



# wwPDB X-ray Structure Validation Summary Report i

May 17, 2020 – 04:41 pm BST

PDB ID : 5L5L  
Title : Plexin A4 full extracellular region, domains 1 to 8 modeled, data to 8 angstrom, spacegroup P2(1)  
Authors : Janssen, B.J.C.; Kong, Y.; Malinauskas, T.; Vangoor, V.R.; Coles, C.H.; Kauffman, R.; Ni, T.; Gilbert, R.J.C.; Padilla-Parra, S.; Pasterkamp, R.J.; Jones, E.Y.  
Deposited on : 2016-05-28  
Resolution : 8.00 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](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 i symbol.

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The following versions of software and data (see references ①) were used in the production of this report:

MolProbity : 4.02b-467  
Xtriage (Phenix) : 1.13  
EDS : 2.11  
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) : 2.11

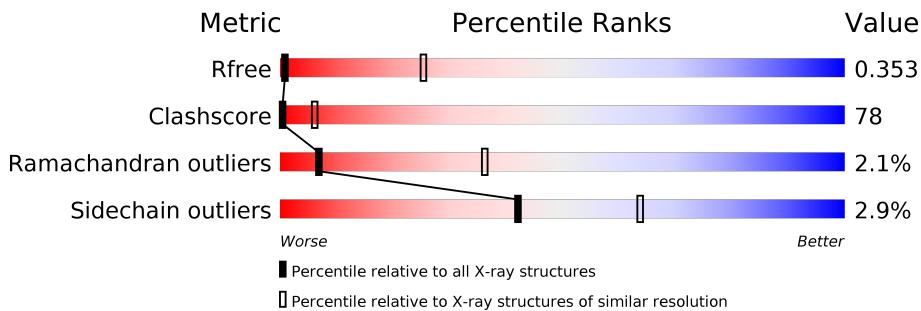
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## X-RAY DIFFRACTION

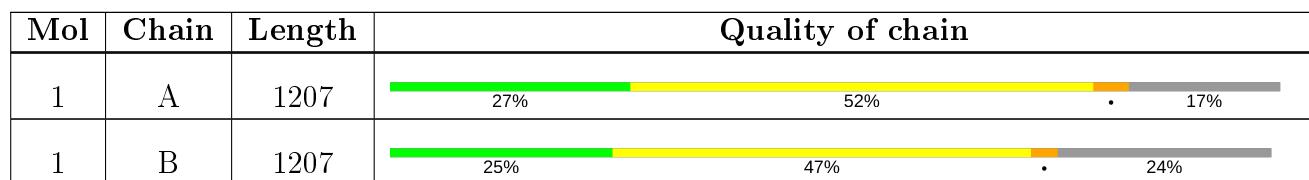
The reported resolution of this entry is 8.00 Å.

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))
$R_{free}$	130704	1005 (11.50-3.90)
Clashscore	141614	1070 (11.50-3.90)
Ramachandran outliers	138981	1003 (11.50-3.90)
Sidechain outliers	138945	1003 (11.50-3.86)

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  $\geq 3$ , 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  $\leq 5\%$ .



## 2 Entry composition i

There is only 1 type of molecule in this entry. The entry contains 15030 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 Plexin-A4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	1000	Total	C 7841	N 4938	O 1356	S 1482	65	0	0
1	B	915	Total	C 7189	N 4533	O 1239	S 1357	60	0	0

