



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 25, 2026 – 02:31 PM EDT

PDB ID : 5CEA / pdb_00005cea
Title : Bd3460 Immunity Protein from Bdellovibrio bacteriovorus
Authors : Lovering, A.L.; Cadby, I.T.; Lambert, C.; Sockett, R.E.
Deposited on : 2015-07-06
Resolution : 1.85 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 : 4-5-2 with Phenix2.0
Xtrriage (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

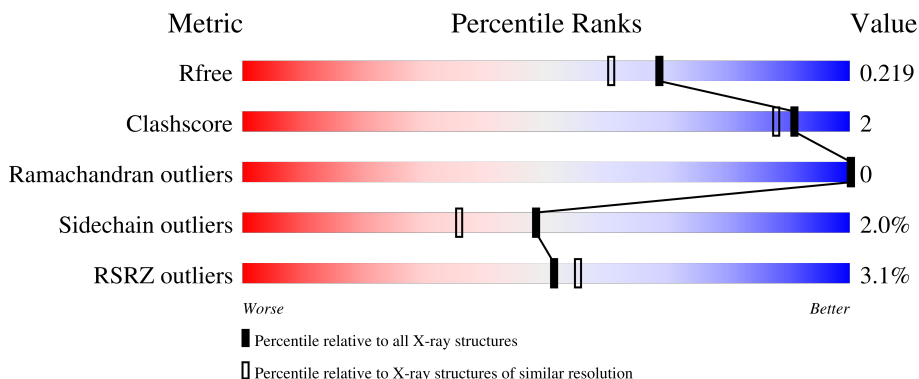
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

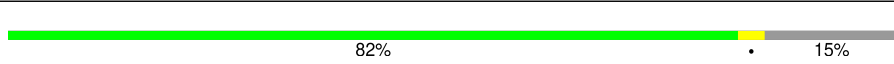
The reported resolution of this entry is 1.85 Å.

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	3428 (1.86-1.86)
Clashscore	190562	3579 (1.86-1.86)
Ramachandran outliers	187476	3553 (1.86-1.86)
Sidechain outliers	187428	3553 (1.86-1.86)
RSRZ outliers	180081	3429 (1.86-1.86)

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 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	230	
1	B	230	
1	C	230	
1	D	230	
1	E	230	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 7800 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 Bd3460.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	193	1430	890	248	288	4	0	0	0
1	D	193	1441	898	250	289	4	0	2	0
1	C	196	1459	910	253	292	4	0	1	0
1	B	195	1448	902	252	290	4	0	0	0
1	E	190	1411	879	244	284	4	0	0	0

There are 55 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	25	MET	ALA	engineered mutation	UNP Q6MHS9
A	221	LEU	-	expression tag	UNP Q6MHS9
A	222	GLU	-	expression tag	UNP Q6MHS9
A	223	HIS	-	expression tag	UNP Q6MHS9
A	224	HIS	-	expression tag	UNP Q6MHS9
A	225	HIS	-	expression tag	UNP Q6MHS9
A	226	HIS	-	expression tag	UNP Q6MHS9
A	227	HIS	-	expression tag	UNP Q6MHS9
A	228	HIS	-	expression tag	UNP Q6MHS9
A	229	HIS	-	expression tag	UNP Q6MHS9
A	230	HIS	-	expression tag	UNP Q6MHS9
D	25	MET	ALA	engineered mutation	UNP Q6MHS9
D	221	LEU	-	expression tag	UNP Q6MHS9
D	222	GLU	-	expression tag	UNP Q6MHS9
D	223	HIS	-	expression tag	UNP Q6MHS9
D	224	HIS	-	expression tag	UNP Q6MHS9
D	225	HIS	-	expression tag	UNP Q6MHS9
D	226	HIS	-	expression tag	UNP Q6MHS9
D	227	HIS	-	expression tag	UNP Q6MHS9

