



# Full wwPDB X-ray Structure Validation Report ⓘ

Apr 6, 2026 – 10:07 AM EDT

PDB ID : 9NX3 / pdb\_00009nx3  
Title : Crystal structure of GP232 tail fiber recognition domain from mycobacteriophage Bxz-1  
Authors : Di, D.; Tsai, J.H.; Krieger, I.V.; Sacchettini, J.C.  
Deposited on : 2025-03-25  
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](mailto: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>.

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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  
Xtrriage (Phenix) : 2.0  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
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) : 2.48.1

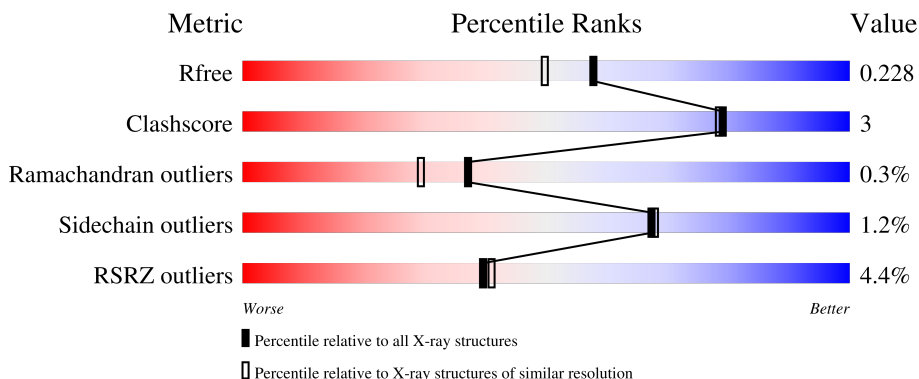
# 1 Overall quality at a glance

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))
$R_{free}$	164625	7293 (1.90-1.90)
Clashscore	180529	8090 (1.90-1.90)
Ramachandran outliers	177936	8022 (1.90-1.90)
Sidechain outliers	177891	8022 (1.90-1.90)
RSRZ outliers	164620	7292 (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  $\geq 3$ , 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	242	
1	B	242	
1	C	242	
1	D	242	
1	E	242	

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Mol	Chain	Length	Quality of chain
1	F	242	 <p>5% 92% 7%</p>

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 11966 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 Capsid decoration protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	237	1685	1043	301	340	1	0	0	0
1	B	240	1700	1052	304	343	1	0	0	0
1	C	237	1685	1043	301	340	1	0	0	0
1	D	239	1709	1058	308	342	1	0	0	0
1	E	237	1689	1046	302	340	1	0	0	0
1	F	242	1734	1073	315	345	1	0	0	0

There are 30 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	3	HIS	-	expression tag	UNP A0A411CKL9
A	4	HIS	-	expression tag	UNP A0A411CKL9
A	5	HIS	-	expression tag	UNP A0A411CKL9
A	6	HIS	-	expression tag	UNP A0A411CKL9
A	7	HIS	-	expression tag	UNP A0A411CKL9
B	3	HIS	-	expression tag	UNP A0A411CKL9
B	4	HIS	-	expression tag	UNP A0A411CKL9
B	5	HIS	-	expression tag	UNP A0A411CKL9
B	6	HIS	-	expression tag	UNP A0A411CKL9
B	7	HIS	-	expression tag	UNP A0A411CKL9
C	3	HIS	-	expression tag	UNP A0A411CKL9
C	4	HIS	-	expression tag	UNP A0A411CKL9
C	5	HIS	-	expression tag	UNP A0A411CKL9
C	6	HIS	-	expression tag	UNP A0A411CKL9
C	7	HIS	-	expression tag	UNP A0A411CKL9
D	3	HIS	-	expression tag	UNP A0A411CKL9
D	4	HIS	-	expression tag	UNP A0A411CKL9

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Chain	Residue	Modelled	Actual	Comment	Reference
D	5	HIS	-	expression tag	UNP A0A411CKL9
D	6	HIS	-	expression tag	UNP A0A411CKL9
D	7	HIS	-	expression tag	UNP A0A411CKL9
E	3	HIS	-	expression tag	UNP A0A411CKL9
E	4	HIS	-	expression tag	UNP A0A411CKL9
E	5	HIS	-	expression tag	UNP A0A411CKL9
E	6	HIS	-	expression tag	UNP A0A411CKL9
E	7	HIS	-	expression tag	UNP A0A411CKL9
F	3	HIS	-	expression tag	UNP A0A411CKL9
F	4	HIS	-	expression tag	UNP A0A411CKL9
F	5	HIS	-	expression tag	UNP A0A411CKL9
F	6	HIS	-	expression tag	UNP A0A411CKL9
F	7	HIS	-	expression tag	UNP A0A411CKL9

- Molecule 2 is water.