There are 26 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	33	GLU	-	expression tag	UNP Q80UG2
A	34	THR	-	expression tag	UNP Q80UG2
A	35	GLY	-	expression tag	UNP Q80UG2
A	1230	GLY	-	expression tag	UNP Q80UG2
A	1231	ARG	-	expression tag	UNP Q80UG2
A	1232	THR	-	expression tag	UNP Q80UG2
A	1233	LYS	-	expression tag	UNP Q80UG2
A	1234	HIS	-	expression tag	UNP Q80UG2
A	1235	HIS	-	expression tag	UNP Q80UG2
A	1236	HIS	-	expression tag	UNP Q80UG2
A	1237	HIS	-	expression tag	UNP Q80UG2
A	1238	HIS	-	expression tag	UNP Q80UG2
A	1239	HIS	-	expression tag	UNP Q80UG2
B	33	GLU	-	expression tag	UNP Q80UG2
B	34	THR	-	expression tag	UNP Q80UG2
B	35	GLY	-	expression tag	UNP Q80UG2
B	1230	GLY	-	expression tag	UNP Q80UG2
B	1231	ARG	-	expression tag	UNP Q80UG2
B	1232	THR	-	expression tag	UNP Q80UG2
B	1233	LYS	-	expression tag	UNP Q80UG2
B	1234	HIS	-	expression tag	UNP Q80UG2
B	1235	HIS	-	expression tag	UNP Q80UG2
B	1236	HIS	-	expression tag	UNP Q80UG2
B	1237	HIS	-	expression tag	UNP Q80UG2
B	1238	HIS	-	expression tag	UNP Q80UG2