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Chain	Residue	Modelled	Actual	Comment	Reference
D	228	HIS	-	expression tag	UNP Q6MHS9
D	229	HIS	-	expression tag	UNP Q6MHS9
D	230	HIS	-	expression tag	UNP Q6MHS9
C	25	MET	ALA	engineered mutation	UNP Q6MHS9
C	221	LEU	-	expression tag	UNP Q6MHS9
C	222	GLU	-	expression tag	UNP Q6MHS9
C	223	HIS	-	expression tag	UNP Q6MHS9
C	224	HIS	-	expression tag	UNP Q6MHS9
C	225	HIS	-	expression tag	UNP Q6MHS9
C	226	HIS	-	expression tag	UNP Q6MHS9
C	227	HIS	-	expression tag	UNP Q6MHS9
C	228	HIS	-	expression tag	UNP Q6MHS9
C	229	HIS	-	expression tag	UNP Q6MHS9
C	230	HIS	-	expression tag	UNP Q6MHS9
B	25	MET	ALA	engineered mutation	UNP Q6MHS9
B	221	LEU	-	expression tag	UNP Q6MHS9
B	222	GLU	-	expression tag	UNP Q6MHS9
B	223	HIS	-	expression tag	UNP Q6MHS9
B	224	HIS	-	expression tag	UNP Q6MHS9
B	225	HIS	-	expression tag	UNP Q6MHS9
B	226	HIS	-	expression tag	UNP Q6MHS9
B	227	HIS	-	expression tag	UNP Q6MHS9
B	228	HIS	-	expression tag	UNP Q6MHS9
B	229	HIS	-	expression tag	UNP Q6MHS9
B	230	HIS	-	expression tag	UNP Q6MHS9
E	25	MET	ALA	engineered mutation	UNP Q6MHS9
E	221	LEU	-	expression tag	UNP Q6MHS9
E	222	GLU	-	expression tag	UNP Q6MHS9
E	223	HIS	-	expression tag	UNP Q6MHS9
E	224	HIS	-	expression tag	UNP Q6MHS9
E	225	HIS	-	expression tag	UNP Q6MHS9
E	226	HIS	-	expression tag	UNP Q6MHS9
E	227	HIS	-	expression tag	UNP Q6MHS9
E	228	HIS	-	expression tag	UNP Q6MHS9
E	229	HIS	-	expression tag	UNP Q6MHS9
E	230	HIS	-	expression tag	UNP Q6MHS9

- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	152	Total O 152 152	0	0

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	D	98	Total 98	O 98	0	0
2	C	159	Total 159	O 159	0	0
2	B	171	Total 171	O 171	0	0
2	E	31	Total 31	O 31	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.

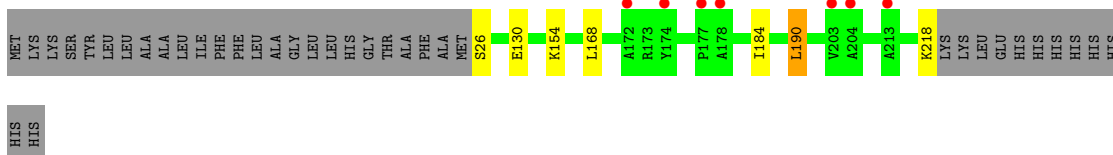
- Molecule 1: Bd3460

Chain A: 




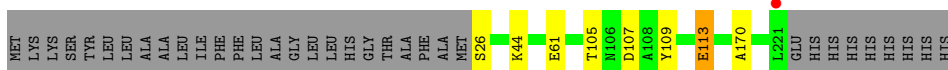
- Molecule 1: Bd3460

Chain D: 




- Molecule 1: Bd3460

Chain C: 




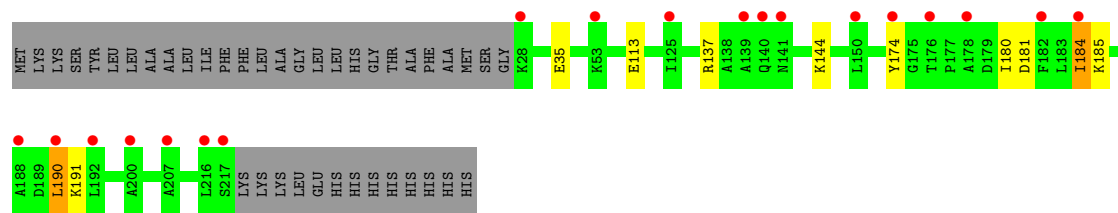
- Molecule 1: Bd3460

Chain B: 



