



# Full wwPDB X-ray Structure Validation Report ⓘ

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PDB ID : 2HLE / pdb\_00002hle  
Title : Structural and biophysical characterization of the EPHB4-EPHRINB2 protein protein interaction and receptor specificity.  
Authors : Chrencik, J.E.; Brooun, A.; Kuhn, P.; Accelerated Technologies Center for Gene to 3D Structure (ATCG3D)  
Deposited on : 2006-07-06  
Resolution : 2.05 Å(reported)

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<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	:	4-5-2 with Phenix2.0
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

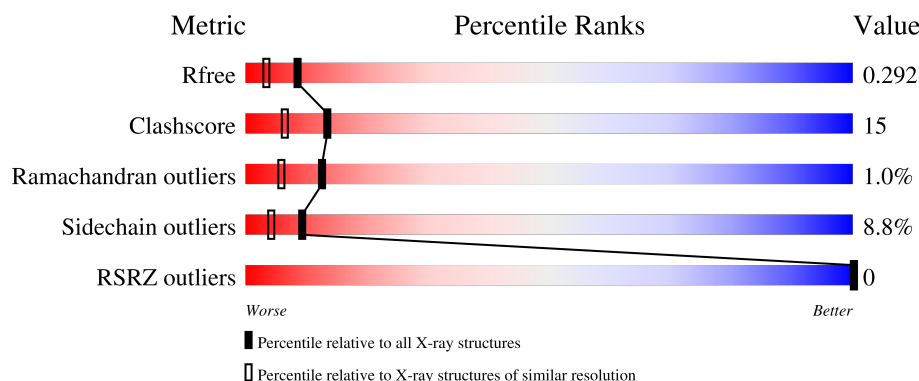
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*



The reported resolution of this entry is 2.05 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	2260 (2.04-2.04)
Clashscore	190562	2333 (2.04-2.04)
Ramachandran outliers	187476	2318 (2.04-2.04)
Sidechain outliers	187428	2318 (2.04-2.04)
RSRZ outliers	180081	2260 (2.04-2.04)

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	188	 76% 22% .
2	B	138	 62% 30% . .

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2564 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-B receptor 4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	188	Total	C	N	O	S	0	1	0
			1479	943	256	273	7			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	9	ALA	-	cloning artifact	UNP P54760
A	10	GLY	-	cloning artifact	UNP P54760
A	11	HIS	-	expression tag	UNP P54760
A	12	HIS	-	expression tag	UNP P54760
A	13	HIS	-	expression tag	UNP P54760
A	14	HIS	-	expression tag	UNP P54760
A	15	HIS	-	expression tag	UNP P54760
A	16	HIS	-	expression tag	UNP P54760

- Molecule 2 is a protein called Ephrin-B2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	133	Total	C	N	O	S	0	3	0
			1006	650	157	192	7			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	106	ARG	LYS	conflict	UNP P52799
B	111	VAL	ILE	conflict	UNP P52799

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	50	Total	O	0	0
			50	50		

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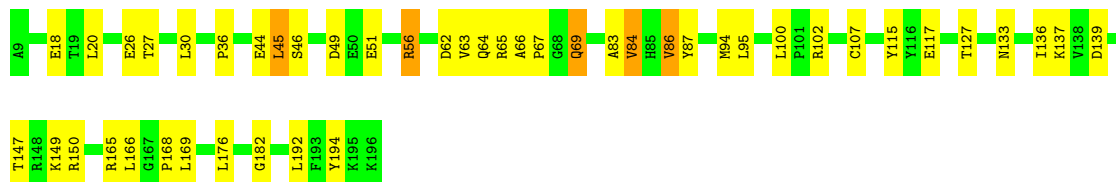
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	29	Total	O	0	0
			29	29		

### 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: Ephrin type-B receptor 4

Chain A: 



- Molecule 2: Ephrin-B2

Chain B: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 41	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	81.08Å 81.08Å 50.95Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.05 20.00 – 2.05	Depositor EDS
% Data completeness (in resolution range)	99.6 (20.00-2.05) 99.6 (20.00-2.05)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	9.89 (at 2.06Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.226 , 0.295 0.226 , 0.292	Depositor DCC
$R_{free}$ test set	1064 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	43.0	Xtriage
Anisotropy	0.089	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 48.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.39$ , $\langle L^2 \rangle = 0.21$	Xtriage
Estimated twinning fraction	0.095 for h,-k,-l	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	2564	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.98% 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	1.12	0/1523	1.08	5/2073 (0.2%)
2	B	0.97	0/1048	0.99	0/1426
All	All	1.06	0/2571	1.05	5/3499 (0.1%)

