



# wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 29, 2023 – 12:13 PM EDT

PDB ID : 3N9H  
Title : Crystal Structural of mutant Y305A in the copper amine oxidase from hansenula polymorpha  
Authors : Chen, Z.; Datta, S.; DuBois, J.L.; Klinman, J.P.; Mathews, F.S.  
Deposited on : 2010-05-30  
Resolution : 2.50 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](mailto: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>.

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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)  
Xtriage (Phenix) : 1.13  
EDS : 2.35  
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) : 2.35

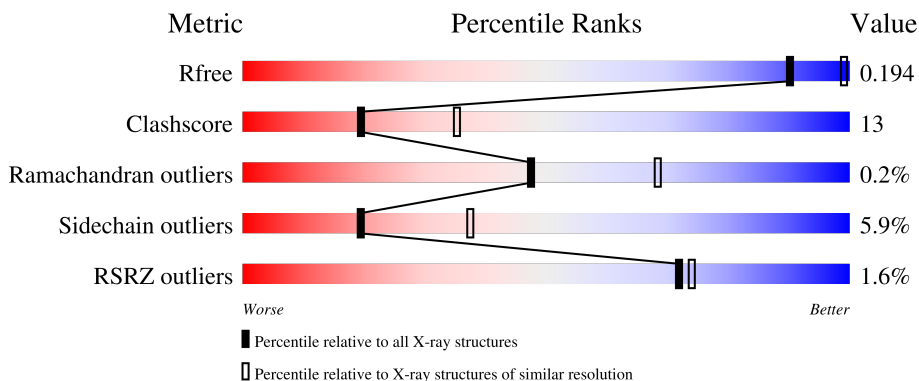
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.50 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	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)
RSRZ outliers	127900	4559 (2.50-2.50)

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  $\geq 3$ , 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	692	
1	B	692	
1	C	692	
1	D	692	
1	E	692	

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Mol	Chain	Length	Quality of chain
1	F	692	 <p>A horizontal bar chart representing the quality of the chain. The bar is divided into three segments: a green segment representing 72%, a yellow segment representing 20%, and a red segment representing 5%. A small red square is visible at the beginning of the bar, and a small black dot is at the end of the red segment.</p>

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 34296 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 Peroxisomal primary amine oxidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	655	5203	3309	895	975	24	0	2	0
1	B	655	5203	3309	895	975	24	0	2	0
1	C	655	5203	3309	895	975	24	0	2	0
1	D	655	5203	3309	895	975	24	0	2	0
1	E	655	5203	3309	895	975	24	0	2	0
1	F	655	5203	3309	895	975	24	0	2	0

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	305	ALA	TYR	engineered mutation	UNP P12807
B	305	ALA	TYR	engineered mutation	UNP P12807
C	305	ALA	TYR	engineered mutation	UNP P12807
D	305	ALA	TYR	engineered mutation	UNP P12807
E	305	ALA	TYR	engineered mutation	UNP P12807
F	305	ALA	TYR	engineered mutation	UNP P12807

- Molecule 2 is COPPER (II) ION (three-letter code: CU) (formula: Cu).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total 1	Cu 1	0	0
2	B	1	Total 1	Cu 1	0	0
2	C	1	Total 1	Cu 1	0	0

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Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	D	1	Total Cu 1 1	0	0
2	E	1	Total Cu 1 1	0	0
2	F	1	Total Cu 1 1	0	0