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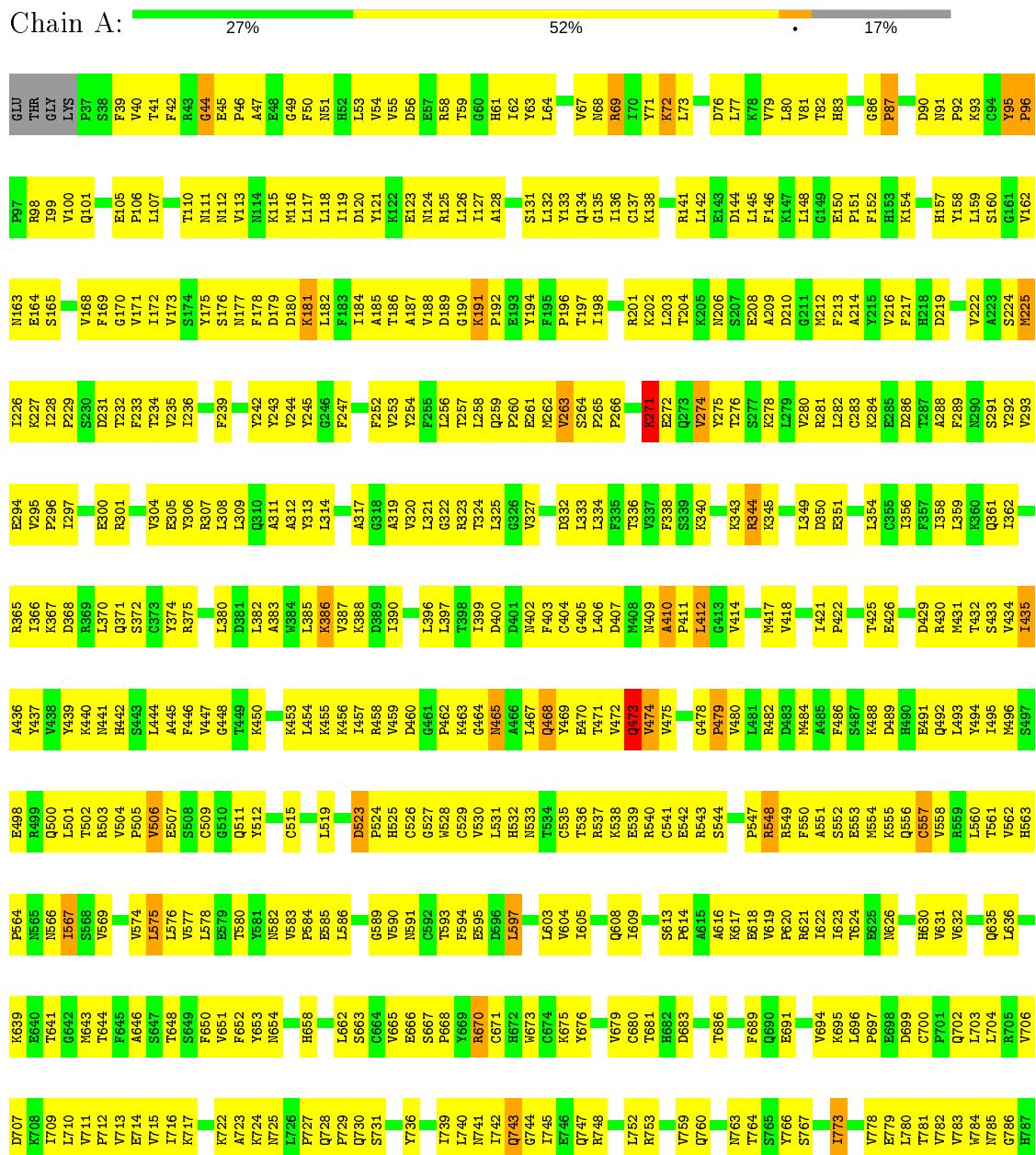
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