



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 21, 2018 – 11:10 PM EST

PDB ID : 2X11  
Title : Crystal structure of the complete EphA2 ectodomain in complex with ephrin A5 receptor binding domain  
Authors : Seiradake, E.; Harlos, K.; Sutton, G.; Aricescu, A.R.; Jones, E.Y.  
Deposited on : 2009-12-21  
Resolution : 4.83 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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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
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20030736
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)	:	rb-20030736

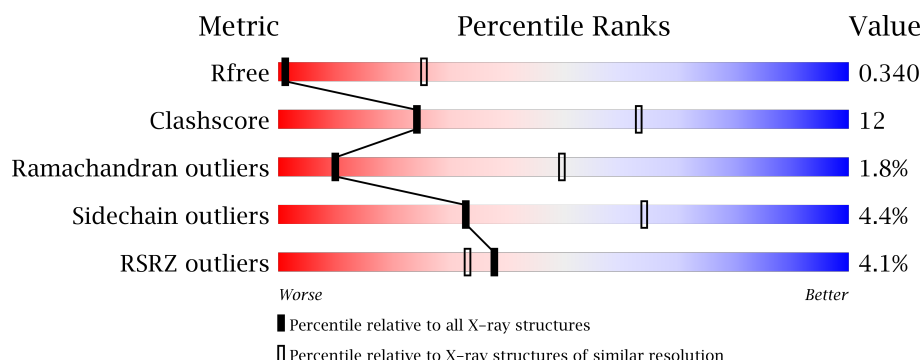
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 4.83 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	1038 (6.02-3.66)
Clashscore	112137	1071 (5.98-3.70)
Ramachandran outliers	110173	1007 (5.98-3.70)
Sidechain outliers	110143	1008 (6.00-3.68)
RSRZ outliers	101464	1009 (6.00-3.68)

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. 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	545	<div> <div>4%</div> <div>65%</div> <div>23%</div> <div>• 10%</div> </div>
2	B	177	<div> <div>3%</div> <div>54%</div> <div>23%</div> <div>•• 21%</div> </div>

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4889 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 EPHRIN TYPE-A RECEPTOR 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	488	Total	C	N	O	S	0	2	0
			3738	2358	628	724	28			

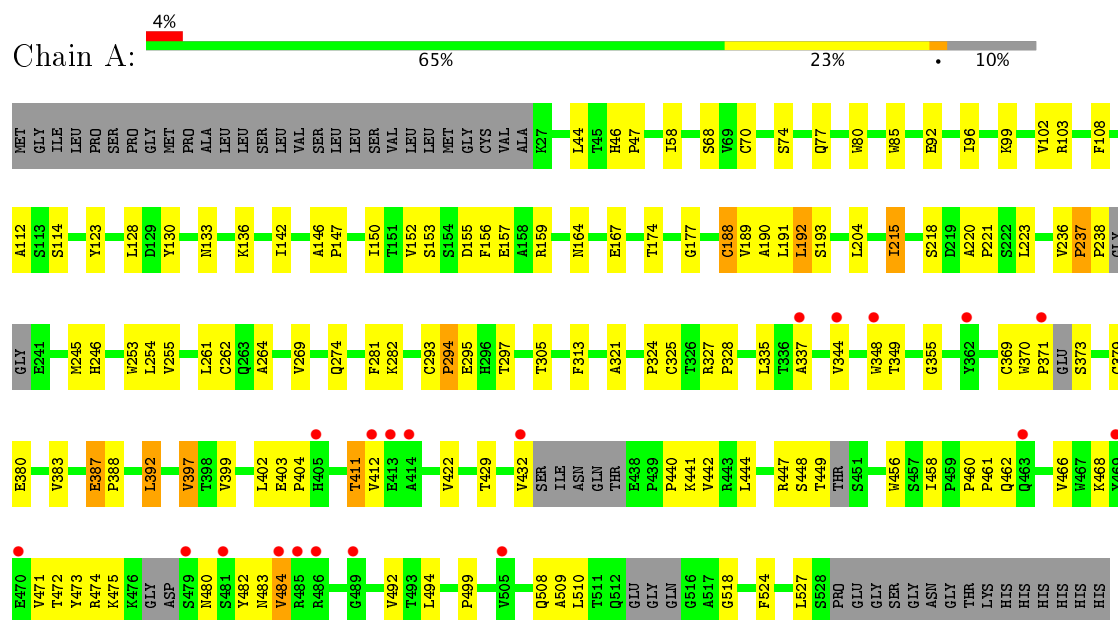
- Molecule 2 is a protein called EPHRIN-A5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	139	Total	C	N	O	S	0	0	1
			1151	736	199	208	8			

