



Full wwPDB X-ray Structure Validation Report ⓘ

Jun 17, 2024 – 11:31 AM EDT

PDB ID : 3HV1
Title : Crystal structure of a polar amino acid ABC uptake transporter substrate binding protein from *Streptococcus thermophilus*
Authors : Palani, K.; Burley, S.K.; Swaminathan, S.; New York SGX Research Center for Structural Genomics (NYSGXRC)
Deposited on : 2009-06-15
Resolution : 1.90 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 ⓘ 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 : 4.02b-467
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 1.20.1
EDS : 2.37.1
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) : 2.37.1

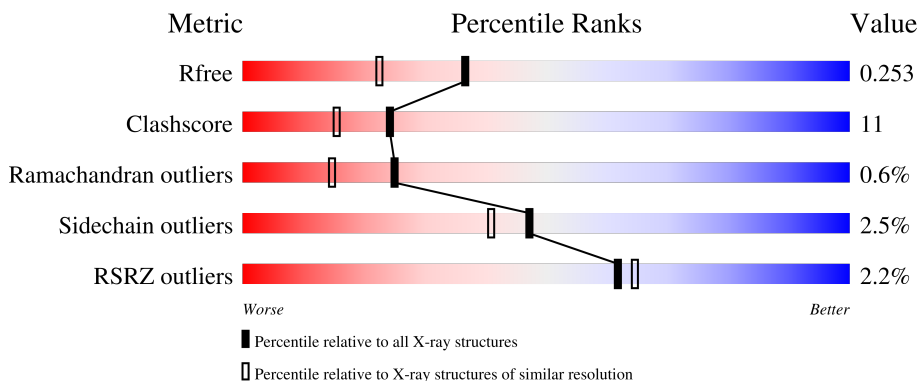
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION


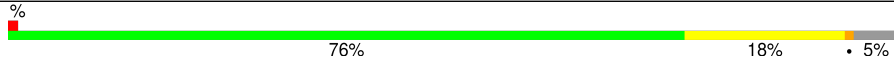
The reported resolution of this entry is 1.90 Å.

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	6207 (1.90-1.90)
Clashscore	141614	6847 (1.90-1.90)
Ramachandran outliers	138981	6760 (1.90-1.90)
Sidechain outliers	138945	6760 (1.90-1.90)
RSRZ outliers	127900	6082 (1.90-1.90)

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	268	
1	B	268	

2 Entry composition i

There are 2 unique types of molecules in this entry. The entry contains 4391 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 Polar amino acid ABC uptake transporter substrate binding protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	Se			
1	A	264	2099	1335	351	408	5	0	0	0
1	B	254	2011	1284	326	396	5	0	0	0

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	24	MSE	-	expression tag	UNP Q5M4P7
A	25	SER	-	expression tag	UNP Q5M4P7
A	26	LEU	-	expression tag	UNP Q5M4P7
A	284	GLU	-	expression tag	UNP Q5M4P7
A	285	GLY	-	expression tag	UNP Q5M4P7
A	286	HIS	-	expression tag	UNP Q5M4P7
A	287	HIS	-	expression tag	UNP Q5M4P7
A	288	HIS	-	expression tag	UNP Q5M4P7
A	289	HIS	-	expression tag	UNP Q5M4P7
A	290	HIS	-	expression tag	UNP Q5M4P7
A	291	HIS	-	expression tag	UNP Q5M4P7
B	24	MSE	-	expression tag	UNP Q5M4P7
B	25	SER	-	expression tag	UNP Q5M4P7
B	26	LEU	-	expression tag	UNP Q5M4P7
B	288	GLU	-	expression tag	UNP Q5M4P7
B	289	GLY	-	expression tag	UNP Q5M4P7
B	290	HIS	-	expression tag	UNP Q5M4P7
B	291	HIS	-	expression tag	UNP Q5M4P7
B	292	HIS	-	expression tag	UNP Q5M4P7
B	293	HIS	-	expression tag	UNP Q5M4P7
B	294	HIS	-	expression tag	UNP Q5M4P7
B	295	HIS	-	expression tag	UNP Q5M4P7