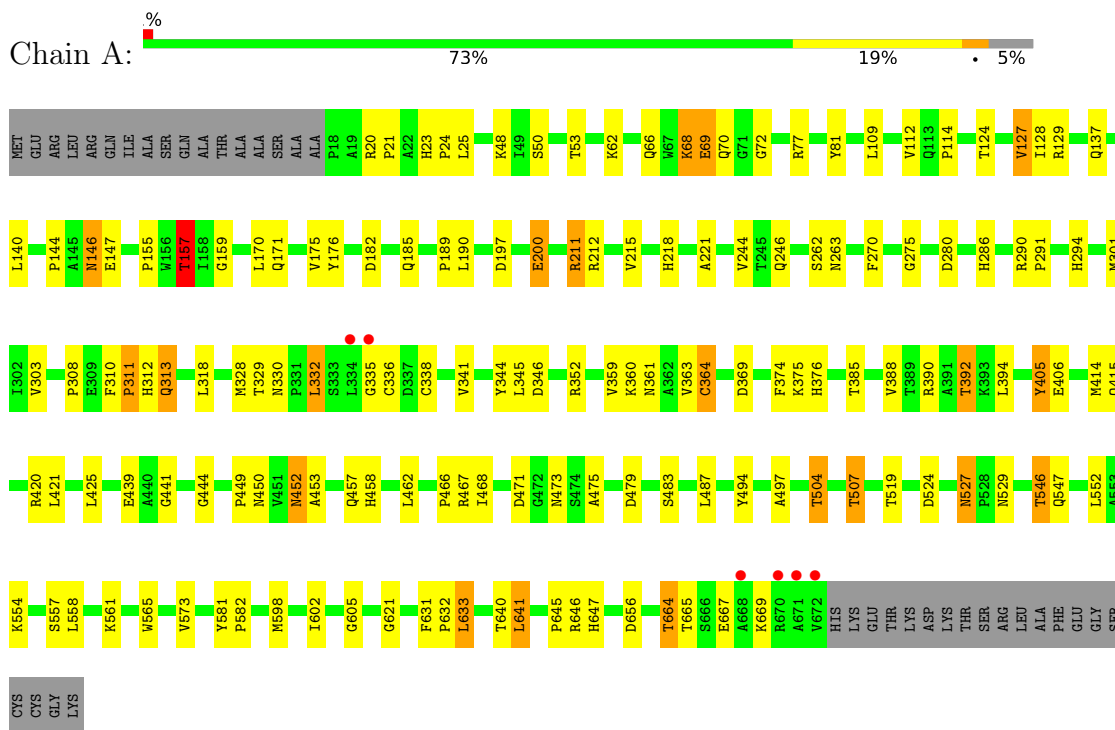
- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	507	Total O 507 507	0	0
3	B	517	Total O 517 517	0	0
3	C	515	Total O 515 515	0	0
3	D	509	Total O 509 509	0	0
3	E	506	Total O 506 506	0	0
3	F	518	Total O 518 518	0	0