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
2	B	0	1

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
1	A	56	ARG	NE-CZ-NH2	-6.92	112.97	119.20
1	A	63	VAL	N-CA-C	6.33	119.92	111.44
1	A	84	VAL	N-CA-C	-5.28	107.27	111.81
1	A	66	ALA	CA-C-N	5.05	126.16	119.84
1	A	66	ALA	C-N-CA	5.05	126.16	119.84

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	B	154	GLY	Peptide

## 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	1479	0	1402	44	0
2	B	1006	0	925	36	0
3	A	50	0	0	2	0
3	B	29	0	0	1	0
All	All	2564	0	2327	71	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 15.

All (71) 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:56:ARG:HH22	2:B:114:THR:CG2	1.93	0.81
2:B:71:LYS:O	2:B:72:THR:HG23	1.81	0.79
1:A:56:ARG:HH22	2:B:114:THR:HG23	1.47	0.78
1:A:20:LEU:HD11	1:A:86:VAL:HG22	1.68	0.76
2:B:62:ASP:OD2	2:B:114:THR:HB	1.86	0.76
1:A:95:LEU:HD13	1:A:147:THR:O	1.86	0.75
1:A:62:ASP:OD1	1:A:65:ARG:HB2	1.90	0.72
1:A:127:THR:OG1	3:A:221:HOH:O	2.07	0.72
1:A:56:ARG:NH2	2:B:114:THR:HG23	2.06	0.70
1:A:95:LEU:HB3	1:A:100:LEU:HD21	1.71	0.70
1:A:95:LEU:HD11	1:A:149:LYS:HG3	1.74	0.70
2:B:78:TYR:CE2	2:B:145:LEU:HD13	2.28	0.68
1:A:20:LEU:CD1	1:A:86:VAL:HG22	2.24	0.67
1:A:83:ALA:HB2	1:A:194:TYR:CD1	2.30	0.66
1:A:166:LEU:HD23	1:A:169:LEU:HD11	1.79	0.65
1:A:20:LEU:HD11	1:A:86:VAL:CG2	2.28	0.64
1:A:115:TYR:HB3	1:A:166:LEU:HD11	1.80	0.63
2:B:36:ILE:HD11	2:B:53:LEU:HD11	1.81	0.62
2:B:36:ILE:HD13	2:B:163:ILE:HD13	1.80	0.62
1:A:20:LEU:CD1	1:A:86:VAL:CG2	2.79	0.61
2:B:45:PHE:CD2	2:B:161:MET:HE2	2.37	0.60
1:A:26:GLU:OE1	1:A:30:LEU:HD23	2.02	0.59
1:A:166:LEU:CD2	1:A:169:LEU:HD11	2.33	0.59