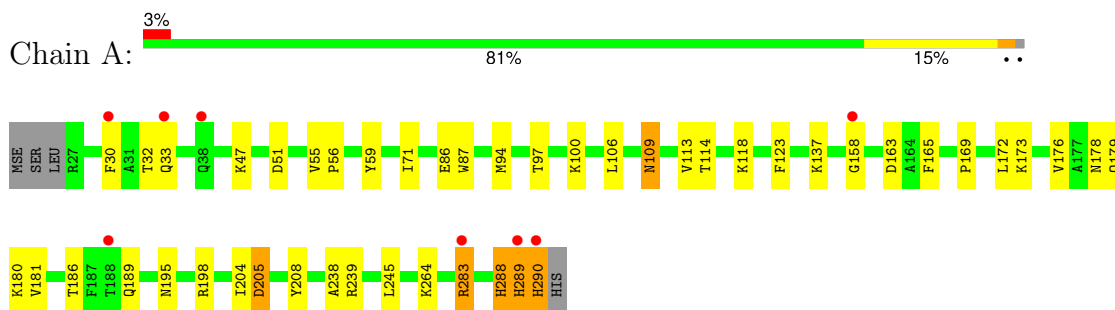
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	168	Total 168	O 168	0	0
2	B	113	Total 113	O 113	0	0

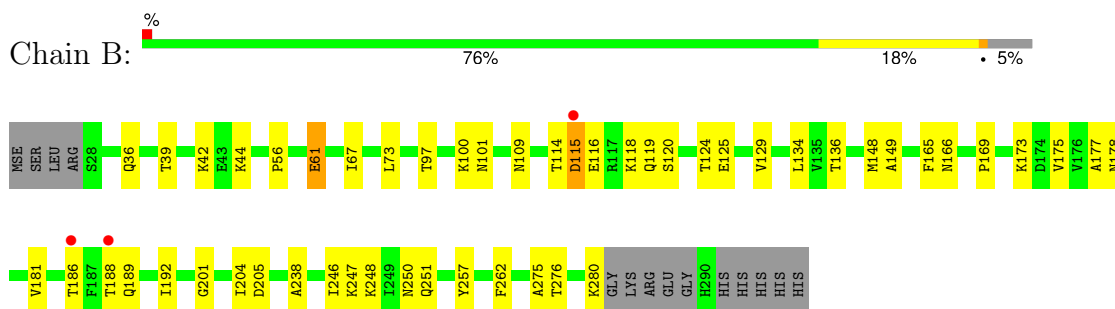
3 Residue-property plots [i](#)

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: Polar amino acid ABC uptake transporter substrate binding protein



- Molecule 1: Polar amino acid ABC uptake transporter substrate binding protein



4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	47.56Å 78.56Å 80.03Å 90.00° 105.41° 90.00°	Depositor
Resolution (Å)	45.02 – 1.90 45.02 – 1.90	Depositor EDS
% Data completeness (in resolution range)	95.6 (45.02-1.90) 95.4 (45.02-1.90)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.81 (at 1.89Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.222 , 0.254 0.222 , 0.253	Depositor DCC
R_{free} test set	2133 reflections (4.82%)	wwPDB-VP
Wilson B-factor (Å ²)	26.8	Xtrriage
Anisotropy	0.395	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 49.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	0.025 for h,-k,-h-l	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	4391	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.91% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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	0.35	0/2139	0.60	0/2876
1	B	0.33	0/2046	0.59	0/2752
All	All	0.34	0/4185	0.59	0/5628

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 [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	2099	0	2037	43	0
1	B	2011	0	1957	46	0
2	A	168	0	0	3	0
2	B	113	0	0	1	0
All	All	4391	0	3994	89	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 11.

All (89) 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:134:LEU:HD11	1:B:148:MSE:HE3	1.39	1.00

