



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 12:08 PM UTC

PDB ID : 3HBX / pdb_00003hbx
Title : Crystal structure of GAD1 from Arabidopsis thaliana
Authors : Gut, H.; Dominici, P.; Pilati, S.; Gruetter, M.G.; Capitani, G.
Deposited on : 2009-05-05
Resolution : 2.67 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

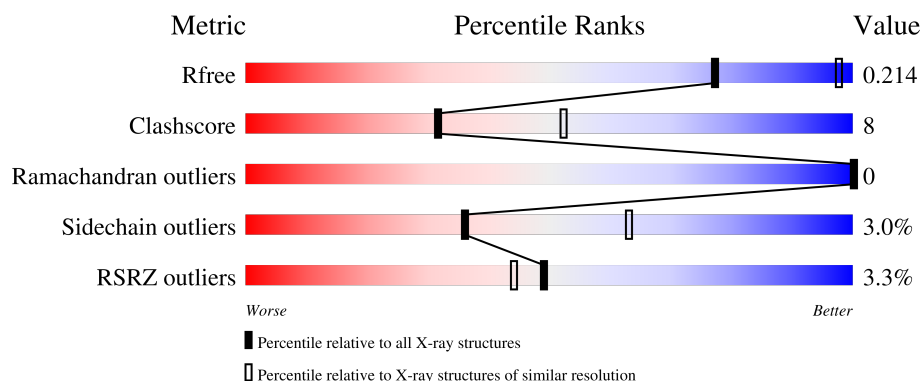
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.67 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	5070 (2.70-2.66)
Clashscore	190562	5409 (2.70-2.66)
Ramachandran outliers	187476	5324 (2.70-2.66)
Sidechain outliers	187428	5324 (2.70-2.66)
RSRZ outliers	180081	5070 (2.70-2.66)

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	502	
1	B	502	
1	C	502	
1	D	502	
1	E	502	

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Mol	Chain	Length	Quality of chain
1	F	502	3% 67% 19% • 13%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 21456 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 Glutamate decarboxylase 1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	437	Total	C	N	O	P	S	0	3	0
			3542	2261	591	669	1	20			
1	B	437	Total	C	N	O	P	S	0	0	0
			3518	2245	588	664	1	20			
1	C	437	Total	C	N	O	P	S	0	0	0
			3518	2245	588	664	1	20			
1	D	436	Total	C	N	O	P	S	0	3	0
			3535	2256	590	668	1	20			
1	E	436	Total	C	N	O	P	S	0	0	0
			3511	2240	587	663	1	20			
1	F	437	Total	C	N	O	P	S	0	0	0
			3518	2245	588	664	1	20			

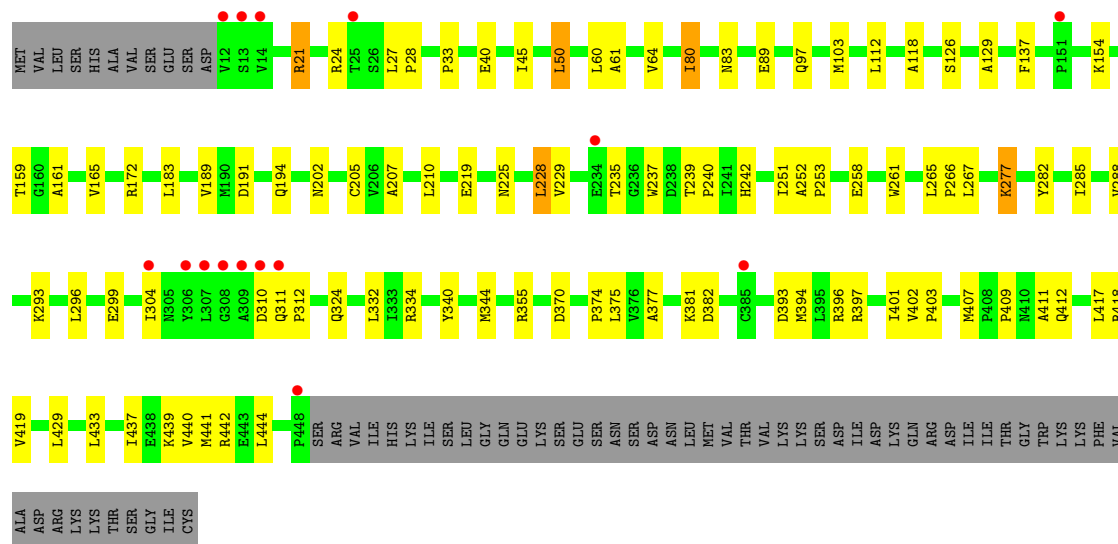
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	58	Total	O	0	0
			58	58		
2	B	51	Total	O	0	0
			51	51		
2	C	59	Total	O	0	0
			59	59		
2	D	68	Total	O	0	0
			68	68		
2	E	41	Total	O	0	0
			41	41		
2	F	37	Total	O	0	0
			37	37		