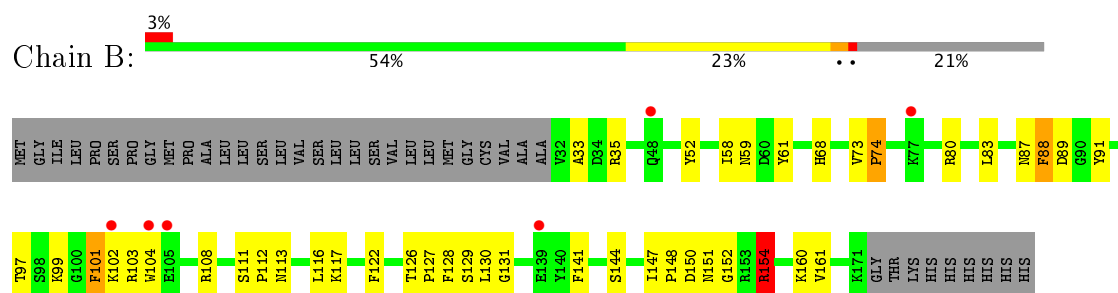
### 3 Residue-property plots

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: EPHRIN TYPE-A RECEPTOR 2



#### • Molecule 2: EPHRIN-A5



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	173.63Å 59.63Å 112.16Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	40.48 – 4.83 49.15 – 4.83	Depositor EDS
% Data completeness (in resolution range)	93.7 (40.48-4.83) 99.8 (49.15-4.83)	Depositor EDS
$R_{merge}$	0.11	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.03 (at 4.86Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, $R_{free}$	0.312 , 0.314 0.316 , 0.340	Depositor DCC
$R_{free}$ test set	273 reflections (4.55%)	DCC
Wilson B-factor (Å <sup>2</sup> )	180.0	Xtriage
Anisotropy	0.319	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.21 , 171.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.80	EDS
Total number of atoms	4889	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	247.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.52% 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

### 5.1 Standard geometry

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	0.22	0/3834	0.42	0/5226
2	B	0.27	0/1190	0.43	0/1612
All	All	0.23	0/5024	0.42	0/6838

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	3738	0	3490	88	0
2	B	1151	0	1068	44	0
All	All	4889	0	4558	117	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 12.

All (117) 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)
2:B:126:THR:HG21	2:B:131:GLY:HA3	1.24	1.11
1:A:159:ARG:HA	2:B:130:LEU:CD1	1.89	1.02

