	2391	577	628	16			
1	C	508	Total	C	N	O	S	0	0	0
			3862	2545	627	674	16			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	44	ALA	GLU	ENGINEERED MUTATION	UNP P54582
A	45	ALA	GLU	ENGINEERED MUTATION	UNP P54582
A	46	ALA	GLU	ENGINEERED MUTATION	UNP P54582
A	153	ASP	GLY	ENGINEERED MUTATION	UNP P54582
B	44	ALA	GLU	ENGINEERED MUTATION	UNP P54582
B	45	ALA	GLU	ENGINEERED MUTATION	UNP P54582
B	46	ALA	GLU	ENGINEERED MUTATION	UNP P54582
B	153	ASP	GLY	ENGINEERED MUTATION	UNP P54582
C	44	ALA	GLU	ENGINEERED MUTATION	UNP P54582
C	45	ALA	GLU	ENGINEERED MUTATION	UNP P54582
C	46	ALA	GLU	ENGINEERED MUTATION	UNP P54582
C	153	ASP	GLY	ENGINEERED MUTATION	UNP P54582

- Molecule 2 is CHOLINE ION (three-letter code: CHT) (formula: C₅H₁₄NO).

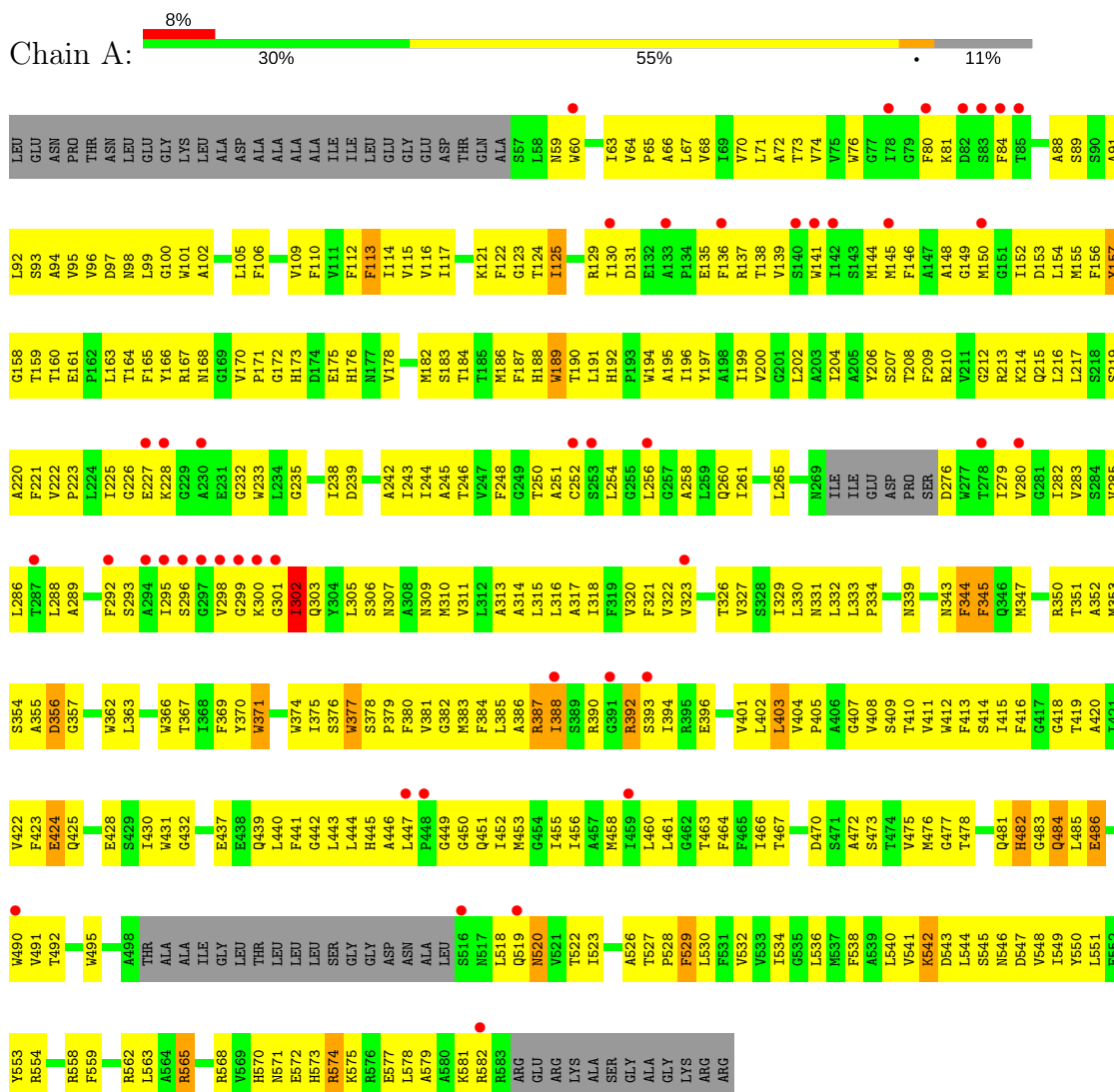


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	C	1	7	5	1	1	0	0

3 Residue-property plots

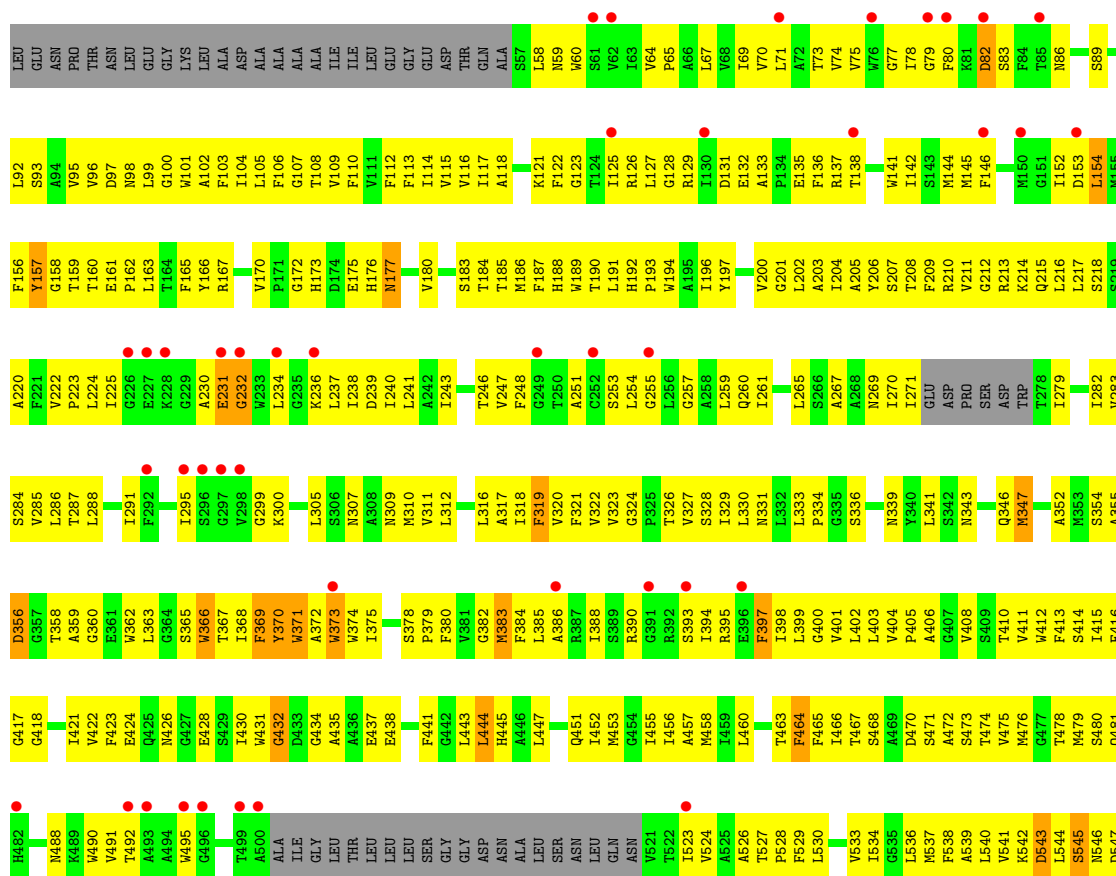
These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are 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: Glycine betaine transporter BetP

