



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 03:00 AM UTC

PDB ID : 7RNP / pdb_00007rnp
Title : Engineered tryptophan synthase b-subunit from *Pyrococcus furiosus*, PfTrpB2B9_H275E with 4-Cl-Trp non-covalently bound
Authors : Higgins, P.M.; Buller, A.R.
Deposited on : 2021-07-29
Resolution : 2.25 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	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
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)	:	2.49

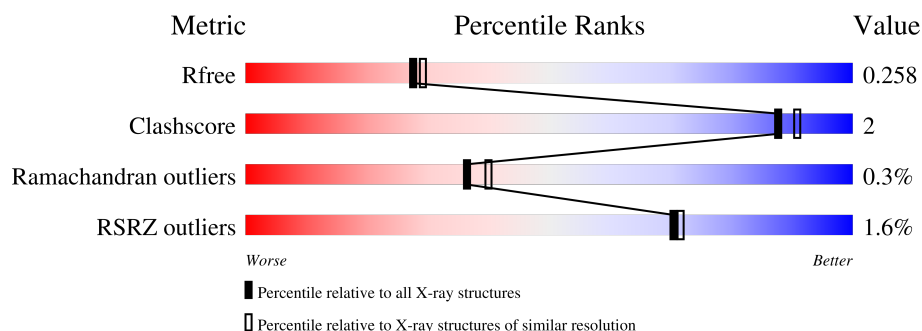
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.25 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}	180053	1898 (2.26-2.26)
Clashscore	190562	2005 (2.26-2.26)
Ramachandran outliers	187476	1965 (2.26-2.26)
RSRZ outliers	180081	1898 (2.26-2.26)

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 $\leq 5\%$. 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	396	% 91% 6% .
1	B	396	% 90% 7% .
1	C	396	3% 90% 5% .
1	D	396	2% 91% 5% .

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 11224 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 beta chain 1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	384	Total	C	N	O	P	S	0	1	0
			2821	1796	476	536	1	12			
1	B	384	Total	C	N	O	P	S	0	1	0
			2818	1796	485	524	1	12			
1	C	379	Total	C	N	O	P	S	0	1	0
			2759	1765	470	513	1	10			
1	D	381	Total	C	N	O	P	S	0	1	0
			2770	1769	476	512	1	12			

There are 68 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	16	VAL	ILE	conflict	UNP Q8U093
A	17	GLY	GLU	conflict	UNP Q8U093
A	68	VAL	ILE	conflict	UNP Q8U093
A	95	LEU	PHE	conflict	UNP Q8U093
A	274	SER	PHE	conflict	UNP Q8U093
A	275	GLU	HIS	engineered mutation	UNP Q8U093
A	292	SER	THR	conflict	UNP Q8U093
A	321	ALA	THR	conflict	UNP Q8U093
A	384	ALA	VAL	conflict	UNP Q8U093
A	389	LEU	-	expression tag	UNP Q8U093
A	390	GLU	-	expression tag	UNP Q8U093
A	391	HIS	-	expression tag	UNP Q8U093
A	392	HIS	-	expression tag	UNP Q8U093
A	393	HIS	-	expression tag	UNP Q8U093
A	394	HIS	-	expression tag	UNP Q8U093
A	395	HIS	-	expression tag	UNP Q8U093
A	396	HIS	-	expression tag	UNP Q8U093
B	16	VAL	ILE	conflict	UNP Q8U093
B	17	GLY	GLU	conflict	UNP Q8U093
B	68	VAL	ILE	conflict	UNP Q8U093
B	95	LEU	PHE	conflict	UNP Q8U093