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:159:ARG:HA	2:B:130:LEU:HD13	1.45	0.98
1:A:92:GLU:HB3	1:A:218:SER:HB2	1.51	0.93
1:A:156:PHE:O	2:B:130:LEU:HD21	1.70	0.91
2:B:154:ARG:HB2	2:B:154:ARG:HH11	1.37	0.90
2:B:87:ASN:OD1	2:B:99:LYS:HB3	1.80	0.81
1:A:293:CYS:HB3	1:A:297:THR:HG21	1.63	0.78
1:A:237:PRO:HD2	1:A:238:PRO:HD3	1.67	0.76
1:A:68:SER:HB2	2:B:127:PRO:HB2	1.69	0.75
2:B:126:THR:HG22	2:B:128:PHE:H	1.53	0.74
1:A:190:ALA:HB3	2:B:128:PHE:HD2	1.53	0.73
2:B:35:ARG:HG2	2:B:61:TYR:HB2	1.69	0.73
1:A:156:PHE:HA	2:B:130:LEU:HG	1.71	0.72
1:A:295:GLU:HB2	1:A:324:PRO:HB3	1.71	0.72
1:A:370:TRP:HB3	1:A:373:SER:HB3	1.71	0.71
1:A:103:ARG:HB3	1:A:188:CYS:HB3	1.76	0.65
2:B:141:PHE:CE2	2:B:160:LYS:HG3	2.32	0.65
2:B:126:THR:HG21	2:B:131:GLY:CA	2.16	0.64
1:A:215:ILE:N	1:A:215:ILE:HD13	2.11	0.64
2:B:88:PHE:O	2:B:91:TYR:N	2.32	0.62
1:A:237:PRO:CD	1:A:238:PRO:HD3	2.29	0.61
1:A:269:VAL:HB	1:A:274:GLN:HG3	1.82	0.61
1:A:335:LEU:HD22	1:A:412:VAL:HG12	1.84	0.59
2:B:80:ARG:HB3	2:B:147:ILE:HD12	1.83	0.59
1:A:153:SER:O	1:A:156:PHE:HB2	2.02	0.59
1:A:246:HIS:ND1	1:A:255:VAL:HG23	2.18	0.59
2:B:151:ASN:HB3	2:B:154:ARG:HH22	1.68	0.58
1:A:411:THR:HG22	1:A:429:THR:HG22	1.86	0.57
1:A:460:PRO:N	1:A:461:PRO:HD2	2.19	0.57
1:A:58:ILE:HG21	2:B:102:LYS:NZ	2.20	0.56
1:A:159:ARG:HA	2:B:130:LEU:HD11	1.83	0.56
1:A:380:GLU:O	1:A:383:VAL:HG22	2.05	0.56
1:A:448:SER:O	1:A:449:THR:HB	2.05	0.56
1:A:99:LYS:HB2	1:A:193:SER:HB3	1.85	0.56
2:B:154:ARG:HB2	2:B:154:ARG:NH1	2.15	0.56
1:A:223:LEU:HD21	1:A:254:LEU:HD12	1.87	0.56
1:A:482:TYR:N	1:A:482:TYR:CD2	2.74	0.55
2:B:58:ILE:O	2:B:59:ASN:HB2	2.06	0.55
1:A:473:TYR:CE2	1:A:483:ASN:HB2	2.41	0.55
2:B:102:LYS:NZ	2:B:102:LYS:HB3	2.21	0.55
1:A:508:GLN:HA	1:A:518:GLY:HA2	1.88	0.55
1:A:344:VAL:CG2	1:A:399:VAL:HB	2.37	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:159:ARG:CA	2:B:130:LEU:CD1	2.76	0.54
1:A:102:VAL:HG21	1:A:147:PRO:HG3	1.90	0.53
1:A:245:MET:HB3	1:A:253:TRP:CE3	2.44	0.53
1:A:293:CYS:HB3	1:A:297:THR:CG2	2.38	0.52
2:B:97:THR:O	2:B:99:LYS:HD3	2.08	0.52
2:B:122:PHE:CE1	2:B:161:VAL:HG11	2.45	0.51
1:A:152:VAL:O	1:A:155:ASP:HB2	2.10	0.51
1:A:70:CYS:HB2	2:B:127:PRO:HG3	1.93	0.51
1:A:474:ARG:HG2	1:A:475:LYS:N	2.27	0.50
2:B:101:PHE:N	2:B:101:PHE:CD1	2.79	0.50
1:A:108:PHE:HZ	1:A:188:CYS:SG	2.34	0.50
2:B:126:THR:CG2	2:B:131:GLY:HA3	2.17	0.50
1:A:123:TYR:HB3	1:A:142:ILE:HD11	1.94	0.49
1:A:85:TRP:CZ2	1:A:177:GLY:HA3	2.47	0.49
1:A:444:LEU:HD11	1:A:524:PHE:HB3	1.95	0.49
1:A:449:THR:OG1	1:A:499:PRO:HA	2.13	0.49