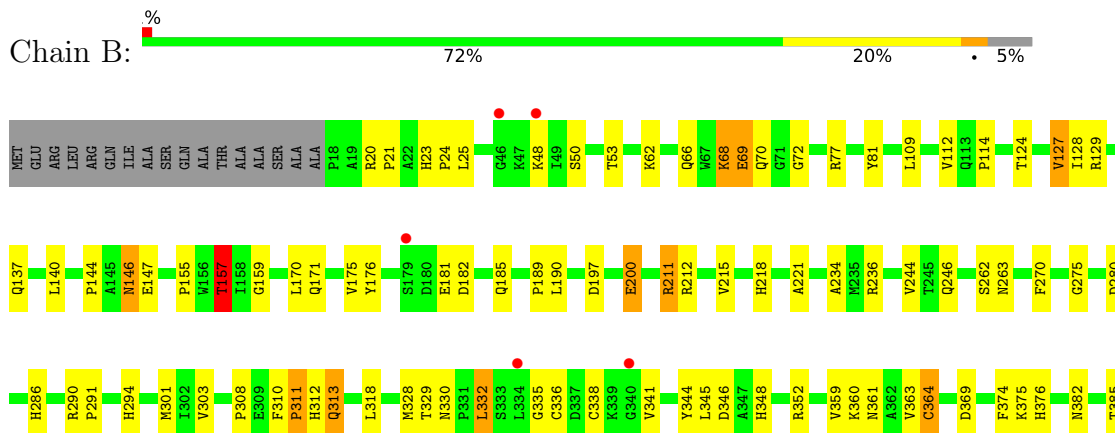
### 3 Residue-property plots

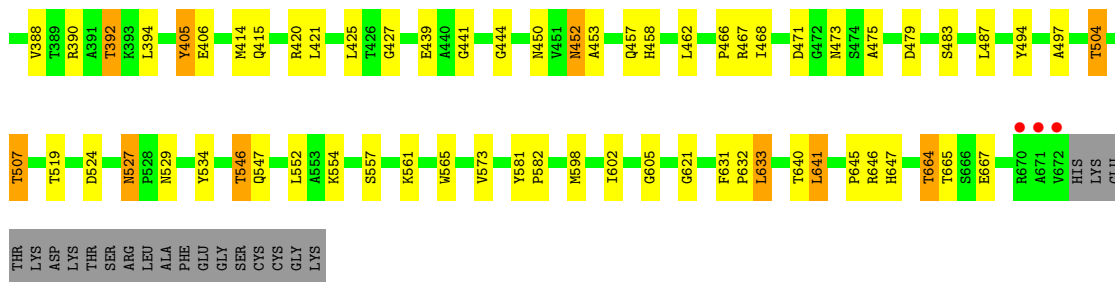
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: Peroxisomal primary amine oxidase