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Chain	Residue	Modelled	Actual	Comment	Reference
B	274	SER	PHE	conflict	UNP Q8U093
B	275	GLU	HIS	engineered mutation	UNP Q8U093
B	292	SER	THR	conflict	UNP Q8U093
B	321	ALA	THR	conflict	UNP Q8U093
B	384	ALA	VAL	conflict	UNP Q8U093
B	389	LEU	-	expression tag	UNP Q8U093
B	390	GLU	-	expression tag	UNP Q8U093
B	391	HIS	-	expression tag	UNP Q8U093
B	392	HIS	-	expression tag	UNP Q8U093
B	393	HIS	-	expression tag	UNP Q8U093
B	394	HIS	-	expression tag	UNP Q8U093
B	395	HIS	-	expression tag	UNP Q8U093
B	396	HIS	-	expression tag	UNP Q8U093
C	16	VAL	ILE	conflict	UNP Q8U093
C	17	GLY	GLU	conflict	UNP Q8U093
C	68	VAL	ILE	conflict	UNP Q8U093
C	95	LEU	PHE	conflict	UNP Q8U093
C	274	SER	PHE	conflict	UNP Q8U093
C	275	GLU	HIS	engineered mutation	UNP Q8U093
C	292	SER	THR	conflict	UNP Q8U093
C	321	ALA	THR	conflict	UNP Q8U093
C	384	ALA	VAL	conflict	UNP Q8U093
C	389	LEU	-	expression tag	UNP Q8U093
C	390	GLU	-	expression tag	UNP Q8U093
C	391	HIS	-	expression tag	UNP Q8U093
C	392	HIS	-	expression tag	UNP Q8U093
C	393	HIS	-	expression tag	UNP Q8U093
C	394	HIS	-	expression tag	UNP Q8U093
C	395	HIS	-	expression tag	UNP Q8U093
C	396	HIS	-	expression tag	UNP Q8U093
D	16	VAL	ILE	conflict	UNP Q8U093
D	17	GLY	GLU	conflict	UNP Q8U093
D	68	VAL	ILE	conflict	UNP Q8U093
D	95	LEU	PHE	conflict	UNP Q8U093
D	274	SER	PHE	conflict	UNP Q8U093
D	275	GLU	HIS	engineered mutation	UNP Q8U093
D	292	SER	THR	conflict	UNP Q8U093
D	321	ALA	THR	conflict	UNP Q8U093
D	384	ALA	VAL	conflict	UNP Q8U093
D	389	LEU	-	expression tag	UNP Q8U093
D	390	GLU	-	expression tag	UNP Q8U093
D	391	HIS	-	expression tag	UNP Q8U093

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Chain	Residue	Modelled	Actual	Comment	Reference
D	392	HIS	-	expression tag	UNP Q8U093
D	393	HIS	-	expression tag	UNP Q8U093
D	394	HIS	-	expression tag	UNP Q8U093
D	395	HIS	-	expression tag	UNP Q8U093
D	396	HIS	-	expression tag	UNP Q8U093

- Molecule 2 is a ligand with the chemical component id 6G5 but its atom names do not match the existing wwPDB Chemical Component Dictionary definition for 6G5. ERROR THIS SHOULD NOT HAPPEN FOLLOWING ANNOTATION.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	Cl	N	O	
			16	11	1	2	2	
2	B	1	Total	C	Cl	N	O	
			16	11	1	2	2	

- Molecule 3 is SODIUM ION (CCD ID: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Na		
			1	1	0	0
3	B	1	Total	Na		
			1	1	0	0
3	C	1	Total	Na		
			1	1	0	0
3	D	1	Total	Na		
			1	1	0	0

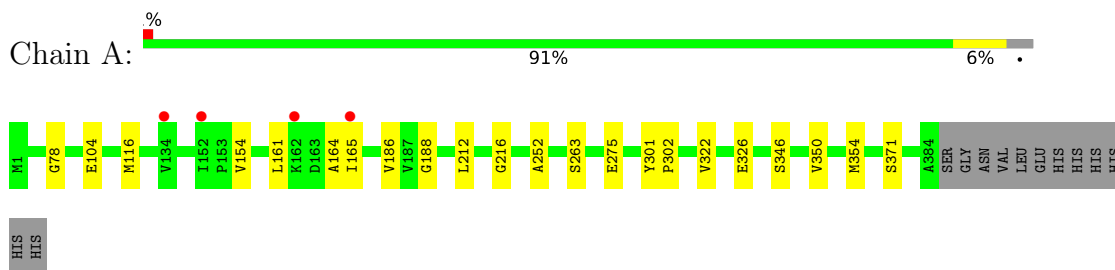
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	13	Total	O		
			13	13	0	0
4	B	3	Total	O		
			3	3	0	0
4	C	2	Total	O		
			2	2	0	0
4	D	2	Total	O		
			2	2	0	0