1:A:440:PRO:HA	1:A:458:ILE:HG23	1.94	0.49
1:A:471:VAL:O	1:A:484:VAL:HA	2.13	0.48
1:A:344:VAL:HG22	1:A:402:LEU:HD11	1.96	0.48
1:A:328:PRO:HG2	1:A:422:VAL:HG11	1.96	0.48
1:A:190:ALA:HB3	2:B:128:PHE:CD2	2.42	0.48
1:A:112:ALA:C	1:A:114:SER:H	2.17	0.47
1:A:237:PRO:HG2	1:A:261:LEU:HD12	1.97	0.47
1:A:236:VAL:HA	1:A:237:PRO:HD3	1.58	0.47
2:B:83:LEU:HD22	2:B:144:SER:HB3	1.97	0.46
1:A:313:PHE:HB3	1:A:325:CYS:HB3	1.96	0.46
1:A:327:ARG:O	1:A:355:GLY:HA3	2.16	0.46
1:A:392:LEU:HD21	1:A:397:VAL:HG11	1.97	0.46
1:A:468:LYS:O	1:A:510:LEU:HB2	2.16	0.46
2:B:103:ARG:HG3	2:B:104:TRP:CE2	2.51	0.46
1:A:456:TRP:HZ3	1:A:492:VAL:HG22	1.80	0.45
1:A:70:CYS:HB2	2:B:127:PRO:CA	2.46	0.45
2:B:73:VAL:HA	2:B:74:PRO:HD3	1.82	0.45
1:A:220:ALA:N	1:A:221:PRO:HD2	2.31	0.45
2:B:128:PHE:CD1	2:B:129:SER:O	2.70	0.45
1:A:447:ARG:HG3	1:A:527:LEU:CD1	2.47	0.45
1:A:294:PRO:HG3	1:A:321:ALA:O	2.17	0.45
1:A:188:CYS:SG	2:B:127:PRO:HA	2.57	0.45
1:A:369:CYS:O	1:A:371:PRO:HD3	2.18	0.44
1:A:440:PRO:HA	1:A:458:ILE:CG2	2.47	0.44
1:A:264:ALA:HB1	1:A:305:THR:HG22	1.99	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:348:TRP:CZ3	1:A:397:VAL:HG22	2.53	0.43
1:A:344:VAL:HG23	1:A:399:VAL:HB	1.99	0.43
1:A:96:ILE:O	1:A:167:GLU:HA	2.18	0.43
1:A:74:SER:HB2	1:A:77:GLN:NE2	2.33	0.43
1:A:348:TRP:CH2	1:A:397:VAL:HG22	2.53	0.43
1:A:46:HIS:HA	1:A:47:PRO:C	2.39	0.42
2:B:108:ARG:HB2	2:B:116:LEU:HD12	2.00	0.42
1:A:337:ALA:HB1	1:A:432:VAL:CG2	2.49	0.42
1:A:215:ILE:CD1	1:A:215:ILE:N	2.74	0.42
1:A:262:CYS:O	1:A:282:LYS:NZ	2.52	0.42
1:A:281:PHE:CD1	1:A:281:PHE:C	2.93	0.42
1:A:189:VAL:HG12	1:A:190:ALA:N	2.33	0.42
1:A:472:THR:HG23	1:A:482:TYR:HD1	1.85	0.42
2:B:68:HIS:HE1	2:B:111:SER:O	2.03	0.42
2:B:116:LEU:HD23	2:B:117:LYS:N	2.35	0.42
1:A:254:LEU:HD23	1:A:254:LEU:HA	1.78	0.42
1:A:92:GLU:HB3	1:A:218:SER:CB	2.36	0.42
1:A:130:TYR:HB3	1:A:133:ASN:HB2	2.01	0.42
1:A:44:LEU:HD23	1:A:44:LEU:C	2.40	0.42
1:A:70:CYS:HB2	2:B:127:PRO:CG	2.51	0.41
2:B:147:ILE:N	2:B:148:PRO:HD2	2.35	0.41
2:B:88:PHE:O	2:B:89:ASP:C	2.59	0.41
2:B:141:PHE:N	2:B:141:PHE:CD1	2.88	0.41
1:A:387:GLU:HG3	1:A:388:PRO:HD2	2.02	0.41
1:A:466:VAL:HG12	1:A:509:ALA:HB1	2.03	0.41
1:A:80:TRP:NE1	1:A:136:LYS:HE3	2.35	0.41
2:B:126:THR:HA	2:B:127:PRO:HD3	1.74	0.41
1:A:99:LYS:HA	1:A:164:ASN:O	2.21	0.40
1:A:192:LEU:HD21	2:B:128:PHE:CE2	2.56	0.40
2:B:122:PHE:CZ	2:B:161:VAL:HG11	2.57	0.40
1:A:146:ALA:HA	1:A:147:PRO:HD3	1.92	0.40
1:A:403:GLU:HA	1:A:404:PRO:HD3	1.84	0.40
1:A:448:SER:HA	1:A:527:LEU:HD22	2.04	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles