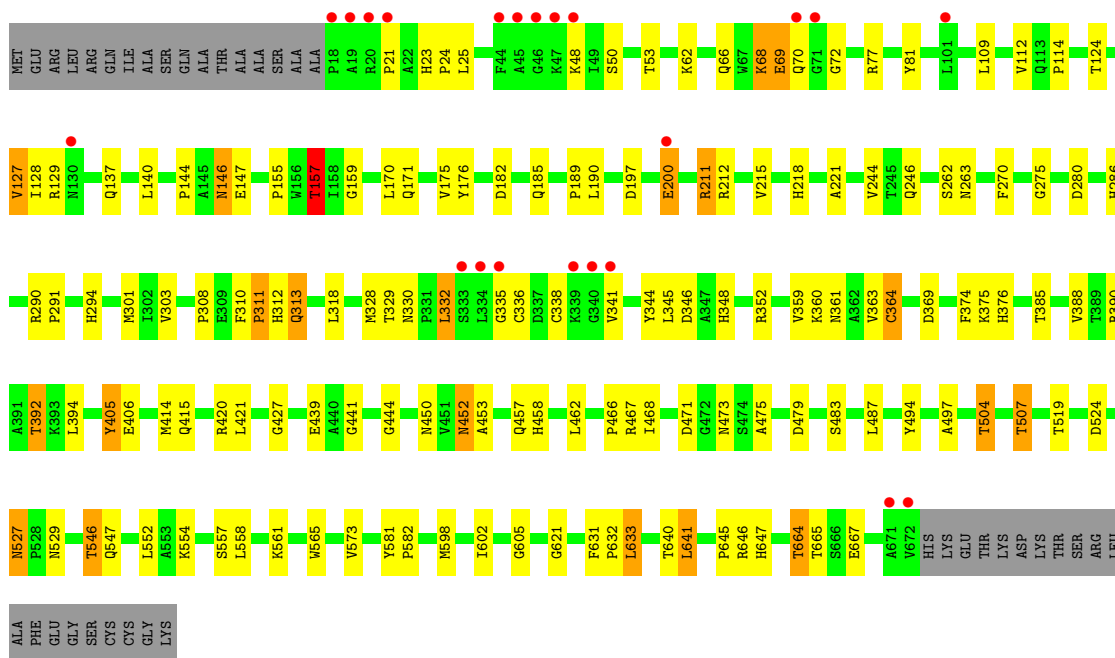


- Molecule 1: Peroxisomal primary amine oxidase

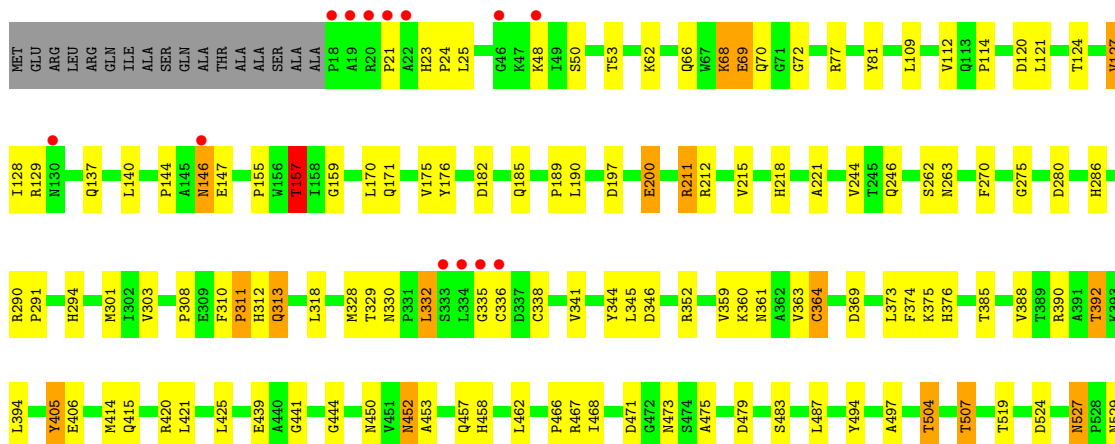
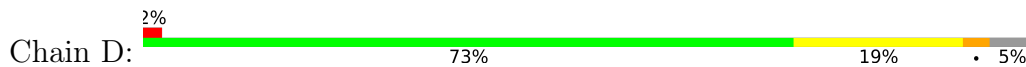