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:47:LYS:HE2	1:A:86:GLU:HG2	1.65	0.79
1:B:125:GLU:H	1:B:250:ASN:HD21	1.33	0.76
1:A:186:THR:OG1	1:A:189:GLN:HG3	1.88	0.74
1:A:178:ASN:O	1:A:180:LYS:HG2	1.90	0.72
1:B:165:PHE:CE2	1:B:173:LYS:HG2	2.25	0.72
1:A:283:ARG:HH11	1:A:283:ARG:HA	1.53	0.71
1:B:100:LYS:HD2	1:B:120:SER:HB3	1.75	0.68
1:B:165:PHE:CZ	1:B:173:LYS:HG2	2.29	0.67
1:B:114:THR:HG22	1:B:116:GLU:H	1.58	0.67
1:A:179:GLN:O	1:A:180:LYS:HD3	1.95	0.66
1:B:165:PHE:O	1:B:173:LYS:HG3	1.94	0.66
1:B:136:THR:HG22	1:B:148:MSE:CE	2.27	0.63
1:B:115:ASP:HA	1:B:118:LYS:HD3	1.79	0.63
1:A:106:LEU:HD21	1:A:245:LEU:HD21	1.81	0.62
1:A:32:THR:HG23	1:A:239:ARG:CD	2.29	0.62
1:A:264:LYS:HB3	1:A:264:LYS:NZ	2.14	0.61
1:A:32:THR:HG23	1:A:239:ARG:HD3	1.82	0.60
1:B:136:THR:HG21	1:B:148:MSE:HE2	1.83	0.60
1:B:125:GLU:H	1:B:250:ASN:ND2	2.01	0.59
1:B:165:PHE:CZ	1:B:181:VAL:HG13	2.38	0.58
1:A:51:ASP:HB3	1:A:109:ASN:ND2	2.19	0.57
1:B:166:ASN:HA	1:B:173:LYS:HD2	1.86	0.57
1:B:136:THR:CG2	1:B:148:MSE:CE	2.81	0.57
1:A:169:PRO:HA	1:A:173:LYS:HB3	1.85	0.57
1:B:136:THR:HG22	1:B:148:MSE:HE1	1.85	0.57
1:A:288:HIS:O	1:A:289:HIS:C	2.43	0.57
1:B:136:THR:CG2	1:B:148:MSE:HE2	2.35	0.56
1:B:149:ALA:HA	1:B:175:VAL:HG12	1.88	0.56
1:B:97:THR:HG22	1:B:101:ASN:ND2	2.21	0.55
1:B:148:MSE:CE	1:B:201:GLY:HA3	2.36	0.55
1:A:51:ASP:H	1:A:109:ASN:ND2	2.05	0.55
1:A:165:PHE:CZ	1:A:173:LYS:HA	2.42	0.54
1:A:51:ASP:HB3	1:A:109:ASN:HD21	1.73	0.54
1:A:288:HIS:O	1:A:288:HIS:ND1	2.38	0.54
1:A:283:ARG:HH11	1:A:283:ARG:CA	2.18	0.54
1:A:137:LYS:HD3	1:A:195:ASN:HA	1.89	0.54
1:B:44:LYS:HD3	2:B:403:HOH:O	2.08	0.53
1:B:188:THR:O	1:B:192:ILE:HG12	2.08	0.53
1:A:283:ARG:HG2	2:A:400:HOH:O	2.08	0.53
1:B:114:THR:O	1:B:118:LYS:HG3	2.08	0.53
1:B:204:ILE:HG13	1:B:205:ASP:N	2.24	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:165:PHE:CZ	1:A:181:VAL:HG13	2.45	0.52
1:B:42:LYS:HB2	1:B:42:LYS:NZ	2.24	0.52
1:A:204:ILE:HG13	1:A:205:ASP:N	2.25	0.52
1:B:165:PHE:CE2	1:B:181:VAL:HG13	2.45	0.52
1:B:247:LYS:O	1:B:251:GLN:HG3	2.10	0.51
1:A:113:VAL:HG22	1:A:123:PHE:CG	2.45	0.51
1:A:288:HIS:O	1:A:290:HIS:N	2.43	0.51
1:B:238:ALA:HB3	1:B:246:ILE:HD11	1.90	0.51
1:B:148:MSE:HE1	1:B:201:GLY:HA3	1.92	0.51
1:A:205:ASP:HB2	1:A:208:TYR:CD2	2.47	0.50
1:A:32:THR:HG21	1:A:100:LYS:O	2.12	0.50
1:A:47:LYS:HE2	1:A:86:GLU:CG	2.41	0.50
1:B:97:THR:HG22	1:B:101:ASN:HD21	1.76	0.49
1:A:71:ILE:HA	1:A:87:TRP:CZ2	2.48	0.48
1:A:106:LEU:CD2	1:A:238:ALA:HB2	2.43	0.48
1:A:283:ARG:HA	1:A:283:ARG:NH1	2.24	0.48
1:A:113:VAL:HG22	1:A:123:PHE:CD2	2.48	0.48
1:B:186:THR:OG1	1:B:189:GLN:HG2	2.13	0.48
1:A:165:PHE:CE2	1:A:181:VAL:HG13	2.50	0.47
1:A:290:HIS:HB3	2:A:337:HOH:O	2.14	0.47
1:A:55:VAL:HA	1:A:59:TYR:CD2	2.50	0.47
1:B:116:GLU:O	1:B:119:GLN:HB2	2.14	0.47
1:B:257:TYR:CZ	1:B:280:LYS:HG2	2.50	0.46
1:A:114:THR:O	1:A:118:LYS:HG3	2.15	0.46
1:B:204:ILE:HG13	1:B:205:ASP:H	1.80	0.46
1:A:94:MSE:HE3	1:A:97:THR:HB	1.97	0.46
1:A:106:LEU:HD23	1:A:238:ALA:HB2	1.97	0.45
1:B:124:THR:HB	1:B:250:ASN:ND2	2.30	0.45
1:B:124:THR:HB	1:B:250:ASN:HD21	1.81	0.45
1:B:61:GLU:HG2	1:B:67:ILE:HD11	1.99	0.45
1:B:262:PHE:CE2	1:B:275:ALA:HB2	2.52	0.45
1:B:169:PRO:HA	1:B:173:LYS:HB2	1.99	0.45
1:A:30:PHE:O	1:A:33:GLN:HB2	2.18	0.44
1:A:289:HIS:CG	1:A:289:HIS:O	2.70	0.43
1:A:172:LEU:O	1:A:176:VAL:HG13	2.19	0.43
1:A:158:GLY:HA2	2:A:434:HOH:O	2.19	0.42
1:A:264:LYS:HB3	1:A:264:LYS:HZ2	1.84	0.42
1:B:129:VAL:HG23	1:B:276:THR:HG22	2.01	0.42
1:B:248:LYS:HA	1:B:248:LYS:HD3	1.91	0.42
1:B:100:LYS:HD2	1:B:120:SER:CB	2.48	0.41
1:B:114:THR:HG22	1:B:116:GLU:N	2.30	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:166:ASN:HD22	1:B:173:LYS:HD2	1.85	0.41
1:B:177:ALA:O	1:B:178:ASN:HB2	2.21	0.41
1:B:36:GLN:O	1:B:39:THR:HB	2.21	0.41
1:B:148:MSE:HE1	1:B:201:GLY:CA	2.51	0.41
1:A:32:THR:HG23	1:A:239:ARG:HD2	2.01	0.40
1:A:47:LYS:CE	1:A:86:GLU:HG2	2.44	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	262/268 (98%)	254 (97%)	6 (2%)	2 (1%)	19	9
1	B	251/268 (94%)	243 (97%)	7 (3%)	1 (0%)	34	24
All	All	513/536 (96%)	497 (97%)	13 (2%)	3 (1%)	25	15