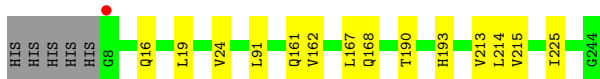
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	367	Total O 367 367	0	0
2	B	257	Total O 257 257	0	0
2	C	332	Total O 332 332	0	0
2	D	301	Total O 301 301	0	0
2	E	203	Total O 203 203	0	0
2	F	304	Total O 304 304	0	0

### 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: Capsid decoration protein

Chain A: 



- Molecule 1: Capsid decoration protein

Chain B: 



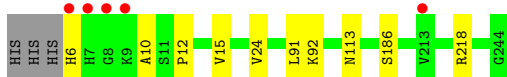
- Molecule 1: Capsid decoration protein

Chain C: 




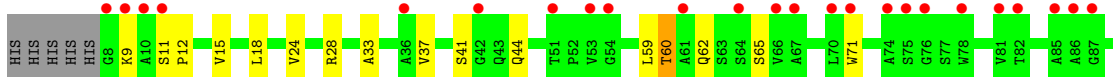
- Molecule 1: Capsid decoration protein

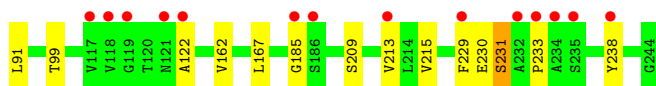
Chain D: 



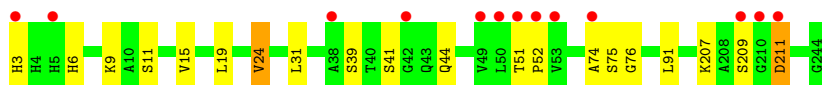
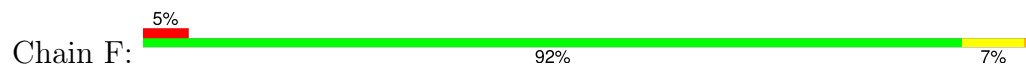
- Molecule 1: Capsid decoration protein

Chain E: 





- Molecule 1: Capsid decoration protein



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	56.84Å 88.39Å 96.33Å 96.16° 102.08° 107.98°	Depositor
Resolution (Å)	41.31 – 1.90 41.31 – 1.90	Depositor EDS
% Data completeness (in resolution range)	93.6 (41.31-1.90) 93.6 (41.31-1.90)	Depositor EDS
$R_{merge}$	0.05	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.99 (at 1.89Å)	Xtrriage
Refinement program	REFMAC 1.20.1_4487	Depositor
R, $R_{free}$	0.182 , 0.220 0.194 , 0.228	Depositor DCC
$R_{free}$ test set	6367 reflections (4.71%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	24.6	Xtrriage
Anisotropy	0.397	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 41.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	11966	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	32.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.56% 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	0.33	0/1712	0.52	0/2343
1	B	0.27	0/1727	0.46	0/2364
1	C	0.32	0/1712	0.50	0/2343
1	D	0.31	0/1738	0.51	0/2377
1	E	0.26	0/1716	0.47	0/2347
1	F	0.30	0/1765	0.48	1/2414 (0.0%)
All	All	0.30	0/10370	0.49	1/14188 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	F	52	PRO	CA-N-CD	-6.46	102.96	112.00

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	1685	0	1657	11	0
1	B	1700	0	1663	9	0
1	C	1685	0	1657	4	0
1	D	1709	0	1682	9	0
1	E	1689	0	1668	18	0
1	F	1734	0	1698	13	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	A	367	0	0	1	0
2	B	257	0	0	1	0
2	C	332	0	0	0	0
2	D	301	0	0	1	0
2	E	203	0	0	1	0
2	F	304	0	0	3	0
All	All	11966	0	10025	52	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 3.