- Molecule 1: Bd3460

Chain E: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	57.43Å 99.64Å 173.70Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	86.85 – 1.85 86.85 – 1.85	Depositor EDS
% Data completeness (in resolution range)	98.7 (86.85-1.85) 98.7 (86.85-1.85)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.20 (at 1.86Å)	Xtrriage
Refinement program	REFMAC 5.8.0103	Depositor
R, R_{free}	0.176 , 0.210 0.188 , 0.219	Depositor DCC
R_{free} test set	4252 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å ²)	25.8	Xtrriage
Anisotropy	0.259	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 38.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	7800	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.15% 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	1.12	1/1438 (0.1%)	0.97	0/1931
1	B	1.31	4/1456 (0.3%)	1.12	5/1953 (0.3%)
1	C	1.20	2/1470 (0.1%)	1.07	1/1972 (0.1%)
1	D	1.04	0/1455	0.93	0/1953
1	E	0.94	0/1419	0.92	1/1907 (0.1%)
All	All	1.13	7/7238 (0.1%)	1.01	7/9716 (0.1%)

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	75	ASN	C-O	7.21	1.32	1.24
1	B	47	ASN	N-CA	6.53	1.54	1.46
1	C	105	THR	C-O	-6.25	1.15	1.24
1	B	50	GLN	N-CA	5.70	1.53	1.46
1	A	97	GLU	CD-OE2	5.27	1.35	1.25
1	B	86	LYS	CA-CB	5.16	1.61	1.53
1	C	170	ALA	N-CA	-5.16	1.40	1.46

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	77	ASP	N-CA-CB	9.00	123.35	110.12
1	B	29	SER	CA-CB-OG	6.46	124.01	111.10
1	B	76	LEU	N-CA-C	-6.45	104.34	111.82
1	C	113	GLU	CB-CA-C	-6.32	100.96	110.88
1	B	114	GLU	CA-CB-CG	-5.57	102.95	114.10
1	E	137	ARG	CB-CG-CD	5.33	123.56	111.30
1	B	29	SER	N-CA-CB	-5.32	101.94	110.46

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	1430	0	1481	3	1
1	B	1448	0	1507	8	1
1	C	1459	0	1523	3	0
1	D	1441	0	1500	6	0
1	E	1411	0	1460	6	2
2	A	152	0	0	1	0
2	B	171	0	0	0	0
2	C	159	0	0	3	0
2	D	98	0	0	0	0
2	E	31	0	0	0	0
All	All	7800	0	7471	25	2

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 2.

All (25) 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:76:LEU:HD11	1:B:114:GLU:HG3	1.29	1.09
1:D:184:ILE:HD11	1:D:190:LEU:HD11	1.52	0.90
1:E:180:ILE:O	1:E:184:ILE:HD12	1.78	0.83
1:D:184:ILE:HD11	1:D:190:LEU:CD1	2.15	0.76
1:D:184:ILE:CD1	1:D:190:LEU:HD11	2.17	0.74
1:E:190:LEU:HD12	1:E:190:LEU:H	1.60	0.67
1:A:106:ASN:O	1:E:191:LYS:HE2	2.00	0.62
1:B:76:LEU:CD1	1:B:114:GLU:HG3	2.19	0.57
1:D:184:ILE:CD1	1:D:190:LEU:CD1	2.81	0.55
1:C:61:GLU:OE2	2:C:301:HOH:O	2.19	0.52
1:A:182:PHE:CE1	1:A:186:LYS:NZ	2.80	0.49
1:B:143:LYS:HE3	1:B:182:PHE:CD1	2.47	0.49
1:B:76:LEU:HD11	1:B:114:GLU:CG	2.21	0.47
1:A:137:ARG:HD2	2:A:396:HOH:O	2.16	0.46
1:C:44:LYS:HE3	2:C:438:HOH:O	2.17	0.45
1:B:50:GLN:HG2	1:B:51:LYS:HD2	1.98	0.45
1:B:140:GLN:HG2	1:B:141:ASN:ND2	2.32	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:113:GLU:HG3	1:E:144:LYS:NZ	2.32	0.44
1:E:180:ILE:HG22	1:E:184:ILE:CD1	2.48	0.43
1:B:38:GLU:O	1:B:73:GLY:CA	2.66	0.43
1:D:168:LEU:HD21	1:D:190:LEU:HD12	2.01	0.43
1:C:107:ASP:HA	1:C:109:TYR:CZ	2.55	0.42
1:D:154:LYS:HG3	2:C:379:HOH:O	2.19	0.41
1:B:143:LYS:HE2	1:B:182:PHE:CE1	2.56	0.41
1:E:181:ASP:O	1:E:185:LYS:HD3	2.21	0.41

