Full wwPDB X-ray Structure Validation Report (i)

Nov 1, 2021 – 11:57 PM EDT

PDB ID	:	3AEH
Title	:	Integral membrane domain of autotransporter Hbp
Authors	:	Tajima, N.; Park, S.-Y.; Tame, J.R.H.
Deposited on	:	2010-02-04
Resolution	:	2.00 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*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

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

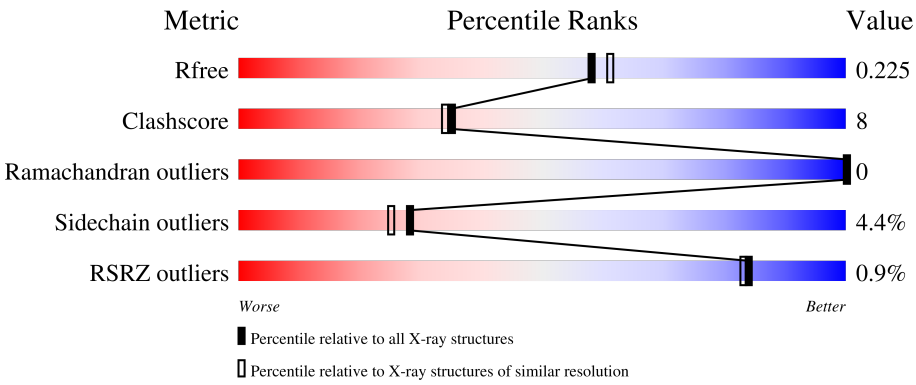
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.23.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.23.2

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (2.00-2.00)

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 <=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	308	% 75% 13% • • 10%
1	B	308	% 77% 11% • 10%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 4602 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 Hemoglobin-binding protease hbp autotransporter.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	277	2160	1349	383	421	7	4	1	0
1	B	277	2160	1349	383	421	7	0	1	0

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1072	GLY	-	expression tag	UNP O88093
A	1073	THR	-	expression tag	UNP O88093
A	1074	MET	-	expression tag	UNP O88093
A	1378	LEU	-	expression tag	UNP O88093
A	1379	GLU	-	expression tag	UNP O88093
A	1100	ASP	ASN	engineered mutation	UNP O88093
B	1072	GLY	-	expression tag	UNP O88093
B	1073	THR	-	expression tag	UNP O88093
B	1074	MET	-	expression tag	UNP O88093
B	1378	LEU	-	expression tag	UNP O88093
B	1379	GLU	-	expression tag	UNP O88093
B	1100	ASP	ASN	engineered mutation	UNP O88093

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
2	A	143	143	143	0	0
2	B	139	139	139	0	0

3 Residue-property plots (i)

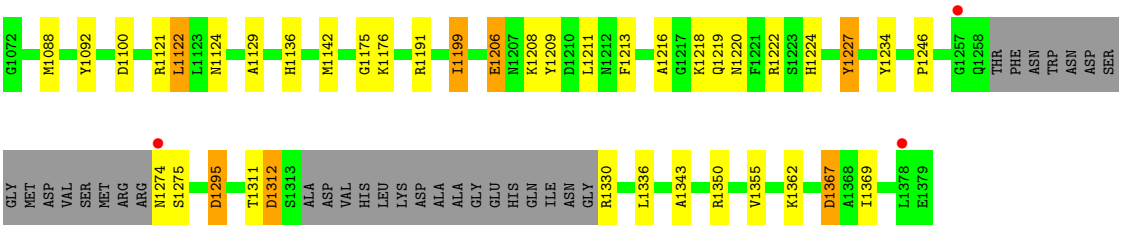
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density.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

Chain A:

• Molecule 1: Hemoglobin-binding protease hbp autotransporter

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	73.01Å 68.89Å 78.38Å 90.00° 117.75° 90.00°	Depositor
Resolution (Å)	48.88 – 2.00 48.88 – 2.00	Depositor EDS
% Data completeness (in resolution range)	96.7 (48.88-2.00) 96.7 (48.88-2.00)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	5.43 (at 2.00Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.175 , 0.222 0.177 , 0.225	Depositor DCC
R_{free} test set	2280 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å^2)	19.9	Xtriage
Anisotropy	0.366	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 40.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	0.478 for h,-k,-h-l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	4602	wwPDB-VP
Average B, all atoms (Å^2)	23.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 12.36% of the height of the origin peak. No significant pseudotranslation is detected.*

[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ 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	1.22	4/2207 (0.2%)	1.07	9/2972 (0.3%)
1	B	1.21	2/2207 (0.1%)	1.05	7/2972 (0.2%)
All	All	1.22	6/4414 (0.1%)	1.06	16/5944 (0.3%)

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	1

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1331	LYS	CB-CG	7.95	1.74	1.52
1	A	1296	TRP	CG-CD1	5.94	1.45	1.36
1	B	1092	TYR	CD1-CE1	5.71	1.48	1.39
1	A	1156	PHE	CE1-CZ	5.69	1.48	1.37
1	B	1343	ALA	CA-CB	5.29	1.63	1.52
1	A	1227	TYR	CD1-CE1	5.28	1.47	1.39