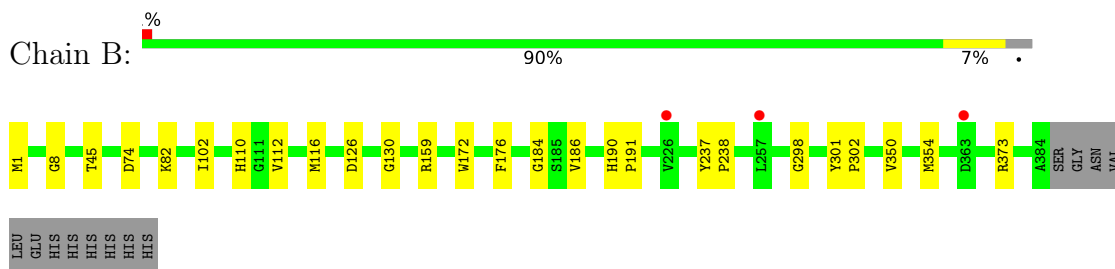
3 Residue-property plots [i](#)

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.

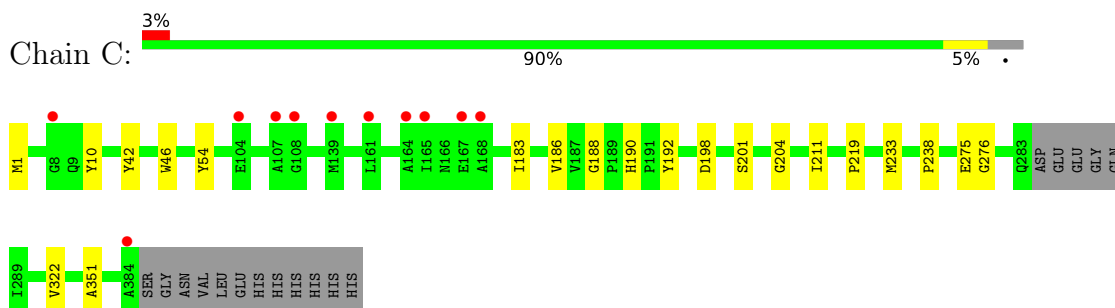
- Molecule 1: Tryptophan synthase beta chain 1



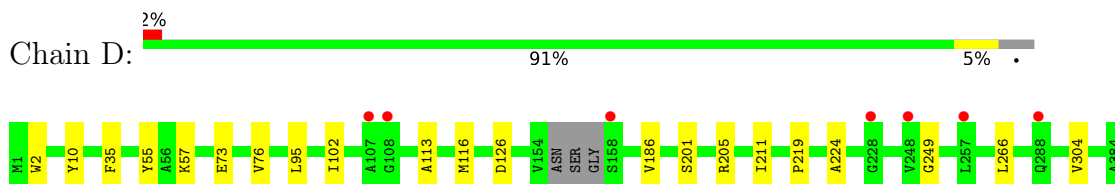
- Molecule 1: Tryptophan synthase beta chain 1



- Molecule 1: Tryptophan synthase beta chain 1



- Molecule 1: Tryptophan synthase beta chain 1



SER
GLY
ASN
VAL
LEU
GLU
HIS
HIS
HIS
HIS
HIS
HIS

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	56.16Å 81.20Å 321.01Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	40.00 – 2.25 40.00 – 2.25	Depositor EDS
% Data completeness (in resolution range)	98.4 (40.00-2.25) 98.4 (40.00-2.25)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.55 (at 2.24Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.227 , 0.267 (Not available) , 0.258	Depositor DCC
R_{free} test set	3482 reflections (4.91%)	wwPDB-VP
Wilson B-factor (Å ²)	55.1	Xtriage
Anisotropy	0.311	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 28.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	11224	wwPDB-VP
Average B, all atoms (Å ²)	71.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.00% 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: NA, 6G5, LLP

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	1.00	0/2857	1.46	0/3889
1	B	1.02	0/2854	1.48	0/3880
1	C	1.02	0/2794	1.48	2/3806 (0.1%)
1	D	1.03	0/2805	1.48	0/3816
All	All	1.02	0/11310	1.47	2/15391 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	233	MET	CA-C-N	5.01	125.55	119.98
1	C	233	MET	C-N-CA	5.01	125.55	119.98

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	2821	0	2666	11	0
1	B	2818	0	2690	13	0
1	C	2759	0	2618	10	0
1	D	2770	0	2625	10	0
2	A	16	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	16	0	0	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
3	D	1	0	0	0	0
4	A	13	0	0	0	0
4	B	3	0	0	0	0
4	C	2	0	0	0	0
4	D	2	0	0	0	0
All	All	11224	0	10599	43	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.