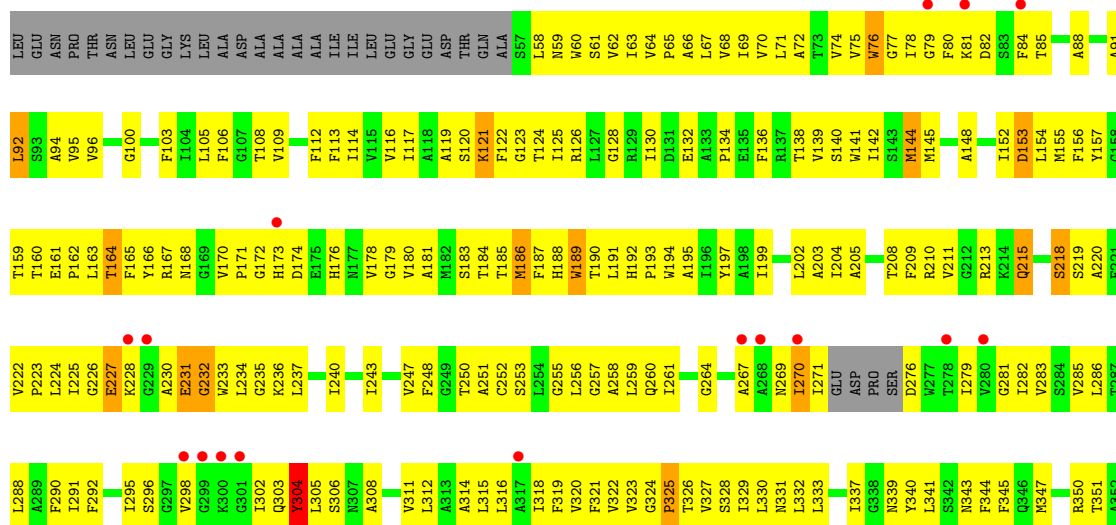
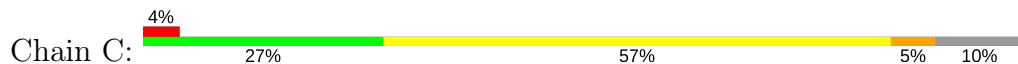


• Molecule 1: Glycine betaine transporter BetP





• Molecule 1: Glycine betaine transporter BetP



Y553	Q481	G418	K353
R554	H482		S354
E555	G483	I421	A355
Q556	Q484	V422	D356
Q557	L485	F423	G357
R558	E486	E424	T358
F559	L487	Q425	A359
R560	N488	N426	
A561		G427	W362
R562	V491	E428	L363
L563	T492	S429	G364
A564	A493	I430	S365
R565	A494	W431	W366
E566	W495	G432	T367
R567	G496	D433	I368
R568	V497	G434	F369
VAL	A498	A435	Y370
HIS		A436	W371
ASN	I502	E437	A372
GLU	G503	E438	W373
HIS	L504	Q439	W374
ARG	T505	L440	I375
LYS	L506	F441	S376
ARG	L507	G442	W377
GLU		L443	S378
LEU	L515	L444	P379
ALA			F380
ALA	L518	L447	V381
LYS	Q519	P448	
ARG	N520		W383
ARG	V521		F384
ARG	T522	Q451	L385
GLU	I523	I452	A386
ARG	V524	M453	R387
LYS	A525	G454	I388
ALA	A526	I455	S389
SER	T527	I456	R390
GLY	P528	A457	G391
ALA	F529	M458	R392
GLY	L530	I459	S393
LYS		L460	I394
ARG	I534	L461	R395
ARG	G535	G462	E396
	L536	T463	F397
	M537	F464	I398
	F538	F465	L399
	A539	I466	G400
	L540	T467	V401
	V541	S468	
	W542	A469	V404
	D543	D470	P405
	L544	S471	
	S545	A472	T410
	N546	S473	T411
	D547	T474	V412
	W548	V475	F413
	I549	M476	S414
	T550	G477	I415
	L551	T478	F416
	E552	M479	G417
		S480	