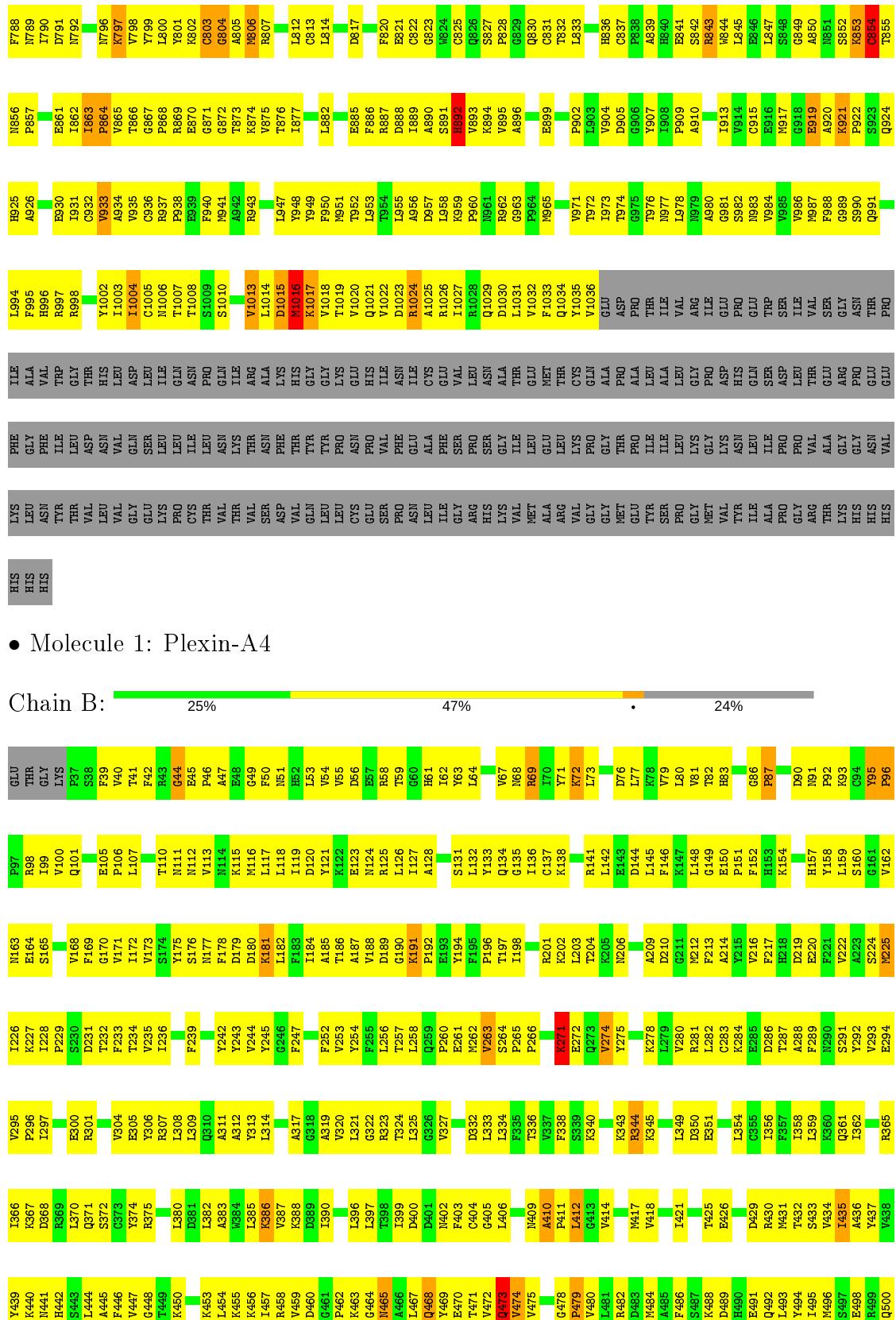
Chain	Residue	Modelled	Actual	Comment	Reference
B	1239	HIS	-	expression tag	UNP Q80UG2