The worst 5 of 43 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:154:VAL:HG21	1:A:164:ALA:HA	1.77	0.66
1:D:2:TRP:HH2	1:D:10:TYR:HH	1.49	0.61
1:A:346:SER:OG	1:A:371:SER:OG	2.17	0.60
1:B:172:TRP:O	1:B:176:PHE:HB3	2.05	0.57
1:C:211:ILE:HG21	1:C:219:PRO:HD3	1.88	0.56

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	382/396 (96%)	372 (97%)	9 (2%)	1 (0%)	36 40
1	B	382/396 (96%)	371 (97%)	10 (3%)	1 (0%)	36 40

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	375/396 (95%)	364 (97%)	10 (3%)	1 (0%)	36	40
1	D	377/396 (95%)	359 (95%)	17 (4%)	1 (0%)	36	40
All	All	1516/1584 (96%)	1466 (97%)	46 (3%)	4 (0%)	36	40

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	186	VAL
1	A	186	VAL
1	B	186	VAL
1	C	186	VAL

5.3.2 Protein sidechains [i](#)

There are no protein residues with a non-rotameric sidechain to report in this entry.

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

4 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	LLP	C	82	1	23,24,25	0.45	0	25,32,34	0.50	0
1	LLP	A	82	1	23,24,25	0.47	0	25,32,34	0.55	0
1	LLP	D	82	1	23,24,25	0.46	0	25,32,34	0.57	0
1	LLP	B	82	1	23,24,25	0.45	0	25,32,34	0.60	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
1	LLP	C	82	1	-	7/16/17/19	0/1/1/1
1	LLP	A	82	1	-	6/16/17/19	0/1/1/1
1	LLP	D	82	1	-	8/16/17/19	0/1/1/1
1	LLP	B	82	1	-	3/16/17/19	0/1/1/1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 24 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	82	LLP	C4-C4'-NZ-CE
1	A	82	LLP	C5'-OP4-P-OP1
1	A	82	LLP	C5'-OP4-P-OP3
1	A	82	LLP	C-CA-CB-CG
1	B	82	LLP	C4-C4'-NZ-CE

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	B	82	LLP	1	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 6 ligands modelled in this entry, 2 could not be matched to an existing wwPDB Chemical Component Dictionary definition at this stage and 4 are monoatomic - leaving 0 for Mogul analysis.

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.

No monomer is involved in short contacts.

5.7 Other polymers

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	383/396 (96%)	0.18	4 (1%) 79 81	31, 59, 96, 116	1 (0%)
1	B	383/396 (96%)	0.28	3 (0%) 82 84	36, 71, 97, 124	1 (0%)
1	C	378/396 (95%)	0.34	11 (2%) 53 54	37, 71, 102, 117	1 (0%)
1	D	380/396 (95%)	0.39	7 (1%) 67 68	41, 76, 111, 146	1 (0%)
All	All	1524/1584 (96%)	0.30	25 (1%) 70 71	31, 70, 102, 146	4 (0%)

The worst 5 of 25 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	164	ALA	3.7
1	C	165	ILE	3.5
1	D	248	VAL	3.5
1	D	257	LEU	2.9
1	C	107	ALA	2.9

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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
1	LLP	C	82	24/25	0.93	0.11	54,67,70,74	0
1	LLP	D	82	24/25	0.93	0.12	53,70,74,75	0
1	LLP	A	82	24/25	0.94	0.12	44,58,67,68	0
1	LLP	B	82	24/25	0.94	0.10	52,66,71,72	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