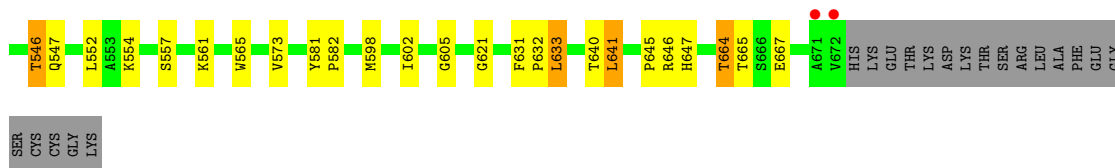


● Molecule 1: Peroxisomal primary amine oxidase

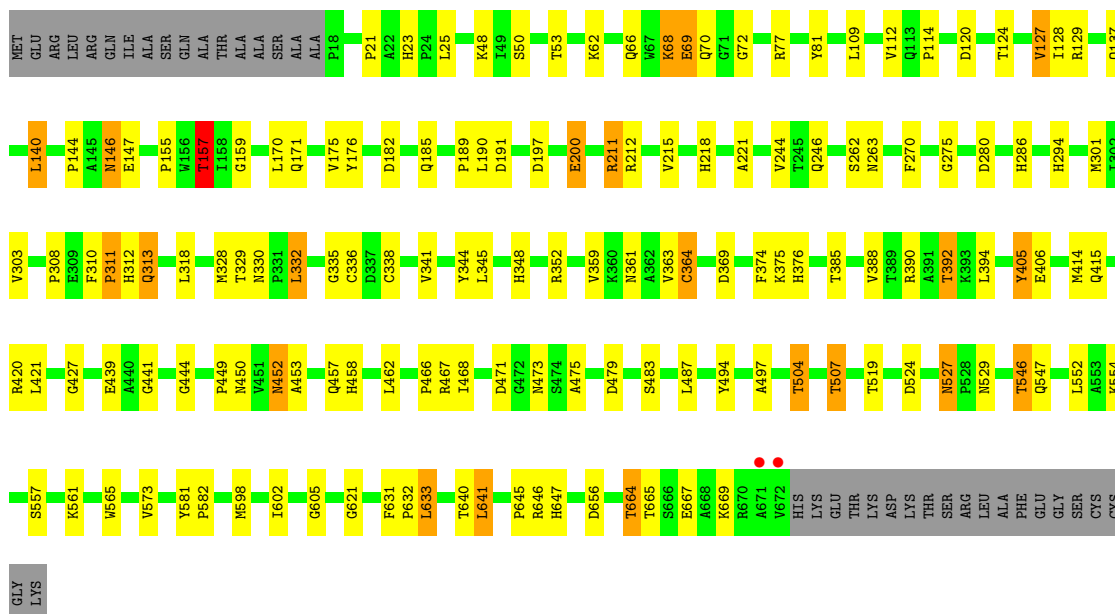


● Molecule 1: Peroxisomal primary amine oxidase

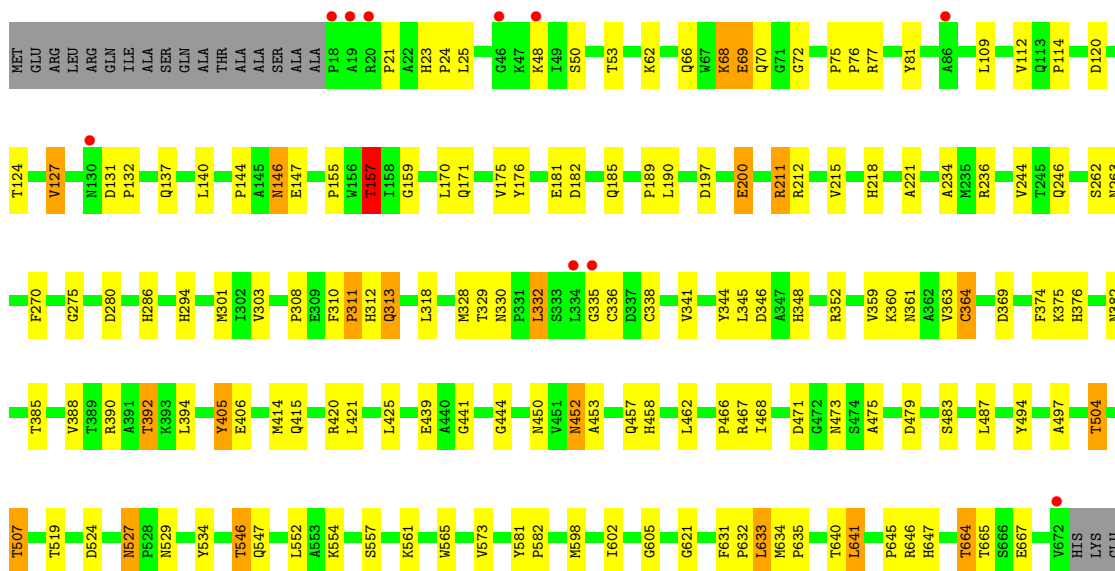




● Molecule 1: Peroxisomal primary amine oxidase



● Molecule 1: Peroxisomal primary amine oxidase





THR  
LYS  
ASP  
LYS  
THR  
SER  
ARG  
LEU  
ALA  
PHE  
GLU  
GLY  
SER  
CYS  
CYS  
GLY  
LYS

## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	138.91Å 147.15Å 233.76Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.10 – 2.50 30.10 – 2.41	Depositor EDS
% Data completeness (in resolution range)	81.0 (30.10-2.50) 75.4 (30.10-2.41)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.41 (at 2.42Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.185 , 0.198 0.182 , 0.194	Depositor DCC
$R_{free}$ test set	13877 reflections (9.99%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	24.8	Xtrriage
Anisotropy	0.555	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 37.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	34296	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	29.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.87% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: TPQ, CU

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	0.47	0/5337	0.76	2/7262 (0.0%)
1	B	0.47	0/5337	0.76	2/7262 (0.0%)
1	C	0.47	0/5337	0.76	2/7262 (0.0%)
1	D	0.47	0/5337	0.76	2/7262 (0.0%)
1	E	0.47	0/5337	0.76	2/7262 (0.0%)
1	F	0.47	0/5337	0.76	2/7262 (0.0%)
All	All	0.47	0/32022	0.76	12/43572 (0.0%)

There are no bond length outliers.