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	1110	ARG	NE-CZ-NH1	9.27	124.93	120.30
1	A	1110	ARG	NE-CZ-NH2	-9.06	115.77	120.30
1	B	1199	ILE	CG1-CB-CG2	-6.99	96.03	111.40
1	A	1122	LEU	CB-CG-CD2	6.83	122.61	111.00
1	B	1295	ASP	CB-CG-OD1	6.73	124.36	118.30
1	B	1121	ARG	NE-CZ-NH1	-6.28	117.16	120.30
1	B	1336	LEU	CB-CG-CD1	-6.01	100.79	111.00
1	A	1336	LEU	CB-CG-CD1	-5.70	101.32	111.00

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	1355	VAL	CG1-CB-CG2	-5.54	102.03	110.90
1	A	1105	ARG	NE-CZ-NH1	5.46	123.03	120.30
1	A	1135	ASP	CB-CG-OD2	5.35	123.12	118.30
1	B	1295	ASP	CB-CG-OD2	-5.32	113.52	118.30
1	A	1293	GLY	N-CA-C	-5.21	100.06	113.10
1	B	1350	ARG	NE-CZ-NH2	-5.13	117.73	120.30
1	A	1121	ARG	NE-CZ-NH1	-5.08	117.76	120.30
1	A	1222	ARG	NE-CZ-NH2	-5.07	117.77	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	1274	ASN	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	2160	0	2040	49	0
1	B	2160	0	2040	29	0
2	A	143	0	0	7	0
2	B	139	0	0	5	1
All	All	4602	0	4080	69	1

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.

All (69) 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:1199:ILE:HD11	1:B:1227:TYR:CE2	1.71	1.24
1:A:1122:LEU:HD13	1:B:1369:ILE:HD11	1.19	1.17
1:B:1199:ILE:HD11	1:B:1227:TYR:HE2	0.92	1.08
1:A:1134:THR:HG22	2:A:113:HOH:O	1.55	1.06