All (52) 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:24:VAL:HG22	1:C:24:VAL:HG11	1.68	0.73
1:B:24:VAL:HG23	2:B:440:HOH:O	1.88	0.73
1:E:9:LYS:HD2	1:F:9:LYS:HB2	1.71	0.73
1:B:24:VAL:HG22	1:B:91:LEU:HD12	1.78	0.64
1:A:16:GLN:HG3	1:C:18:LEU:HD21	1.81	0.62
1:A:162:VAL:HG12	1:A:167:LEU:HD23	1.82	0.60
1:A:161:GLN:OE1	1:A:168:GLN:NE2	2.25	0.58
1:E:37:VAL:HB	1:E:62:GLN:HE22	1.69	0.58
1:F:39:SER:O	1:F:44:GLN:NE2	2.37	0.57
1:B:188:VAL:HG22	1:B:228:GLU:HG3	1.88	0.56
1:F:24:VAL:HG13	1:F:91:LEU:HD12	1.85	0.56
1:E:229:PHE:O	1:E:231:SER:N	2.40	0.55
1:E:33:ALA:O	1:E:60:THR:HB	2.08	0.54
1:F:74:ALA:HB3	2:F:313:HOH:O	2.06	0.54
1:D:24:VAL:HG23	1:D:91:LEU:HD12	1.90	0.54
1:A:19:LEU:HD12	1:B:19:LEU:HD21	1.91	0.53
1:E:59:LEU:HD13	1:E:71:TRP:CD1	2.45	0.52
1:D:24:VAL:CG2	1:D:91:LEU:HD12	2.39	0.52
1:D:6:HIS:N	2:D:307:HOH:O	2.43	0.52
1:E:91:LEU:HD11	1:F:19:LEU:HD22	1.92	0.52
1:A:24:VAL:HG13	2:A:532:HOH:O	2.09	0.51
1:E:24:VAL:HG22	1:E:91:LEU:HD12	1.92	0.50
1:E:28:ARG:HD2	1:E:99:THR:OG1	2.12	0.49
1:F:31:LEU:HD12	1:F:51:THR:HG22	1.93	0.49
1:A:24:VAL:HG12	1:A:91:LEU:HD12	1.94	0.49
1:D:24:VAL:HB	1:F:24:VAL:HG21	1.95	0.49
1:A:213:VAL:HG12	1:A:215:VAL:HG13	1.94	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:41:SER:O	1:E:44:GLN:NE2	2.46	0.48
1:E:65:SER:HB2	1:E:122:ALA:HB1	1.95	0.48
1:E:213:VAL:HG12	1:E:215:VAL:HG13	1.94	0.48
1:A:24:VAL:CG1	1:A:91:LEU:HD12	2.45	0.47
1:F:209:SER:O	1:F:211:ASP:N	2.45	0.47
1:D:92:LYS:HG3	1:D:113:ASN:O	2.16	0.46
1:B:233:PRO:HB3	1:B:238:TYR:HD2	1.82	0.45
1:E:162:VAL:HG22	1:E:167:LEU:HD23	1.99	0.44
1:D:218:ARG:HD2	1:E:209:SER:O	2.18	0.43
1:E:24:VAL:CG2	1:E:91:LEU:HD12	2.48	0.43
1:B:8:GLY:HA2	1:C:11:SER:HB2	2.00	0.43
1:E:24:VAL:HG23	2:E:437:HOH:O	2.17	0.43
1:F:207:LYS:NZ	2:F:317:HOH:O	2.52	0.43
1:F:41:SER:HA	1:F:76:GLY:O	2.18	0.43
1:E:233:PRO:HB3	1:E:238:TYR:CD2	2.54	0.43
1:F:3:HIS:N	2:F:318:HOH:O	2.52	0.43
1:B:51:THR:HB	1:B:73:VAL:HG21	2.01	0.42
1:A:19:LEU:HD11	1:B:19:LEU:HD11	1.99	0.42
1:B:110:GLN:HB2	1:B:128:ILE:HD13	2.01	0.42
1:D:15:VAL:HG21	1:F:15:VAL:HG22	2.02	0.41
1:D:12:PRO:HG2	1:F:6:HIS:O	2.21	0.41
1:A:193:HIS:CD2	1:A:225:ILE:HG23	2.56	0.41
1:D:10:ALA:HB2	1:E:12:PRO:HD3	2.02	0.41
1:E:11:SER:O	1:E:15:VAL:HG23	2.19	0.41
1:C:56:ILE:HD12	1:C:81:VAL:HG12	2.02	0.41

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	235/242 (97%)	232 (99%)	3 (1%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	238/242 (98%)	233 (98%)	5 (2%)	0	100	100
1	C	235/242 (97%)	231 (98%)	4 (2%)	0	100	100
1	D	237/242 (98%)	233 (98%)	4 (2%)	0	100	100
1	E	235/242 (97%)	225 (96%)	7 (3%)	3 (1%)	10	3
1	F	240/242 (99%)	233 (97%)	6 (2%)	1 (0%)	30	22
All	All	1420/1452 (98%)	1387 (98%)	29 (2%)	4 (0%)	37	29