ARG
LYS
LYS
THR
SER
GLY
ILE
CYS

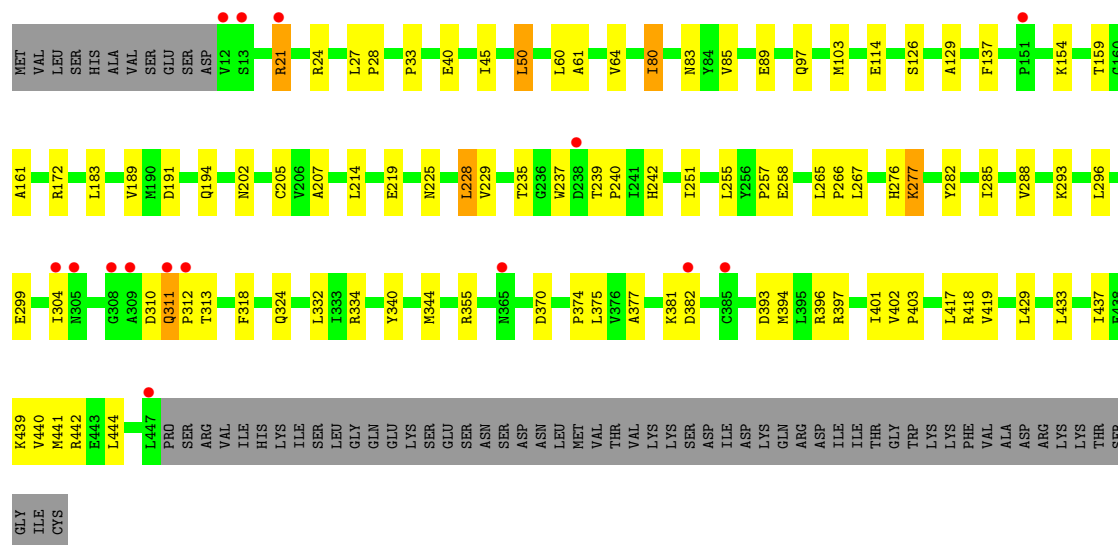
• Molecule 1: Glutamate decarboxylase 1

Chain C: 3% 68% 18% 13%



• Molecule 1: Glutamate decarboxylase 1

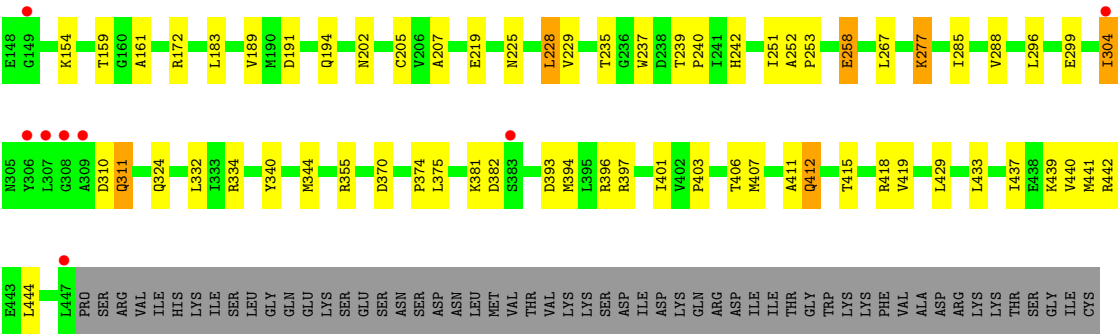
Chain D: 3% 68% 17% 13%



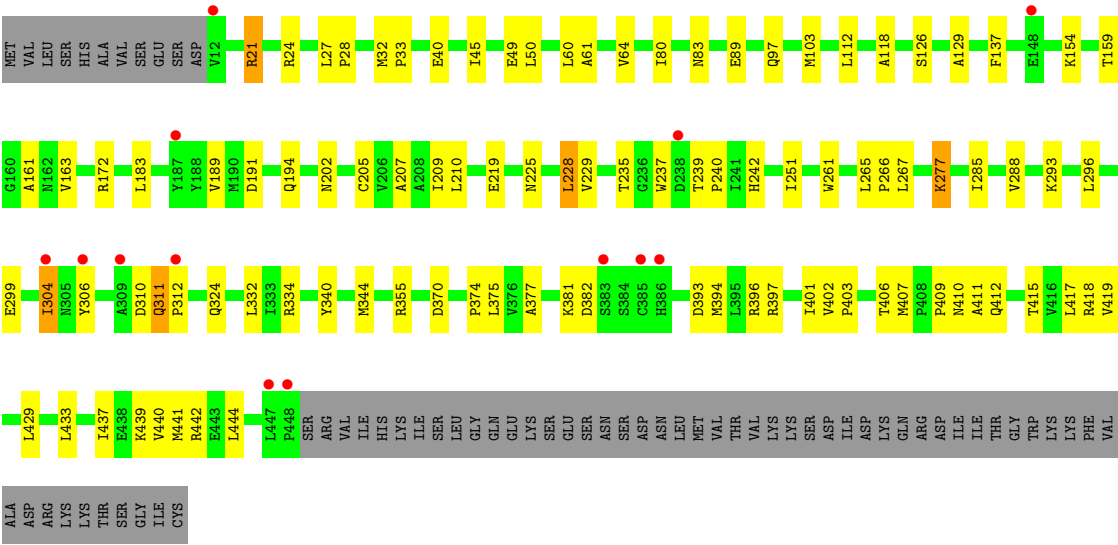
• Molecule 1: Glutamate decarboxylase 1

Chain E: 2% 69% 16% 13%





● Molecule 1: Glutamate decarboxylase 1



4 Data and refinement statistics

Property	Value	Source
Space group	P 32	Depositor
Cell constants a, b, c, α , β , γ	118.10Å 118.10Å 200.58Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	29.09 – 2.67 29.09 – 2.67	Depositor EDS
% Data completeness (in resolution range)	96.2 (29.09-2.67) 96.1 (29.09-2.67)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.08	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.96 (at 2.68Å)	Xtriage
Refinement program	PHENIX 1.4_29	Depositor
R, R_{free}	0.208 , 0.221 0.201 , 0.214	Depositor DCC
R_{free} test set	2227 reflections (2.61%)	wwPDB-VP
Wilson B-factor (Å ²)	45.8	Xtriage
Anisotropy	0.468	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 36.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.54$, $\langle L^2 \rangle = 0.38$	Xtriage
Estimated twinning fraction	0.000 for -h,-k,l 0.000 for h,-h-k,-l 0.000 for -k,-h,-l	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	21456	wwPDB-VP
Average B, all atoms (Å ²)	47.0	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 29.51 % 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 1.5312e-03. 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, 0.333 respectively for untwinned datasets, and 0.375, 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: 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	0.28	0/3596	0.68	0/4878