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:1191:ARG:HH11	1:A:1191:ARG:HG3	1.24	1.01
1:B:1199:ILE:CD1	1:B:1227:TYR:CE2	2.50	0.95
1:A:1191:ARG:HH11	1:A:1191:ARG:CG	1.80	0.94
1:B:1295:ASP:OD1	2:B:258:HOH:O	1.85	0.94
1:A:1122:LEU:HD13	1:B:1369:ILE:CD1	1.96	0.93
1:B:1312:ASP:HB2	2:B:195:HOH:O	1.79	0.82
1:A:1160:MET:HE2	1:A:1185:TYR:CD1	2.18	0.78
1:A:1136:HIS:ND1	1:B:1136:HIS:ND1	2.34	0.75
1:A:1160:MET:HE2	1:A:1185:TYR:HD1	1.51	0.75
1:B:1208:LYS:HE3	1:B:1220:ASN:OD1	1.93	0.69
1:A:1159:VAL:HG12	1:A:1184:PHE:CD1	2.29	0.68
1:A:1167:ASP:OD1	1:A:1176:LYS:HE3	1.96	0.66
1:A:1367:ASP:OD2	1:B:1124[A]:ASN:ND2	2.29	0.66
1:A:1160:MET:HE1	1:A:1199:ILE:HD12	1.78	0.65
1:A:1351:LEU:HD13	1:A:1373:ILE:CD1	2.26	0.65
1:A:1176:LYS:HD3	2:A:95:HOH:O	1.98	0.64
1:A:1159:VAL:HG12	1:A:1184:PHE:CE1	2.34	0.63
1:B:1208:LYS:HG2	1:B:1220:ASN:OD1	2.01	0.61
1:B:1362:LYS:HG3	2:B:172:HOH:O	2.00	0.60
1:A:1191:ARG:CG	1:A:1191:ARG:NH1	2.49	0.59
1:B:1216:ALA:O	1:B:1219:GLN:NE2	2.36	0.58
1:A:1176:LYS:CE	2:A:95:HOH:O	2.51	0.58
1:B:1206:GLU:OE1	1:B:1222:ARG:NE	2.37	0.58
1:A:1362:LYS:HG3	2:A:40:HOH:O	2.04	0.58
1:A:1362:LYS:NZ	1:A:1362:LYS:HB3	2.20	0.56
1:A:1362:LYS:NZ	1:A:1362:LYS:CB	2.68	0.56
1:B:1274:ASN:CG	1:B:1275:SER:H	2.09	0.56
1:A:1124[B]:ASN:HB2	1:B:1369:ILE:HD12	1.91	0.53
1:B:1199:ILE:CD1	1:B:1227:TYR:CD2	2.93	0.52
1:A:1362:LYS:CB	1:A:1362:LYS:HZ2	2.23	0.51
1:B:1311:THR:HG1	1:B:1330:ARG:N	2.09	0.51
1:A:1357:ARG:CB	1:A:1357:ARG:HH11	2.24	0.50
1:A:1274:ASN:OD1	1:A:1274:ASN:O	2.29	0.50
1:B:1175:GLY:HA3	1:B:1209:TYR:CD1	2.47	0.50
1:A:1124[A]:ASN:ND2	1:B:1367:ASP:OD1	2.44	0.50
1:A:1160:MET:CE	1:A:1199:ILE:HD12	2.42	0.50
1:A:1206:GLU:OE2	1:A:1222:ARG:HD3	2.11	0.50
1:A:1092:TYR:CE1	1:A:1311:THR:HA	2.47	0.50
1:A:1122:LEU:CD1	1:B:1369:ILE:CD1	2.82	0.50
1:A:1160:MET:CE	1:A:1199:ILE:CD1	2.90	0.49
1:A:1167:ASP:OD1	1:A:1176:LYS:HG2	2.12	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:1191:ARG:HG3	1:A:1191:ARG:NH1	2.05	0.49
1:A:1136:HIS:CE1	1:B:1136:HIS:HD1	2.30	0.49
1:A:1234:TYR:O	1:A:1246:PRO:HD2	2.13	0.48
1:B:1211:LEU:HB3	1:B:1213:PHE:CE1	2.49	0.48
1:A:1176:LYS:CD	2:A:95:HOH:O	2.59	0.48
1:A:1362:LYS:HB3	1:A:1362:LYS:HZ3	1.81	0.46
1:A:1122:LEU:HD22	1:A:1139:LEU:O	2.16	0.45
1:A:1355:VAL:HG11	1:B:1122:LEU:CD2	2.46	0.45
1:A:1160:MET:CE	1:A:1185:TYR:HD1	2.25	0.45
1:A:1241:THR:OG1	1:A:1289:LYS:NZ	2.45	0.45
1:A:1357:ARG:HG2	1:A:1358:SER:N	2.33	0.43
1:A:1129:ALA:HA	1:A:1362:LYS:O	2.19	0.43
1:A:1136:HIS:HB2	2:B:4:HOH:O	2.18	0.43
1:A:1160:MET:HE1	1:A:1199:ILE:CD1	2.46	0.43
1:A:1211:LEU:HD22	1:A:1219:GLN:HG3	2.00	0.43
1:A:1357:ARG:HB2	1:A:1357:ARG:NH1	2.34	0.43
1:A:1176:LYS:HE3	2:A:95:HOH:O	2.15	0.42
1:A:1357:ARG:HH11	1:A:1357:ARG:HB2	1.83	0.42
1:B:1129:ALA:HA	1:B:1362:LYS:O	2.19	0.42
1:B:1234:TYR:O	1:B:1246:PRO:HD2	2.19	0.42
1:B:1176:LYS:HE3	1:B:1176:LYS:HB3	1.83	0.41
1:B:1100:ASP:OD1	1:B:1100:ASP:C	2.59	0.41
1:A:1362:LYS:CG	2:A:40:HOH:O	2.65	0.41
1:B:1191:ARG:HD2	2:B:269:HOH:O	2.22	0.40

All (1) 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)
2:B:243:HOH:O	2:B:266:HOH:O[2_545]	2.18	0.02

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	272/308 (88%)	267 (98%)	5 (2%)	0	100	100
1	B	272/308 (88%)	270 (99%)	2 (1%)	0	100	100
All	All	544/616 (88%)	537 (99%)	7 (1%)	0	100	100

There are no Ramachandran outliers to report.

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	219/243 (90%)	209 (95%)	10 (5%)	27	23
1	B	219/243 (90%)	210 (96%)	9 (4%)	30	28
All	All	438/486 (90%)	419 (96%)	19 (4%)	28	26

All (19) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1096	ILE
1	A	1122	LEU
1	A	1191	ARG
1	A	1206	GLU
1	A	1222	ARG
1	A	1224	HIS
1	A	1227	TYR
1	A	1330	ARG
1	A	1367	ASP
1	A	1379	GLU
1	B	1088	MET
1	B	1122	LEU
1	B	1142	MET
1	B	1206	GLU
1	B	1218	LYS
1	B	1224	HIS

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Mol	Chain	Res	Type
1	B	1227	TYR
1	B	1312	ASP
1	B	1367	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	1256	GLN

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 monosaccharides 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	277/308 (89%)	-0.40	2 (0%)	87	87	13, 20, 42, 58	2 (0%)
1	B	277/308 (89%)	-0.37	3 (1%)	80	79	13, 20, 44, 55	1 (0%)
All	All	554/616 (89%)	-0.38	5 (0%)	84	83	13, 20, 43, 58	3 (0%)

All (5) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	1257	GLY	3.0
1	A	1214	ALA	2.4
1	B	1378	LEU	2.2
1	A	1087	PHE	2.2
1	B	1274	ASN	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 monosaccharides 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.