All (2) 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:189:ASP:OD2	1:E:174:TYR:OH[1_655]	1.67	0.53
1:B:211:ASP:OD1	1:E:35:GLU:OE2[4_666]	2.19	0.01

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	191/230 (83%)	188 (98%)	3 (2%)	0	100	100
1	B	193/230 (84%)	192 (100%)	1 (0%)	0	100	100
1	C	195/230 (85%)	190 (97%)	5 (3%)	0	100	100
1	D	193/230 (84%)	191 (99%)	2 (1%)	0	100	100
1	E	188/230 (82%)	185 (98%)	3 (2%)	0	100	100
All	All	960/1150 (84%)	946 (98%)	14 (2%)	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	149/179 (83%)	145 (97%)	4 (3%)	39	24
1	B	151/179 (84%)	148 (98%)	3 (2%)	48	36
1	C	153/179 (86%)	151 (99%)	2 (1%)	61	51
1	D	151/179 (84%)	147 (97%)	4 (3%)	40	25
1	E	147/179 (82%)	145 (99%)	2 (1%)	59	49
All	All	751/895 (84%)	736 (98%)	15 (2%)	48	36

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	26	SER
1	A	130	GLU
1	A	186	LYS
1	A	218	LYS
1	D	26	SER
1	D	130	GLU
1	D	190	LEU
1	D	218	LYS
1	C	26	SER
1	C	113	GLU
1	B	26	SER
1	B	51	LYS
1	B	140	GLN
1	E	184	ILE
1	E	190	LEU

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	34	ASN
1	A	50	GLN
1	B	34	ASN

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Mol	Chain	Res	Type
1	B	47	ASN
1	B	59	GLN
1	B	141	ASN
1	E	140	GLN
1	E	141	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 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

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, 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	193/230 (83%)	-0.07	0 100 100	17, 30, 51, 75	0
1	B	195/230 (84%)	-0.03	3 (1%) 72 76	15, 26, 50, 64	0
1	C	196/230 (85%)	-0.16	1 (0%) 87 90	15, 25, 51, 76	1 (0%)
1	D	193/230 (83%)	0.39	7 (3%) 46 50	16, 36, 70, 98	2 (1%)
1	E	190/230 (82%)	1.02	19 (10%) 12 12	27, 53, 97, 119	0
All	All	967/1150 (84%)	0.23	30 (3%) 51 55	15, 32, 75, 119	3 (0%)

All (30) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	E	190	LEU	4.7
1	E	140	GLN	4.2
1	E	174	TYR	4.1
1	C	221	LEU	3.9
1	E	192	LEU	3.7
1	E	182	PHE	3.7
1	D	177	PRO	3.4
1	E	188	ALA	3.4
1	E	150	LEU	3.4
1	E	28	LYS	3.2
1	D	204	ALA	3.2
1	D	172	ALA	3.2
1	D	178	ALA	3.1
1	E	217	SER	2.9
1	D	174	TYR	2.7
1	B	76	LEU	2.6
1	E	184	ILE	2.6
1	D	203	VAL	2.5
1	E	207	ALA	2.5
1	B	26	SER	2.4

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Mol	Chain	Res	Type	RSRZ
1	E	139	ALA	2.3
1	E	178	ALA	2.3
1	B	28	LYS	2.3
1	D	213	ALA	2.3
1	E	141	ASN	2.2
1	E	216	LEU	2.2
1	E	200	ALA	2.2
1	E	53	LYS	2.2
1	E	176	THR	2.1
1	E	125	ILE	2.1

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.