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	E	641	LEU	CA-CB-CG	6.82	130.99	115.30
1	F	641	LEU	CA-CB-CG	6.81	130.96	115.30
1	A	641	LEU	CA-CB-CG	6.79	130.92	115.30
1	B	641	LEU	CA-CB-CG	6.79	130.91	115.30
1	D	641	LEU	CA-CB-CG	6.79	130.91	115.30

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	5203	0	5044	144	3
1	B	5203	0	5044	148	1
1	C	5203	0	5044	149	0
1	D	5203	0	5044	148	2
1	E	5203	0	5044	146	1
1	F	5203	0	5044	148	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
2	E	1	0	0	0	0
2	F	1	0	0	0	0
3	A	507	0	0	15	0
3	B	517	0	0	18	0
3	C	515	0	0	16	0
3	D	509	0	0	16	1
3	E	506	0	0	15	0
3	F	518	0	0	18	0
All	All	34296	0	30264	782	4

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 13.

The worst 5 of 782 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:546:THR:HG21	1:D:546:THR:CG2	1.40	1.50
1:E:546:THR:HG21	1:F:546:THR:CG2	1.41	1.50
1:A:546:THR:HG21	1:B:546:THR:CG2	1.42	1.49
1:C:546:THR:CG2	1:D:546:THR:HG21	1.40	1.48
1:A:546:THR:CG2	1:B:546:THR:HG21	1.41	1.48

All (4) 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:B:20:ARG:CZ	1:E:70:GLN:OE1[4_455]	2.02	0.18
1:A:20:ARG:CZ	1:D:70:GLN:OE1[4_555]	2.10	0.10
1:A:66[B]:GLN:OE1	3:D:1255:HOH:O[4_555]	2.18	0.02
1:A:20:ARG:NH1	1:D:70:GLN:OE1[4_555]	2.19	0.01

## 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	654/692 (94%)	619 (95%)	34 (5%)	1 (0%)	47	68
1	B	654/692 (94%)	619 (95%)	34 (5%)	1 (0%)	47	68
1	C	654/692 (94%)	619 (95%)	34 (5%)	1 (0%)	47	68
1	D	654/692 (94%)	619 (95%)	34 (5%)	1 (0%)	47	68
1	E	654/692 (94%)	619 (95%)	34 (5%)	1 (0%)	47	68
1	F	654/692 (94%)	619 (95%)	34 (5%)	1 (0%)	47	68
All	All	3924/4152 (94%)	3714 (95%)	204 (5%)	6 (0%)	47	68

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	200	GLU
1	B	200	GLU
1	C	200	GLU
1	D	200	GLU
1	E	200	GLU

### 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	566/592 (96%)	533 (94%)	33 (6%)	20	38
1	B	566/592 (96%)	533 (94%)	33 (6%)	20	38
1	C	566/592 (96%)	533 (94%)	33 (6%)	20	38

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	D	566/592 (96%)	533 (94%)	33 (6%)	20	38
1	E	566/592 (96%)	533 (94%)	33 (6%)	20	38
1	F	566/592 (96%)	533 (94%)	33 (6%)	20	38
All	All	3396/3552 (96%)	3198 (94%)	198 (6%)	19	38

5 of 198 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	332	LEU
1	E	211	ARG
1	D	394	LEU
1	D	641	LEU
1	E	364	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 96 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	361	ASN
1	E	313	GLN
1	D	452	ASN
1	E	70	GLN
1	E	452	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](#)

6 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	TPQ	D	405	1	13,14,15	2.35	5 (38%)	15,19,21	1.77	3 (20%)
1	TPQ	B	405	1	13,14,15	2.36	5 (38%)	15,19,21	1.76	3 (20%)
1	TPQ	F	405	1	13,14,15	2.36	5 (38%)	15,19,21	1.77	3 (20%)
1	TPQ	E	405	1	13,14,15	2.35	5 (38%)	15,19,21	1.77	3 (20%)
1	TPQ	A	405	1	13,14,15	2.35	5 (38%)	15,19,21	1.77	3 (20%)
1	TPQ	C	405	1	13,14,15	2.36	5 (38%)	15,19,21	1.77	3 (20%)