### 5.3.1 Protein backbone

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	476/545 (87%)	436 (92%)	37 (8%)	3 (1%)	28	70
2	B	137/177 (77%)	123 (90%)	6 (4%)	8 (6%)	2	24
All	All	613/722 (85%)	559 (91%)	43 (7%)	11 (2%)	10	50

All (11) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	112	PRO
2	B	154	ARG
2	B	113	ASN
1	A	480	ASN
2	B	33	ALA
2	B	88	PHE
2	B	150	ASP
2	B	152	GLY
1	A	237	PRO
1	A	294	PRO
2	B	74	PRO

### 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	402/464 (87%)	382 (95%)	20 (5%)	28	61
2	B	127/159 (80%)	124 (98%)	3 (2%)	54	78

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
All	All	529/623 (85%)	506 (96%)	23 (4%)	33	65

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	128	LEU
1	A	150	ILE
1	A	157	GLU
1	A	174	THR
1	A	188	CYS
1	A	191	LEU
1	A	192	LEU
1	A	204	LEU
1	A	215	ILE
1	A	349	THR
1	A	379	CYS
1	A	387	GLU
1	A	392	LEU
1	A	397	VAL
1	A	411	THR
1	A	441	LYS
1	A	442	VAL
1	A	462	GLN
1	A	484	VAL
1	A	494	LEU
2	B	52	TYR
2	B	101	PHE
2	B	154	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	259	GLN
1	A	333	HIS
2	B	48	GLN
2	B	68	HIS

### 5.3.3 RNA ⓘ

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](#)

There are no chain breaks in this entry.

## 6 Fit of model and data ⓘ

### 6.1 Protein, DNA and RNA chains ⓘ

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	488/545 (89%)	0.26	20 (4%) 38 33	184, 250, 285, 314	0
2	B	139/177 (78%)	0.22	6 (4%) 36 32	253, 269, 293, 298	0
All	All	627/722 (86%)	0.25	26 (4%) 38 33	184, 259, 287, 314	0

All (26) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	337	ALA	4.3
1	A	405	HIS	3.9
1	A	371	PRO	3.7
1	A	470	GLU	3.5
1	A	469	TYR	3.3
1	A	486	ARG	3.3
1	A	412	VAL	3.1
1	A	414	ALA	3.0
1	A	432	VAL	2.6
1	A	362	TYR	2.6
2	B	105	GLU	2.5
1	A	344	VAL	2.4
1	A	479	SER	2.4
2	B	102	LYS	2.4
1	A	489	GLY	2.3
1	A	463	GLN	2.3
2	B	48	GLN	2.3
1	A	413	GLU	2.2
2	B	77	LYS	2.2
1	A	348	TRP	2.2
1	A	505	VAL	2.1
1	A	484	VAL	2.1
1	A	481	SER	2.0
2	B	139	GLU	2.0

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Mol	Chain	Res	Type	RSRZ
2	B	104	TRP	2.0
1	A	485	ARG	2.0

## 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](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.