1	B	0.27	0/3571	0.69	0/4844
1	C	0.27	0/3571	0.68	0/4844
1	D	0.28	0/3588	0.68	0/4866
1	E	0.27	0/3563	0.69	0/4832
1	F	0.26	0/3571	0.68	0/4844
All	All	0.27	0/21460	0.68	0/29108

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	3542	0	3496	66	0
1	B	3518	0	3473	59	0
1	C	3518	0	3473	60	0
1	D	3535	0	3489	64	0
1	E	3511	0	3466	62	0
1	F	3518	0	3473	62	0
2	A	58	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	51	0	0	0	0
2	C	59	0	0	0	0
2	D	68	0	0	1	0
2	E	41	0	0	0	0
2	F	37	0	0	0	0
All	All	21456	0	20870	340	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 8.

The worst 5 of 340 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:21:ARG:HB3	1:B:24:ARG:HH21	1.33	0.94
1:F:21:ARG:HB3	1:F:24:ARG:HH21	1.33	0.94
1:A:21:ARG:HB3	1:A:24:ARG:HH21	1.33	0.93
1:E:21:ARG:HB3	1:E:24:ARG:HH21	1.34	0.93
1:D:21:ARG:HB3	1:D:24:ARG:HH21	1.33	0.93

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	437/502 (87%)	413 (94%)	24 (6%)	0	100	100
1	B	434/502 (86%)	410 (94%)	24 (6%)	0	100	100
1	C	434/502 (86%)	409 (94%)	25 (6%)	0	100	100
1	D	436/502 (87%)	411 (94%)	25 (6%)	0	100	100
1	E	433/502 (86%)	409 (94%)	24 (6%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	F	434/502 (86%)	409 (94%)	25 (6%)	0	100	100
All	All	2608/3012 (87%)	2461 (94%)	147 (6%)	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	388/445 (87%)	376 (97%)	12 (3%)	35	62
1	B	385/445 (86%)	374 (97%)	11 (3%)	37	64
1	C	385/445 (86%)	375 (97%)	10 (3%)	40	68
1	D	387/445 (87%)	373 (96%)	14 (4%)	31	57
1	E	384/445 (86%)	371 (97%)	13 (3%)	32	59
1	F	385/445 (86%)	374 (97%)	11 (3%)	37	64
All	All	2314/2670 (87%)	2243 (97%)	71 (3%)	36	62