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	TPQ	D	405	1	-	3/5/22/24	0/1/1/1
1	TPQ	B	405	1	-	3/5/22/24	0/1/1/1
1	TPQ	F	405	1	-	3/5/22/24	0/1/1/1
1	TPQ	E	405	1	-	3/5/22/24	0/1/1/1
1	TPQ	A	405	1	-	3/5/22/24	0/1/1/1
1	TPQ	C	405	1	-	3/5/22/24	0/1/1/1

The worst 5 of 30 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	405	TPQ	C3-C4	5.06	1.43	1.35
1	E	405	TPQ	C3-C4	5.05	1.43	1.35
1	F	405	TPQ	C3-C4	5.04	1.43	1.35
1	D	405	TPQ	C3-C4	5.03	1.43	1.35
1	A	405	TPQ	C3-C4	5.02	1.43	1.35

The worst 5 of 18 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	405	TPQ	CB-CA-C	-4.46	103.11	111.47
1	E	405	TPQ	CB-CA-C	-4.46	103.11	111.47
1	F	405	TPQ	CB-CA-C	-4.45	103.12	111.47
1	A	405	TPQ	CB-CA-C	-4.45	103.13	111.47
1	D	405	TPQ	CB-CA-C	-4.44	103.14	111.47

There are no chirality outliers.

5 of 18 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	405	TPQ	N-CA-CB-C1
1	A	405	TPQ	C-CA-CB-C1
1	B	405	TPQ	N-CA-CB-C1
1	B	405	TPQ	C-CA-CB-C1
1	C	405	TPQ	N-CA-CB-C1

There are no ring outliers.

6 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	D	405	TPQ	1	0
1	B	405	TPQ	1	0
1	F	405	TPQ	1	0
1	E	405	TPQ	1	0
1	A	405	TPQ	1	0
1	C	405	TPQ	1	0

## 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 6 ligands modelled in this entry, 6 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 [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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	654/692 (94%)	-0.54	6 (0%) 84 86	16, 26, 46, 81	0
1	B	654/692 (94%)	-0.54	8 (1%) 79 80	16, 26, 46, 81	0
1	C	654/692 (94%)	-0.39	22 (3%) 45 48	16, 26, 46, 81	0
1	D	654/692 (94%)	-0.46	15 (2%) 60 63	16, 26, 46, 81	0
1	E	654/692 (94%)	-0.52	2 (0%) 94 94	16, 26, 46, 81	0
1	F	654/692 (94%)	-0.51	10 (1%) 73 75	16, 26, 46, 81	0
All	All	3924/4152 (94%)	-0.49	63 (1%) 72 74	16, 26, 46, 81	0

The worst 5 of 63 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	18	PRO	9.1
1	D	20	ARG	8.0
1	D	19	ALA	7.4
1	D	21	PRO	5.8
1	D	334	LEU	5.8

### 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	TPQ	B	405	14/15	0.89	0.24	32,47,55,57	0
1	TPQ	A	405	14/15	0.91	0.21	32,47,55,57	0
1	TPQ	C	405	14/15	0.91	0.17	32,47,55,57	0
1	TPQ	D	405	14/15	0.91	0.20	32,47,55,57	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
1	TPQ	E	405	14/15	0.92	0.21	32,47,55,57	0
1	TPQ	F	405	14/15	0.92	0.19	32,47,55,57	0

### 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, 95<sup>th</sup> 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
2	CU	A	701	1/1	0.99	0.03	31,31,31,31	0
2	CU	B	701	1/1	0.99	0.02	31,31,31,31	0
2	CU	C	701	1/1	0.99	0.02	31,31,31,31	0
2	CU	E	701	1/1	0.99	0.08	31,31,31,31	0
2	CU	D	701	1/1	1.00	0.03	31,31,31,31	0
2	CU	F	701	1/1	1.00	0.04	31,31,31,31	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.