### 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. 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.

- Molecule 1: Plexin-A4





P922	HIS	ASN	VAL	VAL	T788	W706	L501
	LEU	GLN	GLU	MET	W789	T502	M567
	ILE	SER	TRP	PHE	I770	R503	S568
	ALA	PRO	ASP	GLY	I790	P804	V504
	GLY	PRO	LEU	ILE	J792	T791	V505
	VAL	VAL	VAL	GLN	W792	W793	V506
	ARG	ALA	THR	SER	E861	I862	B507
	THR	CYS	CYS	GLY	E862	K863	S508
	LYS	GLY	GLY	ASN	E863	K797	L575
	HTS	HTS	HTS	PRO	P864	V798	L576
	HTS	ASU	ASU	THR	P865	Y799	C509
	HTS	VAL	VAL	PRO	A934	Y800	V510
	HTS	VAL	VAL	ILE	T866	Y801	Y511
	HTS	LYS	GLY	ARG	I935	Y802	F579
	HTS	LEU	GLY	ARG	R336	K803	Y580
	HTS	ASU	VAL	PRO	R337	R804	Q515
	HTS	TYR	ILE	TRP	P838	T723	V583
	HTS	LEU	GLY	SER	E339	T724	L519
	VAL	ASP	THR	GLN	F940	G805	F584
	LEU	ASN	ILE	VAL	N941	V806	F585
	VAL	VAL	ILE	VAL	I862	Y807	I586
	GLN	CYS	LEU	PRO	E863	V875	Y726
	GLU	TRP	ASP	ASP	E864	I876	T727
	GLU	ASP	LEU	ASN	R943	S808	G661
	GLU	ASP	ILE	LYS	I877	S809	I728
	LEU	LEU	ILE	THR	L597	W861	E662
	LYS	PRO	LEU	THR	V948	E882	Y663
	LEU	CYS	ILE	VAL	Y949	E813	V664
	LYS	THR	ILE	ASP	F950	L814	Y731
	VAL	VAL	VAL	SER	R951	W883	V665
	GLN	GLU	GLU	SER	T864	K884	G666
	GLU	GLU	GLU	ASP	E885	D817	Y732
	GLU	VAL	ILE	ASP	F886	R817	V667
	LYS	THR	VAL	LEU	F886	T739	Y668
	LEU	THR	VAL	ASP	R887	F820	Y669
	VAL	VAL	VAL	GLN	F888	G821	V670
	ASP	ASP	ASP	VAL	I889	C822	I740
	VAL	VAL	VAL	VAL	A890	A891	Y741
	GLN	GLU	VAL	GLN	E891	A892	I742
	GLU	GLU	VAL	VAL	E892	E884	Q743
	VAL	VAL	VAL	VAL	R893	E886	Y744
					F894	D887	V745
					V895	V828	I746
					A896	V829	Y747
					A897	C831	V748
					R898	E831	Y749
					A899	V831	V749
					S800	T832	V750
					A801	V799	F683
					P802	V799	I683
					I803	V799	A616
					E804	V799	A617
					D805	V799	F684
					R806	V799	S613
					V807	V799	I685
					E808	I763	Y686
					R809	I764	V687
					V810	T753	F615
					V811	V753	I682
					F812	V753	E616
					A813	V753	A617
					V814	V753	F617
					F815	V753	S618
					V816	V753	R619
					V817	V753	F620
					V818	V753	R621
					V819	V753	F622
					V820	V753	R623
					V821	V753	F624
					V822	V753	R625
					V823	V753	F626
					V824	V753	R627
					V825	V753	F628
					V826	V753	R629
					V827	V753	F629
					V828	V753	R630
					V829	V753	F631
					V830	V753	R632
					V831	V753	F634
					V832	V753	R635
					V833	V753	F636
					V834	V753	R637
					V835	V753	F638
					V836	V753	R639
					V837	V753	F640
					V838	V753	R641
					V839	V753	F642
					V840	V753	R643
					V841	V753	F644
					V842	V753	R645
					V843	V753	F646
					V844	V753	R647
					V845	V753	F648
					V846	V753	R649
					V847	V753	F650
					V848	V753	R651
					V849	V753	F652
					V850	V753	R653
					V851	V753	F654
					V852	V753	R655
					V853	V753	F656
					V854	V753	R657
					V855	V753	F658
					V856	V753	R659
					V857	V753	F660
					V858	V753	R661
					V859	V753	F662
					V860	V753	R663
					V861	V753	F664
					V862	V753	R665
					V863	V753	F666
					V864	V753	R667
					V865	V753	F668
					V866	V753	R669
					V867	V753	F670
					V868	V753	R671
					V869	V753	F672
					V870	V753	R673
					V871	V753	F674
					V872	V753	R675
					V873	V753	F676
					V874	V753	R677
					V875	V753	F678
					V876	V753	R679
					V877	V753	F680
					V878	V753	R681
					V879	V753	F682
					V880	V753	R683
					V881	V753	F684
					V882	V753	R685
					V883	V753	F686
					V884	V753	R687
					V885	V753	F688
					V886	V753	R689
					V887	V753	F690
					V888	V753	R691
					V889	V753	F692
					V890	V753	R693
					V891	V753	F694
					V892	V753	R695
					V893	V753	F696
					V894	V753	R697
					V895	V753	F698
					V896	V753	R699
					V897	V753	F700
					V898	V753	R701
					V899	V753	F702
					V900	V753	R703
					V901	V753	F704
					V902	V753	R705
					V903	V753	F706
					V904	V753	R707
					V905	V753	F708
					V906	V753	R709
					V907	V753	F710
					V908	V753	R711
					V909	V753	F712
					V910	V753	R713
					V911	V753	F714
					V912	V753	R715
					V913	V753	F716
					V914	V753	R717
					V915	V753	F718
					V916	V753	R719
					V917	V753	F720
					V918	V753	R721
					V919	V753	F722
					V920	V753	R723
					V921	V753	F724

## 4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	142.18 Å    241.00 Å    144.07 Å 90.00°    99.83°    90.00°	Depositor
Resolution (Å)	47.74 – 8.00 47.74 – 8.00	Depositor EDS
% Data completeness (in resolution range)	99.1 (47.74-8.00) 99.5 (47.74-8.00)	Depositor EDS
$R_{merge}$	0.16	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle^1$	3.18 (at 8.32 Å)	Xtriage
Refinement program	PHENIX 1.8.2_1309	Depositor
$R$ , $R_{free}$	0.349 , 0.349 0.348 , 0.353	Depositor DCC
$R_{free}$ test set	488 reflections (4.85%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	450.9	Xtriage
Anisotropy	0.543	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.40 , 550.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.43$ , $\langle L^2 \rangle = 0.25$	Xtriage
Estimated twinning fraction	0.043 for l,-k,h	Xtriage
$F_o, F_c$ correlation	0.70	EDS
Total number of atoms	15030	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	264.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.04% 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 [\(i\)](#)