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	289	HIS
1	A	109	ASN
1	B	109	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	221/219 (101%)	214 (97%)	7 (3%)	39	30
1	B	213/219 (97%)	209 (98%)	4 (2%)	57	53
All	All	434/438 (99%)	423 (98%)	11 (2%)	47	41

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	56	PRO
1	A	163	ASP
1	A	198	ARG
1	A	205	ASP
1	A	283	ARG
1	A	288	HIS
1	A	290	HIS
1	B	56	PRO
1	B	61	GLU
1	B	73	LEU
1	B	115	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	109	ASN
1	A	178	ASN
1	A	210	ASN
1	A	223	ASN
1	A	290	HIS
1	B	101	ASN
1	B	166	ASN
1	B	250	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 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	259/268 (96%)	-0.01	8 (3%) 49 51	14, 27, 49, 63	0
1	B	249/268 (92%)	0.01	3 (1%) 79 81	19, 34, 49, 56	0
All	All	508/536 (94%)	0.00	11 (2%) 62 64	14, 31, 49, 63	0

All (11) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	289	HIS	7.2
1	B	186	THR	3.2
1	A	30	PHE	2.9
1	A	158	GLY	2.8
1	A	33	GLN	2.4
1	A	290	HIS	2.4
1	A	283	ARG	2.1
1	A	188	THR	2.1
1	A	38	GLN	2.1
1	B	115	ASP	2.1
1	B	188	THR	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

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.