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:105:ALA:HB2	2:B:148:LEU:HD21	1.87	0.57
2:B:64:ILE:HD12	2:B:64:ILE:N	2.19	0.57
1:A:44:GLU:OE2	1:A:56:ARG:HD2	2.06	0.55
1:A:51[A]:GLU:HA	1:A:51[A]:GLU:OE1	2.06	0.55
2:B:35:PRO:HB3	2:B:64:ILE:HD11	1.89	0.55
1:A:115:TYR:CE2	1:A:136:ILE:HD12	2.42	0.54
2:B:55:PRO:HG2	2:B:167:VAL:HG22	1.90	0.54
2:B:78:TYR:CD2	2:B:145:LEU:HD13	2.43	0.54
2:B:35:PRO:HB3	2:B:64:ILE:CD1	2.38	0.54
2:B:81:VAL:HG21	2:B:102:LEU:HD12	1.90	0.54
1:A:49:ASP:HB2	3:A:202:HOH:O	2.09	0.52
2:B:82:TYR:CE2	2:B:100:PRO:HB3	2.45	0.52
1:A:95:LEU:CB	1:A:100:LEU:HD21	2.39	0.50
1:A:56:ARG:HH12	2:B:114:THR:CG2	2.25	0.49
2:B:36:ILE:HG21	2:B:163:ILE:HD11	1.95	0.48
1:A:115:TYR:CB	1:A:166:LEU:HD11	2.43	0.48
1:A:176:LEU:HD22	1:A:192:LEU:HD21	1.94	0.48
1:A:45:LEU:HD12	1:A:45:LEU:N	2.29	0.48
1:A:117:GLU:CD	1:A:169:LEU:HD23	2.38	0.48
2:B:88:GLN:HG3	2:B:93:THR:O	2.14	0.48
1:A:44:GLU:OE2	1:A:56:ARG:CD	2.62	0.47
1:A:83:ALA:HB2	1:A:194:TYR:CG	2.48	0.47
1:A:115:TYR:CZ	1:A:136:ILE:HD12	2.51	0.46
2:B:83:MET:HE1	2:B:129:PHE:CE2	2.51	0.46
1:A:44:GLU:O	2:B:60:LYS:NZ	2.31	0.45
2:B:73:VAL:HG12	2:B:75:GLN:CB	2.46	0.44
1:A:56:ARG:HH12	2:B:114:THR:HG21	1.81	0.44
1:A:56:ARG:CZ	2:B:114:THR:HG23	2.47	0.44
2:B:63:ILE:HG22	2:B:102:LEU:HD11	2.00	0.44
1:A:62:ASP:OD1	1:A:65:ARG:HD2	2.17	0.44
1:A:46:SER:HB3	2:B:113:PHE:CE1	2.52	0.43
1:A:26:GLU:OE1	1:A:30:LEU:CD2	2.65	0.43
1:A:56:ARG:HH22	2:B:114:THR:HG22	1.81	0.43
1:A:115:TYR:CG	1:A:166:LEU:HD11	2.53	0.43
2:B:142:ASN:O	2:B:142:ASN:ND2	2.51	0.43
1:A:94:MET:HB2	1:A:94:MET:HE2	1.88	0.43
1:A:107:CYS:HA	1:A:182:GLY:O	2.19	0.43
2:B:39[A]:ASN:OD1	2:B:41:SER:OG	2.19	0.42
1:A:64:GLN:CB	1:A:102:ARG:O	2.66	0.42
2:B:147:GLY:O	2:B:148:LEU:C	2.63	0.42
2:B:39[B]:ASN:ND2	3:B:187:HOH:O	2.53	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:87:TYR:CZ	1:A:165:ARG:CZ	3.03	0.41
1:A:84:VAL:HG13	1:A:168:PRO:HB3	2.02	0.41
2:B:81:VAL:CG2	2:B:102:LEU:HD12	2.50	0.41
2:B:36:ILE:HD13	2:B:163:ILE:CD1	2.50	0.41
1:A:36:PRO:HG3	1:A:69:GLN:NE2	2.37	0.40

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	187/188 (100%)	174 (93%)	11 (6%)	2 (1%)	11	5
2	B	130/138 (94%)	117 (90%)	12 (9%)	1 (1%)	16	9
All	All	317/326 (97%)	291 (92%)	23 (7%)	3 (1%)	12	7

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	67	PRO
2	B	155	VAL
1	A	133	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	150/157 (96%)	142 (95%)	8 (5%)	20	13
2	B	105/125 (84%)	91 (87%)	14 (13%)	4	1
All	All	255/282 (90%)	233 (91%)	22 (9%)	9	4

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	18	GLU
1	A	27	THR
1	A	45	LEU
1	A	69	GLN
1	A	86	VAL
1	A	137	LYS
1	A	139	ASP
1	A	150	ARG
2	B	31	ILE
2	B	33	LEU
2	B	51	LEU
2	B	110	ASP
2	B	114	THR
2	B	119	GLU
2	B	130	GLN
2	B	142	ASN
2	B	146	GLU
2	B	149	ASP
2	B	152	GLU
2	B	158	THR
2	B	161	MET
2	B	163	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	145	HIS
2	B	56	GLN
2	B	151	GLN

### 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 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, 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	188/188 (100%)	-0.81	0 <a href="#">100</a> <a href="#">100</a>	34, 56, 74, 82	3 (1%)
2	B	133/138 (96%)	-0.86	0 <a href="#">100</a> <a href="#">100</a>	28, 53, 71, 83	3 (2%)
All	All	321/326 (98%)	-0.83	0 <a href="#">100</a> <a href="#">100</a>	28, 55, 73, 83	6 (1%)

There are no RSRZ outliers to report.

### 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 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.