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	1.01	5/8007 (0.1%)	1.36	27/10846 (0.2%)
1	B	1.00	5/7344 (0.1%)	1.32	24/9943 (0.2%)
All	All	1.01	10/15351 (0.1%)	1.34	51/20789 (0.2%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	3
1	B	0	4
All	All	0	7

The worst 5 of 10 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	506	VAL	C-N	23.13	1.87	1.34
1	B	506	VAL	C-N	21.10	1.82	1.34
1	A	557	CYS	C-N	-20.82	0.86	1.34
1	B	557	CYS	C-N	-17.13	0.94	1.34
1	A	700	CYS	C-N	-15.63	1.04	1.34

The worst 5 of 51 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	747	GLN	CG-CD-OE1	-38.83	43.94	121.60
1	A	747	GLN	CG-CD-OE1	-38.81	43.98	121.60
1	A	653	TYR	O-C-N	-33.42	69.23	122.70
1	B	557	CYS	O-C-N	-31.89	71.68	122.70
1	A	653	TYR	CA-C-N	23.37	168.61	117.20

There are no chirality outliers.

5 of 7 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	854	CYS	Mainchain
1	A	863	ILE	Peptide
1	A	95	TYR	Peptide
1	B	557	CYS	Mainchain
1	B	95	TYR	Peptide

## 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	7841	0	7710	1244	34
1	B	7189	0	7050	1075	67
All	All	15030	0	14760	2319	69

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 78.

The worst 5 of 2319 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:868:PRO:HD2	1:A:981:GLY:CA	1.32	1.52
1:A:868:PRO:CD	1:A:981:GLY:CA	1.87	1.50
1:A:873:THR:CA	1:A:982:SER:HB2	1.46	1.43
1:A:873:THR:HA	1:A:982:SER:CB	1.48	1.40
1:B:506:VAL:HG22	1:B:525:HIS:NE2	1.33	1.38

The worst 5 of 69 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:A:146:PHE:CE1	1:B:730:GLN:CD[1_655]	0.64	1.56
1:B:287:THR:OG1	1:B:840:HIS:CG[1_655]	0.67	1.53
1:A:146:PHE:CE1	1:B:730:GLN:OE1[1_655]	0.77	1.43
1:A:146:PHE:CD1	1:B:730:GLN:OE1[1_655]	0.78	1.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:287:THR:CA	1:B:840:HIS:NE2[1_655]	0.79	1.41

## 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	994/1207 (82%)	923 (93%)	51 (5%)	20 (2%)	7 38
1	B	907/1207 (75%)	845 (93%)	43 (5%)	19 (2%)	7 36
All	All	1901/2414 (79%)	1768 (93%)	94 (5%)	39 (2%)	7 36

5 of 39 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	96	PRO
1	A	181	LYS
1	A	191	LYS
1	A	410	ALA
1	A	465	ASN

### 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	888/1067 (83%)	861 (97%)	27 (3%)	41 63
1	B	812/1067 (76%)	789 (97%)	23 (3%)	43 65

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	1700/2134 (80%)	1650 (97%)	50 (3%)	42 64

5 of 50 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	892	HIS
1	B	69	ARG
1	B	806	MET
1	A	1004	ILE
1	A	1017	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 53 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	892	HIS
1	B	157	HIS
1	B	789	ASN
1	A	970	GLN
1	A	1006	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)

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)

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 [\(i\)](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	B	6
1	A	5

The worst 5 of 11 chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	B	854:CYS	C	855:THR	N	2.49
1	A	802:LYS	C	803:CYS	N	2.46
1	A	951:MET	C	952:THR	N	2.32
1	B	653:TYR	C	654:ASN	N	2.31
1	B	802:LYS	C	803:CYS	N	2.01

## 6 Fit of model and data [\(i\)](#)

### 6.1 Protein, DNA and RNA chains [\(i\)](#)

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.3 Carbohydrates [\(i\)](#)

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.4 Ligands [\(i\)](#)

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.