5 of 71 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	412	GLN
1	E	433	LEU
1	F	228	LEU
1	C	40	GLU
1	C	21	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 14 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	317	ASN
1	C	337	HIS
1	F	337	HIS

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Mol	Chain	Res	Type
1	E	142	GLN
1	F	142	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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	LLP	D	277	1	23,24,25	1.76	3 (13%)	25,32,34	1.44	4 (16%)
1	LLP	E	277	1	23,24,25	1.75	4 (17%)	25,32,34	1.42	4 (16%)
1	LLP	B	277	1	23,24,25	1.75	3 (13%)	25,32,34	1.43	4 (16%)
1	LLP	F	277	1	23,24,25	1.73	4 (17%)	25,32,34	1.50	4 (16%)
1	LLP	A	277	1	23,24,25	1.75	3 (13%)	25,32,34	1.45	4 (16%)
1	LLP	C	277	1	23,24,25	1.74	4 (17%)	25,32,34	1.45	4 (16%)

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	D	277	1	-	4/16/17/19	0/1/1/1
1	LLP	E	277	1	-	5/16/17/19	0/1/1/1
1	LLP	B	277	1	-	5/16/17/19	0/1/1/1
1	LLP	F	277	1	-	10/16/17/19	0/1/1/1
1	LLP	A	277	1	-	8/16/17/19	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	LLP	C	277	1	-	5/16/17/19	0/1/1/1

The worst 5 of 21 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	277	LLP	O3-C3	-5.87	1.23	1.36
1	D	277	LLP	O3-C3	-5.87	1.23	1.36
1	E	277	LLP	O3-C3	-5.84	1.23	1.36
1	A	277	LLP	O3-C3	-5.83	1.23	1.36
1	F	277	LLP	O3-C3	-5.76	1.23	1.36

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

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	F	277	LLP	OP4-C5'-C5	4.37	117.55	109.36
1	C	277	LLP	OP4-C5'-C5	4.02	116.90	109.36
1	D	277	LLP	OP4-C5'-C5	3.91	116.69	109.36
1	A	277	LLP	OP4-C5'-C5	3.74	116.36	109.36
1	B	277	LLP	OP4-C5'-C5	3.65	116.20	109.36

There are no chirality outliers.

5 of 37 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	277	LLP	C4-C4'-NZ-CE
1	A	277	LLP	C5'-OP4-P-OP2
1	A	277	LLP	C5'-OP4-P-OP3
1	A	277	LLP	O-C-CA-CB
1	B	277	LLP	C4-C4'-NZ-CE

There are no ring outliers.

6 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	D	277	LLP	2	0
1	E	277	LLP	1	0
1	B	277	LLP	1	0
1	F	277	LLP	1	0
1	A	277	LLP	2	0
1	C	277	LLP	1	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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](#)

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	436/502 (86%)	0.18	16 (3%) 45 40	18, 43, 79, 115	3 (0%)
1	B	436/502 (86%)	0.10	16 (3%) 45 40	26, 44, 81, 111	0
1	C	436/502 (86%)	0.07	15 (3%) 48 43	27, 43, 80, 119	0
1	D	435/502 (86%)	0.12	15 (3%) 48 43	17, 43, 77, 107	3 (0%)
1	E	435/502 (86%)	0.06	11 (2%) 58 54	27, 44, 74, 107	3 (0%)
1	F	436/502 (86%)	0.07	13 (2%) 52 48	27, 44, 80, 115	0
All	All	2614/3012 (86%)	0.10	86 (3%) 49 44	17, 43, 80, 119	9 (0%)

The worst 5 of 86 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	309	ALA	6.3
1	F	448	PRO	5.0
1	D	309	ALA	5.0
1	E	308	GLY	4.7
1	E	306	TYR	4.7

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	F	277	24/25	0.95	0.08	26,36,47,50	0
1	LLP	B	277	24/25	0.97	0.07	27,34,44,46	0
1	LLP	C	277	24/25	0.97	0.06	26,33,43,45	0
1	LLP	D	277	24/25	0.97	0.07	26,33,40,42	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
1	LLP	E	277	24/25	0.97	0.07	26,36,42,45	0
1	LLP	A	277	24/25	0.97	0.07	25,32,36,39	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.