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	E	230	GLU
1	F	211	ASP
1	E	231	SER
1	E	185	GLY

### 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	179/185 (97%)	177 (99%)	2 (1%)	70	71
1	B	179/185 (97%)	177 (99%)	2 (1%)	70	71
1	C	179/185 (97%)	176 (98%)	3 (2%)	56	54
1	D	182/185 (98%)	181 (100%)	1 (0%)	86	88
1	E	180/185 (97%)	178 (99%)	2 (1%)	70	71
1	F	184/185 (100%)	181 (98%)	3 (2%)	58	56
All	All	1083/1110 (98%)	1070 (99%)	13 (1%)	67	68

All (13) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	190	THR
1	A	214	LEU

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Mol	Chain	Res	Type
1	B	162	VAL
1	B	173	VAL
1	C	50	LEU
1	C	173	VAL
1	C	188	VAL
1	D	186	SER
1	E	18	LEU
1	E	60	THR
1	F	11	SER
1	F	24	VAL
1	F	75	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (14) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	44	GLN
1	B	161	GLN
1	B	168	GLN
1	C	106	ASN
1	C	161	GLN
1	C	168	GLN
1	D	161	GLN
1	D	168	GLN
1	E	44	GLN
1	E	161	GLN
1	F	3	HIS
1	F	43	GLN
1	F	161	GLN
1	F	168	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 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, 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	237/242 (97%)	-0.42	1 (0%) 89 90	15, 24, 35, 65	0
1	B	240/242 (99%)	0.12	4 (1%) 69 71	18, 34, 58, 77	0
1	C	237/242 (97%)	-0.18	2 (0%) 82 84	18, 26, 39, 66	0
1	D	239/242 (98%)	-0.01	5 (2%) 63 65	16, 28, 44, 93	0
1	E	237/242 (97%)	0.75	38 (16%) 6 5	17, 39, 69, 83	0
1	F	242/242 (100%)	0.10	13 (5%) 32 34	17, 27, 56, 61	0
All	All	1432/1452 (98%)	0.06	63 (4%) 39 41	15, 28, 57, 93	0

All (63) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	F	210	GLY	5.6
1	D	7	HIS	4.8
1	B	6	HIS	4.0
1	C	8	GLY	3.9
1	B	5	HIS	3.7
1	B	7	HIS	3.7
1	F	209	SER	3.7
1	F	53	VAL	3.7
1	D	6	HIS	3.5
1	F	74	ALA	3.5
1	E	119	GLY	3.4
1	E	64	SER	3.4
1	F	42	GLY	3.3
1	E	61	ALA	3.2
1	E	42	GLY	3.2
1	E	74	ALA	3.2
1	E	75	SER	3.1
1	E	87	GLY	3.1
1	F	49	VAL	3.1

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
1	E	54	GLY	3.0
1	E	85	ALA	3.0
1	E	229	PHE	2.9
1	F	3	HIS	2.9
1	E	67	ALA	2.9
1	F	52	PRO	2.8
1	D	213	VAL	2.8
1	F	211	ASP	2.8
1	E	10	ALA	2.7
1	E	235	SER	2.7
1	D	8	GLY	2.7
1	E	53	VAL	2.6
1	E	86	ALA	2.6
1	A	8	GLY	2.6
1	E	76	GLY	2.5
1	F	5	HIS	2.4
1	E	9	LYS	2.4
1	B	38	ALA	2.4
1	E	36	ALA	2.4
1	E	213	VAL	2.4
1	E	186	SER	2.3
1	E	122	ALA	2.3
1	E	232	ALA	2.3
1	E	8	GLY	2.3
1	F	51	THR	2.3
1	F	50	LEU	2.3
1	E	71	TRP	2.2
1	E	78	TRP	2.2
1	C	214	LEU	2.2
1	E	11	SER	2.2
1	E	70	LEU	2.2
1	E	82	THR	2.2
1	E	66	VAL	2.2
1	E	118	VAL	2.1
1	E	238	TYR	2.1
1	E	233	PRO	2.1
1	E	51	THR	2.1
1	E	185	GLY	2.1
1	E	117	VAL	2.0
1	E	234	ALA	2.0
1	D	9	LYS	2.0
1	E	81	VAL	2.0

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Mol	Chain	Res	Type	RSRZ
1	F	38	ALA	2.0
1	E	121	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 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.