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	117.56Å 129.31Å 183.14Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.20 – 3.35 48.18 – 3.30	Depositor EDS
% Data completeness (in resolution range)	91.2 (46.20-3.35) 87.6 (48.18-3.30)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	15.91 (at 3.33Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.6.2_432)	Depositor
R, R_{free}	0.245 , 0.300 0.281 , 0.319	Depositor DCC
R_{free} test set	3705 reflections (11.05%)	DCC
Wilson B-factor (Å ²)	70.2	Xtriage
Anisotropy	0.012	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.27 , 105.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.45$, $\langle L^2 \rangle = 0.28$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.83	EDS
Total number of atoms	11349	wwPDB-VP
Average B, all atoms (Å ²)	107.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.96% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ 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: CHT

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	0.33	0/3967	0.56	1/5397 (0.0%)
1	B	0.37	0/3706	0.59	0/5051
1	C	0.44	0/3960	0.64	0/5396
All	All	0.38	0/11633	0.59	1/15844 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	367	THR	C-N-CA	-5.06	109.06	121.70

There are no chirality outliers.

There are no planarity outliers.

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	3868	0	3897	495	0
1	B	3612	0	3647	542	0
1	C	3862	0	3899	579	0
2	C	7	0	14	6	0
All	All	11349	0	11457	1576	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 69.

The worst 5 of 1576 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:C:170:VAL:CG1	1:C:171:PRO:HD2	1.50	1.41
1:C:226:GLY:HA2	1:C:227:GLU:CB	1.47	1.40
1:C:247:VAL:HG12	1:C:502:ILE:CD1	1.54	1.35
1:B:69:ILE:O	1:B:73:THR:HG23	1.33	1.29
1:B:208:THR:HG22	1:B:213:ARG:O	1.32	1.27

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	498/566 (88%)	426 (86%)	62 (12%)	10 (2%)	9	41
1	B	470/566 (83%)	403 (86%)	61 (13%)	6 (1%)	14	50
1	C	504/566 (89%)	435 (86%)	60 (12%)	9 (2%)	10	43
All	All	1472/1698 (87%)	1264 (86%)	183 (12%)	25 (2%)	11	44

5 of 25 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	377	TRP
1	A	403	LEU
1	B	231	GLU
1	B	432	GLY
1	C	231	GLU

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	396/440 (90%)	378 (96%)	18 (4%)	32	68
1	B	371/440 (84%)	356 (96%)	15 (4%)	36	70
1	C	396/440 (90%)	369 (93%)	27 (7%)	18	55
All	All	1163/1320 (88%)	1103 (95%)	60 (5%)	27	63

5 of 60 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	371	TRP
1	C	76	TRP
1	C	465	PHE
1	B	397	PHE
1	C	121	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 20 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	445	HIS
1	C	173	HIS
1	C	517	ASN
1	B	343	ASN
1	B	426	ASN

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 [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

1 ligand is 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	CHT	C	2486	-	6,6,6	0.79	0	8,8,8	0.33	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	CHT	C	2486	-	-	0/4/4/4	0/0/0/0

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	2486	CHT	6	0

5.7 Other polymers [i](#)

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 [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	504/566 (89%)	0.37	44 (8%)	11 12	28, 107, 309, 534	0
1	B	476/566 (84%)	0.40	47 (9%)	8 8	14, 97, 292, 557	0
1	C	508/566 (89%)	-0.02	20 (3%)	40 40	7, 62, 194, 353	0
All	All	1488/1698 (87%)	0.25	111 (7%)	15 16	7, 86, 284, 557	0

The worst 5 of 111 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	296	SER	15.2
1	B	296	SER	8.9
1	A	297	GLY	8.2
1	A	299	GLY	7.1
1	C	299	GLY	7.0

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, 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
2	CHT	C	2486	7/7	0.70	0.46	6.16	85,89,97,97	0

6.5 Other polymers [i](#)

There are no such residues in this entry.