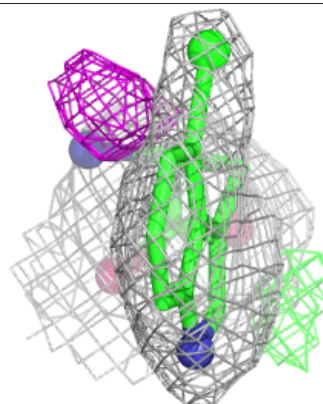
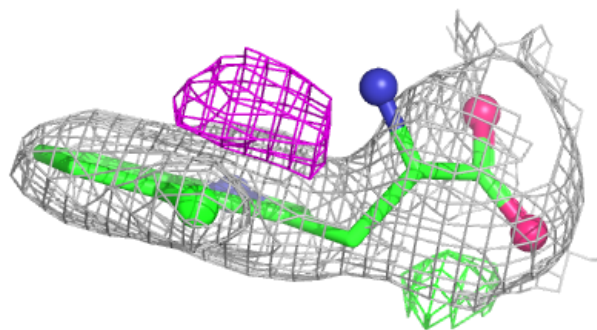
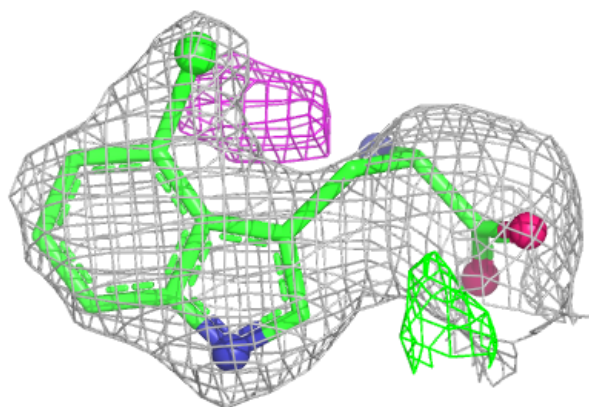
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
3	NA	D	401	1/1	0.83	0.14	80,80,80,80	0
3	NA	C	401	1/1	0.84	0.10	71,71,71,71	0
2	6G5	B	401	16/16	0.84	0.15	77,82,87,95	0
2	6G5	A	401	16/16	0.85	0.14	72,77,83,91	0
3	NA	B	402	1/1	0.87	0.12	64,64,64,64	0
3	NA	A	402	1/1	0.89	0.09	47,47,47,47	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

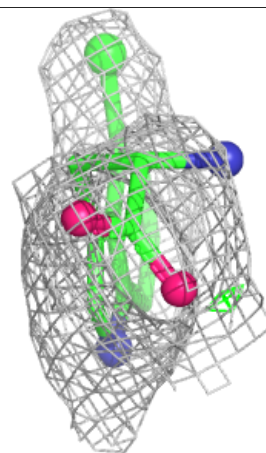
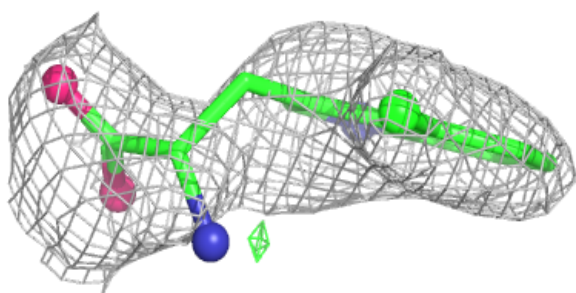
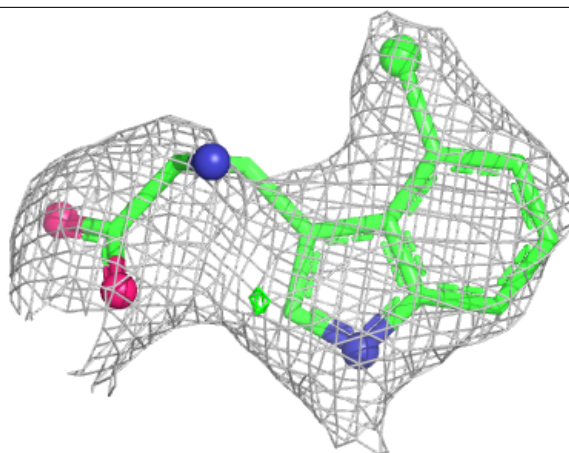
Electron density around 6G5 B 401:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around 6G5 A 401:

$2mF_o - DF_c$ (at 0.7 rmsd) in gray
 $mF_o - DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)



6.5 Other polymers [i](#)

There are no such residues in this entry.